Appendix 6-4 Bat Survey Report

Cleanrath Wind Farm

DOCUMENT DETAILS

Client: Cleanrath Wind Farm Ltd

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1. INTRODUCTION

MKO was commissioned to complete a comprehensive assessment of the potential effects on bats of a constructed wind farm at Cleanrath, Co. Cork. This report provides details of the bat surveys undertaken, including survey design, methods and results, and the assessment of potential effects of the Cleanrath wind farm development on bats. Where necessary, mitigation is prescribed to minimise the potential for likely significant effects on bats associated with any future operation of the windfarm.

Bat surveys were undertaken at Cleanrath Wind Farm in 2015. In addition, bat surveys are currently being undertaken at the site, commencing in April 2020 by MKO. All surveys have been undertaken to industry Best Practice Guidelines at the time of design and execution.

Bat surveys undertaken in 2020, in accordance with Scottish Natural Heritage Guidance (SNH 2019), form the core dataset for the assessment of effects on bats. Surveys undertaken on the site in 2015 and were designed in accordance with the Bat Conservation Trust's guidelines for wind turbine developments (Hundt, 2012).

Bat surveys employed a combination of methods, including desktop study, habitat and landscape assessments, roost inspections, manual activity surveys and static detector surveys at ground level and at height.

1.1 Background

Wind energy provides a clean, sustainable alternative to fossil fuels in generating electricity. However, wind energy development can impact wildlife, directly through mortality and indirectly through disturbance and habitat loss. Bat fatalities have been reported at wind energy facilities around the world, raising concern about the cumulative impacts of such developments on bat populations (Arnett *et al.* 2016). No large-scale studies have been undertaken in Ireland to date. However, a study from the UK estimated bat fatalities at 0 – 5.25 bats per turbine per month (Mathews *et al.* 2016). While these results are not directly applicable to Ireland due to differences in bat species and behaviour, Ireland shares more similarities with bat assemblages of Great Britain, when compared to those of mainland Europe.

Investigative research in North America and mainland Europe have revealed the mechanisms for bat mortality at wind turbines. Fatalities arise from direct collision with moving turbine blades (Horn *et al.* 2008, Cryand *et al.* 2014) and barotrauma (Baer Wald *et al.* 2008), i.e. internal injuries caused by air pressure changes. Why bats fly in the vicinity of wind turbines has been attributed to several different behavioural and environmental factors, e.g. habitat associations, weather conditions and, species ecology.

Pre-construction bat surveys are undertaken to gain an insight into bat activity in the absence of turbines and to predict and mitigate against any future risks identified. Survey design and analyses of results at the Cleanrath wind farm development site was undertaken with reference to the latest policy and legislation, scientific literature and industry guidelines. Any spatial, temporal or behavioural factors that may put bats at risk were fully considered.

Post-construction monitoring is used to assess changes in bat activity patterns and the efficacy of any prescribed mitigation to inform on any changes to curtailment. It can also improve our overall understanding of how bats are interacting with wind turbines and how we can reduce impacts across all wind farm sites (SNH, 2019).

In this case, pre-construction surveys were undertaken in 2015 and found low levels of bat activity on the site and low potential for impacts on bats. The wind farm was granted planning permission and constructed in accordance with this permission. As a precautionary measure, additional surveys and monitoring of the constructed windfarm have been undertaken during its brief period of operation and the current period where it is in sleep mode. The surveys are being undertaken in accordance with the most up to date and relevant guidelines (SNH 2019) which were not available at the time of the 2015 surveys. The most relevant guidelines at that time were the Bat Conservation Trust *'Good Practice Guidelines, 2nd edition, 2012'* (Bat Conservation Trust, 2012) and these were adhered to in full.

1.2 Bat Survey and Assessment Guidance

Several guidelines for surveying bats at wind energy developments have been produced in Europe, the UK and Ireland.

At a European level, the Advisory Committee to the EUROBATS Agreement, to which Ireland is a signatory, have produced *Guidelines for Consideration of Bats in Wind Farm Projects* which outlines an approach for assessing the potential impacts of wind turbines on bats during planning, construction and operation phases (Rodrigues, 2015). However, these guidelines are based on continental scenarios and include more diverse species and behaviours than those typical of Ireland. As such, EUROBATS guidance may recommend a level of survey that may prove inappropriate in Irish scenarios. Nevertheless, the guidance is evidence-based and provides a useful European context, within which Member States are encouraged to produce specific national guidance, focusing on local circumstances.

Bat Conservation Ireland produced *Wind Turbine/Wind Farm Development Bat Survey Guidelines* (BCI, 2012a). This document provides advice to practitioners and decision makers in Ireland on necessary qualifications for surveyors, health and safety considerations, pre-construction and post-construction survey methodologies and information to be included in a report. In the absence of comprehensive Irish research, these guidelines provide generalised methodology rather than detailed technical advice.

The second edition of the UK Bat Conservation Trust *Bat Survey Good Practice Guidelines* (Hundt, 2012) includes a chapter (Chapter 10) on survey methodologies for assessing the potential impacts of wind turbines on bats. The document provides technical guidance for consultants carrying out impact assessments. However, the recommendations are not based on any research findings specific to the UK. A third edition to the guidelines, published in early 2016, removed the chapter on surveying wind turbine developments. Prior to the publication of the BCT guidelines, Natural England's *Bat and Onshore Wind Turbines: Interim Guidance* provided a pragmatic interpretation of the EUROBATS recommendations, as applied to onshore wind energy facilities in the UK (Natural England, 2014). In addition, the Chartered Institute of Ecology and Environmental Management (CIEEM) publishes advice on best practice as well as updates on the current state of knowledge in the *Technical Guidance Series* and in the quarterly publication *In Practice*.

In 2019, Scottish Natural Heritage published *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation* (SNH 2019). The purpose of the guidance is to help planners, developers and ecological consultants to consider the potential effects of onshore wind energy developments on bats. The emphasis is on direct impacts such as collision mortality, but there is reference throughout to the need for a full impact assessment requiring wider consideration of other (indirect) effects. The Guidance replaces previous guidance on the subject; notably that published by Natural England and Chapter 10 of the Bat Conservation Trust publication *Bat Surveys: Good Practice Guidelines (2nd edition)*, (Hundt, 2012) and tailors the generic EUROBATS guidance on assessing the impact of wind turbines on European bats (Rodrigues *et al.* (2014)). The document guides the user through the key elements of survey, impact assessment and mitigation.

The current survey scope, assessment and mitigation provided in this report is accordance with SNH, 2019 Guidance.

1.3 Statement of Authority

In 2015, bat surveys were carried out by John Curtin B.Sc. (Env. Science). John is an experienced bat surveyor. 2020 bat surveys are currently being undertaken by Luke Dodebier (B.Sc.) and Aoife Joyce (B.Sc., M.Sc.) both of which have particular expertise in bat surveys and assessment.

2020 Bat surveys were conducted by MKO ecologists Aoife Joyce (BSc., MSc.), Luke Dodebier (BSc.), Colin Murphy (BSc.), Rachel Walsh (BSc.), and Neil Campbell (BSc.). All staff have relevant academic qualifications to complete the surveys and assessments that they were required to do.

Data analysis was undertaken, and results were compiled by Luke Dodebier. Impact assessment, the design of mitigation and final reporting was completed by Aoife Joyce and Luke Dodebier under the supervision of Pat Roberts (BSc., MCIEEM), who reviewed and approved the final document. Pat has over 15 years' experience in management and ecological assessment. He has supervised the majority of ecological assessments (300+) completed by the company, including more recently, over 200 assessments required in accordance with Article 6(3) of the Habitats Directive.

1.4 Irish Bats: Legislation, Policy and Status

Ireland has nine resident bat species, comprising more than half of Ireland's native terrestrial mammals (Montgomery *et al.*, 2014).

All Irish bats are protected under European legislation, namely the Habitats Directive (92/43/EEC). All Irish species are listed under Annex IV of the Directive, requiring strict protection for individuals, their breeding sites and resting places. The lesser horseshoe bat *(Rhinolophus hipposideros) is further listed under Annex II of the Directive, requiring the designation of conservation areas for the species. Under this Directive, Ireland is obliged to maintain the favourable conservation status of Annex-listed species. This Directive has been transposed into Irish law through the* European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011).

In addition, Irish species are further protected by national legislation (Wildlife Acts 1976-2019). Under this legislation, it is an offence to intentionally disturb, injure or kill a bat, or disturb its roost. Any work at a roost site must be carried out with the agreement of the National Parks and Wildlife Service (NPWS).

The NPWS monitors the conservation status of European protected habitats and species and reports their findings to the European Commission every 6 years in the form of an Article 17 Report. The most recent report for the Republic of Ireland was submitted in 2019. Table 1-1 summarises the current conservation status of Irish bat species and identified threats to Irish bat populations.

Table 1-1 Irish Bat Species Conservation Status and Threats (NPWS, 2019)

Bat Species	Conservation Status	Principal Threats
Common pipistrelle *Pipistrellus pipistrellus*	Favourable	**A05** Removal of small landscape features for agricultural land parcel consolidation (M) **A14** Livestock farming (without grazing) [impact of anti-helminthic dosing on dung fauna] (M) **B09** Clear---cutting, removal of all trees (M) **F01** Conversion from other land uses to housing, settlement or recreational areas (M) **F02** Construction or modification (e.g. of housing and settlements) in existing urban or recreational areas (M) **F24** Residential or recreational activities and structures generating noise, light, heat or other forms of pollution (M) **H08** Other human intrusions and disturbance not mentioned above (Dumping, accidental and deliberate disturbance of bat roosts (e.g. caving) (M) **L06** Interspecific relations (competition, predation, parasitism, pathogens) (M) **M08** Flooding (natural processes) **D01** Wind, wave and tidal power, including infrastructure (M)
Soprano pipistrelle *Pipistrellus pygmaeus*	Favourable	
Nathusius' pipistrelle *Pipistrellus nathusii*	Unknown	
Leisler's bat *Nyctalus leisleri*	Favourable	
Daubenton's bat *Myotis daubentoni*	Favourable	
Natterer's bat *Myotis nattereri*	Favourable	
Whiskered bat *Myotis mystacinus*	Favourable	
Brown long-eared bat *Plecotus auritus*	Favourable	
Lesser horseshoe bat *Rhinolophus hipposideros*	Inadequate	

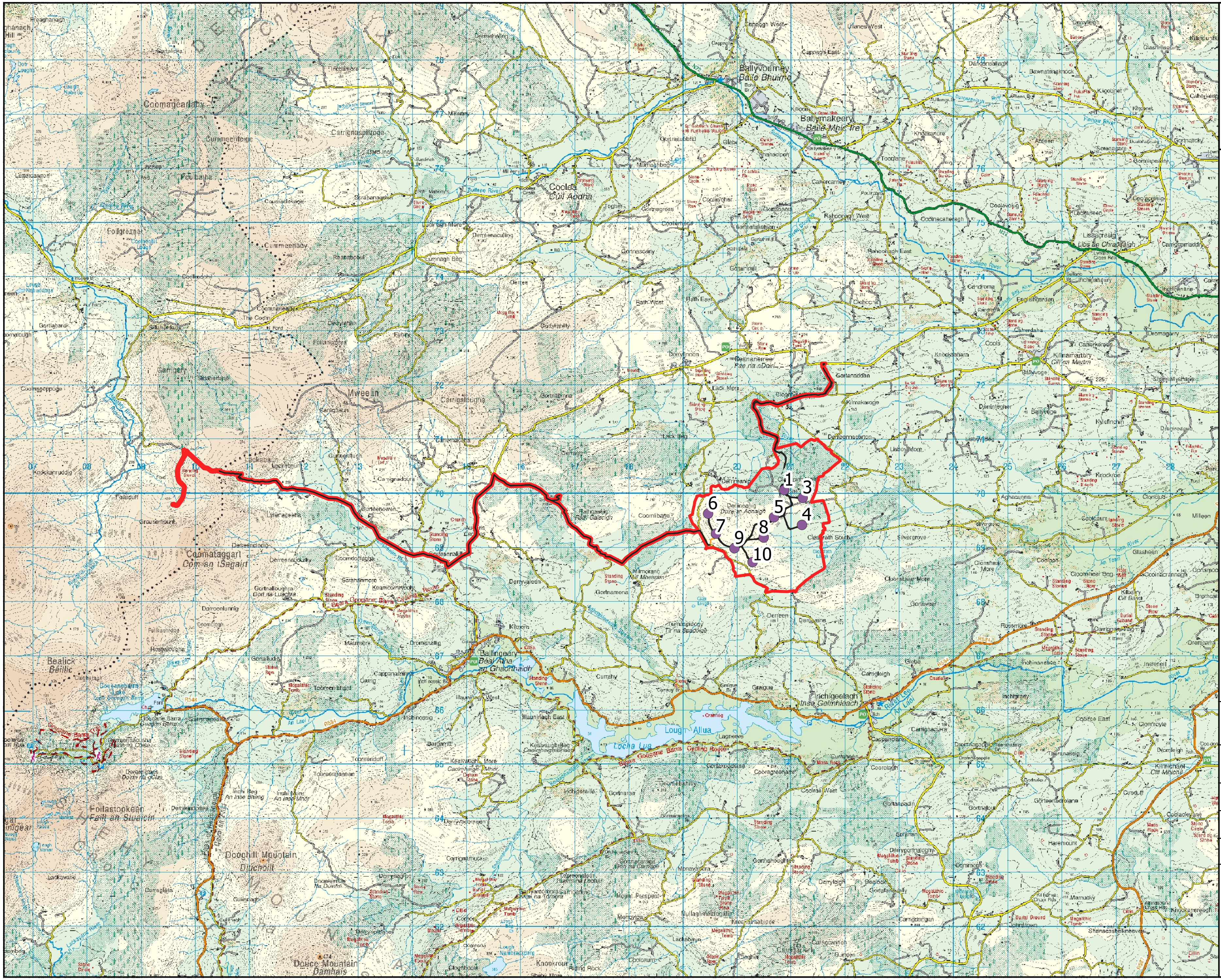
2. PROJECT DESCRIPTION

The site is located at Cleanrath, approximately 12km southwest of Macroom, Co. Cork. The site location is provided in Figure 2-1.

The Cleanrath wind farm development site is accessed via an existing commercial forestry entrance off the local road in the townland of Cloontycarthy.

The Cleanrath wind farm development comprises:

1. *9 No. wind turbines with a ground to blade tip height of 150 metres and all associated foundations and hard-standing areas.*
2. *All associated underground electrical (33kV & 38kV) and communications cabling connecting the turbines to the national electricity grid.*
3. *Upgrade of existing access junctions and roads.*
4. *Upgrade of existing and provision of new site access roads.*
5. *Borrow pit.*
6. *Temporary construction compound.*
7. *Accommodation works along the turbine delivery route*
8. *Temporary roadway to facilitate turbine delivery.*
9. *Forestry Felling*
10. *Site Drainage*
11. *The operation of the wind farm for a period of 25 years.*
12. *The decommissioning of the wind farm, removal of turbines and restoration of the site.*
13. *All associated site development and ancillary works.*



Map Legend

- Grid connection route
- Infrastructure layout
- Study Area Boundary

Drawing Title

Site location

Project Title

Cleanrath WindFarm

Drawn By	PR
DMN	PR
Project No.	Drawing No.
191223a	Figure 2-1
Scale	Date
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3. METHODS

3.1 Consultation

A scoping exercise was undertaken as part of the rEIAR for the Cleanrath wind farm development. A Scoping Document, providing details of the application site and the Cleanrath wind farm development, was prepared by MKO and circulated to consultees in May 2020. As part of this exercise, prominent Irish conservation groups were contacted, and Bat Conservation Ireland (BCI) and National Parks and Wildlife Service (NPWS) were specifically invited to comment on the potential of the Cleanrath wind farm development to affect bats.

Details of consultation responses specifically related to bats are provided in Section 4.1 below.

3.2 Desk Study

A desk study of published material was undertaken prior to conducting field surveys. The aim was to provide context to the site in order to assist bat survey planning and assessment. This included the identification of designated sites, species of interest or any other potential risk factors within the Study Area and the surrounding region. The results of the desk study including sources of information utilised are provided below.

The desk study provides a baseline of the existing bat records for the wider area in which the wind farm site is located. This is useful in determining the likely species to be encountered in the area as well as informing on survey effort and design.

3.2.1 Bat Records

3.2.1.1 National Parks and Wildlife Service Records

The National Parks and Wildlife Service (NPWS) map viewer and website provides information on rare and protected species, sites designated for nature conservation and their conservation objectives. A search was undertaken, on 28th July 2020, of sites designated for the conservation of bats within a 10 km radius of the Study Area (BCI 2012, Hundt, 2012, SNH 2019). This included European designated sites, i.e. SACs, and nationally designated sites, i.e. NHAs and pNHAs. A data request was also sent to the NPWS and data received in relation to the relevant hectads (W16, W17, W26 and W27) on the 30th March 2019.

3.2.1.2 National Biodiversity Data Centre Records

The National Bat Database of Ireland holds records of bat observations received and maintained by BCI. These records include results of national monitoring schemes, roost records as well as ad-hoc observations. A data request for bat records within a 10km radius of the Cleanrath wind farm development site (IG Ref: W20520 69583) was submitted to Bat Conservation Ireland and search results received on 28/07/2020) and examined bat presence and roost records within a 10 km radius of a central point in the Study Area (BCI 2012, Hundt 2012, SNH 2019).

In addition, information on species' range and distribution, available in the 2019 Article 17 Reports (NPWS, 2019), was reviewed in relation to the location of the Cleanrath wind farm development. The aim was to identify any high-risk species at the edge of their range.

Hectads (W16, W17, W26 and W27), which pertains to the current study area, were assessed for bat records.

3.2.2 Bat Species' Range

EU member states are obliged to monitor the conservation status of natural habitats and species listed in the Annexes of the Habitats Directive. Under Article 17, they are required to report to the European Commission every six years. In April 2019, Ireland submitted the third assessment of conservation status for Annex-listed habitats and species, including all species of bats (NPWS, 2019).

The 2019 Article 17 Reports were reviewed for information on bat species' range and distribution in relation to the location of the Cleanrath wind farm development. The aim was to identify any high-risk species at the edge of their range (SNH, 2019).

3.2.3 Landscape Features

3.2.3.1 Ordnance Survey Mapping

Ordnance survey maps (OSI 1:5,000 and 1:50,000) and aerial photographs were reviewed to identify any habitats and features likely to be used by bats. Maps and images of the Study Area and general landscape were examined for suitable foraging or commuting habitats including woodlands and forestry, hedgerows, treelines and watercourses. In addition, any potential roost sites, such as buildings and bridges, were noted for further investigation.

3.2.3.2 Geological Survey Ireland

The Geological Survey Ireland (GSI) online mapping tool and University of Bristol Spelaeological Society (UBSS) Cave Database for the Republic of Ireland were consulted for any indication of natural subterranean bat sites, such as caves, within 10 km of the subject site (BCI, 2012) (last searched on the 11th August 2020). Furthermore, the archaeological database of national monuments was reviewed for any evidence of manmade underground structures, e.g. souterrains, that may be used by bats (last searched on the 11th August 2020).

3.2.3.3 National Biodiversity Data Centre Bat Landscape Mapping

The National Biodiversity Data Centre (NBDC) map viewer presents "Bat Landscape" maps for individual species and for all species combined. Lundy *et al.* (2011) used Maximum Entropy Models to examine the relative importance of bat landscape and habitat associations in Ireland. The resulting map provides a 5-point scale, ranging from highest habitat suitability index (presented in red) to lowest suitability index (presented in green). However, squares highlighted as less favourable may still have local areas of abundance.

The location of the Cleanrath wind farm development was reviewed in relation to bat habitat suitability indices. The aim of this was to assess habitat suitability for all bat species within the Study Area. It is worth noting that these results are based on a modelling exercise and not confirmed bat species records. Regardless, they may provide a useful indication of potential favourable bat associations within the Subject site.

3.2.3.4 Additional Wind Energy Projects in the Wider Landscape

A search for existing and permitted wind energy developments within 10km of the subject site was undertaken (SNH, 2019). The IWEA interactive wind map (iwea.com) was reviewed in conjunction with wind farm planning applications from Cork and Kerry County Councils and An Bord Pleanála. Other infrastructure developments and proposals (e.g. roads) were also noted. Information on the location and scale of these developments was gathered to inform cumulative effects.

3.3 Field Surveys

3.3.1 2015 Bat Surveys

Bat surveys were undertaken in May, July and September 2015 in line with recommendations in Chapter 10 of the Bat Conservation Trust *'Good Practice Guidelines, 2nd edition, 2012'* (Bat Conservation Trust, 2012).

