APPENDIX D-6

Bat Survey Report 2019

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Engineering and Environmental Consultants

Pre-Application Bat Survey Report 2019

Drumnahough Wind Farm

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ISSUE FORM	
Project number	20195
Document number	6001
Document revision	Rev B
Document title	Drumnahough Wind Farm: Pre-Application Bat Survey Report 2019
Document status	Final
Document prepared by	PR [MWP]
Document checked by	GH [MWP 10-07-2020]

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1 INTRODUCTION

To inform the preparation of an Environmental Impact Assessment Report (EIAR) for a proposed wind farm development, Malachy Walsh and Partners, Engineering and Environmental Consultants, were commissioned to carry out a programme of bat activity surveys, in 2019, at the site of said proposed wind farm at a location approximately 13 km southwest of Letterkenny and 11 km northwest of Stranorlar and 10 km north of Ballybofey. The site encompasses the town lands of Cark to the south, Meenadaura to the east, Treankeel to the north and Carrickalangan and Killymasny the latter of which is the location of Connection point option B (Lenalea substation) (see **Figure 1**).The surveys were carried out in order to supplement surveys at the site in 2018 (see **Section 1.2**) and in response to the increased surveying requirements stipulated in SNH (2019).

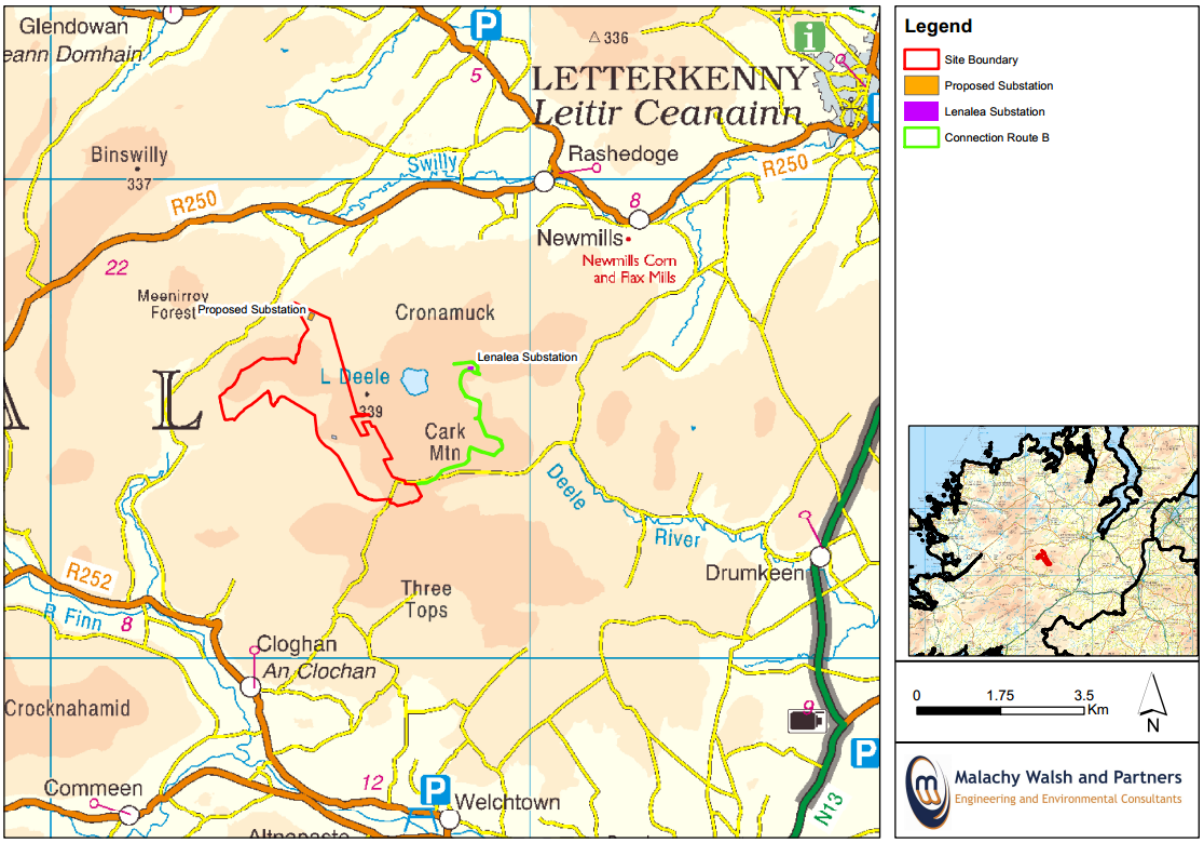

Figure 1: Proposed wind farm location

1.1 BRIEF DESCRIPTION OF THE DEVELOPMENT SITE

The proposed development site, described hereinafter as the 'site', lies within rural upland setting of central Donegal. The proposed wind farm site boundary area is circa 513 ha and elevation ranges from 330 m, between T8 and T9, and 235m elevation west of T1. The site slopes from the south to the northern peak of Cronaglack at 341 m and Crockalough at 339 m to the northeast. Cark Mountain lies to the southeast at a height of 364 m. Lough Deele lies to the east at an elevation of 263 m.

The dominant habitat type throughout the site is conifer forestry occurring in a mosaic of first and second rotation forestry and clear fell. Areas of heath and blanket bog occur in the north-western corner and eastern section of the site. The dominant land-use in the area extending away from the

site comprises commercial forestry plantation, peat bog and marginal agriculture. The site was initially planted with commercial forestry in 1968/69 and some in the early 1970s. Most of the forestry is currently second rotation apart from the eastern side which was planted in the early 1990s.

The site is primarily drained by the River Finn catchment to the south ultimately draining to the River Foyle and Lough Foyle Estuary. Surface water drainage in the area is typically a complex of small drainage ditches created during ground preparation for commercial forestry. These channels feed larger semi-natural watercourses. The primary drainage flows in a southerly or westerly direction through a network of streams which join the River Finn. The northern section of the site drains into both an unnamed stream and Meenadaura stream which eventually join the River Swilly approximately 3km north of the site. Lough Deele lies just over 1km east of the wind farm site boundary and is drained by the Swilly catchment.

Table 1: List and description of the habitats occurring at the site

Habitat	Code	Description/Location/distribution
Upland blanket bog	PB2	Patchy distribution: environs of T1, track between T2 and T3, and between T7 – T11. Occurs as mosaic with HH3, WD4 and PB5 in some areas.
Cutover bog	PB4	Adjacent to proposed route option B and northern limit of Option A. Also occurs as a mosaic with PB5.
Eroding blanket bog	PB5	Confined to the western extent of the sit at highest elevations. Occurs as a mosaic with PB2 in some areas.
Wet heath	HH3	No well defined habitat occurs. This habitat occurs as a mosaic with GS4, PB2 and PB5.
Conifer plantation	WD4	Rectilinear plantations of Sitka spruce of varying age classes are a dominant landscape feature at the site. Occurs as mosaic with PB2.
Recently-felled woodland	WS5	T4 occurs in a wider area of this habitat. This habitat is usually planted quickly after felling.
Eroding/upland rivers	FW1	Tracks and other infrastructure are drained mostly by minor streams in the Finn, Swilly and Deele catchments. These high gradient watercourses comprise some of the headwater streams in these catchments.
Acid oligotrophic lakes	FL2	Lough Deele: a low nutrient water body located north of the site boundary.
Wet grassland	GS4	Occurs adjacent to part of Option B and as a mosaic with Dry-humid acid grassland (GS3) to the north of the site.
Improved agricultural grassland	GA1	Some fields adjacent to Option B have been managed and categorised as such. Occurs as a mosaic with GA1 and GS3 in some areas.
Stone walls and other stonework	BL1	Linear artificial features land boundaries limited to the eastern extent of the site.
Buildings and artificial surfaces	BL3	Linear artificial tracks/roads limited to the eastern extent of the site.

While forest block edges which would typically be used by foraging bats are present, the site generally lacks landscape features such as tree lines and hedgerows that provide the types of habitat connectivity preferentially selected by bat species for navigation to and from foraging grounds and within them.

In summary, therefore, relative to its surroundings, the site is at elevation and is less ecologically and structurally diverse than is the case in the geographical area extending away from the site. While these circumstances clearly do not preclude bat activity, they do reduce the value of the site when compared with the surrounding landscape. Further evidence in this regard is provided in **Section 3.2.2.1**, below.

1.2 RESULTS OF PREVIOUS BAT ACTIVITY SURVEYS

1.2.1 Static Surveys

During the 2018 surveys which were conducted at 4 different locations within and adjacent to the site (See **Figure 2**), Common pipistrelle, soprano pipistrelle, Leisler's bat, species of genus *Myotis* and a number of bat passes that were not identified were recorded. Detectors were deployed on the 25th of July 2018, and recorded for fourteen consecutive nights. Site No. 1, is located towards the southern part of the site, Site No. 2 is located towards the west central part of the site, Site No. 3 is located to the north of the site, and Site No. 4 is located towards the east central part of the site. Habitats chosen were those considered as suitable bat foraging and commuting habitat. Bat activity was recorded at all four sites. Over the fourteen consecutive nights of automated bat surveys, there were 238 bat passes. Leisler's bat was the most common recorded species, with a total of 111 bat passes, followed by Common pipistrelle and Soprano pipistrelle, with 48 and 36 passes respectively. Over the fourteen nights of survey there were 40 passes of *Myotis* species.

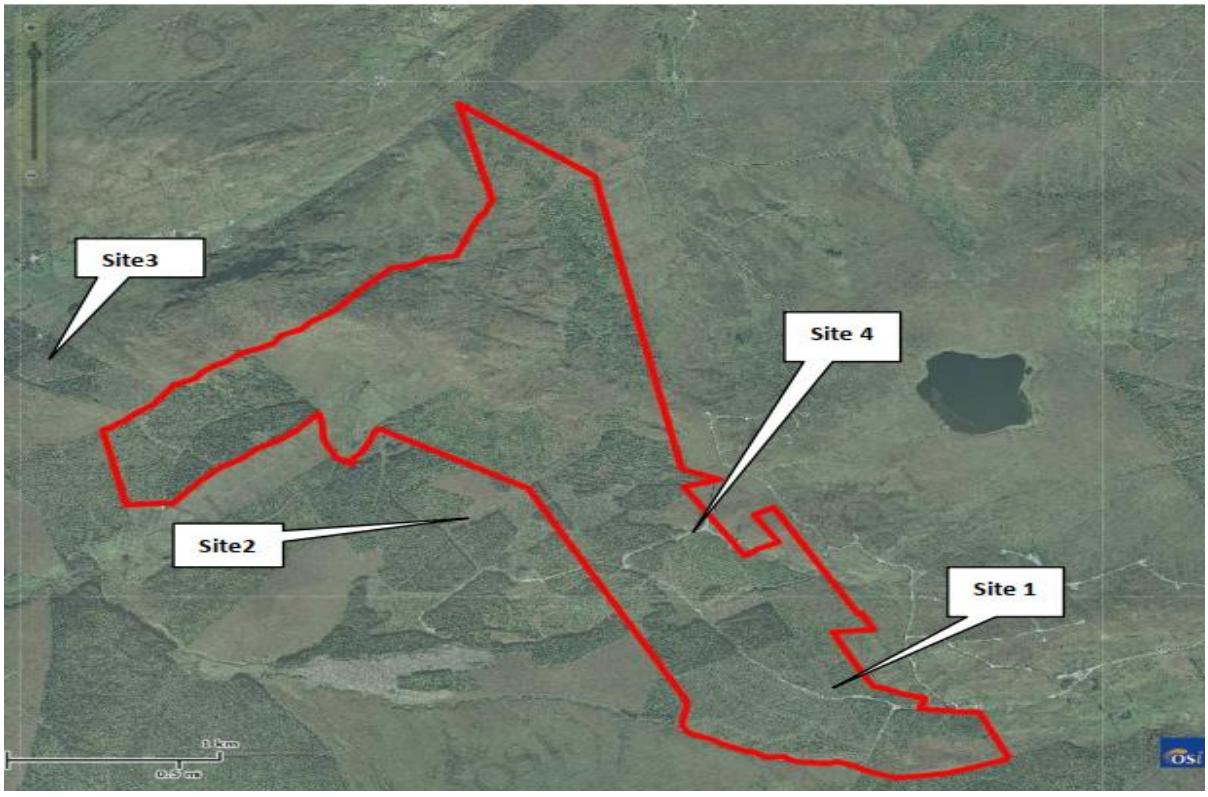

Figure 2: 2018 SP Locations

1.2.2 Transect Surveys

Transect surveys were carried out on the nights of July 18th, August 29th and October 2nd, 2018 during which common pipistrelle, soprano pipistrelle and Leisler's bats were recorded in very low numbers.

