EIAR VOLUME III
Appendices

CHAPTER 7 – BIODIVERSITY

Appendix 7.1: Bat Baseline Report

Tullacondra Green Energy Limited

Appendix 7.1 - Bat Baseline Report

Tullacondra Green Energy Project

604162

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RSK GENERAL NOTES

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1 INTRODUCTION

1.1 Purpose of this report

This report presents the methodology and findings of a baseline study for bats in association with the proposed Tullacondra Wind Farm Project (hereafter referred to as 'the project'). This report forms a technical appendix to Chapter 7 of the Environmental Impact Assessment Report (EIAR) for the project. This bat baseline study was undertaken by RSK on behalf of Tullacondra Green Energy Limited.

The bat baseline study presented in this report includes desk studies and field surveys completed between 2020 and 2023 to inform the project, specifically:

- A desk-based review of relevant designated sites of interest and records of bat species nearby.
- Examination of trees and buildings within and surrounding the site for roosting potential.
- Emergence and re-entry surveys of potential roost features.
- Bat activity surveys, including transects and the use of static detectors.

This document should be read in conjunction with the following figures:

- Figure 3-1 – Wind turbine locations with static recorders.
- Figure 3-2 – Preliminary tree roost survey results (Category 1 and 2 only).
- Figure 3-3 – Daylight / emergence survey locations.
- Figure 3-4 – Bat contacts during walked transects 6th and 7th July 2022.
- Figure 3-5 – Bat contacts during walked transect 2nd August 2022.
- Figure 3-6 – Bat contacts during walked transect 8th August 2022.
- Figure 3-7 – Bat contacts during walked transect 28th August 2022.

1.2 Site overview

The proposed wind farm (hereafter referred to as 'the site') is located approximately 2km south of Lisgriffin Cross, Co. Cork. The site is situated within a rural setting dominated by improved grassland alongside associated hedgerows and treelines. Small sections of woodland can be found within and surrounding the site. No streams were found within the site, although drainage ditches were present throughout, forming boundary features to many of the fields. Elevation on site is uniform ranging from 110m to 130m (OSI Contours). The surrounding area is serviced by a variety of roads from primary to tertiary.

Various designated sites for nature conservation value are present within 15km of the site, notably: Kilcolman Bog Special Protection Area (SPA), 9.1km north-east of the site; and Blackwater River (Cork/Waterford) Special Area of Conservation (SAC), 6.2km north-east of the site at its nearest point.

1.3 Key guidance

This bat baseline study has been prepared in reference to current key industry standard guidance including the following:

- Bats and onshore wind turbines - Survey, Assessment and Mitigation. Scottish Natural Heritage. August, 2021
- UNEP/EUROBATS: Guideline for consideration of bats in wind farm projects, Publication Series No. 3.
- Natural England Technical Information Note TIN051: Bats and onshore wind turbines – Interim Report.
- Guide to Turbines and Wind Farms. Bat Conservation Ireland 2012.
- Bat Conservation Ireland Guidelines for consideration of bats in wind farm projects - Revision 2014
- Wind Turbine/Wind Farm Development Bat Survey Guidelines (BCI, 2012);
- NIEA (2011). Bat survey – specific requirements for wind farm proposals. Northern Ireland Environment Agency, Department of the Environment, Belfast.
- European Commission (2020). Guidance document on wind energy developments and EU nature legislation. Brussels, 18.11.2020 C(2020) 7730 final.
- National Roads Authority (2006) Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes.
- Collins, J. (Editor) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition). Bat Conservation Trust, London.
- McAney, K. (2006) A conservation plan for Irish vesper bats, Irish Wildlife Manual No. 20 National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
- Kelleher, C. & Marnell, F. (2006) Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
- The status of EU protected habitats and species in Ireland: Conservation status in Ireland of habitats and species listed in the European Council Directive on the Conservation of Habitats, Flora and Fauna 92/43/EEC. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.
- NRA (2006b). Guidelines for the Treatment of Bats during the Construction of National Road Schemes. National Roads Authority (now named Transport Infrastructure Ireland), Ireland.
- Aughney, T., Kelleher, C. & Mullen, D. (2008). Bat Survey Guidelines: Traditional Farm Buildings Scheme. The Heritage Council, Áras na hOidhreachta, Church Lane, Kilkenny.
- BTHK (2018). Bat Roosts in Trees – A Guide to Identification and Assessment for Tree-Care and Ecology Professionals. Pelagic Publishing, Exeter UK.
- European Commission (2021). Commission notice. Guidance document on the strict protection of animal species of Community interest under the Habitats Directive
- CIEEM (2021). Bat Mitigation Guidelines. A guide to impact assessment, mitigation and compensation for developments affecting bats. Beta version 1.0.
- NIEA, Natural Environment Division (2021). Guidance on Bat Surveys, Assessment and Mitigation for Onshore Wind Turbine Developments in Northern Ireland.

Information on relevant legislation to this report is provided in Annex 1.

1.4 Statement of authority

Bat surveys were designed by John Curtin. John has over 10 years' experience of conducting bat assessments for wind farm projects. He has also completed the Bat Conservation Ireland, Bat Detector Workshop and Bat Handling Workshop courses, which are the standard training for bat surveys in Ireland. In addition, John is a council member of Bat Conservation Ireland, which monitor national bat populations, and facilitate education of bat communities to the public.

Table 1. Relevant licenses

Description	Licence No
Licence to capture protected wild animals for educational, scientific, or other purposes (bats)	C231/2020
Roost disturbance (bats)	Der/Bat 2020-114
Licence to photograph / film wild animals (bats)	06/2021

In addition, night-time detector surveys were supported by Rory O' Callaghan. Rory has worked as an intern at the National Biodiversity Data Centre, is the National Coordinator for Seasearch Ireland – Citizen science in Irish marine waters and has volunteered for Bat Conservation Ireland monitoring programs such as the Daubenton's waterways survey.

2 METHODOLOGIES

2.1 Desk study

2.1.1 Background data search

Northern Irish Environment Agency (NIEA) guidance states a desktop assessment is required in order to assign a risk level to the site and design future survey work. The appropriate level of survey effort for a site depends on the quality of habitat present and the scale and likely impact of the development. Consideration should be given to the presence of suitable commuting and foraging habitat and the likely presence of bat roosts near proposed turbines. An assessment was conducted for the Tullacondra wind farm study area by examining Ordnance Survey maps, aerial photographs and google street view. Additionally, the National Biodiversity Data Centre (NBDC) and Bat Conservation Ireland (BCI) databases were consulted for details on bat records held for the site and the surroundings. The databases were consulted on the 12/03/2022 and again on the 09/11/2022 for details on historical records from the site and within a 10km radius of it. The BCI Bat Landscape for Habitat Suitability was also examined at this stage, as detailed in Bat landscape.

A data search was conducted in March 2022 and July 2023 to revise existing information from the surrounds of the site. The following information sources were examined:

- Known bat records within a 10km radius of the site from the Bat Conservation Ireland database.
- Adhoc and observational bat records from the National Bat Database held by the National Biodiversity Data Centre[1].
- Review of Ordnance Survey mapping and aerial photography of the site and its environs (i.e., 200m plus rotor radius of the boundary of the proposed development).
- Review of National Parks and Wildlife Service website for records of designated sites within a 15km radius of the site where bats form part or all of the reason for designation[2].
- Collation of data on known caves within a 4km radius of the site from the Cave Database for the Republic of Ireland, compiled by Trinity College[3].
- Review of bat survey data from Ecological Impact Assessments from proposed and permitted developments within the wider environs of the site.

2.1.2 Bat landscape

The sites suitability for foraging, commuting, and roosting bats was assessed using best practice guidance (Lundy, 2011). Such guidance produced a landscape model by analysing data contained in the Irish National Bat Database, maintained by Bat Conservation Ireland and the National Lesser Horseshoe Bat database maintained by the National Parks and Wildlife Service. The maps are a visualisation of the results of the

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[1] Available at: www.biodiversityireland.ie

[2] Available at: https://www.npws.ie/protected-sites

[3] Available at: http://www.ubss.org.uk/search_irishcaves.php

analyses based on a ‘habitat suitability’ index. The index ranges from 0 to 100, with 0 being least favourable and 100 most favourable for bats.

2.2 Field surveys

2.2.1 Assessment of potential roost habitats

Potential tree roosts

Trees within 200m of each proposed turbine location and along access routes (where the potential exists for felling) were examined for potential to host bat roosts in November 2022 following guidelines set out in the Bat Tree Habitat Key (Andrews, 2016) and BCT Guidelines for Professional Ecologists (Collins, 2016).

All trees were assessed from ground level using binoculars.

Examples of crevice features include:

- Natural holes
- Cracks/splits in major limbs
- Loose bark
- Hollows/cavities.

Each tree was assessed and ranked from suitability category 1 – 4, according to guidance from the Bat Conservation Trust (Hundt *et al.*, 2012).

Structures

Structures within 200m of each proposed turbine location were examined for potential to host bat roosts in November 2022. One set of sheds are located within 200m of a proposed turbine: Turbine 9 (150m to the south-west) and so potential roost structures outside this zone were also examined and several derelict sheds and dwellings were examined in the wider landscape. A search was conducted of sheds and derelict dwellings of highest potential that were close to the site or showed connectivity. In situations where access was not possible the surveyor conducted night-time surveys from the adjacent road examining bats and attempting to locate commuting routes and associated roosts.

2.2.2 Bat activity and emergence/re-entry surveys

Bat detectors used during the walked and driven surveys were Wildlife Acoustics Inc. (Massachusetts, USA) Echo Meter Touch Pro 2’s which are triggered to record when a bat call is emitted louder than 18 dB for one second. This detector uses full spectrum sampling; detecting all frequencies simultaneously, meaning that multiple bat calls can be recorded at the same time.

Night-time surveys combined dusk/dawn emergence and re-entry surveys with a combination of walked and driven transects of favourable habitats. These surveys were conducted between June and September 2022. Night-time bat surveys commenced thirty minutes prior to sunset and continued for a minimum of three hours, whilst dawn surveys commenced two hours prior to sunrise and finished at sunrise.

Transects targeted a range of foraging and commuting habitats present in and around the study area. This includes those associated with linear features such as roadside margins, grassland pasture, woodland edges, hedgerows, treelines, and built land. Details of transects are shown in Annex 4, while transect maps can be found in Figures 3-4 to 3-7.

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

Where possible, a positive identification to species level was made. Information on the behaviour was also recorded where available.

Bat activity is governed by the activity of their insect prey and insect abundance is in turn governed by weather conditions and climate. Insects, and therefore bats, are unlikely to be present at temperatures below 7°C or during periods of strong winds or heavy rainfall so surveying in such conditions, while possible is not advisable. All field surveys were undertaken within the active bat season and during good weather conditions (dry to occasional showers and temperature at 8°C and greater).

Bats were identified by their ultrasonic calls coupled with behavioural and flight observations. These identifications were later confirmed using sound analysis of recorded echolocation and social calls with dedicated software (Wildlife Acoustic's Kaleidoscope Pro; version 2.1.0)[4].

2.2.3 Bat static detector surveys

Song Meter Mini and SM4BAT Full spectrum bat recorders were used. SM4BAT recorders were deployed within the study area at the site of the proposed turbines typically for a minimum of ten nights in the spring, summer, and autumn periods. Where detectors were set in the open a timber structure was erected ensuring microphone height was set at 3m.

Each bat pass does not correlate to an individual bat but is representative of bat activity levels. Some species, such as the pipistrelles, will continuously fly around a habitat and therefore, it is likely that a series of bat passes within a similar time frame is one individual bat. On the other hand, Leisler's bats (*Nyctalus leisleri*) tend to travel through an area quickly and therefore, an individual sequence or bat pass is more likely to be indicative of individual bats.

As per SNH (2021) guidance, static units (Song Meter SM4BAT and SM-Mini) were programmed to commence 30 minutes before sunset and finish 30 minutes after sunrise to ensure that bat species that emerge early in the evening and return to roosts late are recorded. SNH states that "*Detectors should be placed at all known turbine locations at wind farms containing less than ten proposed turbines. Where developments have more*

[4] Although there are later editions to this software the surveyor manually verified all calls rather than depending solely on auto identification.

than ten turbines, detectors should be placed within the developable area at ten potential turbine locations plus a third of additional potential turbine sites up to a maximum of 40 detectors for the largest developments". For this project, nine detectors were placed within the site in spring. An additional control was set during summer periods given the precise proposed turbine locations had not been confirmed at that time. During the survey season, turbine positioning changed at several locations, thus several detectors were positioned in different locations to the final proposed turbine locations (see Figure 3-1). In these cases, the author has interpreted data based on similarity of landscape features.

2.2.4 Analysis of Sound Recordings

2.2.4.1 Kaleidoscope

The data was analysed with Wildlife Acoustic's Kaleidoscope Pro; version 2.1.0). This software identifies many of the calls made by Irish bats. All calls not labelled soprano (*Pipistrellus pygmaeus*) or common pipistrelle (*Pipistrellus pipistrellus*) bats were manually verified. Distinguishing between Myotis species recordings is difficult (unless distinctive social calls are recorded thus several calls are recorded to genus level only. These could be either whiskered (*Myotis mystacinus*), Daubenton's (*Myotis daubentoniid*) or Natterer's (*Myotis nattereri*) bat. Similarly, several pipistrelle calls were recorded with a peak frequency of around 40kHz. These calls are lower than expected for common pipistrelle but higher than typical for Nathusius's pipistrelle (*Pipistrellus nathusii*). Following the precautionary approach these calls have been included in ECOBAT as Nathusius's pipistrelle although it is likely many were common pipistrelle.

2.2.4.2 ECOBAT

Results from the static detector surveys were additionally analysed using Ecobat (University of Exeter); a software package that standardizes and performs interpretation of bat activity data (full data report included in Annex 6). It compares static detector data with similar datasets set in similar habitats and ranks activity levels. Ecobat is an online tool which makes assessments of bat activity levels by comparing data entered by the user with bat survey information from similar areas at the same time of year.

In order to ensure quality, all calls not auto identified as common or soprano pipistrelle were manually verified. The data was then entered into Ecobat, and a report was subsequently generated. Specifically, a median bat activity level is calculated which corresponds to a bat activity category (Table 2).

The reference range datasets were stratified to include:

- Only records from within 30 days of the survey date.
- Only records from within 100km^2 of the survey location.
- Records using any make of bat detector.

Following analysis of the recordings, each static recorder location was assigned a bat activity level (Table 2).

Table 2. Median percentile range and corresponding bat activity

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

2.2.5 Constraints and Limitations

It is not always possible to identify a bat call to species level due to the recorded call not being clear. Recorded files from automated detectors may contain only fragments of a call, or the bat may be calling from a distance (from the detector) in which case it may not be clear enough to assign the call to a specific species. In these cases, the call has been assigned to genus level.

Some caution must be taken when comparing activity levels between species, as bias can be shown towards those species with 'louder' or 'lower frequency' echolocation calls. For example, Nyctalus species have louder, and low frequency echolocation calls which carry further than the quieter and more broad-band brown long-eared bat echolocation calls.

A bat contact (for static surveys) is defined as a single detector file which contains at least one bat call. Multiple contacts at any given detector location do not necessarily indicate the presence of more than one bat and should therefore, be interpreted as a level of activity rather than the number of bats recorded.

For the purposes of this analysis, if more than one species was present within the recorded files the prominent species was identified as the species for the Ecobat analysis, therefore some species numbers may be under recorded.

Guidelines in the use of Ecobat recommend a Reference Range of 200+ nights of bat data to be confident in the relative activity level. The reference range is the stratified dataset of bat results recorded in the same region, at the same time of year, by which percentile outputs can be generated. This comprises all records of nightly bat activity across Ireland. Where the reference range fell below this level the comparison inputs were broadened by increasing the date ranger beyond 30 days or the location range from 100km to 200km.

If a genus level ID has been entered into the spreadsheets, for example "Myotis" then all identified Myotis species (including *nattereri*, *mystacinus* and *daubentonii*) will be included in the total for the date of the Myotis. To counter this the species level passes were deducted from the genus level data prior to inputting.

Following the conservative approach, 40kHz activity was included with Nathusius' pipistrelle.

3 RESULTS

3.1 Desk Study

3.1.1 Background data search

Records of five different bat species were returned from the background data search within 10km of the site:

- Common pipistrelle (*Pipistrellus pipistrellus*) 2.3km from the site.
- Soprano pipistrelle (*Pipistrellus pygmaeus*) 2.3km from the site
- Brown Long-eared bat *(Plecotus auritus*) 6.7km to the south of the site.
- Daubenton's bat (*Myotis daubentonii*) (location not provided)
- Leisler's bat (*Nyctalus leisleri*) 9km southeast of the site.

Further information on these records can be found in Annex 2.

3.1.2 Bat Landscape

Table 3 shows the BCI bat landscape model with the site divided into two sections. Section 2 to the south represents 13% of the site and has the highest levels of bat suitability. All turbines are proposed within the northern section, of lower suitability. Brown long-eared, common, and soprano pipistrelle were amber ranked for both areas.

Table 3. Landscape model for areas of the site (green is low suitability for bats, red is high)

Section		1	2
Location		North	South
Area Ha		172	22.6
% of site		87	13
Overall Risk level BCI		19.33	21.44
Nyctalus leisleri	Leisler's bat	26	28
Pipistrellus pipistrellus	common pipistrelle	30	32
Pipistrellus pygmaeus	soprano pipistrelle	29	31
Pipistrellus nathusii	Nathusius pipistrelle	5	7
Plecotus auritus	brown long-eared bat	29	32
Rhinolophus hipposideros	lesser horseshoe bat	0	0
Myotis mystacinus	whiskered bat	15	20
Myotis daubentonii	Daubenton's bat	16	17
Myotis nattereri	Natterer's bat	24	26

3.2 Assessment of potential roost habitats

3.2.1 Potential Tree Roosts

In total, 49 category 1 and 2 trees were recorded within the 200m buffer zones surrounding each proposed turbine location, as shown in Figure 3-2.

3.2.2 Structures

Seven structures with potential for roosting bats were identified during preliminary roost assessments (Table 4).

Table 4. Results of the Preliminary Roost Assessment for bats on built structures

No.	Lat.	Long.	Potential level	Details
1	52.205806	-8.749074	Low	Small derelict shed, with corrugated roof partially fallen in located to northeast of site
2	52.196317	-8.737054	High	Sheds to the south of main site. A number of new buildings clearly in use with low potential for bat activity. Two smaller older stone buildings have potential
3	52.185341	-8.742135	High	Old stone building to south of site with slated roof
4	52.219547	-8.669401	High	Ballybeg Prior ruin located on since discarded cable route 5.1km to the east of the site
5	52.206870	-8.745414	High	Farm buildings to north of site. Includes metal sheds of low activity as well as farmhouse and stone sheds
6	52.222672	-8.745579	Moderate	Church building to Lisgriffin Cross
7	52.177603	-8.739188	High	Derelict house to south of site

During the daytime inspections, no evidence of bats was noted from any of the structures listed in Table 4. Sheds were examined on two occasions. The second survey revealed the presence of a brown long-eared transition roost (four bats recorded roosting in two locations in September 2022).

3.3 Bat activity and emergence/re-entry surveys

A summary of the results of the bat activity and emergence/re-entry surveys is provided below. The full comprehensive data set for these surveys is located in Annex 4.

3.3.1 Emergence/re-entry surveys

Night surveys did not reveal the presence of bat roosts in any of the built structures apart from one. The surveyors did, however, notice bats commuting onto the site from the northern farmsteads, although no roost was found.

Bats were recorded congregating in the sheds at Location 2, and the farm buildings at Location 5 (see Figure 3-3).

A dawn re-entry survey was conducted at Ballybeg Priory (Location 4 see Figure 3-3) on 3 August 2022. A single soprano pipistrelle was recorded roosting here. This location lies 5.1km from the closest proposed turbine.

During the emergence surveys, no emergences from trees were recorded. However, this does not mean that these trees are not in use by bats, but rather they were not in use at the time the survey was carried out. It is noted that the use of such features by bats can be highly transitory.

3.3.2 Bat activity surveys

A total of five different transect routes were surveyed (see Figures 3-4 to 3-7). A brief summary of the results of these surveys is found below in Table 5. Further details on survey efforts and results are included in Annex 4.

Table 5. Summary of bat transect surveys and results

Transect Route	Date	Results
T1	06/07/2022	Walked transect from north-eastern farmyard through southern section of the site. Finished near farm buildings where majority of bat activity was detected.
T2	07/07/2022	Walked remainder of the southern section of site past proposed Turbine 6 location, as this area had high activity recorded from statics. Low level bat activity recorded.
T3	02/08/2022	Driven transect from emergence site to main road.
T4	08/08/2022	Walked transect on treeline approach to farm building, mature trees to east of farmyard and tree line leading to site. Bats commuting up and down tree line to and from farmyard and site.
T5	28/09/2022	Walked transect from emergence count around north of site focusing on ditches and hedgerows for areas of bat activity. Lots of bat activity and insects along ditches and on areas leading to farm.

Overall weather conditions were good during each survey. Surveys during September 2022 were slightly cool, as would be expected for this time of year. Further details of the weather during the surveys are described in Table 6.

Table 6. Weather data for walked transect surveys

Date	Sunset / sunrise	Start / finish	Temp	Wind speed m/s	Wind direction	Rain
06/07/2022	22:03	21:25	16	32	WNW	Overcast
		00:25	12	23	WNW	Dry
07/07/2022	05:23	03:18	14	23	WNW	Dry
		05:23	16	23	WNW	Dry

Date	Sunset / sunrise	Start / finish	Temp	Wind speed m/s	Wind direction	Rain
02/08/2022	21:25	20:55	18	23	SW	Dry
		23:28	15	19	SW	Dry
03/08/2022	05:57	03:57	14	22	SW	Dry
		05:57	16	24	SW	Dry
08/08/2022	21:14	20:44	15	15	WNW	Dry
		23:44	12	14	NW	Dry
09/08/2022	06:06	04:06	12	12	NW	Dry
		06:06	11	12	NNW	Dry
28/08/2022	20:32	19:58	19	17	ESE	Dry
		23:05	16	16	E	Dry
29/08/2022	06:41	04:37	14	14	E	Dry
		06:38	13	11	ENE	Dry
13/09/2022	19:53	19:20	16	0.3	W	Dry
		22:20	13.5	0.5	W	Dry
14/09/2022	07:06	05:06	9	0.8	W	Dry
		07:26	9.5	0	W	Dry

3.3.3 July 6th to the 7th 2022

The details for this survey data set are provided in Figure 3-4.

3.3.3.1 Emergence survey (location 1)

Emergence survey conducted by stand of trees with dilapidated shed. Stand of trees has connectivity to eastern farm buildings. First contact was a brief unseen soprano/common pipistrelle recorded five minutes after sunset. Soon after common and soprano pipistrelle bats were observed entering the area from the direction of the eastern farm buildings with hunting activity observed. On some occasions more than one soprano pipistrelle was observed hunting.

Emergence survey ended at 22:40 with no roosting bats found.

3.3.3.2 Transect (T1)

Sporadic activity observed within the site during the transect survey, particularly compared to around the woodland during emergence period.

3.3.3.3 Transect (T2)

Survey focused on south-eastern section of site by Turbines 9, 6 and 5. Again bat activity was sporadic with occasional common and soprano pipistrelle recorded. At 03:28 a myotis bat was detected.

3.3.3.4 Re-entry survey (location 2)

Survey focused on sheds (2) to the south of the main site. A number of new farm buildings actively used by the landowner which are constructed of metal and are of low potential for roosting bats. Two smaller stone buildings were the focus of the survey; however, the roof on one was largely gone. During the survey four species of bats were recorded; common and soprano pipistrelle, Leisler's bat and brown long-eared bat recorded at 04:24 with overall activity higher than the walked transect. Last bat recorded was a soprano pipistrelle at 04:58, some 25 minutes before sunrise. No evidence of roosting bats was observed.

3.3.4 August 2nd to the 3rd 2022

The detail for this survey data set is provided in Figure 3-5.

3.3.4.1 Emergence survey (location 3)

Hinterland emergence survey conducted by buildings to south of site. The first bat recorded was a common pipistrelle recorded at 21:48 some 22 minutes after sunset. This bat was observed commuting, heading north up the road past the building. Occasional common and soprano pipistrelle alongside Leisler's bats were recorded during the survey; however, none were noted emerging from the building. The building is used as a nesting site by barn swallows (*Hirundo rustica*).

3.3.4.2 Transect (T3)

Transect 3 consisted of a driven transect conducted from the emergence building, then east along the L5302 (just south of the site) to the N20. This route had been considered as a potential turbine delivery route, which has since been relocated.

Common pipistrelle, soprano pipistrelle and Leisler's bat were recorded along the road south of the site.

3.3.4.3 Re-entry survey (location 4)

This re-entry survey was conducted by Ballybeg Priory located along the N20 to the east of the site; over 5km to the closest proposed turbine (Turbine 6). The ruin is situated along the proposed turbine delivery route. At 05:35 a soprano pipistrelle was noted entering a crevice in the southern aspect of the abbey wall.

3.3.5 August 8th to the 9th 2022

More detail for this survey data set is provided in Figure 3-6.

3.3.5.1 Emergence survey (location 5)

The emergence survey was conducted on the farm buildings to the east of Turbine 2. Large amounts of bat activity in all barn buildings was recorded. The farmyard consists of multiple buildings, many constructed of metal sheeting of low bat potential. This survey focused on a stone shed of highest potential within the yard. Bats were not observed emerging from this building (adjacent to milking parlour) or the old farmhouse. Regarding bat behaviour, bats appeared to arrive onto the site from the east, congregating in large metal farm buildings until it got darker. There was some foraging activity observed in the farmyard and a large amount of activity at trees to north of the farmyard. The first bat recorded was a common pipistrelle recorded at 21:48 some 23 minutes after sunset. Common and soprano pipistrelle were observed alongside occasional Leisler's bat after this time.

3.3.5.2 Transect (T4)

Transects were conducted along paths around the farm buildings along treelines to farm buildings, mature trees to east of farmyard and tree lines leading to site. Bats were recorded commuting up and down tree lines to and from the farmyard and site. Again, common, and soprano pipistrelle were recorded alongside Leisler's bat. At 23:21 an unidentified Myotis species was recorded between the farmyard and the western patch of woods.

3.3.5.3 Re-entry survey (location 5)

This survey again focused on the north-eastern farmyard, this time focusing on barns to east of farmyard as bats we observed earliest here during emergence survey. Barns appeared to be unsuitable for roosts (of metal construction with no obvious place to roost) and no bats were observed roosting in the buildings. Occasional common and soprano pipistrelle were observed during the dawn survey alongside a brief myotis contact (04:18) and Leisler's bats.

Survey focused on sheds (2) to the south of the main site. A number of new farm buildings actively used by the landowner are constructed of metal and are of low potential for roosting bat species. Two smaller stone buildings were additionally surveyed; however, the roof on one was largely gone. During the survey four species of bats were recorded; common and soprano pipistrelle, Leisler's bat and brown Long-eared bat recorded at 04:24 with overall activity higher than the walked transect. Last bat recorded was a soprano pipistrelle at 04:58, some 25 minutes before sunrise. No evidence of roosting bats was observed. Occasional pipistrelle social calls were also noted. Final bat calls were recorded at 05:15 for soprano pipistrelle; 58 minutes before sunrise and at 05:15 for Leisler's bat (50 minutes before sunset). No roosting behaviour was observed.

3.3.6 August 28th to the 29th

More detail for this survey data set is provided in Figure 3-7.

3.3.6.1 Emergence survey (location 6)

Emergence survey conducted by an old growth tree to the northwest of site. Leisler's, brown long-eared, common, and soprano pipistrelle were recorded during the survey.

No bats were seen emerging in this area, although bats are likely to be entering the site along treelines. The first bat recorded was a brief unseen Leisler's bat noted 14 minutes after sunset followed by an unseen common pipistrelle 4 minutes later. Occasional activity primarily from common and soprano pipistrelle was recorded after this point. No bats were found emerging from the tree. Soprano pipistrelle was noted feeding along the hedge at 21:08. A brown long-eared bat was noted flying along a hedge at 21:19.

3.3.6.2 *Transect (T5)*

A walked transect was completed starting from the emergence point, around the north of the site, focusing on ditches and hedgerows for areas of bat activity. There was frequent common and soprano pipistrelle activity as well as insect activity along the ditches and on areas leading to the farm. Occasional unseen Leisler's bat was also recorded.

3.3.6.3 *Re-entry survey (location 7)*

Hinterland survey focused on a derelict house to the south of the site with a large patch of trees in the vicinity. Good connectivity to southern part of site was present, and on previous surveys bats were seen coming up the road from this area. Very little bat activity was recorded on this survey, however. Common pipistrelle, soprano pipistrelle, Leisler's bat and an unidentified myotis bat were recorded. Twenty minutes before sunrise a soprano pipistrelle was observed flying west along a treeline away from the house (and from the proposed windfarm). The last contact occurred 18 minutes before sunrise when a distant unseen soprano pipistrelle was recorded. No roosting behaviour was found.

3.3.7 September 13th to the 14th 2022

September surveys solely focused on bat roost potential with no transects completed.

3.3.7.1 *Emergence survey (location 2)*

Emergence survey was conducted by the southern sheds (2). Four bat species were recorded: common and soprano pipistrelle, brown long-eared bat, and Leisler's bat. The first bat contact was a brief unseen common pipistrelle registration recorded at 19:41 some 12 minutes prior to sunset. At 21:05 an internal check of the stone buildings revealed 2 brown long-eared bats in each of the two larger rooms. These bats were roosting along the ridge beams of each room. At 21:09 two common pipistrel bats were recorded flying around the outside of the sheds displaying pairing behaviour: flying together, not hunting and producing multiple social calls.

3.3.7.2 *Re-entry survey (location 8)*

This survey examined the roosting potential of the church building located in Lisgriffin some 2.14km north-west of proposed Turbine 2. Activity was very low with a brief contact from common and soprano pipistrelle. No evidence of roosting behaviour was recorded.

3.4 Bat static detector surveys

The results of the static detector surveys deployed over spring, summer and autumn in 2022 are shown in Table 7 and Table 8 and in Charts 1-4. Overall, seven bat species were recorded (common pipistrelle, soprano pipistrelle, Nathusius' pipistrelle, Leisler's bat, brown long-eared bat, Natterer's bat and Daubenton's bat). Where the call could not be identified to species, the identification was determined to the highest level possible. Several registrations were recorded with a peak frequency of 40kHz. These bats will have been either common or Nathusius's pipistrelle. Further myotis calls were identified only to genus level. More detailed results of this survey type can be found in Annex 5. The locations of the static recorders are shown in reference to the proposed turbine locations in Figure 3-1.

Table 31. Habitats surrounding proposed turbines with comments on static locations and landscape features suitable for bat.

Turbine No	Detectors used for assessing impact	Approx. Distance between detector and turbine	Approximate proportion of habitats within 200m of proposed turbine								Comments on static locations and landscape features suitable for bats	No. of nights static deployed
			Habitat 1	%	Habitat 2	%	Habitat 3	%	Habitat 4+	%		
1	D1	93m SW	GA1	75	BC1	15	WL1	5	WL2, GS4, WS1	5	Detector set along hedgerow with connectivity to the NW and W. Detector malfunctioned for August period.	40 nights
	D1a	At turbine location									Detector set in open field without landscape features at proposed location of turbine. Detector set for summer and August periods. This detector provides good comparative data showing the difference between activity in open habitats to those adjacent to landscape features.	23 nights
2	D2	Close to turbine attached to fence (25 m)	GA1	93	WL1	7	-				Turbine set in grassland 40m from hedge set close to existing fence. Detector set on fence within 25m of proposed turbine. Activity will be similar.	50 nights
3	D3	At turbine location	GA1	93	WL1, WL2	7	-				Turbine set in grassland 20m from hedge. Detector recorded for four nights in August and seven nights in September.	40 nights
4	D4	At turbine location	GA1	93	WL1	7	-				Turbine proposed along existing track with closely cropped hedge.	50 nights

<table>
<tr><th rowspan="2">Turbine No</th><th rowspan="2">Detectors used for assessing impact</th><th rowspan="2">Approx. Distance between detector and turbine</th><th colspan="8">Approximate proportion of habitats within 200m of proposed turbine</th><th rowspan="2">Comments on static locations and landscape features suitable for bats</th><th rowspan="2">No. of nights static deployed</th></tr>
<tr><th>Habitat 1</th><th>%</th><th>Habitat 2</th><th>%</th><th>Habitat 3</th><th>%</th><th>Habitat 4+</th><th>%</th></tr>
<tr><td>5</td><td>D5</td><td>At turbine location</td><td>GA1</td><td>88</td><td>WL1</td><td>7</td><td>WS1, FL8</td><td>5</td><td colspan="2">-</td><td>Turbine proposed adjacent to hedgerow. Small stand of trees surrounding former quarry lies 74m to east.</td><td>50 nights</td></tr>
<tr><td>6</td><td>D6</td><td>60m south</td><td>GA1</td><td>93</td><td>WL1</td><td>7</td><td colspan="4">-</td><td>Detector set along same hedgerow with similar features. Activity will be similar.</td><td>50 nights</td></tr>
<tr><td rowspan="2">7</td><td>D7</td><td>130m south-east</td><td rowspan="2">BC1, GA1, BC3</td><td rowspan="2">88</td><td rowspan="2">WL1</td><td rowspan="2">7</td><td rowspan="2">WS1</td><td rowspan="2">5</td><td rowspan="2" colspan="2">-</td><td>Proposed turbine is set within arable land 45m from the closest landscape feature. Detector was set by a hedgerow. It is likely activity was significantly higher at hedgerow.</td><td>50 nights</td></tr>
<tr><td>D1a</td><td>1450m</td><td>Given the differences in landscape features between D7 and T7 data from this detector is also used given it was set in open habitat similar to T7.</td><td>23 nights</td></tr>
<tr><td>8</td><td>D8</td><td>83m west</td><td>BC1, GA1, BC3</td><td>83</td><td>WL1, WL2</td><td>10</td><td>WS1</td><td>7</td><td>ED2</td><td>+</td><td>Detector set by treeline 83m west of turbine. Turbine is proposed close to hedgerow. Given the additional shelter by detector it is likely to be similar or marginally higher activity at detector location. Detector recorded for first six nights of April survey.</td><td>40 nights</td></tr>
<tr><td>9</td><td>D9</td><td>65m south</td><td>GA1, BC3</td><td>85</td><td>WL1, WL2</td><td>10</td><td>WN</td><td>3</td><td>BL3</td><td>2</td><td>Detector set close to treeline, 65m south of turbine. Turbine is</td><td>50 nights</td></tr>
</table>

Turbine No	Detectors used for assessing impact	Approx. Distance between detector and turbine	Approximate proportion of habitats within 200m of proposed turbine								Comments on static locations and landscape features suitable for bats	No. of nights static deployed
			Habitat 1	%	Habitat 2	%	Habitat 3	%	Habitat 4+	%		
											located within centre of field. Activity is likely to be substantially lower at turbine location than by detector. (Based on comparisons between D1 and D1a).	
	D1a	1.96km									Given the differences in landscape features between D9 and T9 data from this detector is also used given it was set in open habitat similar to T9.	23 nights

Table 7. Static detector results

Common Name	Scientific name	No. of recordings
Leisler's bat	*Nyctalus leisleri*	13,762
Common pipistrelle	*Pipistrellus pipistrellus*	35,238
Soprano pipistrelle	*Pipistrellus pygmaeus*	26,036
Nathusius' pipistrelle	*Pipistrellus nathusii*	36
40 kHz Pipistrelle	-	1,687
Brown long-eared bat	*Plecotus auritus*	474
Natterer's bat	*Myotis nattereri*	179
Daubenton's bat	*Myotis daubentoniid*	2
Unidentified Myotis species		1,630
Total registrations		77,414

Highest overall activity was recorded from detector 3 particularly in relation to soprano pipistrelle activity. Much of this spike in activity occurred over four days: 8th to the 11th of August averaging 1,000 contacts per night. Many of the detectors were placed adjacent to existing treelines and hedgerows. These showed higher activity than those placed away from bat landscape features; detector 2, located adjacent to a fence, had an average bat pass per hour of 7.5 while detector 4, located along a track with low hedges, had an average bat passes per hour of 8.9. In comparison, several of the other detectors (5, 6, 8 and 9) had over 20 bat passes per hour.

3.4.1 Ecobat

Results from the static detector surveys were analysed using Ecobat (University of Exeter); a software package that standardizes and performs interpretation of bat activity data. A summary of the findings is provided below with more detailed data sets provided in Annex 6.

The following static locations are deemed to have a High Bat Activity (for specific bat species) level based on the Percentile Median value:

- D1 common pipistrelle
- D3 common & soprano pipistrelle
- D5 common & soprano pipistrelle
- D7 common pipistrelle
- D8 common pipistrelle
- D9 common pipistrelle.

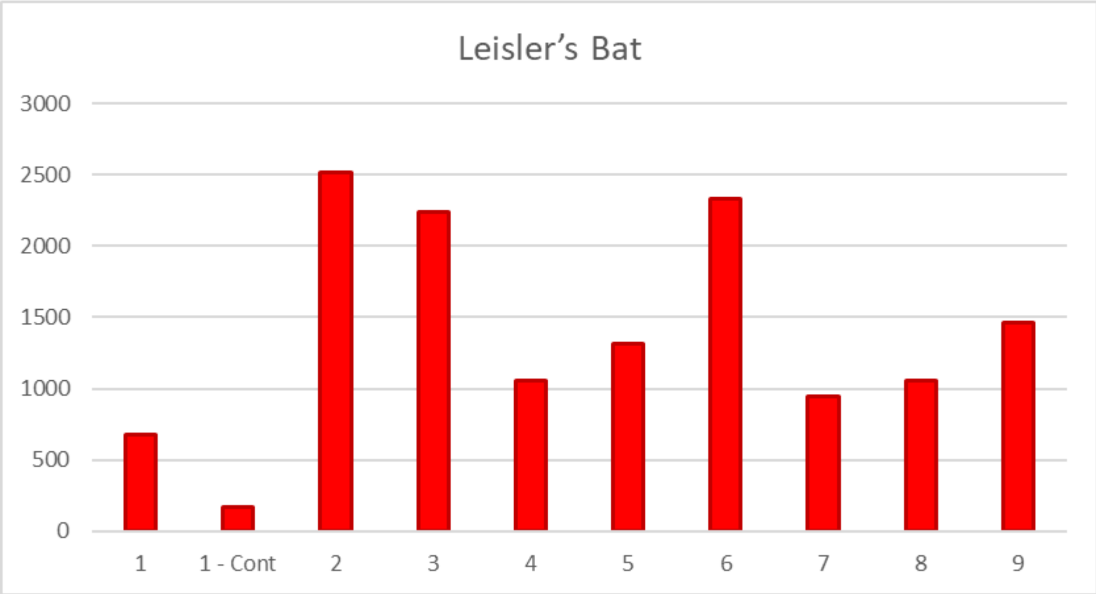

Chart 1. Total number of bat passes recorded for Leisler's bat at each of the static locations

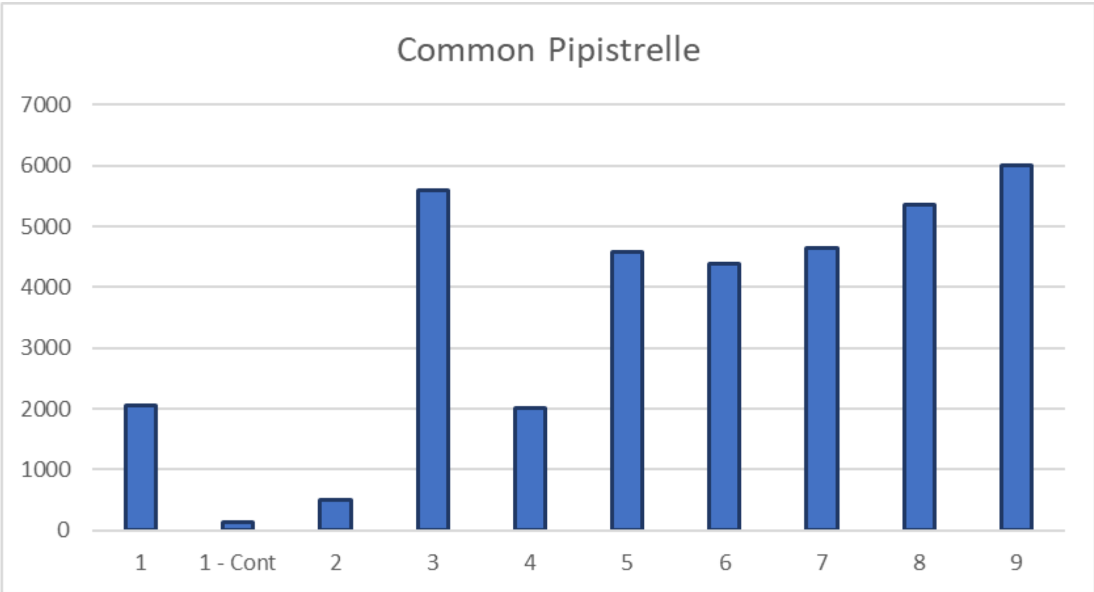

Chart 2. Total number of bat passes recorded for common pipistrelle at each of the static locations

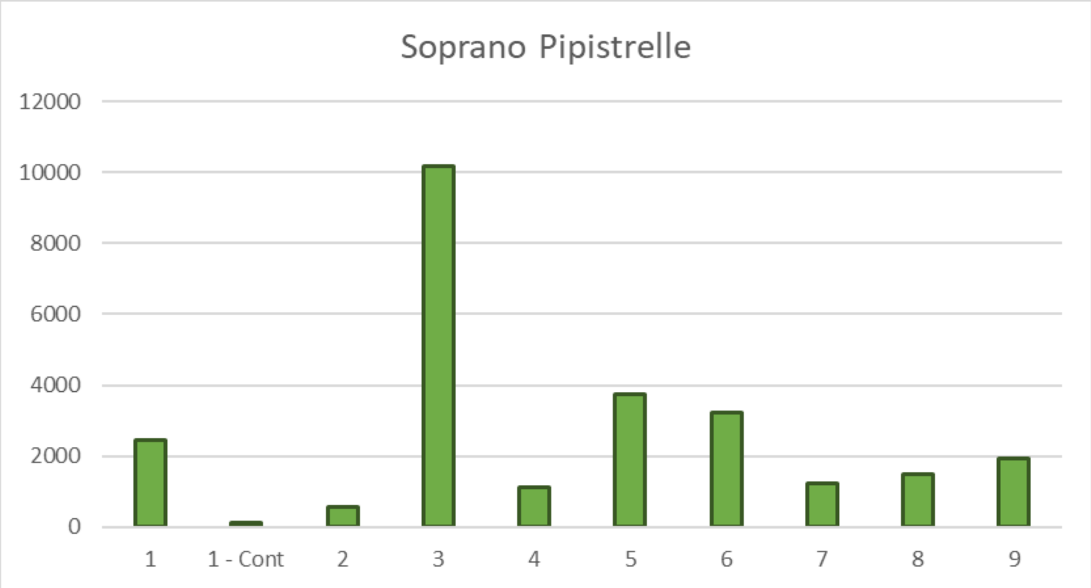

Chart 3. Total number of bat passes recorded for soprano pipistrelle at each of the static locations

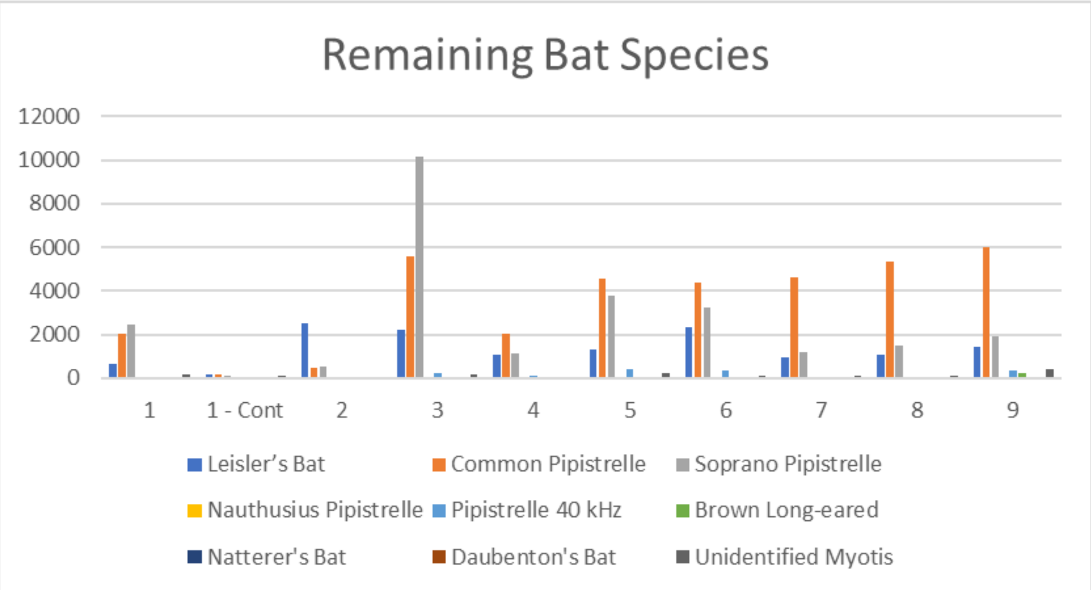

Chart 4. Total number of bat passes for remaining bat species at each of the static detector locations

3.5 Comparison of bat data to weather

Weather data was recorded on site from the 22nd to the 26th of June (LIDAR; mean 10-minute intervals) and during the Autumn period (Ecowitt weather station; 2-minute intervals). Bat activity recorded during these periods were compared to temperature and wind. Table 9 shows maximum and minimum conditions bats were recorded while Table 10 shows the median weather conditions high collision risk bat species were recorded at. Finally, Table 11 shows the ranges of weather conditions when most bat activity occurs.

Table 8. Maximum and minimum weather values where bats were recorded.

	Temperature (°C)	Wind (m/s)
Maximum value with bat recording	17.9	7.5
Minimum value	4.7	0
Minimum value with bat recording	5.4	0

Table 9. Median wind and temperature per species.

Species	Bat passes	Median Temp (°C)	Median windspeed (m/s)
All bats	20,925	11.6	1.3
Leisler's bat	3,041	11.6	0.6
Common Pipistrelle	9,193	12	1.4
Soprano Pipistrelle	7,576	11.6	1.28
Nathusius and 40kHz Pipistrelle	354	11.4	1.5

Table 10. Ranges of weather conditions when most bat activity occurs.

	Contacts above 10 °C and below 5m/s	Contacts above 10.6 °C and below 6.5m/s
Bat passes	16,747	15,802
% of total bat activity[5]	80.2	75.6

[5] 20,890 bat passes recorded with both wind and temperature records.