3.3.1.1 Walked and Car-Based Surveys

Walked mobile detector surveys and car based transects were completed throughout the study area on the nights of 6th/7th May, 2nd/3rd July and 14th/15th September 2015. The surveys used a handheld Wildlife Acoustics Inc. (Massachusetts, USA) Echo Meter EM3 bat detector (with broadband coverage and the ability to record bat calls in real time). The transect routes are shown in Figure 2-1, **Appendix 1** of this report. A contact, as recorded in the results from these surveys, describes a bat observed by the surveyor. This contact can range from a commuter passing quickly to a foraging bat circling a feature lasting for several minutes. Some observations contain multiple bats. When several bats of the same species were encountered together, they were recorded under the one contact. A separate contact was recorded for each species. A contact finished when the recorder assumes the bat is no longer present. The same bat may be recorded in several contacts throughout the night. This survey type cannot estimate abundance of bats, rather activity; the amount of uses bats make of an area/feature.

3.3.1.2 Fixed Site Recordings

Two Song Meter SM3BAT (Wildlife Acoustics, Inc; Massachusetts, USA) 16-bit full spectrum time-expansion recording bat detectors were placed within the study area for a minimum of five nights during May, July and September 2015. Both devices were set to record from sunset to half an hour past sunrise each night, for 9 hours 18 minutes for May, 8 hours for July and automatically adjusting times from sunset to half an hour past sunrise from Sept. One device set within conifer plantation to the east of the site during July malfunctioned thus no registrations were recorded. Excluding this device, the recorders were in position, and recording, for a total of 371 hours 18 minutes over the three months.

Registrations, as recorded in the results from these surveys, followed the Bat Conservation Trust's (2012) definition of a bat pass: "two or more bat calls in a continuous sequence; each sequence or pass is separated by one second or more in which no calls are recorded." The number of bat passes for each species, or species group, identified was counted for each point.

3.3.1.3 Survey of Potential Bat Roost Sites

High Potential Roost Features (PRF) were examined throughout the study period, both during daylight and towards dawn, where swarming behaviour could be observed. Searches focused on buildings and bridges within the study area. Generally, trees in the areas close to turbine locations showed little in the way of observable knotholes, hazard beams and other features of high PRF.

3.3.2 2020 Bat Surveys

Despite the low levels of bat activity recorded in the 2015 surveys and the lack of a requirement to complete any additional survey work, as a precautionary measure, bat surveys that are in full accordance with Scottish Natural Heritage's (SNH) *Guidance for Bats and Onshore Wind Turbines* (SNH, 2019)[1] have commenced in 2020. This guidance was not available in 2015 and the previous surveys were undertaken in line with the most relevant guidance at that time. These bat surveys are employing a combination of methods, including desktop study, habitat and landscape assessments, roost inspections, manual activity surveys and static detector surveys at ground level.

In accordance with SNH Guidance, a full season of bat activity (April - October) is currently being undertaken. Ground-level static detector have been left in situ for at least 10 nights of good weather in each of spring (April-May) and summer (June-mid August) as required by SNH, 2019. Survey methods also include bat habitat suitability appraisal, roost surveys and manual transect surveys carried out throughout the main bat activity season. The surveys will continue throughout the Autumn survey season.

The main aims of the survey's effort are as follows:

- The species assemblage to species level (where these cannot be separated with confidence, to species group e.g. *Myotis sp*.).
- The locations of roosts (particularly maternity and hibernation) and swarming sites in the surrounding area that could be affected by the wind farm proposals at the site.
- The location and extent of commuting or foraging habitat used by bats. This needs to include not only the site itself, but also flight paths and habitats in the surrounding landscape that are likely to bring bats to the site.
- The amount of bat activity on the site, and its spatial and temporal distribution.

3.3.2.1 Bat Habitat Suitability Appraisal

Bat walkover surveys were carried out throughout 2020. During these surveys, habitats within the Study Area were assessed for their suitability to support roosting, foraging and commuting bats. Connectivity with the wider landscape was also considered. Suitability was assessed according to Collins (2016) which provides a grading protocol for roosting habitats and for commuting and foraging areas. Suitability categories are divided into *High*, *Moderate*, *Low* and *Negligible*, and are described fully in **Appendix 2**.

3.3.2.2 Roost Surveys (2020)

A search for roosts was undertaken within 200m plus the rotor radius (i.e. 58.5m) of the boundary of the Cleanrath wind farm development (SNH, 2019). The aim was to determine the presence of roosting bats and the need for further survey work or mitigation. The site was visited in April and June 2020. A walkover was carried out and all structures and trees were assessed for their potential to support roosting bats (see **Appendix 2** for criteria in assessing roosting habitats).

Any potential roost sites were subject to a roost assessment. This comprised a detailed inspection of the exterior and interior (if accessible) to look for evidence of bat use, including live and dead specimens, droppings, feeding remains, urine splashes, fur oil staining and noises.

Any potential tree roosts were examined for the presence of rot holes, hazard beams, cracks and splits, partially detached bark, knot holes, gaps between overlapping branches and any other potential roost features (i.e. PRFs) identified by Andrews (2018).

3.3.2.3 Manual Transects (2020)

Manual activity surveys comprised walked transects at dusk. A representative transect route covering all constructed turbines was selected for the constructed wind farm site. The aim of the manual surveys was

[1] *Scottish Natural Heritage published Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation (SNH 2019).*

to identify bat species using the site and gather any information on bat behaviour and important features used by bats. The transect route was prepared with reference to the site layout, desktop and walkover survey results as well as any health and safety considerations and access limitations. As such, the transect route followed existing roads and tracks.

Transects were walked by two surveyors, recording bats in real time. Surveys commenced 30 minutes before sunset and were completed for 3 hours after sunset. Surveyors were equipped with active full spectrum bat detectors, the Batlogger M bat detector (Elekon AG, Lucerne, Switzerland) and all bat activity was recorded for subsequent analysis to confirm species identifications. Transects surveys were undertaken in Spring and Summer 2020. Table 3-1 summarises survey effort in relation to walked transects.

Table 3-1 2019 Survey Effort - Manual Transects

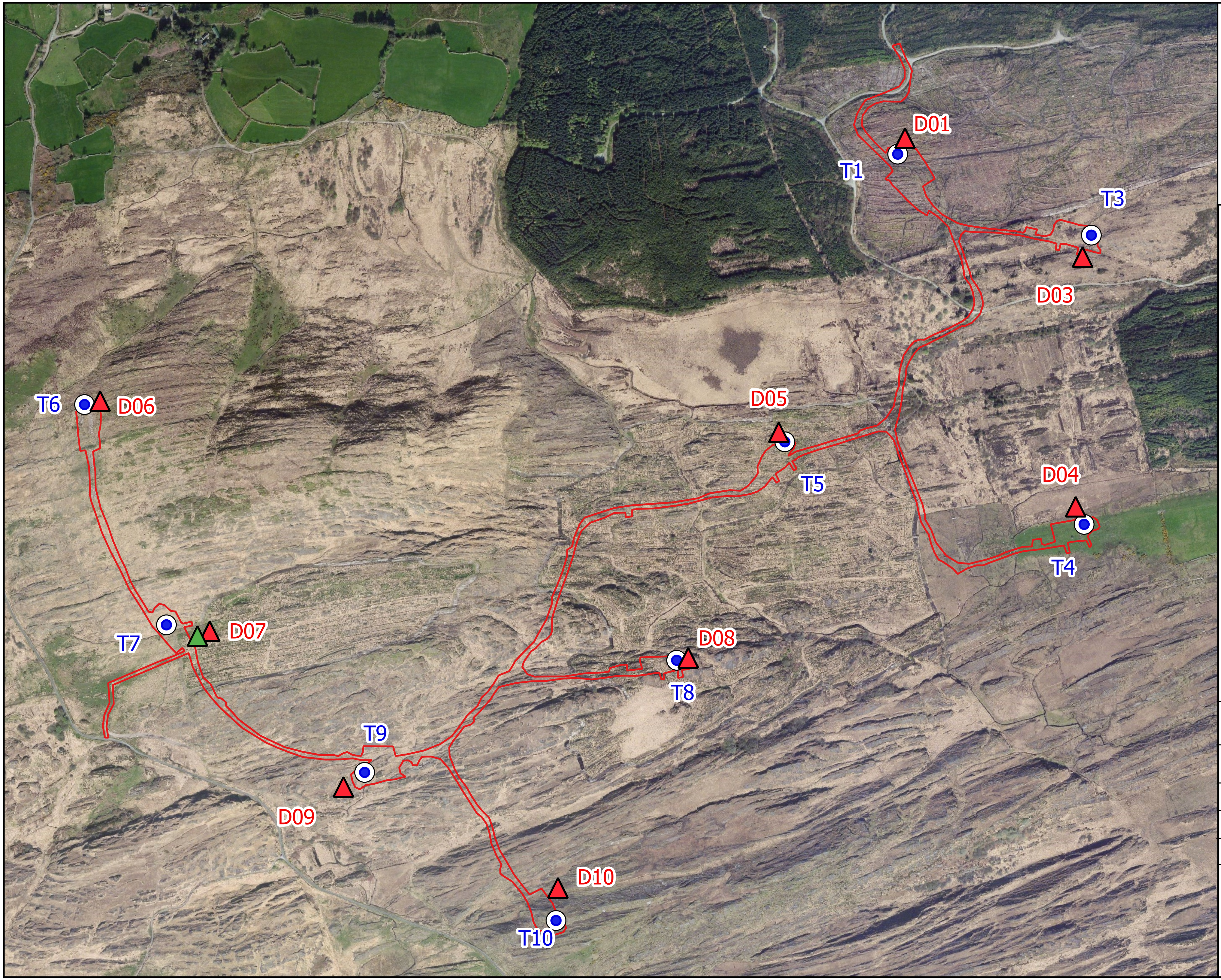
Date	Surveyors	Sunset	Type	Weather	Walked (km)
30th April 2020	Aoife Joyce and Colin Murphy	21:00	Dusk	10˚; dry; light-gentle breeze.	8.1
30th July 2020	Rachel Walsh and Neil Campbell	21:28	Dusk	17-18˚; dry; gentle breeze.	8.5
Total Survey Effort					**16.6**

3.3.2.4 Ground-level Static Surveys (2019)

Where developments have more than 10 turbines, SNH requires 1 detector per turbine up to 10 plus a third of additional turbines. Given that 9 turbines are constructed, 9 detectors were deployed to ensure compliance with SNH guidance. Automated bat detectors were deployed for at least 10 nights in each of spring (April-May) and summer (June-mid August) (SNH, 2019). Autumn surveys will be undertaken. Detector locations were based on constructed turbine locations and sampled the range of available habitats. Figure 3-1 presents static detector locations in relation to the final turbine layout. 2020 static detector locations are described in Table 3-2.

Table 3-2 2019 Ground-level Static Detector Locations

ID	Location	Habitat	Linear Feature within 50m
D06	E119494 N069624	Upland peatland habitat, beside turbine base	Road
D07	E119684 N069225	Upland peatland habitat, beside turbine base, beside spruce trees	Road and immature conifers
D09	E119916 N068955	Upland peatland habitat, beside turbine base	Road
D10	E120288 N068780	Upland peatland habitat, beside turbine base	Road
D8	E120514 N069179	Upland peatland habitat, beside turbine base	Road
D5	E120671 N069570	Upland peatland habitat, beside turbine base	Road
D4	E121186 N069441	Upland peatland habitat, beside turbine base	Road
D3	E121198 N069874	Upland peatland habitat, beside turbine base	Road
D1	E120890 N070080	Upland peatland habitat, beside turbine base	Road



Map Legend

- Development Footprint
- Turbine Locations
- Static Detector Locations
- Weather Station

N

Microsoft product screen shots reprinted with permission from Microsoft Corporation

Drawing Title: 2020 Static Detector Locations	
Project Title: Cleanrath Wind farm	
Drawn By: LD	Checked By: PR
Project No.: 191223a	Drawing No.: Figure 3-1
Scale: 1:8559	Date: 13/08/2020

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Full spectrum bat detectors, Song Meter SM4BAT (Wildlife Acoustics, Maynard, MA, USA), were employed. Settings used were those recommended by the manufacturer for bats, with minor adjustments in gain settings and band pass filters to reduce background noise when recording. Detectors were set to record from 30 minutes before sunset until 30 minutes after sunrise. The Song Meter automatically adjusts sunset and sunrise times using the Solar Calculation Method when provided with GPS coordinates.

Onsite weather monitoring was undertaken concurrently with static detector deployments. One Vantage Pro 2 (Davis Instruments, CA, UCS) was deployed each season and night-time hourly data was tracked remotely to ensure a sufficient number of nights (i.e. minimum 10 no.) with appropriate weather conditions were captured (i.e. dusk temperatures above 8°, wind speeds less than 5m/s and no or only very light rainfall). Table 3-3 summarises survey effort achieved in 2020 for each of the 9 no. detector locations.

Table 3-3 2019 Survey Effort - Ground-level Static Surveys

Season	Survey Period	Total Survey Nights per detector location	Nights with Appropriate Weather
Spring	30th April – 12th May 2020	12	10
Summer	11th June – 25th June 2020	14	10
Total Survey Effort		**26**	**20**

3.3.2.5 2020 Corpse Searching Surveys

Corpse searching surveys were conducted between January and July 2020 and are still ongoing despite the turbines being in 'sleep mode' since May. Searcher efficiency and carcass removal trials were conducted in advance of the commencement of the bat fatality searches to account for ability of the trained search dog to find bat corpses and the effect of scavengers on search results. This allowed for an estimate of the total number of collisions at the wind farm for each survey year.

Searches are being conducted once each month. During each visit, searches are undertaken at each operating turbine location by a team consisting of one surveyor and a trained search dog. The dog is equipped with a GPS collar, so that any finds can be plotted and subjected to review by the accompanying surveyor.

(Edkins, 2014) *Impacts Of Wind Energy Developments On Birds And Bats: Looking Into The Problem*, recommends the "search width should be equal to the maximum rotor tip height", e.g. for Cleanrath; hub height is 92.5m plus half the rotor diameter (117m/2), the spread of searched area, as a rectangle, square or circle, should be 75.5m in either direction form the turbine base." For Cleanrath Wind Farm, the figure of a 151m box centred on the turbine location was agreed.

Recording sheets were used to document bat carcasses encountered in the field. The following details were considered during field surveys: GPS location of each bat carcass, photographic record, carcass condition intact (carcass that is completely intact or not badly decomposed), scavenged (evidence that the carcass was fed upon by a scavenger/predator), distance from the turbine location, date, time, etc. Results of bat casualties will be issued in a final report at the end of each monitoring year.

3.4 Bat Call Analysis

All recordings are analysed using bat call analysis software Kaleidoscope Pro v.5.1.9 (Wildlife Acoustics, MA, USA). The aim of this is to identify, to a species or genus level, what bats were present at the Wind Farm site. Bat species are identified using established call parameters, to create site specific custom classifiers and are manually verified.

Echolocation signal characteristics (including signal shape, peak frequency of maximum energy, signal slope, pulse duration, start frequency, end frequency, pulse bandwidth, inter-pulse interval and power spectra) are compared to published signal characteristics for local bat species (Russ, 1999). Myotis species (potentially Daubenton's bat *(M. daubentonii),* Whiskered bat *(M. mystacinus),* Natterer's bat *(M. nattereri)*) are considered as a single group, due to the difficulty in distinguishing them based on echolocation parameters alone (Russ, 1999). The echolocation of Soprano pipistrelle *(P. pygmaeus)* and Common pipistrelle *(P. pipistrellus)* are distinguished by having distinct (peak frequency of maximum energy in search flight) of ~55 kHz and ~46 kHz respectively (Jones & van Parijs, 1993).

Plate 3-1 below shows a typical sonogram of echolocation pulses for Common pipistrelle recorded with a SM4BAT bioacoustic static bat recording device. The recorded file is illustrated using Wildlife Acoustics Kaleidoscope software.

Individual bats of the same species cannot be distinguished by their echolocation alone. Thus, 'bat passes' are used as a measure of activity (Collins, 2016). A bat pass is defined as a recording of an individual species/species group's echolocation containing at least two echolocation pulses and of maximum 15s duration. All bat passes recorded in the course of this study follow these criteria, allowing comparison.

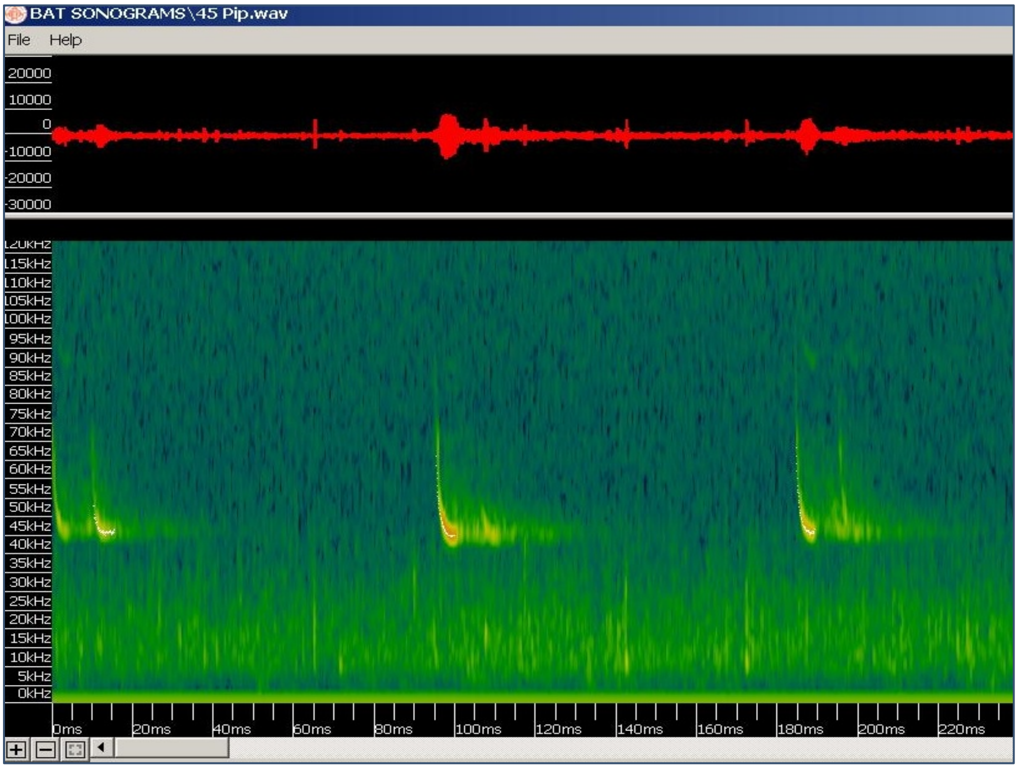


Plate 3-1 Sonogram of echolocation pulses of Common Pipistrelle (Peak Frequency 45kHz).

3.5 Assessment of Bat Activity Levels

Static detector monitoring results were uploaded to the online database tool Eco bat (ecobat.org.uk). This web-based interface, launched in August 2016, allows users to upload activity data and to contrast results with a comparable reference range, allowing objective interpretation. Uploaded data then contributes to the overall dataset to provide increasingly robust outputs. Ecobat generates a percentile rank for each night of activity and provides a numerical way of interpreting levels of bat activity in order to provide objective and consistent assessments. Table 3-4 defines bat activity levels as they relate to Ecobat percentile values (SNH, 2019).

Static detector at ground level results for the constructed wind farm were uploaded in June 2020. Database records used in analyses were limited to those within a similar time of year (within 30 days) and a within a similar geographic region (within 200 km).

Guidelines in the use of Ecobat recommend a Reference Range of 2000+ to be confident in the relative activity level. The reference range is the stratified dataset of bat results recorded in the same region, at the same time of year, by which percentile outputs can be generated. This comprises all records of nightly bat activity across Ireland.

Although there is an increased uptake in the use of Ecobat in Ireland, some of the reference ranges remain below 2000. As Ecobat continues to be utilised in Ireland the accuracy of data outputs and results will improve over time. Results of Ecobat analysis for the Cleanrath wind farm development site can be found in Table 4-6 in the results section below.

Table 3-4 Ecobat percentile score & categorised level of activity (SNH, 2019).

Ecobat Percentile	Bat Activity Level
81 to 100	High
61 to 80	Moderate to High
41 to 60	Moderate
21 to 40	Low to Moderate
0 to 20	Low

3.6 Assessment of Collision Risk

3.6.1 Population Risk

SNH (2019) provides a generic assessment of bat collision risk for UK species, based on species behaviour and flight characteristics. In the guidelines, this measure of collision risk is used, in combination with relative abundance, to indicate the potential vulnerability of British bat populations. No such assessment is provided for Irish bat populations.

