

# Appendix 6-4 Bat Survey Report - 2019



## **Pre-Application Bat Survey Report 2019**

Carrownagowan Wind Farm



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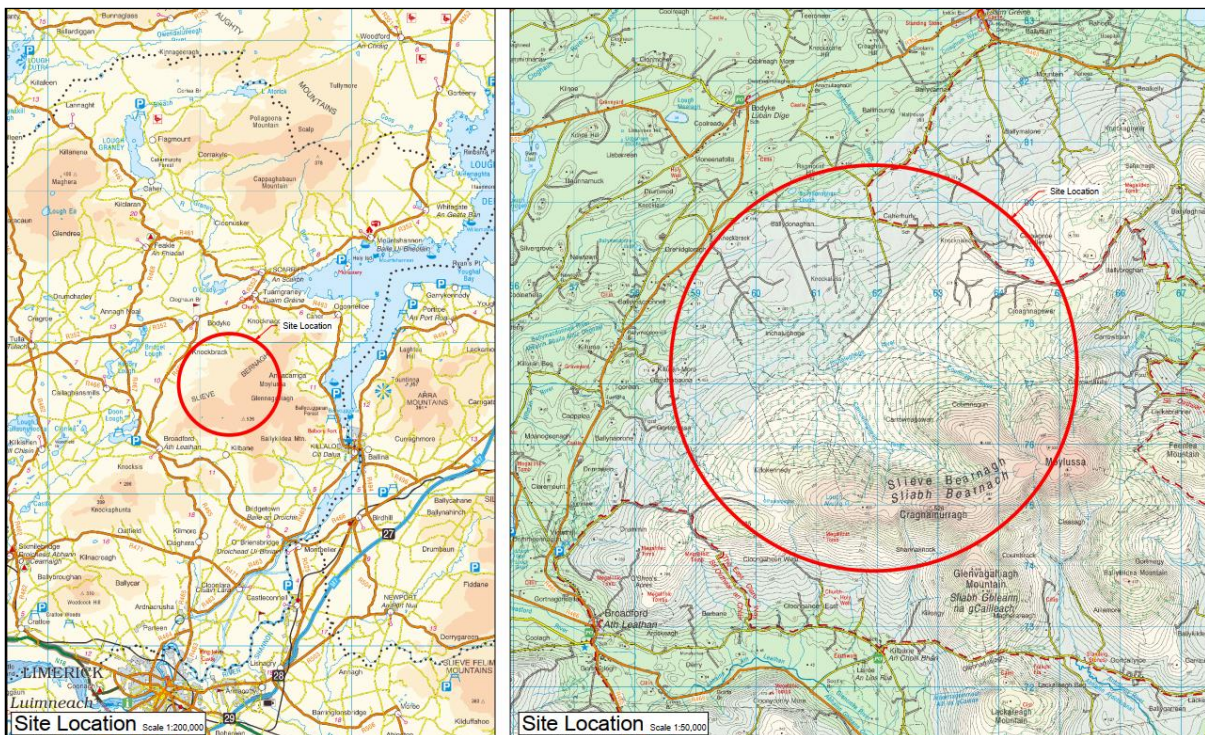
## 1 INTRODUCTION

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 7 km to the north west of Killaloe, County Clare (see **Figure 1**, below). The development site boundary (or red line planning boundary) includes a total land area of 749.69 ha and includes the townlands Ballydonaghan, Caherhurley, Coumnagun, Carrownagowan, Inchalughoge, Killokennedy and Kilbane.

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

### 1.1 SITE LOCATION

The proposed wind farm is located within forested lands on the northern slopes of Slieve Bernagh Mountain, approximately 4 km northeast of the village of Broadford, 7 km north-west of Killaloe and 2.5 km south of the village of Bodyke. Lough Derg lies approximately 4 km to the east of the proposed development area (see **Figure 1**, below).



**Figure 1: Proposed wind farm location**

#### 1.1.1 Brief Description of the Development Site

The development site is situated in an upland area (approx. 200-420m OD), on the north-western slopes of Slieve Bernagh Mountains. The proposed turbines, 19 in total, are situated at elevations ranging from approximately 150 m to 420 m (Above Ordnance Datum) and most area situated above 200m.

The proposed development site (the area within the red line planning boundary) principally consists of conifer plantation of varying age profiles including clear fell, pre and post-thicket phases and mature closed canopy. Remnant areas of cutover bog and wet heath also occur but these are quite discontinuous and fragmented due to the development and expansion of forestry. While some of the remnant areas of bog retain some of the original peat mass most are significantly degraded as a result of the impacts, particularly, on ground water flows, caused by the forestry operations. A number of wet grassland fields are also present. These appear to be reverting from a state where they were once improved forms of agricultural grassland subject to intensive management for at least some period of time.

While forest block edges which would typically be used by foraging bats are present the site generally lacks landscape features such as treelines 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.

## **1.1.2 Results of Previous Bat Activity Surveys**

### *1.1.2.1 Static Surveys*

Static surveys were completed at six different locations within the site in 2018. The bat detectors were deployed on the 18<sup>th</sup> of July 2018, and recorded for 7 consecutive nights. The survey was repeated between the nights of 29<sup>th</sup> of August 2018, and 7<sup>th</sup> of September 2018.

A detector was deployed at an elevation of approximately 95 m on the site met mast for a period of consecutive nights, to provide a sample of the bat activity at turbine height over the survey period.

### *1.1.2.2 Transect Surveys*

Transect surveys were carried out on the nights of the July 18<sup>th</sup>, August 29<sup>th</sup> and October 2<sup>nd</sup>, 2018.

### *1.1.2.3 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 proposed development site is, therefore, primarily used as foraging/commuting habitat, rather than for roosting. The 2018 surveys also established that roost potential within the greater surroundings outside the site, are excellent and numerous; roosting may occur in the dwelling houses, masonry bridges/structures, farm buildings or derelict buildings that occur in the greater area, outside the Carrownagowan site.

## **1.2 PURPOSE OF THE SURVEYS**

The 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 detailed appraisals 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 proposed development site during 2019 and the results of the survey, outlined in this report, will form the basis for the assessments of the potential impacts on bat species, that are identified in the Biodiversity chapter<sup>1</sup> of the, aforementioned, EIAR, that will be completed in said chapter.

### 1.3 SCOPE OF THE SURVEYS

Bat activity surveys conducted included:

#### 1.3.1 Static surveys

Static surveys were conducted during spring summer and autumn 2019 as follows:

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

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

#### 1.3.2 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*)

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<sup>1</sup> Chapter 6



- **Vespertilionidae:**
  - Daubenton's bat (*Myotis daubentoni*)
  - 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*)

The following species abbreviations for bat species are used in this report:

- PIPI: Common pipistrelle (*Pipistrellus pipistrellus*)
- PIPY: Soprano pipistrelle (*Pipistrellus pygmaeus*)
- NYLE: Leisler's bat (*Nyctalus leisleri*)
- MYsp: A bat of the genus *Myotis*
- PLAUR: Brown long-eared bat (*Plecotus auritus*)
- RHHI: Lesser horseshoe bat [LHB] (*Rhinolophus hipposideros*)

## 2.1 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. The distances covered while foraging varies considerably between species. They 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. They are also known to exhibit a level of site loyalty and will frequently return to the same foraging sites night after night (Entwhistle *et al.*, 2001).

All Irish bat species are protected under the Wildlife Acts (1976 to 2012) and by the Habitats Directive<sup>2</sup> 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

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<sup>2</sup> Council Directive 92/43/EEC

at a group level). The current Conservation Status assessments for bat species resident in Ireland are listed in **Table 1**, below; the trend in the Conservation Status for each species is included.

**Table 1: 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 pipistrelle	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 proposed development 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<sup>3</sup> 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 5km grid square resolution the reference area, to which the indices listed in **Table 2**, below, relate, comprise the proposed wind farm site<sup>4</sup> and the wider geographical landscape extending away from it.

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 2**, below, with regard to the area within the proposed wind farm site, not only are the overall habitat suitability ratings for all bat species very low, only 5 of the ratings are above 40 and 16 of the ratings are below 30. These ratings strongly suggest that while activity by certain species is reasonably foreseeable the levels of activity are unlikely to be significant. It is also evident that the ratings for the wider geographical area, denoted as 'Surrounds' in the table, are higher than for the area within the proposed wind farm site. This is consistent with that characteristics of the surrounding area which is at lower elevation, a factor which influences air temperature, and which is characterised by a more ecologically and structurally diverse than is the case within the development site.

**Table 2: Bat Habitat Suitability Index Rating by Species**

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

<sup>3</sup> <https://maps.biodiversityireland.ie/Map>

<sup>4</sup> Denoted in the table as 'West', 'North East', 'South East' and 'Surrounds'

### 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 3**, below, the proposed wind farm site is evaluated as 'Medium' risk.