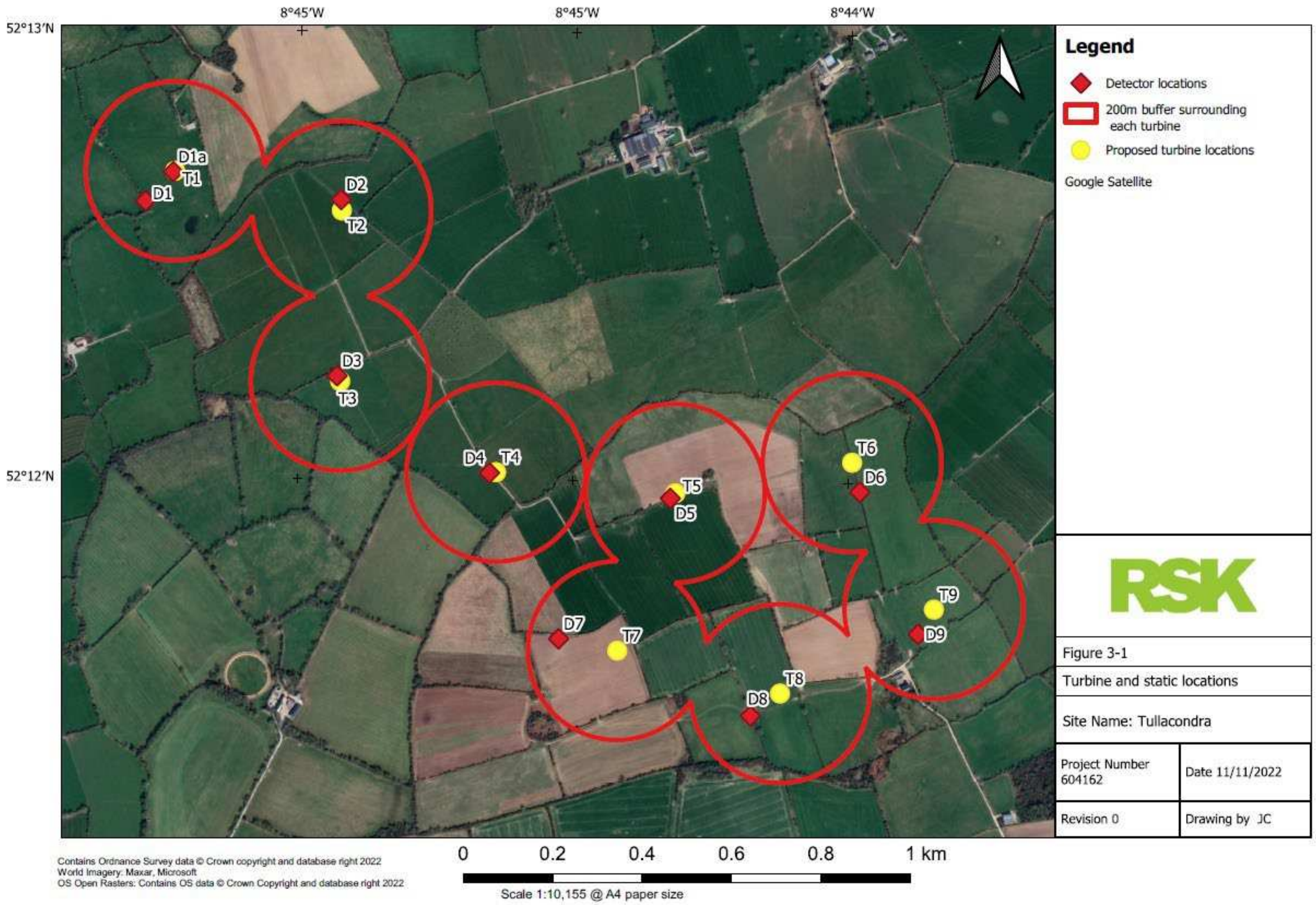

Figure 3.1: Bat Detector Locations

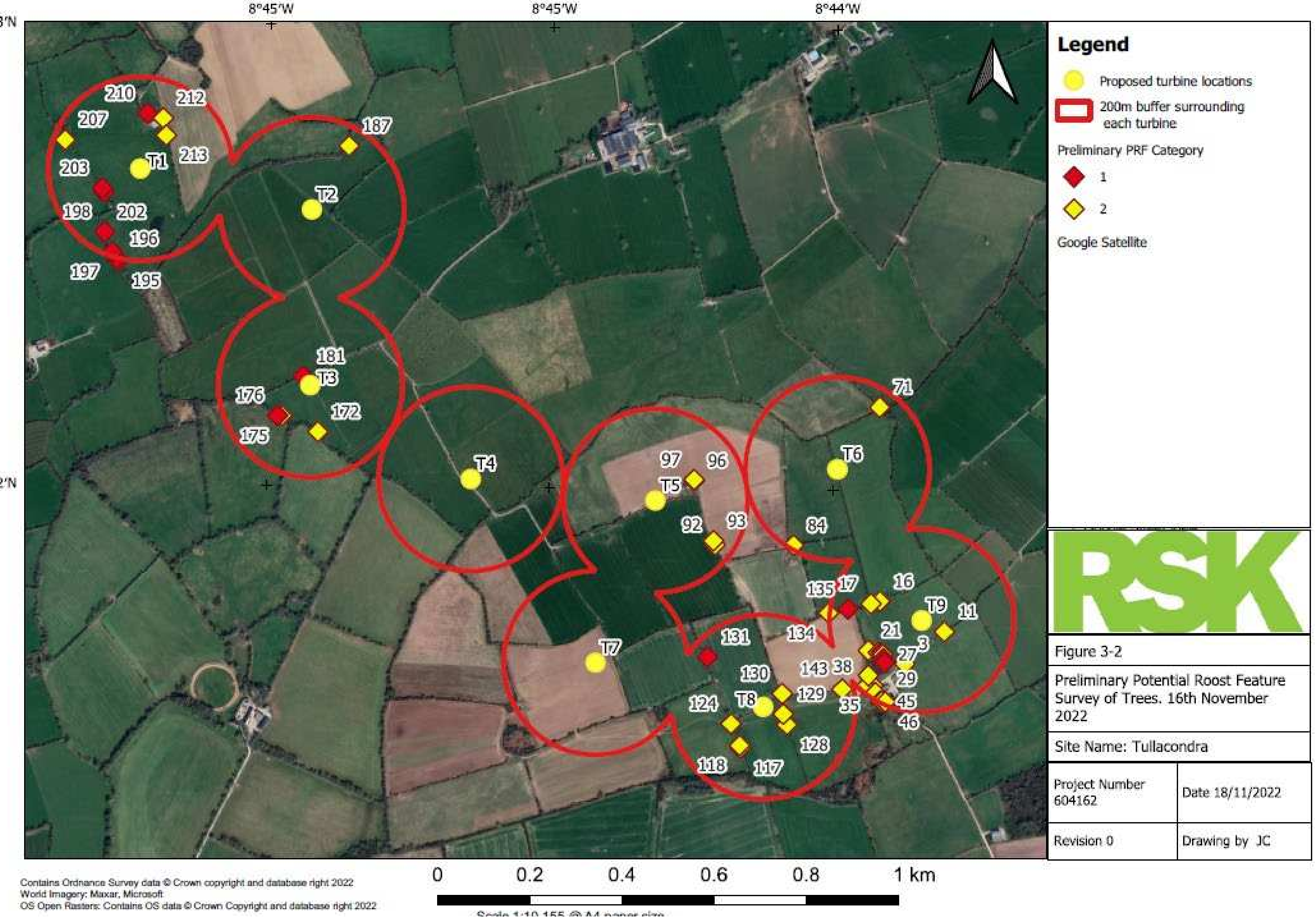

Figure 3.2: Tree Roost Locations

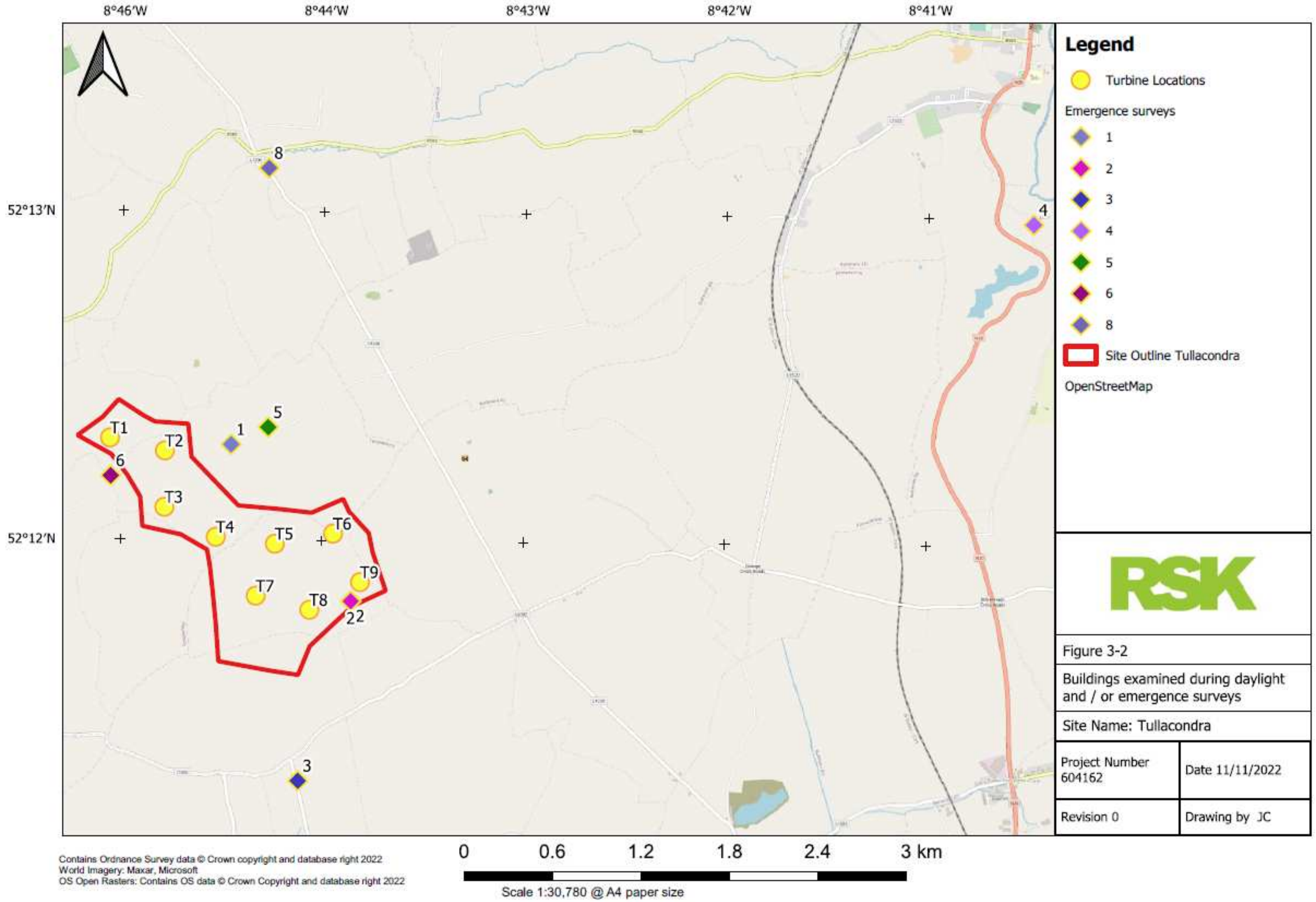

Figure 3.3: Emergence Survey Locations

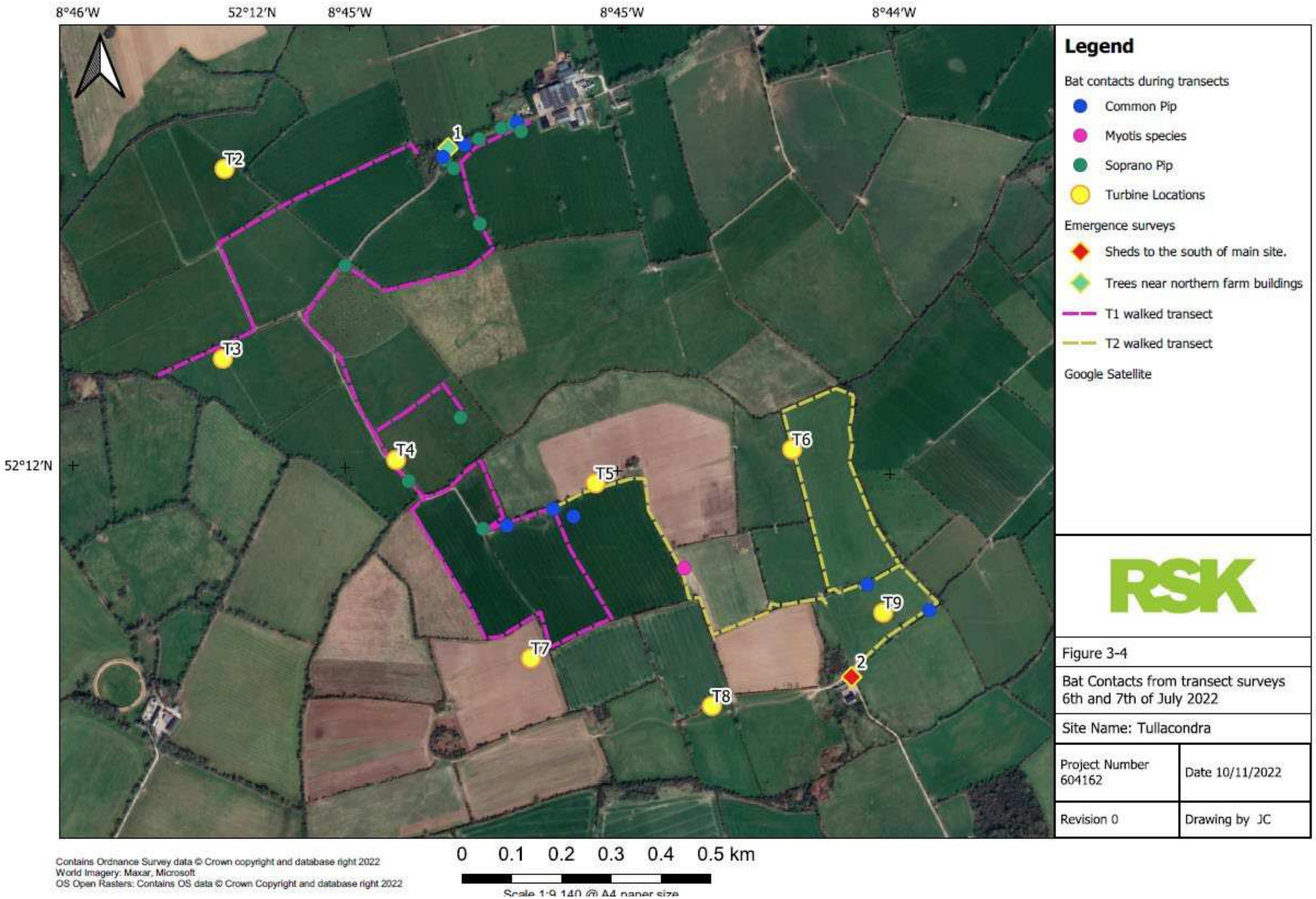

Figure 3.4: Bat contacts during walked transects 6th and 7th July 2022

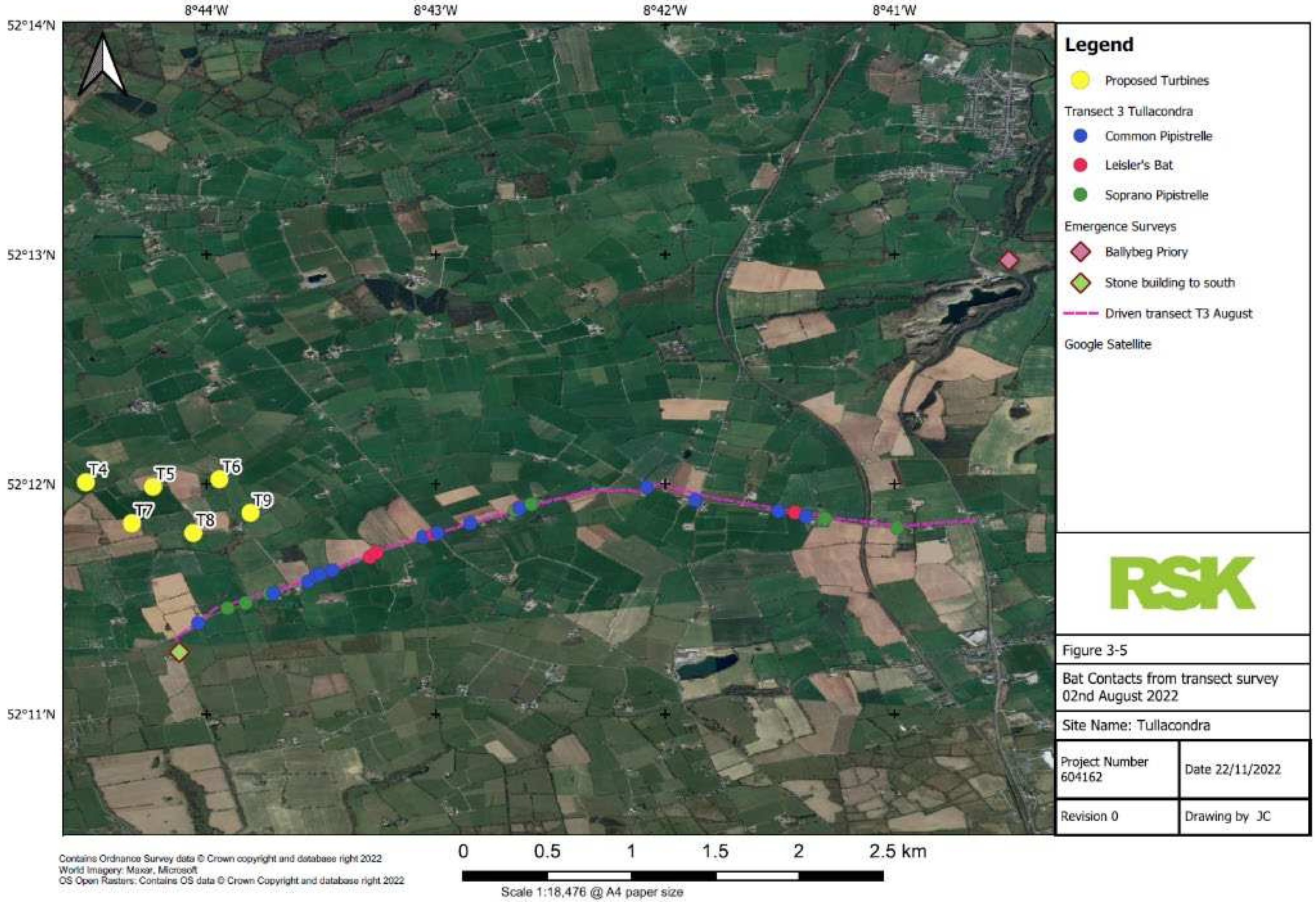

Figure 3.5: Bat contacts during walked transects 2nd August 2022

Figure 3.6: Bat contacts during walked transects 8th August 2022

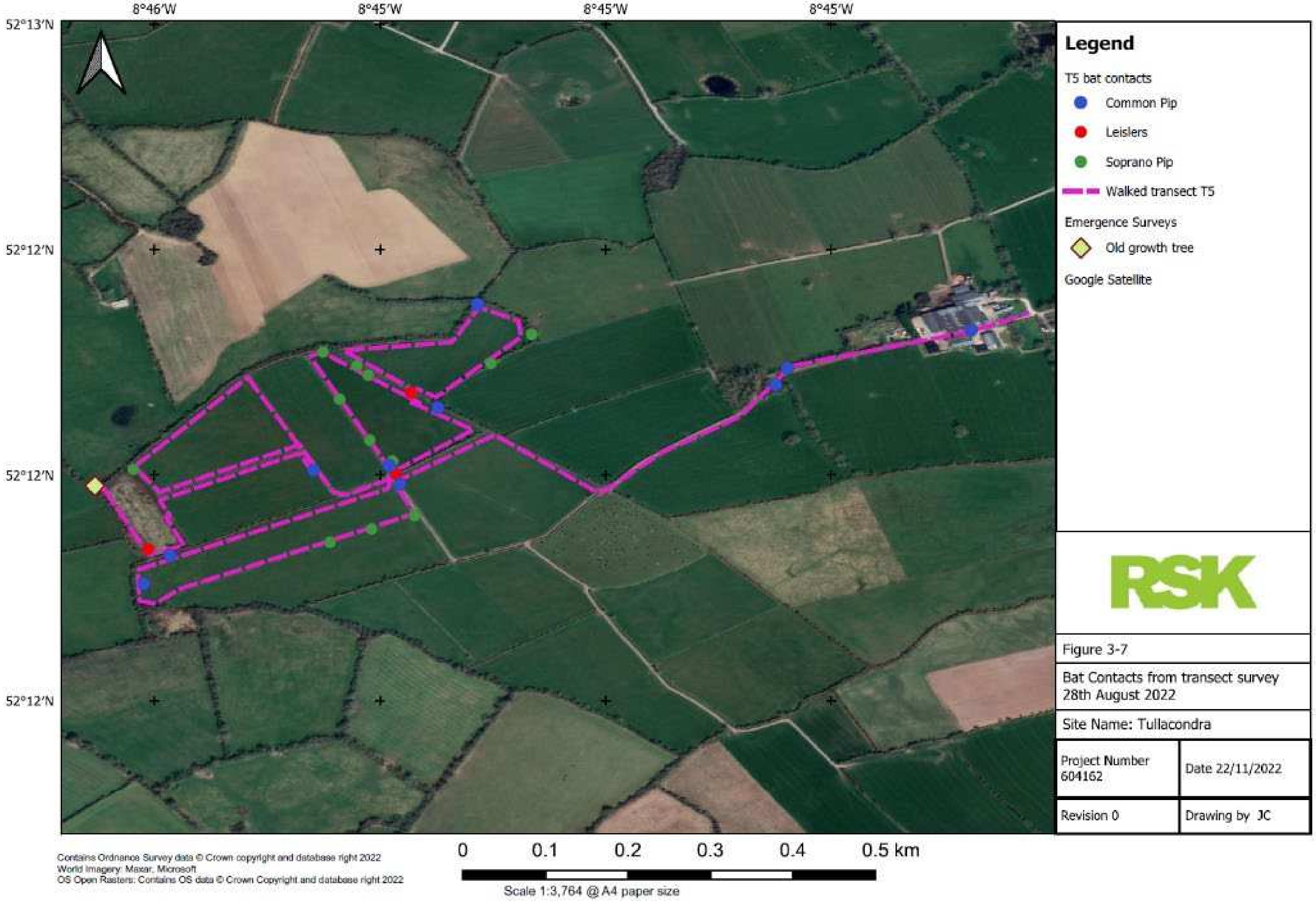

Figure 3.7: Bat contacts during walked transects 28th August 2022

4 EVALUATION AND CONCLUSIONS

The majority of recorded bat roosts found during the desk study were outside of the core sustenance zone (CSZ) from the site for each species. This means that the bats roosting in these locations do not typically range far enough while foraging to be affected by the project. However, bats often change roost location from one night to the next, so it is possible that these bats may relocate closer to the site over time.

It is worth noting that, due to the rural nature of the site, the absence of desktop records is likely due to a lack of study in this location rather than reflecting a low population of bats. This is made evident by the age of some of the records, dating from 1986 to 2007. This is also reflected in the survey results, with seven different species being recorded at varying levels over the course of the survey period.

4.1 Preliminary Roost Assessments

4.1.1 Trees

In total, 49 Category 1 and 2 trees were identified. According to BCT guidelines (2012), Category 1 refers to trees with "features that appear to be suitable for small maternity colonies along with roosts of lower conservation status. Any features that appear to be physically large enough to support smaller numbers of bats (i.e. 5-20 individuals) provide internal darkness, shelter from the wind and rain, are higher than 2m above ground-level, have an entrance point free from clutter and are possibly, though not exclusively, heated by the sun. Meanwhile, a Category 2 tree is one with features that appear to be unsuitable for maternity colonies, but that could be used for mating, occasional roosting, night roosting or hibernation, and support any features that are only physically large enough to support individual bats or low numbers of bats. During the emergence and activity surveys, no emergences from trees were recorded. However, this does not mean that these trees are not in use by bats, but rather they were not in use at the time the survey was carried out.

4.1.2 Structures

Due to the results of the preliminary assessments of buildings, it was possible for the majority of the structures around the site to be scoped out of further surveys. One single roost was found within a 200m buffer of any of the proposed turbine locations; a transition roost for brown long-eared bats found 160m south-west of Turbine 9.

4.1.2.1 NE Farmyard

While a bat roost was not found within the farmyard, good levels of bat activity was recorded, with the earliest contact (common pipistrelle) recorded 12 minutes after sunset; median emergence is 20 minutes after sunset. As such it is likely a bat roost is located close to this point. The closest turbine (Turbine 2) lies over 600m from this farmyard.

4.2 Activity Transects

During walked surveys, a total of five species of bats were recorded: common pipistrelle, soprano pipistrelle, Leisler’s bat, brown long-eared bat, and a myotis species. Where the call could not be identified to species, the identification was determined to the highest possible level. The most commonly recorded species was common and soprano pipistrelle, followed by Leisler’s, with lower levels from other species.

4.3 Static Recorder Monitoring

During static surveys, a total of seven species of bats were recorded: common pipistrelle, soprano pipistrelle, Leisler’s bat, Nathusius’s pipistrelle, brown long-eared bat, Natterer’s bat, and Daubenton’s bat. The most commonly recorded species was common and soprano pipistrelle, followed by Leisler’s, with lower levels from other species.

All bats recorded are classified as ‘Least Concern’ on the Irish Red List (2019) and protected under the EU Habitats Directive Annex IV and Wildlife Acts.

Due to the levels of nightly bat activity (with regard to median values as determined by Ecobat analysis) at each of the static locations, Turbine 1 is the only turbine considered medium risk for all at risk bat species. Turbine 2 and Turbine 7 are high risk for one species (Leisler’s bat and common pipistrelle respectively) while Turbine 4 and Turbine 8 are high risk for two species (Leisler’s bat and common pipistrelle and common pipistrelle and soprano pipistrelle respectively). Turbines 3, 5, 6 and 9 are high risk for common and soprano pipistrelle and Leisler’s bats.

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ANNEX 1 - RELEVANT LEGISLATION

The Wildlife acts 1976 and 2000

The Wildlife Acts are the primary domestic legislation providing for the protection of wildlife in general, and the control of some activities adversely impacting upon wildlife is the Wildlife Act of 1976, as amended. The aims of the Wildlife Act according to the National Parks and Wildlife Service are "... *to provide for the protection and conservation of wild fauna and flora, to conserve a representative sample of important ecosystems, to provide for the development and protection of game resources and to regulate their exploitation, and to provide the services necessary to accomplish such aims*." All bat species are protected under the act. The Wildlife (Amendment) Act of 2000 amended the original Act to improve the effectiveness of the Act to achieve its aims.

It is an offence to:

- Intentionally kill, injure or take a bat.
- Possess or control any live or dead specimen or anything derived from a bat.
- Wilfully interfere with any structure or place used for breeding or resting by a bat.
- Wilfully interfere with a bat while it is occupying a structure or place which it uses for that purpose.

European Communities (Birds and Natural Habitats) Regulations 2011 to 2021

The EC (Birds and Natural Habitats) Regulations 2011-2021 provide strict protection for all of the Irish species listed on Annex IV of the EU's Habitats Directive. It does this by prohibiting certain activities which could impact on the conservation status of those species. Those activities may only be permitted by way of a derogation licence. All bat species found in Ireland are listed under Annex IV of the Directive, while the lesser horseshoe bat is afforded further protection under Annex II.

ANNEX 2 - NOTEWORTHY SPECIES RECORDS

Table 11. Records of bats within 10km of the proposed turbine locations.

Type of Record	Species	Distance to closest proposed turbine	Date of last record	Details	Potential connectivity with site (for roost records)
Roost	*Plecotus auritus*	6.7km S	2007	Transitional roost. 3 bats seen roosting in ridge beam above two piles of droppings	BCT[6] state the CSZ for Brown Long-eared bat is 3km thus the site lies well outside the CSZ for this roost.
Roost	*Nyctalus leisleri*	10km	1986	Old record with no details added.	Shiel (1999) found that the maximum (mean) flight distance recorded for individuals from two Leisler's bat maternity roosts ranged from approximately 4.5km to 7.5km throughout the year. The core zone is likely to be substantially lower than this max mean flight range. BCT states the CSZ for this species is 3km. At 10km the site sits outside the CSZ for this species.
Unknown	*Plecotus auritus*	6.5km SW	1989	Old record with no details added	BCT state the CSZ for Brown Long-eared bat is 3km thus the site lies well outside the CSZ for this record.
Ad hoc	*Pipistrellus pipistrellus sensu lato)* *Pipistrellus pygmaeus*	2.3km	2006	EIS record close to quarry	-
Ad hoc	*Pipistrellus pygmaeus* *Pipistrellus pipistrellus sensu lato)*	6.7km	2007	EIS record – additional data	

[6] A core sustenance zone (CSZ), as applied to bats, refers to the area surrounding a communal bat roost within which habitat availability and quality will have a significant influence on the resilience and conservation status of the colony using the roost. BCT 2020 provide distances for UK Bats.

Type of Record	Species	Distance to closest proposed turbine	Date of last record	Details	Potential connectivity with site (for roost records)
				from 1st roost record	-
Ad hoc	*Plecotus auritus*	8km SE	2005	EIS record from site in Mallow	-
	Pipistrellus pipistrellus sensu lato)				
	Pipistrellus pygmaeus				
Ad hoc	*Myotis daubentonii*	8.7km SE	2007	By bridge in Mallow over R. Blackwater	-
Ad hoc	*Nyctalus leisleri*	9km SE	2005	EIS record from site in Mallow	-
	Pipistrellus pygmaeus				
Ad hoc	*Myotis daubentonii*	9.6km	2007	By bridge in Mallow over R. Blackwater	-

ANNEX 3 – PRELIMINARY ROOST INSPECTION DATA

Table 12. Tree categorisation according to Bat Conservation Trust (Hundt *et al.* 2012)

Tree Category	Description
1	Trees with multiple, highly suitable features capable of supporting larger roosts.
2	Trees with definite bat potential but supporting features suitable for use by singleton bats.
3	Trees have no obvious potential although the tree is of a size and age that elevated surveys may result in cracks or crevices being found or the tree supports some features which may have limited potential to support bats.
4	Trees have no potential.

Table 13. Category 1 and 2 trees recorded surrounding turbines and along the Turbine Delivery Route

Number	Lat	Lon	Category	Name	Description
1	52.1965	-8.73687	4	Ash	Some ivy but not thick at the base. chainsaw cuts but no cavities
2	52.19657	-8.73677	4	Ash	Young. Some ivy but not thick
3	52.19663	-8.73667	2	Ash	Young tree. Double leader. Tearoffs, quick check
4	52.19668	-8.73655	4	Ash	No roosting potential
5	52.19682	-8.73631	4	Ash	No potential
6	52.19688	-8.73621	3	Ash	Two tear offs but no cavities or potential
7	52.1969	-8.73614	4	Ash	No potential
8	52.19704	-8.73583	4	Ash	All have some ivy but not thick enough to form mats
9	52.19717	-8.73561	4	Ash	Small downward facing tear off. No potential
10	52.19723	-8.73555	4	Ash	No potential
11	52.19727	-8.73542	2	Ash	2 small tear offs with limited potential but better check
12	52.19773	-8.73456	4	Blackthorn	6 Blackthorn with no potential
13	52.19801	-8.73498	4	Ash	No potential
14	52.19816	-8.73521	4	Dead tree	Ivy but thick enough to form mat
15	52.19798	-8.73681	4	Dead tree	No potential
16	52.19785	-8.73747	2	Dead tree	Small bit of pealing bark. Quick check

Number	Lat	Lon	Category	Name	Description
17	52.1978	-8.73776	2	Ash	Small canker probably nothing but give a quick check
18	52.19782	-8.73776	4	Ash	Multi stem. No potential
19	52.19723	-8.73805	4	Hawthorn	Mature, no potential
20	52.19697	-8.73778	4	Ash	Immature, no potential
21	52.19689	-8.73783	2	Ash	Small possible cavity on tear off
22	52.19685	-8.73772	3	Ash	Multi limb ash with ivy but not thick.
23	52.19684	-8.73778	4	Ash	Multi limb ash with minimal potential
24	52.19685	-8.73751	2	Ash	Large ash that had fallen. Base has cavity. Check
25	52.19685	-8.73747	4	Ash	Immature
26	52.19685	-8.73742	1	Ash	Overhanging field. Has two tear offs with potential. Check
27	52.19681	-8.73736	2	Dead tree	Ivy has been cut but still quite thick. Check
28	52.19676	-8.73737	4	Ash	Has tear-off but no potential. Stick nests
29	52.19673	-8.73735	1	Ash	Horizontal future on branch, tear-off, check. Stick nest
30	52.19669	-8.73733	4	Ash	Immature
31	52.19668	-8.73729	2	Ash	Without ivy. Has a couple of holes in trunk. Quick check
32	52.19666	-8.7373	1	Ash	Large tree with canker. Check
33	52.19637	-8.73759	3	Ash	No sign but large tree
34	52.19625	-8.73762	4	Ash	No Potential
35	52.19621	-8.73767	2	Ash	One cavity, check
36	52.19622	-8.73776	4	Ash	2 immature ash no potential
37	52.19628	-8.73778	4	Ash	Cluster of immature ash, no potential
38	52.19618	-8.7379	2	Ash	Some canker, doesn’t seem to create cavity but have a quick check
39	52.196	-8.73763	4	Ash	No Potential
40	52.19607	-8.73759	4	Willow	Cluster of immature willow
41	52.19607	-8.73759	2	Fallen tree	Pealing bark
42	52.19598	-8.7375	4	Ash	No Potential
43	52.19596	-8.73748	4	Ash	No Potential
44	52.19591	-8.73742	2	Sycamore	Tear off, quick check
45	52.1959	-8.73738	2	Sycamore	Tear-off and cavity. Check
46	52.19589	-8.73727	2	Dead tree	Check
47	52.19587	-8.73735	4	Ash	No Potential

Number	Lat	Lon	Category	Name	Description
48	52.19583	-8.73732	4	Ash	No Potential
49	52.19584	-8.73715	4	Sycamore	No Potential
50	52.19579	-8.73708	4	Ash	Several low potential semi mature
51	52.19582	-8.73699	4	Ash	No Potential
52	52.19577	-8.73681	4	Blackthorn	No Potential
53	52.196	-8.73689	4	Ash	No Potential
54	52.19597	-8.73684	4	Ash	No Potential
55	52.19593	-8.7368	4	Ash	No Potential
56	52.19591	-8.73675	4	Ash	No Potential
57	52.1959	-8.73675	4	Ash	Canker but no cavity
58	52.19585	-8.73671	3	Ash	No sign but large tree
59	52.19579	-8.73675	4	Saplings	No Potential
60	52.19571	-8.73664	4	Ash	No Potential
61	52.19573	-8.73665	4	Ash	No Potential
62	52.1958	-8.73658	3	Ash	No sign but large tree
63	52.19593	-8.73666	3	Ash	Thick ivy but didn’t form a mat
64	52.1961	-8.73682	4	Ash	No Potential
65	52.19727	-8.734	4	Ash	Hedge no potential
66	52.19803	-8.73418	4	Hedge	No Potential
67	52.19842	-8.73571	4	Ash	Cluster of ash with no potential
68	52.19861	-8.73594	4	Cluster of ash	No potential. Larger have been knocked previously
69	52.19884	-8.73617	3	Ash	Mature. No cavities visible
70	52.20139	-8.73713	4	Hawthorn and willow scrub	No Potential
71	52.20164	-8.73754	2	Dead tree	Ivy. Unlikely but check
72	52.20168	-8.73759	4	Willow	No Potential
73	52.20193	-8.73811	4	Hawthorn	No Potential
74	52.20196	-8.73817	4	Willow	No Potential
75	52.20203	-8.7383	4	Ash	No Potential
76	52.20205	-8.73833	4	Ash	No Potential
77	52.20209	-8.73842	4	Hawthorn	No Potential
78	52.20218	-8.73864	4	Dead	No Potential
79	52.20156	-8.74102	4	Ash	No Potential
80	52.20135	-8.74054	4	Hawthorn	No Potential

Number	Lat	Lon	Category	Name	Description
81	52.20102	-8.73996	3	Hawthorn	Mature. Given category 3 as they are so cluttered but really not much potential
82	52.19886	-8.74048	4	Ash	No Potential
83	52.19885	-8.74073	4	Ash	No Potential
84	52.19893	-8.74024	2	Ash	Canker, unlikely but check
85	52.19869	-8.7423	4	Ash	No Potential
86	52.19863	-8.7424	4	Ash	No Potential
87	52.19866	-8.74247	4	Ash	No Potential
88	52.19868	-8.74249	4	Ash	No Potential
89	52.19871	-8.74253	4	Ash	No Potential
90	52.19879	-8.7426	3	Ash	Some ivy but not thick enough.
91	52.19887	-8.74265	4	Ash cluster	No Potential
92	52.19892	-8.74273	2	Dead ash	Pealing bark check
93	52.199	-8.74278	2	Several dead ash	Check pealing bark
94	52.19935	-8.74301	4	Elder and hawthorn	No potential
95	52.19973	-8.74319	3	Elder	Mature. Given category 3 as they are so cluttered but really not much potential
96	52.20017	-8.74342	2	Willow	Pealing bark quick check
97	52.20019	-8.74342	2	Willow	Tear-off quick check
98	52.20011	-8.74365	4	Willow	No potential
99	52.19977	-8.74432	4	Hedge	No potential
100	52.19944	-8.74589	4	Hedge	No potential
101	52.20078	-8.7468	4	Hedge	No potential
102	52.19823	-8.74731	4	Hedge	No potential
103	52.19693	-8.7485	4	Hedge	No potential
104	52.19696	-8.74906	3	Hawthorn	Mature. Given category 3 as they are so cluttered but really not much potential
105	52.19678	-8.74938	3	Hawthorn	Mature. Given category 3 as they are so cluttered but really not much potential
106	52.19656	-8.74925	4	Hedge	No potential
107	52.19506	-8.748	3	Hawthorn	Mature. Given category 3 as they are so cluttered but really not much potential

Number	Lat	Lon	Category	Name	Description
108	52.1952	-8.74722	3	Hawthorn	Mature. Given category 3 as they are so cluttered but really not much potential
109	52.19525	-8.74699	4	Ash	No Potential
110	52.19528	-8.747	4	Hawthorn	No Potential
111	52.19539	-8.74643	3	Hawthorn	Mature. Given category 3 as they are so cluttered but really not much potential
112	52.1955	-8.74592	3	Hawthorn x2	Mature. Given category 3 as they are so cluttered but really not much potential
113	52.19601	-8.74549	4	Hedge	No Potential
114	52.19566	-8.74443	3	Hedge species	Some maths but little cavities visible. Clutter bumps to 3
115	52.19445	-8.74309	3	Hawthorn	Mature. Given category 3 as they are so cluttered but really not much potential
116	52.19435	-8.74251	4	Blackthorn and willow hedge	No potential
117	52.19496	-8.74187	2	Ash	Tear out check
118	52.19501	-8.74189	2	Ash	Tear-off check
119	52.19517	-8.74201	4	Ash	No Potential
120	52.19518	-8.742	4	Ash	No Potential
121	52.19521	-8.74201	4	Ash	No Potential
122	52.19531	-8.74208	4	Ash	No Potential
123	52.19534	-8.74211	3	Ash	Rated 3 given its maturity and size
124	52.19543	-8.74217	2	Ash	Tear-off check
125	52.19564	-8.74232	4	Ash	No Potential
126	52.19454	-8.74155	4	Ash	No Potential
127	52.19423	-8.74073	4	Hedge	No Potential
128	52.19542	-8.74039	2	Ash	Chainsaw cut. Some tear-offs further up
129	52.19563	-8.74051	2	Ash	Small hole on truck. Check
130	52.19603	-8.74055	2	Elder	Cavity, check
131	52.19673	-8.74293	1	Ash	Very mature. Looks like cavity on limb
132	52.19723	-8.74045	4	Dead	No Potential
133	52.19727	-8.7403	4	Dead tree	No Potential
134	52.19761	-8.7391	2	Hawthorn	Small hole check
135	52.19769	-8.73849	1	Dead tree	Holes

Number	Lat	Lon	Category	Name	Description
136	52.19674	-8.73787	4	Ash	No Potential
137	52.19671	-8.73789	4	Ash	No Potential
138	52.19661	-8.73788	4	Ash	No Potential
139	52.19657	-8.73787	4	Ash	No Potential
140	52.1964	-8.73782	2	Ash	Tear-off and cavity
141	52.1964	-8.73794	4	Ash	No Potential
142	52.19638	-8.73797	4	Ash	No Potential
143	52.19613	-8.73865	2	Dead	Pealing bark
144	52.19611	-8.7388	4	Dead	No Potential
145	52.19611	-8.73889	3	Dead	Very occluded pealed bark
146	52.19611	-8.73901	4	Dead	No Potential
147	52.20163	-8.75211	4	Ash	No Potential
148	52.20147	-8.75195	3	Ash	Ivy but not thick enough. Tiny hole at end of cut off excluded
149	52.20141	-8.75191	4	Ash	No Potential
150	52.20058	-8.75115	4	Ash	No Potential
151	52.2005	-8.75109	4	Ash	No Potential
152	52.19943	-8.74982	3	Ash	Ivy but not thick enough
153	52.19952	-8.7494	4	Hedge of hawthorn	No potential
154	52.19976	-8.74897	4	Ash	No Potential
155	52.2	-8.74808	4	Hedge	No Potential
156	52.19878	-8.75098	4	Hedge	No Potential
157	52.19926	-8.75102	4	Oak	No potential
158	52.19923	-8.75104	4	Ash	No Potential
159	52.19963	-8.75177	4	Sycamore	No Potential
160	52.19967	-8.75182	4	Sycamore	No Potential
161	52.19987	-8.75238	4	Multiple immature	No potential
162	52.19992	-8.75234	4	Ash	No Potential
163	52.20008	-8.75282	4	Ash	No Potential
164	52.20014	-8.75302	3	Ash	Rated 3 given its maturity and size
165	52.20038	-8.75435	4	Sycamore	No Potential
166	52.20058	-8.75436	4	Willow, sycamore, dead tree	No potential
167	52.20054	-8.7546	3	Ash	Rated 3 given its maturity and size
168	52.2008	-8.75444	4	Ash	No Potential

Number	Lat	Lon	Category	Name	Description
169	52.20067	-8.75458	4	Beech	No potential
170	52.20093	-8.75511	4	Ash	No potential
171	52.20103	-8.75526	3	Ash	Rated 3 given its maturity and size
172	52.20105	-8.75538	2	Willow	Tear out unlikely but check
173	52.20124	-8.75638	4	Thick hedge	No potential
174	52.20137	-8.75641	4	Beech	No potential
175	52.20136	-8.75654	2	Oak	Lateral fissure. Unlikely but check
176	52.20136	-8.75667	1	Oak	Mature. Check
177	52.2017	-8.75719	4	Ash	No potential
178	52.20169	-8.75725	4	Ash	No potential
179	52.20159	-8.75717	4	Scrubby	No potential
180	52.20186	-8.75673	4	Ash	No potential
181	52.20213	-8.75587	1	Willow	Horizontal fissures
182	52.20266	-8.75414	4	Ash	No potential
183	52.2028	-8.75344	4	Ash	No potential
184	52.20061	-8.75638	4	Hedge	No potential
185	52.20535	-8.75501	4	Willow	Small cavity totally occluded
186	52.20607	-8.754	3	Ash	Large no feature.
187	52.20664	-8.75449	2	Ash	So large it needs a check
188	52.20687	-8.75435	4	Ash	No potential
189	52.20636	-8.75573	3	Ash	Ivy but not mat forming
190	52.20709	-8.75535	4	Hedge	No potential
191	52.20481	-8.75967	4	Crab apple	No potential
192	52.20472	-8.75978	4	Ash	No potential
193	52.20458	-8.75995	4	Ash	No potential
194	52.20448	-8.76015	4	Willow	4 willow of no potential
195	52.20435	-8.76178	1	Oak	Mature
196	52.20439	-8.76184	1	Oak	Mature
197	52.20452	-8.76197	1	Oak	Mature
198	52.20491	-8.76222	1	Oak	Mature
199	52.20498	-8.76225	3	Dead	Ivy covered falling
200	52.20512	-8.76235	4	Hawthorn	No potential
201	52.20528	-8.7621	4	Willow and elder	Several hedge species of no potential
202	52.20569	-8.76226	1	Elder	Low cavity
203	52.20576	-8.76231	1	Elder	Cavity in branch

Number	Lat	Lon	Category	Name	Description
204	52.2053	-8.76308	4	Hedge	No potential
205	52.20526	-8.76341	4	Ash	No potential
206	52.20521	-8.76364	3	Hawthorn	Mature. Given category 3 as they are so cluttered but really not much potential
207	52.2067	-8.76351	2	Spindle	Small cavity
208	52.20689	-8.76349	4	Blackthorn	No potential
209	52.20768	-8.76147	4	Hedge	No potential
210	52.20723	-8.76089	1	Lime	Leaning. Looks like cavity at tear-off
211	52.20718	-8.76045	4	Ash	No potential
212	52.20714	-8.7604	2	Dead tree	Small potential cavity
213	52.20681	-8.7603	2	Elder	Small potential cavity
214	52.2058	-8.75991	3	Hawthorn	Mature. Given category 3 as they are so cluttered but really not much potential
215	52.20564	-8.75986	3	Hawthorn	Mature. Given category 3 as they are so cluttered but really not much potential

Table 14. Initial roost inspection of built structures

Structure No	Lat	Long	Potential level	Details	Overall results
1	52.2058063	-8.7490749	Low	Derelict shed within woods	No roosting bats
2	52.196317	-8.7370549	High	Sheds to SW of T9	Brown Long-eared (4 bats recorded in September) roost
3	52.185341	-8.742135	High	Old stone building	No roosting bats
4	52.219638	-8.669576	High	Ballybeg Prior	Single Soprano Pipistrelle observed roosting
5	52.2068705	-8.7454147	High	Farmyard to NE	No roosting bats but good bat activity
6	52.203841	-8.761004	Medium	Old growth tree	No roosting bats
7	52.1776039	-8.7391884	High	Derelict house to south	No roosting bats

Structure No	Lat	Long	Potential level	Details	Overall results
8	52.222672	-8.745579	High	RC church in Lisgriffin	No roosting bats

ANNEX 4 – BAT EMERGENCE/ACTIVITY SURVEY DATA

Survey effort summary

Table 15. Summary of survey effort for emergence and activity surveys 2022.

Survey	Date	Survey type	Start Time	End Time	Location	Details	Grid ref (ITM) Start / Finish	Sunset / sunrise
1	06/072022	Roost survey	21:26	22:35	1	Large group of trees located near main farm at entrance to site. Small derelict shed also located here.	52.2058063, -8.7490749	22:03
		Walked transect	22:40	00:25	T1	Walked transect from north-eastern farmyard through southern section of the site. Finished near farm buildings where majority of bat activity was detected.	Loop from 52.2058063, -8.7490749	
2	07/07/2007	Walked transect	03:18	04:00	T2	Walked remaining sections of southern section of site passed proposed turbine 6 as this area had high activity recorded from statics. Low level bat activity recorded.	Loop from 52.196317, -8.7370549	05:23
		Roost survey	04:05	05:23	2	Sheds to the south of main site. A number of new buildings clearly in use with low potential for bat activity. Two smaller older stone buildings were the focus of survey however roof on one was largely gone. No roosting behaviour found.	52.196317, -8.7370549	

Survey	Date	Survey type	Start Time	End Time	Location	Details	Grid ref (ITM) Start / Finish	Sunset / sunrise
3	02/08/2022	Emergence survey	20:55	22:55	3	Old stone building to south of site. Barn swallows and wren nesting in building. While some bat activity observed on the road, no bats found emerging from building or any bat activity in the building.	52.185341, -8.742135	09:25
		Driven transect	23:04	23:28	T3	Driven transect from emergence site to main road.	52.185248, -8.742504 / 52.197234, -8.673264	
4	03/08/2022	Roost survey	03:57	05:57	4	Ballybeg priory near Buttevant approximately 5km from site. Site brightly lit on north face of building at night but south facing aspect in darkness. Lots of small crevices etc. One Soprano pip roosting.	52.219638, -8.669576	05:57
5	08/08/2022	Emergence survey	20:44	22:20	5	Walked around NE farm buildings checking for emerging bats and bat activity. Large amount of bat activity in all barn buildings, particularly buildings to the east housing calves, just after sunset (hunting and gathering rather than roosting). Bats did not seem to be emerging from old stone building adjacent to milking parlour or old farmhouse. It seemed bats were emerging from roost near farmyard and then congregating in farm buildings until it got darker. Some foraging activity in farmyard and large amount of activity at trees to north of farmyard.	52.2068705, -8.7454147	21:14

Survey	Date	Survey type	Start Time	End Time	Location	Details	Grid ref (ITM) Start / Finish		Sunset / sunrise
		Walked transect	22:20	23:44	T4	Walked transect on treeline approach to farm building, mature trees to east of farmyard and tree line leading to site. Bats commuting up and down tree line to and from farmyard and site.	52.207130, -8.7445506	52.206709, -8.7451329	
6	09/08/2022	Roost survey	04:06	06:06	5	Focused roost survey at NE farmyard again. Most barns seemed unsuitable for roosts (metal no obvious place to roost). No bats observed roosting at buildings.	52.206508, -8.745424		06:06
7	28/09/2022	Emergence survey	20:02	21:26	6	Emergence count at old growth tree to northwest of site. No bats emerging in area.	52.203841, -8.761004		20:32
		Walked transect	21:26	23:03	T5	Walked transect from emergence count around north of site focusing on ditches and hedgerows for areas of bat activity. Lots of bat activity and insects along ditches and on areas leading to farm.	52.203841, -8.761004	52.206884, -8.744482	
8	29/08/2022	Roost survey	04:42	06:42	7	Derelict house to south of site (hinterland) with large patch of trees nearby. Good connectivity to southern part of site and on previous surveys bats seen coming up road from this area however very little bat activity detected.	52.1776039, -8.7391884		06:42
9	13/09/2022	Roost survey	19:20	22:20	2	Resurveyed sheds to SE of T9. Two rooms contained 2 brown long-eared bats roosting under rafters. A pair of Common Pipistrelle were flying around the place showing mating behaviour. Pipistrelle were not found to be roosting.	52.196317, -8.7370549		19:53

Survey	Date	Survey type	Start Time	End Time	Location	Details	Grid ref (ITM) Start / Finish	Sunset / sunrise
10	14/09/2022	Roost survey	05:26	07:26	8	RC church in Lisgriffin. No sign of roosting bats.	52.222672, -8.745579	07:26

Emergence survey data

Table 16. Emergence survey by north-eastern woods with derelict shed (west of farmyard)

Location	Contact number	Date	Time	Species	Details	Lat	Long
1	1.1	06/07/2022	22:08	Soprano Pip	Brief unseen	52.20581	-8.74907
1	2.1	06/07/2022	22:10	Common Pip	Bat observed	52.20578	-8.74913
1	3.1	06/07/2022	22:11	Common Pip		52.20577	-8.74914
1	4.1	06/07/2022	22:13	Common Pip	Bat observed coming from direct of farmstead	52.20578	-8.74885
1	5.1	06/07/2022	22:14	Soprano Pip	Bat observed coming from direct farmstead	52.20582	-8.74897
1	6.1	06/07/2022	22:16	Common Pip		52.2058	-8.74902
1	7.1	06/07/2022	22:17	Common Pip		52.20584	-8.74909
1	8.1	06/07/2022	22:18	Common Pip		52.20584	-8.7491
1	9.1	06/07/2022	22:18	Soprano Pip		52.20584	-8.7491
1	10.1	06/07/2022	22:18	Common Pip		52.20583	-8.74924
1	11.1	06/07/2022	22:18	Common Pip	Rapidly transiting up the hedgerow from direction of farmstead	52.20583	-8.74924
1	12.1	06/07/2022	22:21	Soprano Pip		52.20576	-8.74907
1	13.1	06/07/2022	22:22	Common Pip		52.20585	-8.7491

Location	Contact number	Date	Time	Species	Details	Lat	Long
1	14.1	06/07/2022	22:23	Common Pip		52.20573	-8.74919
1	15.1	06/07/2022	22:24	Soprano Pip	Rapidly transiting up the hedgerow from direction of farmstead	52.20586	-8.74923
1	16.1	06/07/2022	22:25	Common Pip	Rapidly transiting up the hedgerow from direction of farmstead	52.20588	-8.74888
1	17.1	06/07/2022	22:27	Common Pip		52.20578	-8.74911
1	18.1	06/07/2022	22:29	Soprano Pip	Two bats observed hunting	52.2057	-8.7491
1	19.1	06/07/2022	22:29	Soprano Pip		52.20577	-8.74917
1	20.1	06/07/2022	22:30	Common Pip		52.20577	-8.74902

Table 17. Emergence survey by southern shed (close to Turbine 9)

Location	Contact number	Date	Time	Species	Details	Lat	Long
2	1.2	07/07/2022	04:07	Soprano Pip		52.19633	-8.73702
2	2.2	07/07/2022	04:08	Common Pip		52.19633	-8.73704
2	3.2	07/07/2022	04:16	Common Pip		52.19613	-8.73705

Location	Contact number	Date	Time	Species	Details	Lat	Long
2	4.2	07/07/2022	04:17	Common Pip		52.19619	-8.73703
2	5.2	07/07/2022	04:21	Common Pip		52.19631	-8.73704
2	6.2	07/07/2022	04:24	Brown Long-eared		52.19624	-8.73746
2	7.2	07/07/2022	04:58	Soprano Pip		52.19618	-8.73774
2	8.2	07/07/2022	04:40	Common Pip		52.19627	-8.73746
2	9.2	07/07/2022	04:41	Leisler's		52.19621	-8.73743
2	10.2	07/07/2022	04:53	Soprano Pip	Commuting, passing overhead	52.19625	-8.73729
2	11.2	07/07/2022	04:53	Soprano Pip		52.1963	-8.73745
2	12.2	07/07/2022	04:58	Soprano Pip		52.19619	-8.73775

Table 18. Emergence survey by southern shed, close to Turbine 9 (repeat survey)

Location	Contact number	Date	Time	Species	Details
2	1	13/09/2022	19:41	Common Pip	Brief first bat recorded
2	2	13/09/2022	20:20	Leisler's	Brief contact
2	3	13/09/2022	20:26	Soprano Pip	Brief
2	4	13/09/2022	20:30	Common Pip	Passing over buildings
2	5	13/09/2022	20:35	Common Pip	Pair flying around shed. Lots of social calls. Swarming, mating behaviour
2	6	13/09/2022	20:46	Natterers	Flying to south of stone shed
2	7	13/09/2022	21:07	Brown long-eared	Two groups of two in the larger rooms. Roosting by rafters.
2	8	13/09/2022	21:08	Leisler's	Brief
2	9	13/09/2022	21:09	Common Pip	

Table 19. Emergence survey of stone buildings to the south of the site.