In Plate 3-2, an adapted assessment of vulnerability for Irish bat populations is provided. This adaptation of the SNH Guidance Table 2 was based on collision risk and species abundance of Irish bat populations. Species' collision risk follows those described in SNH (2019). Relative abundance for Irish species was determined in accordance with Wray *et al.* (2010) using population data available in the 2019 Article 17 reports (NPWS, 2019). Feeding and commuting behaviours, and habitat preferences for bat species in Ireland were also considered.

Relative Abundance	Low Collision Risk	Medium Collision Risk	High Collision Risk
Common species			Common pipistrelle Soprano pipistrelle
Rarer species	Daubenton's bat Brown long-eared bat Lesser horseshoe bat		Leisler's bat
Rarest species	Natterer's bat Whiskered bat		Nathusius' pipistrelle

Low Population Vulnerability	Medium Population Vulnerability	High Population Vulnerability

Plate 3-2 Population vulnerability of Irish bat species (adapted from SNH, 2019)

3.6.2 Site Risk

The likely impact of a Cleanrath wind farm development on bats is related to site-based risk factors, including habitat and development features. The cross-tablature result of habitat risk and project size determines the site risk (i.e. Low, Medium or High) (Plate 3-3) i.e. Table 3a (SNH, 2019). Table 5-1 in the results section describes the criteria and site-specific characteristics used to determine an indicative risk level for the subject site. All site assessment levels, as per SNH (2019) are presented in **Appendix 3**.

		Project Size		
		Small	Medium	Large
Habitat Risk	Low	1	2	3
	Moderate	2	3	4
	High	3	4	5

Low/Lowest Site Risk (1-2)	Medium Site Risk (3)	High/Highest Site Risk (4-5)

Plate 3-3 Site risk level assessment matrix (SNH, 2019)

3.6.3 Overall Risk Assessment

An overall assessment of risk was made by combining the site risk level (i.e. Medium) and the population risk (i.e. Ecobat bat activity outputs), as shown in the overall risk assessment matrix table (Plate 3-4) i.e. Table 3b (SNH, 2019). The assessment was carried out for both median and maximum Ecobat activity categories in order to provide insight into typical bat activity (i.e. median values) and activity peaks (i.e. maximum values).

	Ecobat Activity Category					
Site Risk Level	Nil (0)	Low (1)	Low-Moderate (2)	Moderate (3)	Moderate-High (4)	High (5)
Lowest (1)	0	1	2	3	4	5
Low (2)	0	2	4	6	8	10
Medium (3)	0	3	6	9	12	15
High (4)	0	4	8	12	15	18
Highest (5)	0	5	10	15	20	25

Low Overall Risk (0-4)	Medium Overall Risk (5-12)	High Overall Risk (15-25)

Plate 3-4 Overall risk assessment matrix (SNH, 2019)

This exercise was carried out for each high collision risk species. Overall risk assessments were also considered in the context of any potential impacts at the population level, particularly for species identified as having high population vulnerability (Tables 4-4 – 4-7 below).

3.7 Limitations

A comprehensive suite of 2020 bat surveys are currently being undertaken at the Cleanrath wind farm development site. The surveys undertaken, in accordance with SNH Guidance, provide the information necessary to allow a complete, comprehensive, and robust assessment of the potential impacts of the Cleanrath wind farm development on bats receptors. While this report will include spring and summer bat data, the autumn surveys are still underway and are therefore not yet available.

The information provided in this report accurately and comprehensively describes the baseline environment; provides an accurate prediction of the likely effects of the Cleanrath wind farm development; prescribes mitigation as necessary; and describes the predicted residual impacts. The specialist studies, analysis and reporting have been undertaken in accordance with the appropriate guidelines.

No significant limitations in the scope, scale or context of the assessment have been identified.

4. SURVEY RESULTS

4.1 Consultation

A detailed scoping exercise was undertaken for the constructed wind farm. These results are described fully in the main rEIAR and no specific recommendations were made in relation to bats. BCI and NPWS were invited to comment on the Cleanrath wind farm development and potential effects on bats. However, no response was received as of 11th August 2020.

4.2 Desk Study

4.2.1 National Parks and Wildlife Service Records

NPWS online records were searched on 28th July 2020, determine if records of any rare or protected species of flora or fauna had been recorded within the hectads (W16, W17, W26 and W27). A data request was also sent to the NPWS and data received in relation to the relevant hectads on the 30th March 2019.

Table 4-1 Records for rare and protected species, NPWS.

Common Name	Scientific Name	Status	Hectad
Common pipistrelle	*Pipistrellus pipistrellus*	Annex IV, WA	W26
Brown long-eared bat	*Plecotus auritus*	Annex IV, WA	W27
Lesser horseshoe bat	*Rhinolophus hipposideros*	Annex II, IV, WA	W16, W26, W27

Annex II, Annex IV, Annex V – Of EU Habitats Directive, WA – Irish Wildlife Acts (1976-2017).

4.2.2 National Biodiversity Data Centre Records

The National Biodiversity Data centre database was accessed on 28/07/2020 and the following information was obtained. Table 4-2 lists the bat species recorded within the hectads which pertains to the current study area (W16, W17, W26 and W27).

Table 4-2 NBDC records for protected fauna records (excl. birds).

Common Name	Scientific Name	Status	Hectad
Daubenton's bat	*Myotis daubentonii*	HD Annex IV, WA	W16, W17, W27
Leisler's bat	*Nyctalus leisleri*	HD Annex IV, WA	W16, W17, W26, W27
Common pipistrelle	*Pipistrelle pipistrellus*	HD Annex IV, WA	W16, W17, W26, W27
Soprano pipistrelle	*Pipistrellus pygmaeus*	HD Annex IV, WA	W16, W17, W26, W27
Nathusius's pipistrelle	*Pipistrellus nathusii*	HD Annex IV, WA	W17
Brown long-eared bat	*Plecotus auritus*	HD Annex IV, WA	W17, W26, W27
Natterer's bat	*Myotis nattereri*	Annex IV, WA	W27
Lesser horseshoe bat	*Rhinolophus hipposideros*	HD Annex II, IV, WA	W16, W17, W26, W27

Annex II, Annex IV – Of EU Habitats Directive, WA – Irish Wildlife Acts (1976-2017).

4.2.3 National Bat Database of Ireland

The National Bat Database of Ireland was consulted for records of bat activity and roosts within the Cleanrath wind farm development site and surrounding area. A data request for bat records within a 10km radius of the Cleanrath wind farm development site (IG Ref: W20520 69583) was submitted to Bat Conservation Ireland and search results received on 28/07/2020).

The search yielded 27 no. records for roosts within a 10km radius of the Cleanrath wind farm development. A number transect (n=5) and ad-hoc observations (n=3) have also been recorded from within 10km of the project. Eight of Ireland's nine resident bat species were recorded within 10 km of the works including Common and Soprano pipistrelle, Brown long-eared bat, Leisler's bat, Daubenton's bat, Natterer's bat, Whiskered bat and Lesser horseshoe bat, as well as several records of unidentified bats (Table 4-3).

Table 4-3 BCI Records within 10km of Cleanrath wind farm development

Type	Grid Ref	Results	Designation
Roost	W1567	*Pipistrellus* spp.	Annex IV
	W3074	*Plecotus auritus*	Annex IV
	W2873	*Myotis natterreri; Nyctalus leisleri; Pipistrellus* spp.	Annex IV
	W2366	*Myotis daubentonii; Plecotus auritus*	Annex IV
	W2579	*Pipistrellus* spp.	Annex IV
	W2677	*Plecotus auritus*	Annex IV
	W2976	*Plecotus auritus*	Annex IV
	W2865	*Pipistrellus* spp.	Annex IV
	W2876	*Plecotus auritus*	Annex IV
	W2477	*Plecotus auritus*	Annex IV
	W2074	*Pipistrellus* spp.	Annex IV
	W2575	*Pipistrellus pipistrellus*	Annex IV
	W1165	*Pipistrellus* spp.	Annex IV
	W2176	*Pipistrellus* spp.	Annex IV
	W1175	*Pipistrellus* spp.	Annex IV
	W2369	*Plecotus auritus; Rhinolophus hipposideros*	Annex II, Annex IV
	W1874	*Pipistrellus* spp. *Plecotus auritus*	Annex IV
	W2876	*Plecotus auritus*	Annex IV
	W2875	*Plecotus auritus*	Annex IV
	W3072	*Nyctalus leisleri; Plecotus auritus*	Annex IV
	W2976	*Plecotus auritus*	Annex IV
	W2776	*Plecotus auritus*	Annex IV
	W3074	*Plecotus auritus*	Annex IV
	W2975	Pipistrellus spp.	Annex IV
	W3069	*Rhinolophus hipposideros*	Annex II, Annex IV
	W2369	*Rhinolophus hipposideros*	Annex II, Annex IV
	W1976	*Plecotus auritus*	Annex IV
Transects	W2963673766	*Myotis daubentonii*; Unidentified bat	Annex IV
	W2955867786	*Myotis daubentonii; Nyctalus leisleri*; Unidentified bat	Annex IV
	W3033872856	*Myotis daubentonii*; Unidentified bat	Annex IV
	W3033872856	*Myotis daubentonii*; Unidentified bat	Annex IV
	W3045972955	*Myotis daubentonii*	Annex IV
Ad-Hoc	W1900076000	*Myotis mystacinus/brandtii; Nyctalus leisleri; Pipistrellus pipistrellus Pipistrellus pygmaeus; Plecotus auritus; Rhinolophus hipposideros*	*Annex II, Annex IV*
	W2000077000	*Myotis daubentonii; Myotis mystacinus/brandtii; Myotis natterreri; Nyctalus leisleri; Pipistrellus pipistrellus; Pipistrellus pygmaeus; Plecotus auritus; Rhinolophus hipposideros*	Annex II, Annex IV
	W2010077800	*Myotis daubentonii; Myotis mystacinus/brandtii; Myotis natterreri; Nyctalus leisleri; Pipistrellus pipistrellus; Pipistrellus pygmaeus; Plecotus auritus*	Annex IV

4.2.4 Bat Species Range

The potential for negative impacts is likely to increase where there are high risk species at the edge of their range (SNH, 2019). Therefore, range maps presented in the 2019 Article 17 Reports (NWPS, 2019) were reviewed in relation to the location of the Cleanrath wind farm development.

The main part of the site is located at the edge of the current range for Lesser Horseshoe bat, Nathusius' pipistrelle and Whiskered bat. The site is located outside the current range for Natterers bat, and within range but not at the edge for all other species.

4.2.5 Designated Sites

Within Ireland, the Lesser horseshoe bat is the only bat species requiring the designation of Special Areas of Conservation (SACs) and the site is situated within the known range of this species. Natural Heritage Areas (NHAs) and Natural Heritage Areas (pNHAs) may be designated for any bat species. A search of SACs, NHAs and pNHAs within a 10 km radius of the Study Area found no sites designated for the conservation of bats.

4.2.6 Landscape Features

A review of mapping and photographs provided insight into the habitats and landscape features present at the Cleanrath wind farm development site. In summary, the primary land use within the site is wind energy production upland peatland habitats with coniferous plantations.

A review of the GSI online mapper did not indicate the possible presence of any subterranean sites within the study area and a search of the National Monuments Database did not reveal the presence of any manmade subterranean sites within the study area.

A search of the UBSS Cave Database for the Republic of Ireland found no caves within the site and no caves within 10km of the site Boundary.

A review of the NBDC bat landscape map provided a habitat suitability index of 30.78 (Orange). This indicates that the Cleanrath wind farm development area has *Moderate-high* habitat suitability for bat species.

4.2.7 Other Wind Energy Developments

A search for existing and permitted wind energy developments within 10km of the subject site was undertaken (SNH, 2019). Other infrastructure developments and proposals (e.g. roads) were also noted. Information on the location and scale of these developments was gathered to inform cumulative effects. Table 4-4 provides an overview of other wind farms in the vicinity of the Wind Farm.

Table 4-4 Wind farm developments within 10km of the site

Wind Farm	Description	Location
Clydaghroe / Creedon	Development of a wind farm, the wind farm will consist of 2 wind turbines and service roadways on a site, (an EIS has been submitted with this application)	Clydaghroe Clonkeen Co. Kerry (c. 10km north-west of the Cleanrath wind farm development)
	The development will consist of 1 wind turbine and service roadway. EIS submitted.	Clydaghroe Clonkeen Co. Kerry (c. 10km north-west of the Cleanrath wind farm development)
	Construct a single turbine extension to an existing three turbine windfarm. The maximum hub height will be 68.3m and the maximum rotor diameter will be 82.4m resulting in a maximum tip height of 109.5.	Clydaghroe Clonkeen Co. Kerry (c. 10km north-west of the Cleanrath wind farm development)
Midas	Construct a wind farm (8 no. Turbines) EIS received [4 no. turbines built]	Coolknoohil Co. Kerry (c. 10km west of the Cleanrath wind farm development
	Construct a wind farm consisting of 6 no. Wind turbine generators, electrical substation, septic tank, percolation area, access roadways, buried cable ducts and a 50m anemometer mast. EIS received.	
	Erect four wind turbines of 60m hub height, 52m rotor blade diameter, on-site tracks and cabling [3 no. turbines built]	

Wind Farm	Description	Location
	Erect 5 wind turbines of 60m hub height, 52m rotor blade diameter, on site tracks and cabling [4 no. turbines built]	
	To increase the hub heights of 7 wind turbines of planning reg no. 01/3571 from 49m to 60m hub height	
Shehy More	Ten year permission sought to construct a windfarm and all associated infrastructure. The windfarm will comprise the provision of a total of 12 no. wind turbines [11 no. granted], with a maximum overall blade tip height of up to 131m. The Planning Application is accompanied by an Environmental Impact Statement (EIS) and a Natura Impact Statement (NIS).	Cloghboola, Gortnacarriga, Tooreenalour, Garryantorna, Shehy More, Dunmanway, Co. Cork (c. 6km to the south west of the Cleanrath wind farm development)
Carrigarierk	Ten year planning permission for the construction of a wind farm of up to 5 No. wind turbines, with a maximum ground to blade tip height of up to 140m.	Barnadivane (Kneeves), Co. Cork (c. 8km to the south of the Cleanrath wind farm development)
Knocknamork	Renewable energy development consisting of the provision of a 7 turbine wind farm, solar photovoltaic array, electricity substation, battery storage compound and all associated works. An Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS) have been prepared in respect of the proposed development.	Slievereagh and Coomnaclohy Ballyvourney Co. Cork (c. 10km north of the Cleanrath wind farm development)
Derragh	Development of a wind farm consisting of 6 turbines (each with a maximum hub height of 100, maximum rotor diameter of 100m, and with a total tip height of 150m), a substation, one borrow pit, new internal access roads, upgrading of existing internal access roads and all ancillary works	Derragh, Rathgaskig and Lack Beg near Ballingeary, Co. Cork. Adjacent to the grid connection route for the Cleanrath wind farm development

4.3 Overview of Study Area and Ecological Appraisal

The Wind Farm site (excluding the grid connection route) is located in an area that is dominated by upland peatland and forestry habitat. Results from the desktop review and walkover surveys were used to assess habitats for their suitability to support foraging and commuting bats, and roosting bats, according to Collins (2016). Suitability categories, divided into *High*, *Moderate, Low* and *Negligible*, are described fully in **Appendix 2.**

With regard to foraging and commuting bats, areas of closed canopy forestry as well as exposed siliceous rock and peatland habitats were considered *negligible* suitability, i.e. negligible habitat features on site likely to be used by commuting or foraging bats (Collins, 2016). Forestry edge and scrub habitats may provide greater foraging and commuting opportunities. These habitats within the study area are connected to the wider landscape by further adjacent forestry and scrub. As such, these habitats were classified as *Moderate* suitability, i.e. habitat connected to the wider landscape that could be used by bats for foraging and commuting (Collins, 2016).

With regard to roosting bats, no structures on site were assessed as having roosting potential. Trees present within the site are commercial coniferous species with *Negligible – Low* roosting potential.

4.4 2015 Survey Findings

The 2015 survey findings are fully described and assessed in the bat survey report prepared in 2015, see **Appendix 1** of this report. The below paragraphs provide a summary of the main survey findings.

Five bat species were recorded in the main study area during these surveys: common pipistrelle, soprano pipistrelle, Leisler's bat and brown long-eared bat. A single recording from a likely lesser horseshoe bat was also recorded from a static detector located in mature conifer plantation to the north of the site on the 8th May 2015. A small number of unidentified *Myotis* species were also recorded.

The results of the car and walked surveys show that activity was Low, with a maximum of 0-7.28 bat passes/km. A total of 30.91 km of transects were walked and 18.4 km driven over the survey period and a total of 38 bat contacts were made. This is equivalent to 0.77 bat passes/km travelled. These values are typical for upland exposed habitats.

The majority of the bat contacts recorded during the bat surveys were of common, soprano or unidentified pipistrelle (84% of those recorded during transects and 98% of the contacts recorded by the SM2s). These results fall in line with what is expected since these two species are the two most commonly encountered in Ireland and they have widespread distributions (although it should also be remembered that they are also amongst the species that produce calls that are the most likely to be captured by bat detectors).

The site of the windfarm did not appear to support high quality roosting habitats with few trees of high potential to support roosting bats. No evidence of bat roosting activity was recorded during the survey.

Overall, the numbers of bats recorded within and around the Cleanrath site appear to be typical of upland peatland habitats with coniferous plantations with low overall activity. The site appears to provide suitable feeding grounds for a variety of bat species however no suitable roosting trees or structures were found within the study area.

4.5 2020 Survey results

Despite the finding of low levels of bat activity recorded during the 2015 surveys, dedicated bat surveys commenced at the Cleanrath Wind Farm site in April 2020 and are ongoing. Dedicated walked transects of the built infrastructure, using handheld bat detectors, were and will be undertaken along the Cleanrath wind farm development footprint on a seasonal basis. This has been undertaken along with the use of ground-level static detectors, which have been deployed at each of the 9 turbines.

4.5.1 Roost Surveys

Following the search for roosts in 2020, no structures containing suitable bat roost features were identified within the site boundary. Trees present within the site are commercial coniferous species with *Negligible – Low* roosting potential.

Trees present on site comprise a mixture of mature and immature commercial coniferous species. Overall trees within the site did not provide optimal habitat for roosting bats and were assessed as having *Negligible – Low* roosting potential. Trees may have an increased or decreased probability of hosting roosting bats in certain circumstances i.e. Having large broadleaf trees with cavities or other damage such as rot or loose bark increased probability whereas, Conifer plantations and young trees with little – no damage have a decreased probability of hosting bats (Kelleher and Marnell, 2006).

4.5.2 Manual Transects

Bat activity was recorded during spring and summer surveys. As with the 2015 surveys, bat activity was low, with just 31 bat passes in total recorded across the survey area.

A total of 31 bat passes were recorded. In general, Common pipistrelle (n=29) was recorded most frequently. Smaller instances of Leisler's bat (n=1) and *Myotis* sp. (n=1), were also recorded. However, species composition and activity levels varied significantly between surveys. Transect survey results were calculated as bat passes per km surveyed (to account for differences in survey effort). Plate 4-1 presents results for individual species per survey period. Figures 4-1 and 4-2 present the spatial distribution of bat activity across surveys.