**Table 3: Initial Site risk Assessment**

Habitat Risk		Project Size		
		Small	Medium	Large
		Site Risk Level		
Low		1 <sup>5</sup>	2	3
Moderate		2	3	4
High		3	4	5
Habitat Risk Level				
Habitat Risk	Description			
Low	<ul style="list-style-type: none"> <li>Small number of potential roost features, of low quality. <b>NO</b></li> <li>Low quality foraging habitat that could be used by small numbers of foraging bats. <b>YES</b></li> <li>Isolated site not connected to the wider landscape by prominent linear features. <b>NO</b></li> </ul>			
Moderate	<ul style="list-style-type: none"> <li>Buildings, trees or other structures with moderate-high potential as roost sites on or near the site. <b>NO</b></li> <li>Habitat could be used extensively by foraging bats. <b>YES</b></li> <li>Site is connected to the wider landscape by linear features such as scrub, tree lines and streams. <b>YES</b></li> </ul>			
High	<ul style="list-style-type: none"> <li>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. <b>NO</b></li> <li>Extensive and diverse habitat mosaic of high quality for foraging bats. <b>NO</b></li> <li>Site is connected to the wider landscape by a network of strong linear features such as rivers, blocks of woodland and mature hedgerows. <b>NO</b></li> <li>At/near edge of range and/or on an important flyway. <b>NO</b></li> <li>Close to key roost and/or swarming site. <b>NO</b></li> </ul>			
Project Size Risk Level				
Project Size	Description			
Small	<ul style="list-style-type: none"> <li>Small scale development (<math>\leq 10</math> turbines). <b>NO</b></li> <li>No other wind energy developments within 10km. <b>NO</b></li> <li>Comprising turbines <math>&lt; 50</math>m in height. <b>NO</b></li> </ul>			
Medium	<ul style="list-style-type: none"> <li>Larger developments (between 10 and 40 turbines). <b>YES</b></li> <li>May have some other wind developments within 5km. <b>NO</b></li> <li>Comprising turbines 50-100m in height. <b>NO</b></li> </ul>			
Large	<ul style="list-style-type: none"> <li>Largest developments (<math>&gt; 40</math> turbines) with other wind energy developments within 5km. <b>NO</b></li> <li>Comprising turbines <math>&gt; 100</math>m in height. <b>YES</b></li> </ul>			

<sup>5</sup> Key: (1-2) - low/lowest site risk; (3) - medium site risk; (4-5) - high/highest site risk

### 3.3 SITE INVESTIGATION

The desk top included a preliminary assessment of the availability of landscape features of importance to bats within the Development Area and connecting 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<sup>6</sup>.

During the ground truthing surveys an assessment of the potential value to foraging bats of the existing habitats and features was made. The habitat mix present within the Development Area's agricultural hinterland, the presence of linear landscape features and the types of land use was noted. Given the generally open nature of the 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

The surveys were carried out in compliance with SNH (2019) which stipulates that pre application surveys should take place over a full season of bat activity.

#### 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]

*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*

<sup>6</sup> 'Nature Conservation Advice In Relation To Bats' ( Available at <http://www.dft.gov.uk/ha/standards/ians/pdfs/ian116.pdf>



*at proposed turbine sites (if known), the remainder should be distributed based on the availability of different habitats and topographical features on the site.*

In compliance with SNH (2019) requirements Passive Automated Bat Surveys (PABS), designed to passively sample and record bat activity at pre-selected locations, were conducted during spring, summer and autumn, 2019. 11 units were deployed for the spring surveys and, when it became clear that the final number of turbines could be in excess of 20, 14 units were deployed during summer and autumn.

3 different types of Song Meter<sup>7</sup> bioacoustic recording units were deployed within the proposed development site for 10 nights during each season. 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. The SP locations are illustrated in **Dwg. No. 19107-SK56-B**; details on the SP locations, including grid co-ordinates, are presented in **Table 1, Appendix 1**. In general the distribution of the SP across the site is quite dense with separation distances of between 250m and 500 m. As a result it is likely that there will be little variation in the species mix recorded.

To the extent possible within the constraints of the SNH (2019) methodology, the locations of the bioacoustic units were chosen in the expectation that, should bats be present, detectable levels of activity were reasonably foreseeable at the selected locations, particularly in light of 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). This characteristic of the sampling locations also 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. Vocalisations 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 vocalisations 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.*”

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<sup>7</sup> SMZC, SM3Bat and SM4Bat manufactured by Wildlife Acoustics Ltd.

Notwithstanding the secondary role of this survey type it was decided, in order 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 proposed development and in the geographical area surrounding it site during spring, summer and autumn, 2019. The routes are illustrated in **Appendix 6**.



**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<sup>8</sup> - 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 proposed development 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 treelines 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.

As noted in **Section 3.1**, above, the sonograms generated by recordings of the calls of genus *Myotis* cannot reliably be identified to species level on the basis of sonogram analysis alone. Notwithstanding this difficulty in species identification, due to the fact that Daubenton's bat is most

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<sup>8</sup> Manufactured by Wildwood Ecology

strongly associated with water bodies, where it flies low and level a few centimetres above the surface of lakes, slow-moving rivers and canals, rather than the types of habitat available at the survey area, it is reasonable to infer, in light of the habitat mix present in the survey area that it is less likely to have been recorded than the other two species from the genus and the species is not expected to be reliant on the resources within the survey area.

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 be readily 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'.

#### 3.4.3.1 Static surveys

Post survey, the sound files were converted, using a proprietary software<sup>9</sup>, 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 vocalisation was identified the recording was labelled using tools available in the software. The species identification was 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<sup>10</sup>, to produce sonograms (graphs of the sound recorded). Each sound file was reviewed and any recordings of bat vocalisations were labelled by MWP ecologists who have extensive experience of sonogram analysis.

## 4 RESULTS

### 4.1 DATA REQUEST

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

<sup>9</sup> Kaleidoscope Pro Software (Manufactured by Wildlife Acoustics Ltd.)

<sup>10</sup> AnaLookW (Designed by Titley Scientific)

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

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

With regard to the records for Brandt's bat, the BCI website indicates that this species is not a confirmed resident and has only been found in one location in Ireland to-date (Co. Wicklow, 2003). It is likely that this specimen was a vagrant<sup>11</sup>.

All of these species that can be identified by sonogram analysis were recorded during the surveys detailed below as were members of genus *Myotis* (see **Section 3.1**, above).

## 4.2 STATIC SURVEY

### 4.2.1 Species recorded

On the basis of sonogram analysis the 2019 surveys determined that the following species were present at the SP locations within the proposed development site:

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

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

As can be seen from **Table 4** and **Table 3**, below, 3 species, namely common pipistrelle, Leisler's bat and soprano pipistrelle were the most commonly and frequently recorded. While there is a significant variation in the number of vocalisations by each of these species recorded at different SP's it is reasonable to infer from the survey data, summarised in **Table 4** and **Table 3**, below, that, notwithstanding said variations, these 3 species were present at all SPs throughout their active seasons. The fact that Leisler's bats were not recorded at one SP during spring and not recorded at another during autumn does not materially affect this finding.

While Brown long-eared bat and lesser horseshoe bats and bats from the genus *Myotis*<sup>12</sup> were also present these species were recorded in very low numbers, particularly lesser horseshoe bat which

<sup>11</sup> <https://www.batconservationireland.org/irish-bats/species/brandts-bat>

<sup>12</sup> See Section 3.1 for notes on identifying bats of genus *Myotis* to species level on the basis of sonograms

was recorded on only 10 occasions throughout 2019 and at 3 SPs only. Detailed counts of the vocalisations recorded for each species at each SP and for each season are provided in Table 1 to **Table 14**, inclusive, in **Appendix 2**. The numbers of vocalisations recorded of each species at all SPs are listed in **Table 8** to **Table 13** inclusive, below. These tables are also included in **Appendix 4**.