Location	Contact number	Date	Time	Species	Details	Lat	Long
3	1	02/08/2022	21:48	Common Pip	Commuting Heading north	52.18537	-8.74219
3	2	02/08/2022	21:50	Common Pip	Commuting Heading north	52.18536	-8.74219
3	3	02/08/2022	21:51	Leisler's	Passing	52.18539	-8.74222
3	4	02/08/2022	21:51	Common Pip	Commuting Heading north	52.1854	-8.74234
3	5	02/08/2022	21:54	Soprano Pip		52.18536	-8.74218
3	6	02/08/2022	21:56	Common Pip	Commuting Heading south	52.18539	-8.74224
3	7	02/08/2022	21:56	Leisler's	Brien unseen	52.18539	-8.74224
3	8	02/08/2022	21:57	Soprano Pip	Passing Heading east	52.18539	-8.74222
3	9	02/08/2022	21:59	Leisler's		52.18536	-8.7422
3	10	02/08/2022	22:25	Common Pip	Feeding Heading south	52.18539	-8.74225
3	11	02/08/2022	22:26	Common Pip	Feeding	52.18551	-8.74238
3	12	02/08/2022	22:27	Common Pip	Feeding	52.18549	-8.74236
3	13	02/08/2022	22:29	Common Pip	Feeding	52.18547	-8.74229
3	14	02/08/2022	22:30	Common Pip	Commuting heading north	52.18537	-8.74228

Table 20. Dawn re-entry survey at Ballybeg Priory.

Location	Contact number	Date	Time	Species	Details	Lat	Long
4	1	03/08/2022	04:25	Soprano Pip	Flying overhead heading east	52.21925	-8.66987
4	2	03/08/2022	05:35	Soprano Pip	Roosting in southern aspect of wall (see photo)	52.21945	-8.66993

Table 21. Emergence survey by farmyard to north-eat of the site.

Location	Contact number	Date	Time	Species	Details	Lat	Long
5	1	08/08/2022	21:26	Common Pip	Unseen bat	52.20646	-8.74522
5	2	08/08/2022	21:33	Leisler's	Unseen bat	52.20646	-8.74522
5	3	08/08/2022	21:37	Common Pip	Flying around barn	52.20646	-8.74516
5	4	08/08/2022	21:41	Common Pip	Flying out of barn	52.20643	-8.74521
5	5	08/08/2022	21:45	Common Pip	Bats flying around barn	52.20672	-8.74617
5	6	08/08/2022	21:45	Soprano Pip	Bats flying around barn	52.20672	-8.74617
5	7	08/08/2022	21:46	Common Pip	Flying out of Barn	52.20643	-8.74572
5	8	08/08/2022	21:48	Leisler's	Unseen bat	52.20643	-8.74572
5	9	08/08/2022	21:49	Common Pip	Flying around barn	52.2069	-8.74557
5	10	08/08/2022	21:50	Common Pip		52.20715	-8.74579

Location	Contact number	Date	Time	Species	Details	Lat	Long
5	11	08/08/2022	21:53	Common Pip	Fly in and out of barn	52.20703	-8.74555
5	12	08/08/2022	21:55	Common Pip		52.20724	-8.7451
5	13	08/08/2022	21:58	Soprano Pip		52.20704	-8.74555
5	14	08/08/2022	21:58	Common Pip		52.20704	-8.74555
5	15	08/08/2022	21:59	Common Pip	Flying around farmyard	52.20704	-8.74537
5	16	08/08/2022	22:11	Leisler's		52.20692	-8.74527
5	17	08/08/2022	22:14	Common Pip	Flying towards site	52.2071	-8.74499
5	18	08/08/2022	22:16	Common Pip	heading towards site	52.20708	-8.74533

Table 22. Dawn re-entry survey in NE farmyard (repeated)

Location	Contact number	Date	Time	Species	Details
5	1	09/08/2022	04:16	Common Pip	Occasional activity
5	2	09/08/2022	04:18	Myotis species	brief contact
5	3	09/08/2022	04:22	Soprano Pip	
5	4	09/08/2022	04:24	Common Pip	
5	5	09/08/2022	04:29	Common Pip	Occasional activity
5	6	09/08/2022	04:32	Common Pip	
5	7	09/08/2022	04:35	Leisler	Brief unseen
5	8	09/08/2022	04:36	Soprano Pip	Brief
5	9	09/08/2022	04:37	Common Pip	Feeding
5	10	09/08/2022	04:39	Common Pip Social call	

Location	Contact number	Date	Time	Species	Details
5	11	09/08/2022	04:41	Common Pip Social call	
5	12	09/08/2022	04:41	Soprano Pip Social call	
5	13	09/08/2022	04:41	Common Pip	
5	14	09/08/2022	04:49	Soprano Pip	brief
5	15	09/08/2022	04:50	Common Pip	
5	16	09/08/2022	04:53	Pip social	
5	17	09/08/2022	04:53	Common Pip	
5	18	09/08/2022	04:54	Soprano Pip	Couple of calls
5	19	09/08/2022	04:57	Common Pip	
5	20	09/08/2022	05:07	Soprano Pip	
5	21	09/08/2022	05:15	Leisler	

Table 23. Emergence survey of old growth tree to NW end of the site.

Location	Contact number	Date	Time	Species	Details	Lat	Long
6	1	28/08/2022	20:46	Leisler's	Brief unseen occasional calls	52.20388	-8.76102
6	2	28/08/2022	20:50	Common Pip	Occasional brief calls	52.20388	-8.76102
6	3	28/08/2022	20:56	Leisler's		52.20388	-8.76102
6	4	28/08/2022	20:56	Common Pip		52.20388	-8.76102
6	5	28/08/2022	21:00	Soprano Pip	Brief unseen	52.20372	-8.76085
6	6	28/08/2022	21:00	Common Pip		52.20372	-8.76085
6	7	28/08/2022	21:06	Soprano Pip		52.20372	-8.76085
6	8	28/08/2022	21:07	Social	Likely from Soprano Pipistrelle	52.20372	-8.76085

Location	Contact number	Date	Time	Species	Details	Lat	Long
6	9	28/08/2022	21:07	Common Pip		52.20372	-8.76085
6	10	28/08/2022	21:08	Soprano Pip		52.20372	-8.76085
6	11	28/08/2022	21:08	Soprano Pip	Feeding along hedge	52.20372	-8.76085
6	12	28/08/2022	21:15	Leisler's	Brief	52.20372	-8.76085
6	13	28/08/2022	21:16	Common Pip		52.20372	-8.76085
6	14	28/08/2022	21:18	Common Pip	Passing Flying north off site	52.20377	-8.76107
6	15	28/08/2022	21:19	Brown Long-eared	Flying along hedge	52.20377	-8.76107
6	16	28/08/2022	21:19	Leisler's		52.20377	-8.76107
6	17	28/08/2022	21:20	Common Pip	Commuting Flying south onto site	52.20381	-8.76086
6	18	28/08/2022	21:21	Soprano Pip	Flying east along hedge	52.20359	-8.76085
6	19	28/08/2022	21:24	Soprano Pip		52.20368	-8.76085
6	20	28/08/2022	21:24	Leisler's		52.20368	-8.76085
6	21	28/08/2022	21:26	Common Pip		52.20368	-8.76085

Table 24. Dawn re-entry survey Derelict house to south of site (hinterland).

Location	Contact number	Date	Time	Species	Details	Lat	Long
7	1	29/08/2022	04:56	Myotis species	Brief hunting buzz recorded. Did not see it	52.17776	-8.73929

Location	Contact number	Date	Time	Species	Details	Lat	Long
7	2	29/08/2022	04:56	Common Pip	With social call	52.17776	-8.73929
7	3	29/08/2022	05:05	Leisler's	Occasional contacts from hunting bat	52.17748	-8.73923
7	4	29/08/2022	05:09	Common Pip		52.17756	-8.73925
7	5	29/08/2022	05:12	Myotis species		52..17756	-8.73925
7	6	29/08/2022	05:26	Leisler's	Also Pip social call	52.17754	-8.73924
7	7	29/08/2022	05:32	Soprano Pip	Occasional contacts from hunting bat	52.17754	-8.73924
7	8	29/08/2022	05:34	Leisler's		52.17754	-8.73924
7	9	29/08/2022	06:13	Soprano Pip	eading South	52.17734	-8.73915
7	10	29/08/2022	06:22	Soprano Pip	Flying overhead heading west	52.17746	-8.73929
7	11	29/08/2022	06:24	Soprano Pip	Brief distant unseen	52.1775	-8.73922

Table 25. Re-entry survey by church to north (hinterland).

Location	Contact number	Date	Time	Species	Details
8	1	14/09/2022	06:02	Soprano Pip	brief contact passing
8	2	14/09/2022	06:19	Common Pip	brief contact

Activity survey data

Table 26. Transect survey results from north-eastern farmyard through southern section of the site.

Location	Contact number	Date	Time	Species	Details	Lat	Long
T1	1	06/07/2022	22:38	Soprano Pip		52.20559	-8.74917
T1	2	06/07/2022	23:02	Soprano Pip	Feeding activity	52.19977	-8.75014
T1	3	06/07/2022	23:29	Soprano Pip		52.20094	-8.74863
T1	4	06/07/2022	23:43	Soprano Pip		52.20366	-8.75207
T1	5	06/07/2022	00:07	Soprano Pip		52.20444	-8.74812
T1	6	06/07/2022	00:11	Soprano Pip		52.20544	-8.74891
T1	7	06/07/2022	00:13	Common Pip		52.20565	-8.74923
T1	8	06/07/2022	00:14	Common Pip	Feeding	52.20587	-8.74859
T1	9	06/07/2022	00:15	Soprano Pip		52.20598	-8.74817
T1	10	06/07/2022	00:16	Soprano Pip	Two bats observed hunting	52.20618	-8.74751
T1	11	06/07/2022	00:17	Soprano Pip		52.20624	-8.74719
T1	12	06/07/2022	00:17	Common Pip		52.20628	-8.74705
T1	13	06/07/2022	00:19	Soprano Pip		52.20612	-8.74693

Table 27. Transect survey results through southern section of the site around Turbine 6.

Location	Contact number	Date	Time	Species	Details	Lat	Long
T2	15	07/07/2022	03:18	Soprano Pip		52.19893	-8.74794

Location	Contact number	Date	Time	Species	Details	Lat	Long
T2	16	07/07/2022	03:19	Common Pip		52.19899	-8.74723
T2	17	07/07/2022	03:20	Common Pip		52.1993	-8.74588
T2	18	07/07/2022	03:21	Common Pip		52.19917	-8.74528
T2	19	07/07/2022	03:28	Myotis species	3 contacts	52.19825	-8.74201
T2	20	07/07/2022	03:57	Common Pip		52.19799	-8.73662
T2	21	07/07/2022	04:00	Common Pip		52.19754	-8.73479

Table 28. Driven transect along secondary road to south of the site.

Location	Contact number	Date	Time	Species	Lat	Long
T3	1	02/08/2022	23:06	Common Pipistrelle	52.1879	-8.74072
T3	2	02/08/2022	23:07	Soprano Pipistrelle	52.18921	-8.73815
T3	3	02/08/2022	23:07	Leisler's Bat	52.18921	-8.73815
T3	4	02/08/2022	23:07	Soprano Pipistrelle	52.18965	-8.73657
T3	5	02/08/2022	23:08	Soprano Pipistrelle	52.19048	-8.73449
T3	6	02/08/2022	23:08	Common Pipistrelle	52.1905	-8.73418
T3	7	02/08/2022	23:09	Common Pipistrelle	52.19155	-8.73113
T3	8	02/08/2022	23:09	Common Pipistrelle	52.19206	-8.73045
T3	9	02/08/2022	23:09	Common Pipistrelle	52.19215	-8.73007
T3	10	02/08/2022	23:09	Common Pipistrelle	52.1925	-8.72902
T3	11	02/08/2022	23:10	Leisler's Bat	52.19369	-8.72571

Location	Contact number	Date	Time	Species	Lat	Long
T3	12	02/08/2022	23:10	Leisler's Bat	52.19405	-8.7252
T3	13	02/08/2022	23:11	Common Pipistrelle	52.1954	-8.72113
T3	14	02/08/2022	23:11	Leisler's Bat	52.19565	-8.72019
T3	15	02/08/2022	23:11	Common Pipistrelle	52.19576	-8.71985
T3	16	02/08/2022	23:13	Common Pipistrelle	52.1966	-8.71699
T3	17	02/08/2022	23:14	Soprano Pipistrelle	52.19775	-8.71311
T3	18	02/08/2022	23:14	Leisler's Bat	52.19797	-8.71276
T3	19	02/08/2022	23:14	Common Pipistrelle	52.1979	-8.7127
T3	20	02/08/2022	23:15	Soprano Pipistrelle	52.19824	-8.71168
T3	21	02/08/2022	23:18	Common Pipistrelle	52.19974	-8.7016
T3	22	02/08/2022	23:19	Common Pipistrelle	52.1986	-8.69737
T3	23	02/08/2022	23:22	Common Pipistrelle	52.19763	-8.69012
T3	24	02/08/2022	23:22	Common Pipistrelle	52.19763	-8.69012
T3	25	02/08/2022	23:22	Leisler's Bat	52.19753	-8.68869
T3	26	02/08/2022	23:22	Common Pipistrelle	52.19717	-8.68772
T3	27	02/08/2022	23:23	Soprano Pipistrelle	52.19698	-8.68609
T3	28	02/08/2022	23:24	Soprano Pipistrelle	52.1962	-8.67977

Table 29. Transect survey around treelines, hedges, and paths surrounding the farmyard to the north-east.

Location	Contact number	Date	Time	Species	Details	Lat	Long
T4	1	08/08/2022	22:21	Soprano Pip	Flying up tree line towards site	52.20706	-8.74366
T4	2	08/08/2022	22:23	Soprano Pip	Flying up tree line towards site	52.20713	-8.74334
T4	3	08/08/2022	22:26	Common Pip	Flying along road towards site	52.20746	-8.74236
T4	4	08/08/2022	22:30	Soprano Pip	Towards site	52.20798	-8.74127
T4	5	08/08/2022	22:33	Common Pip	Feeding	52.20814	-8.74084
T4	6	08/08/2022	22:35	Common Pip	Towards site	52.20791	-8.74144
T4	7	08/08/2022	22:48	Common Pip	Lots of bat activity in trees	52.20719	-8.74508
T4	8	08/08/2022	22:48	Soprano Pip	Lots of bat activity in trees	52.2074	-8.745
T4	9	08/08/2022	22:48	Leisler's	Lots of bat activity in trees	52.2079	-8.74504
T4	10	08/08/2022	22:51	Common Pip	Bat activity in farmyard	52.20711	-8.7452
T4	11	08/08/2022	22:51	Soprano Pip	Bat activity in farmyard	52.20715	-8.74528
T4	12	08/08/2022	22:51	Leisler's	Bat activity in farmyard	52.20719	-8.74528
T4	13	08/08/2022	23:00	Common Pip	Feeding	52.20637	-8.74469

Location	Contact number	Date	Time	Species	Details	Lat	Long
T4	14	08/08/2022	23:02	Common Pip	Towards farm	52.20585	-8.74395
T4	15	08/08/2022	23:09	Common Pip	Feeding	52.20626	-8.74466
T4	16	08/08/2022	23:13	Unidentified Pip	Flying around farmyard	52.20637	-8.74645
T4	17	08/08/2022	23:16	Common Pip	Feeding	52.20613	-8.74775
T4	18	08/08/2022	23:21	Myotis	Flew over head	52.20612	-8.74766
T4	19	08/08/2022	23:26	Common Pip	Flying around farmyard	52.2066	-8.74551
T4	20	08/08/2022	23:43	Common Pip		52.20692	-8.7453
T4	21	08/08/2022	23:43	Leisler’s		52.20681	-8.74506
T4	22	08/08/2022	23:43	Soprano Pip		52.2068	-8.74517
T4	23	08/08/2022	23:44	Leisler’s		52.20681	-8.74518

Table 30. Transect in northern half of the site from east to west.

Location	Contact number	Date	Time	Species	Details	Lat	Long
T5	1	28/08/2022	21:31	Leisler’s	Passing	52.20269	-8.76011
T5	2	28/08/2022	21:31	Common Pip	Brief	52.20207	-8.76019
T5	3	28/08/2022	21:43	Soprano Pip	Feeding	52.2041	-8.76038
T5	4	28/08/2022	21:53	Common Pip	Feeding	52.20409	-8.75718
T5	5	28/08/2022	21:55	Leisler’s	Passing	52.20402	-8.75572
T5	6	28/08/2022	21:55	Common Pip	Feeding	52.20384	-8.75565
T5	7	28/08/2022	21:57	Soprano Pip	Feeding	52.20425	-8.75578
T5	8	28/08/2022	21:59	Soprano Pip	Feeding	52.20462	-8.75618

Location	Contact number	Date	Time	Species	Details	Lat	Long
T5	9	28/08/2022	22:00	Soprano Pip	Feeding	52.20534	-8.75672
T5	10	28/08/2022	22:03	Soprano Pip	Feeding	52.20618	-8.75701
T5	11	28/08/2022	22:06	Soprano Pip	Feeding	52.20577	-8.75621
T5	12	28/08/2022	22:07	Leisler's Bat	Passing on detector not observed	52.20546	-8.75545
T5	13	28/08/2022	22:10	Soprano Pip	Feeding	52.20594	-8.75641
T5	14	28/08/2022	22:14	Common Pip	Passing on detector not observed	52.20703	-8.75427
T5	15	28/08/2022	22:16	Soprano Pip	Feeding	52.2065	-8.75332
T5	16	28/08/2022	22:17	Soprano Pip	Feeding	52.20598	-8.75404
T5	17	28/08/2022	22:20	Common Pip	Passing	52.2052	-8.75498
T5	18	28/08/2022	22:23	Common Pip	Passing Flying overhead	52.20416	-8.75584
T5	19	28/08/2022	22:29	Common Pip	Feeding	52.20257	-8.75972
T5	20	28/08/2022	22:38	Soprano Pip	Feeding	52.20281	-8.75689
T5	21	28/08/2022	22:39	Soprano Pip	Feeding	52.20304	-8.75615
T5	22	28/08/2022	22:40	Soprano Pip	Feeding	52.20328	-8.75539
T5	23	28/08/2022	22:55	Common Pip	Passing	52.2056	-8.74899
T5	24	28/08/2022	22:57	Common Pip	2 bats commutin g	52.2059	-8.74878
T5	25	28/08/2022	23:02	Common Pip	Flying around farmyard	52.20657	-8.74552

ANNEX 5 – STATIC DETECTOR DATA

Table 31. Habitats surrounding proposed turbines with comments on static locations and landscape features suitable for bat.

Turbine No	Detectors used for assessing impact	Approx. Distance between detector and turbine	Approximate proportion of habitats within 200m of proposed turbine								Comments on static locations and landscape features suitable for bats	No. of nights static deployed
			Habitat 1	%	Habitat 2	%	Habitat 3	%	Habitat 4+	%		
1	D1	93m SW	GA1	75	BC1	15	WL1	5	WL2, GS4, WS1	5	Detector set along hedgerow with connectivity to the NW and W. Detector malfunctioned for August period.	40 nights
	D1a	At turbine location									Detector set in open field without landscape features at proposed location of turbine. Detector set for summer and August periods. This detector provides good comparative data showing the difference between activity in open habitats to those adjacent to landscape features.	23 nights
2	D2	Close to turbine attached to fence (25 m)	GA1	93	WL1	7	-				Turbine set in grassland 40m from hedge set close to existing fence. Detector set on fence within 25m of proposed turbine. Activity will be similar.	50 nights
3	D3	At turbine location	GA1	93	WL1, WL2	7	-				Turbine set in grassland 20m from hedge. Detector recorded for four nights in August and seven nights in September.	40 nights

Turbine No	Detectors used for assessing impact	Approx. Distance between detector and turbine	Approximate proportion of habitats within 200m of proposed turbine								Comments on static locations and landscape features suitable for bats	No. of nights static deployed
			Habitat 1	%	Habitat 2	%	Habitat 3	%	Habitat 4+	%		
4	D4	At turbine location	GA1	93	WL1	7	-				Turbine proposed along existing track with closely cropped hedge.	50 nights
5	D5	At turbine location	GA1	88	WL1	7	WS1, FL8	5	-		Turbine proposed adjacent to hedgerow. Small stand of trees surrounding former quarry lies 74m to east.	50 nights
6	D6	60m south	GA1	93	WL1	7	-				Detector set along same hedgerow with similar features. Activity will be similar.	50 nights
7	D7	130m south-east	BC1, GA1, BC3	88	WL1	7	WS1	5	-		Proposed turbine is set within arable land 45m from the closest landscape feature. Detector was set by a hedgerow. It is likely activity was significantly higher at hedgerow.	50 nights
	D1a	1450m									Given the differences in landscape features between D7 and T7 data from this detector is also used given it was set in open habitat similar to T7.	23 nights
8	D8	83m west	BC1, GA1, BC3	83	WL1, WL2	10	WS1	7	ED2	+	Detector set by treeline 83m west of turbine. Turbine is proposed close to hedgerow. Given the additional shelter by detector it is likely to be similar or marginally higher activity at detector location. Detector	40 nights

Turbine No	Detectors used for assessing impact	Approx. Distance between detector and turbine	Approximate proportion of habitats within 200m of proposed turbine								Comments on static locations and landscape features suitable for bats	No. of nights static deployed
			Habitat 1	%	Habitat 2	%	Habitat 3	%	Habitat 4+	%		
											recorded for first six nights of April survey.	
9	D9	65m south	GA1, BC3	85	WL1, WL2	10	WN	3	BL3	2	Detector set close to treeline, 65m south of turbine. Turbine is located within centre of field. Activity is likely to be substantially lower at turbine location than by detector. (Based on comparisons between D1 and D1a).	50 nights
	D1a	1.96km									Given the differences in landscape features between D9 and T9 data from this detector is also used given it was set in open habitat similar to T9.	23 nights

Table 32. Summary static detector results by species.

Detector	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total	Minutes recorded	Bat passes per hour
1	674	2059	2431	1	63	44	26	0	189	5298	22939	13.9
1a	166	141	135	0	7	22	3	0	124	474	11586	2.5
2	2521	492	553	0	39	24	4	0	51	3633	29009	7.5
3	2243	5582	10163	1	231	51	4	0	186	18275	22248	49.3
4	1055	2009	1130	1	98	24	5	0	56	4322	29009	8.9
5	1317	4572	3753	11	436	49	44	0	241	10182	29009	21.1
6	2331	4386	3239	1	328	15	18	2	139	10320	29009	21.3
7	943	4636	1212	12	79	17	4	0	114	6903	29009	14.3
8	1052	5363	1478	1	51	22	8	0	109	7975	23781	20.1
9	1460	5998	1942	8	355	206	63	0	421	10032	29009	20.7
Total	13762	35238	26036	36	1687	474	179	2	1630	77414	254608	18.2
Average Bat passes per hour[7]	3.1	8.0	6.3	0.01	0.4	0.1	0.04	0.0	0.4	-		

[7] Over the whole site

Table 33. Bat activity within each activity band for each species – all seasons combined

Location	Species	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity	Median Percentile	Bat Activity Category
1	*Myotis*	1	3	6	16	14	29	Low to Moderate
1	*Myotis daubentonii*	0	0	0	0	40	0	Low
1	*Myotis nattereri*	0	1	1	1	37	0	Low
1	*Nyctalus leisleri*	9	13	9	3	6	65	Moderate to High
1	*Pipistrellus nathusii*	0	2	3	5	30	0	Low
1	***Pipistrellus pipistrellus***	**28**	**5**	**4**	**2**	**1**	**85**	**High**
1	*Pipistrellus pygmaeus*	18	17	3	1	1	79	Moderate to High
1	*Plecotus auritus*	0	1	4	5	30	0	Low
1a	*Myotis*	0	6	3	4	10	29	Low to Moderate
1a	*Myotis daubentonii*	0	0	0	0	23	0	Low
1a	*Myotis nattereri*	0	0	0	0	23	0	Low
1a	*Nyctalus leisleri*	0	7	5	4	7	42	Moderate
1a	*Pipistrellus nathusii*	0	0	0	1	22	0	Low
1a	*Pipistrellus pipistrellus*	1	2	8	4	8	35	Low to Moderate
1a	*Pipistrellus pygmaeus*	0	4	9	5	5	42	Moderate
1a	*Plecotus auritus*	0	0	2	3	18	0	Low
2	*Myotis*	0	0	4	8	38	7	Low
2	*Myotis daubentonii*	0	0	0	0	50	0	Low
2	*Myotis nattereri*	0	0	0	0	50	0	Low
2	*Nyctalus leisleri*	16	17	10	1	6	72	Moderate to High

Location	Species	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity	Median Percentile	Bat Activity Category
2	*Pipistrellus nathusii*	0	0	3	8	39	0	Low
2	*Pipistrellus pipistrellus*	6	11	15	5	13	53	Moderate
2	*Pipistrellus pygmaeus*	4	20	10	3	13	59	Moderate
2	*Plecotus auritus*	0	0	0	6	44	0	Low
3	*Myotis*	1	5	9	13	12	31	Low to Moderate
3	*Myotis daubentonii*	0	0	0	0	40	0	Low
3	*Myotis nattereri*	0	0	0	1	39	0	Low
3	*Nyctalus leisleri*	14	11	6	2	7	70	Moderate to High
3	*Pipistrellus nathusii*	4	2	4	6	24	8	Low
3	***Pipistrellus pipistrellus***	**26**	**7**	**3**	**2**	**2**	**91**	**High**
3	***Pipistrellus pygmaeus***	**29**	**7**	**1**	**0**	**3**	**94**	**High**
3	*Plecotus auritus*	0	0	6	4	30	4	Low
4	*Myotis*	0	0	2	11	37	7	Low
4	*Myotis daubentonii*	0	0	0	0	50	0	Low
4	*Myotis nattereri*	0	0	0	0	50	0	Low
4	*Nyctalus leisleri*	10	18	12	2	8	66	Moderate to High
4	*Pipistrellus nathusii*	0	2	7	3	38	5	Low
4	*Pipistrellus pipistrellus*	13	15	7	2	13	66	Moderate to High
4	*Pipistrellus pygmaeus*	8	14	15	6	7	57	Moderate
4	*Plecotus auritus*	0	0	0	1	49	0	Low
5	*Myotis*	2	6	11	10	21	28	Low to Moderate

Location	Species	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity	Median Percentile	Bat Activity Category
5	*Myotis daubentonii*	0	0	0	0	50	0	Low
5	*Myotis nattereri*	0	2	2	3	43	0	Low
5	*Nyctalus leisleri*	12	17	7	8	6	63	Moderate to High
5	*Pipistrellus nathusii*	2	8	5	13	22	29	Low to Moderate
5	***Pipistrellus pipistrellus***	**32**	**8**	**4**	**1**	**5**	**87**	**High**
5	***Pipistrellus pygmaeus***	**29**	**10**	**3**	**0**	**8**	**85**	**High**
5	*Plecotus auritus*	0	0	3	8	39	5	Low
6	*Myotis*	0	2	11	17	20	31	Low to Moderate
6	*Myotis daubentonii*	0	0	0	1	49	0	Low
6	*Myotis nattereri*	0	0	0	2	48	0	Low
6	*Nyctalus leisleri*	15	13	13	5	4	62	Moderate to High
6	*Pipistrellus nathusii*	4	4	1	5	36	0	Low
6	*Pipistrellus pipistrellus*	22	9	8	6	5	77	Moderate to High
6	*Pipistrellus pygmaeus*	21	10	7	5	7	72	Moderate to High
6	*Plecotus auritus*	0	0	0	2	48	0	Low
7	*Myotis*	0	0	14	11	25	19	Low
7	*Myotis daubentonii*	0	0	0	0	50	0	Low
7	*Myotis nattereri*	0	0	0	0	50	0	Low
7	*Nyctalus leisleri*	12	12	10	7	9	59	Moderate
7	*Pipistrellus nathusii*	0	2	8	6	34	0	Low
7	***Pipistrellus pipistrellus***	**26**	**10**	**7**	**0**	**7**	**81**	**High**
7	*Pipistrellus pygmaeus*	13	11	16	1	9	59	Moderate

Location	Species	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity	Median Percentile	Bat Activity Category
7	*Plecotus auritus*	0	0	0	3	47	0	Low
8	*Myotis*	0	3	9	5	23	16	Low
8	*Myotis daubentonii*	0	0	0	0	40	0	Low
8	*Myotis nattereri*	0	0	0	2	38	0	Low
8	*Nyctalus leisleri*	7	12	8	3	10	56	Moderate
8	*Pipistrellus nathusii*	0	0	7	5	28	0	Low
8	***Pipistrellus pipistrellus***	**31**	**5**	**1**	**0**	**3**	**94**	**High**
8	*Pipistrellus pygmaeus*	16	15	5	1	3	77	Moderate to High
8	*Plecotus auritus*	0	0	1	3	36	0	Low
9	*Myotis*	6	0	9	8	27	12	Low
9	*Myotis daubentonii*	0	0	0	0	50	0	Low
9	*Myotis nattereri*	0	2	3	1	44	0	Low
9	*Nyctalus leisleri*	15	14	6	4	11	68	Moderate to High
9	*Pipistrellus nathusii*	1	13	11	6	19	38	Low to Moderate
9	***Pipistrellus pipistrellus***	**37**	**7**	**2**	**1**	**3**	**90**	**High**
9	*Pipistrellus pygmaeus*	17	13	10	4	6	70	Moderate to High
9	*Plecotus auritus*	0	5	15	11	19	29	Low to Moderate

Table 34. Static results per season.

Spring; 15th to the 30th of April												
Detector	Leisler's Bat	Common Pipistrelle	Soprano Pipistrelle	Nauthusius Pipistrelle	Pipistrelle 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total	Minutes recorded	Bat passes per hour (BPH)
1	384	1006	1548	0	51	30	2	0	31	3052	9131	20.1
2	2010	269	275	0	31	6	2	0	22	2615	9131	17.2
3	386	2716	2047	1	210	32	0	0	59	5451	9131	35.8
4	644	1293	486	0	71	6	0	0	10	2510	9131	16.5
5	981	1018	754	1	134	22	2	0	18	2930	9131	19.3
6	1952	1639	1455	1	312	6	2	0	16	5383	9131	35.4
7	402	537	189	0	47	5	0	0	18	1198	9131	7.9
8	52	167	79	0	2	0	0	0	1	301	3903	4.6
9	653	754	266	0	107	71	0	0	15	1866	9131	12.3
Total	7464	9399	7099	3	965	178	8	0	190	25306	76951	19.7
BPH	5.8	7.3	5.5	0.0	0.8	0.1	0.0	0.0	0.1			

Summer; 15th to the 27th of June												
Detector	Leisler's Bat	Common Pipistrelle	Soprano Pipistrelle	Nauthusius Pipistrelle	Pipistrelle 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total	Minutes recorded	Bat passes per hour
1	80	722	660	0	12	4	24	0	139	1641	5516	17.8
1a	42	43	59	0	2	20	2	0	110	278	5516	3.0
2	110	98	99	0	2	1	0	0	2	312	5516	3.4
3	69	1250	1109	0	16	2	1	0	66	2513	5516	27.3
4	74	340	419	0	17	0	1	0	17	868	5516	9.4
5	48	1160	1533	5	34	10	19	0	129	2938	5516	32.0
6	144	508	525	0	11	0	4	2	41	1235	5516	13.4
7	52	1618	189	10	22	8	1	0	34	1934	5516	21.0
8	769	2157	355	0	39	10	2	0	17	3349	5516	36.4
9	465	950	118	8	195	59	0	0	23	1818	5516	19.8
Total	1853	8846	5066	23	350	114	54	2	578	16886		

BPH	2.0	9.6	5.5	0.0	0.4	0.1	0.1	0.0	0.6		55160	18.4
August; 8th to the 17th												
Detector	**Leisler's Bat**	**Common Pipistrelle**	**Soprano Pipistrelle**	**Nauthusius Pipistrelle**	**Pipistrelle 40 kHz**	**Brown Long-eared**	**Natterer's Bat**	**Daubenton's Bat**	**Unidentified Myotis**	**Total**	**Minutes recorded**	**Bat passes per hour**
1	Failed to record											
1a	124	98	76	0	5	2	1	0	14	320	6070	3.2
2	290	92	136	0	4	7	0	0	16	545	6070	5.4
3	52	1046	4081	0	3	9	0	0	5	5196	2381	130.9
4	227	306	157	0	5	11	0	0	19	725	6070	7.2
5	161	1042	653	0	17	12	9	0	58	1952	6070	19.3
6	154	2125	1119	0	5	6	7	0	65	3481	6070	34.4
7	410	2273	727	1	10	2	0	0	40	3463	6070	34.2
8	193	1301	274	1	9	9	2	0	24	1813	6070	17.9
9	325	2848	982	0	51	57	63	0	355	4681	6070	46.3
Total	1936	11131	8205	2	109	115	82	0	596	22176	50941	26.1
BPH	2.3	13.1	9.7	0.0	0.1	0.1	0.1	0.0	0.7			
Autumn; 13th to 23rd of September												
Detector	**Leisler's Bat**	**Common Pipistrelle**	**Soprano Pipistrelle**	**Nauthusius Pipistrelle**	**Pipistrelle 40 kHz**	**Brown Long-eared**	**Natterer's Bat**	**Daubenton's Bat**	**Unidentified Myotis**	**Total**	**Minutes recorded**	**Bat passes per hour**
1	210	331	223	1	0	10	0	0	19	794	8292	5.7
2	111	33	43	0	2	10	2	0	11	212	8292	1.5
3	1736	570	2926	0	2	8	3	0	56	5301	5220	60.9
4	110	70	68	1	5	7	4	0	10	275	8292	2.0

5	127	1352	813	5	251	5	14	0	36	2603	8292	18.8
6	81	114	140	0	0	3	5	0	17	360	8292	2.6
7	79	208	107	1	0	2	3	0	22	422	8292	3.1
8	38	1738	770	0	1	3	4	0	67	2621	8292	19.0
9	17	1446	576	0	2	19	0	0	28	2088	8292	15.1
Total	2509	5862	5666	8	263	67	35	0	266	14676	71556	12.3
BPH	2.1	4.9	4.8	0.0	0.2	0.1	0.0	0.0	0.2			

Table 35. All static results combined

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
1	1	1	15th April	20	34	47	0	4	0	0	0	9	114
1	2	2	16th April	6	3	3	0	0	0	0	0	0	12
1	3	3	17th April	1	2	4	0	0	0	0	0	3	10
1	4	4	18th April	0	2	1	0	0	0	0	0	0	3
1	5	5	19th April	19	11	16	0	0	0	0	0	1	47
1	6	6	20th April	50	104	63	0	4	1	0	0	2	224

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
1	7	7	21th April	42	91	461	0	1	0	0	0	0	595
1	8	8	22th April	17	40	104	0	0	0	0	0	1	162
1	9	9	23th April	11	69	17	0	0	0	1	0	3	101
1	10	10	24th April	22	41	67	0	3	6	0	0	2	141
1	11	11	25th April	48	53	78	0	2	3	0	0	3	187
1	12	12	26th April	35	16	24	0	1	0	0	0	1	77
1	13	13	27th April	47	200	298	0	17	2	0	0	2	566
1	14	14	28th April	30	28	57	0	1	5	0	0	1	122
1	15	15	29th April	23	208	178	0	16	10	1	0	3	439
1	16	16	30th April	13	104	130	0	2	3	0	0	0	252
1	17	1	15th June	5	68	58	0	3	0	0	0	3	137
1	18	2	16th June	20	83	25	0	3	0	0	0	2	133
1	19	3	17th June	8	59	27	0	0	1	0	0	3	98
1	20	4	18th June	0	31	26	0	0	2	0	0	3	62

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
1	21	5	19th June	3	53	28	0	1	0	0	0	3	88
1	22	6	20th June	2	63	97	0	3	0	0	0	3	168
1	23	7	21st June	14	97	84	0	1	1	0	0	2	199
1	24	8	22nd June	5	115	83	0	1	0	0	0	2	206
1	25	9	23rd June	19	73	56	0	0	0	1	0	7	156
1	26	10	24th June	0	5	16	0	0	0	0	0	2	23
1	27	11	25th June	0	35	128	0	0	0	15	0	80	258
1	28	12	26th June	3	40	29	0	0	0	6	0	14	92
1	29	13	27th June	1	0	3	0	0	0	2	0	15	21
1	30	1	13th September	7	7	11	0	0	0	0	0	0	25
1	31	2	14th September	11	36	25	0	0	1	0	0	1	74
1	32	3	15th September	11	9	22	0	0	3	0	0	2	47

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
1	33	4	16th September	7	14	12	0	0	3	0	0	1	37
1	34	5	17th September	4	35	15	1	0	0	0	0	3	58
1	35	6	18th September	10	36	14	0	0	0	0	0	3	63
1	36	7	19th September	60	41	47	0	0	0	0	0	2	150
1	37	8	20th September	27	57	48	0	0	3	0	0	1	136
1	38	9	21st September	8	8	14	0	0	0	0	0	0	30
1	39	10	22nd September	60	16	5	0	0	0	0	0	0	81
1	40	11	23rd September	5	72	10	0	0	0	0	0	6	93
2	1	1	15th April	76	11	9	0	2	0	0	0	1	99
2	2	2	16th April	21	2	1	0	0	0	0	0	0	24
2	3	3	17th April	3	0	0	0	0	0	0	0	3	6

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
2	4	4	18th April	0	0	0	0	0	0	0	0	1	1
2	5	5	19th April	41	4	1	0	2	0	0	0	0	48
2	6	6	20th April	561	36	24	0	2	0	0	0	2	625
2	7	7	21th April	183	33	37	0	5	0	0	0	1	259
2	8	8	22th April	83	20	30	0	1	0	1	0	1	136
2	9	9	23th April	40	5	17	0	0	0	0	0	1	63
2	10	10	24th April	103	6	11	0	2	0	0	0	0	122
2	11	11	25th April	176	34	19	0	2	2	1	0	2	236
2	12	12	26th April	81	4	7	0	1	0	0	0	1	94
2	13	13	27th April	307	29	23	0	5	2	0	0	4	370
2	14	14	28th April	131	12	11	0	1	0	0	0	2	157
2	15	15	29th April	105	40	42	0	6	1	0	0	2	196
2	16	16	30th April	99	33	43	0	2	1	0	0	1	179
2	17	1	15th June	0	5	6	0	0	1	0	0	0	12

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
2	18	2	16th June	31	17	10	0	0	0	0	0	0	58
2	19	3	17th June	3	16	10	0	0	0	0	0	1	30
2	20	4	18th June	5	4	6	0	0	0	0	0	0	15
2	21	5	19th June	10	8	12	0	0	0	0	0	0	30
2	22	6	20th June	6	8	7	0	0	0	0	0	0	21
2	23	7	21st June	20	9	15	0	2	0	0	0	0	46
2	24	8	22nd June	6	19	16	0	0	0	0	0	1	42
2	25	9	23rd June	24	11	17	0	0	0	0	0	0	52
2	26	10	24th June	0	0	0	0	0	0	0	0	0	0
2	27	11	25th June	0	0	0	0	0	0	0	0	0	0
2	28	12	26th June	1	1	0	0	0	0	0	0	0	2
2	29	13	27th June	4	0	0	0	0	0	0	0	0	4
2	30	1	8th August	35	3	9	0	0	3	0	0	4	54
2	31	2	9th August	22	6	16	0	0	1	0	0	3	48

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
2	32	3	10th August	18	16	20	0	1	2	0	0	2	59
2	33	4	11th August	21	11	17	0	0	0	0	0	4	53
2	34	5	12th August	31	18	15	0	2	0	0	0	0	66
2	35	6	13th August	40	15	18	0	1	0	0	0	2	76
2	36	7	14th August	24	19	25	0	0	1	0	0	1	70
2	37	8	15th August	13	1	2	0	0	0	0	0	0	16
2	38	9	16th August	10	1	2	0	0	0	0	0	0	13
2	39	10	17th August	76	2	12	0	0	0	0	0	0	90
2	40	1	13th September	6	1	4	0	0	0	0	0	1	12
2	41	2	14th September	14	6	5	0	0	1	0	0	6	32
2	42	3	15th September	6	1	3	0	0	0	0	0	0	10
2	43	4	16th September	9	2	0	0	0	2	0	0	0	13

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
2	44	5	17th September	5	3	0	0	0	0	0	0	1	9
2	45	6	18th September	17	5	3	0	0	2	0	0	0	27
2	46	7	19th September	20	6	7	0	2	0	0	0	0	35
2	47	8	20th September	12	6	6	0	0	1	0	0	1	26
2	48	9	21st September	16	3	12	0	0	1	1	0	0	33
2	49	10	22nd September	6	0	2	0	0	1	0	0	0	9
2	50	11	23rd September	0	0	1	0	0	2	1	0	2	6
3	1	1	15th April	15	445	96	0	31	0	0	0	0	587
3	2	2	16th April	10	19	80	0	1	0	0	0	1	111
3	3	3	17th April	0	7	7	0	0	0	0	0	2	16
3	4	4	18th April	1	0	0	0	0	0	0	0	2	3

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
3	5	5	19th April	11	4	14	0	2	0	0	0	2	33
3	6	6	20th April	44	485	240	0	23	1	0	0	2	795
3	7	7	21th April	31	34	67	0	5	7	0	0	3	147
3	8	8	22th April	25	70	59	1	1	6	0	0	5	167
3	9	9	23th April	15	105	109	0	2	0	0	0	2	233
3	10	10	24th April	47	46	17	0	1	3	0	0	2	116
3	11	11	25th April	26	373	444	0	28	1	0	0	1	873
3	12	12	26th April	24	22	32	0	3	2	0	0	1	84
3	13	13	27th April	39	524	468	0	61	1	0	0	17	1110
3	14	14	28th April	39	317	223	0	11	1	0	0	5	596
3	15	15	29th April	37	230	167	0	36	6	0	0	13	489
3	16	16	30th April	22	35	24	0	5	4	0	0	1	91
3	17	1	15th June	7	380	33	0	1	0	0	0	3	424
3	18	2	16th June	24	139	161	0	8	1	0	0	3	336

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
3	19	3	17th June	1	149	172	0	0	0	0	0	9	331
3	20	4	18th June	0	10	16	0	0	0	0	0	6	32
3	21	5	19th June	8	30	32	0	0	0	1	0	8	79
3	22	6	20th June	0	86	66	0	3	0	0	0	14	169
3	23	7	21st June	6	118	187	0	1	1	0	0	7	320
3	24	8	22nd June	10	122	161	0	1	0	0	0	12	306
3	25	9	23rd June	6	191	233	0	2	0	0	0	2	434
3	26	10	24th June	1	0	0	0	0	0	0	0	0	1
3	27	11	25th June	3	2	1	0	0	0	0	0	1	7
3	28	12	26th June	1	12	30	0	0	0	0	0	1	44
3	29	13	27th June	2	11	17	0	0	0	0	0	0	30
3	30	1	8th August	11	105	1025	0	0	5	0	0	0	1146
3	31	2	9th August	17	190	915	0	0	2	0	0	3	1127
3	32	3	10th August	13	495	1118	0	2	0	0	0	1	1629

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
3	33	4	11th August	11	256	1023	0	1	2	0	0	1	1294
3	did not record	did not record	12th August	0	0	0	0	0	0	0	0	0	0
3	did not record	did not record	13th August	0	0	0	0	0	0	0	0	0	0
3	did not record	did not record	14th August	0	0	0	0	0	0	0	0	0	0
3	did not record	did not record	15th August	0	0	0	0	0	0	0	0	0	0
3	did not record	did not record	16th August	0	0	0	0	0	0	0	0	0	0
3	did not record	did not record	17th August	0	0	0	0	0	0	0	0	0	0
3	34	1	13th September	344	40	269	0	0	1	0	0	2	656
3	35	2	14th September	344	84	1498	0	0	2	2	0	29	1959
3	36	3	15th September	226	2	170	0	0	2	0	0	2	402
3	37	4	16th September	250	4	676	0	0	0	0	0	9	939
3	38	5	17th September	142	19	19	0	0	1	0	0	3	184

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
3	39	6	18th September	232	82	103	0	2	0	1	0	7	427
3	40	7	19th September	198	339	191	0	0	2	0	0	4	734
3	did not record	did not record	20th September	0	0	0	0	0	0	0	0	0	0
3	did not record	did not record	21st September	0	0	0	0	0	0	0	0	0	0
3	did not record	did not record	22nd September	0	0	0	0	0	0	0	0	0	0
3	did not record	did not record	23rd September	0	0	0	0	0	0	0	0	0	0
4	1	1	15th April	17	12	7	0	1	0	0	0	0	37
4	2	2	16th April	11	4	2	0	0	1	0	0	0	18
4	3	3	17th April	1	0	0	0	0	0	0	0	0	1
4	4	4	18th April	0	0	0	0	0	0	0	0	0	0
4	5	5	19th April	1	0	0	0	1	0	0	0	0	2
4	6	6	20th April	120	12	5	0	3	0	0	0	1	141