1.2.3 Roost Surveys

Daytime visual roost surveys conducted in 2018 established that the conifer woodland within the site boundary has a low potential value as roosting habitat for bat species and that the site is, therefore, primarily used as foraging/commuting habitat, rather than for roosting. During the surveys a derelict/dilapidated house situated within the site boundary c. 425m to the west of T8 (closest site infrastructure) was identified. This was revisited in the period February to March 2019 and again on 2 occasions during the summer 2019 survey period. Daytime visual surveys did not identify any evidence of roosting bats or of any use by bats, and the structure is not considered optimal as a significant bat roost such as maternity roost/other significant roost for bat species (see 2018 Report). In addition, the structure is not well connected to habitats extending away, as it is situated in isolation. It must be noted that the development site is situated in a remote upland area, and the availability of roosts in the immediate area are poor/suboptimal. Extending further away from the site, bat roosting potential includes one off dwelling houses, masonry bridges/structures, farm buildings and derelict buildings that occur in the greater area. The BCI data request response did not identify any documented bat roost sites in the proximity of the Drumnahough site (closest are in the area around Ballybofey approximately 10 km away.

1.3 PURPOSE OF THE SURVEYS

The 2019 surveys were carried out in order to supplement the 2018 surveys and in response to the increased surveying requirements stipulated in SNH (2019).

Bats are legally protected by Irish and European legislation designed to maintain and restore these protected species to a situation where their populations are in a favourable conservation status. To ensure that bats are protected, an assessment of impacts of the proposed development is required.

To that end a detailed appraisal of the following are required:

- The level of activity of all bat species recorded at the site assessed both spatially and temporally.
- The risk of turbine-related mortality for all bat species recorded at the site during bat activity surveys.
- The effect on the species' population status if predicted impacts are not mitigated

The surveys have established the extent of bat activity at the site during 2019.The results outlined in this report will form the basis for the assessments of the potential impacts on bat species in the Biodiversity chapter[1] of the EIAR.

1.4 SCOPE OF THE SURVEYS

Bat activity surveys conducted included:

[1] Chapter 6

1.4.1 Static surveys

11 bioacoustic recorders were deployed as follows:

- Spring: 2/5 to 12/5;
- Summer: 6/7 to 16/7; and
- Autumn: 17/9 to 26/9.

Further detail is provided in **Section 3.4.1**, below (see also Appendix 5).

1.4.2 Transect Surveys

Transect surveys were conducted on the nights of 5/6, 1/8 and 31/10, 2019. Further detail is provided in **Section 3.4.2**, below.

2 BAT SPECIES IN IRELAND

In Ireland there are 9 resident bat species of two families (Rhinolophidae and Vespertilionidae). These species are:

- **Rhinolophidae:**
  - Lesser horseshoe bat *(Rhinolophus hipposideros)*
- **Vespertilionidae:**
  - Daubenton's bat *(Myotis daubentonii)*
  - Whiskered bat *(Myotis mystacinus)*
  - Natterer's bat *(Myotis nattereri)*
  - Common pipistrelle *(Pipistrellus pipistrellus)*
  - Soprano pipistrelle *(Pipistrellus pygmaeus)*
  - Nathusius' pipistrelle (*Pipistrellus nathusii*)
  - Leisler's bat *(Nyctalus leisleri)*
  - Brown long-eared bat *(Plecotus auritus)*

One individual each of Brandt's bat and the greater horseshoe bat have been also found, the Brandt's bat in Wicklow in 2003 and the greater horseshoe bat in Wexford in 2013. Both species are likely to be vagrants since there is no evidence of additional specimens[2].

2.1 HABITAT ASSOCIATIONS

The interplay between habitat mix, environmental conditions, topography and availability of prey is a key determinant of whether a location is suitable for bat. Bats in Ireland feed exclusively on insects and in the summer they generally emerge from their roosts at dusk to feed. While the distances covered while foraging varies considerably between individual species, all are known to use a number of different foraging sites in the same night and move between them to locate areas of high insect density. Because bats preferentially select certain habitats and avoid others, each species has a strong association with different habitat types and they are known to exhibit a high level of site loyalty and will frequently return to the same foraging sites night after night (Entwhistle *et al*., 2001).

Table 2 lists and ranks the relative importance to bat species of certain landscape features bats use as they feed, roost and travel. They use hunting grounds or foraging habitats to find food and

[2] Information in this section from: https://www.batconservationireland.org/irish-bats/species

commuting habitats to travel. Bog habitat of the type which is dominant in the upland areas extending away from the proposed development site is avoided by all Irish species (Lundy *et al*., 2011).

Table 2: Landscape features of importance to bat species

Features of high importance	Features of medium importance	Features of low importance
Underground sites	Improved pasture	Intensive arable
Buildings with high bat roost potential	Drainage ditches	Dense urban, particularly lit areas
Broadleaved woodland and scrub	Walls and fences	
River valleys	Minor roads (no hedges)	
Small field systems with low intensity pasture	Exposed upland sites	
Tree lines and hedgerows	Coniferous woodland	
Bridges and structures with high bat roost potential		

(Adapted from the UK Department of Transport's Interim Advice Note 116/08 Nature Conservation Advice In Relation To Bats)[3]

There is also a correlation between bat activity and elevation, a relationship which is complex due to its multi-factorial nature (Erickson *et al.*, 2003); the elevation of a location, therefore, influences the level of bat activity that occurs.

2.2 METABOLIC CONSTRAINTS

Bats belong to the order Chiroptera, a name of Greek origin meaning "hand-wing" which reflects the fact that the wing of a bat does resemble a modified human hand with a flexible skin membrane that extends between each long finger bone and the many movable joints that make bats agile fliers. Because bats have a thin wing membrane, flying during the heat of the day could be hazardous causing excessive absorption of heat and resulting in dehydration and possible heat prostration. Nocturnality offers protection from the heat and helps bats maintain body temperature and moisture. It also affords protection from aerial predators most of which hunt during the day.

To locate and catch prey, insectivorous bats use an acoustic orientation called echolocation. They emit a series of supersonic cries through the mouth or nose and detect flying insects by the echoes reflected back. Insectivorous bats use a seasonal feeding strategy to help build fat reserves during the summer and autumn, prior to their hibernation during winter - a time, generally, when insects are not available. As insectivores, bats in Ireland feed on arthropods which contain the energy-rich carbohydrate chitin, which is indigestible for the typical mammalian gastrointestinal tract. However European vespertilionid bat species have evolved an enzymatic adaptation (acidic mammalian chitinase) which enables them to digest the chitin present in their primary source of food to optimize resource use and energy intake (Strobel *et al.*, 2013[4]).

[3] Available at http://www.dft.gov.uk/ha/standards/ians/pdfs/ian116.pdf

[4]Strobel *et al.* (2013) included analyses of; *inter alia*, *P. pipistrellus*, *P. auritus*, *M. nattereri*, *M. daubentonii*, and *N. leisleri* all of which are vespertilionid bat species resident in Ireland.

Even though they share the characteristics of all mammals: hair, regulated body temperature, the ability to bear their young alive and nurse them - bats are the only mammals to truly fly. As true fliers, rather than gliders, bats use flapping flight which is one of the most expensive activities in terms of metabolic cost (Winter *et al*., 1998). Flying consumes so much energy that each female bat is only able to produce a single off-spring a year and a bat typically will need to consume about 1/3 of its own body weight in food per night; a common pipistrelle, for example, can eat over 3,000 insects in a single night. As a group, therefore, bats have evolved to favour minimal mass because of the energetic demands of flight.

This aspect of their ecology, this high metabolic demand, is a key determinant in the foraging strategies of all bat species. Speculative foraging carries too low a risk/reward ratio in that the metabolic cost of flight is so high that bats will seek out locations that have previously rewarded energy cost inputs. This aspect of their behaviours is demonstrated by the previously mentioned high level of site loyalty exhibited by bat species and the repeated return to the same foraging sites night after night (Entwhistle *et al*., 2001). In addition, because the cost of flight increases with decreasing body size, de Jong (1994 cited in Erickson *et al*., 2003) hypothesized that smaller bats with slower flight could be restricted from using habitats where insect abundance was low and long-distance foraging flights were required and where every increase of 100 m in elevation causes a decrease of 1^0C in air temperature.

Differences in activity on different nights could be the result of climatic conditions, insect availability or morphological differences between species. Cooler and windier nights tend to suppress flight activity of bats (Anthony *et al.,* 1981, O'Farrell, 1967, Stebbings, 1968 all cited in Erickson *et al*., 2003) by imposing thermoregulatory stress and by reducing the activity of their insect prey.

2.3 LEGAL AND CONSERVATION STATUS OF BAT SPECIES IN IRELAND

Bats in Ireland feed exclusively on insects and in the summer they generally emerge from their roosts at dusk to feed. All Irish bat species are protected under the Wildlife Acts (1976 to 2018) and by the Habitats Directive[5] which protects rare species, including bats and their habitats, and requires that appropriate monitoring of populations be undertaken. All bats are listed in Annex IV of the Habitats Directive as species protected across their entire natural range and the lesser horseshoe bat is further listed under Annex II as a species for which core areas of their habitat must be protected under the Habitats Directive and within the Natura 2000 network of protected sites.

Across Europe bats are further protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982), which, in relation to bats, exists to conserve all species and their habitats. The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983) was instigated to protect migrant species across all European boundaries. The Irish government has ratified both these conventions.

Under Article 11 of the Habitats Directive, each member state is obliged to undertake surveillance of the conservation status of the natural habitats and species in the Annexes and, under Article 17, to report to the European Commission every six years on their status and on the implementation of the measures taken under the Directive. In April 2019, Ireland submitted the third assessment of conservation status for 59 habitats and 60 species (including three overview assessments of species

[5] Council Directive 92/43/EEC

at a group level). The current Conservation Status assessments for bat species resident in Ireland are listed in **Table 3**, below; the trend in the Conservation Status for each species is included.

Table 3: Overall assessment of Conservation Status for bat species resident in Ireland (NPWS, 2019)

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

3 SURVEY METHODOLOGY

3.1 CONSTRAINTS

There are three species of the genus *Myotis* resident in Ireland namely; Daubenton's bat (*M. daubentonii*), whiskered bat (*M. mystacinus*) and Natterer's bat (*M. nattereri*). Because the sonograms generated by recordings of the calls of these species cannot reliably be identified to species level on the basis of sonogram analysis alone, any calls attributed to the genus are specified as *Myotis* spp. in this report.