**Table 4: Seasonal presence absence by species and SP**

SP	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Lesser horseshoe bat	Brown long-eared bat
1	Spring, summer	3 seasons	3 seasons	3 seasons	Summer	Not recorded
2	3 seasons	3 seasons	3 seasons	3 seasons	Not recorded	Not recorded
3	Summer, autumn	3 seasons	3 seasons	3 seasons	Not recorded	3 seasons
4	3 seasons	3 seasons	3 seasons	3 seasons	Not recorded	3 seasons
5	3 seasons	3 seasons	3 seasons	3 seasons	Not recorded	3 seasons
6	Summer, autumn	3 seasons	3 seasons	3 seasons	Not recorded	3 seasons
7	3 seasons	3 seasons	3 seasons	3 seasons	Not recorded	3 seasons
8	3 seasons	3 seasons	3 seasons	3 seasons	Not recorded	Summer, autumn
9	3 seasons	3 seasons	3 seasons	3 seasons	Spring	Summer, autumn
10	Summer, autumn	Summer, autumn	3 seasons	3 seasons	Not recorded	Summer, autumn
11	3 seasons	3 seasons	3 seasons	3 seasons	Not recorded	3 seasons
<b>SPs surveyed during summer &amp; autumn only</b>						
12	2 seasons	2 seasons	2 seasons	2 seasons	Not recorded	2 seasons
13	2 seasons	Summer	2 seasons	2 seasons	2 seasons	Autumn
14	2 seasons	2 seasons	2 seasons	2 seasons	Not recorded	2 seasons

**Table 5: Species' cumulative totals by SP**

SP	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Lesser horseshoe bat	Brown long-eared bat	NoID
1	15	262	530	34	1	0	74
2	31	292	181	83	0	0	71
3	43	363	1843	116	0	55	67
4	16	497	1056	101	0	20	51
5	24	741	752	117	0	23	83
6	16	778	363	146	0	20	84
7	18	208	1165	519	0	66	105
8	11	422	246	50	0	20	27
9	12	238	1861	120	4	12	53
10	18	12	521	21	0	11	107
11	23	117	1568	157	0	16	137
<b>SPs surveyed during summer &amp; autumn only</b>							
12	5	77	451	68	0	18	48
13	21	39	1435	196	5	3	58
14	6	78	1130	109	0	14	31
<b>TOTAL</b>	<b>259</b>	<b>4,124</b>	<b>13,102</b>	<b>1,837</b>	<b>10</b>	<b>278</b>	<b>996</b>



#### 4.2.2 Levels of Activity Recorded at Individual SPs

The seasonal and annual totals of all bat vocalisations recorded at each SP are listed in **Table 6**, below and the SPs are ranked by total number of vocalisations recorded in **Table 7**, below.

**Table 6: Seasonal & annual totals all SPs**

SP1	SP2	SP3	SP4	SP5	SP6	SP7	SP8	SP9	SP10	SP11	SP12	SP13	SP14
112	156	375	498	706	793	142	286	133	59	580			
643	92	1526	178	417	163	1011	239	1075	374	860	176	528	436
161	410	586	1065	617	451	928	251	1092	257	578	491	1229	932
916	658	2487	1741	1740	1407	2081	776	2300	690	2018	667	1757	1368

**Table 7: SP ranked by level of activity spring to autumn surveys**

SP	Total
2	658
12	667
10	690
8	776
1	916
14	1368
6	1407
5	1740
4	1741
13	1757
11	2018
7	2081
9	2300
3	2487

#### 4.2.3 Species Rates of Activity at Individual SPs

The numbers of vocalisations recorded of each species at all SPs are listed in **Table 8** to **Table 13** inclusive, below.

**Table 8: Common pipistrelle vocalisations recorded by SP and season**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Spring	21	10	36	43	23	43	26	9	1	28	471			
Summer	412	19	1468	102	276	59	597	133	884	321	725	95	392	409
Autumn	97	152	339	911	453	261	542	104	976	172	372	356	1043	721
<b>Total<sup>13</sup></b>	530	181	1843	1056	752	363	1165	246	1861	521	1568	451	1435	1130
<b>Average<sup>14</sup></b>	17.7	6.0	61.4	35.2	25.0	12.1	38.8	8.2	62.0	17.4	52.3	22.6	71.8	56.5

**Table 9: Leisler's bat vocalisations recorded by SP and season**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Spring	77	127	304	440	652	374	86	263	111	0	8			
Summer	173	50	8	40	62	63	74	78	117	5	45	43	39	18
Autumn	12	115	51	17	27	41	48	81	10	7	64	34	0	60

<sup>13</sup> SP1 to SP11: Total from 30 nights of surveys. SP12 to SP14: Total from 20 nights of surveys.

<sup>14</sup> SP1 to SP11: Nightly average over 30 nights. SP12 to SP14: Nightly average over 20 nights.

<b>Total</b>	262	292	363	497	741	778	208	422	238	12	117	77	39	78
<b>Average</b>	8.7	9.7	12.1	15.6	24.7	25.9	6.9	14.0	7.9	0.4	3.9	3.9	2.0	3.9

**Table 10: Soprano pipistrelle vocalisations recorded by SP and season**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Spring	1	4	4	2	8	14	19	3	1	1	17			
Summer	5	5	27	19	22	23	252	8	35	13	38	11	45	2
Autumn	28	74	85	80	87	109	248	39	84	7	102	57	151	107
<b>Total</b>	<b>34</b>	<b>83</b>	<b>116</b>	<b>101</b>	<b>117</b>	<b>146</b>	<b>519</b>	<b>50</b>	<b>120</b>	<b>21</b>	<b>157</b>	<b>68</b>	<b>196</b>	<b>109</b>
<b>Average</b>	<b>1.1</b>	<b>2.8</b>	<b>3.9</b>	<b>3.4</b>	<b>3.9</b>	<b>4.9</b>	<b>17.3</b>	<b>1.7</b>	<b>4.0</b>	<b>0.7</b>	<b>5.2</b>	<b>3.4</b>	<b>9.8</b>	<b>5.5</b>

**Table 11: Myotis spp. bat vocalisations recorded by SP and season**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Spring	2	1	0	4	2	0	2	1	1	0	5			
Summer	13	8	2	6	12	6	9	7	10	7	11	14	1	0
Autumn	0	22	41	6	10	10	7	3	1	11	7	7	5	0
<b>Total</b>	<b>15</b>	<b>31</b>	<b>43</b>	<b>16</b>	<b>24</b>	<b>16</b>	<b>18</b>	<b>11</b>	<b>12</b>	<b>18</b>	<b>23</b>	<b>21</b>	<b>6</b>	<b>0</b>
<b>Average</b>	<b>0.5</b>	<b>1.0</b>	<b>1.4</b>	<b>0.5</b>	<b>0.8</b>	<b>0.5</b>	<b>0.6</b>	<b>0.4</b>	<b>0.4</b>	<b>0.6</b>	<b>0.8</b>	<b>1.0</b>	<b>0.3</b>	<b>0</b>

**Table 12: Brown long-eared bat vocalisations recorded by SP and season**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Spring	0	0	8	2	5	4	6	0	0	0	1			
Summer	0	0	3	5	1	1	20	3	6	1	4	4	0	2
Autumn	0	0	44	13	17	15	40	17	6	10	11	14	3	12
<b>Total</b>	<b>0</b>	<b>0</b>	<b>55</b>	<b>20</b>	<b>23</b>	<b>20</b>	<b>66</b>	<b>20</b>	<b>12</b>	<b>11</b>	<b>16</b>	<b>18</b>	<b>3</b>	<b>14</b>
<b>Average</b>	<b>0</b>	<b>0</b>	<b>1.8</b>	<b>0.7</b>	<b>0.8</b>	<b>0.7</b>	<b>2.2</b>	<b>0.7</b>	<b>0.4</b>	<b>0.4</b>	<b>0.5</b>	<b>0.6</b>	<b>0.1</b>	<b>0.5</b>

**Table 13: Lesser horseshoe bat vocalisations recorded by SP and season**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Spring	0	0	0	0	0	0	0	0	4	0	0			
Summer	1	0	0	0	0	0	0	0	0	0	0	0	2	0
Autumn	0	0	0	0	0	0	0	0	0	0	0	0	3	0
<b>Total</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>0</b>
<b>Average</b>	<b>0.03</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.3</b>	<b>0</b>

#### 4.2.3.1 Seasonal and Annual rates

As noted previously, common pipistrelle was the most frequently recorded species and was recorded at all SPs and during each season. However, a detailed review of **Table 1** to **Table 14**, inclusive, in **Appendix 2**, clearly demonstrates that there was a significant seasonal variation in the number of vocalisations recorded at individual SPs and between SPs. These ranged from a low of 1 over the 10 nights of the spring survey at SP9, to a peak of 1,468 at SP3 during the 10 nights of the summer surveys.

In light of the fact that these figures represent the number of vocalisations recorded over a 10 night period, the survey data evidence supports the conclusion that nightly usage of the site, even at its highest recorded level, was low. The peak number of vocalisations (1,468) was recorded over a 10

night period giving a mathematical peak of 147 vocalisations on a single night. Leisler's bat, the next most frequently recorded species, was by comparison, recorded at approximately one third (1/3) the rate that of common pipistrelle and was not recorded at SP11 during the spring surveys or at SP14 during autumn. It is concluded, therefore, that, notwithstanding that the survey data demonstrates that this species regularly uses the proposed development site; the level of use is also low. Soprano pipistrelle while the least frequently recorded of the 3 was, as was the case with common pipistrelle, recorded at all SPs and during each season. However, in light of the number of vocalisations recorded, it is concluded that this species' use of the site is very low. Further detail on this aspect of the recorded levels of activity is provided in **Section 4.2.3.2**, below, where details on the average seasonal hourly rates are provided.