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
4	7	7	21th April	90	68	39	0	25	1	0	0	0	223
4	8	8	22th April	45	45	47	0	1	1	0	0	2	141
4	9	9	23th April	41	7	10	0	1	0	0	0	0	59
4	10	10	24th April	38	5	6	0	2	0	0	0	0	51
4	11	11	25th April	84	46	25	0	5	1	0	0	2	163
4	12	12	26th April	11	1	3	0	0	0	0	0	0	15
4	13	13	27th April	104	81	15	0	4	0	0	0	4	208
4	14	14	28th April	45	9	2	0	1	0	0	0	0	57
4	15	15	29th April	22	497	209	0	20	2	0	0	1	751
4	16	16	30th April	14	506	116	0	7	0	0	0	0	643
4	17	1	15th June	4	16	6	0	4	0	0	0	1	31
4	18	2	16th June	21	20	56	0	2	0	0	0	0	99
4	19	3	17th June	19	24	39	0	1	0	1	0	2	86
4	20	4	18th June	1	1	3	0	0	0	0	0	2	7

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
4	21	5	19th June	3	36	23	0	1	0	0	0	0	63
4	22	6	20th June	9	7	11	0	1	0	0	0	3	31
4	23	7	21st June	4	33	30	0	0	0	0	0	1	68
4	24	8	22nd June	4	169	178	0	3	0	0	0	3	357
4	25	9	23rd June	6	25	27	0	5	0	0	0	3	66
4	26	10	24th June	0	0	0	0	0	0	0	0	0	0
4	27	11	25th June	0	0	38	0	0	0	0	0	0	38
4	28	12	26th June	2	9	8	0	0	0	0	0	1	20
4	29	13	27th June	1	0	0	0	0	0	0	0	1	2
4	30	1	8th August	18	18	12	0	1	1	0	0	4	54
4	31	2	9th August	23	19	10	0	0	1	0	0	2	55
4	32	3	10th August	11	40	19	0	0	1	0	0	0	71
4	33	4	11th August	20	34	17	0	1	2	0	0	2	76
4	34	5	12th August	27	61	27	0	2	0	0	0	2	119

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
4	35	6	13th August	45	39	34	0	0	1	0	0	2	121
4	36	7	14th August	30	72	30	0	0	2	0	0	2	136
4	37	8	15th August	20	1	0	0	0	0	0	0	0	21
4	38	9	16th August	12	0	2	0	0	2	0	0	1	17
4	39	10	17th August	21	22	6	0	1	1	0	0	4	55
4	40	1	13th Septem ber	11	5	6	0	0	1	0	0	1	24
4	41	2	14th Septem ber	36	9	12	0	0	1	1	0	4	63
4	42	3	15th Septem ber	6	1	2	0	0	0	1	0	0	10
4	43	4	16th Septem ber	0	1	4	0	0	1	1	0	0	7
4	44	5	17th Septem ber	5	2	3	0	0	0	0	0	0	10
4	45	6	18th Septem ber	7	9	4	0	1	0	0	0	0	21

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
4	46	7	19th September	8	21	19	1	0	1	1	0	1	52
4	47	8	20th September	10	7	5	0	4	0	0	0	2	28
4	48	9	21st September	10	12	7	0	0	1	0	0	1	31
4	49	10	22nd September	13	2	2	0	0	1	0	0	0	18
4	50	11	23rd September	4	1	4	0	0	1	0	0	1	11
5	1	1	15th April	20	180	138	0	2	0	0	0	0	340
5	2	2	16th April	11	62	18	1	9	0	0	0	0	101
5	3	3	17th April	2	1	0	0	0	0	0	0	1	4
5	4	4	18th April	0	0	0	0	0	0	0	0	1	1
5	5	5	19th April	19	11	1	0	2	3	0	0	1	37
5	6	6	20th April	59	168	87	0	16	2	2	0	1	335
5	7	7	21th April	104	39	30	0	3	1	0	0	2	179

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
5	8	8	22th April	130	47	30	0	5	1	0	0	1	214
5	9	9	23th April	111	28	44	0	2	0	0	0	1	186
5	10	10	24th April	85	8	14	0	0	0	0	0	1	108
5	11	11	25th April	62	106	109	0	12	5	0	0	1	295
5	12	12	26th April	33	5	7	0	2	1	0	0	3	51
5	13	13	27th April	102	110	140	0	9	0	0	0	1	362
5	14	14	28th April	113	72	24	0	25	2	0	0	1	237
5	15	15	29th April	43	158	89	0	40	6	0	0	2	338
5	16	16	30th April	87	23	23	0	7	1	0	0	1	142
5	17	1	15th June	2	33	95	0	3	1	1	0	5	140
5	18	2	16th June	12	116	199	0	1	0	0	0	13	341
5	19	3	17th June	3	346	229	2	17	0	0	0	1	598
5	20	4	18th June	1	73	35	0	0	2	0	0	10	121
5	21	5	19th June	2	117	151	0	2	0	0	0	0	272

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
5	22	6	20th June	3	33	64	0	1	2	1	0	11	115
5	23	7	21st June	8	133	235	0	3	1	1	0	5	386
5	24	8	22nd June	3	147	284	0	4	2	4	0	29	473
5	25	9	23rd June	11	153	232	1	2	1	10	0	47	457
5	26	10	24th June	0	0	1	0	0	0	1	0	0	2
5	27	11	25th June	2	0	1	0	0	0	0	0	1	4
5	28	12	26th June	0	4	7	2	1	1	1	0	5	21
5	29	13	27th June	1	5	0	0	0	0	0	0	2	8
5	30	1	8th August	21	65	28	0	0	3	1	0	8	126
5	31	2	9th August	18	106	24	0	0	1	0	0	11	160
5	32	3	10th August	7	127	80	0	3	1	0	0	4	222
5	33	4	11th August	15	60	29	0	2	2	5	0	7	120
5	34	5	12th August	30	142	124	0	8	3	0	0	5	312
5	35	6	13th August	14	139	105	0	1	1	0	0	2	262

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
5	36	7	14th August	17	201	107	0	3	1	3	0	12	344
5	37	8	15th August	21	3	2	0	0	0	0	0	0	26
5	38	9	16th August	5	0	1	0	0	0	0	0	3	9
5	39	10	17th August	13	199	153	0	0	0	0	0	6	371
5	40	1	13th September	8	19	25	0	1	0	0	0	1	54
5	41	2	14th September	46	926	180	3	221	0	0	0	3	1379
5	42	3	15th September	6	14	97	0	1	0	0	0	0	118
5	43	4	16th September	13	23	21	0	2	0	0	0	3	62
5	44	5	17th September	3	11	12	0	0	0	1	0	1	28
5	45	6	18th September	7	42	35	0	0	1	3	0	13	101
5	46	7	19th September	12	125	159	0	10	3	0	0	6	315

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
5	47	8	20th September	0	59	102	1	13	0	10	0	4	189
5	48	9	21st September	16	114	85	1	2	0	0	0	2	220
5	49	10	22nd September	6	6	5	0	0	0	0	0	2	19
5	50	11	23rd September	10	13	92	0	1	1	0	0	1	118
6	1	1	15th April	48	12	13	0	2	0	0	0	2	77
6	2	2	16th April	9	3	1	0	0	0	0	0	0	13
6	3	3	17th April	7	5	3	0	0	0	0	0	0	15
6	4	4	18th April	0	0	0	0	1	0	0	0	0	1
6	5	5	19th April	41	7	11	0	1	0	1	0	1	62
6	6	6	20th April	102	96	30	0	55	0	0	0	2	285
6	7	7	21th April	187	313	81	0	22	0	0	0	1	604
6	8	8	22th April	273	132	98	1	6	0	0	0	0	510

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
6	9	9	23th April	269	101	37	0	22	1	0	0	1	431
6	10	10	24th April	110	65	49	0	11	0	0	0	0	235
6	11	11	25th April	203	121	136	0	63	1	0	0	0	524
6	12	12	26th April	70	7	10	0	0	0	0	0	2	89
6	13	13	27th April	258	77	178	0	12	0	0	0	2	527
6	14	14	28th April	52	26	4	0	0	0	0	0	0	82
6	15	15	29th April	136	439	491	0	73	2	1	0	5	1147
6	16	16	30th April	187	235	313	0	44	2	0	0	0	781
6	17	1	15th June	8	48	40	0	1	0	0	0	3	100
6	18	2	16th June	49	26	31	0	1	0	0	0	5	112
6	19	3	17th June	5	17	11	0	2	0	0	0	5	40
6	20	4	18th June	2	3	2	0	0	0	0	0	3	10
6	21	5	19th June	5	2	3	0	0	0	0	2	1	13
6	22	6	20th June	8	93	91	0	2	0	1	0	5	200

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
6	23	7	21st June	19	135	180	0	2	0	1	0	5	342
6	24	8	22nd June	12	131	124	0	2	0	1	0	5	275
6	25	9	23rd June	33	46	40	0	0	0	0	0	1	120
6	26	10	24th June	0	1	0	0	0	0	0	0	0	1
6	27	11	25th June	3	1	0	0	0	0	0	0	1	5
6	28	12	26th June	0	5	3	0	0	0	1	0	7	16
6	29	13	27th June	0	0	0	0	1	0	0	0	0	1
6	30	1	8th August	23	78	17	0	0	1	2	0	18	139
6	31	2	9th August	10	38	34	0	0	2	1	0	15	100
6	32	3	10th August	13	339	215	0	0	2	1	0	1	571
6	33	4	11th August	11	537	202	0	1	0	1	0	9	761
6	34	5	12th August	18	168	207	0	2	0	0	0	8	403
6	35	6	13th August	13	628	250	0	2	0	1	0	3	897
6	36	7	14th August	25	256	171	0	0	0	0	0	4	456

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
6	37	8	15th August	7	0	0	0	0	0	0	0	0	7
6	38	9	16th August	13	4	4	0	0	0	1	0	3	25
6	39	10	17th August	21	77	19	0	0	1	0	0	4	122
6	40	1	13th Septem ber	5	7	7	0	0	0	0	0	0	19
6	41	2	14th Septem ber	21	25	23	0	0	0	0	0	2	71
6	42	3	15th Septem ber	4	2	4	0	0	1	0	0	3	14
6	43	4	16th Septem ber	3	7	8	0	0	0	2	0	0	20
6	44	5	17th Septem ber	7	5	1	0	0	0	0	0	0	13
6	45	6	18th Septem ber	6	17	8	0	0	1	0	0	6	38
6	46	7	19th Septem ber	12	20	21	0	0	1	0	0	2	56
6	47	8	20th Septem ber	5	14	17	0	0	0	0	0	2	38

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
6	48	9	21st September	12	13	7	0	0	0	2	0	2	36
6	49	10	22nd September	3	2	42	0	0	0	0	0	0	47
6	50	11	23rd September	3	2	2	0	0	0	1	0	0	8
7	1	1	15th April	15	39	6	0	4	0	0	0	0	64
7	2	2	16th April	1	0	0	0	0	0	0	0	0	1
7	3	3	17th April	1	0	1	0	0	1	0	0	1	4
7	4	4	18th April	1	0	0	0	0	0	0	0	0	1
7	5	5	19th April	7	6	1	0	2	1	0	0	1	18
7	6	6	20th April	39	13	6	0	2	0	0	0	1	61
7	7	7	21th April	29	72	41	0	6	1	0	0	3	152
7	8	8	22th April	49	38	15	0	1	0	0	0	0	103
7	9	9	23th April	29	23	19	0	3	0	0	0	1	75
7	10	10	24th April	41	26	9	0	0	0	0	0	1	77

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
7	11	11	25th April	44	41	17	0	4	0	0	0	1	107
7	12	12	26th April	18	14	3	0	0	2	0	0	3	40
7	13	13	27th April	57	57	11	0	4	0	0	0	4	133
7	14	14	28th April	24	11	3	0	2	0	0	0	2	42
7	15	15	29th April	31	181	52	0	19	0	0	0	0	283
7	16	16	30th April	16	16	5	0	0	0	0	0	0	37
7	17	1	15th June	3	84	8	0	1	0	0	0	2	98
7	18	2	16th June	10	72	42	2	4	1	0	0	3	134
7	19	3	17th June	0	97	9	0	1	0	0	0	4	111
7	20	4	18th June	0	5	1	0	0	0	0	0	4	10
7	21	5	19th June	15	180	6	0	0	0	0	0	0	201
7	22	6	20th June	0	129	8	3	12	1	0	0	1	154
7	23	7	21st June	3	271	38	0	2	0	0	0	3	317
7	24	8	22nd June	6	558	46	3	2	2	1	0	7	625

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
7	25	9	23rd June	11	217	31	2	0	1	0	0	5	267
7	26	10	24th June	1	0	0	0	0	0	0	0	1	2
7	27	11	25th June	3	0	0	0	0	0	0	0	1	4
7	28	12	26th June	0	5	0	0	0	3	0	0	3	11
7	29	13	27th June	0	0	0	0	0	0	0	0	0	0
7	30	1	8th August	27	228	35	0	0	0	0	0	0	290
7	31	2	9th August	11	294	44	0	0	2	0	0	5	356
7	32	3	10th August	24	266	60	0	0	0	0	0	8	358
7	33	4	11th August	13	412	110	0	0	0	0	0	4	539
7	34	5	12th August	59	256	68	1	5	0	0	0	10	399
7	35	6	13th August	96	418	135	0	4	0	0	0	4	657
7	36	7	14th August	109	229	77	0	1	0	0	0	1	417
7	37	8	15th August	10	10	11	0	0	0	0	0	1	32
7	38	9	16th August	5	14	4	0	0	0	0	0	3	26

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
7	39	10	17th August	56	146	183	0	0	0	0	0	4	389
7	40	1	13th September	17	4	10	0	0	0	0	0	0	31
7	41	2	14th September	19	73	16	1	0	0	0	0	4	113
7	42	3	15th September	6	0	7	0	0	0	0	0	2	15
7	43	4	16th September	8	7	7	0	0	0	1	0	2	25
7	44	5	17th September	5	6	7	0	0	0	1	0	3	22
7	45	6	18th September	6	30	13	0	0	1	0	0	0	50
7	46	7	19th September	7	33	15	0	0	0	1	0	4	60
7	47	8	20th September	3	22	10	0	0	0	0	0	4	39
7	48	9	21st September	3	11	7	0	0	1	0	0	1	23

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
7	49	10	22nd September	3	11	7	0	0	0	0	0	1	22
7	50	11	23rd September	2	11	8	0	0	0	0	0	1	22
8	1	1	15th April	22	108	51	0	0	0	0	0	0	181
8	2	2	16th April	8	10	1	0	0	0	0	0	0	19
8	3	3	17th April	3	20	12	0	0	0	0	0	0	35
8	4	4	18th April	1	1	0	0	0	0	0	0	1	3
8	5	5	19th April	8	18	6	0	2	0	0	0	0	34
8	6	6	20th April	10	10	9	0	0	0	0	0	0	29
8	7	7	21th April	0	0	0	0	0	0	0	0	0	0
8	8	8	22th April	0	0	0	0	0	0	0	0	0	0
8	9	9	23th April	0	0	0	0	0	0	0	0	0	0
8	10	10	24th April	0	0	0	0	0	0	0	0	0	0
8	11	11	25th April	0	0	0	0	0	0	0	0	0	0

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
8	12	12	26th April	0	0	0	0	0	0	0	0	0	0
8	13	13	27th April	0	0	0	0	0	0	0	0	0	0
8	14	14	28th April	0	0	0	0	0	0	0	0	0	0
8	15	15	29th April	0	0	0	0	0	0	0	0	0	0
8	16	16	30th April	0	0	0	0	0	0	0	0	0	0
8	17	1	15th June	198	250	44	0	4	0	0	0	1	497
8	18	2	16th June	49	169	32	0	4	2	0	0	0	256
8	19	3	17th June	3	133	19	0	2	0	0	0	0	157
8	20	4	18th June	10	116	16	0	1	0	0	0	0	143
8	21	5	19th June	15	105	17	0	1	0	0	0	0	138
8	22	6	20th June	290	206	19	0	4	4	0	0	4	527
8	23	7	21st June	121	224	46	0	3	2	0	0	4	400
8	24	8	22nd June	33	182	37	0	5	1	2	0	6	266
8	25	9	23rd June	39	236	54	0	5	0	0	0	2	336

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
8	26	10	24th June	0	0	0	0	0	0	0	0	0	0
8	27	11	25th June	0	169	25	0	5	0	0	0	0	199
8	28	12	26th June	9	215	5	0	2	1	0	0	0	232
8	29	13	27th June	2	152	41	0	3	0	0	0	0	198
8	30	1	8th August	32	158	9	0	0	1	1	0	0	201
8	31	2	9th August	14	151	7	0	0	1	1	0	5	179
8	32	3	10th August	8	241	38	0	1	1	0	0	2	291
8	33	4	11th August	8	94	25	0	0	1	0	0	3	131
8	34	5	12th August	35	214	65	1	4	1	0	0	2	322
8	35	6	13th August	43	151	36	0	2	0	0	0	2	234
8	36	7	14th August	26	255	31	0	2	2	0	0	6	322
8	37	8	15th August	1	0	54	0	0	0	0	0	0	55
8	38	9	16th August	5	9	5	0	0	1	0	0	1	21
8	39	10	17th August	21	28	4	0	0	1	0	0	3	57

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
8	40	1	13th September	5	140	37	0	0	0	0	0	4	186
8	40	2	14th September	6	175	129	0	1	0	0	0	4	315
8	40	3	15th September	3	36	10	0	0	0	0	0	1	50
8	40	4	16th September	4	145	26	0	0	1	0	0	11	187
8	40	5	17th September	1	233	39	0	0	2	1	0	9	285
8	40	6	18th September	1	429	77	0	0	0	0	0	19	526
8	40	7	19th September	15	228	54	0	0	0	1	0	7	305
8	40	8	20th September	0	87	214	0	0	0	2	0	6	309
8	40	9	21st September	1	192	150	0	0	0	0	0	3	346
8	40	10	22nd September	1	38	16	0	0	0	0	0	3	58

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
8	40	11	23rd September	1	35	18	0	0	0	0	0	0	54
9	1	1	15th April	11	126	43	0	8	3	0	0	3	194
9	2	2	16th April	8	42	17	0	2	0	0	0	0	69
9	3	3	17th April	1	21	2	0	7	0	0	0	1	32
9	4	4	18th April	0	1	1	0	0	2	0	0	1	5
9	5	5	19th April	15	23	6	0	9	1	0	0	0	54
9	6	6	20th April	20	77	33	0	4	0	0	0	0	134
9	7	7	21th April	58	51	41	0	7	4	0	0	1	162
9	8	8	22th April	47	28	5	0	3	2	0	0	0	85
9	9	9	23th April	58	55	10	0	3	1	0	0	0	127
9	10	10	24th April	31	27	5	0	7	6	0	0	0	76
9	11	11	25th April	57	67	12	0	10	7	0	0	1	154
9	12	12	26th April	20	32	6	0	5	7	0	0	2	72
9	13	13	27th April	128	47	13	0	12	21	0	0	3	224

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
9	14	14	28th April	22	70	14	0	7	6	0	0	1	120
9	15	15	29th April	82	78	44	0	21	10	0	0	1	236
9	16	16	30th April	95	9	14	0	2	1	0	0	1	122
9	17	1	15th June	8	85	25	0	21	10	0	0	0	149
9	18	2	16th June	62	145	24	1	18	4	0	0	9	263
9	19	3	17th June	59	141	6	1	43	0	0	0	0	250
9	20	4	18th June	8	48	1	0	29	1	0	0	0	87
9	21	5	19th June	13	43	2	0	15	0	0	0	0	73
9	22	6	20th June	14	44	3	1	21	9	0	0	2	94
9	23	7	21st June	28	66	15	0	22	12	0	0	2	145
9	24	8	22nd June	59	80	6	0	15	11	0	0	1	172
9	25	9	23rd June	203	108	15	2	4	8	0	0	4	344
9	26	10	24th June	1	15	0	0	2	0	0	0	0	18
9	27	11	25th June	4	12	0	1	0	1	0	0	3	21

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
9	28	12	26th June	0	29	2	0	5	1	0	0	1	38
9	29	13	27th June	6	134	19	2	0	2	0	0	1	164
9	30	1	8th August	77	149	64	0	0	4	9	0	44	347
9	31	2	9th August	61	155	50	0	1	12	14	0	57	350
9	32	3	10th August	26	225	112	0	4	6	17	0	68	458
9	33	4	11th August	20	173	78	0	8	4	10	0	68	361
9	34	5	12th August	29	245	117	0	30	9	3	0	57	490
9	35	6	13th August	36	192	74	0	4	2	5	0	42	355
9	36	7	14th August	47	260	64	0	2	10	2	0	9	394
9	37	8	15th August	1	935	70	0	1	0	0	0	1	1008
9	38	9	16th August	9	143	29	0	0	0	2	0	7	190
9	39	10	17th August	19	371	324	0	1	10	1	0	2	728
9	40	1	13th September	2	5	1	0	0	2	0	0	7	17

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
9	41	2	14th September	7	20	5	0	0	0	0	0	0	32
9	42	3	15th September	0	1	1	0	0	1	0	0	3	6
9	43	4	16th September	0	3	4	0	0	2	0	0	5	14
9	44	5	17th September	3	91	11	0	0	2	0	0	3	110
9	45	6	18th September	1	65	33	0	0	3	0	0	5	107
9	46	7	19th September	2	174	164	0	1	4	0	0	1	346
9	47	8	20th September	0	185	63	0	1	2	0	0	2	253
9	48	9	21st September	2	894	284	0	0	2	0	0	1	1183
9	49	10	22nd September	0	8	6	0	0	0	0	0	1	15
9	50	11	23rd September	0	0	4	0	0	1	0	0	0	5

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
1 - cont	1	1	15th June	3	3	2	0	0	6	0	0	21	35
1 - cont	2	2	16th June	14	6	4	0	2	1	0	0	3	30
1 - cont	3	3	17th June	3	4	5	0	0	0	0	0	2	14
1 - cont	4	4	18th June	0	2	3	0	0	0	0	0	12	17
1 - cont	5	5	19th June	2	1	0	0	0	0	1	0	8	12
1 - cont	6	6	20th June	0	5	4	0	0	0	0	0	17	26
1 - cont	7	7	21st June	4	2	6	0	0	2	1	0	8	23
1 - cont	8	8	22nd June	4	12	11	0	0	2	0	0	15	44
1 - cont	9	9	23rd June	11	5	21	0	0	7	0	0	12	56
1 - cont	10	10	24th June	0	0	2	0	0	0	0	0	0	2
1 - cont	11	11	25th June	0	0	0	0	0	0	0	0	0	0
1 - cont	12	12	26th June	0	3	1	0	0	2	0	0	12	18
1 - cont	13	13	27th June	1	0	0	0	0	0	0	0	0	1
1 - cont	14	1	8th August	10	1	6	0	1	0	0	0	0	18

Turbine	Total days per turbine	Days per season	Date	Leisler's Bat	Common Pip	Soprano Pip	Nathusius Pip	Pip 40 kHz	Brown Long-eared	Natterer's Bat	Daubenton's Bat	Unidentified Myotis	Total
1 - cont	15	2	9th August	13	6	4	0	0	0	0	0	3	26
1 - cont	16	3	10th August	11	12	9	0	1	1	0	0	1	35
1 - cont	17	4	11th August	16	10	11	0	0	0	0	0	3	40
1 - cont	18	5	12th August	29	13	15	0	1	0	0	0	0	58
1 - cont	19	6	13th August	15	10	17	0	2	1	1	0	4	50
1 - cont	20	7	14th August	16	45	5	0	0	0	0	0	0	66
1 - cont	21	8	15th August	0	0	0	0	0	0	0	0	0	0
1 - cont	22	9	16th August	4	1	3	0	0	0	0	0	1	9
1 - cont	23	10	17th August	10	0	6	0	0	0	0	0	2	18

ANNEX 6 – ECOBAT DATA

Ecobat Bat Activity Analysis

Site Name: Tullacondra

John Curtin

09/11/2022

Summary

Bat surveys were conducted at Tullacondra 1, Tullacondra 2, Tullacondra 3, Tullacondra 4, Tullacondra 5, Tullacondra 6, Tullacondra 7, Tullacondra 8, Tullacondra 9, for 16 nights between 2022-04-15 and 2022-04-30, using Wildlife Acoustics static bat detectors. The maximum of passes recorded in a single night was 561 passes, and 8 species were recorded.

The reference range dataset was stratified to include:

- Only records from within 30 days of the survey date.
- Only records from within 100km^2 of the survey location.
- Records using any make of bat detector.

Table 1

Summary table showing the number of nights recorded bat activity fell into each activity band for each species.

Location	Species/Species Group	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
Tullacondra 1	*Myotis*	0	1	4	3	8
Tullacondra 1	*Myotis daubentonii*	0	0	0	0	16
Tullacondra 1	*Myotis nattereri*	0	0	0	0	16
Tullacondra 1	*Nyctalus leisleri*	6	7	1	0	2
Tullacondra 1	*Pipistrellus nathusii*	0	2	3	2	9
Tullacondra 1	*Pipistrellus pipistrellus*	11	2	1	2	0
Tullacondra 1	*Pipistrellus pygmaeus*	10	3	2	0	1
Tullacondra 1	*Plecotus auritus*	0	1	4	1	10

Tullacondra 2	*Myotis*	0	0	3	4	9
Tullacondra 2	*Myotis daubentonii*	0	0	0	0	16
Tullacondra 2	*Myotis nattereri*	0	0	0	0	16
Tullacondra 2	*Nyctalus leisleri*	13	1	1	0	1
Tullacondra 2	*Pipistrellus nathusii*	0	0	3	6	7
Tullacondra 2	*Pipistrellus pipistrellus*	6	3	4	1	2
Tullacondra 2	*Pipistrellus pygmaeus*	4	7	1	0	4
Tullacondra 2	*Plecotus auritus*	0	0	0	2	14
Tullacondra 3	*Myotis*	0	2	3	6	5
Tullacondra 3	*Myotis daubentonii*	0	0	0	0	16
Tullacondra 3	*Myotis nattereri*	0	0	0	0	16
Tullacondra 3	*Nyctalus leisleri*	7	7	0	0	2
Tullacondra 3	*Pipistrellus nathusii*	4	2	3	3	4
Tullacondra 3	*Pipistrellus pipistrellus*	11	2	2	0	1
Tullacondra 3	*Pipistrellus pygmaeus*	11	3	1	0	1
Tullacondra 3	*Plecotus auritus*	0	0	5	1	10
Tullacondra 4	*Myotis*	0	0	1	2	13
Tullacondra 4	*Myotis daubentonii*	0	0	0	0	16
Tullacondra 4	*Myotis nattereri*	0	0	0	0	16
Tullacondra 4	*Nyctalus leisleri*	8	5	0	0	3
Tullacondra 4	*Pipistrellus nathusii*	0	2	4	1	9
Tullacondra 4	*Pipistrellus pipistrellus*	6	3	3	0	4
Tullacondra 4	*Pipistrellus pygmaeus*	4	3	4	2	3
Tullacondra 4	*Plecotus auritus*	0	0	0	1	15
Tullacondra 5	*Myotis*	0	0	2	2	12
Tullacondra 5	*Myotis daubentonii*	0	0	0	0	16
Tullacondra 5	*Myotis nattereri*	0	0	0	1	15

Tullacondra 5	*Nyctalus leisleri*	11	3	0	1	1
Tullacondra 5	*Pipistrellus nathusii*	1	5	3	4	3
Tullacondra 5	*Pipistrellus pipistrellus*	10	3	1	0	2
Tullacondra 5	*Pipistrellus pygmaeus*	8	4	1	0	3
Tullacondra 5	*Plecotus auritus*	0	0	3	2	11
Tullacondra 6	*Myotis*	0	0	1	5	10
Tullacondra 6	*Myotis daubentonii*	0	0	0	0	16
Tullacondra 6	*Myotis nattereri*	0	0	0	0	16
Tullacondra 6	*Nyctalus leisleri*	13	1	1	0	1
Tullacondra 6	*Pipistrellus nathusii*	4	4	1	1	6
Tullacondra 6	*Pipistrellus pipistrellus*	10	1	4	0	1
Tullacondra 6	*Pipistrellus pygmaeus*	9	3	2	0	2
Tullacondra 6	*Plecotus auritus*	0	0	0	2	14
Tullacondra 7	*Myotis*	0	0	3	1	12
Tullacondra 7	*Myotis daubentonii*	0	0	0	0	16
Tullacondra 7	*Myotis nattereri*	0	0	0	0	16
Tullacondra 7	*Nyctalus leisleri*	8	4	1	0	3
Tullacondra 7	*Pipistrellus nathusii*	0	1	5	3	7
Tullacondra 7	*Pipistrellus pipistrellus*	7	5	1	0	3
Tullacondra 7	*Pipistrellus pygmaeus*	2	5	5	0	4
Tullacondra 7	*Plecotus auritus*	0	0	0	1	15
Tullacondra 8	*Myotis*	0	0	0	0	6
Tullacondra 8	*Myotis daubentonii*	0	0	0	0	6
Tullacondra 8	*Myotis nattereri*	0	0	0	0	6
Tullacondra 8	*Nyctalus leisleri*	0	4	1	0	1
Tullacondra 8	*Pipistrellus nathusii*	0	0	0	1	5
Tullacondra 8	*Pipistrellus pipistrellus*	1	4	0	0	1

Tullacondra 8	*Pipistrellus pygmaeus*	1	2	1	0	2
Tullacondra 8	*Plecotus auritus*	0	0	0	0	6
Tullacondra 9	*Myotis*	0	0	2	1	13
Tullacondra 9	*Myotis daubentonii*	0	0	0	0	16
Tullacondra 9	*Myotis nattereri*	0	0	0	0	16
Tullacondra 9	*Nyctalus leisleri*	8	6	0	0	2
Tullacondra 9	*Pipistrellus nathusii*	0	5	8	2	1
Tullacondra 9	*Pipistrellus pipistrellus*	12	3	0	0	1
Tullacondra 9	*Pipistrellus pygmaeus*	4	6	4	1	1
Tullacondra 9	*Plecotus auritus*	0	2	6	2	6

Table 2

Summary table showing key metrics for each species recorded.

Location	Species/Species Group	Median Percentile	95% CIs	Max Percentile	Nights Recorded	Reference Range
Tullacondra 1	*Myotis*	22	21.5 - 44.5	64	16	1223
Tullacondra 1	*Myotis daubentonii*	0	0 - 0	0	16	370
Tullacondra 1	*Myotis nattereri*	0	0 - 0	12	16	295
Tullacondra 1	*Nyctalus leisleri*	78	68.5 - 82.5	88	16	1687
Tullacondra 1	*Pipistrellus nathusii*	12	21.5 - 57.5	74	16	513
Tullacondra 1	*Pipistrellus pipistrellus*	86	62 - 90	96	16	1689
Tullacondra 1	*Pipistrellus pygmaeus*	90	66 - 92.5	99	16	1375
Tullacondra 1	*Plecotus auritus*	0	21.5 - 60.5	65	16	810
Tullacondra 2	*Myotis*	12	12 - 36	48	16	1223
Tullacondra 2	*Myotis daubentonii*	0	0 - 0	0	16	370
Tullacondra 2	*Myotis nattereri*	0	0 - 0	12	16	295
Tullacondra 2	*Nyctalus leisleri*	93	85.5 - 94.5	99	16	1687
Tullacondra 2	*Pipistrellus nathusii*	31	21.5 - 42	56	16	513

Tullacondra 2	*Pipistrellus pipistrellus*	68	57 - 82	85	16	1689
Tullacondra 2	*Pipistrellus pygmaeus*	71	47 - 80	86	16	1375
Tullacondra 2	*Plecotus auritus*	0	12 - 31	31	16	810
Tullacondra 3	*Myotis*	31	21.5 - 47	74	16	1223
Tullacondra 3	*Myotis daubentonii*	0	0 - 0	0	16	370
Tullacondra 3	*Myotis nattereri*	0	0 - 0	0	16	295
Tullacondra 3	*Nyctalus leisleri*	80	72 - 82.5	87	16	1687
Tullacondra 3	*Pipistrellus nathusii*	47	32.5 - 71.5	90	16	513
Tullacondra 3	*Pipistrellus pipistrellus*	89	78 - 95.5	99	16	1689
Tullacondra 3	*Pipistrellus pygmaeus*	91	81 - 95	99	16	1375
Tullacondra 3	*Plecotus auritus*	12	12 - 52	59	16	810
Tullacondra 4	*Myotis*	0	12 - 39.5	48	16	1223
Tullacondra 4	*Myotis daubentonii*	0	0 - 0	0	16	370
Tullacondra 4	*Myotis nattereri*	0	0 - 0	0	16	295
Tullacondra 4	*Nyctalus leisleri*	82	52.5 - 88.5	94	16	1687
Tullacondra 4	*Pipistrellus nathusii*	12	12 - 55.5	80	16	513
Tullacondra 4	*Pipistrellus pipistrellus*	66	55.5 - 88.5	99	16	1689
Tullacondra 4	*Pipistrellus pygmaeus*	58	50 - 80.5	96	16	1375
Tullacondra 4	*Plecotus auritus*	0	12 - 12	31	16	810
Tullacondra 5	*Myotis*	12	12 - 26.5	41	16	1223
Tullacondra 5	*Myotis daubentonii*	0	0 - 0	0	16	370
Tullacondra 5	*Myotis nattereri*	0	0 - 0	31	16	295
Tullacondra 5	*Nyctalus leisleri*	90	79.5 - 92.5	95	16	1687
Tullacondra 5	*Pipistrellus nathusii*	47	42 - 68.5	85	16	513
Tullacondra 5	*Pipistrellus pipistrellus*	86	70 - 91.5	96	16	1689
Tullacondra 5	*Pipistrellus pygmaeus*	81	70.5 - 88.5	95	16	1375
Tullacondra 5	*Plecotus auritus*	12	12 - 42	56	16	810

Tullacondra 6	*Myotis*	6	21.5 - 43.5	56	16	1223
Tullacondra 6	*Myotis daubentonii*	0	0 - 0	0	16	370
Tullacondra 6	*Myotis nattereri*	0	0 - 0	12	16	295
Tullacondra 6	*Nyctalus leisleri*	94	80 - 95.5	97	16	1687
Tullacondra 6	*Pipistrellus nathusii*	63	45 - 84	91	16	513
Tullacondra 6	*Pipistrellus pipistrellus*	91	69.5 - 94	99	16	1689
Tullacondra 6	*Pipistrellus pygmaeus*	83	61.5 - 91.5	99	16	1375
Tullacondra 6	*Plecotus auritus*	0	12 - 31	31	16	810
Tullacondra 7	*Myotis*	12	12 - 30	48	16	1223
Tullacondra 7	*Myotis daubentonii*	0	0 - 0	0	16	370
Tullacondra 7	*Myotis nattereri*	0	0 - 0	0	16	295
Tullacondra 7	*Nyctalus leisleri*	81	47 - 83.5	89	16	1687
Tullacondra 7	*Pipistrellus nathusii*	31	30 - 53.5	76	16	513
Tullacondra 7	*Pipistrellus pipistrellus*	76	71 - 87	96	16	1689
Tullacondra 7	*Pipistrellus pygmaeus*	56	42 - 72	88	16	1375
Tullacondra 7	*Plecotus auritus*	0	12 - 12	31	16	810
Tullacondra 8	*Myotis*	0	0 - 0	12	6	1223
Tullacondra 8	*Myotis daubentonii*	0	0 - 0	0	6	370
Tullacondra 8	*Myotis nattereri*	0	0 - 0	0	6	295
Tullacondra 8	*Nyctalus leisleri*	61	36.5 - 69.5	78	6	1687
Tullacondra 8	*Pipistrellus nathusii*	0	0 - 0	31	6	513
Tullacondra 8	*Pipistrellus pipistrellus*	70	38.5 - 84.5	94	6	1689
Tullacondra 8	*Pipistrellus pygmaeus*	60	38 - 76	88	6	1375
Tullacondra 8	*Plecotus auritus*	0	0 - 0	0	6	810
Tullacondra 9	*Myotis*	12	12 - 26.5	41	16	1223
Tullacondra 9	*Myotis daubentonii*	0	0 - 0	0	16	370
Tullacondra 9	*Myotis nattereri*	0	0 - 0	0	16	295

Tullacondra 9	*Nyctalus leisleri*	80	72 - 88	95	16	1687
Tullacondra 9	*Pipistrellus nathusii*	59	46 - 62	77	16	513
Tullacondra 9	*Pipistrellus pipistrellus*	87	77.5 - 89	94	16	1689
Tullacondra 9	*Pipistrellus pygmaeus*	69	53 - 75.5	86	16	1375
Tullacondra 9	*Plecotus auritus*	36	30 - 57.5	77	16	810

Charts

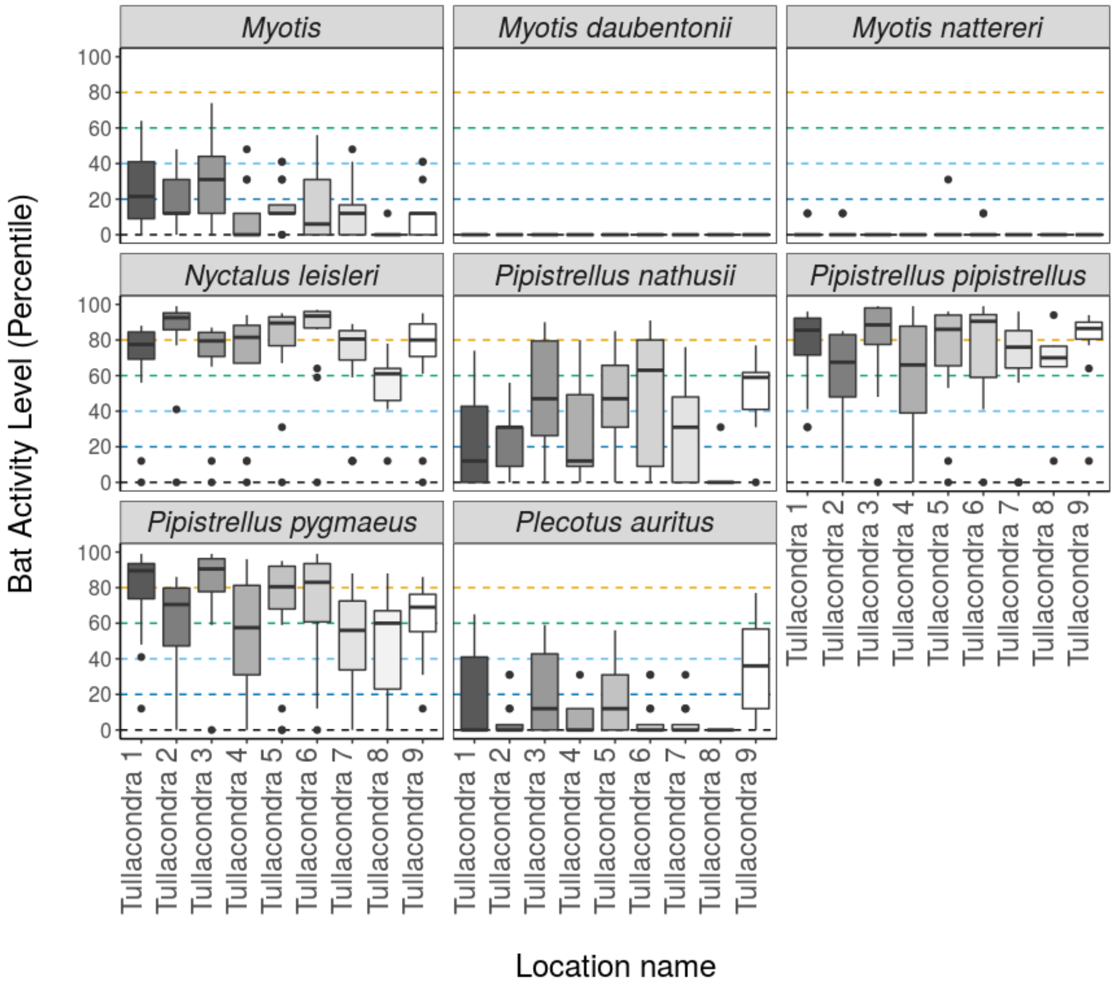
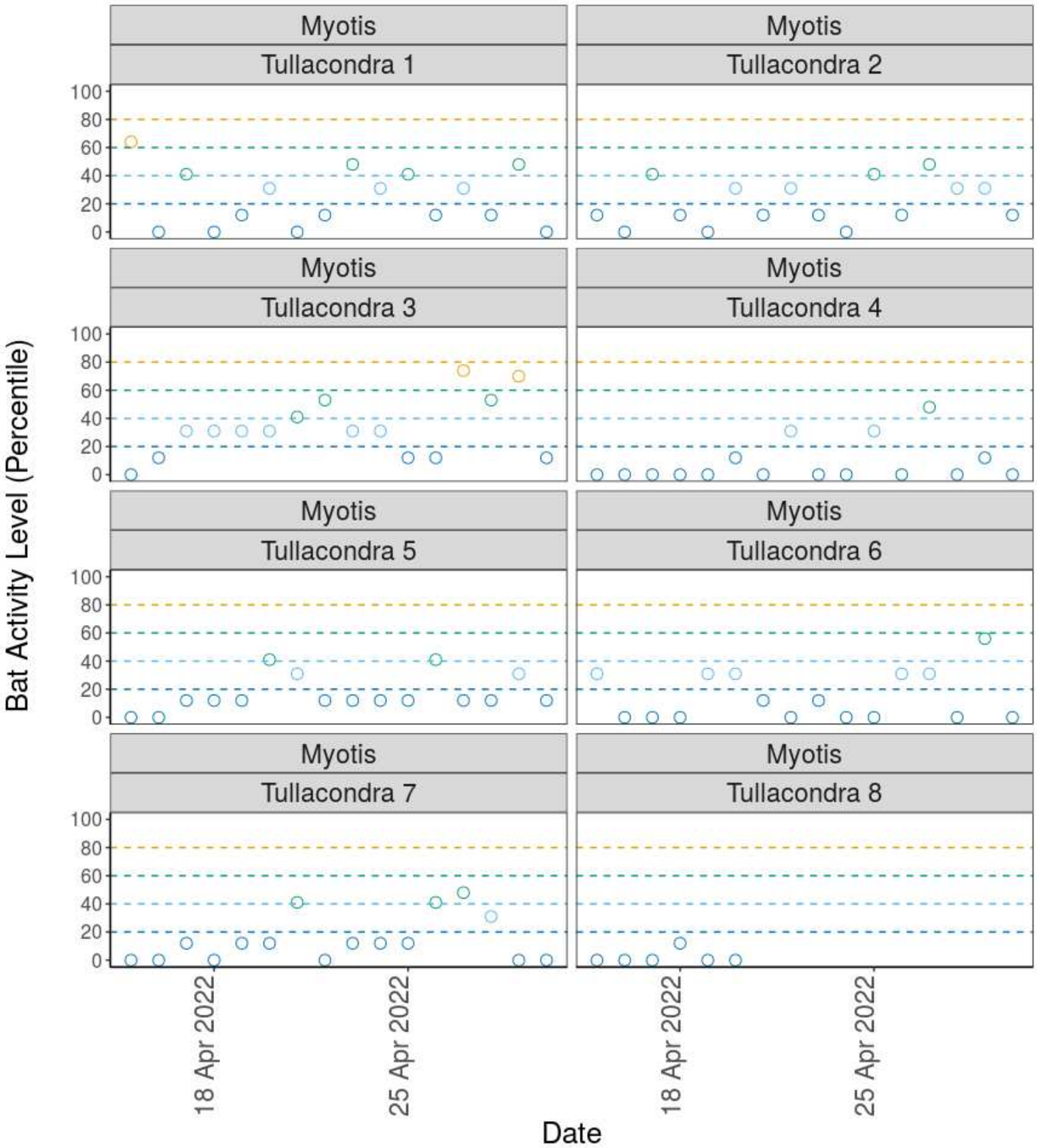


Chart 1. Differences in activity between static detector locations, split by species and location. The centre line indicates the median activity level whereas the box represents the interquartile range (the spread of the middle 50% of nights of activity)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Tullacondra 1
Myotis
Tullacondra 2
Myotis
Tullacondra 3
Myotis
Tullacondra 4
Myotis
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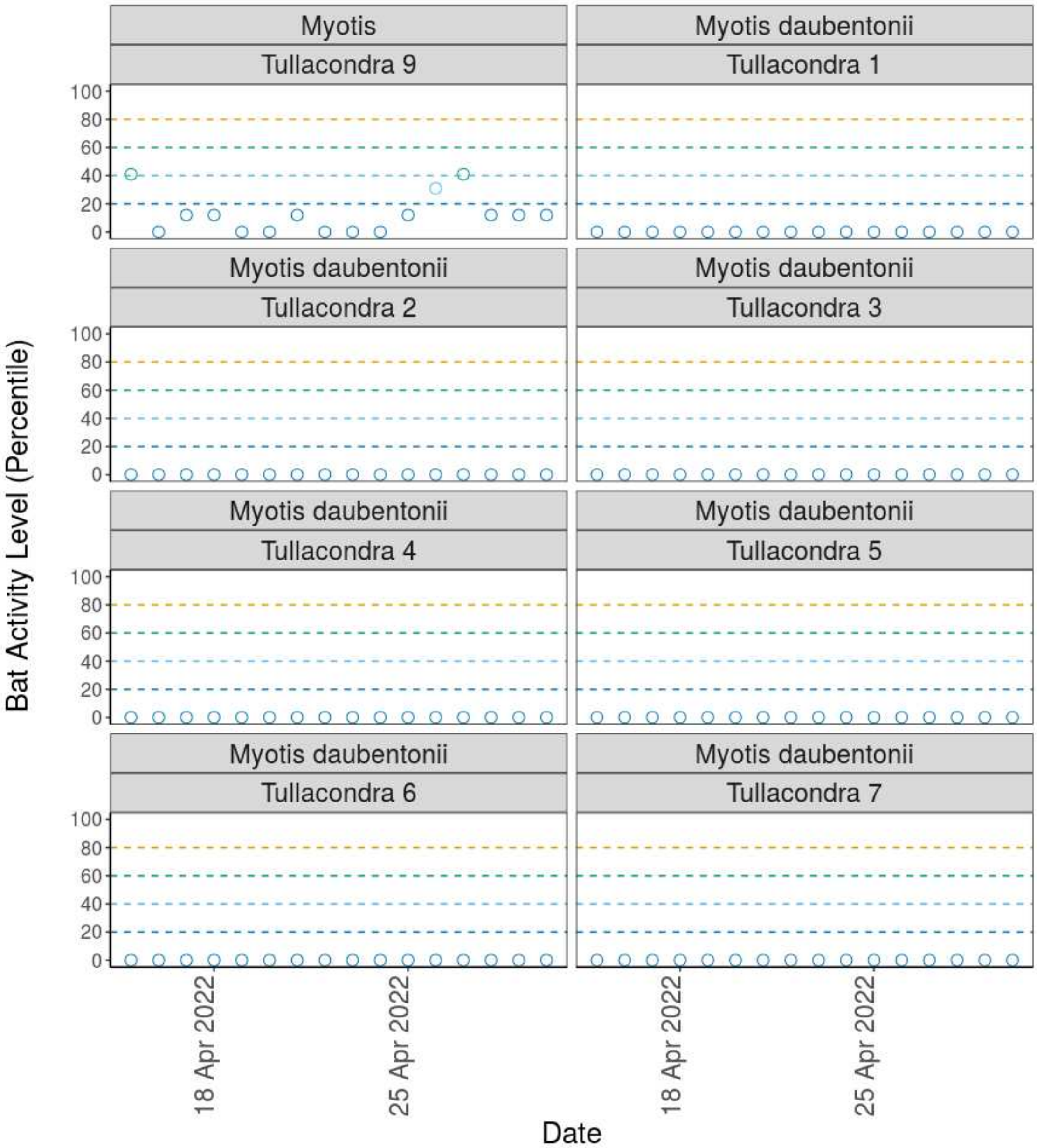
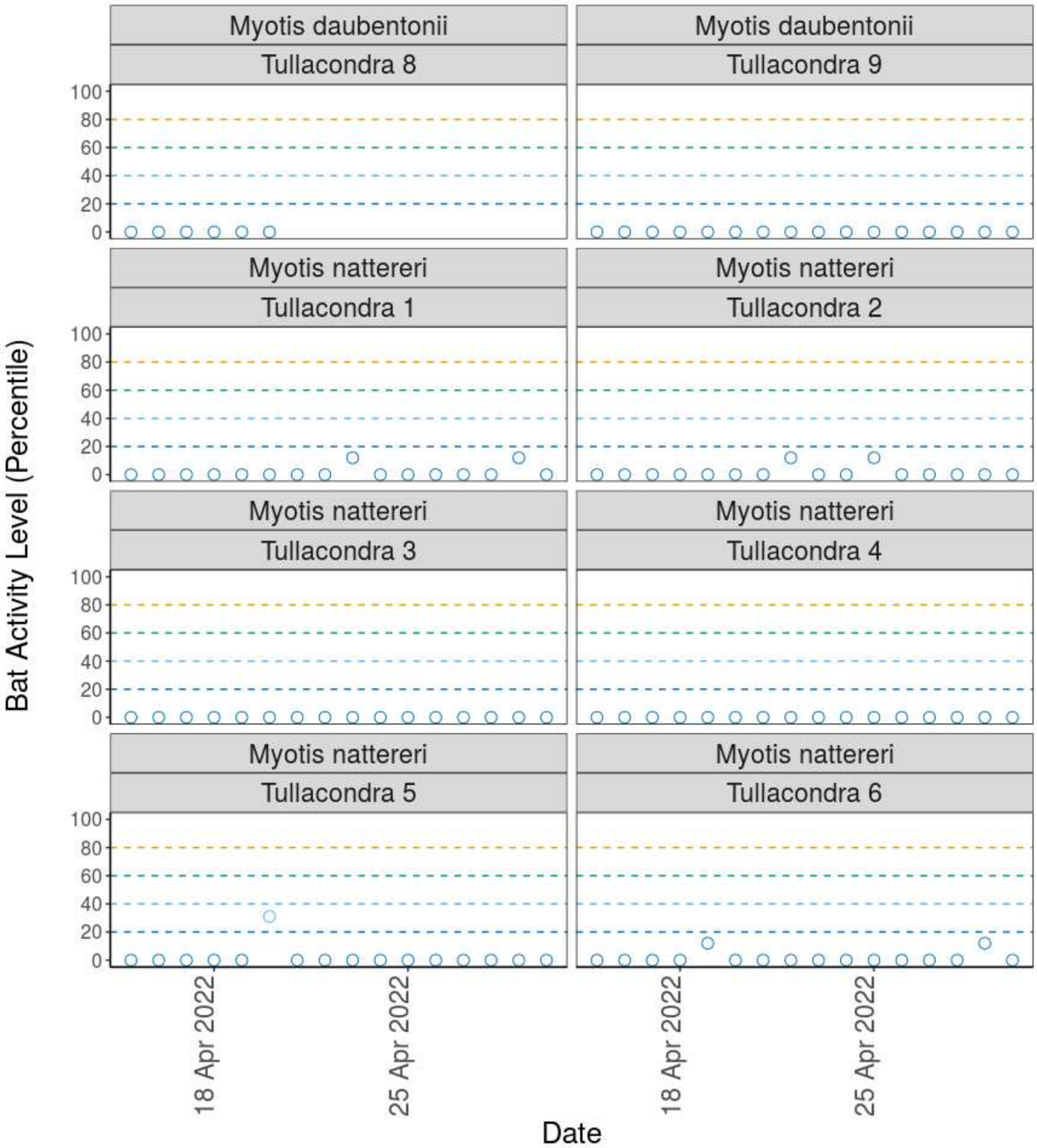
Myotis
Tullacondra 6
Myotis
Tullacondra 7
Myotis
Tullacondra 8
Bat Activity Level (Percentile)
100
80
60
40
20
0
18 Apr 2022
25 Apr 2022
Date