3.2 DESK STUDY

A desk study was carried out to collate available information on the bat species likely to be present. This comprised a review of the following publications, datasets and on line resources:

- *The Status of EU Protected Habitats And Species In Ireland* (NPWS, 2019)
- OSI Aerial photography and 1:50000 mapping
- National Parks and Wildlife Service (NPWS)
- Bat Conservation Ireland publications and website
- National Biodiversity Centre (NBDC) (on-line map-viewer)
- Aerial imagery available at Google Earth and Bing Maps
- Other information sources and reports footnoted in the course of the report

3.2.1 Data Request

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

3.2.2 Data Base Search

3.2.2.1 Bat Habitat Suitability Index

The National Biodiversity Data Centre's online mapper[6] includes a Bat Habitat Suitability Index (BHSI) layer derived from an analysis of the habitat and landscape associations of Irish bats compiled in Lundy *et al.* (2011). The index evaluation ratings range from 0 to 100 with 0 being the least favourable and 100 the most favourable for bats. Index evaluations are available for each individual species and an overall rating is also available for all species in combination. As the ratings are mapped to a 2 km grid square resolution the reference area, to which the indices listed in **Table 4**, below, relate, comprise the proposed wind farm site and lands immediately adjacent. The ratings listed in **Table 7**, below, pertain to the 25x2 km grids that encompass the site and its extended surrounds.

These ratings, while not predictive, provide meaningful metrics that characterise the value of the area within and surrounding the proposed wind farm site to bat species and are an indicator as to the likelihood that different bat species are, or are not, likely to be a significant presence in the area within and around the site. This likelihood then, in turn, indicates the probability that bats may use the area. This is so because bats preferentially select certain habitats and avoid others and each species has a strong association with different habitat types and they are known to exhibit a high level of site loyalty and will frequently return to the same foraging sites night after night (Entwhistle *et al*., 2001).

As can be seen from the ratings listed in **Table 4**, with regard to the area within the proposed wind farm site[7], not only are the overall habitat suitability ratings for all bat species very low, the area has a zero value rating for 2 species namely, Nathusius' pipistrelle and Lesser horseshoe bat. Of the 36 individual species ratings listed, only 11 (30%) are above 20; of these only 3 (8%) are above 30. For clarity, the ratings for each 2 km Grid are ranked (without species attribution) in **Table 5**, below, and the percentage of the total that fall within the different data classes are listed in **Table 6**, below.

Table 4: Bat Habitat Suitability Index Ratings by species

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

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

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

Table 5: Species Ratings ranked (lowest to highest)

C00H/C00M (South)	C00N/C00H (North)/C00M (North)	C00R/C00S (South)	C00S (North)
0	0	0	0
0	0	0	0
7	7	8	14
13	18	11	16
14	18	12	18
15	20	12	21
19	24	16	22
20	30	18	28
25	34	21	30

Table 6: % of species Ratings evaluations per Ratings class

Ratings class	Number in class	% of total
0	8	22
1-9	3	8
10-19	14	39
20-29	8	22
> 30	3	8

Table 7: 'All bats' BHSI Ratings for 25x2 km grids encompassing the site and surrounds

C00E	C00J	C00P	C00U	C00Z
11.78	16.78	16.78	16.78	16.56
C00D	C00I	C00N	C00T	C00Y
11.78	16.78	16.78	16.56-16.78	16.56
C00C	C00H	C00M	C00S	C00X
11.22-11.78	12.56	12.56-16.78	12.56-16.78	10.89-16.56
C00B	C00G	C00L	C00R	C00W
11.22	12.56	12.56	10.89-12.56	10.89
C00A	C00F	C00K	C00Q	C00V
11.22	12.56	12.56	10.89	10.89

3.2.3 Initial Site Risk Assessment

In order to characterise potential risks that may exist at the site SNH (2019) recommends that an Initial Site Risk Assessment (ISRA) of site based risk factors be carried out. This ISRA is based on a consideration of habitat and development related features of the proposed wind farm site to provide an evaluation of the site's risk level. Using the risk criteria outlined in **Table 8**, below, the proposed wind farm site is evaluated as 'Low' risk.

Table 8: Initial Site risk Assessment

Habitat Risk	Project Size		
	Small	Medium	Large
	Site Risk Level		
Low	1[8]	2	3
Moderate	2	3	4
High	3	4	5

Habitat Risk Level	
Habitat Risk	**Description**
Low	• Small number of potential roost features, of low quality. NO ROOST FEATURES • Low quality foraging habitat that could be used by small numbers of foraging bats. YES • Isolated site not connected to the wider landscape by prominent linear features. YES
Moderate	• Buildings, trees or other structures with moderate-high potential as roost sites on or near the site. NO • Habitat could be used extensively by foraging bats. NO • Site is connected to the wider landscape by linear features such as scrub, tree lines and streams. NO
High	• Numerous suitable buildings, trees (particularly mature ancient woodland) or other structures with moderate-high potential as roost sites on or near the site, and/or confirmed roosts present close to or on the site. NO • Extensive and diverse habitat mosaic of high quality for foraging bats. NO • Site is connected to the wider landscape by a network of strong linear features such as rivers, blocks of woodland and mature hedgerows. NO • At/near edge of range and/or on an important flyway. NO • Close to key roost and/or swarming site. NO
Project Size Risk Level	
Project Size	**Description**
Small	• Small scale development (≤10 turbines). NO • No other wind energy developments within 10km. NO • Comprising turbines <50m in height. NO
Medium	• Larger developments (between 10 and 40 turbines). YES • May have some other wind developments within 5km. YES • Comprising turbines 50-100m in height. NO
Large	• Largest developments (>40 turbines) with other wind energy developments within 5km. NO • Comprising turbines >100m in height.). YES

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

3.3 SITE INVESTIGATION

The desk top study included a preliminary assessment of the availability of landscape features of importance to bats within the Development Area that also connect it to the geographical area extending away from it. This initial assessment was supplemented by a ground truthing daytime survey conducted when the remote survey bioacoustic units were deployed.

The purpose of this daytime survey was to ensure that the locations of the remote bioacoustic units would intersect with a representative habitat mix present and would, therefore, accurately sample the activity of any bat populations present. When determining which landscape features were of importance to bat species, cognisance was taken, during both the desk top and ground truthing assessments, of NRA (2006a and 2006b), Collins (2016) and of the UK Department of Transport's Interim Advice Note 116/08[9].

During the ground truthing surveys an assessment of the potential value to foraging bats of the existing habitats and features was made. Given the generally open and elevated character of the site and surrounding landscape, particular attention was paid to the presence of linear features within the site that connected the site to the surrounding hinterland.

3.4 FIELD SURVEY DESIGN

Passive Automated Bat Surveys (PABS), designed to passively sample and record bat activity at 11 preselected sampling points (SP), were conducted during spring, summer and autumn, 2019, in compliance with SNH (2019) requirements. 2 different types of Song Meter[10] bioacoustic recording units were deployed within the site for 10 nights during each season.

3.4.1 Static Surveys

Three key criteria from SNH (2019) informed the survey design. These are, as follows:

1. **Minimum survey effort for ground-based surveys**:

   *The minimum level of pre-application survey required using static detectors is 10 nights in each of: spring (April-May), summer (June-mid-August) and autumn (mid-August-October***.**

2. ***Number of detectors required:***

   Detectors should be placed at all known turbine locations at wind farms containing less than ten proposed turbines. Where developments have more than ten turbines, detectors should be placed within the developable area at ten potential turbine locations plus a third of additional potential turbine sites.

3. **Location of detector units:**

   At sites where the proposed turbine locations are known, ***static detectors should be placed*** *[....]* ***at or close to these points****.* [Emphasis added]

[9] 'Nature Conservation Advice In Relation To Bats'(Available at http://www.dft.gov.uk/ha/standards/ians/pdfs/ian116.pdf

[10] SMZC, SM4Bat manufactured by Wildlife Acoustics Ltd.

> *The selection of locations at which to place detectors should be based on professional judgement, but at large sites, it is recommended that beyond the initial ten detectors placed at proposed turbine sites (if known), the remainder should be distributed based on the availability of different habitats and topographical features on the site.*

The SP and turbine locations are illustrated in **Figure 3**; details on the habitats at the SP locations are summarised in **Table 9**.Further **d**etails, including grid co-ordinates, are presented in **Table 1**, **Appendix 1**.

Because the final layout of the turbines had not been determined at the outset of the surveys the units were located in compliance with SNH (2019) as it pertains to sites where turbine locations are not known (see point 3 above). Notwithstanding that turbine locations were not finalised, information was available with regard to potential locations and cognisance of this was taken when sampling points were selected. Based on the information available at the time of initial deployment, the detectors were placed at, or as near to, turbines as access allowed while at the same time appropriately sampling the different habitats and topographical features of the site. Subsequently, in or around July 2019, revisions to the turbine layout were made. At that time, it was the assessment of the lead surveyor that, in the interests of consistency, and in order to ensure that the data could be compared across seasons that the SP locations should not be changed.

The relative homogeneity of the conifer plantation that dominates meant that the range of habitats from which sampling points within the site could be selected was quite restricted. To the extent possible within the constraints of the SNH (2019) methodology, the SP locations were chosen in the expectation that, should bats be present, detectable levels of activity were reasonably foreseeable at the selected locations. To that end - subject to the aforementioned homogeneity of the site – any variations within the plantation such as woodland edges, forest tracks, firebreaks or interface area where plantation edges abutted other habitat types were selected. Notwithstanding that turbines were likely to be sited within areas currently occupied by conifer plantation; no SPs were located within this habitat type on the grounds that no bat activity was reasonably foreseeable within conifer blocks particularly where the crop had reached post thicket phase.