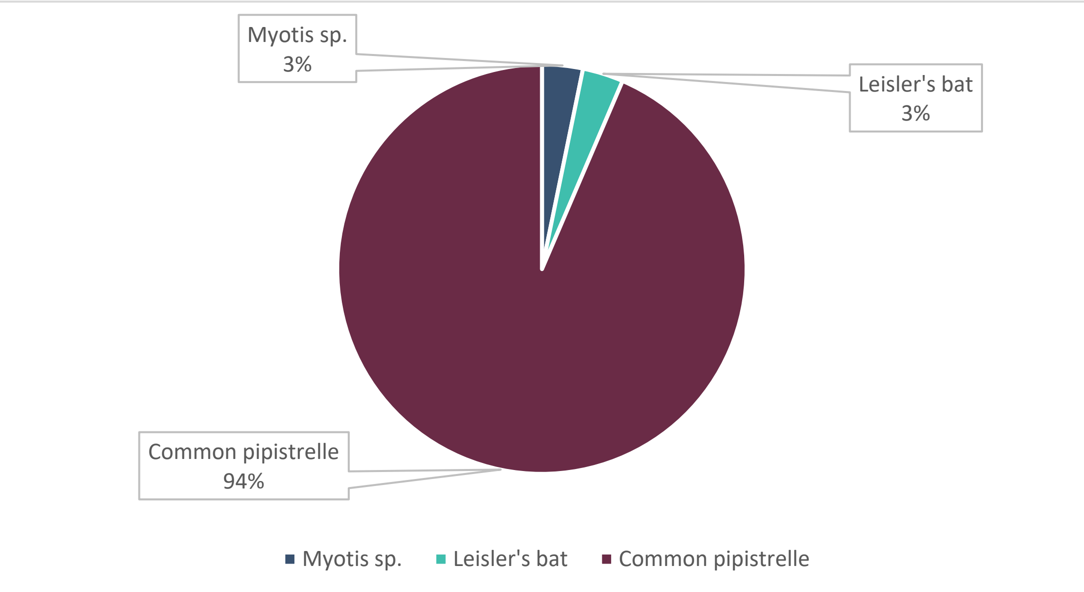
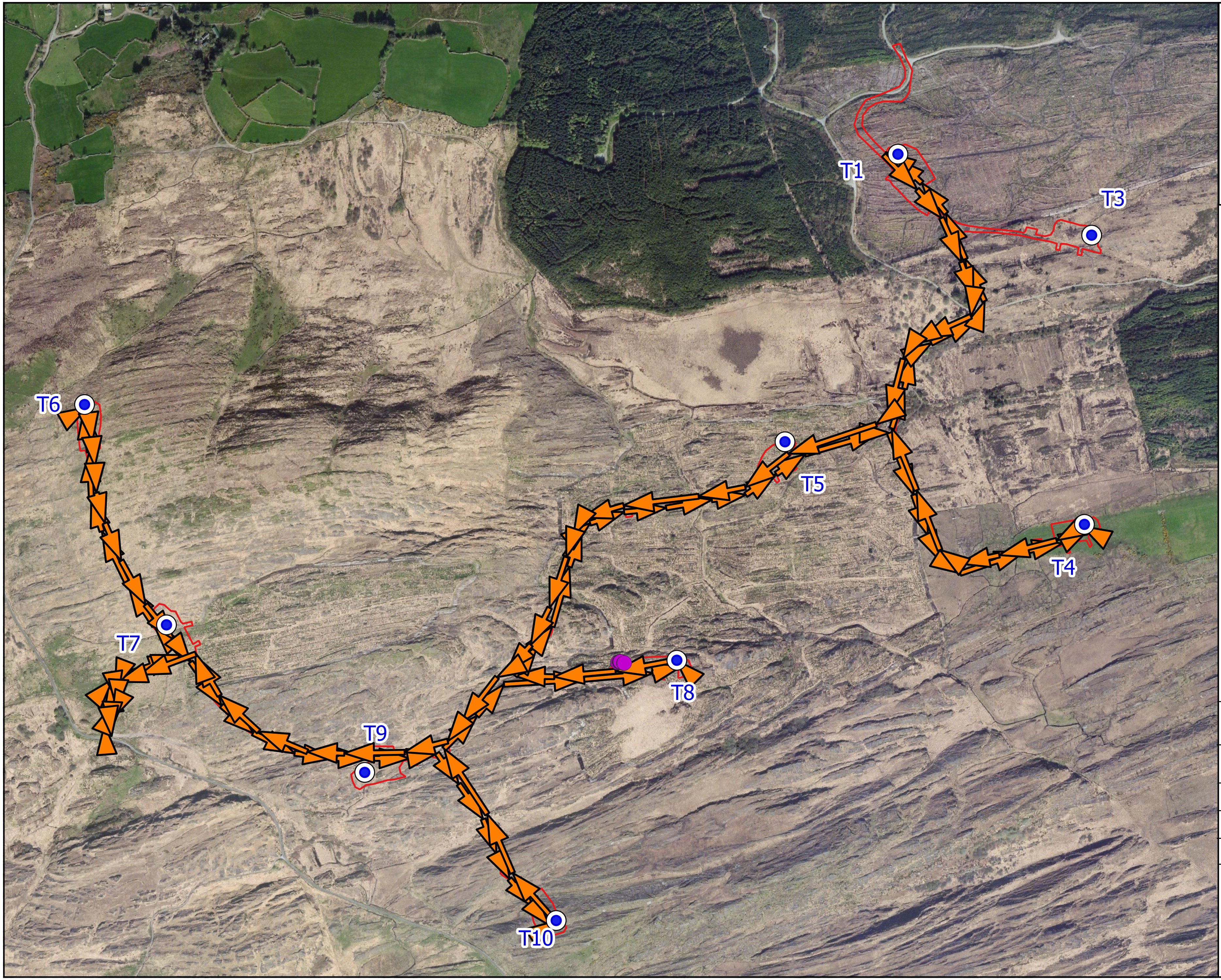


Plate 4-1 Spring and Summer Manual Transects 2020 - Species Composition



Map Legend

- Development Footprint
- Turbine Locations
- Spring Transect Route
- Common Pipistrelle

Microsoft product screen shots reprinted with permission from Microsoft Corporation

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Drawing Title	
Spring Transect Route 2020	
Project Title	
Cleanrath Wind farm	
Drawn By: LD	Checked By: PR
Project No.: 191223a	Drawing No.: Figure 4-1
Scale: 1:8559	Date: 13/08/2020

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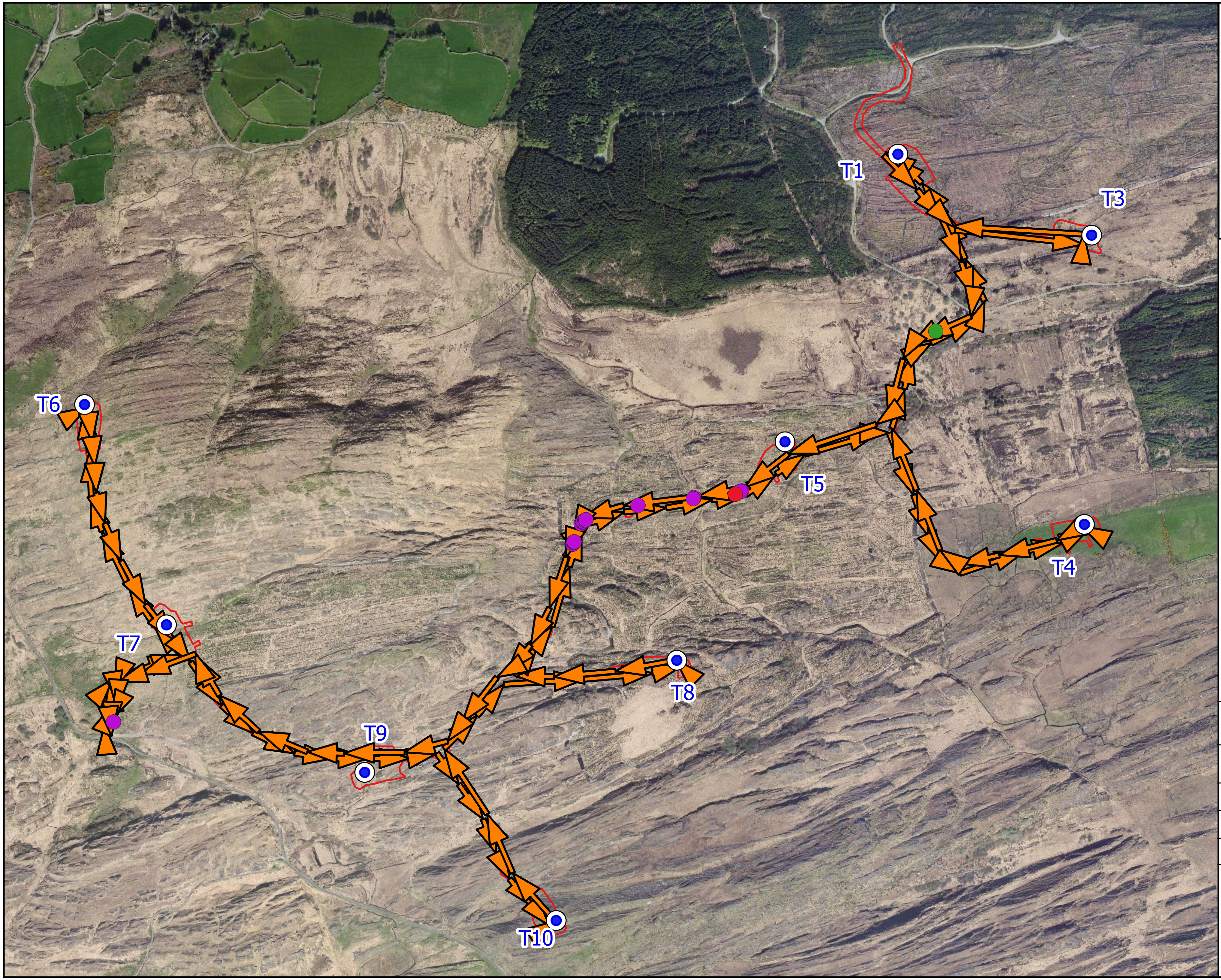

Map Legend

- Development Footprint
- Turbine Locations
- Summer Transect Route
- Myotis sp.
- Leislers
- Common Pipistrelle

Drawing Title: Summer Transect Route 2020	
Project Title: Cleanrath Wind farm	
Drawn By: LD	Checked By: PR
Project No.: 191223a	Drawing No.: Figure 4-2
Scale: 1:8559	Date: 13/08/2020

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4.5.3 Ground-level Static Surveys

In total, 5,164 bat passes were recorded across spring and summer deployments. In general, Common pipistrelle (n=4197) occurred most frequently, followed by Leisler's bat (n= 494) and Soprano pipistrelle (n=296). Instances of *Myotis* sp. (n=97), Brown long-eared bat (n=67), Nathusius' pipistrelle (n=8) and Lesser Horseshoe bat (n=5) were significantly less. Plate 4-2 presents relative species composition across all ground-level static detector surveys. This is a low level of activity in comparison to other sites surveyed.

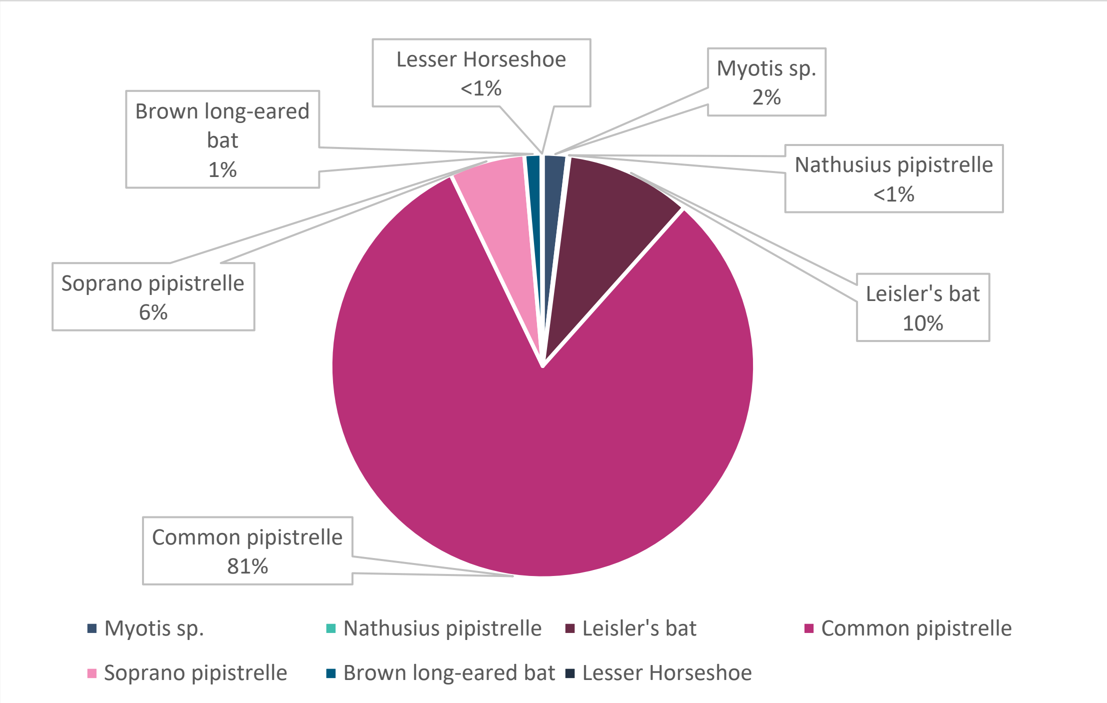

Plate 4-2 Static detector surveys: Species composition across all deployments (total bat passes)

Bat activity was calculated as total bat passes per hour (bpph) per season to account for any bias in survey effort, resulting from varying night lengths between seasons. Plate 4-3 and Table 4-5 presents these results for each species. Bat activity was dominated by Common pipistrelle in spring and summer. Leisler's bat and Soprano pipistrelle were the second and third most common across the spring and summer season. Instances of *Myotis* sp., Brown long-eared bat, Nathusius' pipistrelle and Lesser Horseshoe bat were relatively rare.

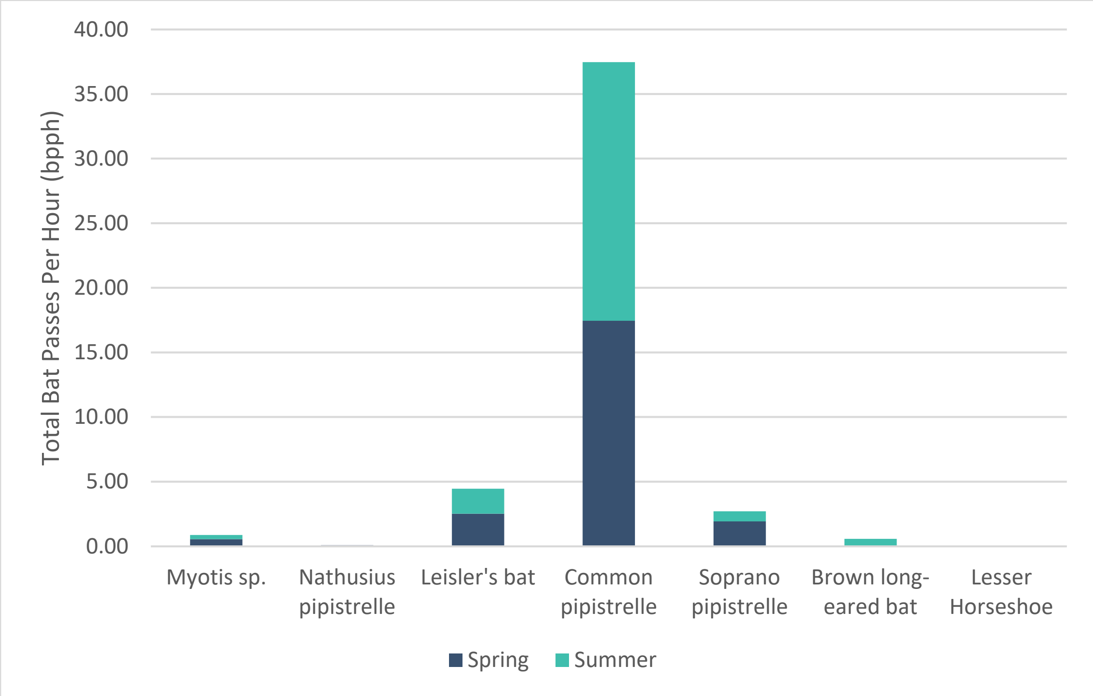

Plate 4-3 Static detector surveys: Species composition across all deployments (total bat passes per hour, all nights)

Table 4-5 Static detector surveys: Species composition across all deployments (total bat passes per hour, all nights).

	Spring	Summer
Total survey hours	106.2	117.1
Myotis sp.	0.56	0.32
Nathusius' pipistrelle	0.08	0.00
Leisler's bat	2.52	1.93
Common pipistrelle	17.46	20.01
Soprano pipistrelle	1.93	0.78
Brown long-eared bat	0.06	0.52
Lesser Horseshoe bat	0.04	0.01

The Nightly Pass Rate (i.e. total bat passes per hour, per night) was used to determine typical bat activity at the site. Activity was variable between survey nights. Therefore, the median Nightly Pass Rate was used as the most appropriate measure of bat activity (Linott & Mathews, 2018). Plate 4-4 illustrates the Median Nightly Pass Rate per species per deployment. Zero data, when a species was not detected on a night, was also included.

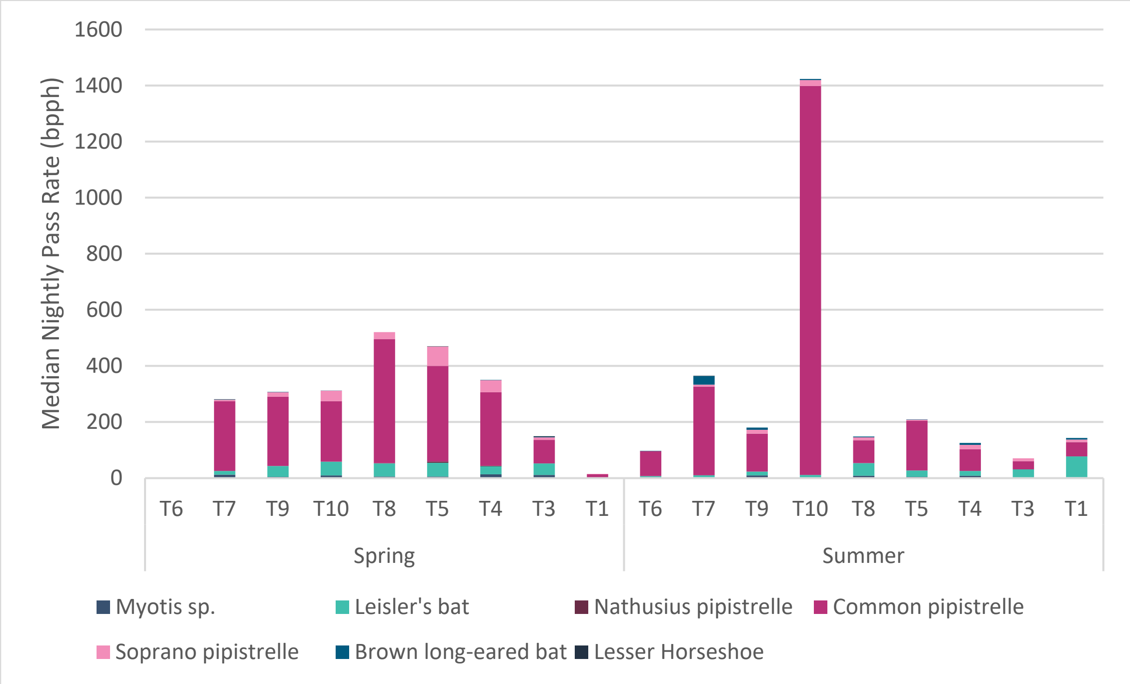

Plate 4-4 Static detector surveys: Median Nightly Pass Rate (bat passes per hour) including absences, per location per survey period.

Common pipistrelle was predominant across all detectors during the spring and summer seasons, particularly at detector 10 in the summer, where Leisler's bat activity was significantly higher than all other species. The only exception is D15 in summer, where Leisler's bat activity is slightly more abundant than Common pipistrelle.

Following the precautionary principle, bat activity levels were objectively assessed against a reference dataset using Ecobat. Table 4-6 presents the results of Ecobat analysis for each species, per season on a site-level. **Appendix 4** provides these results per detector. Common pipistrelle, Soprano pipistrelle and Leisler's bat had at least ***Moderate*** median bat activity during spring. Common pipistrelle median bat activity reduced to ***Moderate*** in summer from ***Moderate to high*** in spring. Leisler's bat reduced to ***Low to Moderate*** in summer and Soprano pipistrelle to ***Low***. Median bat activity during spring was ***Low*** for all other species.

Activity peaks were found to be high for Common pipistrelle throughout both seasons. Soprano pipistrelle and Leisler's bats were found to be ***Moderate to high*** during peak activity times in spring and summer.

Nathusius' pipistrelle was found to have ***Moderate*** activity during peak activity times in spring but was not recorded during the summer season. *Myotis* sp. was ***Moderate*** at peak activity for spring and summer, whereas Brown long-eared bat was ***Low*** in spring and ***Moderate to High*** in summer. Lesser Horseshoe was ***Low*** at peak activity in both seasons.