While species from the genus *Myotis* and brown long-eared bat were recorded in significantly lower numbers these species, also, maintained a relatively consistent presence on the site albeit at a significantly reduced level than those recorded for the 3 primary species. As noted in the preceding section, lesser horseshoe bats was recorded on only 10 occasions throughout 2019 and at 3 SPs only. During spring, vocalisations were recorded on 4 occasions at SP9; in summer the recordings comprised 1 vocalisation at SP1 and 2 at SP14; and, in autumn, 3 vocalisations were recorded at SP14 (see **Table 2** and **Table 3** above and tables in **Appendix 2**).

The seasonal variation in the numbers of vocalisations is best illustrated by using the SPs for which 3 seasons of survey data are available (SP1 to SP11). As can be seen from **Table 14**, below, the numbers of vocalisations recorded in spring is approximately half those recorded in summer and autumn which are almost identical.

**Table 14: Seasonal comparison for SP surveyed spring, summer and autumn (SP1 to SP11)**

SP1	SP2	SP3	SP4	SP5	SP6	SP7	SP8	SP9	SP10	SP11	Total
112	156	375	498	706	793	142	286	133	59	580	3840
643	92	1526	178	417	163	1011	239	1075	374	860	6578
161	410	586	1065	617	451	928	251	1092	257	578	6396
916	658	2487	1741	1740	1407	2081	776	2300	690	2018	16814

#### 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 14**, inclusive, in **Appendix 3**. In calculating the averages, nightly durations of 9, 6 and 10 hours were used, respectively, for spring summer and autumn<sup>15</sup>.

As can be seen from the tables in **Appendix 3** and in **Table 15**, below, the average seasonal hourly rate for any species exceeded 5 per hour on only 16 occasions. This number (16) is notable as it equates to only 8% of the 200 data points<sup>16</sup> in the tables in **Appendix 3**. 14 of the 16 pertain to common pipistrelle and 2 to Leisler's bat. On only 4 of the 16 occasions in question did the rate exceed 10 per hour of which only one was in excess of 24 per hour. Only 15%<sup>17</sup> fall within the range

<sup>15</sup> Using sunset to sunrise as per <https://www.timeanddate.com/sun/@2961574?month=9&year=2019>

<sup>16</sup> 200 data points represent sonograms identified to species or, in the case of *Myotis* bats, genus level.

<sup>17</sup> % figures are rounded and therefore give a total of 101.

1 to 5 and the vast majority (78%) of the average hourly rates for all species at all SPs do not exceed 1 vocalisation per hour.

**Table 15: Average hourly rates exceeding 5/hour with species and SP**

Species	Season	SP	Hourly rate
Common pipistrelle	Summer	1	6.87
	Summer	3	24.47
	Autumn		9.11
	Summer	7	9.95
	Autumn		5.42
	Summer	9	14.73
	Autumn		9.76
	Summer	11	5.35
	Spring	12	5.23
	Autumn		12.08
	Summer	14	6.53
	Autumn		10.43
	Summer	15	6.81
	Autumn		7.21
Leisler's bat	Spring	5	7.24
	Spring	6	7.49

#### 4.3 TRANSECT SURVEYS

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.

## 5 DISCUSSION

Because an individual bat can be the source of more than one, or even many, vocalisations, the numbers of vocalisations recorded by the bioacoustic units are not a direct measure of numbers of any bat species. In fact, the number of vocalisations 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 proposed Carrownagowan Wind Farm site, particularly in light of the number of units deployed and the density of their distribution across the site. As was noted previously and, as illustrated in **Dwg. No. 19107-SK56-B**, the distribution of the SPs across the site is quite dense with separation distances averaging between 250 m and 500 m.

On the basis of the numbers of vocalisations recorded (see **Table 1** to **Table 14** in **Appendix 2**), it is concluded that common pipistrelle, Leisler's bat and soprano pipistrelle maintained a consistent presence at the site albeit at highly variable rates at individual SPs and at different SPs and this variation occurred both within seasons and between seasons. The levels of activity recorded strongly suggest that the proposed development site is within the foraging range of local populations of these species albeit with low levels of activity indicative of an area at the upper, in terms of elevation, and least used limit. For further detail on the influence of topography and habitat mix on bat activity levels see **Section 4.2.3.2** above, and paragraph 6 of this section, below.

While species from the genus *Myotis* and brown long-eared bats were recorded in significantly lower numbers than the 3 primary species, they also maintained a relatively consistent presence on the site, albeit at significantly reduced levels than those recorded for the 3 primary species. On the basis of the numbers of vocalisations recorded, it is concluded that brown long-eared bats and species from the genus *Myotis* use the site somewhat sporadically. Therefore, while the site is within the extended foraging range of local populations of these species the level of use is indicative of occasional use and not consistent with those expected within the core foraging range. 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 equates to a nightly average of 9 bats, that the level of activity of these species is very low.

With regard to lesser horseshoe bats, as was noted in **Section 4.2.3.1**, above, this species was recorded on only 10 occasions throughout 2019 and at 3 SPs only. On the basis of the numbers of vocalisations recorded and in light of the number of SPs where it was recorded it is concluded that this species' use of the site is rare and the site is not within the core, or extended, foraging range of the local population of this species. The individuals recorded are considered to be vagrants hunting or commuting through the site outside their core foraging grounds.

As can be seen from **Dwg. No. 19107-SK56-B**; the SPs were relatively densely clustered within the proposed development site with most SPs within 250 m to 500 m of the nearest adjacent SP. 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. 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 nor is there any way to reliably infer that these rates are consistent with historical trends nor to predict that the patterns in activity recorded during the 2019 survey period will be replicated in future years.

In conclusion, the survey data indicate that common pipistrelle, soprano pipistrelle, Leisler's bat, brown long-eared bat, species from the genus *Myotis* and lesser horseshoe bat 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 in **Section 4.2.3.2**, above, the peak rate of vocalisations recorded for any species was 24.47 per hour, which was recorded at SP3 during the summer surveys. Only 8% of the 200 data points in the tables in **Appendix 3** exceed 5 vocalisations per hour; only 15% fall within the range 1 to 5 and the vast majority (78%) of the average hourly rates for all species at all SPs do not exceed 1 vocalisation per hour. The survey evidence indicates



that the extent of site usage while consistent throughout the survey periods occurred at very low levels and rates.

The level of usage as reflected in the average hourly rates and the significant fluctuations in recorded vocalisations across all the species are consistent with the BHSI ratings for the site and its surrounds, as outlined in **Section 3.2.2.1**, above, which indicate that the area's overall BHSI ratings for all bat species is very low with only 5 of the ratings above 40 and 16 of the ratings below 30. The ratings for the wider geographical area, denoted as 'Surrounds' in **Table 2, Section 3.2.2.1**, above, are higher than for the area within the proposed wind farm site. This is consistent 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 area 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. 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.

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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	561889	679148	Conifer plantation
2	560507	676972	Pre thicket-young conifer
3	559296	675701	Cutover bog (re-vegetated well). Conifer edge Lodge pole pine/Sitka
4	560798	675913	Pre thicket conifer, young conifer, Sitka saplings
5	563094	677208	Conifer plantation, sitka. Poor growth, and juvenile, scrub
6	563729	677018	Conifer plantation (Sitka), Access track
7	562875	678090	Recently clear felled, large scale area.
8	562284	677806	Blanket bog, conifer edge
9	561848	677442	Pre thicket conifer, conifer plantation to south, and west, stream and Blanket bog off to north.
10	561311	677299	Junction towards centre of site, Clear fell, river, nice riparian corridor
11	561758	676502	Mature Conifer plantation
<b>Surveyed in summer and autumn only</b>			
12	559904	676015	Pre thicket conifer. Large stand of juvenile conifer
13	562192	678685	Conifer edge, and wet grassland, reverting from agricultural grassland. Hedgerows
14	561064	676577	Conifer edge, Sitka, scrub edge



## Appendix 2

### Seasonal and annual totals of vocalisations per species by SP





**Table 1: SP1 Seasonal and annual totals**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Lesser horseshoe bat	No ID	Total
Spring	2	77	21	1	0	11	112
Summer	13	173	412	5	1	39	643
Autumn	0	12	97	28	0	24	161
<b>Total</b>	<b>15</b>	<b>262</b>	<b>530</b>	<b>34</b>	<b>1</b>	<b>74</b>	<b>916</b>