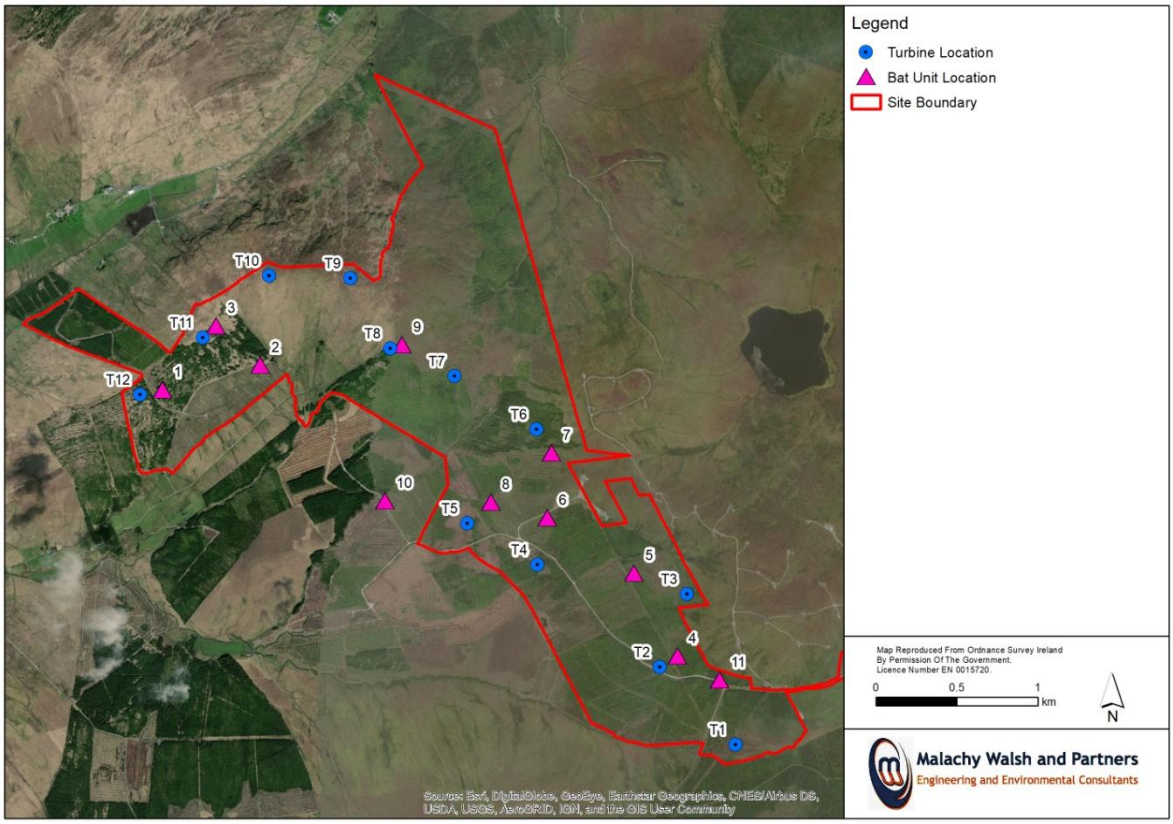

Figure 3: 2019 Sampling Point (SP) Locations

Table 9: Habitats at Sampling Points

SP	Habitat
1	Conifer: edge/access track interface
2	Conifer: edge
3	Conifer: edge/upland blanket bog interface
4	Conifer: fire break
5	Conifer: fire break
6	Conifer: edge/access track interface
7	Conifer: Fire break, flush-rising of stream
8	Conifer
9	Conifer: edge/upland blanket bog interface
10	Conifer: edge/blanket bog interface with stream adjacent
11	Conifer: edge/access track interface

Notwithstanding that SP10 is outside the site's western boundary it was included because this location had the highest level of bat activity recorded in 2018, because it was considered to be best example of habitat suitable for bats encountered during the various ground truthing surveys and because It acted as something of a control to determine the level of bat activity at a suitable location offsite that can be compared with those locations surveyed within the site.

The unit at SP10 was positioned in recently planted conifer plantation, with a small stand of juvenile broadleaves immediately adjacent, and with a conifer expanse extending away to the south. The

recently planted area comprises trees that are c.1 – 1.5m in height. There is little recolonisation of bramble etc. and it is likely that the trees were planted a short time after felling c. 1 year. A stream of approximately 1.5 m width, draining south west, is situated approximately 30 m to the north west of the SP. Bank side vegetation comprises mainly low growing grass species and the stream is relatively open with little to no cover and is not overgrown with any bramble or scrub element. Mature conifer plantation, which does not extend to the stream, is situated adjacent to the northwest with its forest edge aligned generally parallel to the stream. Narrow stretches of bog land/degraded upland blanket bog are present some 50 m or so to the northeast, and these further expand to the northeast.

The fact that bats are known to exhibit a high level of site loyalty and will frequently return to the same foraging sites night after night (Entwhistle *et al*., 2001) increased the probability that any species with a habitual presence in the survey area would, at some point, be encountered at the sampling locations. The units were programmed to begin recording at sunset each evening and to continue until dawn the next morning. Prior to deployment the latitude, longitude and time zone for each survey location was inputted to each unit and each then automatically determined the times of dawn and dusk, thereby, reducing the likelihood of operator error. Calls emitted by bats that passed within the detecting range of the units, between the hours of sunset and dawn, were recorded and their calls stored for later analysis. Each unit has an omnidirectional microphone that detects bat ultrasonic calls and each unit can record and store data on internal SD cards.

The total numbers of bat passes by each species at each SP and for each season are provided in **Tables 1** to **14**, inclusive, in **Appendix 2**.

3.4.2 Transect surveys

With regard to transect surveys SNH (2019) notes that while they *"can be used to complement the information gained from static detectors and other sources. Their applicability is discretionary and site-specific."*

Notwithstanding the secondary role of this survey type it was decided, to ensure that bat activity at the site was comprehensively sampled, that bat activity transect surveys would be carried out. Driven transects were undertaken within the site and in the geographical area surrounding it site during spring, summer and autumn, 2019. The routes are illustrated in **Figure 4** to **Figure 6**, inclusive.

Photograph 1: AnaBat SD2 with roof mounted microphone shown on left

The surveys were conducted using the AnaBat SD2 Detector System (AnaBat SD2 Flash Card Bat Detector) with roof mounted microphone (See **Photograph 1**, above) in conjunction with the BatNav KML Generator[11] - a plug-in, add on, device. The AnaBat unit samples ultrasonic calls on a continuous basis and records the information onto an internal CF card. Each time an ultrasonic sound that matches preset parameters is detected, an individual sound file, marked with the date and time (to the second), is recorded by the AnaBat unit. A GPS co ordinate for each sound file is then generated by the BatNav KML Generator. The route surveyed was routed through the site and the area extending away from it and was designed to intersect with the range of foraging and commuting habitats present - particularly those associated with linear features such as roadside margins and woodland edges and hedgerows and mature tree lines which are of particular value to commuting and foraging bats.

3.4.3 Sonogram Analysis

It should be noted that the total number of sound files recorded at each location on any given night is not an indicator of the number of individual bats. Bats will frequently fly over and back along short sections of habitat if prey is readily available while foraging and they use linear features to navigate through the landscape to and from roosts and within foraging sites.

[11] Manufactured by Wildwood Ecology

Not every call emitted by a bat is the echolocation call that is characteristic of the species in question. Many bat species use differently structured echolocation calls, adapted to their habitat structure or foraging situation (Miller & Degn, 1981; Fenton, 1987; Rydell, 1990; Kalko, Schnitzler & Schnitzler, 1993; Jones, 1995 cited in Pfalzer *et al.,* 2003). In addition to echolocation calls bats use 'social' calls which are differentiated from echolocation calls by their solely communicational function. Pfalzer *et al.* (2003) categorise these into 4 types, as follows, squawk, trill (repeated), cheep (curved) and song (complex). While these can readily be attributed to bats they cannot be used to differentiate between species. In this report any calls that match the parameters outlined in the preceding sentences are designated as unidentified. Sonograms of this category are shown in the various tables under the column heading 'NoID'.

3.4.3.1 Static surveys

Post survey, the sound files were converted, using a proprietary software[12], to produce sonograms (graphs of the sound recorded). As each species has a unique audio signature, the sonograms, or graphs, can be used to distinguish between one species and another. Using their training and experience of sonogram analysis the surveyors used the software to eliminate all data files that were not generated by bats. Once an individual bat pass is identified the recording is labelled using tools available in the software. The species identification is then confirmed by MWP ecologists who have extensive experience of sonogram analysis.

3.4.3.2 Transect surveys

Post survey, the sound files were converted, using a proprietary software[13], to produce sonograms (graphs of the sound recorded). Each sound file is reviewed and any recordings of bat passes are labelled by MWP ecologists who have extensive experience of sonogram analysis. The GPS locations generated by the BatNav KML Generator are then appended to each call and a map illustrating the distribution of bat activity is produced using proprietary software[14]. The distributions of activity for each season are illustrated in **Figure 4** to **Figure 6**, inclusive.

4 RESULTS

4.1 DATA REQUEST

Data from transect surveys, roost surveys, BATLAS 2010 and from EIS surveys were supplied by Bat Conservation Ireland. While Grid references are provided for many of these records, due to the sensitivity of the data, they will not be reported here. However, 4 figure grid references can be provided to statutory bodies on request. These records, which are summarised in **Table 10**, below, indicate that the following species are recorded, or historically have been recorded, within a 10 km radius of the proposed wind farm site.

- Brown long-eared bat (*P. auritus*);
- Common pipistrelle (*P. pipistrellus*);
- Daubenton's bat (*M. daubentonii*);

[12] Kaleidoscope Pro Software (Manufactured by Wildlife Acoustics Ltd.)

[13] AnaLookW (Designed by Titley Scientific)

[14] Map-a-Bat Pro

- Leisler's bat (*N. leisleri*);
- Natterer's bat (*M. nattereri*); and
- Soprano pipistrelle (*P. pygmaeus*).

Bats from the genus *Myotis*, which were not identified to species level, were also included in the BCI records. In light of the fact that the BCI website indicates that Brandt's bat (*Myotis brandtii*) is not a confirmed resident and has only been found in one location in Ireland to-date in Co. Wicklow, where a specimen that was deemed a vagrant[15] was recorded in 2003, it is reasonable to infer that that any bats identified to genus included in BCI records do not include Brandt's bat. All of the species included in the BCI records, which can be identified by sonogram analysis, were recorded during the surveys detailed below, as were members of genus *Myotis* (see **Section 3.1**, above).

With regard to the BCI records derived from roost surveys, the records provided do not identify the specific sites and the location is identified to the town name only. In this case that town is approximately 11 km south east of the site.

Table 10: BCI Records

Data Source	Date	Species
Roost Surveys	Undated	Brown long-eared bat; common pipistrelle; Daubenton's bat; Natterer's bat; soprano pipistrelle.
BATLAS 2010	17/9/2009	Common pipistrelle; Daubenton's bat; Leisler's bat; Natterer's bat; soprano pipistrelle.
EIS Surveys	17/06/2013	Brown long-eared bat; common pipistrelle; Daubenton's bat; Leisler's bat; Natterer's bat; soprano pipistrelle.
Transect Surveys	2004, 2006-2008,2009	Brown long-eared bat; common pipistrelle; Daubenton's bat; Leisler's bat; *Myotis* spp.; Natterer's bat; *Pipistrellus* spp. (45kHz/55kHz); soprano pipistrelle; unidentified bat

4.2 STATIC SURVEY

The results of the surveys presented in **Sections 4.2.1** to **4.2.3,** inclusive, include those for SP10 which is outside the site's western boundary. Notwithstanding its location outside the red line boundary, and, therefore outside the development area proper, this location was selected because it was considered judicious to sample activity at what was the optimal habitat for bats identified during the desktop study and in light of the survey results in 2018. Its proximity to the site coupled with its higher potential value as bat habitat, relative to those within the site, further justified its inclusion. As will be seen, in the results outlined in the sections hereunder, the highest number of bat passes was recorded at this SP.

4.2.1 Species Recorded

Sonogram analysis of the 2019 survey data determined that the following species were present at the SP locations within and, with the inclusion of SP10, outside the site:

- Brown long-eared bat (*P. auritus*);
- Common pipistrelle (*P. pipistrellus*);
- Leisler's bat (*N. leisleri*); and

[15] https://www.batconservationireland.org/irish-bats/species/brandts-bat

- Soprano pipistrelle (*P. pygmaeus*).

In addition, species from the genus *Myotis* were also recorded.

The numbers of bat passes recorded of each species at all SPs are listed in **Table 15** to **Table 19**, inclusive. As can be seen from **Table 11** and **Table 12**, three species, namely common pipistrelle, Leisler's bat and Soprano pipistrelle, were the most frequently recorded. While brown long-eared bat and bats from the genus *Myotis*[16] were also active throughout, these species were recorded in very low numbers; species from genus *Myotis* were recorded on a total of 394 occasions and brown long-eared bat on 148 occasions throughout the 30 nights of surveys. As can be seen from **Table 12**, below, there are significant variations in the numbers of bat passes of each of these species both within seasons and between seasonal surveys.