Table 4-6 Static detector surveys: Site-level Ecobat Analysis

Survey Period	Median Percentile	Median Bat Activity	Max Percentile	Max Bat Activity	Nights Recorded	Ref Range
Common pipistrelle						
Spring	68	Moderate - High	94	High	70	1980
Summer	55	Moderate	98	High	108	3312
Soprano pipistrelle						
Spring	43	Moderate	76	Moderate - High	41	1822
Summer	17	Low	65	Moderate - High	45	3090
Nathusius' pipistrelle						
Spring	19	Low	43	Moderate	4	340
Summer	-	Nil	-	Nil	-	-
Leisler's bat						
Spring	43	Moderate	73	Moderate - High	45	1686
Summer	33	Low - Moderate	68	Moderate - High	64	2644
Myotis sp.						
Spring	10	Low	48	Moderate	34	1402
Summer	17	Low	52	Moderate	26	2229
Brown long-eared bat						
Spring	10	Low	10	Low	6	699
Summer	17	Low	68	Moderate - High	27	1358
Lesser Horseshoe bat						
Spring	10	Low	10	Low	4	53
Summer	17	Low	17	Low	1	54

4.5.4 Corpse search monitoring

Corpse searching surveys were conducted between January and July 2020. This is undertaken using both hand searching and a trained search dog to detect any potential bat fatalities. To date (27.07.2020), one Leisler's bat corpse has been found on site on the 11th June 2020, at Turbine 8.

4.6 Significance of Bat population recorded at the site

Ecological evaluation and within this Section follows a methodology that is set out in Chapter three of the '*Guidelines for Assessment of Ecological Impacts of National Roads Schemes'* (NRA, 2009).

All bat species in Ireland are protected under the Bonn Convention (1992), Bern Convention (1982) and the EU Habitats Directive (92/43/EEC). Additionally, in Ireland bat species are afforded further protection under the Birds and Natural Habitats Regulations (2011) and the Wildlife Acts 1976-2019. No bat roosts were identified within the footprint of the Cleanrath wind farm development. Bats as an Ecological Receptor have been assigned ***Local Importance (Higher value***) on the basis that the habitats within the study area are utilised by a regularly occurring bat population of Local Importance.

The Cleanrath wind farm development site does not support a roosting site of ecological significance.

5. RISK AND IMPACT ASSESSMENT

As per SNH Guidance, wind farms present four potential risks to bats:

- Collision mortality, barotrauma and other injuries
- Loss or damage to commuting and foraging habitat
- Loss of, or damage to, roosts
- Displacement of individuals or populations

For each of these four risks, the detailed knowledge of bat distribution and activity within the study area has been utilized to predict the potential effects of the wind farm on bats.

5.1 Collision Mortality

5.1.1 Assessment of Site-Risk

The likely impact of a development on bats is related to site-based risk factors, including habitat and development features. The site risk assessment, as per Table 3a of the SNH guidance, is provided in Table 5-1 below.

Table 5-1 Site Risk Assessment

Criteria	Site-specific Evaluation	Individual Risk	Site Assessment
Habitat Risk	No potential roost features identified within the site.	Low	Low
	upland peatland habitats with coniferous plantations within the site (Low foraging/commuting suitability)	Low	
	Connected to wider landscape by forestry habitats.	Moderate	
Project Size	Small scale development (3 no. turbines)	Small	Large
	Other wind energy developments within 5km (see Table 4-3)	Large	
	Comprising turbines >100 m in height	Large	
Site Risk Assessment (from criteria in Plate 3-3)			Medium Site Risk (3)

The site of the Cleanrath wind farm development is located primarily in upland peatland habitats with coniferous plantations. As per table 3a of the SNH Guidance (2019), it has a *Low* habitat risk score. The Cleanrath wind farm development includes 9 turbines of over 100m in height. As per Table 3a, it is a small project (9 turbines) but the turbines are greater than 100m in height and thus for the purposes of the assessment, it is considered to be a *Large* project. It is also noted that there are other wind farm developments in the surrounding area, with the closest being approximately 1.7km from the turbines associated with the Cleanrath wind farm development.

The cross tabulation of a large project on a low risk site results in an overall risk score of ***Medium*** (SNH Table 3a).

5.1.2 Assessment of Collision Risk

The following high-risk species were recorded during the dedicated surveys:

- Leisler's bat,
- Common pipistrelle
- Soprano pipistrelle
- Nathusius' pipistrelle

The Overall Risk Assessment for high collision risk species is provided in the sections below. Overall Risk was determined, in accordance with Table 3b of SNH guidance (**Appendix 5**), by a cross-tablature of the site risk level (i.e. Medium) and Ecobat bat activity outputs for each species. The assessment was carried out for both median and maximum Ecobat activity categories in order to provide insight into typical bat activity (i.e. median values) and activity peaks (i.e. maximum values). SNH recommends that that most appropriate activity level (i.e. median or maximum) be utilised to determine the overall risk assessment for a species.

As per SNH guidance there is no requirement to complete an Overall Risk Assessment for low risk species. During the extensive suite of surveys undertaken that following low risk species were recorded:

- *Myotis* sp.
- Lesser Horseshoe
- Brown long-eared Bat

Overall activity levels were low for the above species no significant collision related effects are anticipated.

5.1.2.1 Leisler's bat

This site is within the current range of the Leisler's bat (NPWS, 2019). Leisler's bats are classed as a rarer species of a high population risk which have a high collision risk (Plate 3-2). Leisler's bats were recorded during activity surveys across the site. When assessed in the context of the identified site risk and in line with Table 3b (SNH 2019) overall activity risk for Leisler's bat was found to be ***Medium*** at typical activity levels and at peak activity levels across spring and summer (See Table 5-2).

Based on site visits in 2015 and 2020 and survey data, including walked transects, it is determined that the Typical Activity (i.e. Median) is a highly precautionary finding given the nature of the site, which is an upland peatland habitats with coniferous plantations with low levels of bat activity recorded during the walked transects undertaken.

However, following the precautionary principle, there is **Medium** collision risk level assigned to the local population of Leisler's Bat.

Table 5-2 Leisler's bat - Overall risk assessment

Survey Period	Site Risk	Typical Activity (Median)	Typical Risk Assessment (as per Table 3b SNH 2019)	Activity Peaks (Maximum)	Peak Risk Assessment (as per Table 3b SNH 2019)
Spring	Medium (3)	Moderate (3)	Typical Risk is Medium (9)	Moderate to High (4)	Typical Risk is Medium (12)
Summer		Low to Moderate (2)	Typical Risk is Medium (6)	Moderate to High (4)	Typical Risk is Medium (12)

5.1.2.2 Soprano pipistrelle

This site is within the current range of the Soprano pipistrelle bat (NPWS, 2019). Soprano pipistrelle are classed as a common species of a medium population risk which have a high potential collision risk (Plate 3-2). Soprano pipistrelle were recorded during activity surveys across the site. When assessed in the context of the identified site risk and in line with Table 3b (SNH 2019) overall activity risk for Soprano pipistrelle was found to be ***Medium*** and ***Low*** at typical activity levels and ***Medium*** at peak activity levels across spring and summer (See Table 5-3 below).

Based on site visits in 2015 and 2020 and survey data, including walked transects, it is determined that the Typical Activity (i.e. Median) is a highly precautionary finding given the nature of the site, which is an upland peatland habitats with coniferous plantations with low levels of bat activity recorded during the walked transects undertaken.

Following the precautionary principle, there is **Medium** collision risk level assigned to the local population of Soprano Pipistrelle.

Table 5-3 Soprano pipistrelle – Overall risk assessment

Survey Period	Site Risk	Typical Activity (Median)	Typical Risk Assessment (as per Table 3b SNH 2019)	Activity Peaks (Maximum)	Peak Risk Assessment (as per Table 3b SNH 2019)
Spring	Medium (3)	Moderate (3)	Typical Risk is Medium (9)	Moderate to High (4)	Peak Risk is Medium (12)
Summer		Low (1)	Typical Risk is Low (3)	Moderate to High (4)	Peak Risk is Medium (12)

5.1.2.3 Common pipistrelle

This site is within the current range of the Common pipistrelle bat (NPWS, 2019). Common pipistrelle are classed as a common species of a medium population risk which have a high collision risk (Plate 3-2). Common pipistrelle were recorded during activity surveys across the site. When assessed in the context of the identified site risk and in line with Table 3b (SNH 2019); overall activity risk for Common pipistrelle at typical activity levels was found to be ***Medium*** in Spring and Summer. Peak risk levels for Common pipistrelle were ***High*** in Spring and Summer (See Table 4-9).

Based on site visits in 2015 and 2020 and survey data, including walked transects, it is determined that the Typical Activity (i.e. Median) is a highly precautionary finding given the nature of the site, which is an upland peatland habitats with coniferous plantations with low levels of bat activity recorded during the walked transects undertaken.

Following the precautionary principle, there is **Medium** collision risk level assigned to the local population of Common Pipistrelle.

Table 5-4 Common pipistrelle – Overall risk assessment

Survey Period	Site Risk	Typical Activity (Median)	Typical Risk Assessment (as per Table 3b SNH 2019)	Activity Peaks (Maximum)	Peak Risk Assessment (as per Table 3b SNH 2019)
Spring	Medium (3)	Moderate to High (4)	Typical Risk is Medium (12)	High (5)	Peak Risk is High (15)
Summer		Moderate (3)	Typical Risk is Medium (9)	High (5)	Peak Risk is High (15)

5.1.2.4 Nathusius' pipistrelle

This site is within the current range of the Nathusius' pipistrelle bat (NPWS, 2019). Nathusius' pipistrelle are classed as a rarest species of a high population risk which have a high collision risk (Plate 3-2). Nathusius' pipistrelle were recorded during activity surveys in spring. When assessed in the context of the identified site risk and in line with Table 3b (SNH 2019); overall activity risk for Nathusius' pipistrelle at typical activity levels was found to be ***Low*** in Spring and Summer. Peak risk levels for Nathusius' pipistrelle were ***Moderate and Low*** in Spring and Summer (See Table 4-9).

Based on site visits in 2015 and 2020 and survey data, including walked transects, it is determined that the Typical Activity (i.e. Median) is reflective of the nature of the site, which is upland peatland habitats with coniferous plantations with low levels of bat activity.

Thus, there is **Low** collision risk level assigned to the local population of Nathusius' Pipistrelle.

Table 5-5 Nathusius' pipistrelle – Overall risk assessment

Survey Period	Site Risk	Typical Activity (Median)	Typical Risk Assessment (as per Table 3b SNH 2019)	Activity Peaks (Maximum)	Peak Risk Assessment (as per Table 3b SNH 2019)
Spring	Medium (3)	Low (1)	Typical Risk is Low (3)	Moderate (3)	Peak Risk is Moderate (9)
Summer		Nil (0)	Typical Risk is Low (0)	Nil (0)	Peak Risk is Low (0)

5.2 Loss or damage to commuting and foraging habitat

In absence of appropriate design, the loss or degradation of commuting/foraging habitat has potential to reduce feeding opportunities and/or displace bat populations. However, the Cleanrath wind farm development is already constructed and is predominantly located within upland peatland habitats with coniferous plantations therefore there has been and will be no significant loss of bat foraging/commuting habitat associated with the wind farm development.

The Cleanrath wind farm development, including the creation of new road infrastructure and grid connection route, has had the potential to increase the amount and availability of linear landscape features that may be utilised by bats for commuting or foraging due to the opening up the commercial forestry.

No significant effects with regard to loss of commuting and foraging habitat are likely to occur or have occurred.

5.3 Loss of, or damage to, roosts

The Cleanrath wind farm development is predominantly located within upland peatland habitats with coniferous plantations. The trees in the plantation provide *Negligible-Low* roosting potential for bats.

Overall, no roosting sites were identified, therefore none will be impacted by the Cleanrath wind farm development. There will be no loss of tree roosting habitat or linear landscape connectivity associated with these works. There was no potential for the installation of the grid connection (within existing roads) to have impacted on bats.

No significant effects with regard to loss of, or damage to, roosts likely to have occurred or to occur into the future.

5.4 Displacement of individuals or populations

The Cleanrath wind farm development (excluding the grid connection) is predominantly located within upland peatland habitats with coniferous plantations. There has been and will be no net loss of linear landscape features for commuting and foraging bats and there has been and will be no loss of any roosting site of ecological significance. The habitats on the site will remain suitable for bats and no significant displacement of individuals or populations is anticipated.

5.5 Corpse search monitoring

Corpse searching surveys were conducted between January and July 2020. This is undertaken using both hand searching and a trained search dog to detect any potential bat fatalities. To date (27th July 2020), only one Leisler's bat corpse has been found on site on the 11th June 2020, at Turbine 8. This is not considered significant. However, corpse searches will continue into year 2 and 3 of the post construction monitoring.

6. BEST PRACTICE AND MITIGATION MEASURES

This section describes the best practice and site-specific mitigation measures that were implemented and are in place to avoid and reduce the potential for significant effects on local bat populations.

6.1 Standard Best Practice Measures

6.1.1 Noise Restrictions

Plant machinery was turned off when not in use and all plant and equipment for use complied with the Construction Plant and Equipment Permissible Noise Levels Regulations (SI 359/1996). There is no evidence or likelihood that significant disturbance to bat species occurred during the construction phase of this development. These restrictions will apply during any future operation also.

6.1.2 Lighting Restrictions

Where lighting was required during construction, directional lighting was used to prevent overspill on to woodland/forestry edges. This was achieved using lighting accessories, such as hoods, cowls, louvres and shields, to direct the light to the intended area only. These restrictions will apply during any future operation also.

6.1.3 Buffering

A 50m buffer from the blade tip to the nearest woodland, as recommended by the Natural England (2014) and SNH (2019) guidelines, has been implemented. These vegetation-free areas will be maintained during the operational life of the development.

The correct buffer distance was measured from the blade tip sweep to the canopy of the nearest habitat feature (Plate 6-1). Measuring 50m for the base of the turbine to the habitat feature is inadequate as tall tree canopies may put bat populations at risk. It is necessary to calculate the distance between the edge of the habitat feature and the centre of the tower (b). Using the formula:

$$b = \sqrt{(50 + bl)^2 - (hh - fh)^2}$$

Where, **bl** =Blade length, **hh** = hub height, **fh** = feature height all in metres.

E.g. (below) **b** = 69.3m (Plate 6-1)

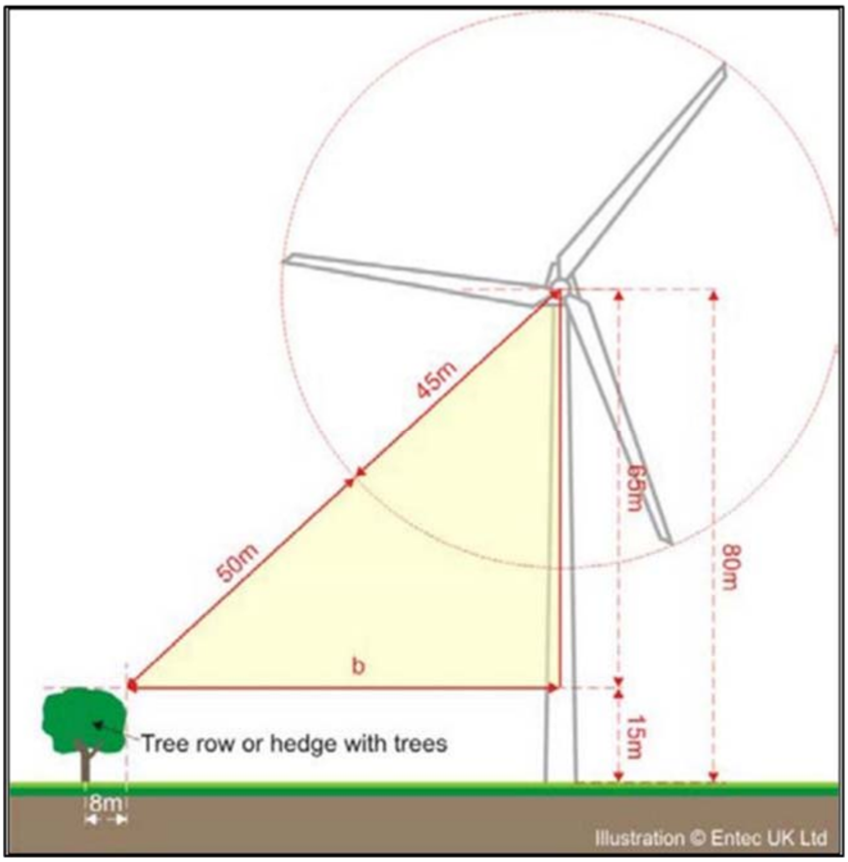

Plate 6-1 Calculate buffer distances (Natural England, 2014).

6.2 Site Specific Mitigation and Monitoring Programme

The Ecobat analysis calculated risk levels for high collision risk bat species was typically ***Medium*** with ***High*** seasonal peaks recorded for some species. This risk level is highly precautionary given the nature of the site, which is an upland peatland habitats and conifer plantation with low levels of bat activity recorded during the walked transects.

However, taking a precautionary approach and given that high collision risk was recorded at peak activity levels (for Common Pipistrelle only), an adaptive monitoring and mitigation strategy has been devised for the Cleanrath wind farm development in line with the case study example provided in Appendix 5 of the SNH Guidance.

7. INCORPORATION OF MITIGATION AND MONITORING

The following sections describe the mitigation measures implemented on site to minimise/avoid impacts on bat species locally.

7.1 Post-Construction Monitoring

As described in Section 3.3.2, operational phase monitoring is ongoing at the site, including the use of walked transects, static bat detectors and corpse searching at each of the 9 turbines. These surveys will continue for the period that the wind farm is in sleep mode. However, should it become operational in the future, the scope of the monitoring will be increased to align with SNH 2019.

7.1.1 Forestry felling

As part of Cleanrath wind farm development, forestry felling was required around a number of turbines. This was undertaken to ensure that the distance from the rotating blade tip of the turbine to the nearest part of the nearest trees will be a minimum of 50m. This mitigation measure is designed to avoid bats foraging in, or close to planted conifers, from coming into the close proximity of rotating turbines blades and is based on best practice from the UK. Trees will not be replanted in the future within the felled areas. This has been implemented on site, see Plate 7-1.

Plate 7-1 Example of forestry felling undertaken around Turbine no. 11

7.1.2 Post Construction Monitoring & Assessment of Adaptive Mitigation Requirement

As per SNH Guidance at least 3 years of post-construction monitoring is required to assess the effects of construction related habitat modification on bat activity. For example, it may be that the construction of wind turbines significantly reduces bat activity at the site relative to that recorded pre-construction and to a level at which there is no longer potential for significant effects on bats (SNH 2019).

Current and ongoing bat monitoring being conducted on site, where turbines are operating in sleep mode, will be utilised in conjunction with the 2015 bat survey findings. This will be used to assess bat activity patterns and to inform the design of any advanced site-specific mitigation requirements, including curtailment if deemed necessary, to ensure that there are no significant residual effects on bat species.

7.1.2.1 Operational Year 1

Static monitoring at turbine bases shall take place at each turbine during the bat activity season (between April and October). Full spectrum recording detectors shall be utilised for the same duration as during pre-application surveys and at the same density (SNH, 2019).

Key weather parameters and other factors that are known to influence collision risk will be monitored and shall include:

- Windspeed in m/s (measured at nacelle height)
- Temperature (ºC)
- Precipitation (mm/hr)

Carcass searches, to monitor and record bat fatalities, shall be conducted at each turbine. This shall include searcher efficiency trials and an assessment of scavenger removal rates to determine the appropriate correction factor to be applied in relation to determining an accurate estimate of collision mortality. The methodology used to conduct and assess carcass searches in provided in **Appendix 5**.

At the end of Year 1, and if a curtailment requirement is identified (i.e. significant bat fatalities encountered), a curtailment programme shall be devised around key activity periods and weather parameters.

Curtailment involves raising the cut-in speed of the relevant turbines with associated loss of power generation in combination with reducing the blade rotation (blade feathering) below the cut-in speed. The most basic and least sophisticated form of curtailment "blanket" curtailment -involves feathering the blades between dusk and dawn over the entire bat active period (April to October). A more sophisticated and efficient solution is to focus on certain times and dates, corresponding with those periods when the highest level of bat activity is expected to occur. Further savings can be achieved by programming the SCADA operating system to only pause/feather the blades below a specified wind speed and above a specified temperature within specified time periods.

In order to minimise down time, the threshold values at which turbines are feathered should be site specific and informed by bat activity peaks at that location, but as an indication, they are likely to be in the range of wind speeds between 5.0 and 6.5m/s and at temperatures above approximately 10 or 11ºC measured at the nacelle. Significant savings can be achieved by so-called "smart "curtailment over the other less sophisticated alternatives.

The effectiveness of curtailment needs to be monitored in order to determine (a) whether it is working effectively (i.e. the level of bat mortality is incidental), and (b) whether the curtailment regime can be refined such that turbine down-time can be minimised whilst ensuring that it remains effective at preventing casualties.