**Table 2: SP2 Seasonal and annual totals**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	NoID	Total
Spring	1	127	10	4	14	156
Summer	8	50	19	5	10	92
Autumn	22	115	152	74	47	410
<b>Total</b>	<b>31</b>	<b>292</b>	<b>181</b>	<b>83</b>	<b>71</b>	<b>658</b>

**Table 3: SP3 Seasonal and annual totals**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	No ID	Total
Spring	0	304	36	4	8	23	375
Summer	2	8	1468	27	3	18	1526
Autumn	41	51	339	85	44	26	586
<b>Total</b>	<b>43</b>	<b>363</b>	<b>1843</b>	<b>116</b>	<b>55</b>	<b>67</b>	<b>2487</b>

**Table 4: SP4 Seasonal and annual totals**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	No ID	Total
Spring	4	440	43	2	2	7	498
Summer	6	40	102	19	5	6	178
Autumn	6	17	911	80	13	38	1065
<b>Total</b>	<b>16</b>	<b>497</b>	<b>1056</b>	<b>101</b>	<b>20</b>	<b>51</b>	<b>1741</b>

**Table 5: SP5 Seasonal and annual totals**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	No ID	Total
Spring	2	652	23	8	5	16	706
Summer	12	62	276	22	1	44	417
Autumn	10	27	453	87	17	23	617
<b>Total</b>	<b>24</b>	<b>741</b>	<b>752</b>	<b>117</b>	<b>23</b>	<b>83</b>	<b>1740</b>

Table 6: SP6 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	No ID	Total
Spring	0	674	43	14	4	58	793
Summer	6	63	59	23	1	11	163
Autumn	10	41	261	109	15	15	451
<b>Total</b>	<b>16</b>	<b>778</b>	<b>363</b>	<b>146</b>	<b>20</b>	<b>84</b>	<b>1407</b>

Table 7: SP7 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	No ID	Total
Spring	2	86	26	19	6	3	142
Summer	9	74	597	252	20	59	1011
Autumn	7	48	542	248	40	43	928
<b>Total</b>	<b>18</b>	<b>208</b>	<b>1165</b>	<b>519</b>	<b>66</b>	<b>105</b>	<b>2081</b>

Table 8: SP8 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	1	263	9	3	0	10	286
Summer	7	78	133	8	3	10	239
Autumn	3	81	104	39	17	7	251
<b>Total</b>	<b>11</b>	<b>422</b>	<b>246</b>	<b>50</b>	<b>20</b>	<b>27</b>	<b>776</b>

Table 9: SP9 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Lesser horseshoe bat	Brown long-eared bat	NoID	Total
Spring	1	111	1	1	4	0	15	133
Summer	10	117	884	35	0	6	23	1075
Autumn	1	10	976	84	0	6	15	1092
<b>Total</b>	<b>12</b>	<b>238</b>	<b>1861</b>	<b>120</b>	<b>4</b>	<b>12</b>	<b>53</b>	<b>2300</b>

Table 10: SP10 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	No ID	Total
Spring			28	1		30	59
Summer	7	5	321	13	1	27	374
Autumn	11	7	172	7	10	50	257
<b>Total</b>	<b>18</b>	<b>12</b>	<b>521</b>	<b>21</b>	<b>11</b>	<b>107</b>	<b>690</b>

Table 11: SP11 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	No ID	Total
Spring	5	8	471	17	1	78	580
Summer	11	45	725	38	4	37	860
Autumn	7	64	372	102	11	22	578
<b>Total</b>	<b>23</b>	<b>117</b>	<b>1568</b>	<b>157</b>	<b>16</b>	<b>137</b>	<b>2018</b>

Table 12: SP12 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	No ID	Total
Summer	3	43	95	11	4	20	176
Autumn	2	34	356	57	14	28	491
<b>Total</b>	<b>5</b>	<b>77</b>	<b>451</b>	<b>68</b>	<b>18</b>	<b>48</b>	<b>667</b>

Table 13: SP13 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	Lesser horseshoe bat	No ID	Total
Summer	14	39	392	45		2	36	528
Autumn	7	0	1043	151	3	3	22	1229
<b>Total</b>	<b>21</b>	<b>39</b>	<b>1435</b>	<b>196</b>	<b>3</b>	<b>5</b>	<b>58</b>	<b>1757</b>

Table 14: SP14 Seasonal and annual totals

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	No ID	Total
Summer	1	18	409	2	2	4	436
Autumn	5	60	721	107	12	27	932
<b>Total</b>	<b>6</b>	<b>78</b>	<b>1130</b>	<b>109</b>	<b>14</b>	<b>31</b>	<b>1368</b>



## Appendix 3

### Average hourly species' rates by season per SP





**Table 1: SP1 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Lesser horseshoe bat	NoID	Total
Spring	0.02	0.86	0.23	0.01	0	0.12	1.22
Summer	0.22	2.88	6.87	0.083	0.017	0.65	10.72
Autumn	0	0.12	0.97	0.28	0	0.24	1.61

**Table 2: SP2 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Lesser horseshoe bat	NoID	Total
Spring	0.01	1.41	0.11	0.04	0	0.16	1.73
Summer	0.13	0.83	0.32	0.08	0.17	1.53	0.13
Autumn	0.22	1.15	1.52	0.74	0.47	4.1	0.22

**Table 3: SP3 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	0	3.38	0.40	0.04	0.09	0.26	6.51
Summer	0.03	0.13	24.47	0.45	0.05	0.30	25.43
Autumn	0.41	0.51	3.39	0.85	0.44	0.26	5.86

**Table 4: SP4 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	0.04	4.89	0.48	0.02	0.02	0.08	11.83
Summer	0.10	0.67	1.70	0.32	0.08	0.10	2.96
Autumn	0.06	0.17	9.11	0.8	0.13	0.38	10.65

**Table 5: SP5 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	0.02	7.24	0.26	0.09	0.06	0.18	6.86
Summer	0.20	1.03	4.60	0.37	0.02	0.73	6.95
Autumn	0.10	0.27	4.53	0.87	0.17	0.23	6.17

**Table 6: SP6 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	0	7.49	0.48	0.16	0.04	0.64	5.01
Summer	0.10	1.05	0.98	0.38	0.02	0.18	2.72
Autumn	0.10	0.41	2.61	1.09	0.15	0.15	4.51

**Table 7: SP7 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	0.02	0.96	0.29	0.21	0.07	0.03	10.31
Summer	0.15	1.23	9.95	4.2	0.33	0.98	16.85
Autumn	0.07	0.48	5.42	2.48	0.40	0.43	9.28

**Table 8: SP8 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	0.01	2.92	0.10	0.03	0	0.11	2.79
Summer	0.12	1.30	2.22	0.13	0.05	0.17	3.98
Autumn	0.03	0.81	1.04	0.39	0.17	0.07	2.51

**Table 9: SP9 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Lesser horseshoe bat	Brown long-eared bat	No ID	Total
Spring	0.01	1.23	0.01	0.01	0.04	0	0.17	12.13
Summer	0.17	1.95	14.73	0.58	0	0.10	0.38	17.91
Autumn	0.01	0.10	9.76	0.84	0	0.06	0.15	10.92

**Table 10: SP10 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	0	0	0.31	0.01	0	0.33	2.86
Summer	0.12	0.83	5.35	0.22	0.02	0.45	6.23
Autumn	0.11	0.07	1.72	0.07	0.10	0.50	2.57

**Table 11: SP11 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Spring	0.06	0.09	5.23	0.19	0.01	0.87	6.42
Summer	0.18	0.75	12.08	0.63	0.07	0.62	14.33
Autumn	0.07	0.64	3.72	1.02	0.11	0.22	5.78

**Table 12: SP12 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Summer	0.05	0.72	1.58	0.18	0.07	0.33	2.93
Autumn	0.02	0.37	3.56	0.57	0.14	0.28	4.91

**Table 13: SP13 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	Lesser horseshoe bat	No ID	Total
Summer	0.23	0.65	6.53	0.75	0	0.03	0.60	8.80
Autumn	0.07	0	10.43	1.51	0.03	0.03	0.22	12.29

**Table 14: SP14 Average hourly species' rates by season**

	Myotis spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Brown long-eared bat	NoID	Total
Summer	0.17	0.30	6.81	0.03	0.03	0.67	7.27
Autumn	0.05	0.60	7.21	1.07	0.12	0.27	9.32