Table 11: Seasonal presence absence by species and SP

SP	*Myotis* spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat
1	3 seasons	3 seasons	Summer/autumn	Summer/autumn	Autumn
2	Summer/autumn	Summer/autumn	3 seasons	3 seasons	Summer/autumn
3	3 seasons	Summer/autumn	3 seasons	3 seasons	Summer/autumn
4	Summer/autumn	3 seasons	Summer/autumn	3 seasons	Autumn
5	Spring/autumn	Summer	Summer/autumn	Summer/autumn	Autumn
6	3 seasons	Summer/autumn	Summer/autumn	3 seasons	Summer/autumn
7	3 seasons	3 seasons	Summer/autumn	Summer/autumn	Summer
8	Spring/summer	Summer	Summer/autumn	Summer/autumn	Autumn
9	3 seasons	Summer/autumn	Summer/autumn	Summer/autumn	Autumn
10	3 seasons	3 seasons	3 seasons	3 seasons	3 seasons
11	3 seasons	Summer/autumn	Summer/autumn	3 seasons	Summer/autumn

Table 12: Species' cumulative totals by SP

SP	*Myotis* spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID
1	39	620	304	139	2	160
2	68	122	126	133	12	58
3	23	491	469	181	2	143
4	15	97	209	167	2	77
5	7	27	182	163	3	113
6	22	98	148	108	3	65
7	69	87	46	21	5	104
8	23	35	504	296	3	69
9	53	82	128	83	2	65
10	68	452	468	199	106	443
11	7	93	130	147	8	245
Total	394	2204	2714	1637	148	1542

4.2.2 Levels of Activity Recorded at Individual SPs

As noted previously the total number of sound files recorded at each location on any given night is not an indicator of the number of individual bats; bats will frequently fly over and back along short sections of habitat if prey is readily available. SP10, the sampling point with the highest total, is outside the site.

[16] See Section 3.1 for notes on identifying bats of genus *Myotis* to species level on the basis of sonograms

The seasonal[17] and annual[18] totals of all bat passes, both those identified to genus to species level and those designated as unidentified[19], that were recorded at each SP are listed in **Table 13**, below. The level of activity of all species during the spring surveys was extremely low. The SPs are ranked (lowest to highest) by total number of bat passes recorded in **Table 14**, below. There was a significant increase in the level of activity recorded during the summer surveys and the highest level of activity was recorded in autumn.

Table 13: Seasonal & annual totals all SPs

SP No.	1	2	3	4	5	6	7	8	9	10	11	Total
Spring	14	6	8	5	3	10	62	12	1	66	6	193
Summer	122	199	47	124	188	128	145	910	140	1278	184	3465
Autumn	1,137	345	1254	438	304	306	125	8	272	392	440	5021
Total	1273	550	1309	567	495	444	332	930	413	1736	630	8679

Table 14: SP ranked by level of activity spring to autumn surveys

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

4.2.3 Species Rates of Activity at Individual SPs

The numbers of bat passes recorded of each species at all SPs are listed in **Table 15** to **Table 19**, inclusive. The total numbers recorded at each SP and the nightly averages of bat passes recorded over the course of the three survey seasons are included. As was noted previously SP10, the sampling point with the highest total, is outside the site; the level of activity of each species at this SP are summarised here:

- Common pipistrelle: SP10 is the second highest but only one pass less than the highest (SP3).
- Leisler's bat: SP10 is the third highest, slightly lower than SP3 and c. 30% lower than SP1.
  Soprano pipistrelle: SP10 is joint second highest with SP2 and only 1 pass behind SP7.
- *Myotis* spp. SP10 is the second highest, 30% lower than SP8 and followed by SP3.
- Brown long-eared bat: SP10 is far in excess of all others, SP2 being the only other SP to exceed 10 passes.

[17] A duration of 10 nights per season

[18] A duration of 30 nights

[19] See **Section 3.4.3**

A comparison is made in **Section 4.2.3.1** below, between **Table 24** (in which the results from SP10 have been included) and **Table 25** (in which the results from SP10 are not included). This demonstrates that the inclusion of the results from SP10, and notwithstanding the fact that SP10 is outside the site, does not skew, or render inaccurate, the analyses of the results presented in **Section 5** as they pertain to activity within the site.

Table 15: Common pipistrelle bat passes recorded by SP and season

SP	1	2	3	4	5	6	7	8	9	10	11	Total
Spring	0	1	0	0	0	0	0	0	0	1	0	2
Summer	6	10	14	20	93	26	18	498	62	415	34	1196
Autumn	298	115	455	189	89	122	28	6	66	52	96	1516
Total[20]	304	126	469	209	182	148	46	504	128	468	130	2714
Average[21]	10.10	4.20	15.63	6.96	6.07	4.93	1.53	16.80	4.27	15.60	4.33	

Table 16: Leisler's bat passes recorded by SP and season

	1	2	3	4	5	6	7	8	9	10	11	Total
Spring	1	0	0	2	0	0	1	0	0	2	0	6
Summer	64	49	22	62	27	36	35	35	21	416	78	845
Autumn	555	73	469	33	0	62	51	0	61	34	15	1353
Total	620	122	491	97	27	98	87	35	82	452	93	2204
Average	20.67	4.07	16.37	3.23	0.90	3.27	2.90	1.17	2.73	15.07	3.10	

Table 17: Soprano pipistrelle bat passes recorded by SP and season

	1	2	3	4	5	6	7	8	9	10	11	Total
Spring	0	2	0	2	0	1	1	0	0	14	2	22
Summer	31	47	5	26	26	41	15	295	22	133	12	653
Autumn	108	84	176	139	137	66	5	1	61	52	133	962
Total	139	133	181	167	163	108	21	296	83	199	147	1637
Average	4.63	4.43	6.03	5.57	5.43	3.60	0.70	9.87	2.77	6.63	4.90	

[20] Table 15 to Table 19: Total from 30 nights of surveys.

[21] Table 15 to Table 19: Nightly average over 30 nights.

Table 18: *Myotis* spp. bat passes recorded by SP and season

	1	2	3	4	5	6	7	8	9	10	11	Total
Spring	10	0	6	0	2	7	47	7	1	6	1	87
Summer	12	55	3	3	0	10	20	16	7	41	4	171
Autumn	17	13	14	12	5	5	2	0	45	21	2	136
Total	39	68	23	15	7	22	69	23	53	68	7	394
Average	1.30	2.27	0.77	0.50	0.23	0.73	2.30	0.77	1.77	2.27	0.23	

Table 19: Brown long-eared bat passes recorded by SP and season

	1	2	3	4	5	6	7	8	9	10	11	Total
Spring	0	0	0	0	0	0	0	0	0	8	0	8
Summer	0	7	0	0	0	1	1	3	0	31	3	46
Autumn	2	5	2	2	3	2	4	0	2	67	5	94
Total	2	12	2	2	3	3	5	3	2	106	8	148
Average	0.07	0.40	0.07	0.07	0.10	0.10	0.17	0.10	0.07	3.53	0.27	

4.2.3.1 Seasonal and Annual rates

The data listed in **Table 15** to **Table 19**, inclusive, show that there was a significant variation in the number of bat passes of each species recorded at individual SPs; a variation that is pronounced when a comparison is made between seasons. The seasonal variation in the numbers of bat passes is illustrated in **Table 20**, below; the total number of bat passes recorded in spring is significantly lower than the number recorded in summer which is itself lower than the number recorded in autumn.

Table 20: Seasonal comparison by SP

SP No.	1	2	3	4	5	6	7	8	9	10	11	Total
Spring	14	6	8	5	3	10	62	12	1	66	6	193
Summer	122	199	47	124	188	128	145	910	140	1278	184	3465
Autumn	1137	345	1254	438	304	306	125	8	272	392	440	5021
Total	1273	550	1309	567	495	444	332	930	413	1736	630	8679

The circumstances with regard to common pipistrelle, the most frequently recorded species, are illustrative of these seasonal variations. Only 2 bat passes attributed to the species were recorded during the spring surveys but, by contrast, 1,196 bat passes were recorded during the summer surveys and 1,516 were recorded during the autumn surveys. As can be seen from **Table 21**, below, activity across the site during the spring surveys by all species was extremely low at all SPs. Therefore, while there are considerable differences between the levels of activity of common pipistrelle recorded in spring, when compared with summer (**Table 22**) and autumn (**Table 23**), the level is consistent with that recorded for all species during spring which was low in the extreme; 193 bat passes recorded over a 10 night period gives an average of only 19 per night across all 11 sampling points. In light of the fact that these figures represent the number of bat passes recorded over a 10 night period during spring 2019, the survey data evidence supports the conclusion that nightly usage of the site, even at its highest recorded level, was extremely low during the spring 2019. The highest number of bat passes during each of the survey seasons is highlighted in green in the tables below.

Table 21: Number of bat passes of each species recorded at each SP during spring surveys.

SP	*Myotis* spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
1	10	1	0	0	0	3	14
2	0	0	1	2	0	3	6
3	6	0	0	0	0	2	8
4	0	2	0	2	0	1	5
5	2	0	0	0	0	1	3
6	7	0	0	1	0	2	10
7	47	1	0	1	0	13	62
8	7	0	0	0	0	5	12
9	1	0	0	0	0	0	1
10	6	2	1	14	8	35	66
11	1	0	0	2	0	3	6
Total	87	6	2	22	8	68	193

Table 22: Number of bat passes of each species recorded at each SP during summer surveys.

SP	*Myotis* spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
1	12	64	6	31	0	9	122
2	55	49	10	47	7	31	199
3	3	22	14	5	0	3	47
4	3	62	20	26	0	13	124
5	0	27	93	26	0	42	188
6	10	36	26	41	1	14	128
7	20	35	18	15	1	56	145
8	16	35	498	295	3	63	910
9	7	21	62	22	0	28	140
10	41	416	415	133	31	242	1278
11	4	78	34	12	3	53	184
Total	171	845	1196	653	46	554	3465

Table 23: Number of bat passes of each species recorded at each SP during autumn surveys.

SP	*Myotis* spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
1	17	555	298	108	2	157	1137
2	13	73	115	84	5	55	345
3	14	469	455	176	2	138	1254
4	12	33	189	139	2	63	438
5	5	0	89	137	3	70	304
6	5	62	122	66	2	49	306
7	2	51	28	5	4	35	125
8	0	0	6	1	0	1	8
9	45	61	66	61	2	37	272
10	21	34	52	52	67	166	392
11	2	15	96	133	5	189	440
Total	136	1353	1516	962	94	960	5021

The highest number of bat passes of any species recorded over a 10 night period (555 Leisler's bat passes) occurred during the autumn survey at SP1. This value gives a mathematical average of 56[22] bat passes per night which is indicative of a very low level of activity even at this high of recorded bat passes. As can be seen from the tables above the number of Leisler's bats recorded was generally significantly less than the peak figure of 555 and the bulk of the values recorded are below 50 bat passes per night.

165 of the data points in the tables above have been attributed to individual species or members of genus *Myotis*. **Table 24**, below lists the number of data points that fall within different data classes. Of the 165 data points, only 17 are in excess of 100. In other words the numbers of any species recorded exceeded 100 on only 17 occasions (10%); 105 (63%) of the values are in the range 1 to 100 and no species were recorded on 46 occasions (27%). **Table 25**, from which the results from SP10 have been excluded, demonstrates that the inclusion of said results, notwithstanding that they

[22] 55.5 rounded up

reflect data taken outside the site, does not skew, or render inaccurate, the analyses of the activity presented in the remainder of this report.