7.1.2.2 Operational Years 2 & 3

Where a curtailment requirement is identified, monitoring surveys shall continue in Year 2 and 3 and the success of the curtailment strategy shall be assessed in line with the baseline data collected in the subsequent year/years.

The performance of the curtailment programme in terms of its ability to respond to the changes in bat abundance based on temperature and wind speed shall be analysed to confirm it is neither significantly over- nor under- curtailing during different periods of bat activity.

At the end of each year, the efficacy of the curtailment programme shall be reviewed, and any identified efficiencies incorporated into the curtailment programme.

7.2 Residual Impacts

Taking into consideration the proposed and implemented best practice and adaptive mitigation measures; significant residual effects on bats with regard to 1) Collision mortality, barotrauma and other injuries, 2) Loss or damage to commuting and foraging habitat, 3) Loss of, or damage to, roosts and 4) Displacement of individuals or populations are not likely to have occurred or to occur during any future operation or decommissioning.

8. CONCLUSION

This report provides a full and comprehensive assessment of the potential for impact on bat populations at the Cleanrath wind farm development site, based on surveys carried out in 2015 and 2020. The surveys and assessment provided in this report are in accordance with the relevant industry guidance. Following consideration of the residual effects (post mitigation) that may have occurred during construction, the brief period of operation and the current phase of sleep mode, it is noted that the Cleanrath wind farm development has not resulted in any significant effects on bats.

Following an extremely precautionary approach, ongoing monitoring and mitigation, is prescribed to avoid the potential for any significant impacts on bat species during any future operation.

Provided that the Cleanrath wind farm development is operated in accordance with the design, best practice and mitigation that is described within this report; there will be no significant effects on bats at any geographic scale.

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APPENDIX 1

2015 BAT REPORT

Bat Survey Report

Proposed Wind Farm, Cleanrath, Co. Cork

McCarthy
Keville
O'Sullivan

Planning & Environmental Consultants

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1 INTRODUCTION

1.1 General Introduction

This bat survey has been carried out in order to provide information on bat activity at the site of a proposed windfarm at Cleanrath North, Co. Cork. Bat surveys were carried out on site over the 2015 bat surveying season.

Planning permission is currently sought for the erection of an eleven turbine wind turbine development and associated site infrastructure within the site. After walked and static surveys on site it was concluded that the site is used by bats for foraging, however roost sites are very limited. Overall bat activity was low on site, typical for upland conifer plantation and open exposed grassland / heath habitats and thus, the erection of the wind farm development is unlikely to have any significant impact on bat species.

1.2 Statement of Authority

Surveys were designed by Pat Roberts B.Sc, MCIEEM and carried out by John Curtin B.Sc. (Env. Science). John has over four years professional experience undertaking bat surveys and has completed a range of bat surveys for a number of development led projects including wind farms. He has also completed the Bat Detector Workshop in association with Bat Conservation Ireland and is regarded as the standard training workshop for carrying out of bat surveys in Ireland. The workshop follows guidelines developed by Bat Conservation Ireland - 'Good Practice Guidelines' (Bat Conservation Ireland, 2012). In addition, he has taken part in voluntary research projects such as the Daubenton's bat waterways survey, the brown long-eared bat roost monitoring scheme and trialled the BATLAS 2020.

2 METHODOLOGY

The surveys undertaken are in line with recommendations in Chapter 10 of the Bat Conservation Trust 'Good Practice Guidelines, 2nd edition, 2012' (Bat Conservation Trust, 2012). Bat surveys were undertaken during the months of May, July and September 2015.

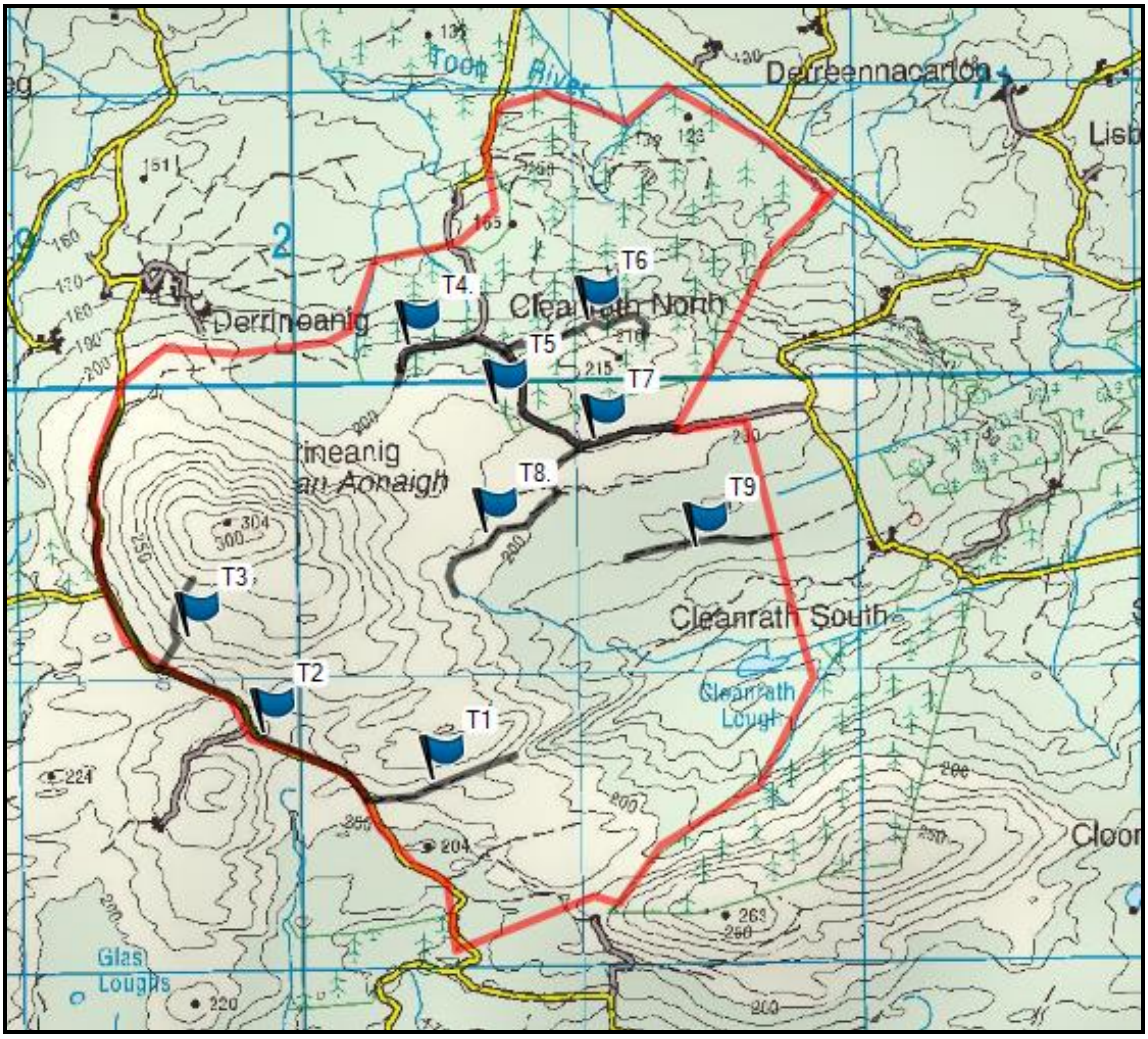
A bat detector survey is the principal method of assessing bat populations in a given area. These surveys utilize detectors which detect the presence of bats by converting their echolocation ultrasound signals, as they are emitted by the bats, to audible frequencies. Most species of bat found in Ireland are identifiable by the use of such detectors. The activities of bats are also noted, including feeding, commuting and roosts. Bat activity is highest at times just after dusk and before dawn thus surveys are based from thirty minutes before sunset for three hours and for two hours preceding sunrise. The recommended survey season for detector surveys is the period from the beginning of June to the end August, as studies during this period will provide information on any maternity roosts in the study area.

2.1 Transect Descriptions

Walked and car driven transects were based throughout the study area utilising roads, paths and through open grassland and heath. The site was divided into nine transects (as shown in Figure 1.1) and are summarised below:

- **Transect 1:** This transect started from the road at the south-western end of the site and is based on a mosaic habitat of bare siliceous rock, acid grassland and heath. It follows an eastern direction and ends at a valley leading to lowland bog.
- **Transect 2:** This primarily driven transect is based along the south-western road that borders the site. This transects dissects both open heath and acid grassland habitats along with patches of willow scrub.
- **Transect 3:** Similar to transect 1 this route is based on exposed siliceous rock and acid grassland. There is a steep incline uphill to the northwest.
- **Transect 4:** Follows a short track through mature conifer plantation in the centre of the site. The conifer plantation here provides more shelter from prevailing winds than many areas of the site.
- **Transect 5:** Is based along a road through the centre of the site. Conifer plantation of various ages borders both sides.
- **Transect 6:** Follows a path and track from the road, east through predominantly young, second rotation conifer plantation.
- **Transect 7:** This transect continues from transect 5 along the central road dissecting the study area. This transect borders several habitat types but generally open heath alongside areas of scrub. It is more exposed than transect 5.
- **Transect 8:** This is another transect through relatively young conifer plantation.
- **Transect 9:** Passes through improved and wet grassland. The transect follows a peninsula of lowland with hills to the north, west and south.

Figure 2.1: Transect surveys undertaken at the proposed development site at Cleanrath, Co. Cork.



3 RESULTS

The results of the walked, car and static surveys are described in the following sections below.

3.1.1 Fixed Bat Point Detector

Two Song Meter SM3BAT (Wildlife Acoustics, Inc; Massachusetts, USA) 16-bit full spectrum time-expansion recording bat detectors were placed within the study area for a minimum of five nights during May, July and September. Static detectors were installed according to the guidelines as set out in Bat Conservation Ireland's 'Bat Survey Guidelines 2012'

Registrations as described below follow the Bat Conservation Trusts definition of a bat pass; 'two or more bat calls in a continuous sequence; each sequence or pass is separated by one second or more in which no calls are recorded. The number of bat passes for each species or species group identified is counted for each' point. (BCT Good Practice Guidelines 2nd Ed 2012).

Table 3.1: Locations of static detector

Location	Habitat description	Date	Total hours
120841 70412	Set within mature conifer plantation to the north of the site	06/07th to 11th/12th May	46hrs 30min
120472 68543	Set to a fence post to the south of the site on exposed rock and grassland	06/07th to 11th/12th May	46hrs 30min
121479 69818	Set within conifers to the east of the site	02nd/03rd to 07th/08th July	48hrs
119754 69544	Attached to gorse bush on exposed summit of acid grassland to west of site	02nd/03rd to 07th/08th July	48hrs
120365 70091	Within mature plantation by transect 4	14th/15th to 20th/21st Sept	91hrs 9min
121254 70150	Within young conifer plantation towards the north of the site at end of transect 6	14th/15th to 20th/21st Sept	91hrs 9min

Both devices were set to record from sunset to half an hour past sunrise each night, for 9 hours 18 minutes for May, 8 hours for July and automatically adjusting times from sunset to half an hour past sunrise from Sept. One device set within conifer plantation to the east of the site during July malfunctioned thus no registrations were recorded. Baring this device the recorders were thus in position and recording giving a total of 371 hours 18 minutes of recording over the three months. Weather information is provided by Met Éireann from the weather station located in Cork Airport (http://www.met.ie/climate/daily-data.asp).

Table 3.2 below details weather conditions during the recording period of the static detector. Overall conditions varied, with two nights during May being particularly wet. Baring these, conditions were suitable for bat activity

Table 3.2: Weather conditions during static detector surveys

Date	Wind direction	Mean speed	Min temp	Rain (mm)
06th/07th May	SW	F3	6	

Date	Wind direction	Mean speed	Min temp	Rain (mm)
07th/08th May	S to SW	F2	9.0	Drizzle and rain throughout night
08th 09th May	SW	F2 TO 5	7.0	
09th/10th May	SW	F3 TO 6	10.0	Drizzle and rain dry from 1 to 3
10th/11th May	W	F2 to 5	5.0	
02nd/03rd Jul	SW	F3	13.0	
03rd/04th Jul	SSW	F3 to 4	14.0	Drizzle from 11:00 rain from 04:00
04th/05th Jul	NW	F3 to 4	9.0	
05th/06th Jul	NW	F2	9.0	
06th/07th Jul	NW to W	F2 to 3	10.5	
07th/08th Jul	N to NW	F0 to 2	12.0	Shower at 05:00
15th/16th Sep	NE	F2 to 3	11.0	
16th/17th Sep	ENE	F3 to 4	15.5	
17th/18th Sep	E	F4	14.5	
18th/19th Sep	NE	F1 to 3	15.5	
19th/20th Sep	N	F3	14.5	Drizzle from 22:00, shower at 03:00
20th/21st Sep	N	F3	8.5	
21st/22nd Sep	N	F2	11.0	Shower at 02:00

The results of the Static detector surveys are shown below in **Tables 3.3 to 3.7** below

Table 3.3: Results of SM2 Detector from exposed site with rock, acid grassland and heath during May

Date	Species	Passes	Details
6th/7th May	Soprano Pipistrelle	1	21:51
	Myotis Species	2	Registrations recorded at 22:33 and 01:23
7th/8th May	Common Pipistrelle	11	First contact recorded at 21:41, with occasional calls until 23:01
	Soprano Pipistrelle	1	One registration recorded at 22:57
	Myotis Species	3	Recordings from 23:02, 23:32 and 02:45
8th/9th May	Soprano Pipistrelle	1	One recording from 01:44
9th/10th May	Common Pipistrelle	1	One recording at 21:30
	Soprano Pipistrelle	1	Single recording from 04:22

Date	Species	Passes	Details
10th/11th May	No recordings		
11th/12th May	No recordings		

Table 3.4: Results of SM2 Detector from mature conifer plantation to north of site during May

Date	Species	Passes	Details
6th/7th May	Common Pipistrelle	4	Four registrations recorded at; 22:16, 23:56, 04:09 and 04:24
7th/8th May	Common Pipistrelle	10	Occasional contacts from 21:36 until 22:45
8th/9th May	Probable Lesser Horseshoe Bat	1	Poor, brief recording from 22:32
9th/10th May	No recordings		
10th/11th May	No recordings		
11th/12th May	No recordings		

Table 3.5: Results of SM2 Detector from heath at summit of hill to south-west

Date	Species	Passes	Details
2nd/3rd July	Common Pipistrelle	334	Frequent registrations from 23:10 until 03:35
	Soprano Pipistrelle	3	Registrations recorded at; 23:31 23:52, 00:07
3rd/4th July	No recordings		
4th/5th July	Common Pipistrelle	63	Recorded from 22:59 and frequently until 23:53. Further recordings at 01:27 and from 02:20 until 02:59 and 04:03 until 04:27
	Myotis Bat	1	One recording at 23:53

5th/6th July	Common Pipistrelle	206	Frequent recordings from 22:55 until 02:00
6th/7th July	Common Pipistrelle	1	One registration recorded at 23:35
7th/8th July	Common Pipistrelle	24	First recording at 03:26 with occasional recordings until 05:45

Table 3.6: Results of SM2 Detector from young second rotation forestry September

Date	Species	Passes	Details
15th/16th Sept	Common Pipistrelle	9	Occasional registrations recorded from 20:29 until 20:58 and at 22:57, 23:11, 01:23, 03:29 and 05:41
	Soprano Pipistrelle	7	Infrequent recording from; 20:19, 20:30, 20:45, 21:11, 05:39 and 06:17
16th/17th Sept	Common Pipistrelle	3	Recordings from; 20:43, 00:43 and 06:30
	Soprano Pipistrelle	1	One recording from 21:54
17th/18th Sept	Common Pipistrelle	1	Recorded at 02:24
	Soprano Pipistrelle	1	Recorded at 00:31
18th/19th Sept	Common Pipistrelle	35	First recorded at 20:12 with frequent recordings from 20:32 until 20:46 and again at 22:52, 22:54, 03:02 and 06:33
	Soprano Pipistrelle	23	Recorded at 20:16 and 20:24 with further registrations recorded from 20:48 to 21:25. Further records at 23:03, from 03:11 to 03:12, at 05:38 and from 06:28 to 06:39
	Myotis Species	3	Two recordings from 20:41 and another from 05:27
19th/20th Sept	Common Pipistrelle	24	Occasional recordings from 20:33 to 00:13 and from 02:17 to 03:50. Further recording at 05:55
	Soprano Pipistrelle	10	20:13: to 20:39 than infrequent single passes at 21:38, 21:52, 03:10, 04:31 and 0536

Table 3.7: Results of SM2 Detector from conifer plantation September

Date	Species	Passes	Details
15th/16th Sept	Common Pipistrelle	25	Occasional calls from 23:28 to 02:34, with further registrations recorded at 04:10 and 06:36
	Soprano Pipistrelle	5	Registrations recorded from 21:13 to 21:16
	Myotis Bat	2	21:22 and 03:52
16th/17th Sept	Common Pipistrelle	50	Frequent calls from 20:12 to 21:12, at 22:53, 01:05 with social call, from 01:30 to 01:37 and at 04:06, 04:57 and 05:50
	Myotis Bat	2	Calls recorded at 05:38 and 05:53
17th/18th Sept	Common Pipistrelle	17	Registrations recorded at 21:15, 22:02 and from 23:10 to 00:33 and again from 02:22 to 03:49. A further registration recorded at 05:28
	Soprano Pipistrelle	11	First recorded at 21:12 than 22:14, than sporadically from 00:53 to 06:18
18th/19th Sept	Common Pipistrelle	7	Infrequent recordings from 20:10 to 22:07 and at 00:32, 00:38 (with social call),03:13 and 05:23
	Soprano Pipistrelle	2	Recorded at 22:21 and 05:23
19th/20th Sept	Common Pipistrelle	5	Recorded at 22:13, 21:33, 23:31, 02:38 and 02:54
	Soprano Pipistrelle	3	Registrations recorded at 21:08, 22:43, 22:44
	Myotis Bat	1	Recorded at 21:16
20th/21st Sept	Common Pipistrelle	5	Recorded at 21:41, 01:44, 03:25, 03:27 and 05:56
	Soprano Pipistrelle	3	Recorded at 23:44, 01:07 and 04:15
	Myotis Bat	1	One recording at 23:02

3.1.2 Transect Survey

A dusk/dawn mobile detector survey was carried out along pre-selected walked and driven transect routes (along tracks and paths, roads and fields) on the nights of the 6th/7th May, 2nd/3rd of July and 14th/15th August. The walked transect routes are shown in Figure 2.1. A handheld Wildlife Acoustics Inc. (Massachusetts, USA) Echo Meter EM3 bat detector (with broadband coverage and the ability to record bat calls in real time) was used. The survey followed the guidelines as set out in Bat Conservation Ireland's 'Bat Survey Guidelines' (Bat Conservation Ireland, 2012).

A contact as shown below describes a bat observed by the surveyor. This contact can range from a commuter passing quickly to a foraging bat circling a feature lasting for several minutes. Some observations contain multiple bats. When several bats of the same species are encountered together they are recorded under the one contact. A separate contact is recorded for each species. A contact finishes when the recorder assumes the bat is no longer present. It is likely that the same bat is recorded in several contacts throughout the night. This survey type cannot estimate abundance of bats, rather activity; *the amount of use bats make of an area / feature.*

Sunset on the 6th of May occurred at 21:05 with sun rising on the 7th at 05:59. Westerly winds gusted up to 3.2 metres per second at dusk but dropped to still by midnight (from 0 to 3 on the Beaufort scale). A waxing gibbous moonrise (3/4 moon approaching full moon) rose at 23:32 on the 6th and set at 07:45 on the 7th. Cloud cover ranged from 50 to 85% throughout the night. The air temperature varied during the night of the survey between 10.5 degrees Celsius at 20:30 to as low as 7.0 degrees Celsius by dawn of the 7th. No rain fell during the survey period with overall conditions good for bat survey work.

Sunset on the 2nd of July occurred at 22:00. Southerly winds ranging from 0 to 2.8 meters per second or force 0-2 were recorded throughout the survey period. A full moon rose at 22:36. Cloud cover varied from 25 to 100% throughout the survey. The air temperature varied during the night of the survey between 17.8 to 14.3 degrees Celsius. No rain occurred during the survey with overall conditions being ideal for bat surveys.

Sunset on the 14th of September fell at 19:58 whilst sunrise on the 15th occurred at 07:08. Winds varied through the night from 2.9 meters per second to 0.7 in sheltered areas or force 1 to 2. A new moon occurred during the survey. Cloud cover varied from 100% at dusk to clear from 23:15. Temperatures varied through the night, ranging from 9.3 to 8.5 degrees Celsius.

The results of the car based transects are shown in **Table 3.8**, below with the walked transects presented in **Table 3.9**.