## Appendix 4

Total vocalisations by species for all SP's and each season



Table 1: Common pipistrelle vocalisations recorded by SP and season

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Spring	21	10	36	43	23	43	26	9	1	28	471			
Summer	412	19	1468	102	276	59	597	133	884	321	725	95	392	409
Autumn	97	152	339	911	453	261	542	104	976	172	372	356	1043	721
<b>Total</b>	<b>530</b>	<b>181</b>	<b>1843</b>	<b>1056</b>	<b>752</b>	<b>363</b>	<b>1165</b>	<b>246</b>	<b>1861</b>	<b>521</b>	<b>1568</b>	<b>451</b>	<b>1435</b>	<b>1130</b>
<b>Average</b>	<b>17.7</b>	<b>6.0</b>	<b>61.4</b>	<b>35.2</b>	<b>25.0</b>	<b>12.1</b>	<b>38.8</b>	<b>8.2</b>	<b>62.0</b>	<b>17.4</b>	<b>52.3</b>	<b>22.6</b>	<b>71.8</b>	<b>56.5</b>

Table 2: Soprano pipistrelle vocalisations recorded by SP and season

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Spring	1	4	4	2	8	14	19	3	1	1	17			
Summer	5	5	27	19	22	23	252	8	35	13	38	11	45	2
Autumn	28	74	85	80	87	109	248	39	84	7	102	57	151	107
<b>Total</b>	<b>34</b>	<b>83</b>	<b>116</b>	<b>101</b>	<b>117</b>	<b>146</b>	<b>519</b>	<b>50</b>	<b>120</b>	<b>21</b>	<b>157</b>	<b>68</b>	<b>196</b>	<b>109</b>
<b>Average</b>	<b>1.1</b>	<b>2.8</b>	<b>3.9</b>	<b>3.4</b>	<b>3.9</b>	<b>4.9</b>	<b>17.3</b>	<b>1.7</b>	<b>4.0</b>	<b>0.7</b>	<b>5.2</b>	<b>3.4</b>	<b>9.8</b>	<b>5.5</b>

Table 3: Leisler's bat vocalisations recorded by SP and season

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Spring	77	127	304	440	652	374	86	263	111	0	8			
Summer	173	50	8	40	62	63	74	78	117	5	45	43	39	18
Autumn	12	115	51	17	27	41	48	81	10	7	64	34	0	60
<b>Total</b>	<b>262</b>	<b>292</b>	<b>363</b>	<b>497</b>	<b>741</b>	<b>778</b>	<b>208</b>	<b>422</b>	<b>238</b>	<b>12</b>	<b>117</b>	<b>77</b>	<b>39</b>	<b>78</b>
<b>Average</b>	<b>8.7</b>	<b>9.7</b>	<b>12.1</b>	<b>15.6</b>	<b>24.7</b>	<b>25.9</b>	<b>6.9</b>	<b>14.0</b>	<b>7.9</b>	<b>0.4</b>	<b>3.9</b>	<b>3.9</b>	<b>2.0</b>	<b>3.9</b>

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

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Spring	2	1	0	4	2	0	2	1	1	0	5			
Summer	13	8	2	6	12	6	9	7	10	7	11	14	1	0
Autumn	0	22	41	6	10	10	7	3	1	11	7	7	5	0
<b>Total</b>	<b>15</b>	<b>31</b>	<b>43</b>	<b>16</b>	<b>24</b>	<b>16</b>	<b>18</b>	<b>11</b>	<b>12</b>	<b>18</b>	<b>23</b>	<b>21</b>	<b>6</b>	<b>0</b>
<b>Average</b>	<b>0.5</b>	<b>1.0</b>	<b>1.4</b>	<b>0.5</b>	<b>0.8</b>	<b>0.5</b>	<b>0.6</b>	<b>0.4</b>	<b>0.4</b>	<b>0.6</b>	<b>0.8</b>	<b>1.0</b>	<b>0.3</b>	<b>0</b>

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

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Spring	0	0	8	2	5	4	6	0	0	0	1			
Summer	0	0	3	5	1	1	20	3	6	1	4	4	0	2
Autumn	0	0	44	13	17	15	40	17	6	10	11	14	3	12
<b>Total<sup>1</sup></b>	<b>0</b>	<b>0</b>	<b>55</b>	<b>20</b>	<b>23</b>	<b>20</b>	<b>66</b>	<b>20</b>	<b>12</b>	<b>11</b>	<b>16</b>	<b>18</b>	<b>3</b>	<b>14</b>
<b>Average<sup>2</sup></b>	<b>0</b>	<b>0</b>	<b>1.8</b>	<b>0.7</b>	<b>0.8</b>	<b>0.7</b>	<b>2.2</b>	<b>0.7</b>	<b>0.4</b>	<b>0.4</b>	<b>0.5</b>	<b>0.9</b>	<b>0.2</b>	<b>0.7</b>

<sup>1</sup> SP1 to SP11: Total from 30 nights of surveys. SP12 to SP14: Total from 20 nights of surveys.<sup>2</sup> SP1 to SP11: Nightly average over 30 nights. SP12 to SP14: Nightly average over 20 nights



**Table 6: Lesser horseshoe bat vocalisations recorded by SP and season**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Spring	0	0	0	0	0	0	0	0	4	0	0			
Summer	1	0	0	0	0	0	0	0	0	0	0	0	2	0
Autumn	0	0	0	0	0	0	0	0	0	0	0	0	3	0
<b>Total<sup>3</sup></b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>0</b>
<b>Average<sup>4</sup></b>	<b>0.03</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.3</b>	<b>0</b>

<sup>3</sup> SP1 to SP11: Total from 30 nights of surveys. SP12 to SP14: Total from 20 nights of surveys.

<sup>4</sup> SP1 to SP11: Nightly average over 30 nights. SP12 to SP14: Nightly average over 20 nights

## Appendix 5

### Unit deployment details by SP



**Table 1: SPRING 2019 Deployment Details**

Sampling Point	Dates Deployed	No sound files recorded	Unit Type
SP1	21/4 -30/4	26/4	SMZC
SP2	21/4 -30/4	21/4 & 26/4	SMZC
SP3	21/4 -30/4		SMZC
SP4	21/4 -30/4		SM4
SP5	21/4 -30/4		SM4
SP6	21/4 -30/4		SM3
SP7	21/4 -30/4	26/4	SMZC
SP8	21/4 -30/4		SM4
SP9	21/4 -30/4	21/4 & 26/4	SMZC
SP10	5/6 – 17/6 <sup>1</sup>		SMZC
SP11	5/6 – 17/6		SMZC

**Table 2: SUMMER 2019 Deployment Details**

Sampling Point	Dates Deployed	No sound files recorded	Unit Type
SP1	25/6 – 4/7		SMZC
SP2	25/6 – 4/7	26/6	SMZC
SP3	25/6 – 4/7	2/7 to 4/7	SM4
SP4	25/6 – 4/7		SM4
SP5	25/6 – 4/7		SM4
SP6	25/6 – 4/7		SM4
SP7	5/7 – 17/7 <sup>1</sup>		SM4
SP8	25/6 – 4/7		SM4
SP9	25/6 – 4/7	4/7	SM4
SP10	25/6 – 4/7		SMZC
SP11	25/6 – 4/7		SM4
SP12	25/6 – 4/7		SM4
SP13	5/7 – 16/7 <sup>1</sup>		SMZC
SP14	25/6 – 4/7	26/6 & 29/6.	SMZC