Table 24: Number of values within data classes

Data Class	No of values	%
0	46	27
1-10	49	63
11-50	37	
51-100	19	
101-200	9	10
201-300	2	
301-400	0	
401-500	5	
>500	1	

Table 25: Number of values within data classes

Data Class	No of values	%
0	43	29
1-10	45	62
11-50	32	
51-100	16	
101-200	8	9
201-300	2	
301-400	0	
401-500	3	
>500	1	

4.2.3.2 Average Hourly Rates

The average hourly numbers of each species recorded at each SP during each season are listed in **Table 1** to **Table 11**, inclusive, in **Appendix 3**. In calculating the averages, nightly durations of 9, 6 and 10 hours were used, respectively, for spring summer and autumn[23].

As can be seen from the tables in **Appendix 3**, the average seasonal hourly rate for any species did not exceed 10 per hour on any occasion and exceeded 5 per hour on only 4 occasions. As can be seen in **Table 26**, below, 2 of these 4 occasions pertain to common pipistrelle and 2 to Leisler's bat. This number (4) is notable as it equates to only 2.4% of the 165 data points[24] in the tables in **Appendix 3**. Only 17 (10.3%)[25] of the rates fall within the range 1 to 5 and the vast majority (62.5%) of the average hourly rates for all species at all SPs do not exceed 1 bat pass per hour and, in fact, 24.8% of the data points have a zero value.

[23] Using sunset to sunrise as per https://www.timeanddate.com/sun/@2961574?month=9&year=2019

[24] 200 data points represent sonograms identified to species or, in the case of *Myotis* bats, genus level.

[25] % figures are rounded and therefore give a total of 101.

Table 26: Average hourly rates exceeding 5/hour with species and SP

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

4.3 TRANSECT SURVEYS

The distributions of activity recorded during transect surveys are shown in **Figure 4** to **Figure 6**, inclusive. While there is variation in the numbers of individuals encountered, the species mix duplicates that recorded during the static surveys. The level of activity recorded during the summer is significantly higher than on either of the other two seasons and outcome broadly consistent with the patterns of activity recorded during the passive surveys.

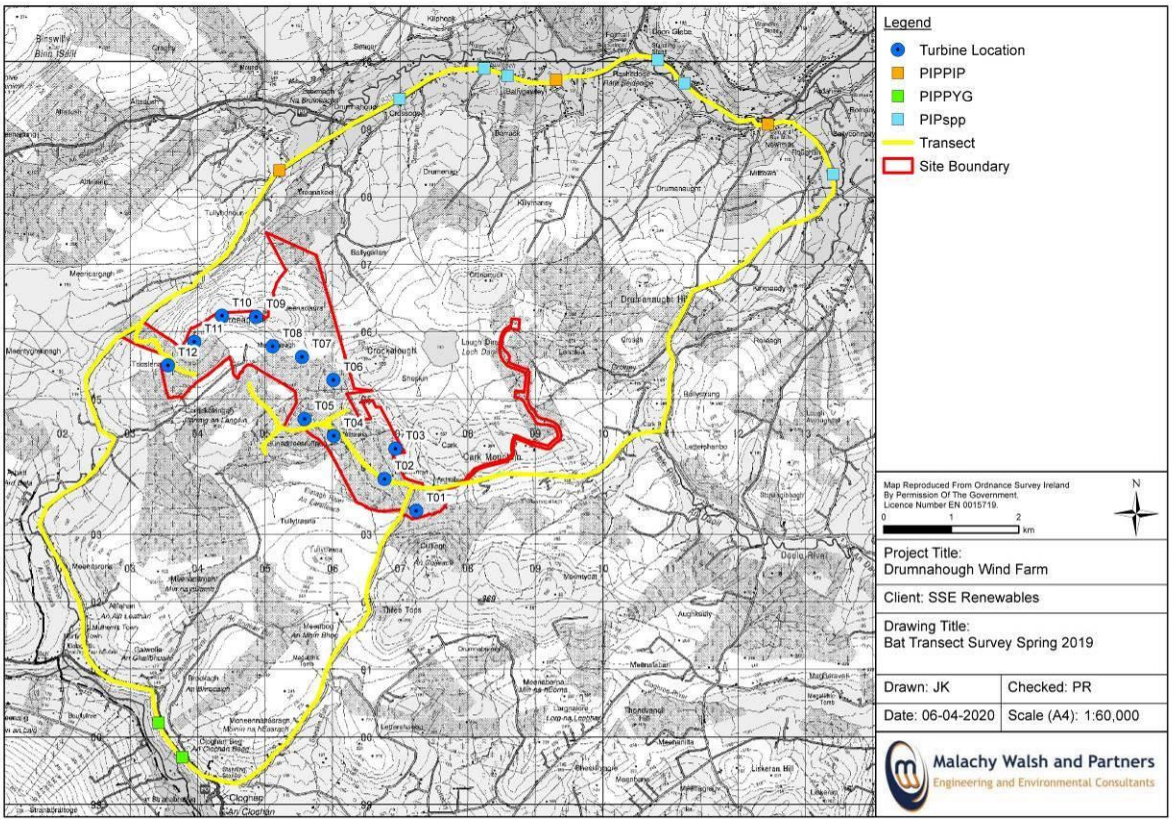

Figure 4: Spring Transect

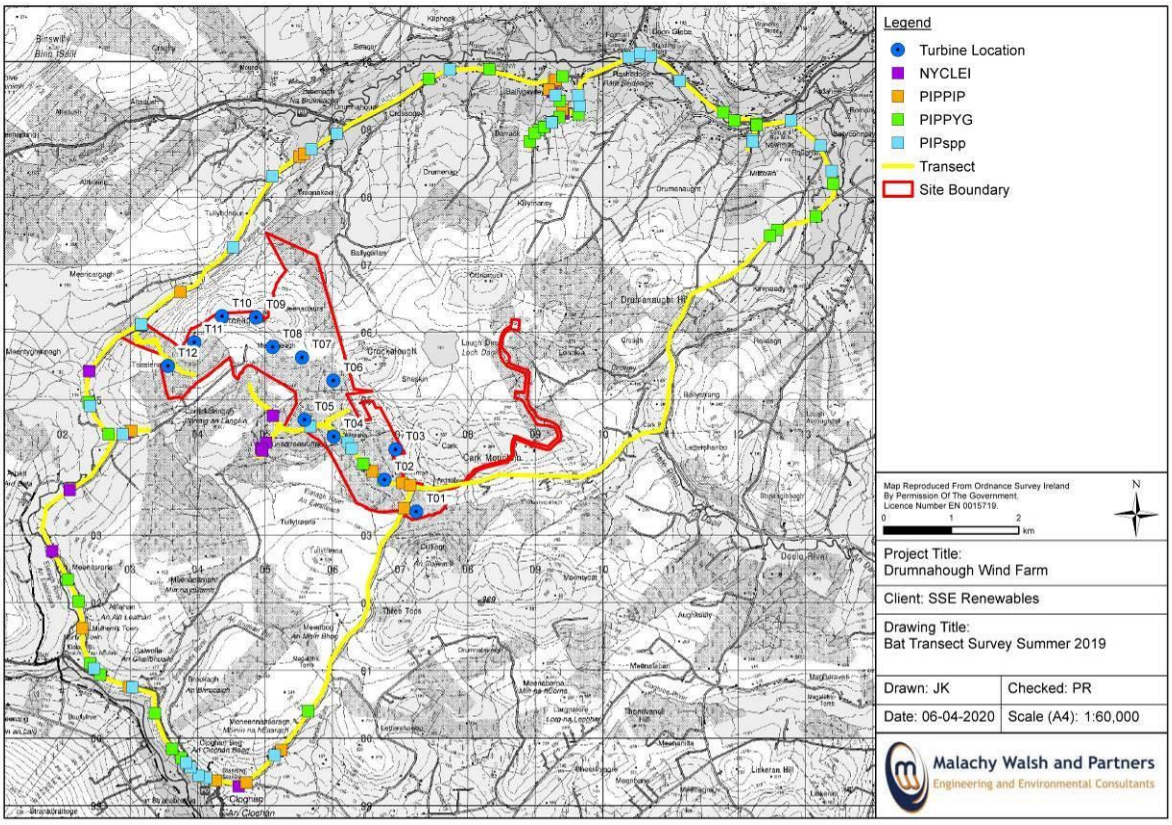

Figure 5: Summer Transect

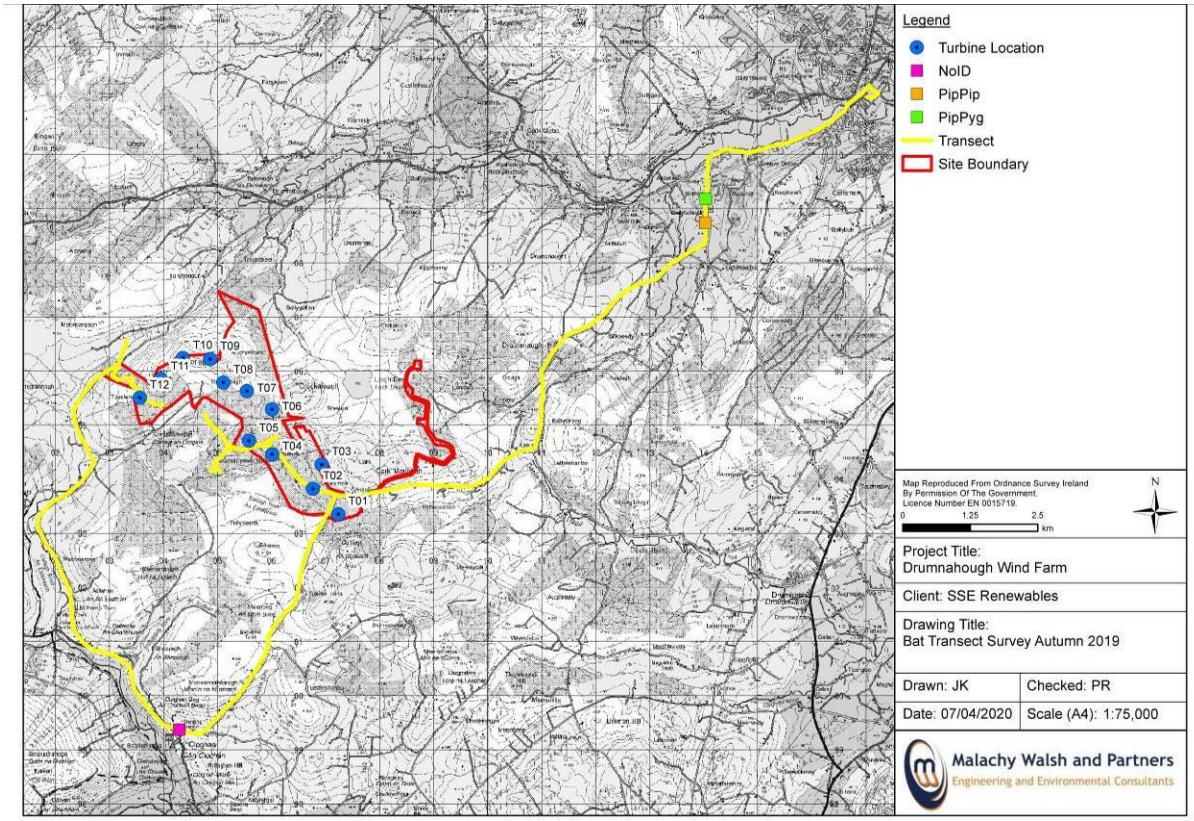

Figure 6: Autumn Transect

5 DISCUSSION

5.1 SUITABILITY OF THE SITE AS BAT HABITAT

As can be seen from the BHSI ratings listed in **Table 4**, above, with regard to the area within the proposed wind farm site[26], not only are the overall habitat suitability ratings for all bat species very low, the area has a zero value rating for two species namely, Nathusius' pipistrelle and lesser horseshoe bat. Of the 36 individual species ratings listed, only eleven (30%) are above 20; of these only three (8%) are above 30. Because bats preferentially select certain habitats and avoid others - each species has a strong association with different habitat types - and they are known to exhibit a high level of site loyalty and will frequently return to the same foraging sites night after night (Entwhistle *et al*., 2001) - there is a strong correlation between bat activity and the habitat mix of an area. There is also a correlation between bat activity and elevation, a relationship which is complex due to its multi-factorial nature (Erickson *et al*., 2003); differences in activity at different elevations could be the result of climatic conditions, insect availability or morphological differences between species. In addition cooler and windier nights such as in locations similar to the proposed wind farm site tend to suppress flight activity of bats (Anthony *et al*., 1981, O'Farrell, 1967, Stebbings, 1968 cited in Erickson *et al*., 2003) by imposing thermoregulatory stress and by reducing the activity of their insect prey. Because the cost of flight increases with decreasing body size, de Jong (1994 cited in Erickson *et al*., 2003) hypothesized that smaller bats with slower flight would be restricted from using high elevation habitats where insect abundance was low and long-distance foraging flights were required and where every increase of 100 m in elevation causes a decrease of 1^0C in air temperature.