Table 3.8: Results of Car based transects

Transect No.	Date	Length (m)	Start time	Finish Time	Time taken	No. passes	Passes/km	Species	Notes
2	06/05/2015	1890	21:43	21:51	00:08				
2	07/05/2015	1890	04:44	04:50	00:06				
2	02/07/2015	1890	22:14	22:20	00:06				
2	02/07/2015	1890	22:21	22:29	00:08	1	0.53	UP	
2	02/07/2015	1890	22:51	23:01	00:10	3	1.59	UP=2; CP=1	Brief
2	14/09/2015	1890	20:14	20:22	00:08				
5	06/05/2015	412	22:56	23:00	00:04				
5	06/05/2015	412	00:22	00:24	00:02				
5	07/05/2015	412	05:41	05:43	00:02				
5	03/07/2015	412	03:21	03:34	00:13	1	2.43	CP	
5	14/09/2015	412	22:11	22:14	00:03				
5	15/09/2015	412	05:51	05:54	00:03				

7	06/05/2015	764	23:01	23:08	00:07				
7	06/05/2015	764	00:17	00:21	00:04				
7	07/05/2015	764	05:44	05:49	00:05				
7	03/07/2015	764	03:35	03:42	00:07	1	1.31	CP	Feeding
7	14/09/2015	764	22:15	22:20	00:05				
7	15/09/2015	764	05:55	05:58	00:03				

CP = Common Pipistrelle; UP = Unidentified Pipistrelle

Table 3.9: Results of Walked transects

Transect No.	Date	Length (m)	Start time	Finish Time	Time taken	No. passes	Passes/km	Species	Notes
1	06/05/2015	562	20:36	21:05	00:29				
1	06/05/2015	562	21:06	21:13	00:07				
1	07/05/2015	562	03:59	04:11	00:12				
1	07/05/2015	562	04:12	04:21	00:09				
1	02/07/2015	562	22:31	22:40	00:09				
1	02/07/2015	562	22:41	22:51	00:10	1	1.78	UP	
1	14/09/2015	562	19:54	20:08	00:14				
1	14/09/2015	562	20:09	20:13	00:04				
1	14/09/2015	562	21:02	21:12	00:10	2	3.56	SP=2	
1	14/09/2015	562	21:13	21:21	00:08				
2	14/09/2015	1890	20:44	21:01	00:17	5	2.65	UP=2; CP=3	1st contact 2 CP. Bats feeding along road
2	14/09/2015	1890	21:22	21:36	00:14	3	1.59	CP=3	Brief contacts
3	06/05/2015	311	21:23	21:34	00:11				
3	06/05/2015	311	21:35	21:40	00:05				
3	07/05/2015	311	04:26	04:33	00:07				
3	07/05/2015	311	04:34	04:42	00:08				
3	02/07/2015	311	21:39	22:01	00:22				
3	02/07/2015	311	22:02	22:10	00:08				
3	02/07/2015	311	23:04	23:17	00:13				
3	02/07/2015	311	23:18	23:25	00:07				
3	14/09/2015	311	20:24	20:33	00:09				
3	14/09/2015	311	20:34	20:44	00:10	2	6.43	CP; UP	Brief close to road
4	06/05/2015	320	22:14	22:23	00:09	1	3.13	CP	2 bats feeding

Transect No.	Date	Length (m)	Start time	Finish Time	Time taken	No. passes	Passes/km	Species	Notes
4	06/05/2015	320	22:24	22:28	00:04				
4	07/05/2015	320	05:06	05:11	00:05				
4	07/05/2015	320	05:12	05:15	00:03				
4	02/07/2015	320	23:47	23:53	00:06	1	3.13	CP	
4	02/07/2015	320	23:54	00:00	00:06	1	3.13	CP	Feeding 1.5m high
4	03/07/2015	320	04:50	04:54	00:04				
4	03/07/2015	320	04:55	04:59	00:04				
4	14/09/2015	320	21:58	22:04	00:06				
4	14/09/2015	320	22:05	22:10	00:05				
4	15/09/2015	320	05:38	05:44	00:06	2	6.25	CP; BLE	BLE 1.5m high
4	15/09/2015	320	05:45	05:49	00:04				
5	02/07/2015	412	00:01	00:11	00:10	3	7.28	SP, CP=2	Final pass with 3 CP Feeding
6	06/05/2015	648	22:32	22:41	00:09				
6	06/05/2015	648	22:42	22:51	00:09				
6	07/05/2015	648	05:16	05:26	00:10				
6	07/05/2015	648	05:27	05:34	00:07				
6	02/07/2015	648	00:16	00:30	00:14	1	1.54	CP	Unseen
6	02/07/2015	648	00:31	00:44	00:13	4	6.17	CP=3; MYO	Myo brief unseen
6	03/07/2015	648	05:02	05:11	00:09				
6	03/07/2015	648	05:12	05:20	00:08				
6	15/09/2015	648	05:06	05:19	00:13				
6	15/09/2015	648	05:20	05:31	00:11				
8	06/05/2015	756	23:16	23:28	00:12				
8	06/05/2015	756	23:29	23:39	00:10	1	1.32	MYO	
8	03/07/2015	756	04:18	04:32	00:14	1	1.32	LB	
8	03/07/2015	756	04:33	04:45	00:12	1	1.32	LB	
8	14/09/2015	756	22:54	23:02	00:08	1	1.32	CP	5m high feeding
8	14/09/2015	756	23:03	23:15	00:12				
9	06/05/2015	523	23:50	23:58	00:08				
9	06/05/2015	523	23:59	00:06	00:07				
9	03/07/2015	523	03:52	04:00	00:08				
9	03/07/2015	523	04:01	04:09	00:08	2	3.82	CP; SP	Feeding
9	14/09/2015	523	22:27	22:34	00:07				

Transect No.	Date	Length (m)	Start time	Finish Time	Time taken	No. passes	Passes/km	Species	Notes
9	14/09/2015	523	22:35	22:41	00:06				

CP = Common Pipistrelle; SP = Soprano Pipistrelle; UP = Unidentified Pipistrelle; BLE = Brown Long-eared Bat; MYO = Myotis; LB = Leisler's Bat

4 DISCUSSION

Five bats were identified to species level throughout the surveys: Common Pipistrelle (*Pipistrellus pipistrellus*), Soprano Pipistrelle (*Pipistrellus pygmaeus*), Leisler's bat (*Nyctalus leisleri*) and Brown Long-eared Bat (*Plecotus auritus*). A single recording from a likely Lesser Horseshoe Bat (*Rhinolophus hipposideros*) was also recorded from the static detector placed in mature conifer plantation to the north of the site at 22:32 on the 8th May. Although the recording is hazy, false readings at 105kHz are unlikely. Further to these, a small number of registrations of Myotis sp. bats were also recorded. It can be very difficult to separate the three species of Myotis bat that are regularly found in Ireland and on these occasions it was not possible to do so.

A number of contacts/recordings have been labelled as 'Unidentified Pipistrelle'. These bats will have been either Common or Soprano Pipistrelle and were not identified to species level because the recorded frequency of the CF tail was at about 50 kHz (the typical frequency for Common Pipistrelle is 45 kHz, while the typical frequency for the Soprano Pipistrelle is 55 kHz).

The results of the car and walked surveys show that activity was Low, with a maximum of 7.28 and a minimum of 0 bat passes being recorded per km walked. A total of 30.91 kilometres of transects were walked and 18.4 kilometres driven over the survey period and a total of 38 bat contacts were made. This is equivalent to 0.77 bat passes per kilometre travelled. These values are typical for upland exposed habitats. In comparison a survey completed by the same surveyor using the same methodologies recorded a value of 10.21 bat passes per kilometre in lowland conifer plantation in Athenry, Co. Galway during August of 2013.

As can be seen on Figure 3.1 (showing the location of each bat contact made during the surveys) several transects showed higher bat activity than others. To the south of the site transect 2, based along the road with sections of scrub for cover, showed higher activity than transects 1 and 3; both based in open grass and heath habitats. The other exposed site; transect 9 through lowland grassland also had little activity. Transects through conifer plantation showed marginally higher activity with some recordings on each of transects 4, 6 and 8. Highest activity occurred on the 02/07/2015 on transect 5 at 00:01 where three separate contacts of common and soprano pipistrelle were observed, the last of these containing three common pipistrelle bats feeding together.

In May one SM2 recorder was set along a forested path within conifer plantation. The recorder was deployed for 46 hours 30 minutes. During this recording time (2790 minutes) a total of 15 bat passes were recorded, giving an average of 0.32 bat passes per hour.

Also in May another SM2 recorder was set attached to a fence in open acid grassland/heath habitat to the south of the site. Similar to the previously described placement, this unit was deployed for 46 hours 30 minutes. This detector recorded 21 bat passes giving an average of 0.45 bat passes per hour.

As these units were set and recording concurrently results of both can be compared. Both units recorded very low activity levels but with similar results in regard to species composition barring the recording of a probable Lesser Horseshoe bat from the conifer site. Neither unit recorded any activity on the 10th/11th or 11th/12th indicating poor weather conditions which may have affected bat activity levels.

In July one unit was set attached to a gorse bush on the exposed summit of acid grassland to the west of site. This unit was set to record for 48 hours over the six night period. In this time of 2880 minutes, 632 bat passes were recorded giving an average of 13.17 passes per hour. Of these passes, the majority are from Common Pipistrelle with 334 passes recorded from this species on the 2nd/3rd July. It should be noted that although contacts with the same species are recorded separately, in many cases these passes are likely to be the result of a single bat foraging in the area.

In September the two SM2 units were again set on site. One was attached to a conifer adjacent to a path along transect 4 with another set in a more exposed site within newly replanted conifer towards the north of the site. The units were each set for a total of 91 hours 9 minutes of recording time over a six night period. Within the mature conifer forestry 139 bat passes were recorded giving an average of 1.52 passes per hour. 117 passes were recorded from the newly planted conifers resulting in an average of 1.28.

As part of a pilot monitoring scheme for woodland bats in the Republic of Ireland during summer 2007, workers for Bat Conservation Ireland (BCI) carried out similar recording work. At three of the broadleaved woodland sites studied (in Co's. Cavan, Tipperary and Meath) averages of 10.83, 14.27 and 47.52 bat passes were recorded per hour of darkness. The simple rate of bat passes recorded per hour indicates that the bat activity at that particular point at the edge of a recently cut conifer plantation within the study area is approximately equal to the lower end of the spectrum of activity recorded at these broadleaved woodland sites.

The majority of the bat contacts recorded during the bat surveys were of common, soprano or unidentified pipistrelle (84% of those recorded during transects and 98% of the contacts recorded by the SM2s). These results fall in line with what is expected since these two species are the two most commonly encountered in Ireland and they have widespread distributions (although it should also be remembered that they are also amongst the species that produce calls that are the most likely to be captured by bat detectors).

During the walked survey an estimation of the flying height of any observed bat was noted. Of the 38 recorded contacts during the surveys 11 of the contacts had an estimated flying height all of which were recorded below 15m, well below the collision risk zone of turbines. Although no Leisler's bats were visually observed, these typically fly at heights within risk of collision.

The site of the proposed windfarm did not appear to support high quality roosting habitats with few trees of high potential to support roosting bats. No evidence of bat roosting activity was recorded during the survey. The earliest recording from the static detector bat was at 21:30 on the night of the 09th/10th May from the open heath habitat to the south of the site, by a common pipistrelle some 19 minutes after sunset, at typical emergence/swarming times for pipistrelles and could indicate a roost location close by. It should be noted that minimum temperatures during this night was 10 degrees Celsius and in these conditions it is common for pipistrelle bats to emerge early, even before sunset. The latest recording from the static detectors was at 05:45 on the 7th July from the detector stationed at the summit of a hill to the south of the site. This bat was recorded passing 21 minutes after sunrise in an exposed area. This area does not contain likely structures for housing roosts. The earliest recording from the walked survey occurred at 22:23, 23 minutes after sunset on the 2nd July. This recording occurred along transect 2 on a section of open heath with a stand of conifer plantation offsite to the south west.

Towards dawn of the 15th Sept an abandoned house to the north-west of the study area north of transect 5 was examined for evidence of roosting bats. During this period (06:06 – to dawn, at 07:08) no bats were observed flying in the area. A second structure was also examined close to the site; bridge No: CL-L74332-000100 (Grid Ref: 120744 70993) to the north of transect 5 lying just outside the study area was searched however showed no signs of bat habitation.

As previously mentioned, a single registration was recorded from a probable Lesser Horseshoe Bat. This is noteworthy due to the location of a Lesser Horseshoe roost in the townland of Silvergrove within a kilometre of the site to the east. This roost had 50 individuals during a count from June 2007 (Biodiversity.ie data). Lesser Horseshoe Bats have a high frequency call (over 105kHz) that quickly looses power with an increase in distance from the origin and thus tends to be infrequently recorded by bat detectors. This may mean the bats are under recorded in this type of survey.

Overall, the numbers of bats recorded within and around the Cleanrath site appear to be typical of upland conifer plantations with low overall activity. The site appears to provide suitable feeding grounds for a variety of bat species however no suitable roosting trees or structures were found within the study area.

5 CONCLUSIONS

The site of the proposed wind farm development provides some foraging habitats for bat species. Overall, activity levels were low throughout the survey period. Evidence from the static detectors suggests bats use both open grassland and heath habitats as well as areas of forestry. Transect results show bats utilising landscape features such as roads with patches of scrub as well as edges of forestry. The recording of a single call from a Lesser Horseshoe bat suggest this bat type may occasionally use some areas within the site for feeding. The site contained very little suitable roosting habitat with the exception of an abandoned house which showed no signs of bat usage. These observations are based on the following:

- Results of a daylight site walkover and three dawn and dusk walked and driven bat surveys;
- Erection of static detectors for 185 hours 39 minutes of recording time;
- Absence of potential roost sites within the study area; and
- The dominant habitats recorded within the study area (conifer plantation and open acid grassland/heath) and exposed nature of the site considered to be of limited value for commuting and foraging bats in the wider study area.

APPENDIX 2

BAT HABITAT SUITABILITY ASSESSMENT

Bat Survey Report

Appendix 2 – Habitat Suitability Assessment

HABITAT SUITABILITY ASSESSMENT

Guidelines for assessing the potential suitability of a site for bats, based on the presence of habitat features (taken from Collins, 2016)

Suitability	Roosting Habitats	Commuting and Foraging Habitats
Negligible	Negligible habitat features on site likely to be used by roosting bats.	Negligible habitat features on site likely to be used by commuting or foraging bats.
Low	A structure with one or more potential roost sites that could be used by individual bats opportunistically. However, these potential roost sites do not provide enough space, shelter, protection, appropriate conditions1 and/or suitable surrounding habitat to be used on a regular basis or by larger numbers of bats, i.e. unlikely to be suitable for maternity or hibernation2. A tree of sufficient size and age to contain potential roost features but with none seen from the ground or features seen with only very limited roosting potential3.	Habitat that could be used by small numbers of commuting bats such as a gappy hedgerow or unvegetated stream, but isolated, i.e. not very well connected to the surrounding landscape by other habitats. Suitable, but isolated habitat that could be used by small numbers of foraging bats such as a lone tree (not in a parkland situation) or a patch of scrub.
Moderate	A structure or tree with one or more potential roost sites that could be used by bats due to their size, shelter, protection, conditions and surrounding habitat but unlikely to support a roost of high conservation status (with respect to roost type only – the assessments in this table are made irrespective of species conservation status, which is established after presence is confirmed).	Continuous habitat connected to the wider landscape that could be used by bats for commuting such as lines of trees and scrub or linked back gardens. Habitat that is connected to the wider landscape that could be used by bats for foraging such as trees, scrub, grassland or water.
High	A structure or tree with one or potential roost sites that are obviously suitable for use by larger numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, conditions and surrounding habitat.	Continuous, high-quality habitat that is well connected to the wider landscape that is likely to be used regularly by commuting bats such as river valleys, streams, hedgerows, lines of trees and woodland edge. High-quality habitat that is well connected to the wider landscape that is likely to be used regularly by foraging bats such as broadleaved woodland, tree-lined watercourses and grazed parkland. Site is close to and connected to known roosts.

[1] For example, in terms of temperature, humidity, height above ground, light levels or levels of disturbance.

[2] Larger numbers of Common pipistrelle may be present during autumn and winter in large buildings in highly urbanised areas, based on evidence from the Netherlands (Korsten *et al.* 2015).

[3] Categorisation aligns with BS 8596:2015 Surveying for bats in trees and woodland (BSI, 2015).

APPENDIX 3

SITE RISK ASSESSMENT

Planning and Environmental Consultants

Bat Survey Report

Appendix 3 – Site Risk Assessment (Table 3a, SNH)

Planning and Environmental Consultants

SITE RISK ASSESSMENT

Table 3a: *Stage 1 - Initial site risk assessment*

Site Risk Level (1-5)*	Project Size			
		Small	**Medium**	**Large**
Habitat Risk	**Low**	1	2	3
	Moderate	2	3	4
	High	3	4	5

Key: Green (1-2) - low/lowest site risk; Amber (3) - medium site risk; Red (4-5) - high/highest site risk.

* Some sites could conceivably be assessed as being of no (0) risk to bats. This assessment is only likely to be valid in more extreme environments, such as above the known altitudinal range of bats, or outside the known geographical distribution of any resident British species.

Habitat Risk	Description
Low	Small number of potential roost features, of low quality. Low quality foraging habitat that could be used by small numbers of foraging bats. Isolated site not connected to the wider landscape by prominent linear features.
Moderate	Buildings, trees or other structures with moderate-high potential as roost sites on or near the site. Habitat could be used extensively by foraging bats. Site is connected to the wider landscape by linear features such as scrub, tree lines and streams.
High	Numerous suitable buildings, trees (particularly mature ancient woodland) or other structures with moderate-high potential as roost sites on or near the site, and/or confirmed roosts present close to or on the site. Extensive and diverse habitat mosaic of high quality for foraging bats. Site is connected to the wider landscape by a network of strong linear features such as rivers, blocks of woodland and mature hedgerows. At/near edge of range and/or on an important flyway. Close to key roost and/or swarming site.

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

APPENDIX 4

2020 ECOBAT PER DETECTOR RESULTS

Bat Survey Report

Appendix 4 – Ecobat Per Detector Results 2020

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Summary tables are provided for each species recorded showing key metrics per detector per survey period.