<sup>1</sup> Only 10 nights of data were included for analysis

**Table 3: Autumn 2019 Deployment Details**

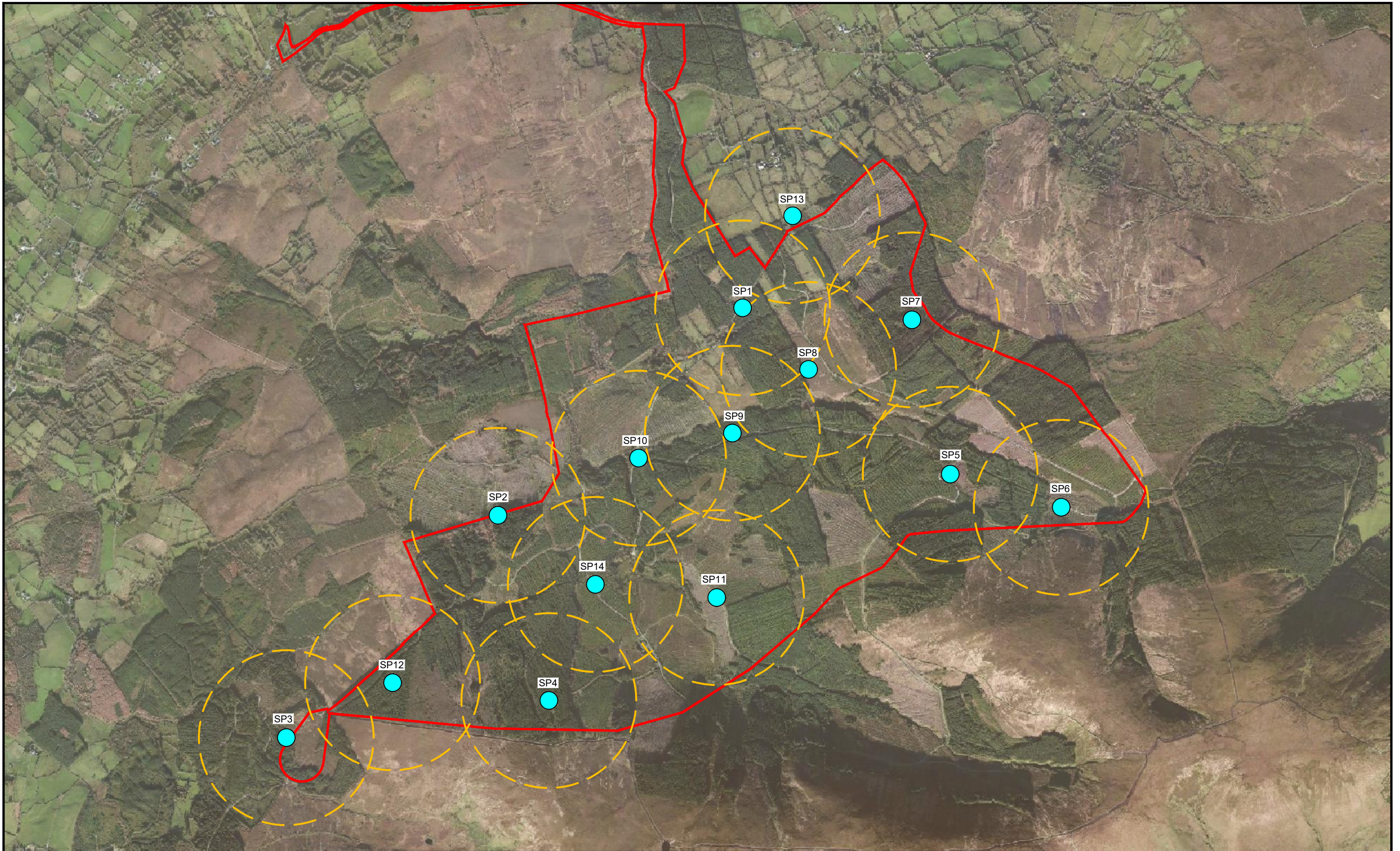
Sampling Point	Dates Deployed	No sound files recorded	Unit Type
SP1	5/9 – 15/9		SMZC
SP2	5/9 – 15/9		SM4
SP3	5/9 – 15/9		SM4
SP4	5/9 – 15/9	12/9 to 15/9	SM4
SP5	5/9 – 15/9		SM4
SP6	5/9 – 15/9		SM4
SP7	16/9 – 25/9		SM4
SP8	5/9 – 15/9		SM4
SP9	5/9 – 15/9	7/9 to 15/9	SM4
SP10	5/9 – 15/9		SMZC
SP11	5/9 – 15/9		SMZC
SP12	5/9 – 15/9		SMZC
SP13	16/9 – 25/9	17/9 to 25/9	SM4
SP14	5/9 – 15/9		SM4




## Appendix 6

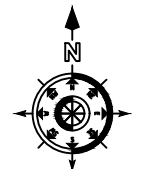
### Drawings







 SP1 Bat Survey Point Location  
 Site Boundary  
 500m Buffer




Rev.	Date	Description	by	ch'd	app
B	16.12.19	Issued For Information	JK	MK	MK
A	04.12.19	Issued For Information	JK	MK	MK

Client



Project  
Carrownagowan Wind Farm

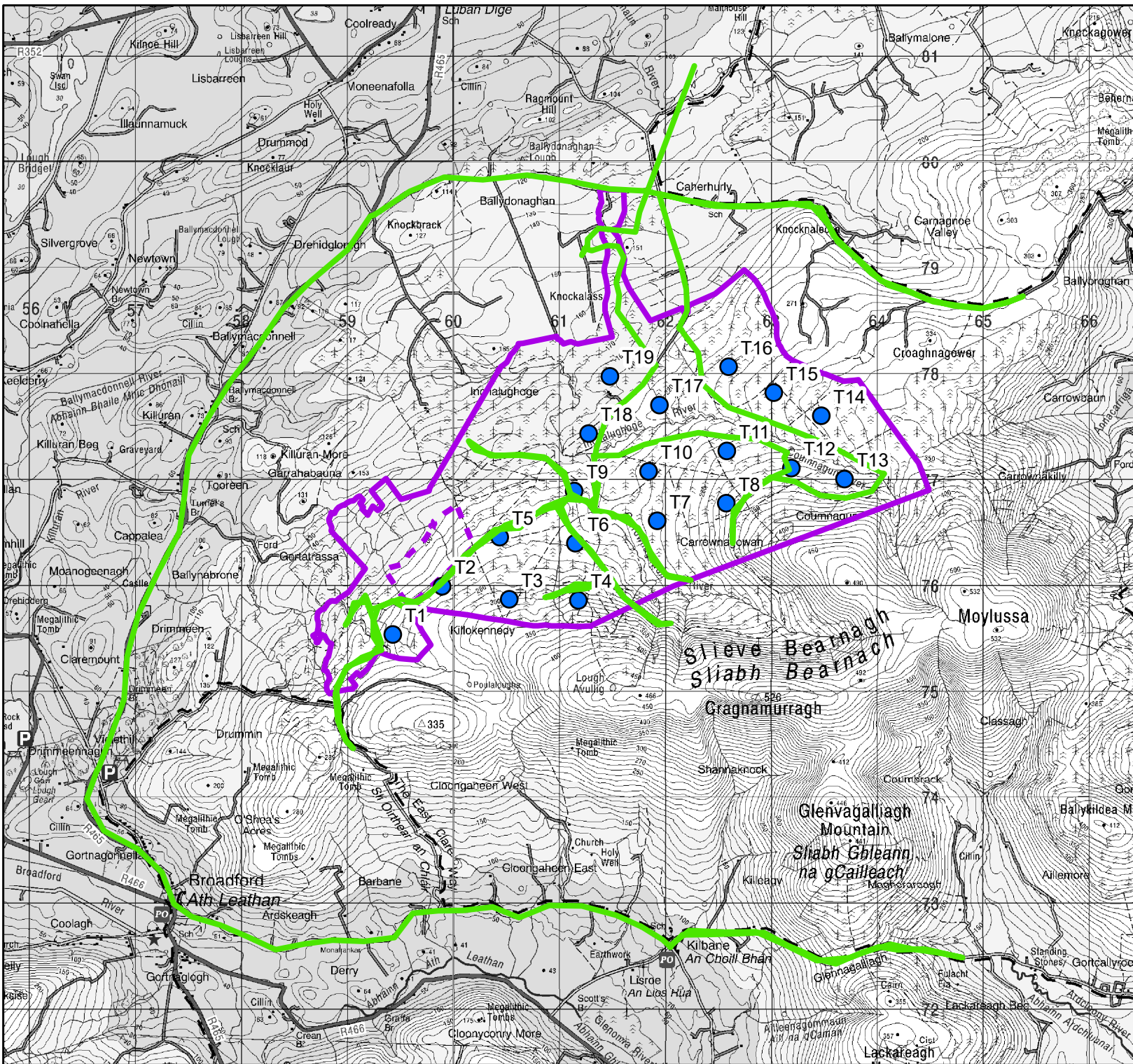
Title  
Bat Survey Locations and 500m Buffer



**Malachy Walsh and Partners**  
Consulting Engineers  
Cork | Tralee | London | Limerick

Scales (A3)	1:20,000	Drg. No.	19107-SK56	Rev.	B
Drawn	JK	04.12.2019			
Checked	MK	04.12.2019			

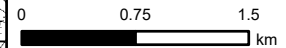




**Legend**

- Bat Transect
- Turbine Location (19WTG)
- Study Area
- Lands Not Involved

Map Reproduced From Ordnance Survey Ireland  
By Permission Of The Government.  
Licence Number EN 0015719.