Myotis
Tullacondra 9
Myotis daubentonii
Tullacondra 1
Myotis daubentonii
Tullacondra 2
Myotis daubentonii
Tullacondra 3
Myotis daubentonii
Tullacondra 4
Myotis daubentonii
Tullacondra 5
Myotis daubentonii
Tullacondra 6
Myotis daubentonii
Tullacondra 7
Bat Activity Level (Percentile)
0
20
40
60
80
100
18 Apr 2022
25 Apr 2022
Date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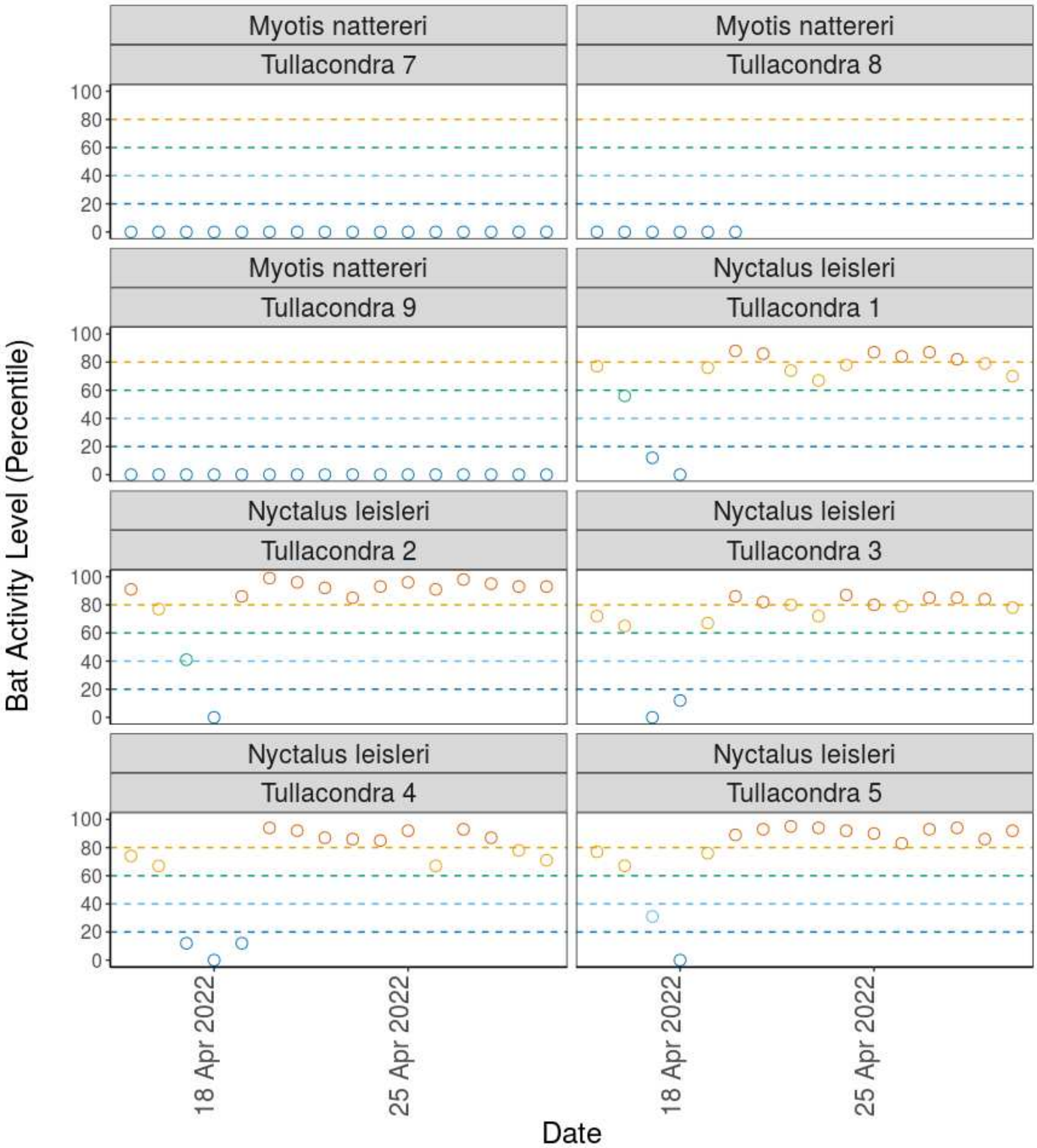
Tullacondra 8
Myotis daubentonii
Tullacondra 9
Myotis nattereri
Tullacondra 1
Myotis nattereri
Tullacondra 2
Myotis nattereri
Tullacondra 3
Myotis nattereri
Tullacondra 4
Myotis nattereri
Tullacondra 5
Myotis nattereri
Tullacondra 6
Bat Activity Level (Percentile)
0
20
40
60
80
100
18 Apr 2022
25 Apr 2022
Date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Myotis nattereri
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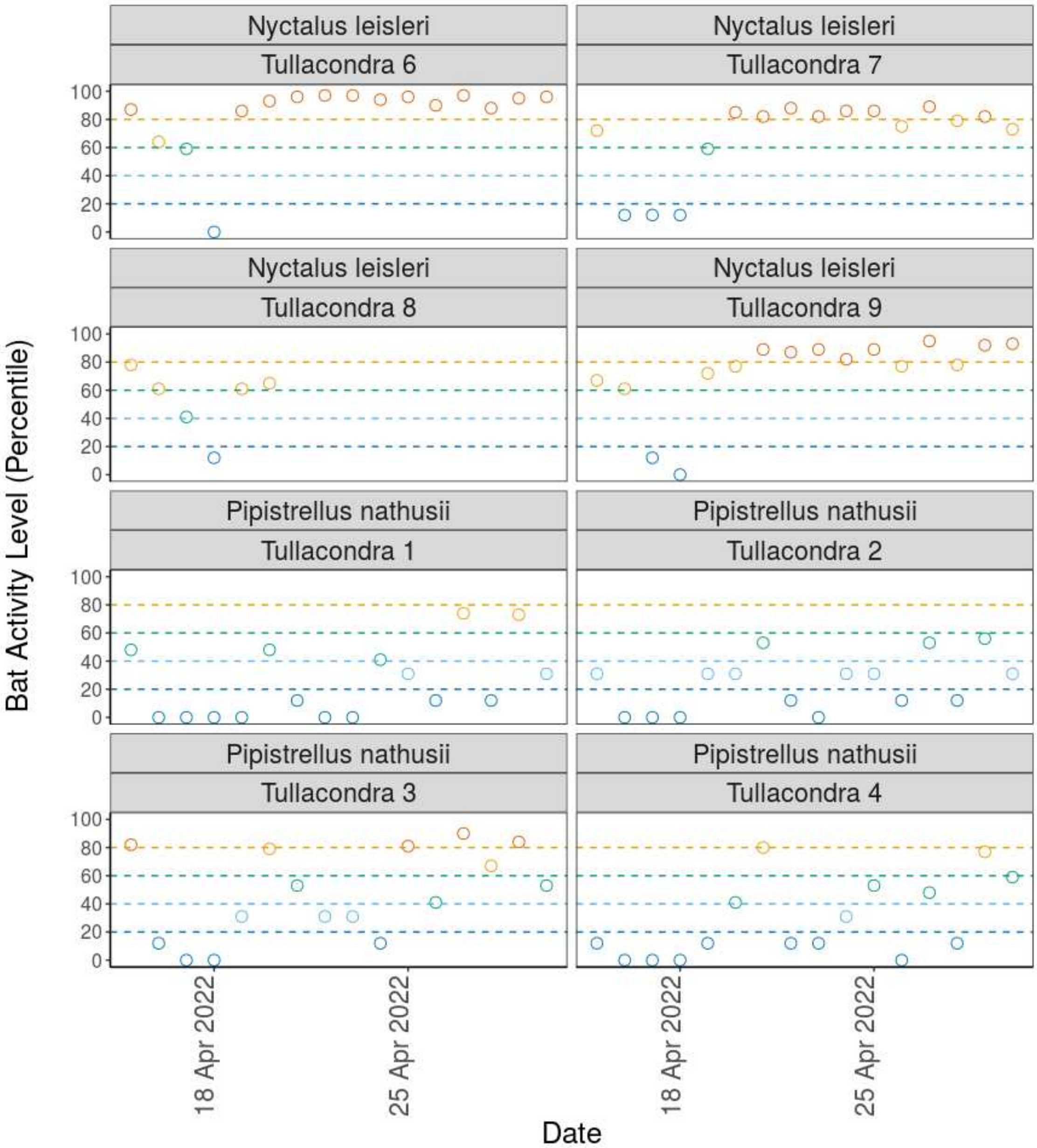
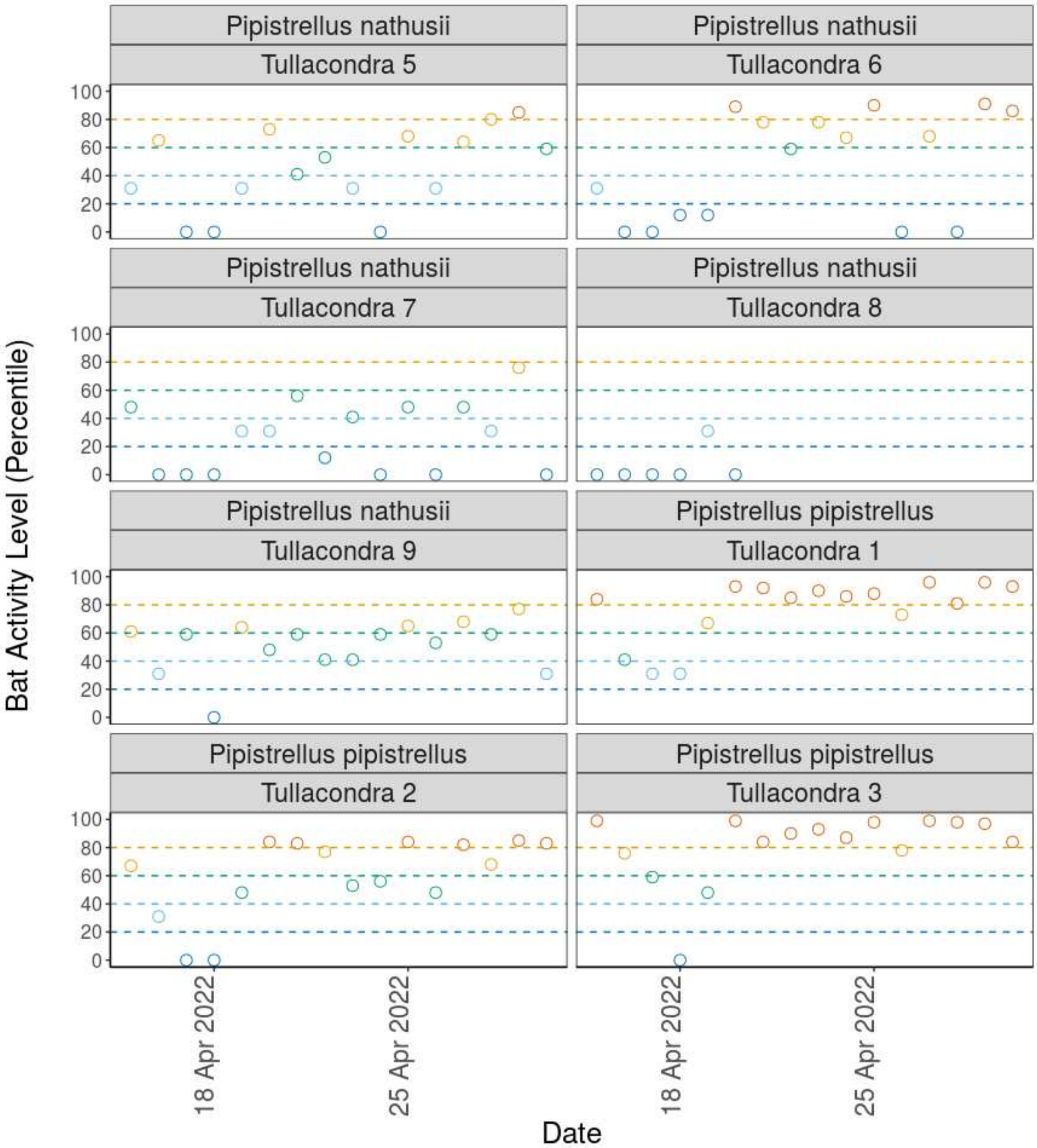
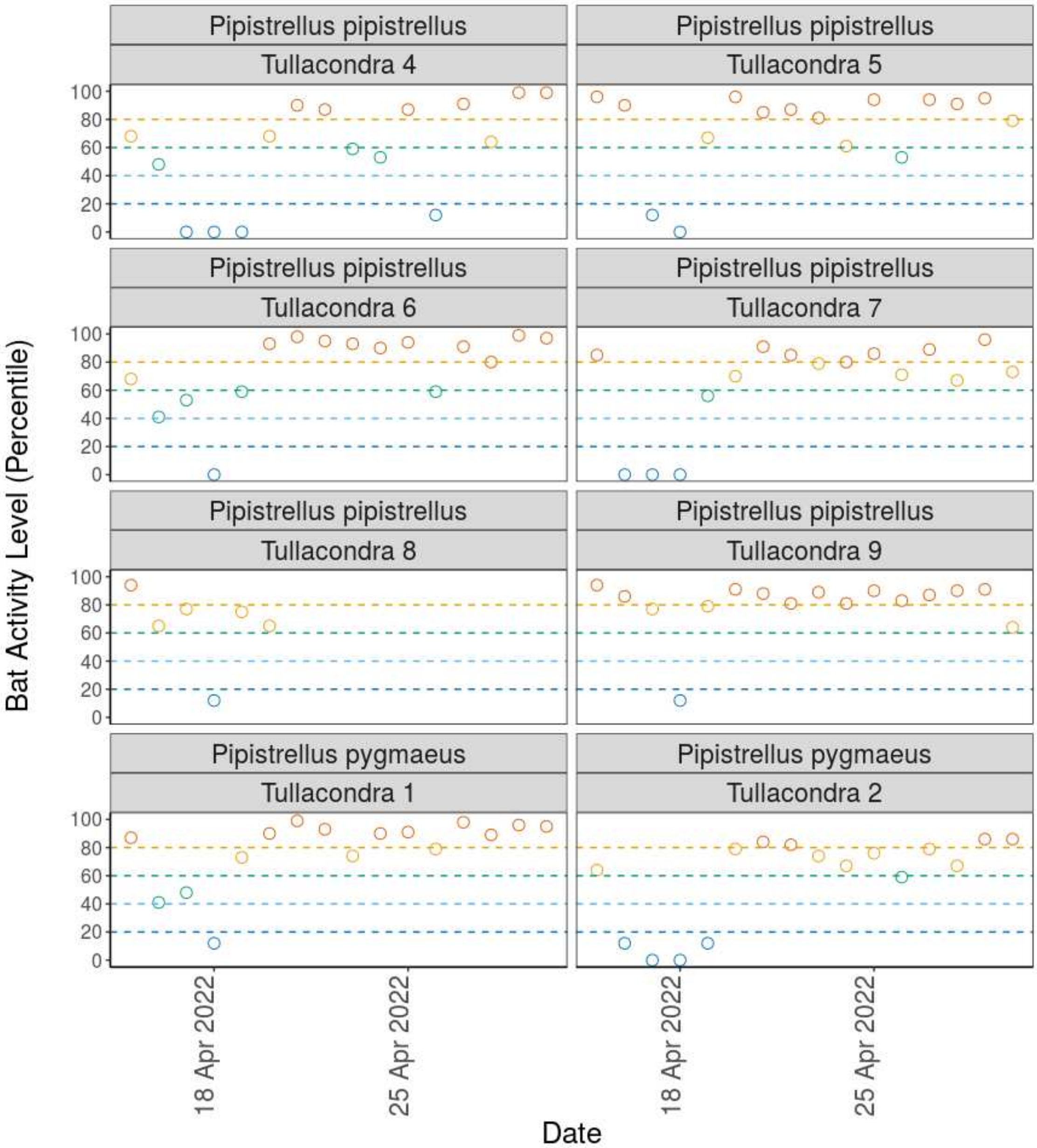
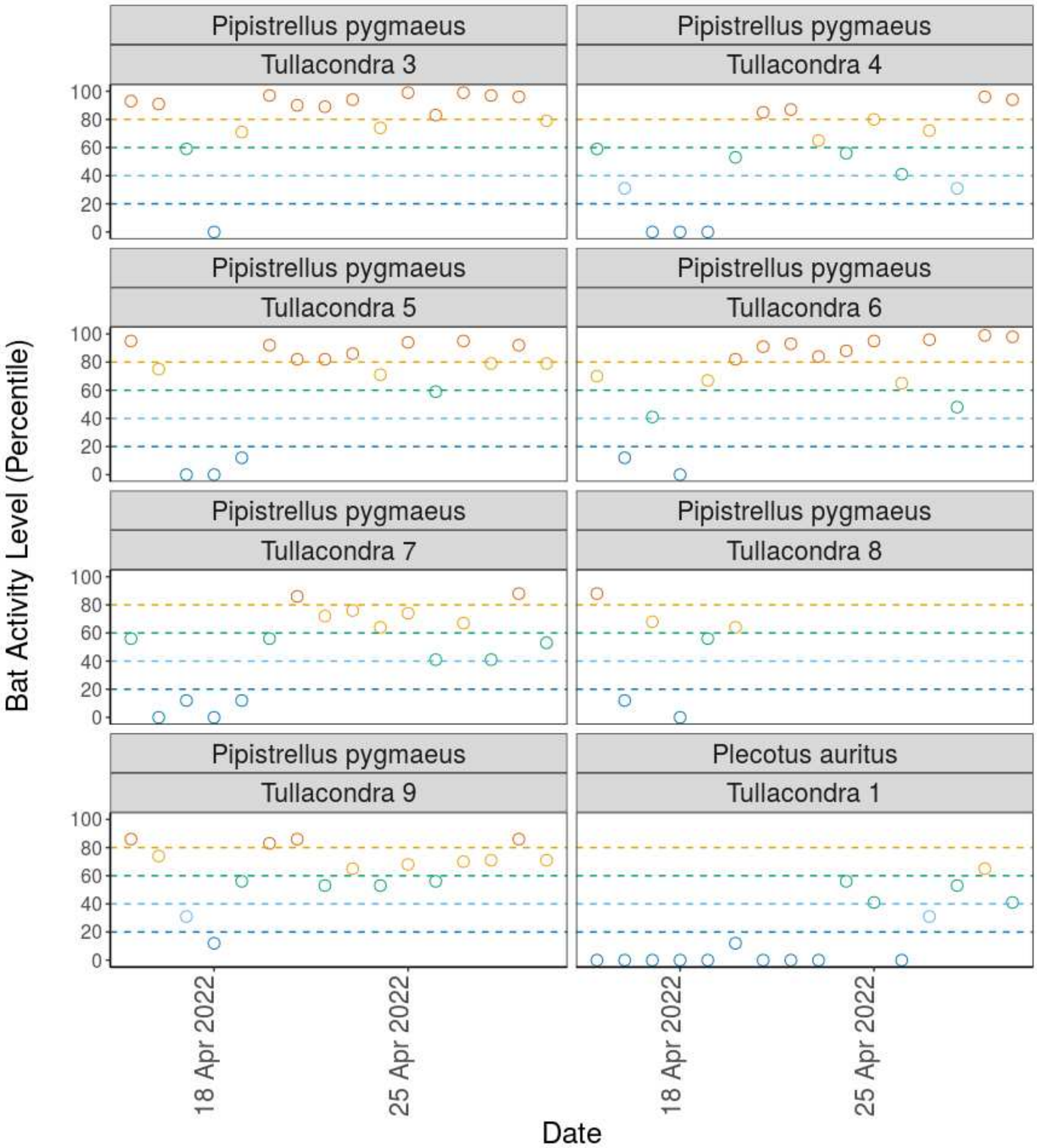
Myotis nattereri
Tullacondra 9
Nyctalus leisleri
Tullacondra 1
Nyctalus leisleri
Tullacondra 2
Nyctalus leisleri
Tullacondra 3
Nyctalus leisleri
Tullacondra 4
Nyctalus leisleri
Tullacondra 5
Bat Activity Level (Percentile)
100
80
60
40
20
0
18 Apr 2022
25 Apr 2022
Date


Nyctalus leisleri
Tullacondra 6
Nyctalus leisleri
Tullacondra 7
Nyctalus leisleri
Tullacondra 8
Nyctalus leisleri
Tullacondra 9
Pipistrellus nathusii
Tullacondra 1
Pipistrellus nathusii
Tullacondra 2
Pipistrellus nathusii
Tullacondra 3
Pipistrellus nathusii
Tullacondra 4
Bat Activity Level (Percentile)
100
80
60
40
20
0
18 Apr 2022
25 Apr 2022
Date


Pipistrellus nathusii
Tullacondra 5
Pipistrellus nathusii
Tullacondra 6
Pipistrellus nathusii
Tullacondra 7
Pipistrellus nathusii
Tullacondra 8
Pipistrellus nathusii
Tullacondra 9
Pipistrellus pipistrellus
Tullacondra 1
Pipistrellus pipistrellus
Tullacondra 2
Pipistrellus pipistrellus
Tullacondra 3
Bat Activity Level (Percentile)
0
20
40
60
80
100
18 Apr 2022
25 Apr 2022
Date


Pipistrellus pipistrellus
Tullacondra 4
Pipistrellus pipistrellus
Tullacondra 5
Pipistrellus pipistrellus
Tullacondra 6
Pipistrellus pipistrellus
Tullacondra 7
Pipistrellus pipistrellus
Tullacondra 8
Pipistrellus pipistrellus
Tullacondra 9
Pipistrellus pygmaeus
Tullacondra 1
Pipistrellus pygmaeus
Tullacondra 2
Bat Activity Level (Percentile)
0
20
40
60
80
100
18 Apr 2022
25 Apr 2022
Date


Pipistrellus pygmaeus
Tullacondra 3
Pipistrellus pygmaeus
Tullacondra 4
Pipistrellus pygmaeus
Tullacondra 5
Pipistrellus pygmaeus
Tullacondra 6
Pipistrellus pygmaeus
Tullacondra 7
Pipistrellus pygmaeus
Tullacondra 8
Pipistrellus pygmaeus
Tullacondra 9
Plecotus auritus
Tullacondra 1
Bat Activity Level (Percentile)
100
80
60
40
20
0
18 Apr 2022
25 Apr 2022
Date

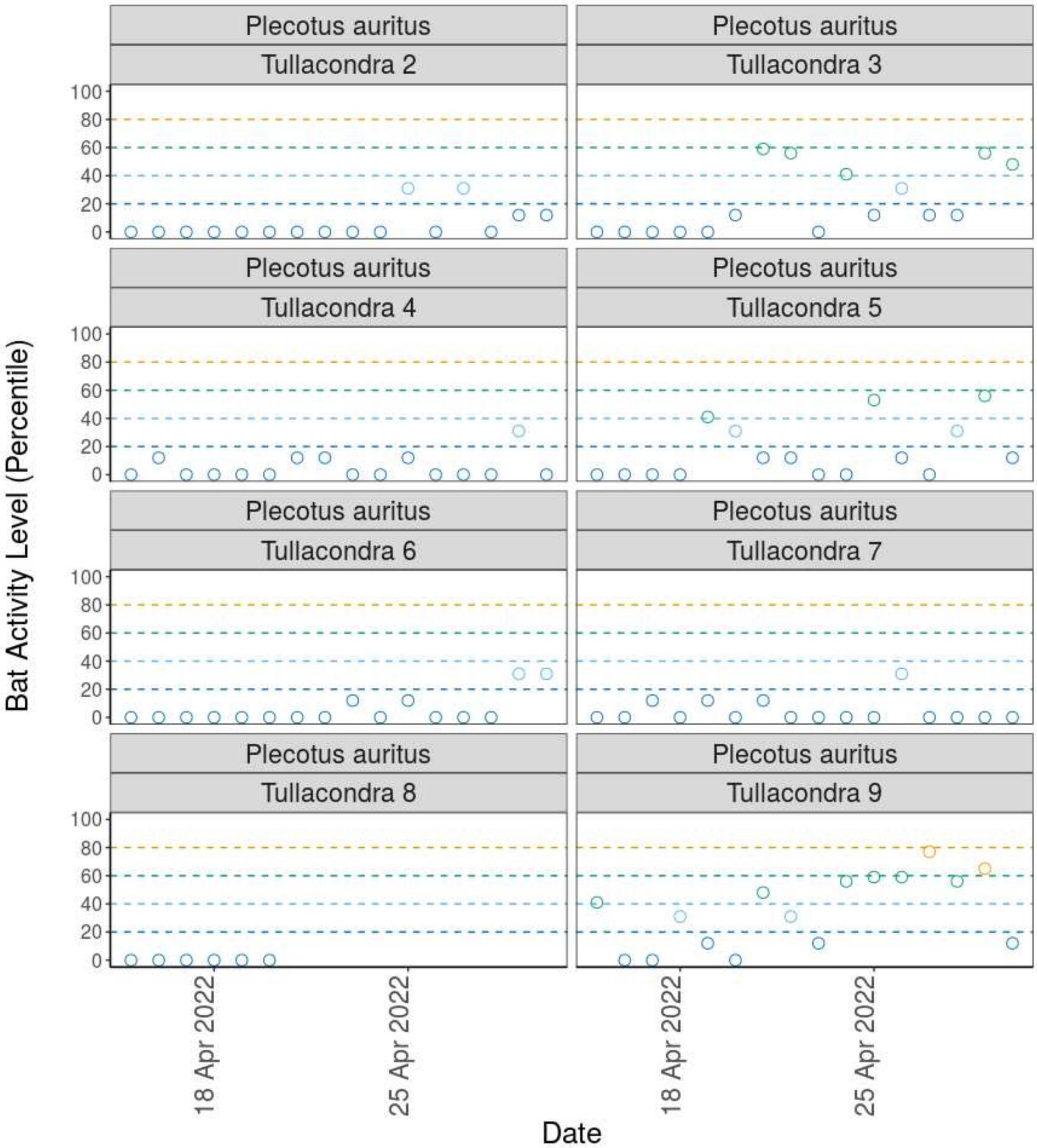


Chart 2. The activity level (percentile) of bats recorded across each night of the bat survey, split by location and species.

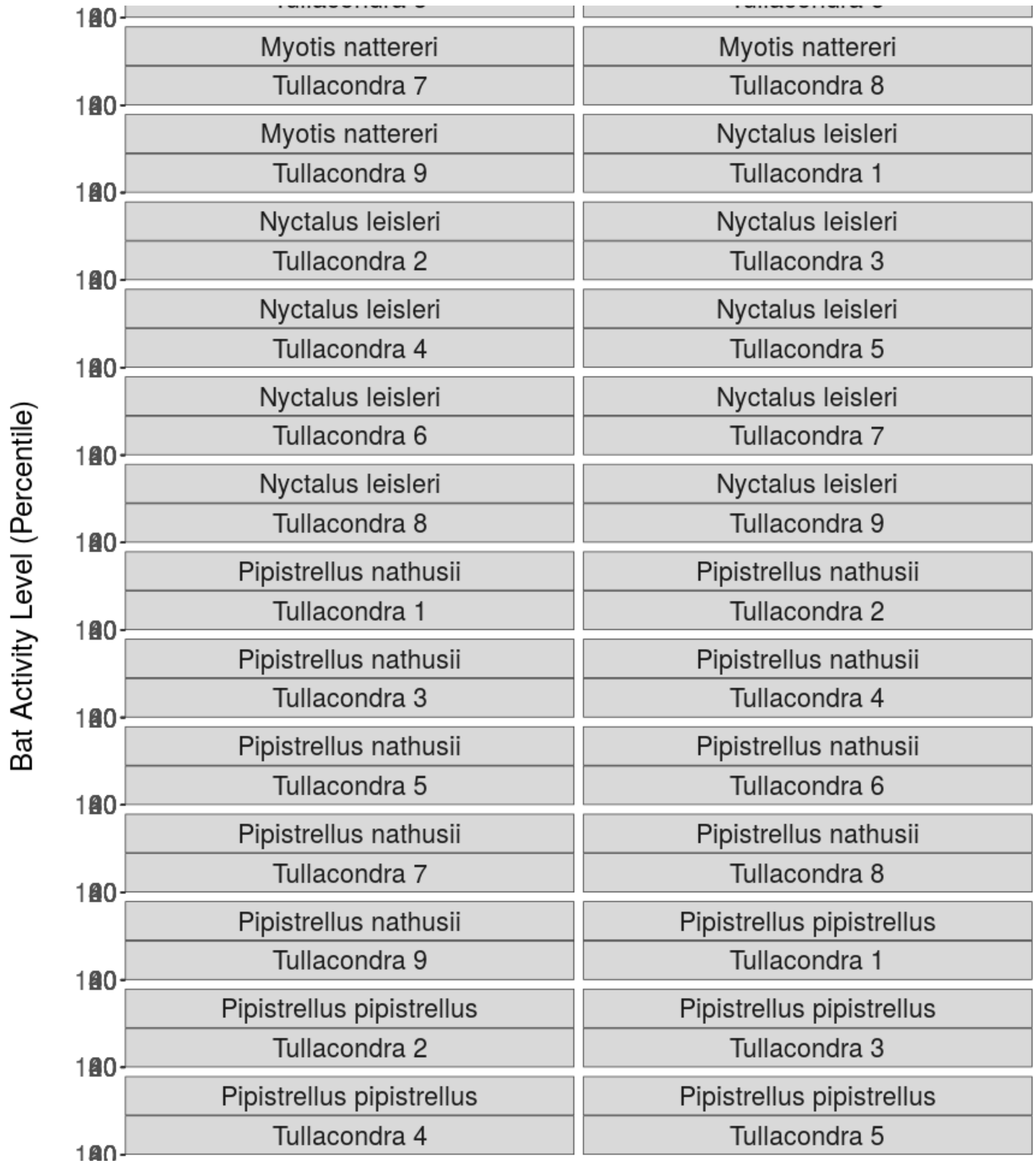


Chart 3. The relationship between recorded bat activity (percentile) and the temperature at sunset, split by species and location.

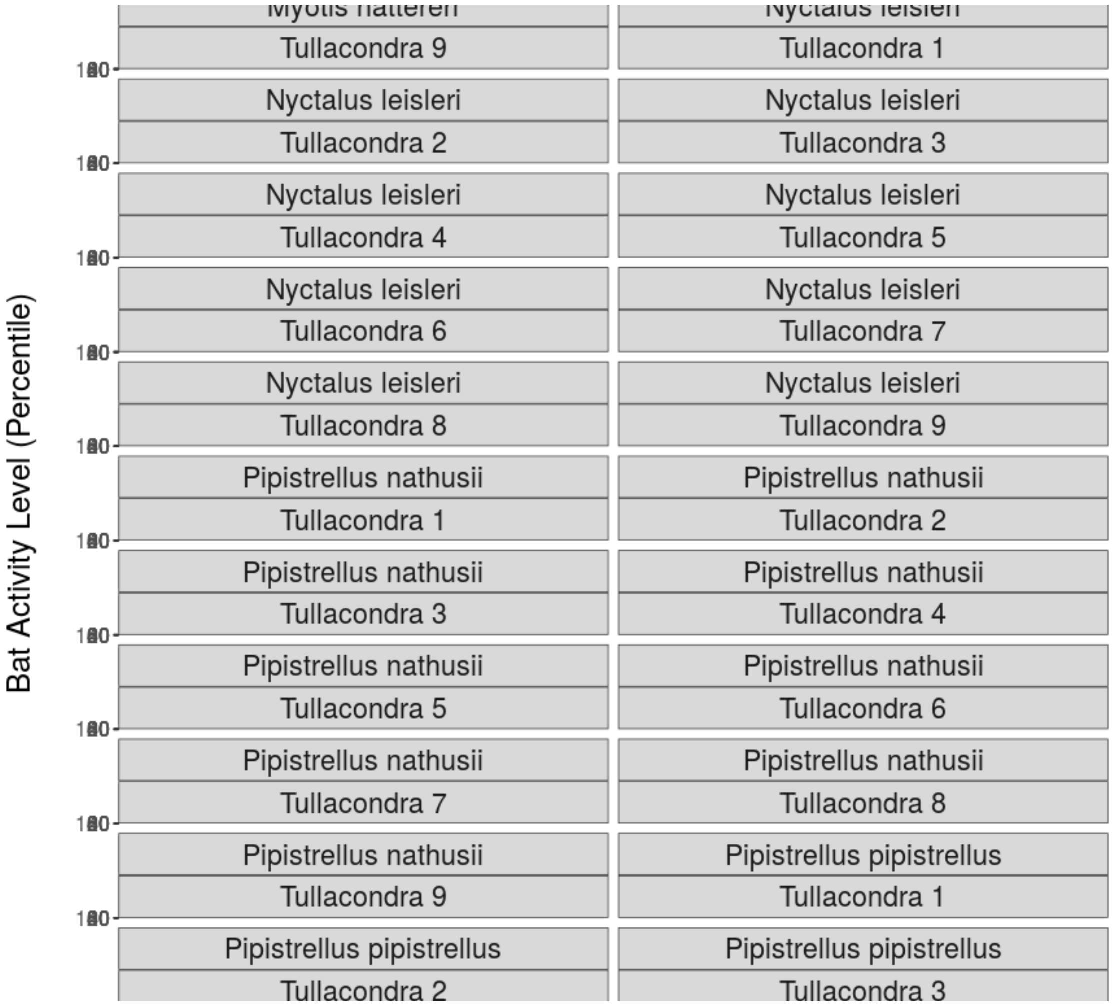


Chart 4. The relationship between recorded bat activity (percentile) and the temperature at sunset, split by location and species.

Ecobat Bat Activity Analysis

Site Name: Tullacondra Summer

John Curtin

- 09/11/2022

Summary

Bat surveys were conducted at Tullacondra 1, Tullacondra 1a, Tullacondra 2, Tullacondra 3, Tullacondra 4, Tullacondra 5, Tullacondra 6, Tullacondra 7, Tullacondra 8, Tullacondra 9, for 13 nights between 2022-06-15 and 2022-06-27, using Wildlife Acoustics static bat detectors. The maximum of passes recorded in a single night was 558 passes, and 8 species were recorded.

The reference range dataset was stratified to include:

- Only records from within 30 days of the survey date.
- Only records from within 100km² of the survey location.

- Records using any make of bat detector.

Table 1

Summary table showing the number of nights recorded bat activity fell into each activity band for each species.

Location	Species/Species Group	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
Tullacondra 1	*Myotis*	1	2	1	9	0
Tullacondra 1	*Myotis daubentonii*	0	0	0	0	13
Tullacondra 1	*Myotis nattereri*	0	1	1	1	10
Tullacondra 1	*Nyctalus leisleri*	0	3	3	3	4
Tullacondra 1	*Pipistrellus nathusii*	0	0	0	3	10
Tullacondra 1	*Pipistrellus pipistrellus*	11	0	1	0	1
Tullacondra 1	*Pipistrellus pygmaeus*	6	6	0	1	0
Tullacondra 1	*Plecotus auritus*	0	0	0	1	12
Tullacondra 1a	*Myotis*	0	6	2	2	3
Tullacondra 1a	*Myotis daubentonii*	0	0	0	0	13
Tullacondra 1a	*Myotis nattereri*	0	0	0	0	13
Tullacondra 1a	*Nyctalus leisleri*	0	2	2	3	6
Tullacondra 1a	*Pipistrellus nathusii*	0	0	0	1	12
Tullacondra 1a	*Pipistrellus pipistrellus*	0	1	4	4	4
Tullacondra 1a	*Pipistrellus pygmaeus*	0	2	4	3	4
Tullacondra 1a	*Plecotus auritus*	0	0	2	3	8
Tullacondra 2	*Myotis*	0	0	0	0	13
Tullacondra 2	*Myotis daubentonii*	0	0	0	0	13
Tullacondra 2	*Myotis nattereri*	0	0	0	0	13
Tullacondra 2	*Nyctalus leisleri*	1	3	4	1	4
Tullacondra 2	*Pipistrellus nathusii*	0	0	0	1	12
Tullacondra 2	*Pipistrellus pipistrellus*	0	4	5	0	4

Tullacondra 2	*Pipistrellus pygmaeus*	0	6	3	0	4
Tullacondra 2	*Plecotus auritus*	0	0	0	0	13
Tullacondra 3	*Myotis*	0	2	4	3	4
Tullacondra 3	*Myotis daubentonii*	0	0	0	0	13
Tullacondra 3	*Myotis nattereri*	0	0	0	0	13
Tullacondra 3	*Nyctalus leisleri*	0	2	4	2	5
Tullacondra 3	*Pipistrellus nathusii*	0	0	1	2	10
Tullacondra 3	*Pipistrellus pipistrellus*	7	4	0	1	1
Tullacondra 3	*Pipistrellus pygmaeus*	8	3	0	0	2
Tullacondra 3	*Plecotus auritus*	0	0	0	0	13
Tullacondra 4	*Myotis*	0	0	0	5	8
Tullacondra 4	*Myotis daubentonii*	0	0	0	0	13
Tullacondra 4	*Myotis nattereri*	0	0	0	0	13
Tullacondra 4	*Nyctalus leisleri*	0	2	5	2	4
Tullacondra 4	*Pipistrellus nathusii*	0	0	2	2	9
Tullacondra 4	*Pipistrellus pipistrellus*	3	4	2	0	4
Tullacondra 4	*Pipistrellus pygmaeus*	4	4	2	1	2
Tullacondra 4	*Plecotus auritus*	0	0	0	0	13
Tullacondra 5	*Myotis*	2	3	3	1	4
Tullacondra 5	*Myotis daubentonii*	0	0	0	0	13
Tullacondra 5	*Myotis nattereri*	0	1	1	0	11
Tullacondra 5	*Nyctalus leisleri*	0	2	1	6	4
Tullacondra 5	*Pipistrellus nathusii*	0	1	1	5	6
Tullacondra 5	*Pipistrellus pipistrellus*	9	0	2	0	2
Tullacondra 5	*Pipistrellus pygmaeus*	9	0	1	0	3
Tullacondra 5	*Plecotus auritus*	0	0	0	3	10
Tullacondra 6	*Myotis*	0	0	6	3	4

Tullacondra 6	*Myotis daubentonii*	0	0	0	1	12
Tullacondra 6	*Myotis nattereri*	0	0	0	0	13
Tullacondra 6	*Nyctalus leisleri*	2	2	4	2	3
Tullacondra 6	*Pipistrellus nathusii*	0	0	0	4	9
Tullacondra 6	*Pipistrellus pipistrellus*	5	2	1	2	3
Tullacondra 6	*Pipistrellus pygmaeus*	6	1	0	3	3
Tullacondra 6	*Plecotus auritus*	0	0	0	0	13
Tullacondra 7	*Myotis*	0	0	4	4	5
Tullacondra 7	*Myotis daubentonii*	0	0	0	0	13
Tullacondra 7	*Myotis nattereri*	0	0	0	0	13
Tullacondra 7	*Nyctalus leisleri*	0	3	1	3	6
Tullacondra 7	*Pipistrellus nathusii*	0	1	2	2	8
Tullacondra 7	*Pipistrellus pipistrellus*	8	0	2	0	3
Tullacondra 7	*Pipistrellus pygmaeus*	4	0	4	0	5
Tullacondra 7	*Plecotus auritus*	0	0	0	2	11
Tullacondra 8	*Myotis*	0	0	3	1	9
Tullacondra 8	*Myotis daubentonii*	0	0	0	0	13
Tullacondra 8	*Myotis nattereri*	0	0	0	1	12
Tullacondra 8	*Nyctalus leisleri*	6	2	1	2	2
Tullacondra 8	*Pipistrellus nathusii*	0	0	6	4	3
Tullacondra 8	*Pipistrellus pipistrellus*	12	0	0	0	1
Tullacondra 8	*Pipistrellus pygmaeus*	6	5	1	0	1
Tullacondra 8	*Plecotus auritus*	0	0	1	2	10
Tullacondra 9	*Myotis*	0	0	2	3	8
Tullacondra 9	*Myotis daubentonii*	0	0	0	0	13
Tullacondra 9	*Myotis nattereri*	0	0	0	0	13
Tullacondra 9	*Nyctalus leisleri*	4	3	4	0	2

Tullacondra 9	*Pipistrellus nathusii*	1	7	2	2	1
Tullacondra 9	*Pipistrellus pipistrellus*	10	3	0	0	0
Tullacondra 9	*Pipistrellus pygmaeus*	0	5	2	3	3
Tullacondra 9	*Plecotus auritus*	0	3	3	1	6

Table 2

Summary table showing key metrics for each species recorded.