As outlined in **Section 1.1,** above, there is little in the way of variation within the habitat structure of the site and, relative to its surroundings, the site is less ecologically and structurally diverse than is the case in the geographical area extending away from it into lower elevations. Much of the area comprises low-growing, open vegetation with low plant species richness that lacks the variety and complexity required for high macroinvertebrate productivity. As a result, the site will provide less insect prey biomass than in the areas at lower elevation that surround it which bats are more likely to preferentially select. The 'site' is upland in character and is dominated by an open and relatively featureless terrain that lacks the types of landscape features that would provide shelter for prey and habitat connectivity for bats both within the site and between the site and the surrounding landscape.

Therefore in light of the low BHSI ratings for the site, its elevation, which ranges from 235 m, to 300 m, and the conifer, bog and heath habitats that dominate (see **Section 1.1**, above), it is considered that the site is of relatively low value for bat species particularly by comparison with the characteristics of the surrounding area which is at lower elevation, a factor which influences air temperature, and which is characterised by a more ecologically and structurally diverse habitat mix than is the case within the development site. It is also evident from the 'All species' ratings for the wider geographical area, comprising the 25x2 km Grids, that are listed in **Table 7**, above, which are broadly similar to the ratings listed in **Table 4**, that the development site is not adjacent to any locations rated as being of high ecological value to bats. Therefore, while ongoing bat activity by certain species is reasonably foreseeable, the levels of activity are unlikely to be significant at any

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

point and it is concluded that the levels of activity recorded during 2019 are reflective of the normal patterns that pertain at the site.

5.2 BAT ACTIVITY LEVELS DURING 2019 SURVEYS

Because an individual bat can be the source of more than one, or even many, calls, the numbers of bat passes recorded by the bioacoustic units are not a direct measure of numbers of any bat species. In fact, the number of bat passes recorded is likely to be greater than the numbers of bats that generated them. However, the numbers recorded are a reliable proxy for the levels of bat activity at the site, particularly in light of the number of units deployed and the density of their distribution across the site as illustrated in **Figure 3.**

On the basis of the numbers of bat passes recorded it is concluded that no bat species were present to any significant extent during the spring, 2019 surveys. However, common pipistrelle, Leisler's bat and soprano pipistrelle did maintain a relatively consistent presence at the site, albeit at highly variable rates at individual SPs and at different SPs, during the summer and autumn surveys. The levels of activity recorded, described in **Section 4.2.2** and **Section 4.2.3**, above, strongly suggest that, while the site is within the extended foraging range of local populations of these species the levels of activity are relatively low. It is concluded, therefore, that the levels of activity recorded are indicative of an area at the upper, in terms of elevation, and least used limit of their foraging ranges and the development site is not, therefore, within the core foraging range of these species.

As was noted previously, the results of the surveys presented in **Sections 4.2.1** to **4.2.3,** inclusive, include those for SP10 which is outside the site's western boundary and which, as can be seen from **Table 14**, was the location with the highest level of activity across all species and was the location where the activity of brown-long-eared bat (106 bat passes) was far in excess of all other SPs, SP2 being the only other SP to exceed 10 passes. The fact that the sampling point with the highest level of activity is outside the development site proper indicates that the development site has a reduced value, relative even to its immediate surroundings. It also demonstrates the extent to which bats routinely return to high value foraging grounds and preferentially select locations that have previously rewarded energy cost inputs.

While species from the genus *Myotis* and brown long-eared bats were recorded in significantly lower numbers than the 3 primary species, they also maintained a relatively consistent presence during the summer and autumn surveys, albeit at significantly reduced levels than those recorded for the 3 primary species. On the basis of the numbers of bat passes recorded, it is concluded that brown long-eared bats and species from the genus *Myotis* use the site sporadically rather than consistently or regularly and in low numbers only. Therefore, while the site is within the extended foraging range of local populations of these species the level of use is indicative of occasional use and not consistent with those expected within the core foraging range. With regard to brown long-eared bats, and bats from the genus *Myotis* it is considered, in light of the fact that the numbers recorded over 30 nights of surveying equate to a nightly average of 5 brown long-eared bat passes and 13 passes generated by bats from genus *Myotis,* that the level of activity of these species is extremely low. This is particularly the case with brown long-eared bats which were recorded almost exclusively outside the site at SP10.It is concluded that use of the proposed wind farm site by these species is rare and the site is not within the core, or extended, foraging range of the local population of this

species. The individuals recorded are considered to be vagrants hunting or commuting outside their core foraging grounds.

When viewed in the context of the distribution of the SPs across the site, no clear pattern in the levels of activity that can be attributed to the locations of individual SPs, to habitat type or to elevation is evident. While it is the case that there is a marked difference between the levels of activity recorded at individual locations and the range of values is quite broad, the individual data points do not provide reliable evidence to support any conclusion as to why higher numbers were recorded at certain locations and not others.

With regard to average hourly rates, summarised in **Table 27**, below, only 2.4% of the 165 data points in the tables in **Appendix 3** exceed 5 bat passes per hour; only 10.3% fall within the range 1 to 5 and the vast majority (87.3%) of the average hourly rates for all species at all SPs do not exceed 1 bat pass per hour. Of those with rates of 1 per hour, or less, 26.7% have a zero value. It is concluded that the survey evidence indicates that the extent of site usage occurred at very low levels and rates.

Table 27: Average hourly rates

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

In summary, the survey data indicate that common pipistrelle, soprano pipistrelle, Leisler's bat, brown long-eared bat and species from the genus *Myotis* were present at the site during the 2019 surveys. However, there was a marked contrast between the levels of activity recorded for individual species and even the species most frequently recorded, namely common pipistrelle, Leisler's bat and soprano pipistrelle were recorded at very low average hourly rates. Notwithstanding the variation and the lack of smoothness in the data, it is clear, as illustrated by **Table 1** to **Table 14**, inclusive, in **Appendix 3**, that the average hourly rates, even for the most frequently recorded species, are very low. As outlined **Table 26,** above, the peak rate of bat passes recorded for any species was 8.30 per hour, which was recorded at SP8 during the summer surveys.

With regard to variations in the levels of activity at different SPs within the site (see **Table 14**); while the range in values is quite broad – from 332 passes at SP7 to 1309 passes at SP3 – the levels of activity recorded at individual SPs in 2019 are not predictive of risk to bats at specific locations post construction. This is due to a number of factors, particularly the fact that the construction of the proposed wind farm will result in significant alteration in the proportion of the site occupied by conifer woodland that will be caused by the clear fell required to accommodate turbines and hardstand areas. Clear fell will result in the creation of new habitats comprising potential commuting corridors and foraging grounds. The extent to which individual species migrate into these and the levels of activity that will occur in these newly created areas cannot be estimated or predicted in advance and the survey evidence could not support any assessment as to which turbines would have

a greater impact on bats than others. This aspect of the proposed development will be dealt with in Chapter 6 of the EIAR.

5.3 CONCLUSION

As can be seen from the ratings listed in **Table 4**, above, with regard to the area within the proposed wind farm site[27], not only are the overall habitat suitability ratings for all bat species very low, the area has a zero value rating for two species namely, Nathusius' pipistrelle and lesser horseshoe bat. Of the thirty six individual species ratings listed, only eleven (30%) are above 20; of these only three (8%) are above 30. While the BHSI ratings for the area within the 25x2 km grids that encompass the wider area extending away from the site are broadly similar, the fact that the wider area is at lower elevation, a factor which influences air temperature, and is characterised by a more ecologically and structurally diverse habitat mix than is the case within the development site, would provide more in the way of prey biomass, shelter and habitat complexity and would have environmental conditions more conducive to bats than is the case within the development site. In summary the site is situated in an ecological setting where all of the characteristics that are conducive to high and sustained levels of bat activity are abundantly available in the area extending away from the proposed wind farm site rather than within the site. As a result, the site is of less significance to foraging bats than the habitats of higher ecological value that surround it. While bats from certain species were recorded relatively consistently the levels of site usage were, even at the highest recorded levels, extremely low. The levels of usage, as reflected in the average hourly rates and the significant fluctuations in recorded bat passes across all the species are consistent with the BHSI ratings for the site and its surrounds and the numbers of bat passes were extremely low. While some figures are high in relative terms (relative to others within a SP data set) they are not high in absolute terms and even the relative increases are in low numbers. The fact that SP10, which is outside the site, is consistently high or highest in terms of level of activity, (see **Table 14** and paragraph 1 of **Section 4.2.3**) reinforces the conclusion that the site proper is suboptimal for bats a conclusion consistent with the fact that coniferous woodland is a feature of 'medium importance' to bats (see **Table 2**).

This conclusion, when viewed in conjunction with the assessment in **Section 3.2.3**, above, that the habitat and development related features of the proposed wind farm site render the site as intrinsically 'Low' risk to bat species suggest that the proposed development should not pose a significant risk to bat species.

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

6 REFERENCES

Collins, J. (ed.) (2016). *Bat Surveys for Professional Ecologists: Good Practice Guidelines*, (3rd edn). The Bat Conservation Trust, London.

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

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

Lundy, M.G., Aughney T., Montgomery W., and Roche N, (2011). *Landscape conservation for Irish bats & species specific roosting characteristics*. Published by Bat Conservation Ireland.

National Parks and Wildlife Service (NPWS) (2019). *The Status of EU Protected Habitats and Species in Ireland*. Species Assessments Volume 3, Version 1.0. Unpublished NPWS Report, Edited by: Deirdre Lynn and Fionnuala O'Neill.

National Roads Authority (NRA) (2006a) Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes. National Roads Authority.

National Roads Authority (NRA) (2006b) Guidelines for the Treatment of Bats during the Construction of National Road Schemes. National Roads Authority.

Pfalzer, G. and Kusch, J. (2003). Structure and variability of bat social calls: implications for specificity and individual recognition. *J. Zool., Lond*. (2003) **261**, 21–33.