**Project Title:**  
Carrowmagowan Wind Farm

**Client:** Coillte

**Drawing Title:**  
Bat Transects - Autumn

**Drawn:** JK

**Checked:** PR

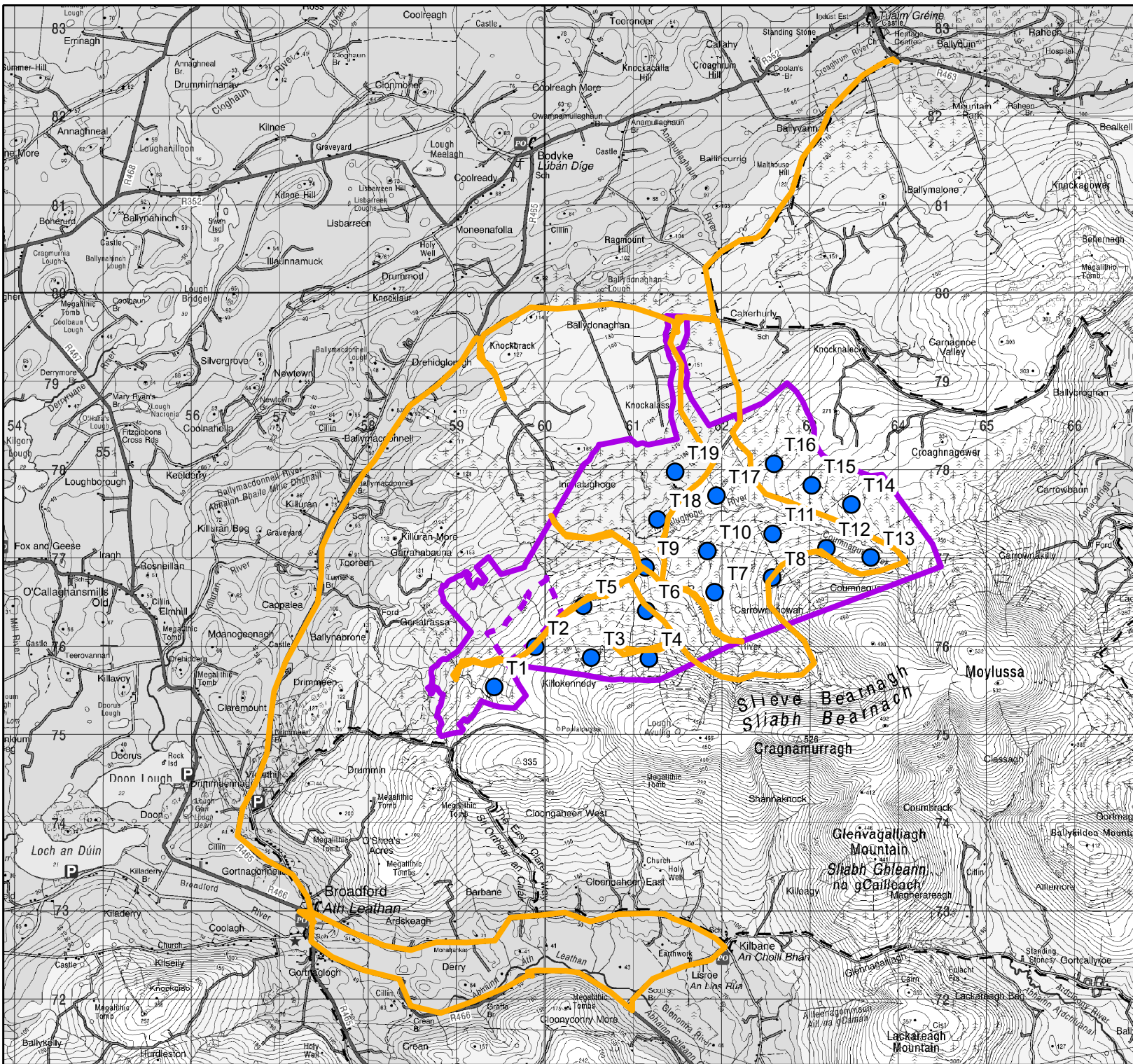
**Date:** 16-12-2019

**Scale (A4):** 1:50,000



**Malachy Walsh and Partners**  
Engineering and Environmental Consultants





- Legend**
- Bat Transect
  - Turbine Location (19WTG)
  - Study Area
  - Lands Not Involved

Map Reproduced From Ordnance Survey Ireland  
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 Licence Number EN 0015719.

0 1 2 km

**Project Title:**  
 Carrowmagowan Wind Farm

**Client:** Coillte

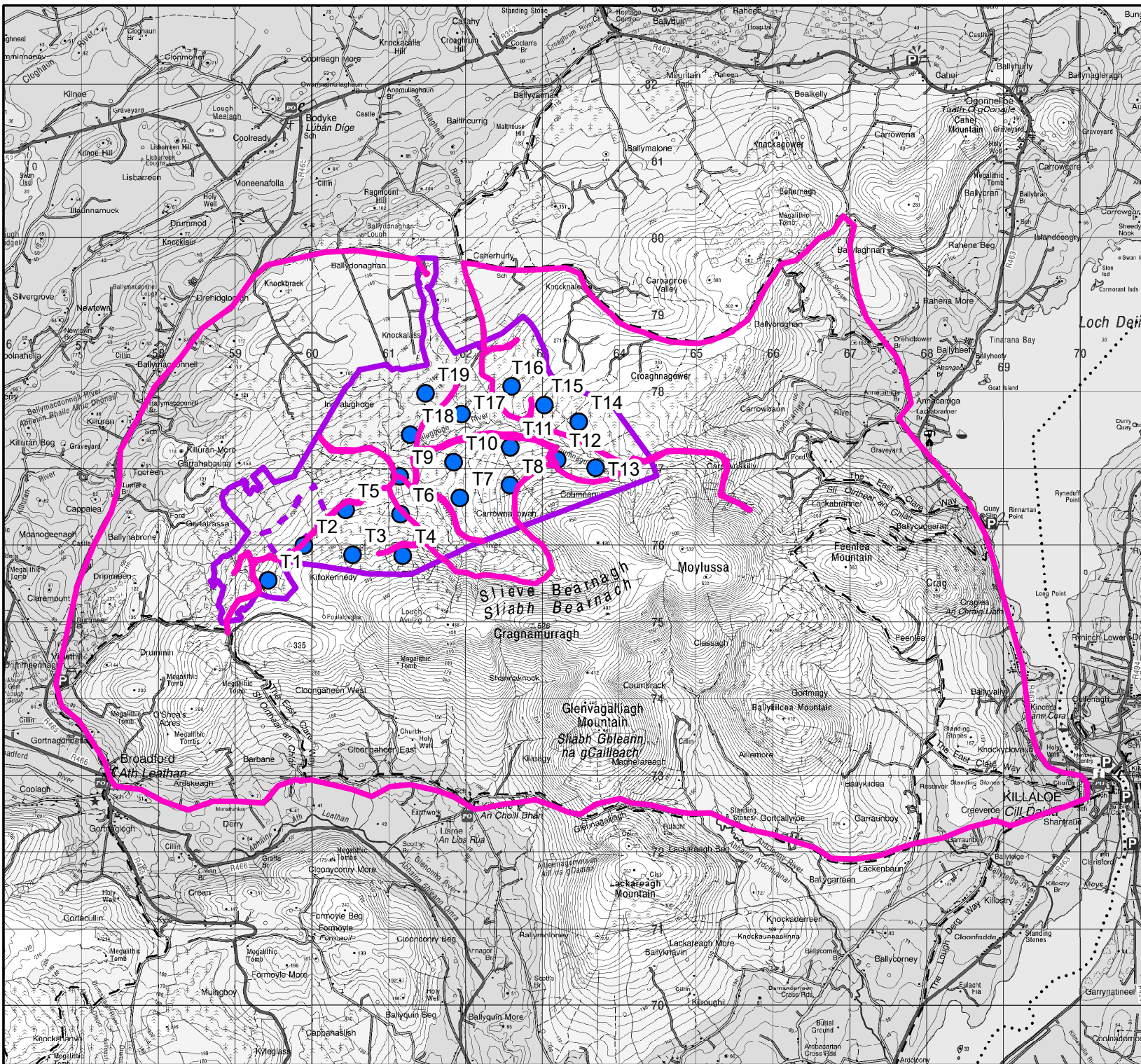
**Drawing Title:**  
 Bat Transects - Spring

<b>Drawn:</b> JK	<b>Checked:</b> PR
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<b>Date:</b> 16-12-2019	<b>Scale (A4):</b> 1:59,987
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**Legend**

- Bat Transect
- Turbine Location (19WTG)
- Study Area
- Lands Not Involved

Map Reproduced From Ordnance Survey Ireland  
 By Permission Of The Government.  
 Licence Number EN 0015719.

0 1.25 2.5  
 km

**Project Title:**  
 Carrownagowan Wind Farm

**Client:** Coillte

**Drawing Title:**  
 Bat Transects - Summer

**Drawn:** JK      **Checked:** PR

**Date:** 16-12-2019      **Scale (A4):** 1:69,000

**Malachy Walsh and Partners**  
 Engineering and Environmental Consultants