Location	Species/Species Group	Median Percentile	95% CIs	Max Percentile	Nights Recorded	Reference Range
Tullacondra 1	*Myotis*	35	30.5 - 59	92	13	1824
Tullacondra 1	*Myotis daubentonii*	0	0 - 0	0	13	443
Tullacondra 1	*Myotis nattereri*	0	8 - 69	69	13	370
Tullacondra 1	*Nyctalus leisleri*	35	30.5 - 65	74	13	2263
Tullacondra 1	*Pipistrellus nathusii*	0	8 - 35	35	13	619
Tullacondra 1	*Pipistrellus pipistrellus*	88	81 - 90	93	13	2656
Tullacondra 1	*Pipistrellus pygmaeus*	79	74 - 89	94	13	2465
Tullacondra 1	*Plecotus auritus*	0	8 - 8	26	13	1186
Tullacondra 1a	*Myotis*	59	45 - 69	74	13	1824
Tullacondra 1a	*Myotis daubentonii*	0	0 - 0	0	13	443
Tullacondra 1a	*Myotis nattereri*	0	0 - 0	8	13	370
Tullacondra 1a	*Nyctalus leisleri*	26	21.5 - 55	68	13	2263
Tullacondra 1a	*Pipistrellus nathusii*	0	0 - 0	26	13	619
Tullacondra 1a	*Pipistrellus pipistrellus*	35	26 - 49.5	64	13	2656
Tullacondra 1a	*Pipistrellus pygmaeus*	35	26 - 57	74	13	2465
Tullacondra 1a	*Plecotus auritus*	0	17 - 51	54	13	1186
Tullacondra 2	*Myotis*	0	0 - 0	8	13	1824
Tullacondra 2	*Myotis daubentonii*	0	0 - 0	0	13	443
Tullacondra 2	*Myotis nattereri*	0	0 - 0	0	13	370
Tullacondra 2	*Nyctalus leisleri*	47	35 - 69	80	13	2263

Tullacondra 2	*Pipistrellus nathusii*	0	0 - 0	26	13	619
Tullacondra 2	*Pipistrellus pipistrellus*	57	39 - 67	73	13	2656
Tullacondra 2	*Pipistrellus pygmaeus*	54	54 - 69	71	13	2465
Tullacondra 2	*Plecotus auritus*	0	0 - 0	8	13	1186
Tullacondra 3	*Myotis*	35	29.5 - 59	68	13	1824
Tullacondra 3	*Myotis daubentonii*	0	0 - 0	0	13	443
Tullacondra 3	*Myotis nattereri*	0	0 - 0	8	13	370
Tullacondra 3	*Nyctalus leisleri*	35	21.5 - 56	77	13	2263
Tullacondra 3	*Pipistrellus nathusii*	0	8 - 35	57	13	619
Tullacondra 3	*Pipistrellus pipistrellus*	91	62 - 94.5	98	13	2656
Tullacondra 3	*Pipistrellus pygmaeus*	81	70.5 - 95	97	13	2465
Tullacondra 3	*Plecotus auritus*	0	0 - 0	8	13	1186
Tullacondra 4	*Myotis*	8	8 - 35	35	13	1824
Tullacondra 4	*Myotis daubentonii*	0	0 - 0	0	13	443
Tullacondra 4	*Myotis nattereri*	0	0 - 0	8	13	370
Tullacondra 4	*Nyctalus leisleri*	42	25 - 58	74	13	2263
Tullacondra 4	*Pipistrellus nathusii*	8	8 - 36.5	47	13	619
Tullacondra 4	*Pipistrellus pipistrellus*	70	44.5 - 82.5	95	13	2656
Tullacondra 4	*Pipistrellus pygmaeus*	76	57.5 - 84	96	13	2465
Tullacondra 4	*Plecotus auritus*	0	0 - 0	0	13	1186
Tullacondra 5	*Myotis*	51	29.5 - 66	88	13	1824
Tullacondra 5	*Myotis daubentonii*	0	0 - 0	0	13	443
Tullacondra 5	*Myotis nattereri*	8	8 - 25	61	13	370
Tullacondra 5	*Nyctalus leisleri*	26	21.5 - 49	64	13	2263
Tullacondra 5	*Pipistrellus nathusii*	26	21.5 - 54	73	13	619
Tullacondra 5	*Pipistrellus pipistrellus*	90	68 - 94.5	98	13	2656
Tullacondra 5	*Pipistrellus pygmaeus*	92	52 - 96.5	97	13	2465

Tullacondra 5	*Plecotus auritus*	8	8 - 17	26	13	1186
Tullacondra 6	*Myotis*	35	27.5 - 51	57	13	1824
Tullacondra 6	*Myotis daubentonii*	0	0 - 0	26	13	443
Tullacondra 6	*Myotis nattereri*	0	0 - 0	8	13	370
Tullacondra 6	*Nyctalus leisleri*	47	41.5 - 72.5	86	13	2263
Tullacondra 6	*Pipistrellus nathusii*	8	17 - 26	26	13	619
Tullacondra 6	*Pipistrellus pipistrellus*	71	39.5 - 86	94	13	2656
Tullacondra 6	*Pipistrellus pygmaeus*	63	49 - 90	96	13	2465
Tullacondra 6	*Plecotus auritus*	0	0 - 0	0	13	1186
Tullacondra 7	*Myotis*	35	21.5 - 42	57	13	1824
Tullacondra 7	*Myotis daubentonii*	0	0 - 0	0	13	443
Tullacondra 7	*Myotis nattereri*	0	0 - 0	8	13	370
Tullacondra 7	*Nyctalus leisleri*	35	21.5 - 63	69	13	2263
Tullacondra 7	*Pipistrellus nathusii*	8	17 - 51	69	13	619
Tullacondra 7	*Pipistrellus pipistrellus*	91	69.5 - 96.5	99	13	2656
Tullacondra 7	*Pipistrellus pygmaeus*	57	44 - 83	85	13	2465
Tullacondra 7	*Plecotus auritus*	0	8 - 21.5	35	13	1186
Tullacondra 8	*Myotis*	0	8 - 57	57	13	1824
Tullacondra 8	*Myotis daubentonii*	0	0 - 0	0	13	443
Tullacondra 8	*Myotis nattereri*	0	0 - 0	26	13	370
Tullacondra 8	*Nyctalus leisleri*	69	55 - 89.5	97	13	2263
Tullacondra 8	*Pipistrellus nathusii*	35	25 - 44.5	47	13	619
Tullacondra 8	*Pipistrellus pipistrellus*	95	94 - 96.5	97	13	2656
Tullacondra 8	*Pipistrellus pygmaeus*	77	70.5 - 84	87	13	2465
Tullacondra 8	*Plecotus auritus*	0	8 - 34	42	13	1186
Tullacondra 9	*Myotis*	8	8 - 42	59	13	1824
Tullacondra 9	*Myotis daubentonii*	0	0 - 0	0	13	443

Tullacondra 9	*Myotis nattereri*	0	0 - 0	0	13	370
Tullacondra 9	*Nyctalus leisleri*	66	49.5 - 83.5	96	13	2263
Tullacondra 9	*Pipistrellus nathusii*	69	41.5 - 74.5	85	13	619
Tullacondra 9	*Pipistrellus pipistrellus*	89	79 - 92	94	13	2656
Tullacondra 9	*Pipistrellus pygmaeus*	51	30.5 - 71	77	13	2465
Tullacondra 9	*Plecotus auritus*	26	17 - 61	64	13	1186

Charts

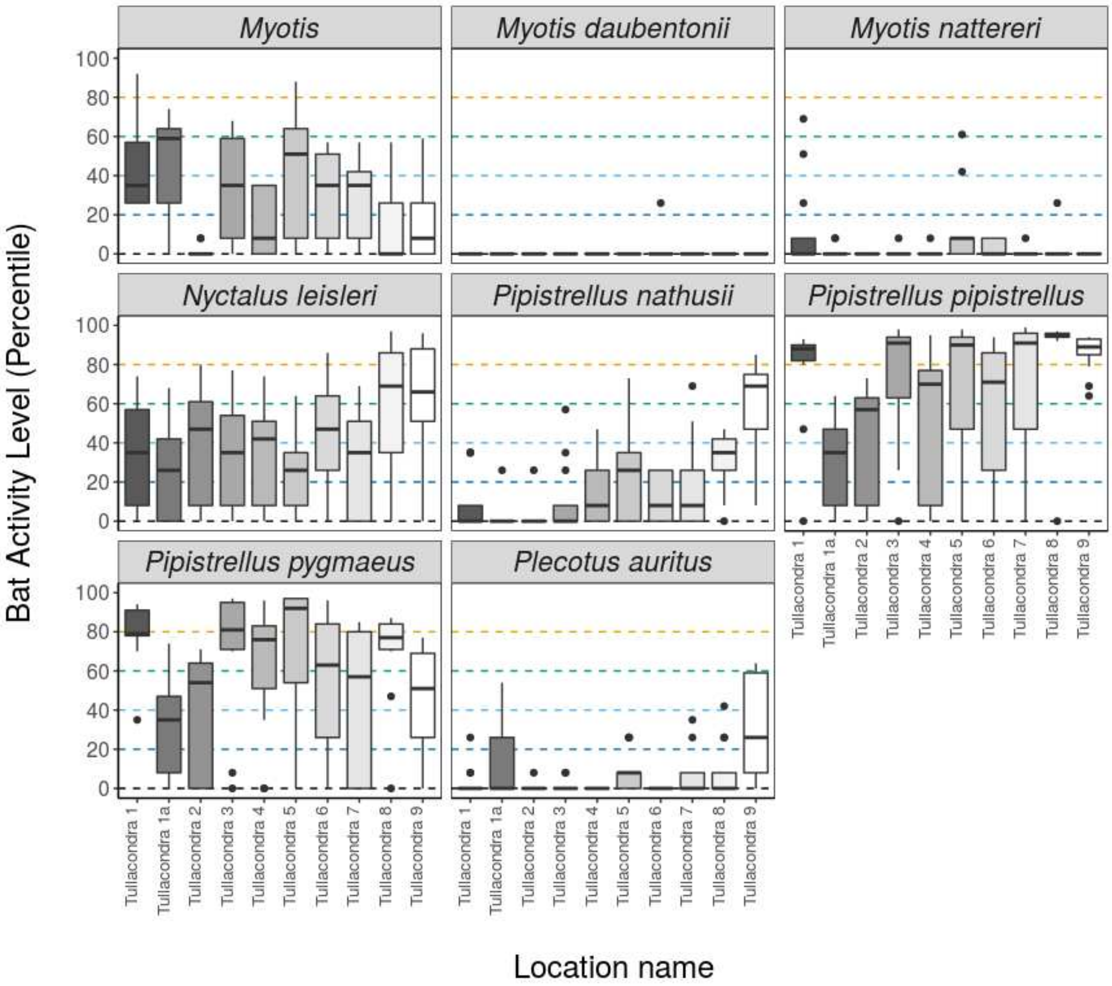
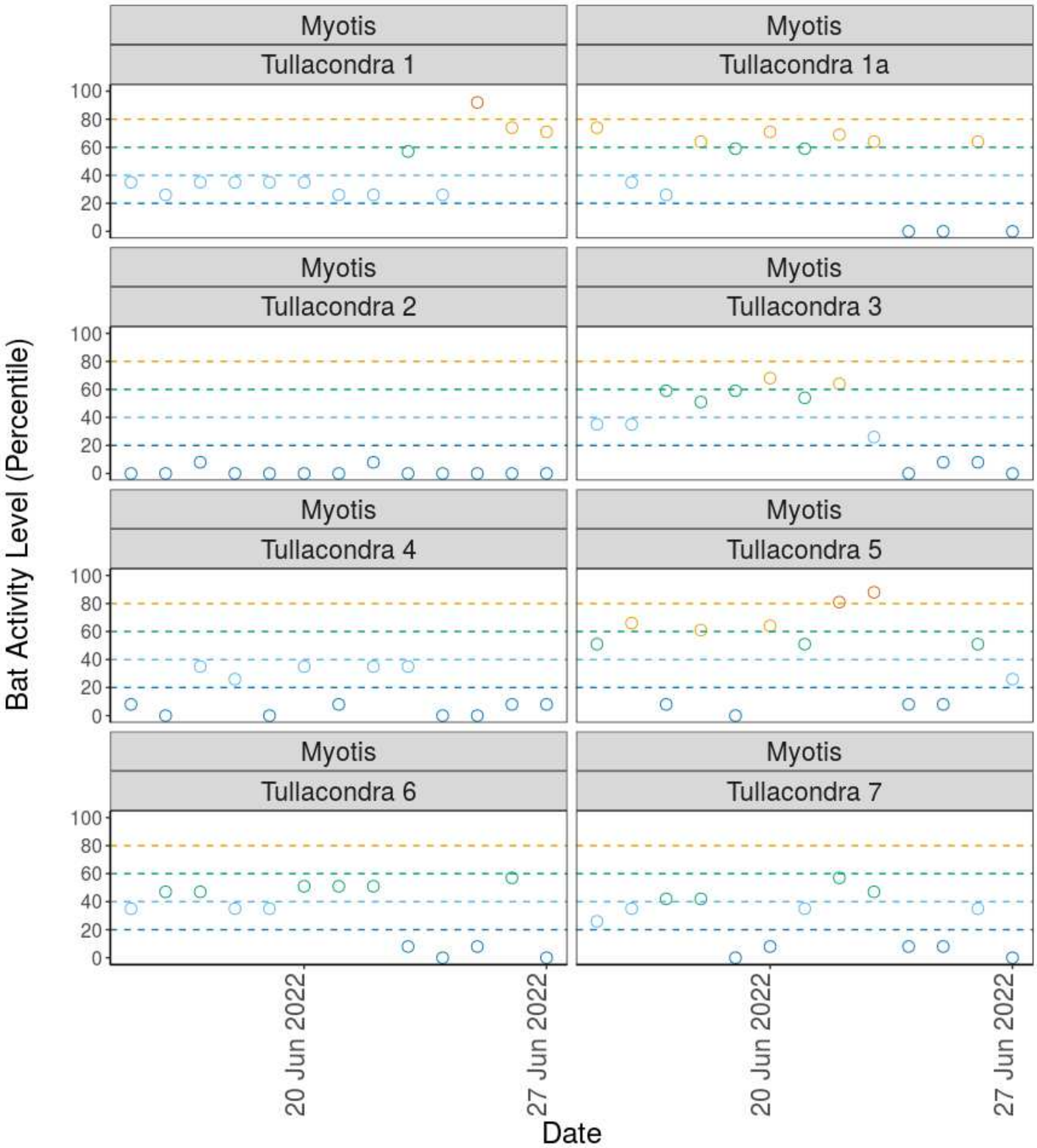
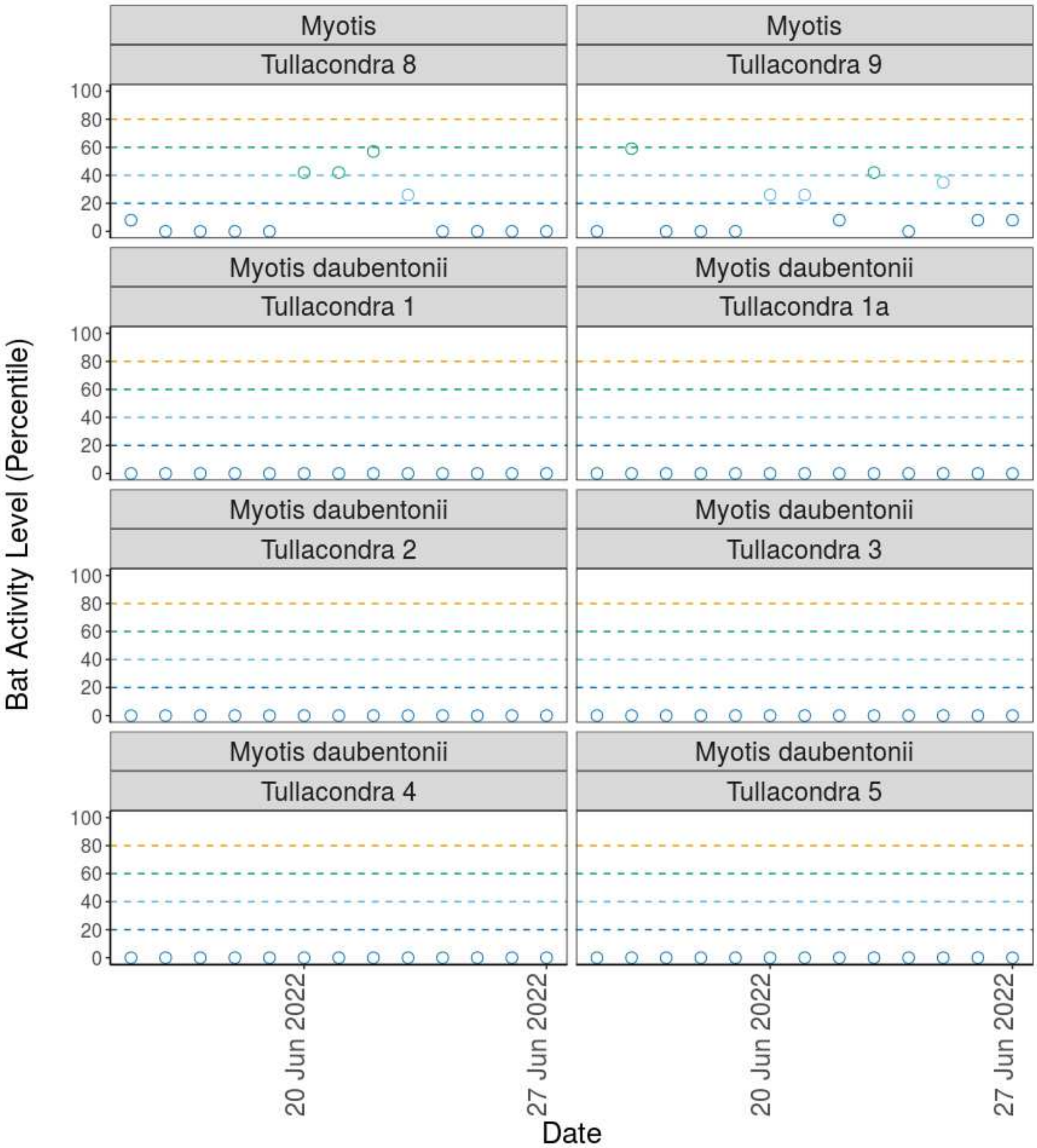
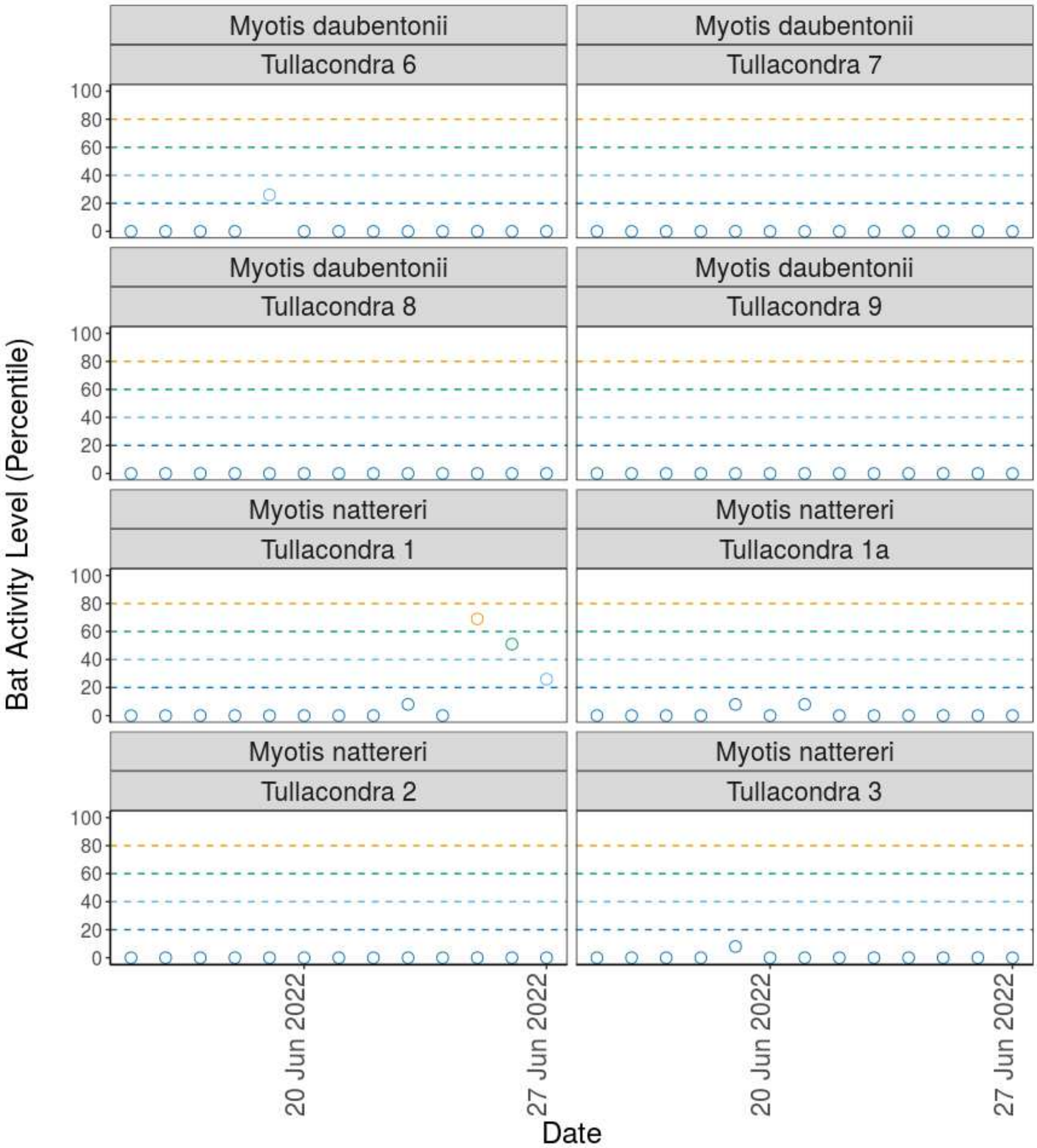


Chart 1. Differences in activity between static detector locations, split by species and location. The centre line indicates the median activity level whereas the box represents the interquartile range (the spread of the middle 50% of nights of activity)

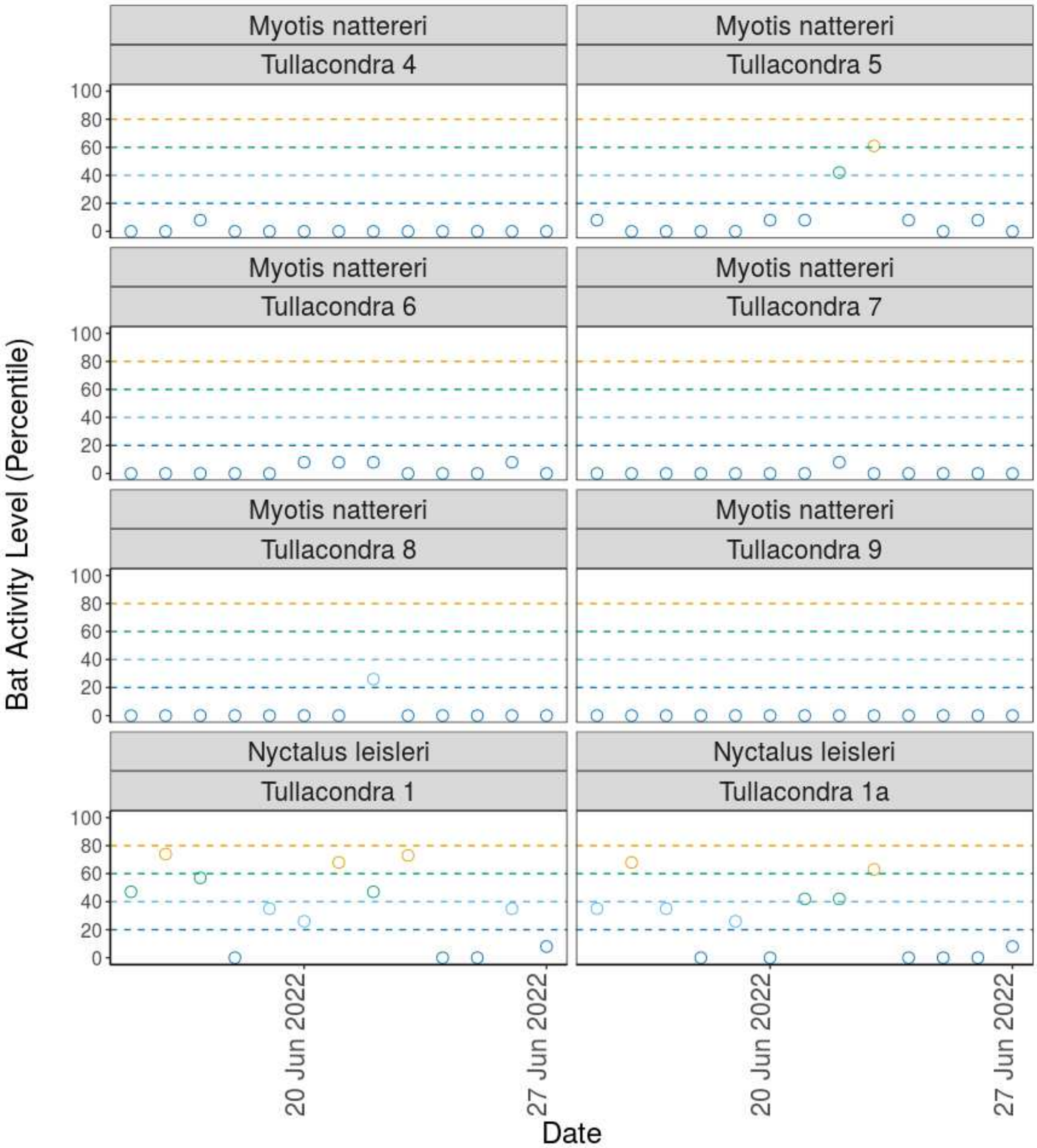


Myotis
Tullacondra 1
Myotis
Tullacondra 1a
Myotis
Tullacondra 2
Myotis
Tullacondra 3
Myotis
Tullacondra 4
Myotis
Tullacondra 5
Myotis
Tullacondra 6
Myotis
Tullacondra 7
Bat Activity Level (Percentile)
100
80
60
40
20
0
20 Jun 2022
27 Jun 2022
Date

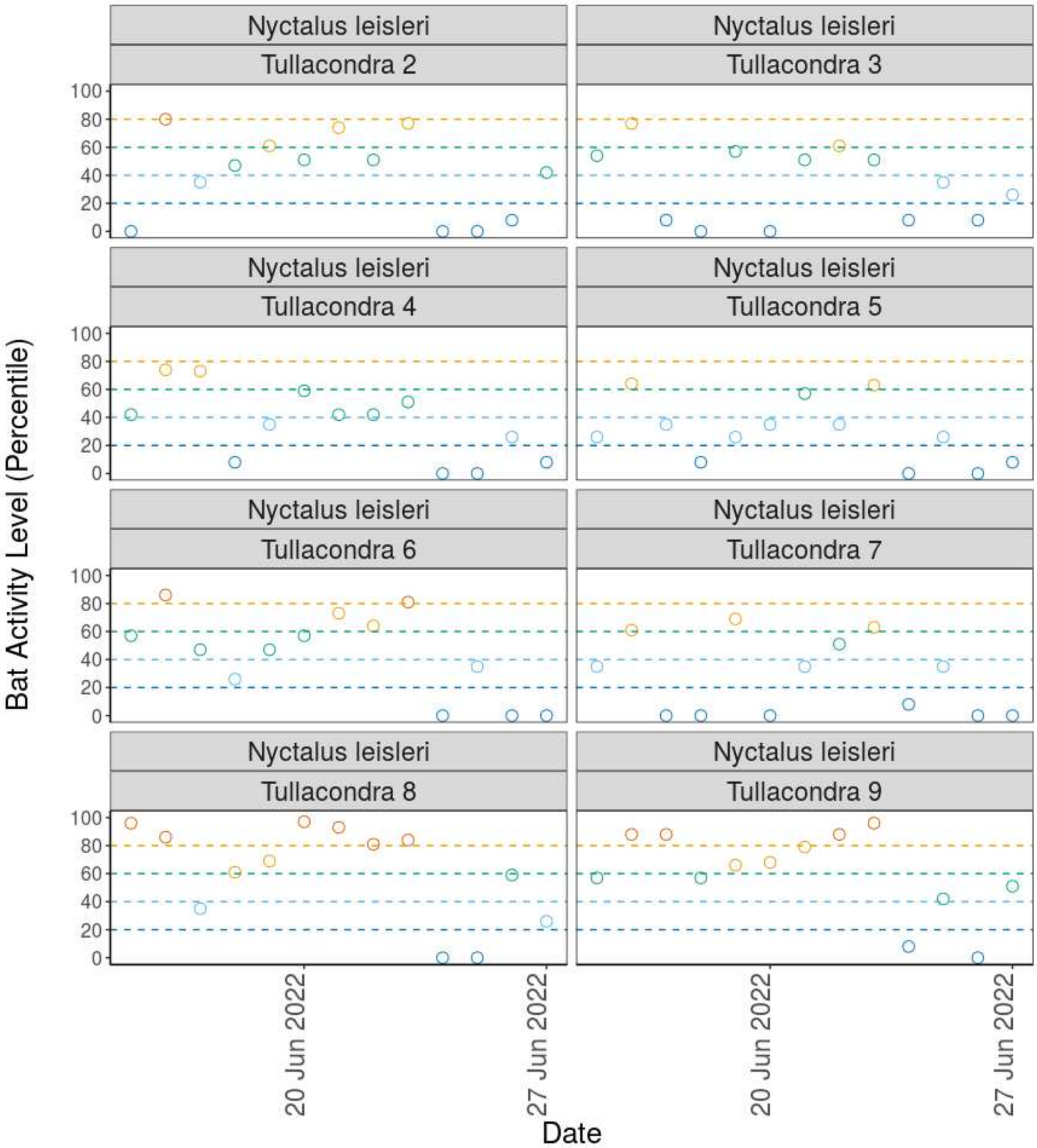

Myotis
Tullacondra 8
Myotis
Tullacondra 9
Myotis daubentonii
Tullacondra 1
Myotis daubentonii
Tullacondra 1a
Myotis daubentonii
Tullacondra 2
Myotis daubentonii
Tullacondra 3
Myotis daubentonii
Tullacondra 4
Myotis daubentonii
Tullacondra 5
Bat Activity Level (Percentile)
100
80
60
40
20
0
20 Jun 2022
27 Jun 2022
Date



Myotis daubentonii
Tullacondra 6
Myotis daubentonii
Tullacondra 7
Myotis daubentonii
Tullacondra 8
Myotis daubentonii
Tullacondra 9
Myotis nattereri
Tullacondra 1
Myotis nattereri
Tullacondra 1a
Myotis nattereri
Tullacondra 2
Myotis nattereri
Tullacondra 3
Bat Activity Level (Percentile)
0
20
40
60
80
100
20 Jun 2022
27 Jun 2022
Date



Myotis nattereri
Tullacondra 4
Myotis nattereri
Tullacondra 5
Myotis nattereri
Tullacondra 6
Myotis nattereri
Tullacondra 7
Myotis nattereri
Tullacondra 8
Myotis nattereri
Tullacondra 9
Nyctalus leisleri
Tullacondra 1
Nyctalus leisleri
Tullacondra 1a
Bat Activity Level (Percentile)
100
80
60
40
20
0
20 Jun 2022
27 Jun 2022
Date


Nyctalus leisleri
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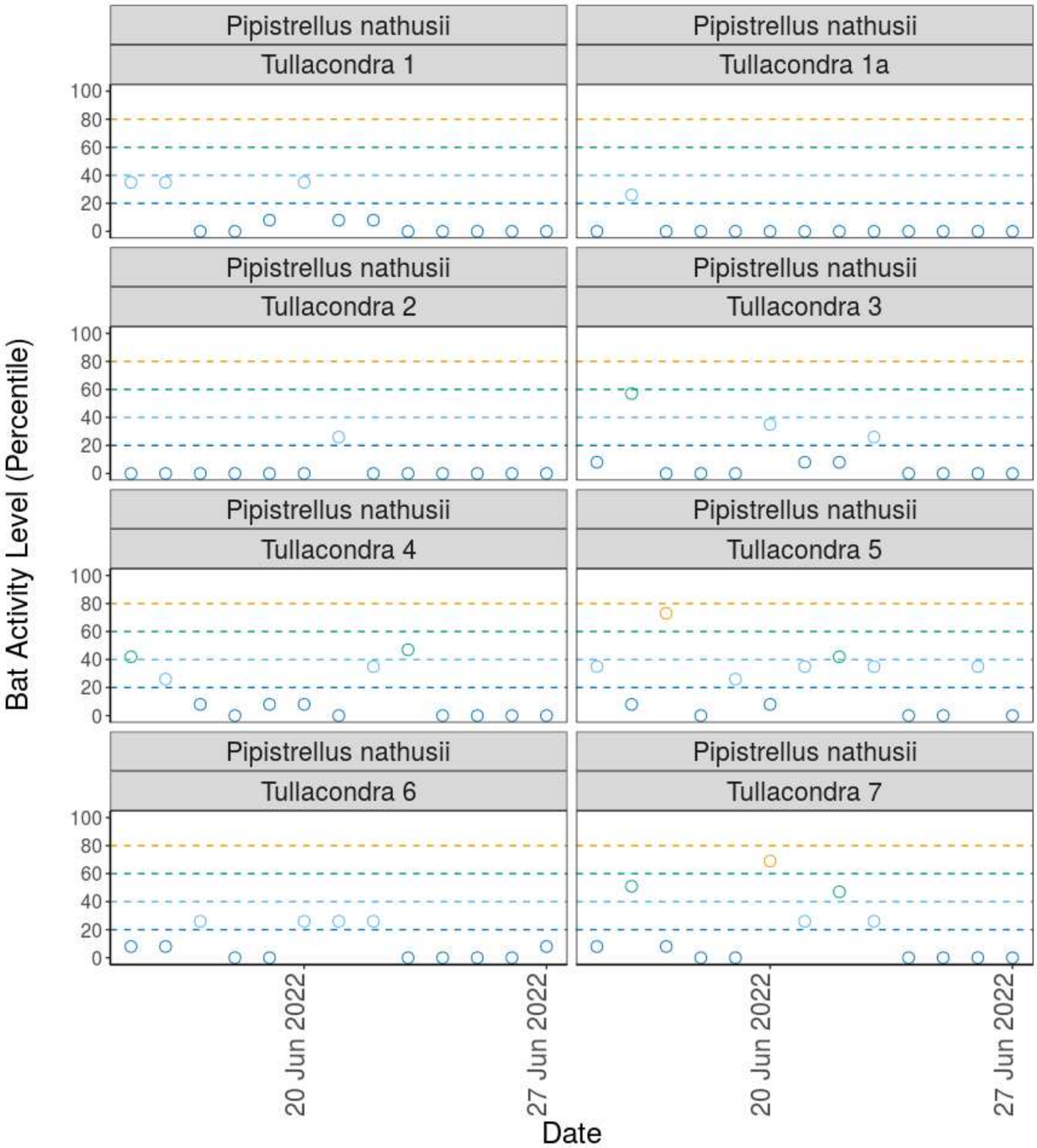
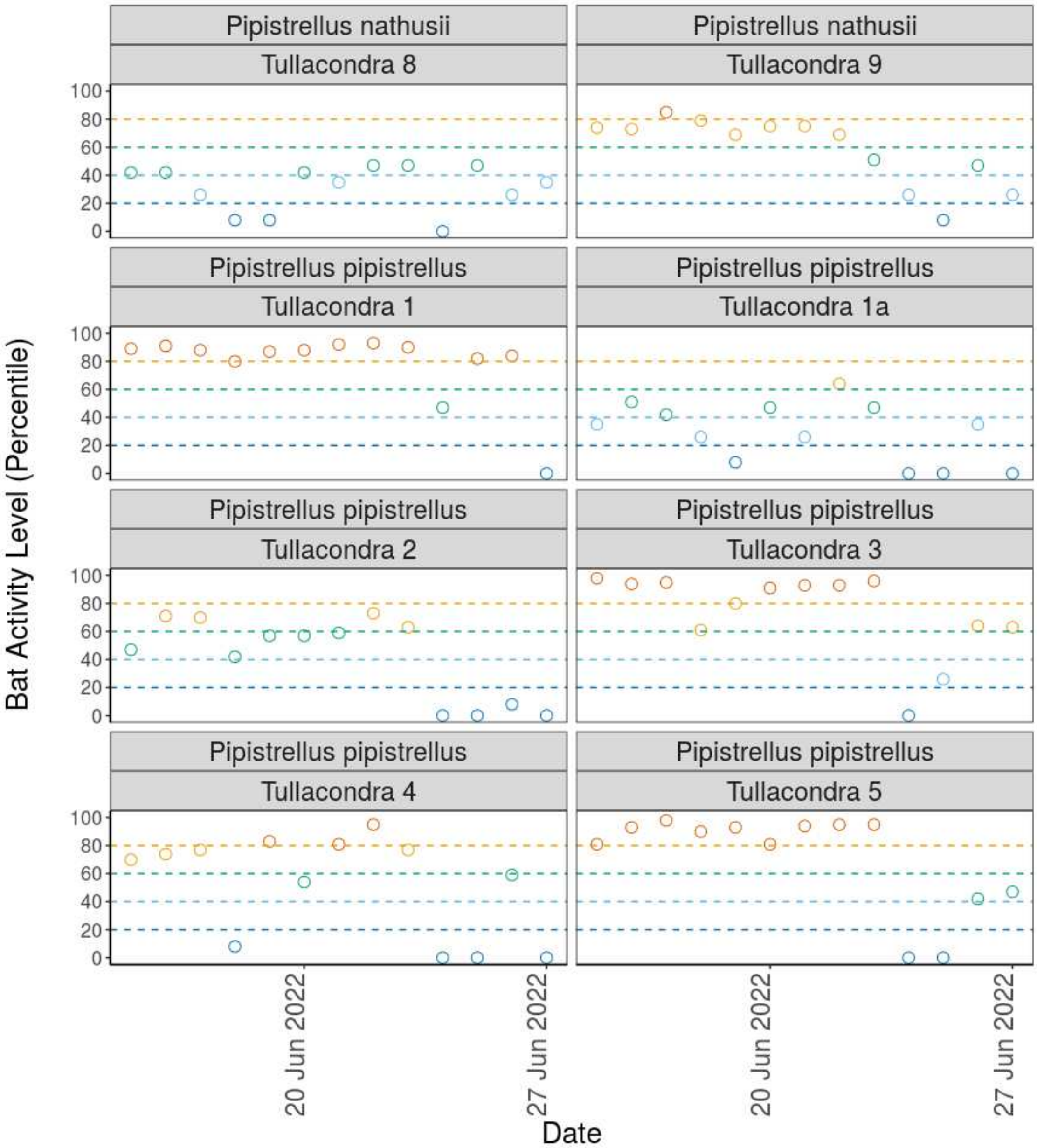
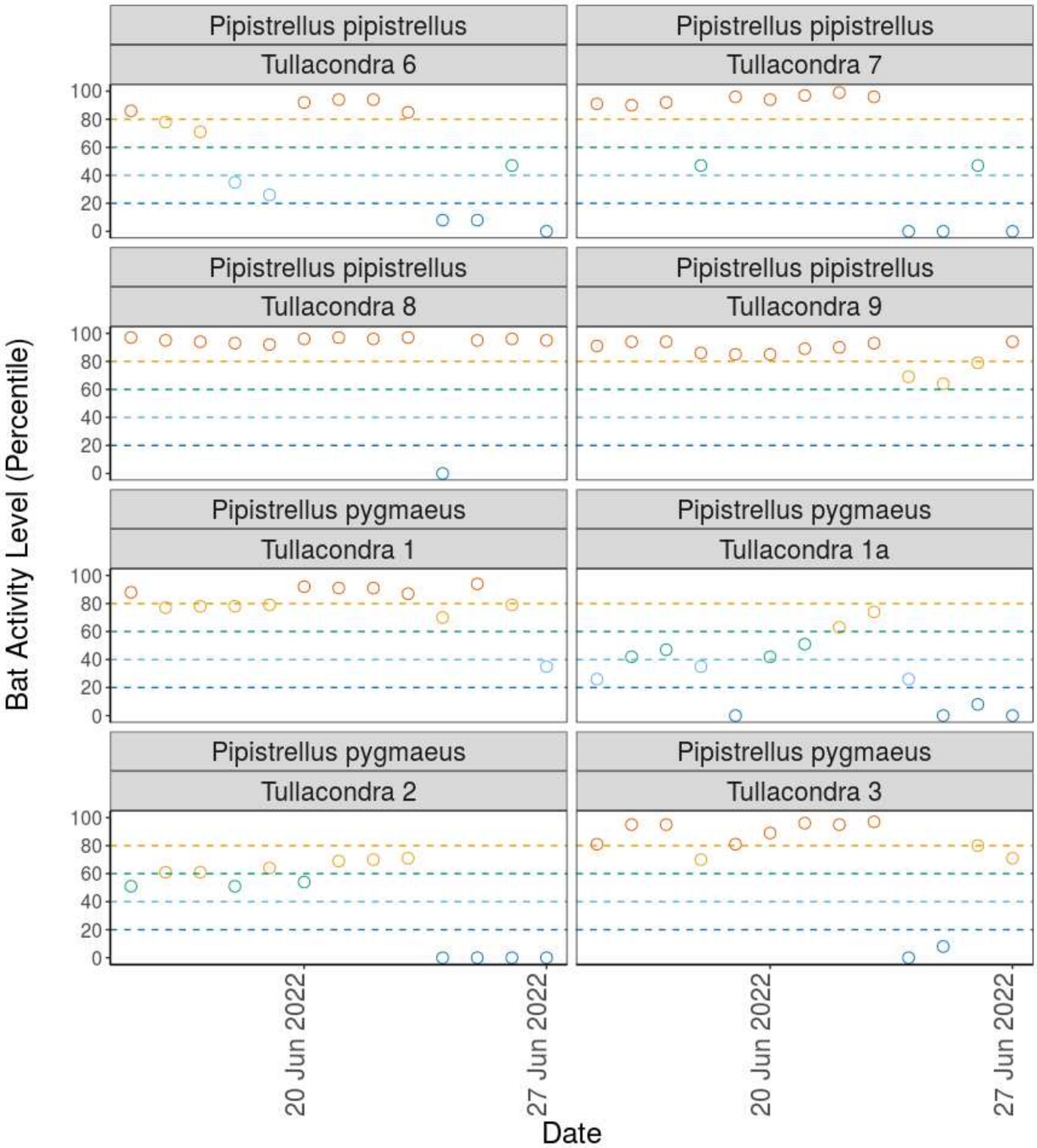
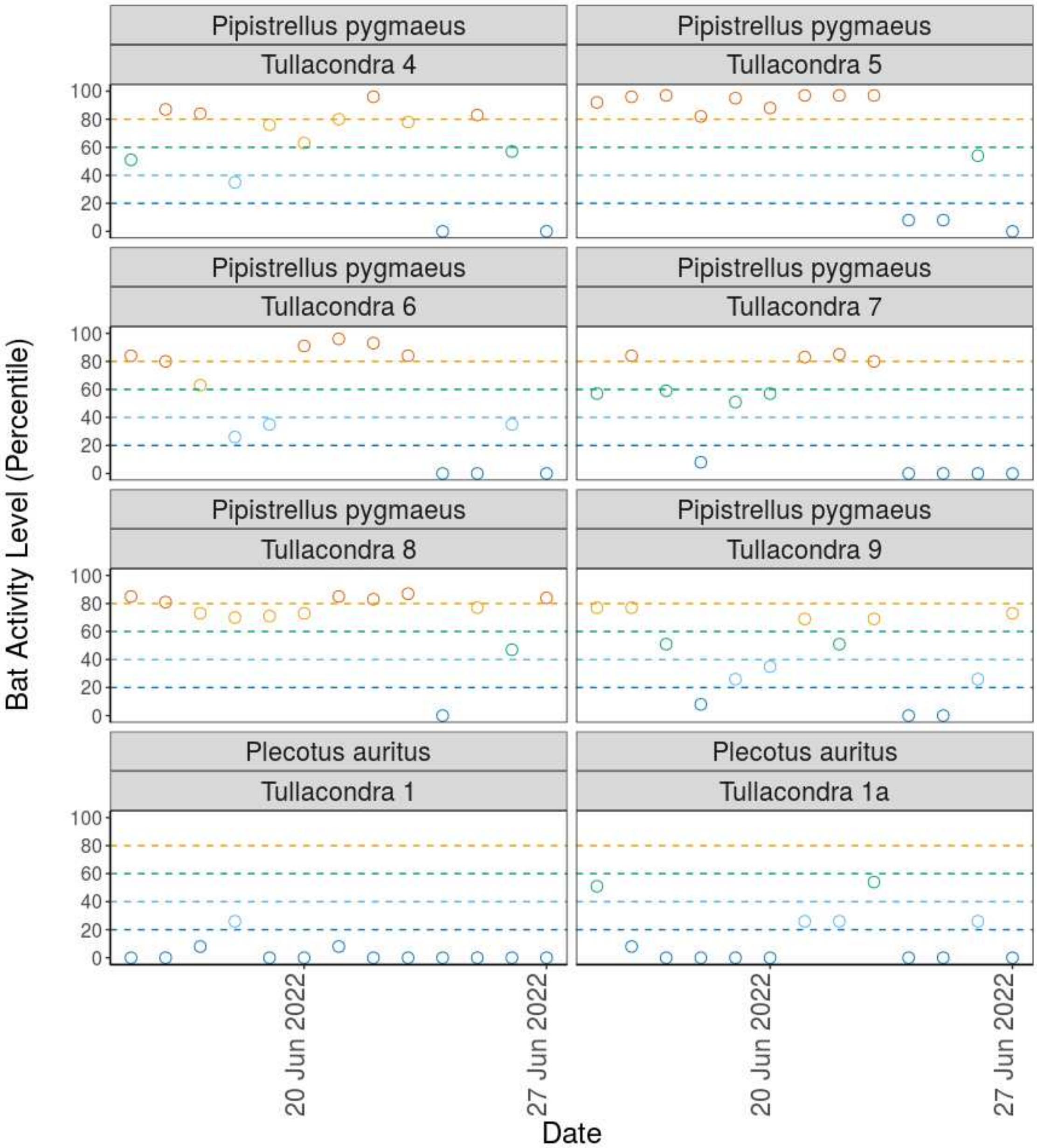
Nyctalus leisleri
Tullacondra 3
Nyctalus leisleri
Tullacondra 4
Nyctalus leisleri
Tullacondra 5
Nyctalus leisleri
Tullacondra 6
Nyctalus leisleri
Tullacondra 7
Nyctalus leisleri
Tullacondra 8
Nyctalus leisleri
Tullacondra 9
Bat Activity Level (Percentile)
0
20
40
60
80
100
20 Jun 2022
27 Jun 2022
Date


Pipistrellus nathusii
Tullacondra 1
Pipistrellus nathusii
Tullacondra 1a
Pipistrellus nathusii
Tullacondra 2
Pipistrellus nathusii
Tullacondra 3
Pipistrellus nathusii
Tullacondra 4
Pipistrellus nathusii
Tullacondra 5
Pipistrellus nathusii
Tullacondra 6
Pipistrellus nathusii
Tullacondra 7
Bat Activity Level (Percentile)
0
20
40
60
80
100
20 Jun 2022
27 Jun 2022
Date


Pipistrellus nathusii
Tullacondra 8
Pipistrellus nathusii
Tullacondra 9
Pipistrellus pipistrellus
Tullacondra 1
Pipistrellus pipistrellus
Tullacondra 1a
Pipistrellus pipistrellus
Tullacondra 2
Pipistrellus pipistrellus
Tullacondra 3
Pipistrellus pipistrellus
Tullacondra 4
Pipistrellus pipistrellus
Tullacondra 5
Bat Activity Level (Percentile)
100
80
60
40
20
0
20 Jun 2022
27 Jun 2022
Date


Pipistrellus pipistrellus
Tullacondra 6
Pipistrellus pipistrellus
Tullacondra 7
Pipistrellus pipistrellus
Tullacondra 8
Pipistrellus pipistrellus
Tullacondra 9
Pipistrellus pygmaeus
Tullacondra 1
Pipistrellus pygmaeus
Tullacondra 1a
Pipistrellus pygmaeus
Tullacondra 2
Pipistrellus pygmaeus
Tullacondra 3
Bat Activity Level (Percentile)
100
80
60
40
20
0
20 Jun 2022
27 Jun 2022
Date


Pipistrellus pygmaeus
Tullacondra 4
Pipistrellus pygmaeus
Tullacondra 5
Pipistrellus pygmaeus
Tullacondra 6
Pipistrellus pygmaeus
Tullacondra 7
Pipistrellus pygmaeus
Tullacondra 8
Pipistrellus pygmaeus
Tullacondra 9
Plecotus auritus
Tullacondra 1
Plecotus auritus
Tullacondra 1a
Bat Activity Level (Percentile)
100
80
60
40
20
0
20 Jun 2022
27 Jun 2022
Date

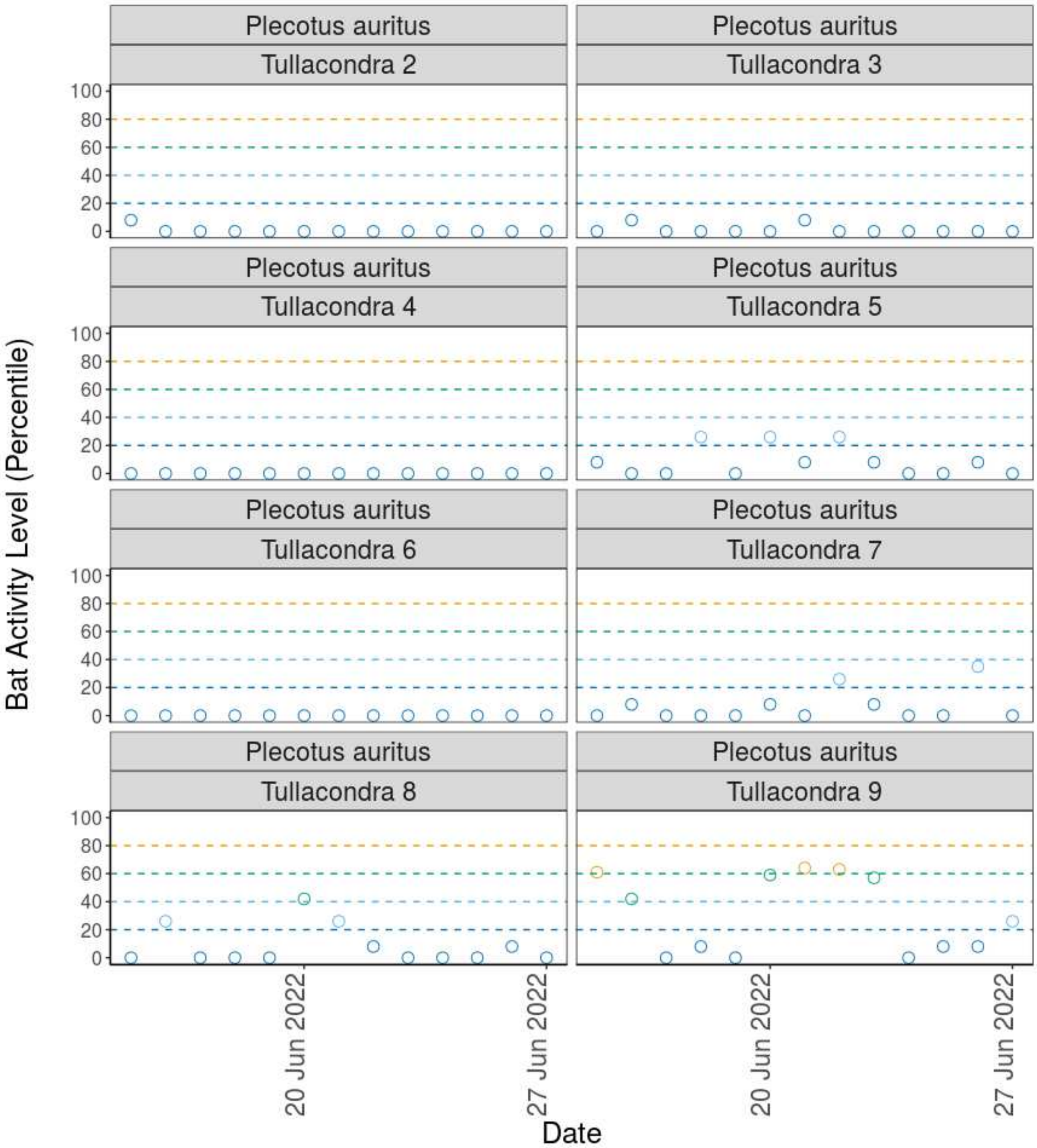


Chart 2. The activity level (percentile) of bats recorded across each night of the bat survey, split by location and species.