Scottish Natural Heritage (SNH) (2019). *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation*. Prepared jointly by Scottish Natural Heritage, Natural England, Natural Resources Wales, RenewableUK, Scottish Power Renewables, Ecotricity Ltd, the University of Exeter and the Bat Conservation Trust (BCT).

Strobel, S., Roswag, A., Becker, N. Trenczek, T., & Encarnacão,J. (2013). Insectivorous bats digest chitin in the stomach using acidic mammalian chitinase. *PLoS One*. 8(**9**)

Winter, Y. and von Helversen, O. (1998). The energy cost of flight: do small bats fly more cheaply than birds? *Journal of Comparative Physiology B. Biochemical, Systems, and Environmental Physiology*. 168(**2**): 105-11.

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Appendix 1

Sampling Points Grid co-ordinates

Table 1: Details of SP locations

Sampling Point	GPS		Habitat Description
	X	Y	
1	603656	905521	Conifer edge/access track
2	604257	905674	Conifer edge
3	603985	905915	Upland blanket bog/Conifer edge
4	606827	903885	Fire break in conifer
5	606560	904395	Fire break in conifer
6	606026	904736	Access track/conifer
7	606052	905133	Conifer plantation, firebreak, flush-rising of stream
8	605677	904832	Conifer
9	605131	905799	Conifer edge/upland blanket bog
10	605025	904838	Recently planted 2nd rotation, stream, Blanket bog
11	607088	903737	Access track/conifer

Appendix 2

Seasonal and annual totals of bat passes per species by SP

Table 1: SP1 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	10	1	0	0	0	3	14
Summer	12	64	6	31	0	9	122
Autumn	17	555	298	108	2	157	1137
Total	39	620	304	139	2	169	1273

Table 2: SP2 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	0	0	1	2	0	3	6
Summer	55	49	10	47	7	31	199
Autumn	13	73	115	84	5	55	345
Total	68	122	126	133	12	89	550

Table 3: SP3 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	6	0	0	0	0	2	8
Summer	3	22	14	5	0	3	47
Autumn	14	469	455	176	2	138	1254
Total	23	491	469	181	2	143	1309

Table 4: SP4 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	0	2	0	2	0	1	5
Summer	3	62	20	26	0	13	124
Autumn	12	33	189	139	2	63	438
Total	15	97	209	167	2	77	567

Table 5: SP5 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	2	0	0	0	0	1	3
Summer	0	27	93	26	0	42	188
Autumn	5	0	89	137	3	70	304
Total	7	27	182	163	3	113	495

Table 6: SP6 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	7	0	0	1	0	2	10
Summer	10	36	26	41	1	14	128
Autumn	5	62	122	66	2	49	306
Total	22	98	148	108	3	65	444

Table 7: SP7 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	47	1	0	1	0	13	62
Summer	20	35	18	15	1	56	145
Autumn	2	51	28	5	4	35	125
Total	69	87	46	21	5	104	332

Table 8: SP8 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	7	0	0	0	0	5	12
Summer	16	35	498	295	3	63	910
Autumn	0	0	6	1	0	1	8
Total	23	35	504	296	3	69	930

Table 9: SP9 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	1	0	0	0	0	0	1
Summer	7	21	62	22	0	28	140
Autumn	45	61	66	61	2	37	272
Total	53	82	128	83	2	65	413

Table 10: SP10 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	6	2	1	14	8	35	66
Summer	41	416	415	133	31	242	1278
Autumn	21	34	52	52	67	166	392
Total	68	452	468	199	106	443	1736

Table 11: SP11 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	1	0	0	2	0	3	6
Summer	4	78	34	12	3	53	184
Autumn	2	15	96	133	5	189	440
Total	7	93	130	147	8	245	630

Appendix 3

Average hourly species' rates by season per SP

Table 1: SP1 Average hourly species' rates by season[1]

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat
Spring	0.11	0.01	0.00	0.00	0.00
Summer	0.20	1.07	0.10	0.52	0.00
Autumn	0.17	**5.55**	2.98	0.11	0.02

Table 2: SP2 Average hourly species' rates by season

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat
Spring	0.00	0.00	0.01	0.02	0.00
Summer	0.92	0.82	0.17	0.78	0.12
Autumn	0.13	0.73	1.15	0.84	0.05

Table 3: SP3 Average hourly species' rates by season

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat
Spring	0.07	0.00	0.00	0.00	0.00
Summer	0.05	0.37	0.23	0.08	0.00
Autumn	0.14	4.69	4.55	1.73	0.02

Table 4: SP4 Average hourly species' rates by season

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat
Spring	0.00	0.02	0.00	0.02	0.00
Summer	0.05	1.03	0.33	0.43	0.00
Autumn	0.12	0.33	1.89	1.39	0.02

Table 5: SP5 Average hourly species' rates by season

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat
Spring	0.02	0.00	0.00	0.00	0.00
Summer	0.00	0.45	1.55	0.43	0.00
Autumn	0.05	0.00.	0.89	1.37	0.03

Table 6: SP6 Average hourly species' rates by season

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat
Spring	0.07	0.00	0.00	0.01	0.00
Summer	0.17	0.60	0.43	0.68	0.02
Autumn	0.05	0.62	1.22	0.66	0.02

[1] In calculating the averages, nightly durations of 9, 6 and 10 hours were used, respectively, for spring summer and autumn. [Using sunset to sunrise as per https://www.timeanddate.com/sun/@2961574?month=9&year=2019]

Table 7: SP7 Average hourly species' rates by season

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat
Spring	0.04	0.01	0.00	0.01	0.00
Summer	0.33	0.58	0.30	0.25	0.02
Autumn	0.02	0.51	0.28	0.05	0.04

Table 8: SP8 Average hourly species' rates by season

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat
Spring	0.08	0.00	0.00	0.00	0.00
Summer	0.27	0.58	**8.30**	4.92	0.05
Autumn	0.00	0.00	0.06	0.01	0.00

Table 9: SP9 Average hourly species' rates by season

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat
Spring	0.01	0.00	0.00	0.00	0.00
Summer	0.12	0.35	1.03	0.37	0.00
Autumn	0.45	0.61	0.66	0.61	0.02

Table 10: SP10 Average hourly species' rates by season

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat
Spring	0.07	0.20	0.01	0.15	0.89
Summer	0.68	**6.93**	**6.91**	2.22	0.52
Autumn	0.21	0.34	0.52	0.52	0.67

Table 11: SP11 Average hourly species' rates by season

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat
Spring	0.01	0.00	0.00	0.02	0.00
Summer	0.07	1.30	0.57	0.20	0.05
Autumn	0.02	0.15	0.96	1.33	0.05

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Appendix 4

Total bat passes by species for all SP's and each season

Table 1: Common pipistrelle vocalisations recorded by SP and season

SP	1	2	3	4	5	6	7	8	9	10	11	Total
Spring	0	1	0	0	0	0	0	0	0	1	0	2
Summer	6	10	14	20	93	26	18	498	62	415	34	1196
Autumn	298	115	455	189	89	122	28	6	66	52	96	1516
Total[1]	304	126	469	209	182	148	46	504	128	468	130	2714
Average[2]	10.10	4.20	15.63	6.96	6.07	4.93	1.53	16.80	4.27	15.60	4.33	

Table 2: Leisler's bat vocalisations recorded by SP and season

	1	2	3	4	5	6	7	8	9	10	11	Total
Spring	1	0	0	2	0	0	1	0	0	2	0	6
Summer	64	49	22	62	27	36	35	35	21	416	78	845
Autumn	555	73	469	33	0	62	51	0	61	34	15	1353
Total	620	122	491	97	27	98	87	35	82	452	93	2204
Average	20.67	4.07	16.37	3.23	0.90	3.27	2.90	1.17	2.73	15.07	3.10	

Table 3: Soprano pipistrelle vocalisations recorded by SP and season

	1	2	3	4	5	6	7	8	9	10	11	Total
Spring	0	2	0	2	0	1	1	0	0	14	2	22
Summer	31	47	5	26	26	41	15	295	22	133	12	653
Autumn	108	84	176	139	137	66	5	1	61	52	133	962
Total	139	133	181	167	163	108	21	296	83	199	147	1637
Average	4.63	4.43	6.03	5.57	5.43	3.60	0.70	9.87	2.77	6.63	4.90	

[1] All tables in this appendix: Total from 30 nights of surveys.

[2] All tables in this appendix: Nightly average over 30 nights.

Table 4: *Myotis* spp. bat vocalisations recorded by SP and season

	1	2	3	4	5	6	7	8	9	10	11	Total
Spring	10	0	6	0	2	7	47	7	1	6	1	87
Summer	12	55	3	3	0	10	20	16	7	41	4	171
Autumn	17	13	14	12	5	5	2	0	45	21	2	136
Total	39	68	23	15	7	22	69	23	53	68	7	394
Average	1.30	2.27	0.77	0.50	0.23	0.73	2.30	0.77	1.77	2.27	0.23	

Table 5: Brown long-eared bat vocalisations recorded by SP and season

	1	2	3	4	5	6	7	8	9	10	11	Total
Spring	0	0	0	0	0	0	0	0	0	8	0	8
Summer	0	7	0	0	0	1	1	3	0	31	3	46
Autumn	2	5	2	2	3	2	4	0	2	67	5	94
Total	2	12	2	2	3	3	5	3	2	106	8	148
Average	0.07	0.40	0.07	0.07	0.10	0.10	0.17	0.10	0.07	3.53	0.27	

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Appendix 5

Unit deployment details by SP

Table 1: SPRING 2019 Deployment Details

Sampling Point	Dates Deployed	No sound files recorded	Unit Type
SP1	2/5 -12/5	2.8,9 10/5	SM4
SP2	2/5 -12/5	5,6,7/5	SM4
SP3	2/5 -12/5	6,8/5	SM4
SP4	2/5 -12/5	6.9,11/5	SM4
SP5	2/5 -12/5	2,3,5,6,7/5	SM4
SP6	2/5 -12/5	6,10/5	SM4
SP7	2/5 -12/5		SM4
SP8	3/5 -12/5	2,4,6,7,8,10/5	SM4
SP9	3/5 -12/5	2,4,6,7,9,11/5	SMZC
SP10	3/5 -12/5	2,4/5	SMZC
SP11	3/5 -12/5	2,3,4,5,6,7,9,10/5	SMZC

Table 2: SUMMER 2019 Deployment Details

Sampling Point	Dates Deployed	No sound files recorded	Unit Type
SP1	6/7-16/7		SM4
SP2	6/7-16/7	11/7	SM4
SP3	6/7-16/7	13/7	SM4
SP4	6/7-16/7	12/7	SM4
SP5	6/7-16/7	8,10/7	SMZC
SP6	6/7-16/7		SM4
SP7	6/7-16/7		SMZC
SP8	6/7-16/7		SM4
SP9	6/7-16/7	8,11/7	SMZC
SP10	6/7-16/7		SM4
SP11	6/7-16/7		SMZC

Table 3: Autumn 2019 Deployment Details

Sampling Point	Dates Deployed	No sound files recorded	Unit Type
SP1	17/9 – 27/9		SM4
SP2	17/9 – 27/9		SM4
SP3	17/9 – 27/9		SM4
SP4	17/9 – 27/9		SM4
SP5	17/9 – 27/9	26/9	SMZC
SP6	17/9 – 27/9	26/9	SM4
SP7	17/9 – 27/9	26/9	SM4
SP8	17/9 – 27/9		SM4
SP9	17/9 – 27/9		SM4
SP10	17/9 – 27/9		SM4
SP11	17/9 – 27/9		SMZC