LEISLERS BAT

Survey Period	Nights Recorded	Ref Range	Detector ID	Median Bat Activity Level	Median Bat Activity	Max Bat Activity Level	Max Bat Activity Level
Spring	0	1686	D06	-	Nil	-	Nil
Spring	6	1686	D07	28	Low to Moderate	43	Moderate
Spring	6	1686	D09	43	Moderate	66	Moderate to High
Spring	6	1686	D10	57	Moderate	63	Moderate to High
Spring	7	1686	D08	53	Moderate	71	Moderate to High
Spring	7	1686	D05	37	Low to Moderate	71	Moderate to High
Spring	5	1686	D04	53	Moderate	58	Moderate
Spring	7	1686	D03	37	Low to Moderate	73	Moderate to High
Spring	1	1686	D01	10	Low	10	Low
Summer	3	2644	D06	17	Low	42	Moderate
Summer	2	2644	D07	45	Moderate	47	Moderate
Summer	4	2644	D09	42	Moderate	58	Moderate
Summer	5	2644	D10	33	Low to Moderate	47	Moderate
Summer	9	2644	D08	42	Moderate	68	Moderate to High
Summer	10	2644	D05	38	Low to Moderate	47	Moderate
Summer	10	2644	D04	17	Low	47	Moderate
Summer	8	2644	D03	38	Low to Moderate	68	Moderate to High
Summer	13	2644	D01	42	Moderate	68	Moderate to High

Appendix 1 Detector Scale bat activity level for Leislers bat

SOPRANO PIPISTRELLE

Survey Period	Nights Recorded	Ref Range	Detector ID	Median Bat Activity Level	Median Bat Activity	Max Bat Activity Level	Max Bat Activity Level
Spring	-	1822	D06	-	Nil	-	Nil
Spring	1	1822	D07	48	Moderate	48	Moderate
Spring	5	1822	D09	43	Moderate	48	Moderate
Spring	7	1822	D10	43	Moderate	64	Moderate to High
Spring	8	1822	D08	40	Low to Moderate	48	Moderate
Spring	6	1822	D05	50	Moderate	76	Moderate to High
Spring	7	1822	D04	51	Moderate	65	Moderate to High
Spring	5	1822	D03	28	Low to Moderate	37	Low to Moderate
Spring	2	1822	D01	10	Low	10	Low
Summer	-	3090	D06	-	Nil	-	Nil
Summer	5	3090	D07	17	Low	33	Low to Moderate
Summer	4	3090	D09	17	Low	65	Moderate to High
Summer	8	3090	D10	33	Low to Moderate	58	Moderate
Summer	6	3090	D08	25	Low to Moderate	42	Moderate
Summer	2	3090	D05	30	Low to Moderate	42	Moderate
Summer	7	3090	D04	33	Low to Moderate	52	Moderate
Summer	7	3090	D03	17	Low	42	Moderate
Summer	6	3090	D01	25	Low to Moderate	33	Low to Moderate

COMMON PIPISTRELLE

Survey Period	Nights Recorded	Ref Range	Detector ID	Median Bat Activity Level	Median Bat Activity	Max Bat Activity Level	Max Bat Activity Level
Spring	-	1980	D06	-	Nil	-	Nil
Spring	10	1980	D07	76	Moderate to High	84	High
Spring	8	1980	D09	80	Moderate to High	85	High
Spring	9	1980	D10	63	Moderate to High	86	High
Spring	10	1980	D08	78	Moderate to High	94	High
Spring	9	1980	D05	76	Moderate to High	92	High
Spring	9	1980	D04	73	Moderate to High	88	High
Spring	8	1980	D03	54	Moderate	78	Moderate to High
Spring	7	1980	D01	10	Low	43	Moderate
Summer	8	3312	D06	40	Low to Moderate	89	High
Summer	14	3312	D07	74	Moderate to High	89	High
Summer	13	3312	D09	47	Moderate	83	High
Summer	15	3312	D10	71	Moderate to High	98	High
Summer	13	3312	D08	47	Moderate	73	Moderate to High
Summer	13	3312	D05	62	Moderate to High	82	High
Summer	12	3312	D04	47	Moderate	68	Moderate to High
Summer	9	3312	D03	33	Low to Moderate	58	Moderate
Summer	11	3312	D01	42	Moderate	67	Moderate to High

NATHUSIUS PIPISTRELLE							
Survey Period	Nights Recorded	Ref Range	Detector ID	Median Bat Activity Level	Median Bat Activity	Max Bat Activity Level	Max Bat Activity Level
Spring	-	340	D06	-	Nil	-	Nil
Spring	-	340	D07	-	Nil	-	Nil
Spring	-	340	D09	-	Nil	-	Nil
Spring	-	340	D10	-	Nil	-	Nil
Spring	1	340	D08	10	Low	10	Low
Spring	2	340	D05	27	Low to Moderate	43	Moderate
Spring	1	340	D04	28	Low to Moderate	28	Low to Moderate
Spring	-	340	D03	-	Nil	-	Nil
Spring	-	340	D01	-	Nil	-	Nil
Summer	-	-	D06	-	Nil	-	Nil
Summer	-	-	D07	-	Nil	-	Nil
Summer	-	-	D09	-	Nil	-	Nil
Summer	-	-	D10	-	Nil	-	Nil
Summer	-	-	D08	-	Nil	-	Nil
Summer	-	-	D05	-	Nil	-	Nil
Summer	-	-	D04	-	Nil	-	Nil
Summer	-	-	D03	-	Nil	-	Nil
Summer	-	-	D01	-	Nil	-	Nil

MYOTIS SP.

Survey Period	Nights Recorded	Ref Range	Detector ID	Median Bat Activity Level	Median Bat Activity	Max Bat Activity Level	Max Bat Activity Level
Spring	-	1402	D06	-	Nil	-	Nil
Spring	7	1402	D07	10	Low	43	Moderate
Spring	3	1402	D09	10	Low	28	Low to Moderate
Spring	4	1402	D10	19	Low	48	Moderate
Spring	2	1402	D08	27	Low to Moderate	43	Moderate
Spring	5	1402	D05	10	Low	10	Low
Spring	7	1402	D04	28	Low to Moderate	43	Moderate
Spring	6	1402	D03	10	Low	43	Moderate
Spring	-	1402	D01	-	Nil	-	Nil
Summer	2	2229	D06	17	Low	17	Low
Summer	3	2229	D07	17	Low	17	Low
Summer	5	2229	D09	17	Low	42	Moderate
Summer	1	2229	D10	17	Low	17	Low
Summer	3	2229	D08	33	Low to Moderate	52	Moderate
Summer	3	2229	D05	17	Low	33	Low to Moderate
Summer	6	2229	D04	17	Low	33	Low to Moderate
Summer	-	2229	D03	-	Nil	-	Nil
Summer	3	2229	D01	17	Low	17	Low

BROWN LONG-EARED BAT							
Survey Period	Nights Recorded	Ref Range	Detector ID	Median Bat Activity Level	Median Bat Activity	Max Bat Activity Level	Max Bat Activity Level
Spring	-	699	D06	-	Nil	-	Nil
Spring	1	699	D07	10	Low	10	Low
Spring	1	699	D09	10	Low	10	Low
Spring	1	699	D10	10	Low	10	Low
Spring	-	699	D08	-	Nil	-	Nil
Spring	-	699	D05	-	Nil	-	Nil
Spring	-	699	D04	-	Nil	-	Nil
Spring	-	699	D03	-	Nil	-	Nil
Spring	-	699	D01	-	Nil	-	Nil
Summer	1	1358	D06	17	Low	17	Low
Summer	7	1358	D07	47	Moderate	68	Moderate to High
Summer	4	1358	D09	25	Low to Moderate	47	Moderate
Summer	3	1358	D10	17	Low	33	Low to Moderate
Summer	3	1358	D08	17	Low	17	Low
Summer	1	1358	D05	17	Low	17	Low
Summer	5	1358	D04	17	Low	33	Low to Moderate
Summer	-	-	D03	-	Nil	-	Nil
Summer	3	1358	D01	17	Low	47	Moderate

LESSER HORSESHOE

Survey Period	Nights Recorded	Ref Range	Detector ID	Median Bat Activity Level	Median Bat Activity	Max Bat Activity Level	Max Bat Activity Level
Spring	-	53	D06	-	Nil	-	Nil
Spring	1	53	D07	10	Low	10	Low
Spring	-	53	D09	-	Nil	-	Nil
Spring	1	53	D10	10	Low	10	Low
Spring	-	53	D08	-	Nil	-	Nil
Spring	-	53	D05	-	Nil	-	Nil
Spring	-	53	D04	-	Nil	-	Nil
Spring	2	53	D03	10	Low	10	Low
Spring	-	53	D01	-	Nil	-	Nil
Summer	-	54	D06	-	Nil	-	Nil
Summer	1	54	D07	17	Low	17	Low
Summer	-	54	D09	-	Nil	-	Nil
Summer	-	54	D10	-	Nil	-	Nil
Summer	-	54	D08	-	Nil	-	Nil
Summer	-	54	D05	-	Nil	-	Nil
Summer	-	54	D04	-	Nil	-	Nil
Summer	-	54	D03	-	Nil	-	Nil
Summer	-	54	D01	-	Nil	-	Nil

APPENDIX 5

OVERALL RISK ASSESSMENT

Bat Survey Report

Appendix 5 – Overall Risk Assessment (Table 3b, SNH)

Planning and Environmental Consultants

Table 3b: *Stage 2 - Overall risk assessment*

Site risk level (from Table 3a)	Ecobat activity category (or equivalent justified categorisation)					
	Nil (0)	Low (1)	Low-moderate (2)	Moderate (3)	Moderate-high (4)	High (5)
Lowest (1)	0	1	2	3	4	5
Low (2)	0	2	4	6	8	10
Med (3)	0	3	6	9	12	15
High (4)	0	4	8	12	15	18
Highest (5)	0	5	10	15	20	25

The scores in the table are a product of multiplying site risk level and the Ecobat activity category (or equivalent). The activity categories equate to those given in Table 1 for high collision risk species. Nil (0) means no bat activity was recorded across the whole site, but caution is needed here, because although the values given in this column are "0", at sites where pre-construction surveys found no bat activity, there remains the possibility that new turbines could attract some bat species, thereby altering the level of risk that applies in reality.

Overall assessment:

Low (green)	0-4
Medium (amber)	5-12
High (red)	15-25

It is important to have an understanding of both "typical" and unusually high levels of bat activity at a site so that potentially important peaks in activity are not overlooked. It is therefore recommended that both the highest Ecobat activity category and the most frequent activity category (i.e. the median) are assessed separately in Table 3b and presented in the overall risk assessment. A judgement can then be made on which is the most relevant. It should be noted that presenting mean activity levels can be highly misleading where the data are highly skewed, as is frequently the case with bat activity at wind turbines (Lintott & Mathews, 2018).

APPENDIX 6

CARCASS SEARCHING METHODOLOGY

Planning and Environmental Consultants

Bat Survey Report

Appendix 6 – Carcass Searching Methodology

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1. METHODOLOGY

1.1.1 Corpse Searches

Bird and bat strike corpse searches are used to detect any possible turbine related bird / bat collision incidents at the site. Wind farm studies from the United States show that the majority of birds that collide with wind turbines remain within 63m of the structure (Young, 2003) whilst evidence suggests >80% of bat casualties can be found within ½ the maximum distance of turbine height to ground; 75.5m in the case of Cleanrath (Strickland, 2011). On the basis of a comprehensive literature review and review of habitats in the surroundings it was decided to carry out a search of a 151-metre diameter with the turbine centred within this area.

All carcasses located within the study areas, regardless of species, will be recorded. For carcasses where the cause of death was not apparent, the fatality was conservatively accredited to the Wind Farm as per (Johnson, 2003).

Where fatalities comprise decomposed remains or feather spots and species identification is uncertain, samples will be sent for DNA identification.

1.1.1.1 Search area

Guidance on recommended search area surrounding each wind turbine varies however a radius of no less than 50m is necessary (Rodrigues, 2015). (Atienza, 2011) Guidelines for Assessing the Impact of Wind Farms on Birds and Bats (Version 4.0) states "the ground search area has to be at least 10% more than the rotor diameter". The turbines erected in Cleanrath have a turbine sweep diameter of 117m thus the search area should be 117m x 117m in this case. (Edkins, 2014) *Impacts Of Wind Energy Developments On Birds And Bats: Looking Into The Problem*, recommends the "search width should be equal to the maximum rotor tip height", e.g. for Cleanrath; hub height is 92.5m plus half the rotor diameter (117m/2), the spread of searched area, as a rectangle, square or circle, should be 75.5m in either direction form the turbine base." For Cleanrath Wind Farm site the figure of a 151m box centred on the turbine location was agreed.

1.1.2 Dog Lead Searches

Carcass searches were traditionally completed by human observers whose efficiency is influenced by a number of factors including; carcass type (size, colour, state of decomposition), environmental conditions (vegetation type and density, topography, weather conditions) and observer competence (ability to detect). Reviews of previous studies state human searches are often conducted with low efficiency rates which may contributes to severe bias in mortality estimates. The use of dogs and their olfactory capabilities has been suggested as a way to increase carcass detection rates (Bernardino et al; 2012).

Numerous studies have been conducted demonstrating that dogs have a superior ability to detect bird and bat carcasses than humans, particularly with small carcasses or in dense vegetation (Homan, 2001), (Arnett, 2006), (Paula, 2011), (Reed, 2011), (Mathews F. M., 2013), (Rafael Barrientosa, 2018).

Searches at the windfarm will be made with the addition of a German wire-haired pointer (Lara), trained by an internationally acclaimed dog trainer in 2018 specifically to find bird and bat corpses. During the course of previous searches numerous fatalities have been found including Peregrine Falcon, Kestrel, Gull, Pigeon, Passerines and Leisler's Bat.

1.1.3 Methodology

Methodologies for dog lead corpse searches within the site will broadly follow those used by (Bennett, 2015) who extolls the use of a flexible methodology when completing surveys. ''The dog and handler must adapt their survey technique to the current site conditions. Further, the use of transects should be treated as a guide only, with flexibility to deviate off the transect essential. In ideal conditions, a trained dog will detect the target scent before the survey commences. Allowing the dog, the freedom to "follow the nose" and seek out scents is an essential part of the survey".

Wind conditions can play an important role in determining the capability of a dog to find carcasses. As the scent of a carcass is carried with the wind, each search starts downwind of the turbine and typically works back and forth across wind whilst also moving upwind. Table 2-1 (Bennett 2015) lists considerations that influence efficiency rates. Where conditions are less than ideal further time is taken per search.

Table 1-1 Summary of factors that influence a dog's ability to detect carcasses (Bennett 2015)

Consideration	Issue	Management
Relationship between dog and handler	Handler must be able to monitor the dogs 'performance to determine interest and likely success on a day-by-day, and hour-by-hour basis	Handlers should be appropriately experienced with dog training and behaviour
	Handler must recognise when the dog has detected a scent to enable them to go off transect	Dog and handler should live together and have a strong relationship outside of work
		Regularly use roadkill to stimulate success and monitor performance
Wind speed: Still	On days with no wind there is nothing to carry the scent of the carcass to the dog and detection will be more difficult	Identify days as low wind
		Reduce the distance between transects to allow the dog to cover more ground and be closer to the source of the scent
Wind speed: Low-Medium	Ideal scenting conditions for dogs	Maximum spacing between transects
Wind speed: High	Dogs will become overloaded with scents from much further than the survey area	Reduce spacing between transacts on downwind side of turbine. Allow the dog freedom to follow scents off transects
Wind speed: Extreme	It is more difficult for dogs to locate sources of scents in extreme wind conditions	Allow the dog freedom to follow scents. Maintain constant spacing along transects. Encourage the dog more frequently. Use roadkill to stimulate success and monitor performance
Temperature: Cold (<8 °C approximately)	Scents are reduced in cold conditions	Reduce the distance between transects to allow the dog to cover more ground and be closer to the source of the scent
Temperature: Mildly cool to warm (<30 °C approximately)	As scents warm up, they become more readily detected	Maintain recommended transect distances (dependent upon wind and precipitation)
Topography: flat	Scents are readily carried from one side of the survey area to the other	Maximum transect spacing

Topography:	Undulating Scents may be not be uniformly detected across the site	Ensure transects encompass depressions as well as rises
Topography: Steep	Steep sites may reduce exposure to scents depending upon the interaction with the wind	Ensure transects are crossing the direction of wind from the survey area
Vegetation: low (<5 cm	Detection is based on vision and scent	Maximum transect spacing
Vegetation: medium to tall grass	Dogs may be below the optimum scenting area and vegetation may reduce the exposure of the scent to wind	Ensure the dog has the freedom to "hop/bounce" through the survey area to reach the scents above the vegetation height
Vegetation: dense heath land	Vegetation may reduce the exposure of the scent to wind Scented vegetation (i.e. flowers) may increase the time to find target scents	Ensure dogs are adequately target trained to eliminate confounding scents. Reduce transects to cover more terrain
Vegetation: Trees/Scrub	Reduction in wind speed	Reduce distance between transects
Target Species	Large carcasses are more readily detected then small carcasses Carcasses from species not of interest (i.e. lambs, rabbits) can provide additional scents	Ensure dogs are adequately target trained to eliminate confounding scents

Data recorded at the beginning of surveys will include meteorological data (cloud cover, temperature and wind velocity) and ground cover information (vegetation type and height).

Any carcasses found will have their position noted with GPS and photographed in- situ. The state of each carcass will be recorded on a corpse record card (Appendix 2) using the following condition categories, as per Johnson et al. 2003:

Intact - a carcass that is completely intact, is not badly decomposed, ad shows no sign of being fed upon by a predator or scavenger.

Scavenged - an entire carcass which shows signs of being fed upon by a predator or scavenger, or a portion(s) of a carcass in one location such as wings, legs, skeletal remains or pieces of skin.

Feather Spot - ten or more feathers at one location indicating predation or scavenging. If only feathers are found, 10 or more total feathers or two or more primaries must be discovered to consider the observation a casualty.

2. STATEMENT OF WORK

2.1 Task Outline

2.1.1 Task 1 – Desktop review of the site

This will include reviewing ortho images of lands surrounding the wind turbine bases. A percentage score for the various habitats within the search area will be estimated. This figure will be used when completing the searcher efficiency trial.

2.1.2 Task 2 – Searcher efficiency / Carcass removal trials.

Corpse searching work will be calibrated to account for the dog's ability to find bird and bat corpses and to account for scavenging of corpses by animals, so that it will be possible to estimate the total number of collision victims. Lara is benchmarked with an efficiency of 80%. Lara will also be tracked using a gps collars to show his movements as well as his handler. The handler: Keith will carry a gps with the boundaries mapped.

Acknowledging that bird and bat corpses may be lost to scavengers, on-site experimentation will be necessary using sample corpses to determine the rate of losses to scavengers over a monthly period.

2.1.2.1 Carcass removal

The Derragh CEMP document refers to the potential of predator swarming effects when carrying out predation trials and requests the removal of turbines used in the trial from monitoring. Smallwood, 2010 states 'conventional scavenger removal trials might have produced biased estimates by placing groups of 10, 20, and more bird carcasses at once in open terrain study areas, exceeding the capacity of vertebrate scavengers to process and remove all evidence of the carcasses by trial's end' and devised an alternate strategy to avoid scavenger swamping by placing only 1-5 bird carcasses at a time and record scavenging events by placing each carcass in front of camera traps. (Barrientos, 2018) provides a review of searcher efficiency and carcass persistence in infrastructure driven mortality assessment and found small birds are not a substitute for bats during predation trials.

Based on the above it is proposed to conduct the carcass removal trials at two turbines located at Cleanrath: turbine 1 representing closed canopy habitats and turbine 6 representing open habitats. These turbines will not be included as part of the carcass searches. The trial will be conduct over the course of a year where a single carcass will be placed at Cleanrath turbines 1 and 6 every other month of year one.

Following methodologies presented in (Smallwood, 2010) camera traps will be placed on angle-iron post facing the camera north to minimize direct sunlight on the camera's lens and infrared sensors. Cameras placed 1-2 m from the carcass and <1 m above ground and tilted it slightly downward to center the carcass in camera's field of view. GPS location, distance and baring to the closest wind turbine will be recorded.

Each placed carcass will represent one trial and will be monitored for 30 days or until scavenger(s) removed the carcass, whichever comes first. A determination on carcass removal will be made when no body parts containing flesh or bone or > 10 disarticulated feathers can be found.

2.1.2.2 Searcher efficiency

This test examines how efficient the searcher is and involves the placement of ten birds and bats throughout the Cleanrath site in proportion to habitats within the search zone both sites. Carcasses will be left out in the trial area by one worker and searched for by another two days later. A 24 - 48 hour period between laying carcasses and searching for them will help to prevent the dog following the scent of the layer rather than the carcasses. Of the bird range used during the trial, six will be Pheasants. Pheasants are an appropriate species to use as they weigh 750 – 1700g and so span the weight ranges of medium sized raptors such as hen harrier and buzzard. In addition, two bats and two passerines will also be used. After the searcher efficiency trial all carcasses will be removed from the site. All carcasses not already predated will be removed after the trial is completed.

2.1.3 Task 3 – Monthly corpse searches

The Derragh CEMP states 'Turbine searches for fatalities are to be undertaken' at intervals selected to effectively sample fatality rates based on carcass removal rates (e.g. 2 per month)'. Prior to a carcass removal trial, it is not possible to definitively quantify an effective search rate. Smallwood 2010 states during their trial, given that >50% of all summer-placed birds carcasses were removed in <10 days, fatality search intervals should be ≤ 14 days. ***This quotation provisionally provides for 2 searches per month however if predation levels prove high, shorter search intervals may be necessary.**

Searches will be planned to take place in good working weather conditions. This means low to medium wind speeds (force 1 – 5).

The CEMP also requests 'an opportunity for a standardised approach with a possible control group and/or variation in search techniques such as straight line transects/ randomly selected spiral transects/ dog searches as a means of robustly estimating the post construction impact in terms of fatality'. Although the benefit of dog lead searches over human is widely documented it is proposed to conduct a walked search from a single turbine prior to each full dog lead survey. Results of this search can be used as a comparison to the finding of the full searches. A plot size of 130m x 130m was chosen for the site with each plot centred on a turbine and the sides orientated North/South, East/West. The surveyor will walk transects based 8m apart with the searcher looking 4m on either side.

Searches will be conducted on a monthly basis for Cleanrath with surveys for each site to run concurrently thus mileage costs will not increase. As previously mentioned, turbines 1 and 6 will be excluded from the searches and will be dedicated to predation trials. The met mast located on site will be included in the search.

2.1.4 Task 4 – Reports

A report summarising the results of the collision searches will be compiled at the end of each monitoring year. This will include maps with tracks of dog and handler alongside the location of any corpse found. Searcher efficiency percentage, in combination with scavenger rates and numbers of corpses found will be modelled resulting in a calculated, overall mortality rate for the windfarm over the study period.