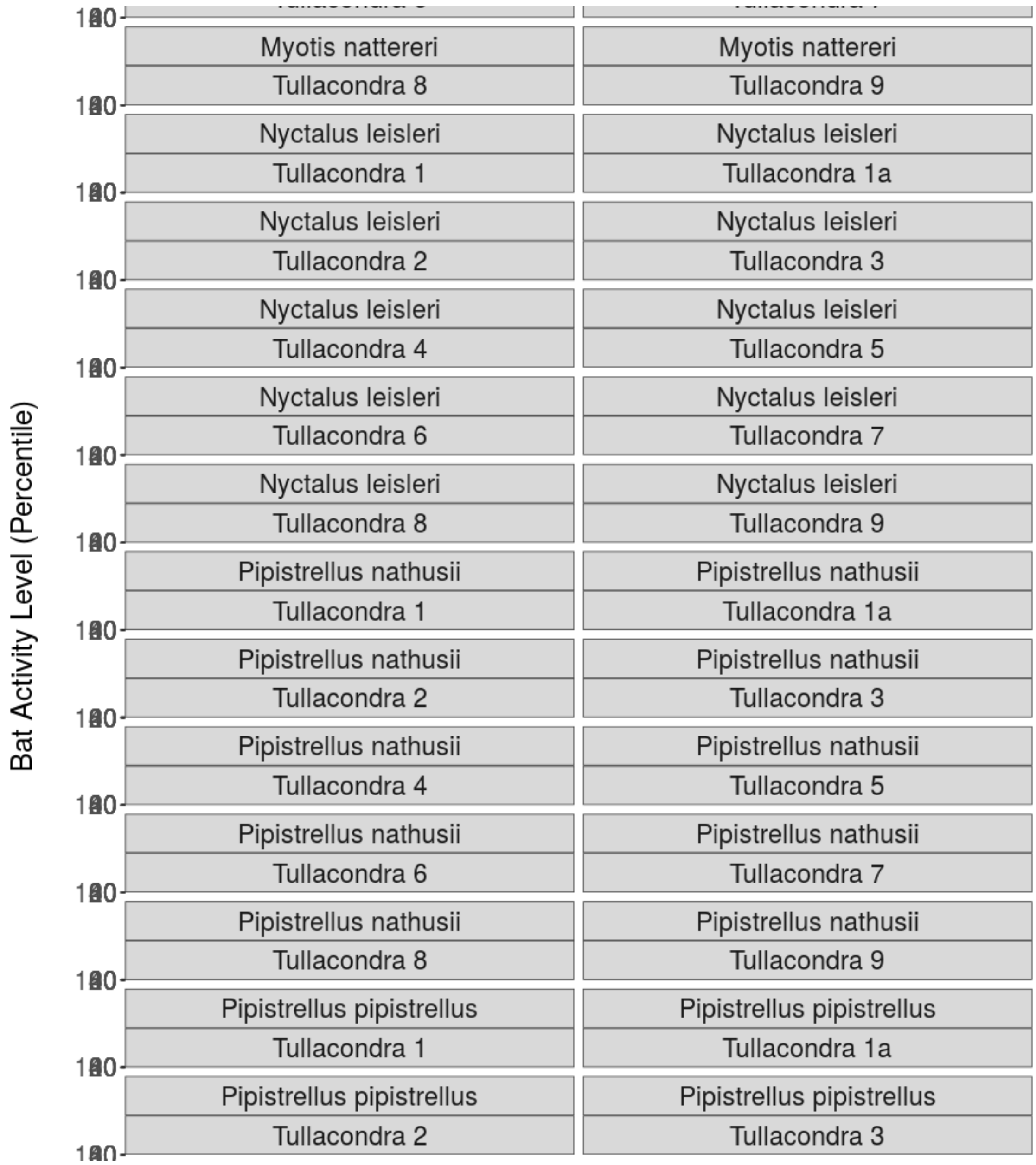


Chart 3. The relationship between recorded bat activity (percentile) and the temperature at sunset, split by species and location.

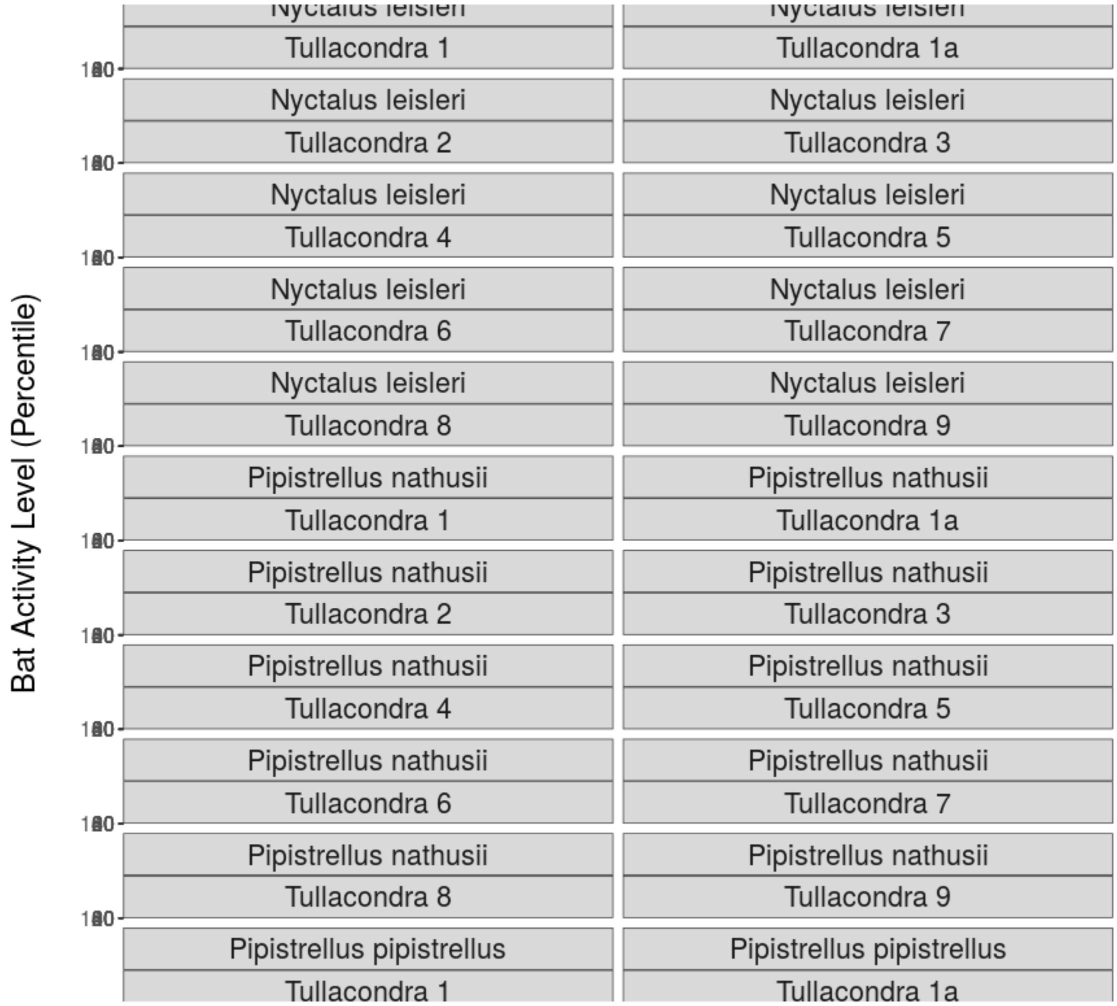


Chart 4. The relationship between recorded bat activity (percentile) and the temperature at sunset, split by location and species.

Ecobat Bat Activity Analysis

Site Name: Tullacondra August

John Curtin

09/11/2022

Summary

Bat surveys were conducted at Tullacondra 1a, Tullacondra 2, Tullacondra 3, Tullacondra 4, Tullacondra 5, Tullacondra 6, Tullacondra 7, Tullacondra 8, Tullacondra 9, for 10 nights between 2022-08-08 and 2022-08-17, using Wildlife Acoustics static bat detectors. The maximum of passes recorded in a single night was 1118 passes, and 8 species were recorded.

The reference range dataset was stratified to include:

- Only records from within 30 days of the survey date.
- Only records from within 100km² of the survey location.
- Records using any make of bat detector.

Table 1

Summary table showing the number of nights recorded bat activity fell into each activity band for each species.

Location	Species/Species Group	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
Tullacondra 1a	*Myotis*	0	0	1	2	7
Tullacondra 1a	*Myotis daubentonii*	0	0	0	0	10
Tullacondra 1a	*Myotis nattereri*	0	0	0	0	10
Tullacondra 1a	*Nyctalus leisleri*	0	5	3	1	1
Tullacondra 1a	*Pipistrellus nathusii*	0	0	0	0	10
Tullacondra 1a	*Pipistrellus pipistrellus*	1	1	4	0	4
Tullacondra 1a	*Pipistrellus pygmaeus*	0	2	5	2	1
Tullacondra 1a	*Plecotus auritus*	0	0	0	0	10
Tullacondra 2	*Myotis*	0	0	0	3	7
Tullacondra 2	*Myotis daubentonii*	0	0	0	0	10
Tullacondra 2	*Myotis nattereri*	0	0	0	0	10
Tullacondra 2	*Nyctalus leisleri*	2	7	1	0	0
Tullacondra 2	*Pipistrellus nathusii*	0	0	0	0	10
Tullacondra 2	*Pipistrellus pipistrellus*	0	4	2	1	3
Tullacondra 2	*Pipistrellus pygmaeus*	0	6	2	0	2
Tullacondra 2	*Plecotus auritus*	0	0	0	1	9
Tullacondra 3	*Myotis*	0	0	0	1	3
Tullacondra 3	*Myotis daubentonii*	0	0	0	0	4
Tullacondra 3	*Myotis nattereri*	0	0	0	0	4
Tullacondra 3	*Nyctalus leisleri*	0	2	2	0	0
Tullacondra 3	*Pipistrellus nathusii*	0	0	0	0	4
Tullacondra 3	*Pipistrellus pipistrellus*	4	0	0	0	0
Tullacondra 3	*Pipistrellus pygmaeus*	4	0	0	0	0

Tullacondra 3	*Plecotus auritus*	0	0	1	0	3
Tullacondra 4	*Myotis*	0	0	0	2	8
Tullacondra 4	*Myotis daubentonii*	0	0	0	0	10
Tullacondra 4	*Myotis nattereri*	0	0	0	0	10
Tullacondra 4	*Nyctalus leisleri*	1	7	2	0	0
Tullacondra 4	*Pipistrellus nathusii*	0	0	0	0	10
Tullacondra 4	*Pipistrellus pipistrellus*	4	4	0	0	2
Tullacondra 4	*Pipistrellus pygmaeus*	0	5	3	0	2
Tullacondra 4	*Plecotus auritus*	0	0	0	0	10
Tullacondra 5	*Myotis*	0	1	5	2	2
Tullacondra 5	*Myotis daubentonii*	0	0	0	0	10
Tullacondra 5	*Myotis nattereri*	0	0	1	1	8
Tullacondra 5	*Nyctalus leisleri*	0	8	2	0	0
Tullacondra 5	*Pipistrellus nathusii*	0	0	1	2	7
Tullacondra 5	*Pipistrellus pipistrellus*	8	0	0	1	1
Tullacondra 5	*Pipistrellus pygmaeus*	5	3	0	0	2
Tullacondra 5	*Plecotus auritus*	0	0	0	2	8
Tullacondra 6	*Myotis*	0	2	2	4	2
Tullacondra 6	*Myotis daubentonii*	0	0	0	0	10
Tullacondra 6	*Myotis nattereri*	0	0	0	0	10
Tullacondra 6	*Nyctalus leisleri*	0	7	3	0	0
Tullacondra 6	*Pipistrellus nathusii*	0	0	0	0	10
Tullacondra 6	*Pipistrellus pipistrellus*	7	1	0	1	1
Tullacondra 6	*Pipistrellus pygmaeus*	5	3	0	1	1
Tullacondra 6	*Plecotus auritus*	0	0	0	0	10
Tullacondra 7	*Myotis*	0	0	3	4	3
Tullacondra 7	*Myotis daubentonii*	0	0	0	0	10

Tullacondra 7	*Myotis nattereri*	0	0	0	0	10
Tullacondra 7	*Nyctalus leisleri*	4	3	3	0	0
Tullacondra 7	*Pipistrellus nathusii*	0	0	1	1	8
Tullacondra 7	*Pipistrellus pipistrellus*	8	1	1	0	0
Tullacondra 7	*Pipistrellus pygmaeus*	7	1	1	1	0
Tullacondra 7	*Plecotus auritus*	0	0	0	0	10
Tullacondra 8	*Myotis*	0	0	2	2	6
Tullacondra 8	*Myotis daubentonii*	0	0	0	0	10
Tullacondra 8	*Myotis nattereri*	0	0	0	0	10
Tullacondra 8	*Nyctalus leisleri*	1	5	3	0	1
Tullacondra 8	*Pipistrellus nathusii*	0	0	1	0	9
Tullacondra 8	*Pipistrellus pipistrellus*	7	1	1	0	1
Tullacondra 8	*Pipistrellus pygmaeus*	2	4	3	1	0
Tullacondra 8	*Plecotus auritus*	0	0	0	0	10
Tullacondra 9	*Myotis*	6	0	2	1	1
Tullacondra 9	*Myotis daubentonii*	0	0	0	0	10
Tullacondra 9	*Myotis nattereri*	0	2	3	1	4
Tullacondra 9	*Nyctalus leisleri*	3	5	1	0	1
Tullacondra 9	*Pipistrellus nathusii*	0	1	1	2	6
Tullacondra 9	*Pipistrellus pipistrellus*	10	0	0	0	0
Tullacondra 9	*Pipistrellus pygmaeus*	9	1	0	0	0
Tullacondra 9	*Plecotus auritus*	0	0	5	2	3

Table 2

Summary table showing key metrics for each species recorded.

Location	Species/Species Group	Median Percentile	95% CIs	Max Percentile	Nights Recorded	Reference Range
Tullacondra 1a	*Myotis*	5	5 - 34.5	40	10	2453
Tullacondra 1a	*Myotis daubentonii*	0	0 - 0	0	10	493

Tullacondra 1a	*Myotis nattereri*	0	0 - 0	5	10	506
Tullacondra 1a	*Nyctalus leisleri*	59	49 - 66.5	76	10	2842
Tullacondra 1a	*Pipistrellus nathusii*	0	5 - 5	20	10	529
Tullacondra 1a	*Pipistrellus pipistrellus*	49	24.5 - 68	82	10	3162
Tullacondra 1a	*Pipistrellus pygmaeus*	44	36.5 - 59.5	66	10	3170
Tullacondra 1a	*Plecotus auritus*	0	0 - 0	5	10	1966
Tullacondra 2	*Myotis*	13	12.5 - 35	35	10	2453
Tullacondra 2	*Myotis daubentonii*	0	0 - 0	0	10	493
Tullacondra 2	*Myotis nattereri*	0	0 - 0	0	10	506
Tullacondra 2	*Nyctalus leisleri*	72	63.5 - 79.5	88	10	2842
Tullacondra 2	*Pipistrellus nathusii*	0	5 - 5	20	10	529
Tullacondra 2	*Pipistrellus pipistrellus*	51	20 - 65	68	10	3162
Tullacondra 2	*Pipistrellus pygmaeus*	64	41.5 - 68	73	10	3170
Tullacondra 2	*Plecotus auritus*	0	5 - 20	29	10	1966
Tullacondra 3	*Myotis*	5	5 - 5	29	4	2453
Tullacondra 3	*Myotis daubentonii*	0	0 - 0	0	4	493
Tullacondra 3	*Myotis nattereri*	0	0 - 0	0	4	506
Tullacondra 3	*Nyctalus leisleri*	59	57 - 61.5	66	4	2842
Tullacondra 3	*Pipistrellus nathusii*	3	12.5 - 12.5	20	4	529
Tullacondra 3	*Pipistrellus pipistrellus*	95	90 - 98	98	4	3162
Tullacondra 3	*Pipistrellus pygmaeus*	99	99 - 99	100	4	3170
Tullacondra 3	*Plecotus auritus*	20	20 - 20	40	4	1966
Tullacondra 4	*Myotis*	20	12.5 - 27.5	35	10	2453
Tullacondra 4	*Myotis daubentonii*	0	0 - 0	0	10	493
Tullacondra 4	*Myotis nattereri*	0	0 - 0	0	10	506
Tullacondra 4	*Nyctalus leisleri*	70	63.5 - 75.5	82	10	2842
Tullacondra 4	*Pipistrellus nathusii*	0	5 - 5	20	10	529

Tullacondra 4	*Pipistrellus pipistrellus*	75	42.5 - 83.5	88	10	3162
Tullacondra 4	*Pipistrellus pygmaeus*	62	44 - 74	78	10	3170
Tullacondra 4	*Plecotus auritus*	5	5 - 12.5	20	10	1966
Tullacondra 5	*Myotis*	42	32 - 57.5	63	10	2453
Tullacondra 5	*Myotis daubentonii*	0	0 - 0	0	10	493
Tullacondra 5	*Myotis nattereri*	0	5 - 40	40	10	506
Tullacondra 5	*Nyctalus leisleri*	65	53.5 - 70	76	10	2842
Tullacondra 5	*Pipistrellus nathusii*	3	5 - 50	50	10	529
Tullacondra 5	*Pipistrellus pipistrellus*	92	60.5 - 93.5	95	10	3162
Tullacondra 5	*Pipistrellus pygmaeus*	82	46.5 - 91	93	10	3170
Tullacondra 5	*Plecotus auritus*	5	5 - 17	29	10	1966
Tullacondra 6	*Myotis*	35	35 - 59.5	69	10	2453
Tullacondra 6	*Myotis daubentonii*	0	0 - 0	0	10	493
Tullacondra 6	*Myotis nattereri*	5	5 - 5	20	10	506
Tullacondra 6	*Nyctalus leisleri*	60	55.5 - 69.5	73	10	2842
Tullacondra 6	*Pipistrellus nathusii*	0	20 - 20	20	10	529
Tullacondra 6	*Pipistrellus pipistrellus*	91	65.5 - 97.5	99	10	3162
Tullacondra 6	*Pipistrellus pygmaeus*	86	65 - 95	96	10	3170
Tullacondra 6	*Plecotus auritus*	0	5 - 20	20	10	1966
Tullacondra 7	*Myotis*	35	20 - 44.5	54	10	2453
Tullacondra 7	*Myotis daubentonii*	0	0 - 0	0	10	493
Tullacondra 7	*Myotis nattereri*	0	0 - 0	0	10	506
Tullacondra 7	*Nyctalus leisleri*	73	57 - 85	91	10	2842
Tullacondra 7	*Pipistrellus nathusii*	0	5 - 44	44	10	529
Tullacondra 7	*Pipistrellus pipistrellus*	96	75 - 97	98	10	3162
Tullacondra 7	*Pipistrellus pygmaeus*	86	61.5 - 90.5	94	10	3170
Tullacondra 7	*Plecotus auritus*	0	0 - 0	20	10	1966

Tullacondra 8	*Myotis*	20	12.5 - 36.5	44	10	2453
Tullacondra 8	*Myotis daubentonii*	0	0 - 0	0	10	493
Tullacondra 8	*Myotis nattereri*	0	0 - 0	5	10	506
Tullacondra 8	*Nyctalus leisleri*	66	40 - 76.5	82	10	2842
Tullacondra 8	*Pipistrellus nathusii*	0	12.5 - 30	40	10	529
Tullacondra 8	*Pipistrellus pipistrellus*	93	73 - 95	96	10	3162
Tullacondra 8	*Pipistrellus pygmaeus*	75	47 - 81.5	86	10	3170
Tullacondra 8	*Plecotus auritus*	5	5 - 5	20	10	1966
Tullacondra 9	*Myotis*	84	44 - 86.5	89	10	2453
Tullacondra 9	*Myotis daubentonii*	0	0 - 0	0	10	493
Tullacondra 9	*Myotis nattereri*	35	20 - 58	66	10	506
Tullacondra 9	*Nyctalus leisleri*	75	44 - 82.5	88	10	2842
Tullacondra 9	*Pipistrellus nathusii*	13	5 - 48	76	10	529
Tullacondra 9	*Pipistrellus pipistrellus*	95	93.5 - 96.5	99	10	3162
Tullacondra 9	*Pipistrellus pygmaeus*	88	83.5 - 91.5	97	10	3170
Tullacondra 9	*Plecotus auritus*	40	32 - 55.5	58	10	1966

Charts

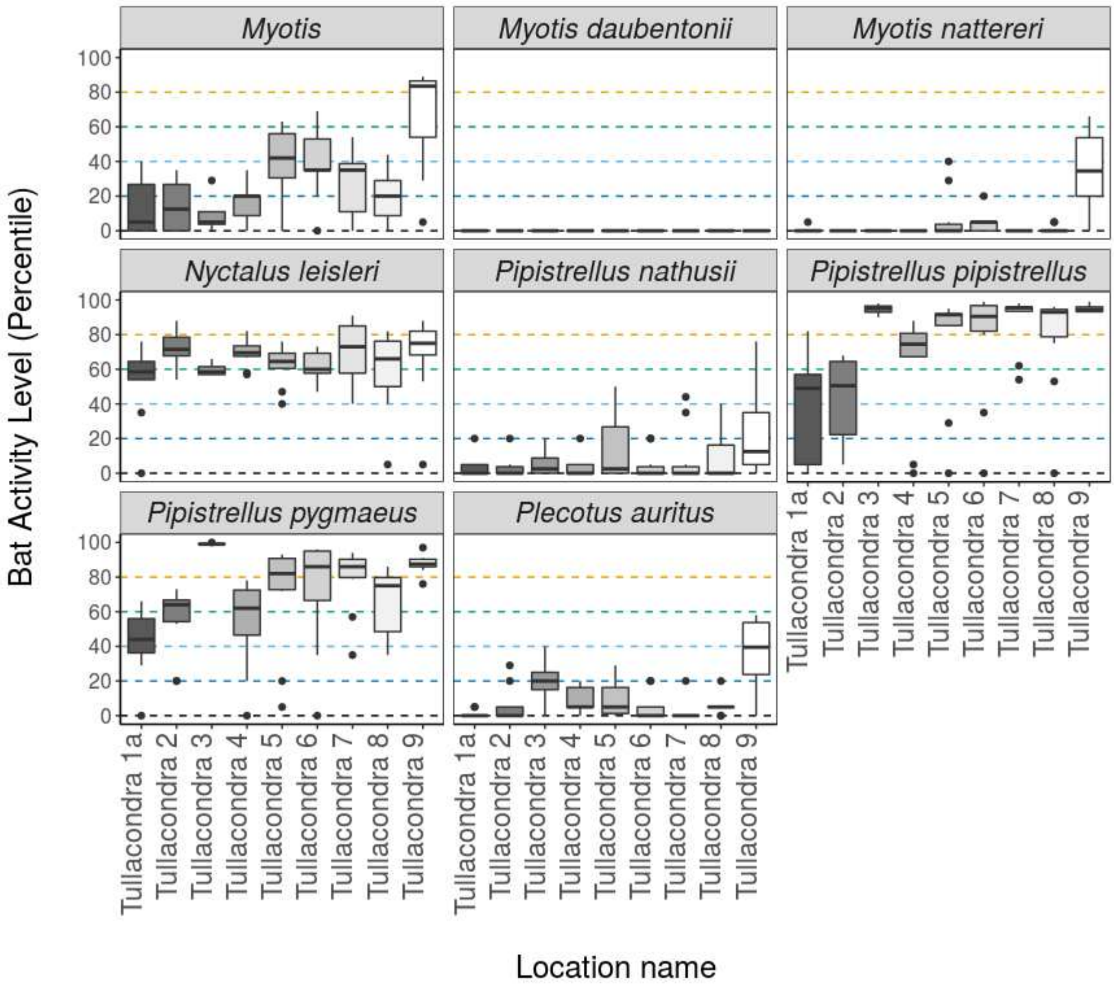
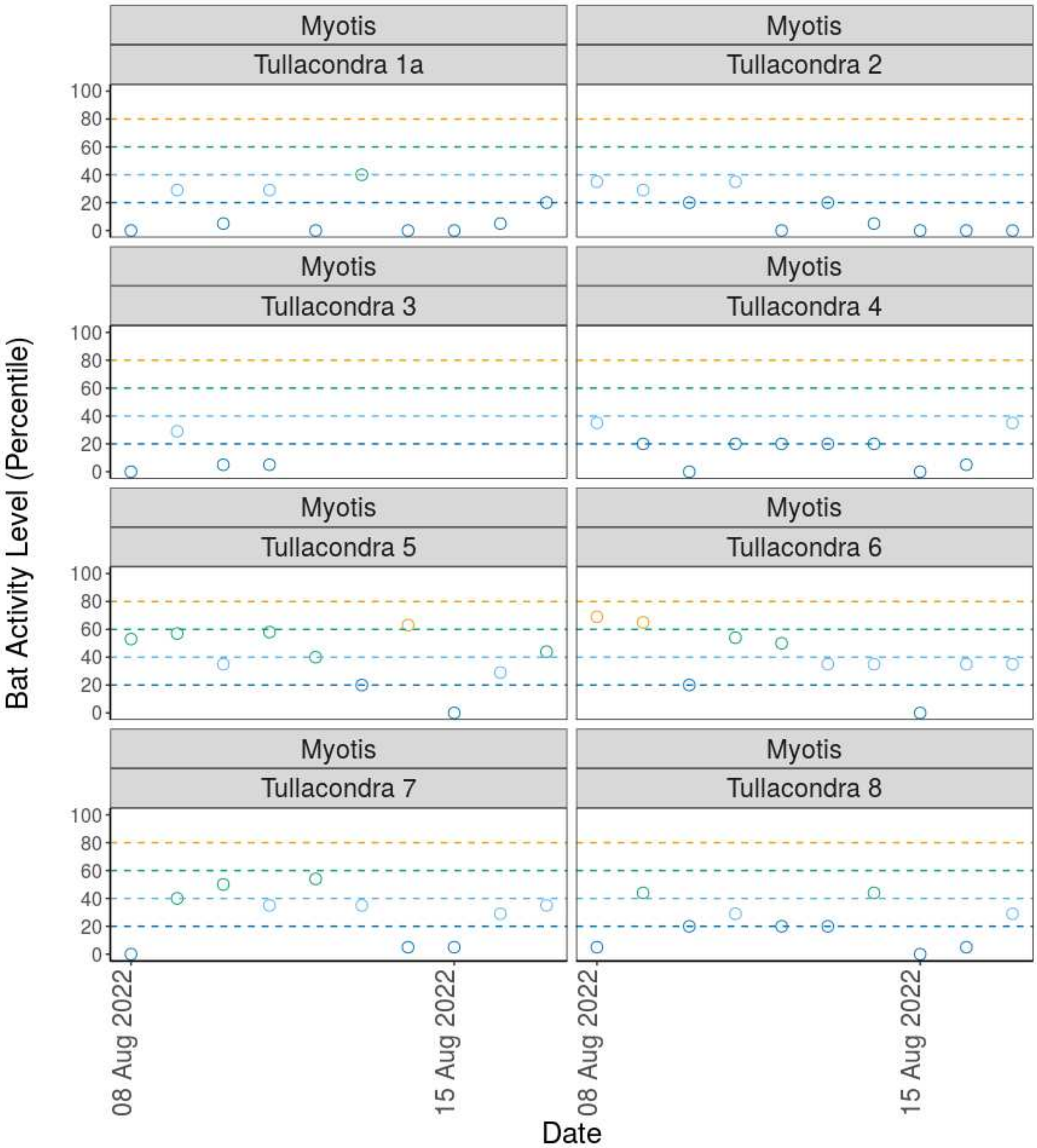
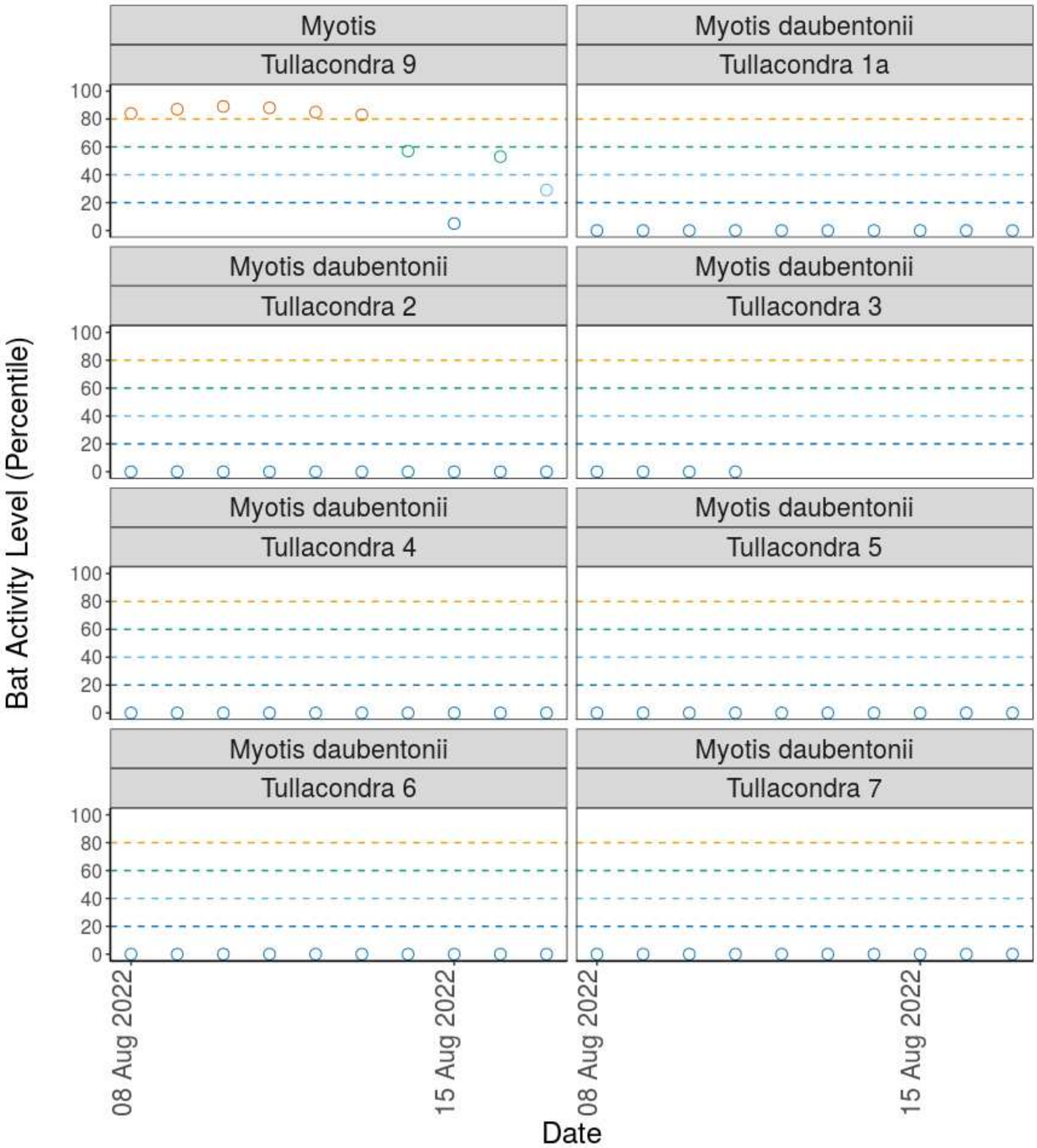


Chart 1. Differences in activity between static detector locations, split by species and location. The centre line indicates the median activity level whereas the box represents the interquartile range (the spread of the middle 50% of nights of activity)


Myotis
Tullacondra 1a
Myotis
Tullacondra 2
Myotis
Tullacondra 3
Myotis
Tullacondra 4
Myotis
Tullacondra 5
Myotis
Tullacondra 6
Myotis
Tullacondra 7
Myotis
Tullacondra 8
Bat Activity Level (Percentile)
100
80
60
40
20
0
08 Aug 2022
15 Aug 2022
Date


Myotis
Tullacondra 9
Myotis daubentonii
Tullacondra 1a
Myotis daubentonii
Tullacondra 2
Myotis daubentonii
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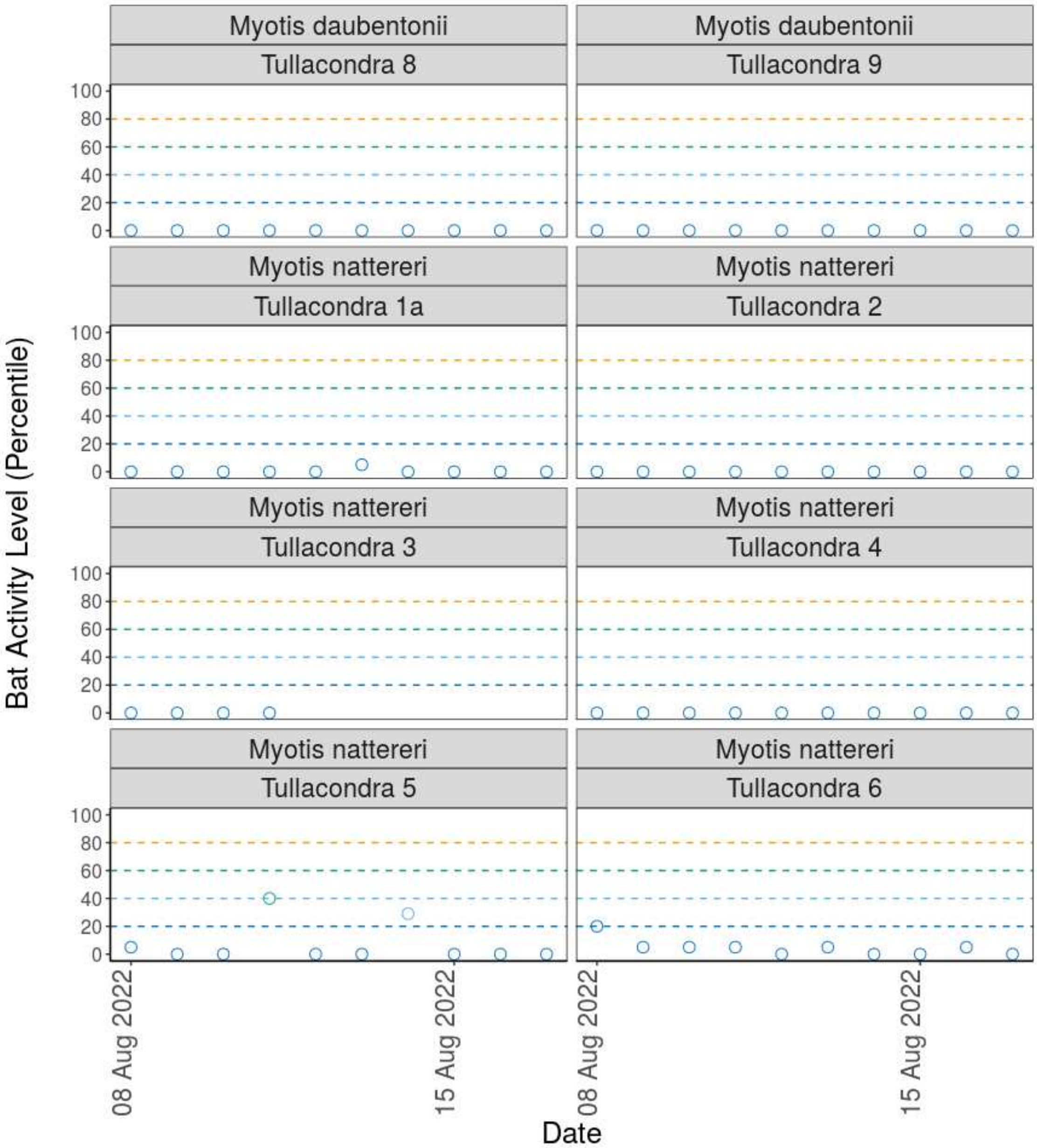
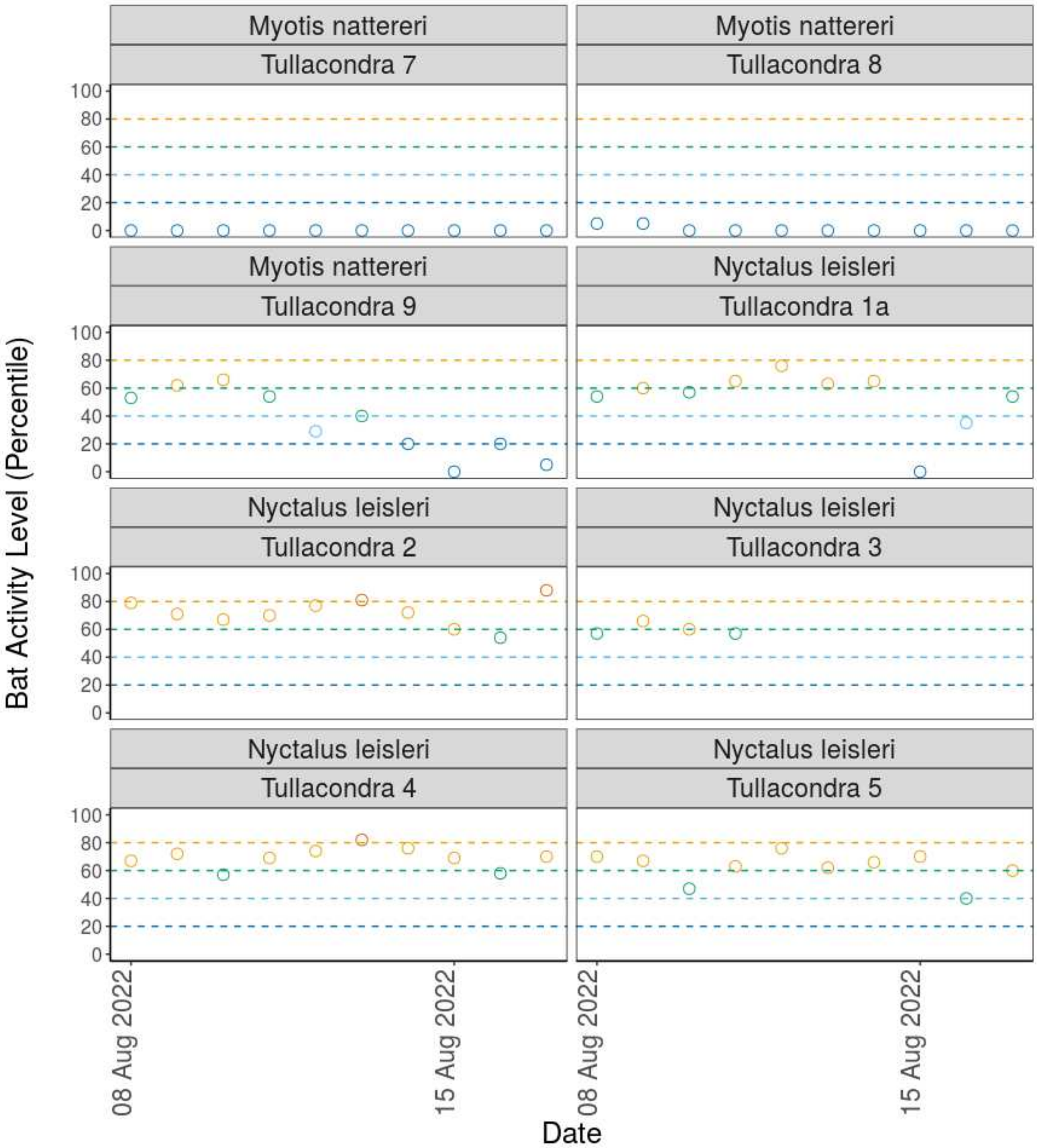
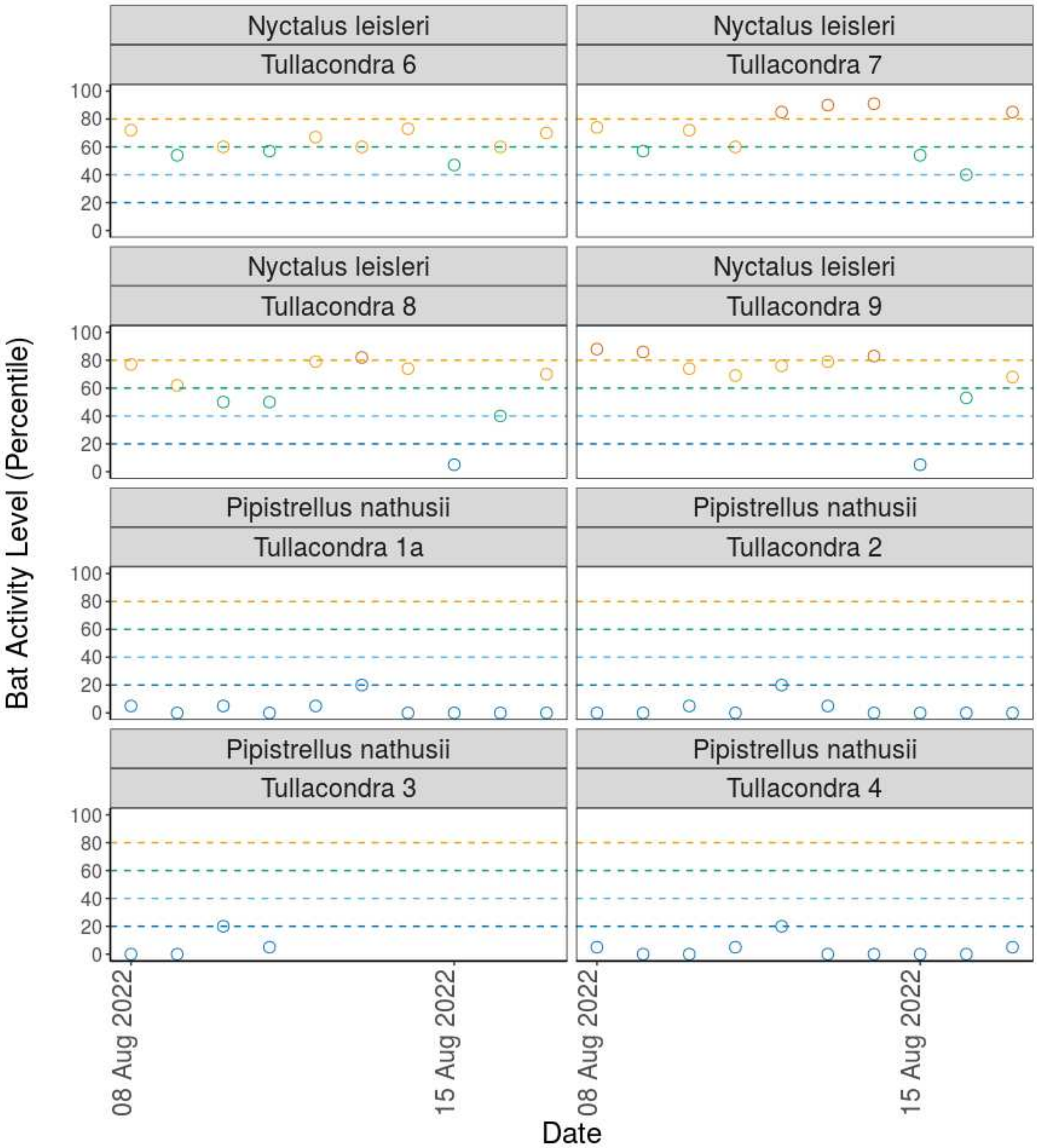
Myotis daubentonii
Tullacondra 4
Myotis daubentonii
Tullacondra 5
Myotis daubentonii
Tullacondra 6
Myotis daubentonii
Tullacondra 7
Bat Activity Level (Percentile)
100
80
60
40
20
0
08 Aug 2022
15 Aug 2022
Date

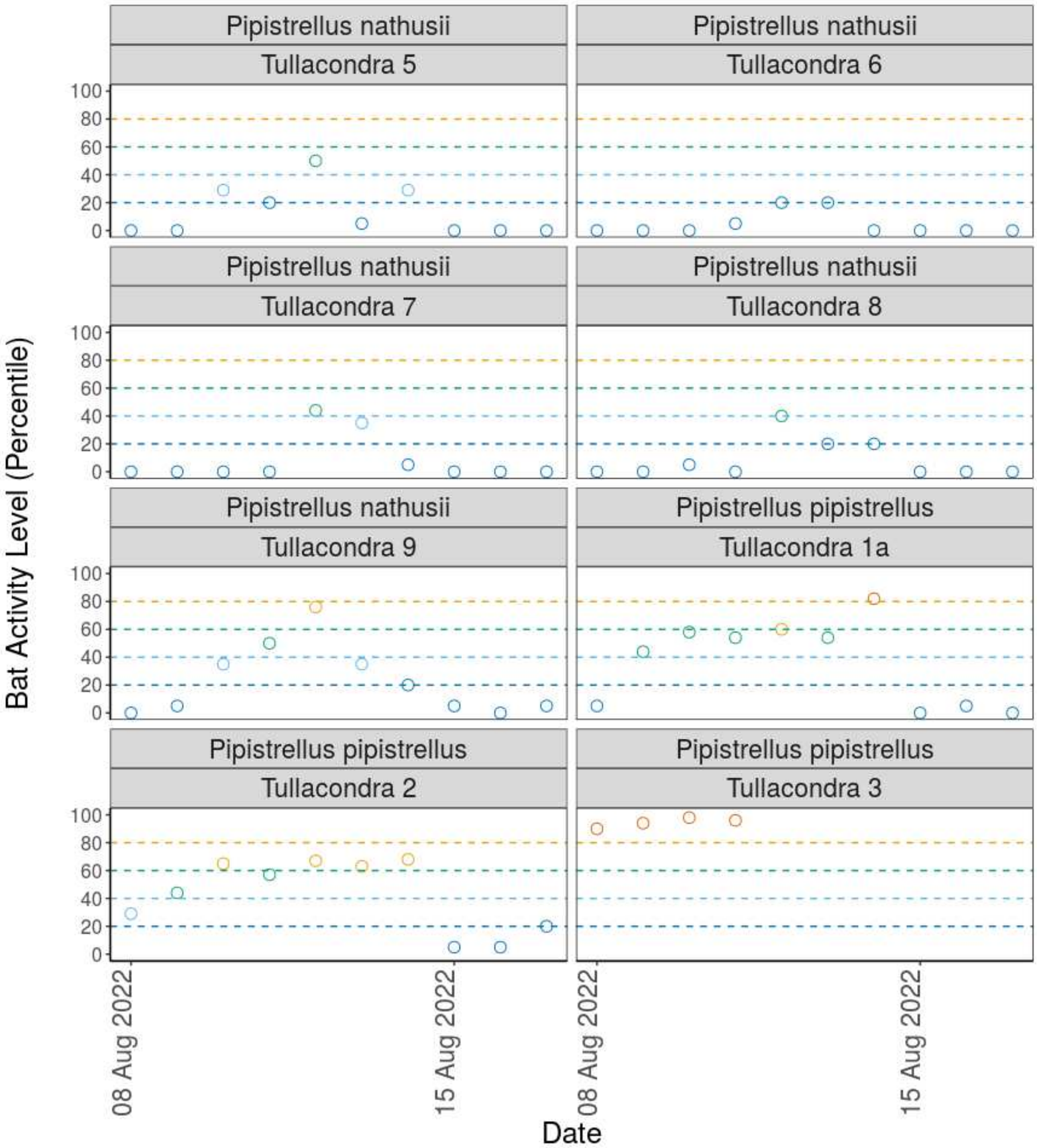


Myotis daubentonii
Tullacondra 8
Myotis daubentonii
Tullacondra 9
Myotis nattereri
Tullacondra 1a
Myotis nattereri
Tullacondra 2
Myotis nattereri
Tullacondra 3
Myotis nattereri
Tullacondra 4
Myotis nattereri
Tullacondra 5
Myotis nattereri
Tullacondra 6
Bat Activity Level (Percentile)
100
80
60
40
20
0
08 Aug 2022
15 Aug 2022
Date


Myotis nattereri
Tullacondra 7
Myotis nattereri
Tullacondra 8
Myotis nattereri
Tullacondra 9
Nyctalus leisleri
Tullacondra 1a
Nyctalus leisleri
Tullacondra 2
Nyctalus leisleri
Tullacondra 3
Nyctalus leisleri
Tullacondra 4
Nyctalus leisleri
Tullacondra 5
Bat Activity Level (Percentile)
100
80
60
40
20
0
08 Aug 2022
15 Aug 2022
Date



Nyctalus leisleri
Tullacondra 6
Nyctalus leisleri
Tullacondra 7
Nyctalus leisleri
Tullacondra 8
Nyctalus leisleri
Tullacondra 9
Pipistrellus nathusii
Tullacondra 1a
Pipistrellus nathusii
Tullacondra 2
Pipistrellus nathusii
Tullacondra 3
Pipistrellus nathusii
Tullacondra 4
Bat Activity Level (Percentile)
100
80
60
40
20
0
08 Aug 2022
15 Aug 2022
Date


Pipistrellus nathusii
Tullacondra 5
Pipistrellus nathusii
Tullacondra 6
Pipistrellus nathusii
Tullacondra 7
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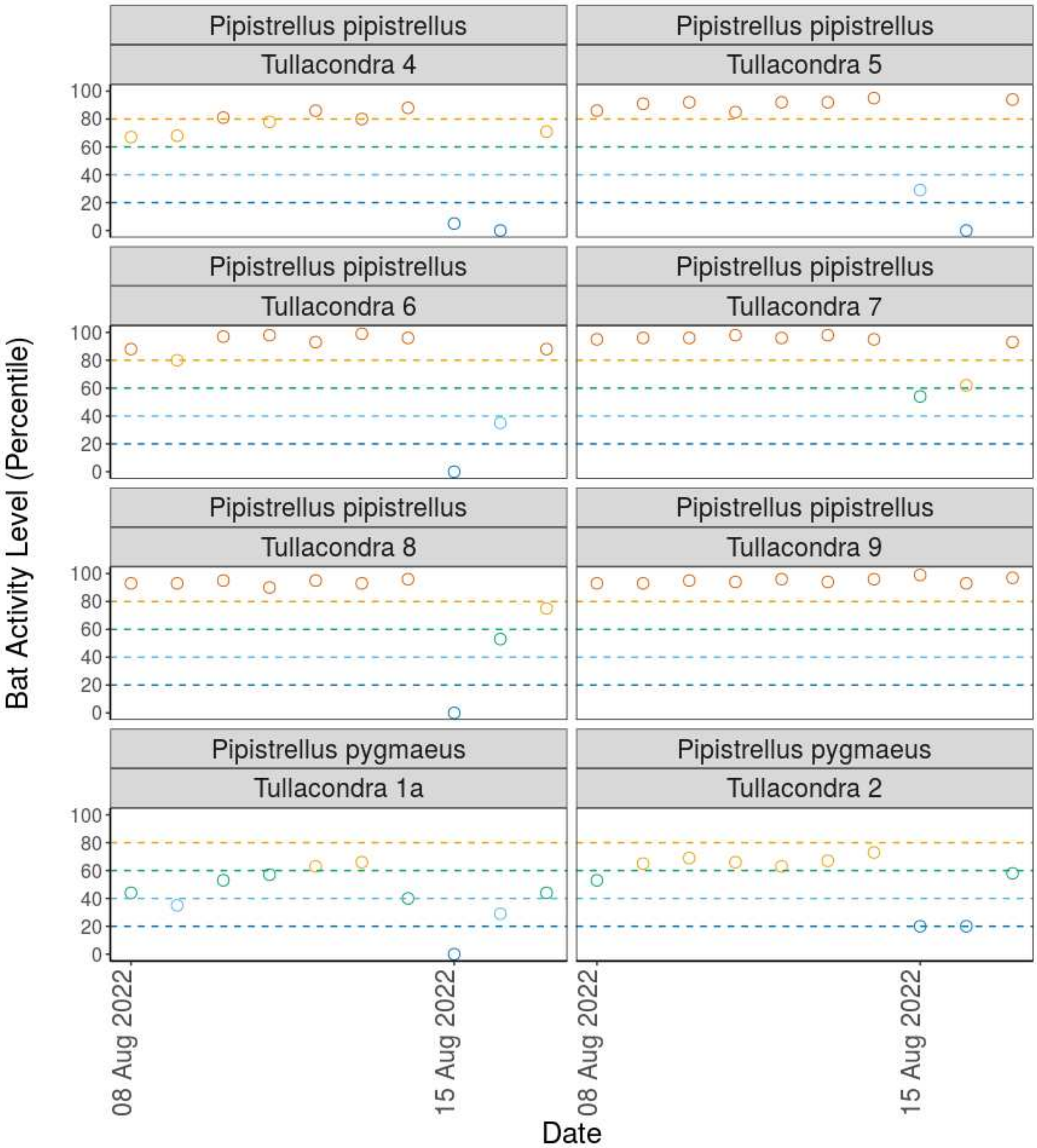
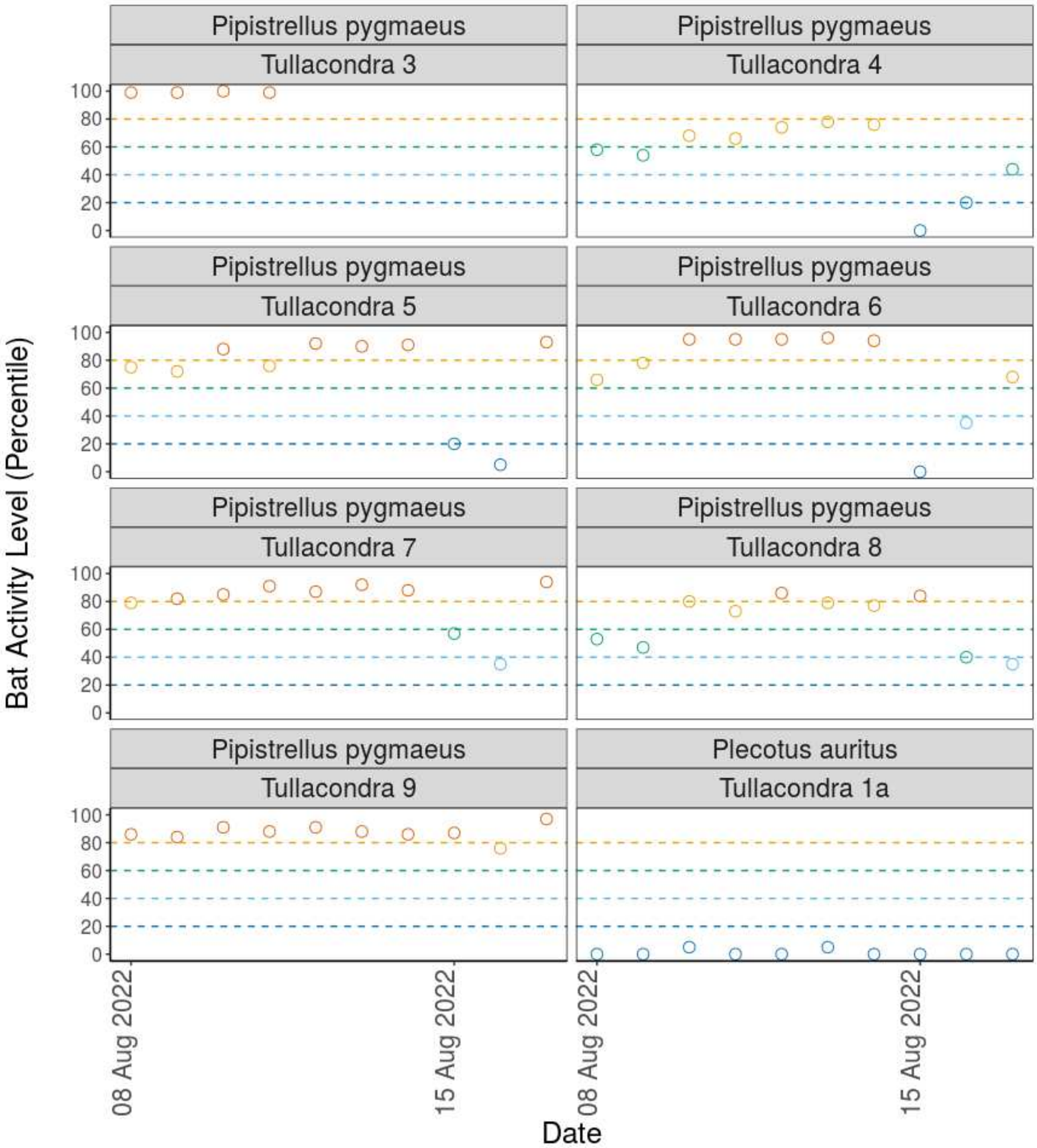
Tullacondra 8
Pipistrellus nathusii
Tullacondra 9
Pipistrellus pipistrellus
Tullacondra 1a
Pipistrellus pipistrellus
Tullacondra 2
Pipistrellus pipistrellus
Tullacondra 3
Bat Activity Level (Percentile)
100
80
60
40
20
0
08 Aug 2022
15 Aug 2022
Date


Pipistrellus pipistrellus
Tullacondra 4
Pipistrellus pipistrellus
Tullacondra 5
Pipistrellus pipistrellus
Tullacondra 6
Pipistrellus pipistrellus
Tullacondra 7
Pipistrellus pipistrellus
Tullacondra 8
Pipistrellus pipistrellus
Tullacondra 9
Pipistrellus pygmaeus
Tullacondra 1a
Pipistrellus pygmaeus
Tullacondra 2
Bat Activity Level (Percentile)
100
80
60
40
20
0
08 Aug 2022
15 Aug 2022
Date



Pipistrellus pygmaeus
Tullacondra 3
Pipistrellus pygmaeus
Tullacondra 4
Pipistrellus pygmaeus
Tullacondra 5
Pipistrellus pygmaeus
Tullacondra 6
Pipistrellus pygmaeus
Tullacondra 7
Pipistrellus pygmaeus
Tullacondra 8
Pipistrellus pygmaeus
Tullacondra 9
Plecotus auritus
Tullacondra 1a
Bat Activity Level (Percentile)
100
80
60
40
20
0
08 Aug 2022
15 Aug 2022
Date

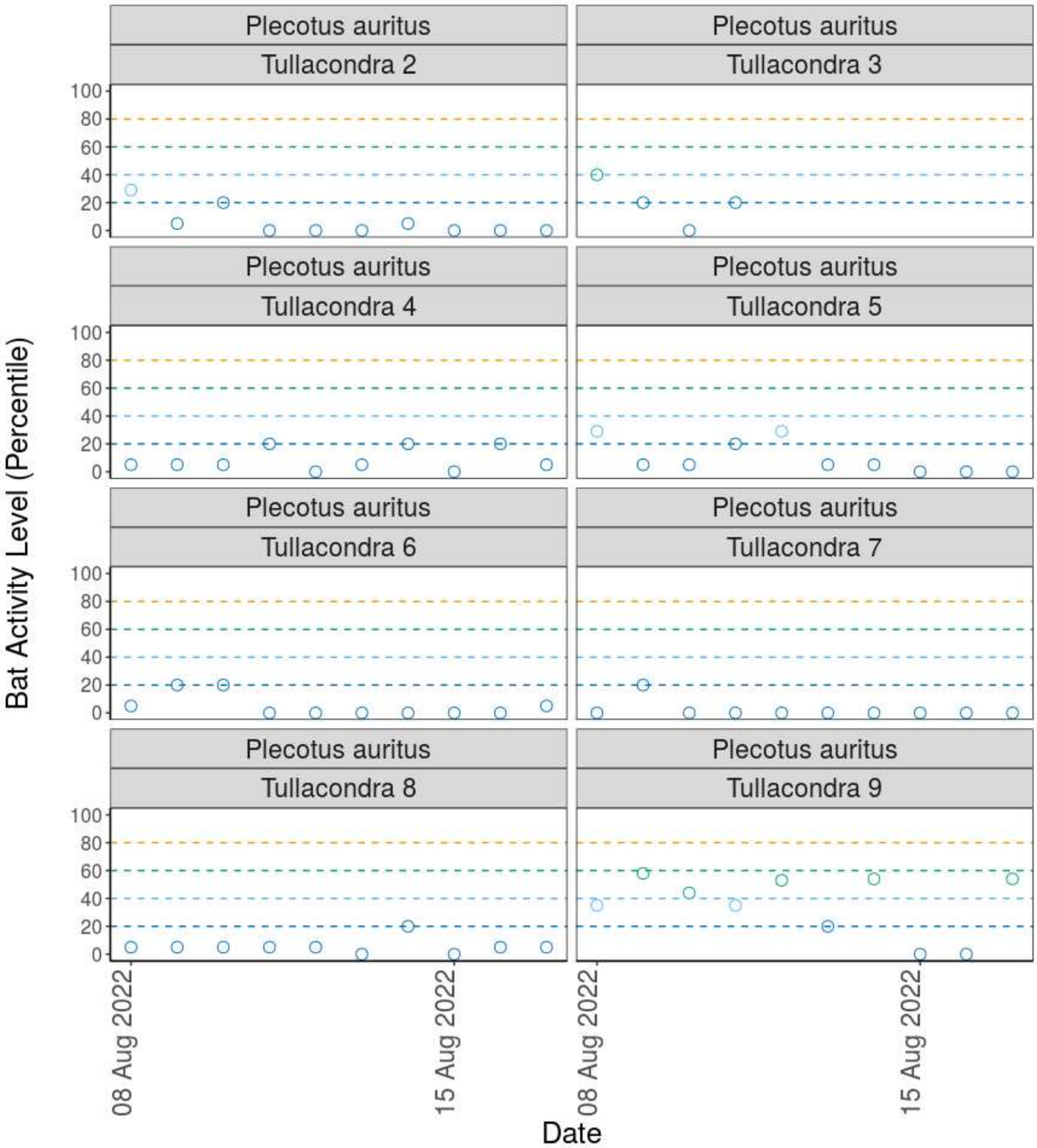


Chart 2. The activity level (percentile) of bats recorded across each night of the bat survey, split by location and species.

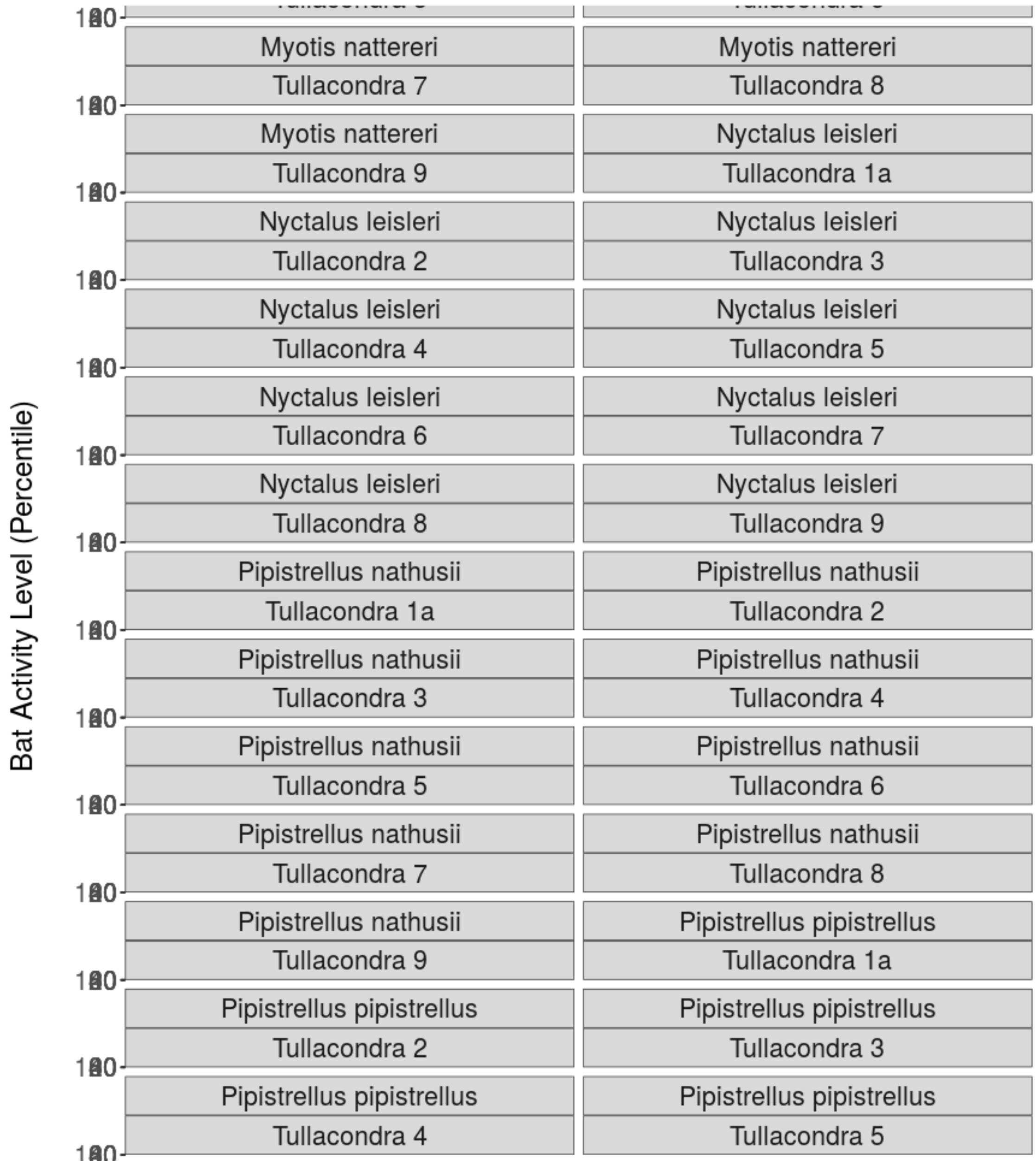


Chart 3. The relationship between recorded bat activity (percentile) and the temperature at sunset, split by species and location.

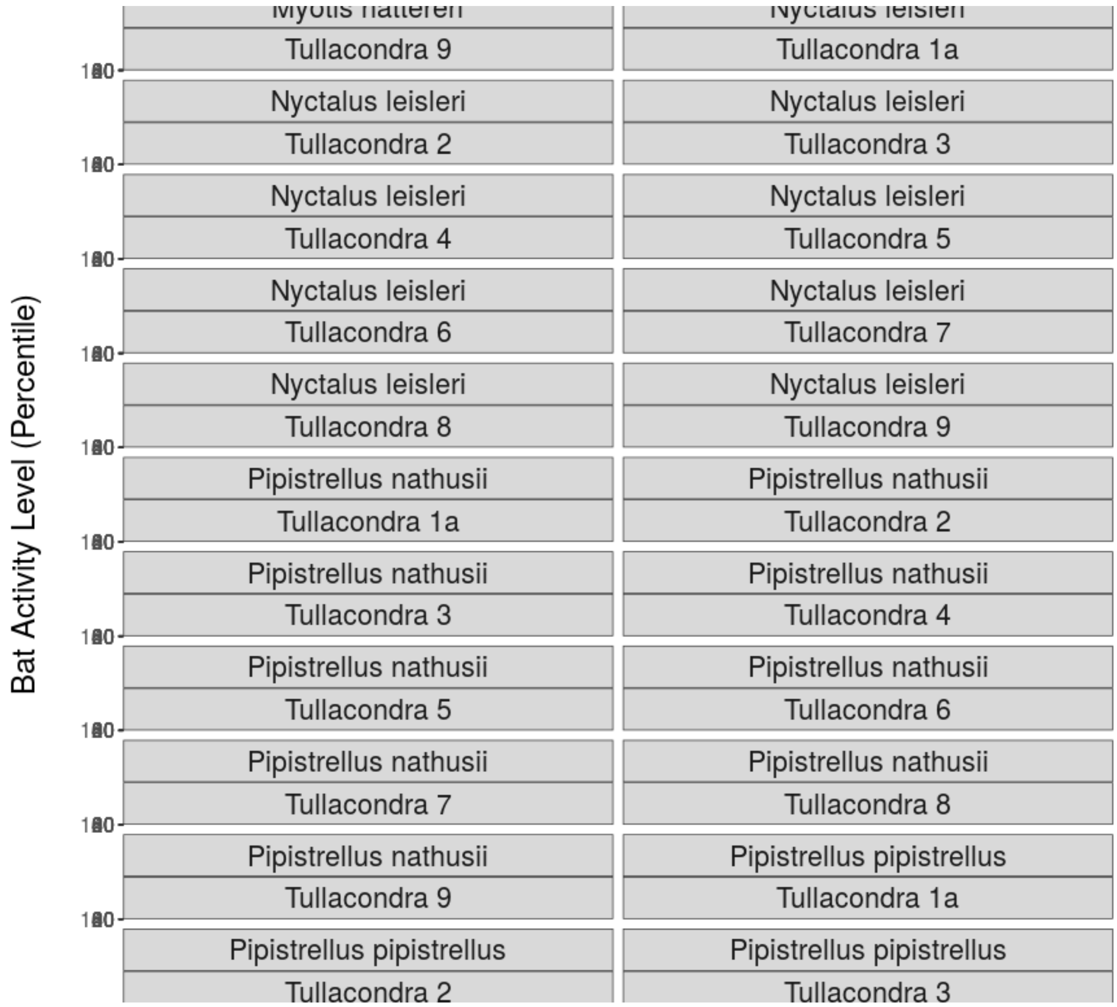


Chart 4. The relationship between recorded bat activity (percentile) and the temperature at sunset, split by location and species.

Ecobat Bat Activity Analysis

Site Name: Tullacondra All Seasons

John Curtin

09/11/2022

Summary

Bat surveys were conducted at Tullacondra 1, Tullacondra 2, Tullacondra 3, Tullacondra 4, Tullacondra 5, Tullacondra 6, Tullacondra 7, Tullacondra 8, Tullacondra 9, Tullacondra 1a, for 50 nights between 2022-04-15 and 2022-09-23, using Wildlife Acoustics static bat detectors. The maximum of passes recorded in a single night was 1498 passes, and 8 species were recorded.

The reference range dataset was stratified to include:

- Only records from within 30 days of the survey date.
- Only records from within 100km^2 of the survey location.
- Records using any make of bat detector.

Table 1

Summary table showing the number of nights recorded bat activity fell into each activity band for each species.

Location	Species/Species Group	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
Tullacondra 1	*Myotis*	1	3	6	16	14
Tullacondra 1	*Myotis daubentonii*	0	0	0	0	40
Tullacondra 1	*Myotis nattereri*	0	1	1	1	37
Tullacondra 1	*Nyctalus leisleri*	9	13	9	3	6
Tullacondra 1	*Pipistrellus nathusii*	0	2	3	5	30
Tullacondra 1	*Pipistrellus pipistrellus*	28	5	4	2	1
Tullacondra 1	*Pipistrellus pygmaeus*	18	17	3	1	1
Tullacondra 1	*Plecotus auritus*	0	1	4	5	30
Tullacondra 1a	*Myotis*	0	6	3	4	10
Tullacondra 1a	*Myotis daubentonii*	0	0	0	0	23
Tullacondra 1a	*Myotis nattereri*	0	0	0	0	23
Tullacondra 1a	*Nyctalus leisleri*	0	7	5	4	7
Tullacondra 1a	*Pipistrellus nathusii*	0	0	0	1	22
Tullacondra 1a	*Pipistrellus pipistrellus*	1	2	8	4	8
Tullacondra 1a	*Pipistrellus pygmaeus*	0	4	9	5	5
Tullacondra 1a	*Plecotus auritus*	0	0	2	3	18
Tullacondra 2	*Myotis*	0	0	4	8	38
Tullacondra 2	*Myotis daubentonii*	0	0	0	0	50
Tullacondra 2	*Myotis nattereri*	0	0	0	0	50
Tullacondra 2	*Nyctalus leisleri*	16	17	10	1	6
Tullacondra 2	*Pipistrellus nathusii*	0	0	3	8	39
Tullacondra 2	*Pipistrellus pipistrellus*	6	11	15	5	13
Tullacondra 2	*Pipistrellus pygmaeus*	4	20	10	3	13

Tullacondra 2	*Plecotus auritus*	0	0	0	6	44
Tullacondra 3	*Myotis*	1	5	9	13	12
Tullacondra 3	*Myotis daubentonii*	0	0	0	0	40
Tullacondra 3	*Myotis nattereri*	0	0	0	1	39
Tullacondra 3	*Nyctalus leisleri*	14	11	6	2	7
Tullacondra 3	*Pipistrellus nathusii*	4	2	4	6	24
Tullacondra 3	*Pipistrellus pipistrellus*	26	7	3	2	2
Tullacondra 3	*Pipistrellus pygmaeus*	29	7	1	0	3
Tullacondra 3	*Plecotus auritus*	0	0	6	4	30
Tullacondra 4	*Myotis*	0	0	2	11	37
Tullacondra 4	*Myotis daubentonii*	0	0	0	0	50
Tullacondra 4	*Myotis nattereri*	0	0	0	0	50
Tullacondra 4	*Nyctalus leisleri*	10	18	12	2	8
Tullacondra 4	*Pipistrellus nathusii*	0	2	7	3	38
Tullacondra 4	*Pipistrellus pipistrellus*	13	15	7	2	13
Tullacondra 4	*Pipistrellus pygmaeus*	8	14	15	6	7
Tullacondra 4	*Plecotus auritus*	0	0	0	1	49
Tullacondra 5	*Myotis*	2	6	11	10	21
Tullacondra 5	*Myotis daubentonii*	0	0	0	0	50
Tullacondra 5	*Myotis nattereri*	0	2	2	3	43
Tullacondra 5	*Nyctalus leisleri*	12	17	7	8	6
Tullacondra 5	*Pipistrellus nathusii*	2	8	5	13	22
Tullacondra 5	*Pipistrellus pipistrellus*	32	8	4	1	5
Tullacondra 5	*Pipistrellus pygmaeus*	29	10	3	0	8
Tullacondra 5	*Plecotus auritus*	0	0	3	8	39
Tullacondra 6	*Myotis*	0	2	11	17	20
Tullacondra 6	*Myotis daubentonii*	0	0	0	1	49

Tullacondra 6	*Myotis nattereri*	0	0	0	2	48
Tullacondra 6	*Nyctalus leisleri*	15	13	13	5	4
Tullacondra 6	*Pipistrellus nathusii*	4	4	1	5	36
Tullacondra 6	*Pipistrellus pipistrellus*	22	9	8	6	5
Tullacondra 6	*Pipistrellus pygmaeus*	21	10	7	5	7
Tullacondra 6	*Plecotus auritus*	0	0	0	2	48
Tullacondra 7	*Myotis*	0	0	14	11	25
Tullacondra 7	*Myotis daubentonii*	0	0	0	0	50
Tullacondra 7	*Myotis nattereri*	0	0	0	0	50
Tullacondra 7	*Nyctalus leisleri*	12	12	10	7	9
Tullacondra 7	*Pipistrellus nathusii*	0	2	8	6	34
Tullacondra 7	*Pipistrellus pipistrellus*	26	10	7	0	7
Tullacondra 7	*Pipistrellus pygmaeus*	13	11	16	1	9
Tullacondra 7	*Plecotus auritus*	0	0	0	3	47
Tullacondra 8	*Myotis*	0	3	9	5	23
Tullacondra 8	*Myotis daubentonii*	0	0	0	0	40
Tullacondra 8	*Myotis nattereri*	0	0	0	2	38
Tullacondra 8	*Nyctalus leisleri*	7	12	8	3	10
Tullacondra 8	*Pipistrellus nathusii*	0	0	7	5	28
Tullacondra 8	*Pipistrellus pipistrellus*	31	5	1	0	3
Tullacondra 8	*Pipistrellus pygmaeus*	16	15	5	1	3
Tullacondra 8	*Plecotus auritus*	0	0	1	3	36
Tullacondra 9	*Myotis*	6	0	9	8	27
Tullacondra 9	*Myotis daubentonii*	0	0	0	0	50
Tullacondra 9	*Myotis nattereri*	0	2	3	1	44
Tullacondra 9	*Nyctalus leisleri*	15	14	6	4	11
Tullacondra 9	*Pipistrellus nathusii*	1	13	11	6	19

Tullacondra 9	*Pipistrellus pipistrellus*	37	7	2	1	3
Tullacondra 9	*Pipistrellus pygmaeus*	17	13	10	4	6
Tullacondra 9	*Plecotus auritus*	0	5	15	11	19

Table 2

Summary table showing key metrics for each species recorded.

Location	Species/Species Group	Median Percentile	95% CIs	Max Percentile	Nights Recorded	Reference Range
Tullacondra 1	*Myotis*	29	26.5 - 41.5	92	40	1673
Tullacondra 1	*Myotis daubentonii*	0	0 - 0	0	40	454.8
Tullacondra 1	*Myotis nattereri*	0	10 - 51	69	40	398.3
Tullacondra 1	*Nyctalus leisleri*	65	57.5 - 72.5	89	40	1969
Tullacondra 1	*Pipistrellus nathusii*	0	19.5 - 41.5	74	40	540.3
Tullacondra 1	*Pipistrellus pipistrellus*	85	75.5 - 87	96	40	2276
Tullacondra 1	*Pipistrellus pygmaeus*	79	74 - 84.5	99	40	2089
Tullacondra 1	*Plecotus auritus*	0	22 - 45	65	40	1201
Tullacondra 1a	*Myotis*	29	32 - 61.5	74	23	2097
Tullacondra 1a	*Myotis daubentonii*	0	0 - 0	0	23	464.7
Tullacondra 1a	*Myotis nattereri*	0	8 - 8	8	23	429.1
Tullacondra 1a	*Nyctalus leisleri*	42	40 - 61	76	23	2515
Tullacondra 1a	*Pipistrellus nathusii*	0	5 - 15.5	26	23	579.9
Tullacondra 1a	*Pipistrellus pipistrellus*	35	30.5 - 52.5	82	23	2876
Tullacondra 1a	*Pipistrellus pygmaeus*	42	36.5 - 53	74	23	2772
Tullacondra 1a	*Plecotus auritus*	0	6.5 - 40	54	23	1525
Tullacondra 2	*Myotis*	7	16 - 28	53	50	1829
Tullacondra 2	*Myotis daubentonii*	0	0 - 0	0	50	462.4
Tullacondra 2	*Myotis nattereri*	0	7 - 12	12	50	419.8
Tullacondra 2	*Nyctalus leisleri*	72	66 - 78	99	50	2143
Tullacondra 2	*Pipistrellus nathusii*	0	18 - 34	56	50	538

Tullacondra 2	*Pipistrellus pipistrellus*	53	45 - 61	85	50	2453
Tullacondra 2	*Pipistrellus pygmaeus*	59	52 - 66	86	50	2305
Tullacondra 2	*Plecotus auritus*	0	8.5 - 21.5	31	50	1354
Tullacondra 3	*Myotis*	31	30.5 - 45	82	40	1704
Tullacondra 3	*Myotis daubentonii*	0	0 - 0	0	40	444.9
Tullacondra 3	*Myotis nattereri*	0	7 - 26	26	40	390.7
Tullacondra 3	*Nyctalus leisleri*	70	58.5 - 78	98	40	2050
Tullacondra 3	*Pipistrellus nathusii*	8	26 - 54	90	40	544.5
Tullacondra 3	*Pipistrellus pipistrellus*	91	78.5 - 92	99	40	2324
Tullacondra 3	*Pipistrellus pygmaeus*	94	85 - 95	100	40	2138
Tullacondra 3	*Plecotus auritus*	4	16.5 - 34	59	40	1219
Tullacondra 4	*Myotis*	7	16 - 27.5	49	50	1829
Tullacondra 4	*Myotis daubentonii*	0	0 - 0	0	50	462.4
Tullacondra 4	*Myotis nattereri*	0	7 - 7	8	50	419.8
Tullacondra 4	*Nyctalus leisleri*	66	57 - 70.5	94	50	2143
Tullacondra 4	*Pipistrellus nathusii*	5	14 - 36.5	80	50	538
Tullacondra 4	*Pipistrellus pipistrellus*	66	54.5 - 74	99	50	2453
Tullacondra 4	*Pipistrellus pygmaeus*	57	54.5 - 68.5	96	50	2305
Tullacondra 4	*Plecotus auritus*	0	7 - 13.5	31	50	1354
Tullacondra 5	*Myotis*	28	26.5 - 42	88	50	1829
Tullacondra 5	*Myotis daubentonii*	0	0 - 0	0	50	462.4
Tullacondra 5	*Myotis nattereri*	0	8 - 35.5	63	50	419.8
Tullacondra 5	*Nyctalus leisleri*	63	56 - 71	95	50	2143
Tullacondra 5	*Pipistrellus nathusii*	29	32 - 50.5	96	50	538
Tullacondra 5	*Pipistrellus pipistrellus*	87	78 - 89.5	99	50	2453
Tullacondra 5	*Pipistrellus pygmaeus*	85	76.5 - 88	97	50	2305
Tullacondra 5	*Plecotus auritus*	5	12 - 26	56	50	1354

Tullacondra 6	*Myotis*	31	30.5 - 42	69	50	1829
Tullacondra 6	*Myotis daubentonii*	0	0 - 0	26	50	462.4
Tullacondra 6	*Myotis nattereri*	0	6.5 - 15.5	26	50	419.8
Tullacondra 6	*Nyctalus leisleri*	62	60.5 - 74	97	50	2143
Tullacondra 6	*Pipistrellus nathusii*	0	21.5 - 55.5	91	50	538
Tullacondra 6	*Pipistrellus pipistrellus*	77	62.5 - 82	99	50	2453
Tullacondra 6	*Pipistrellus pygmaeus*	72	63 - 80.5	99	50	2305
Tullacondra 6	*Plecotus auritus*	0	7 - 21.5	31	50	1354
Tullacondra 7	*Myotis*	19	23.5 - 35	57	50	1829
Tullacondra 7	*Myotis daubentonii*	0	0 - 0	0	50	462.4
Tullacondra 7	*Myotis nattereri*	0	7 - 7	8	50	419.8
Tullacondra 7	*Nyctalus leisleri*	59	53.5 - 69	91	50	2143
Tullacondra 7	*Pipistrellus nathusii*	0	26.5 - 46	76	50	538
Tullacondra 7	*Pipistrellus pipistrellus*	81	75 - 87.5	99	50	2453
Tullacondra 7	*Pipistrellus pygmaeus*	59	59.5 - 72	94	50	2305
Tullacondra 7	*Plecotus auritus*	0	8 - 21.5	35	50	1354
Tullacondra 8	*Myotis*	16	25.5 - 43.5	75	40	1981
Tullacondra 8	*Myotis daubentonii*	0	0 - 0	0	40	485.5
Tullacondra 8	*Myotis nattereri*	0	5 - 26	26	40	451.1
Tullacondra 8	*Nyctalus leisleri*	56	43.5 - 65.5	97	40	2258
Tullacondra 8	*Pipistrellus nathusii*	0	21.5 - 38.5	47	40	544.3
Tullacondra 8	*Pipistrellus pipistrellus*	94	86 - 94.5	98	40	2645
Tullacondra 8	*Pipistrellus pygmaeus*	77	69 - 81	96	40	2538
Tullacondra 8	*Plecotus auritus*	0	5 - 17	42	40	1490
Tullacondra 9	*Myotis*	12	24.5 - 47	89	50	1829
Tullacondra 9	*Myotis daubentonii*	0	0 - 0	0	50	462.4
Tullacondra 9	*Myotis nattereri*	0	20 - 58	66	50	419.8

Tullacondra 9	*Nyctalus leisleri*	68	57.5 - 77	96	50	2143
Tullacondra 9	*Pipistrellus nathusii*	38	39.5 - 58	85	50	538
Tullacondra 9	*Pipistrellus pipistrellus*	90	83 - 90.5	99	50	2453
Tullacondra 9	*Pipistrellus pygmaeus*	70	58.5 - 74	97	50	2305
Tullacondra 9	*Plecotus auritus*	29	32 - 45	77	50	1354

Charts

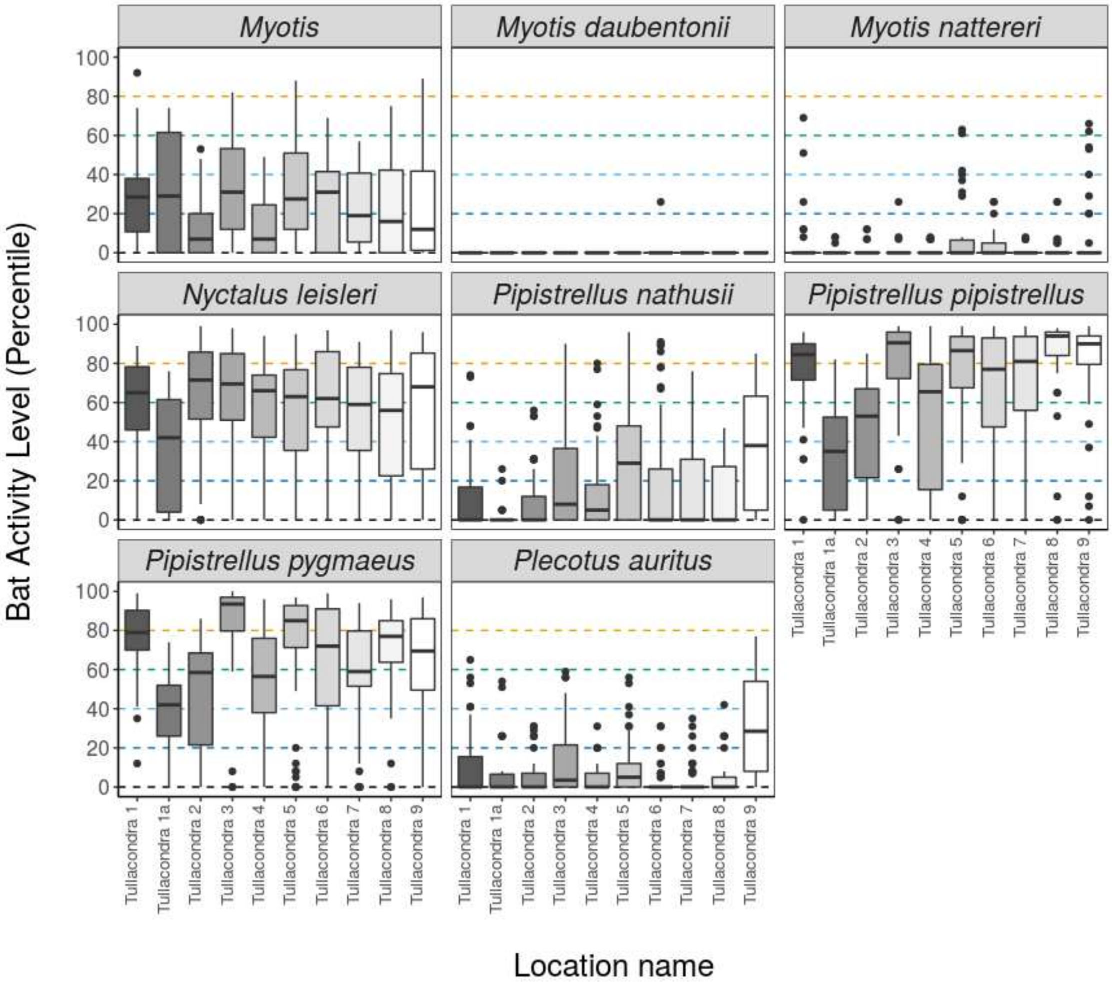
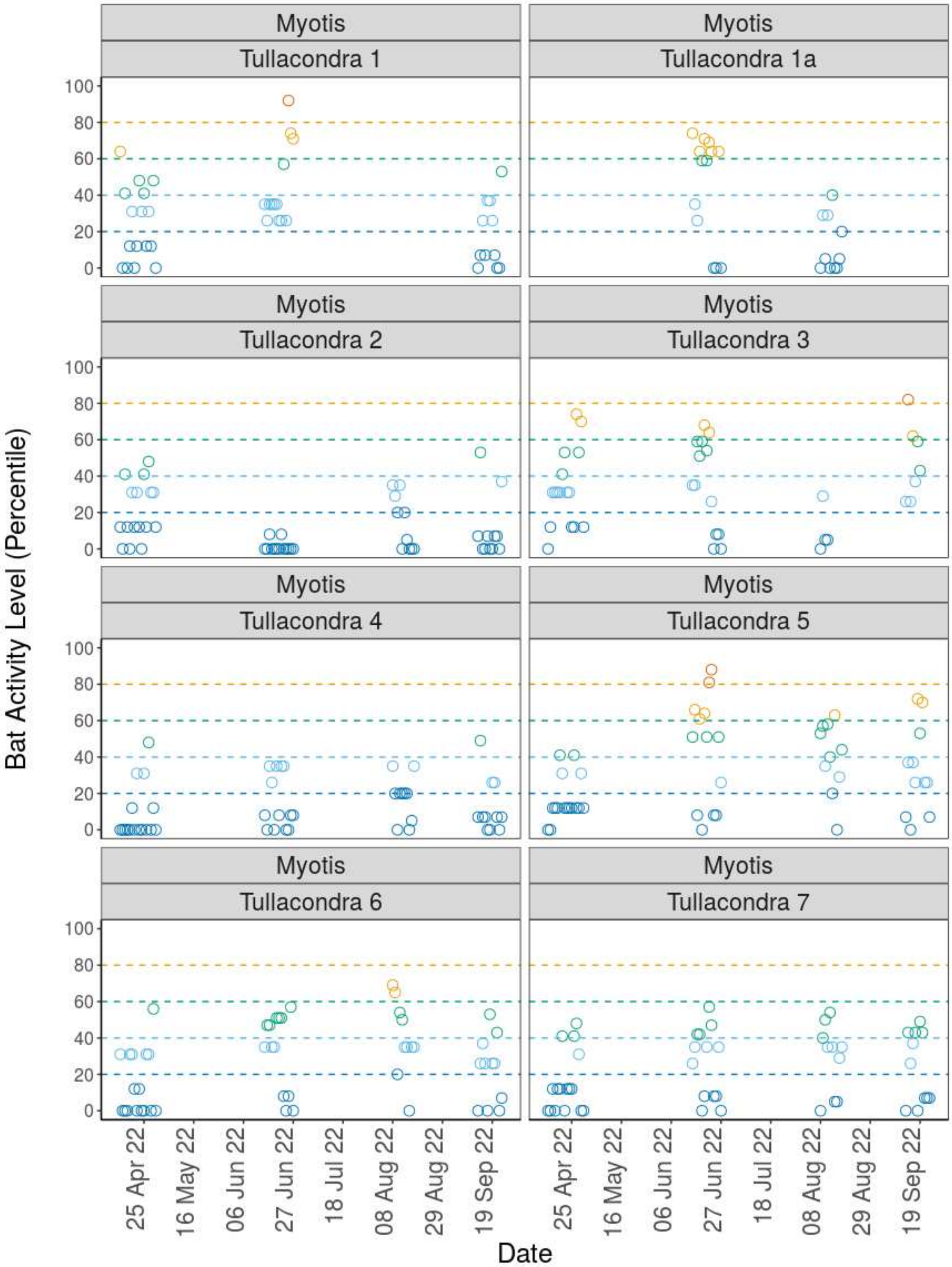


Chart 1. Differences in activity between static detector locations, split by species and location. The centre line indicates the median activity level whereas the box represents the interquartile range (the spread of the middle 50% of nights of activity)



Myotis
Tullacondra 1
Myotis
Tullacondra 1a
Myotis
Tullacondra 2
Myotis
Tullacondra 3
Myotis
Tullacondra 4
Myotis
Tullacondra 5
Myotis
Tullacondra 6
Myotis
Tullacondra 7
Bat Activity Level (Percentile)
0
20
40
60
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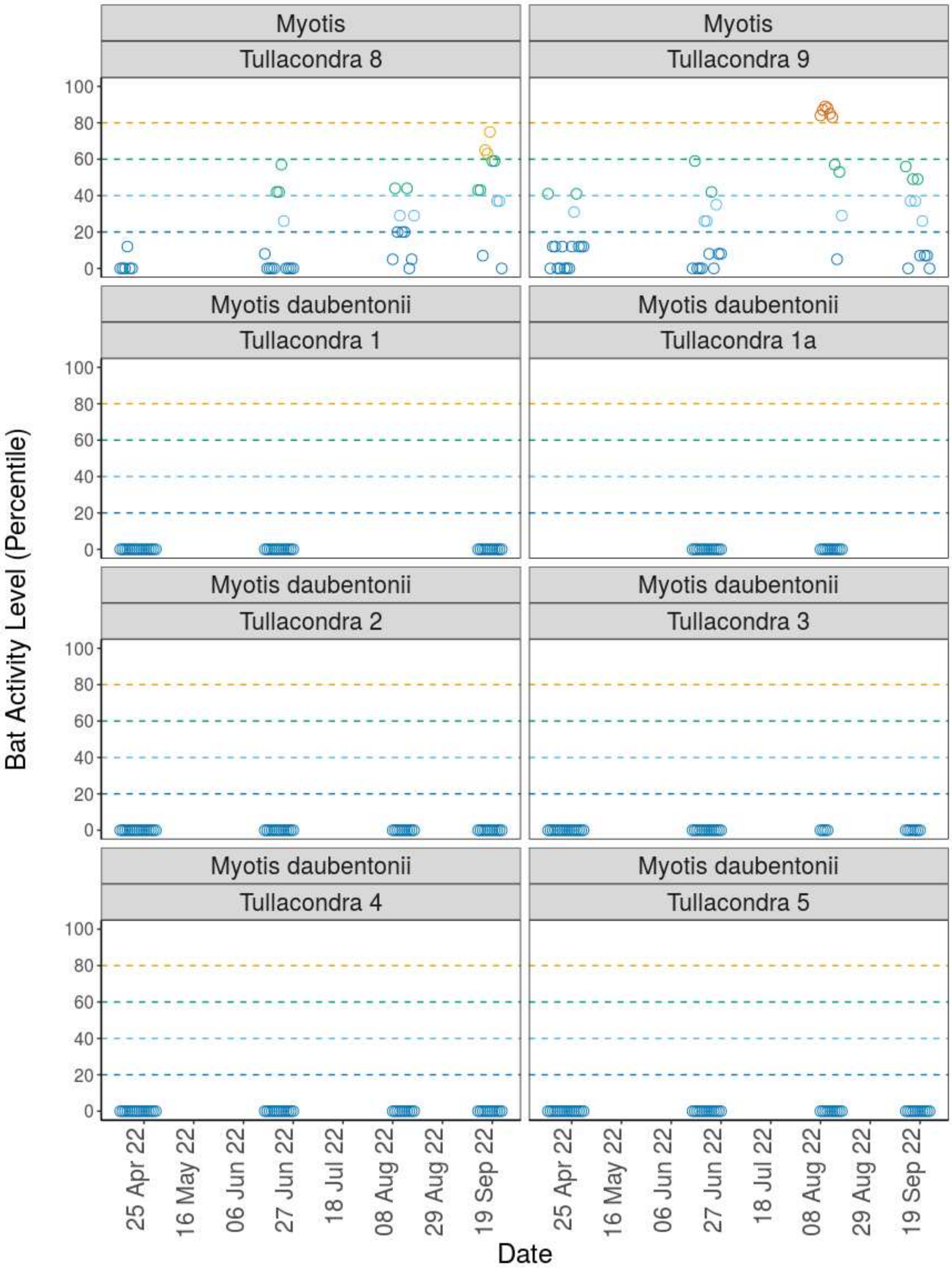
25 Apr 22
16 May 22
06 Jun 22
27 Jun 22
18 Jul 22
08 Aug 22
29 Aug 22
19 Sep 22
Date



Myotis
Tullacondra 8
Myotis
Tullacondra 9
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Tullacondra 1
Myotis daubentonii
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Myotis daubentonii
Tullacondra 2
Myotis daubentonii
Tullacondra 3
Myotis daubentonii
Tullacondra 4
Myotis daubentonii
Tullacondra 5
Bat Activity Level (Percentile)
0
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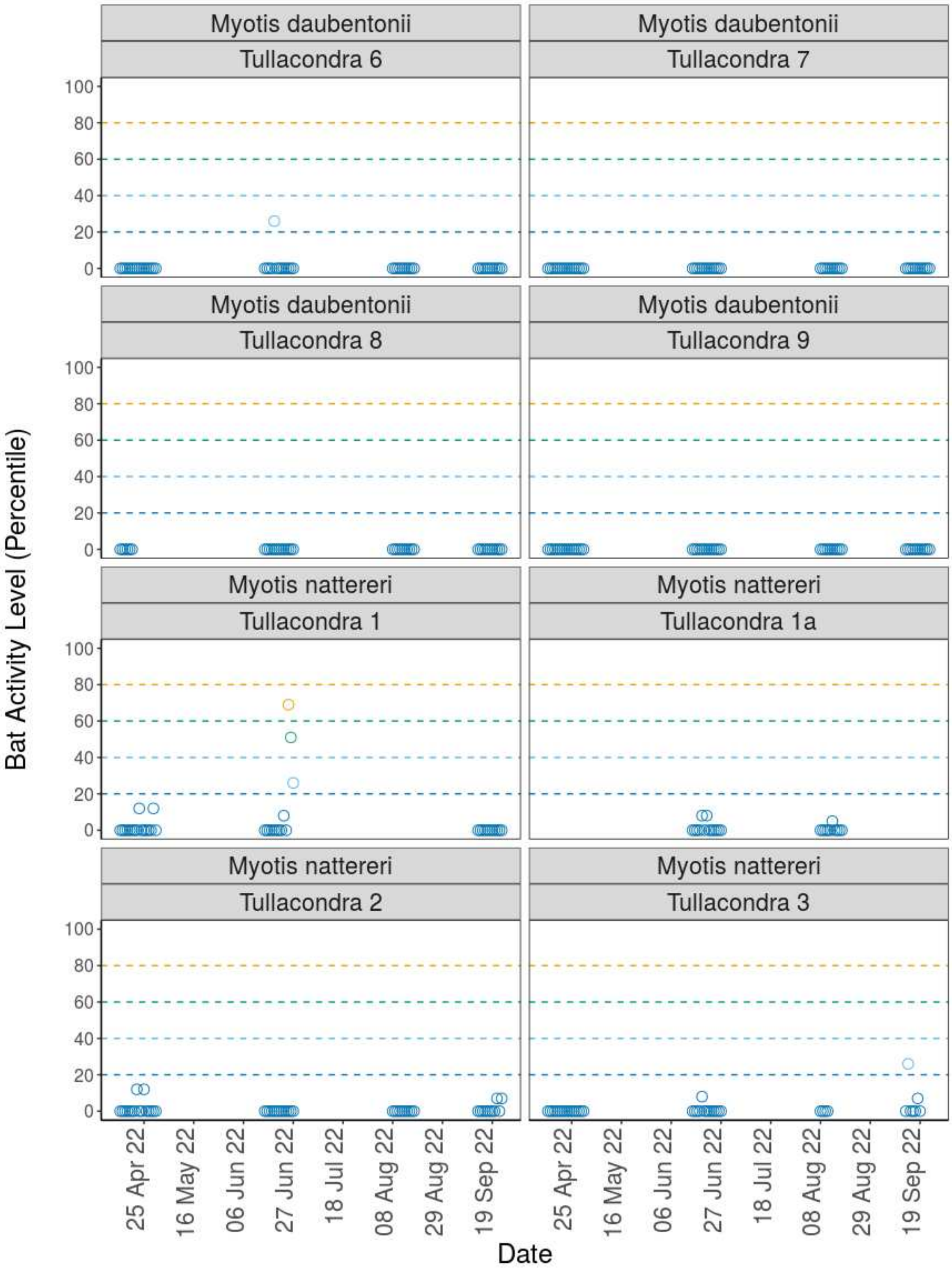
19 Sep 22
Date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Tullacondra 9
Myotis nattereri
Tullacondra 1
Myotis nattereri
Tullacondra 1a
Myotis nattereri
Tullacondra 2
Myotis nattereri
Tullacondra 3
Bat Activity Level (Percentile)
100
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27 Jun 22
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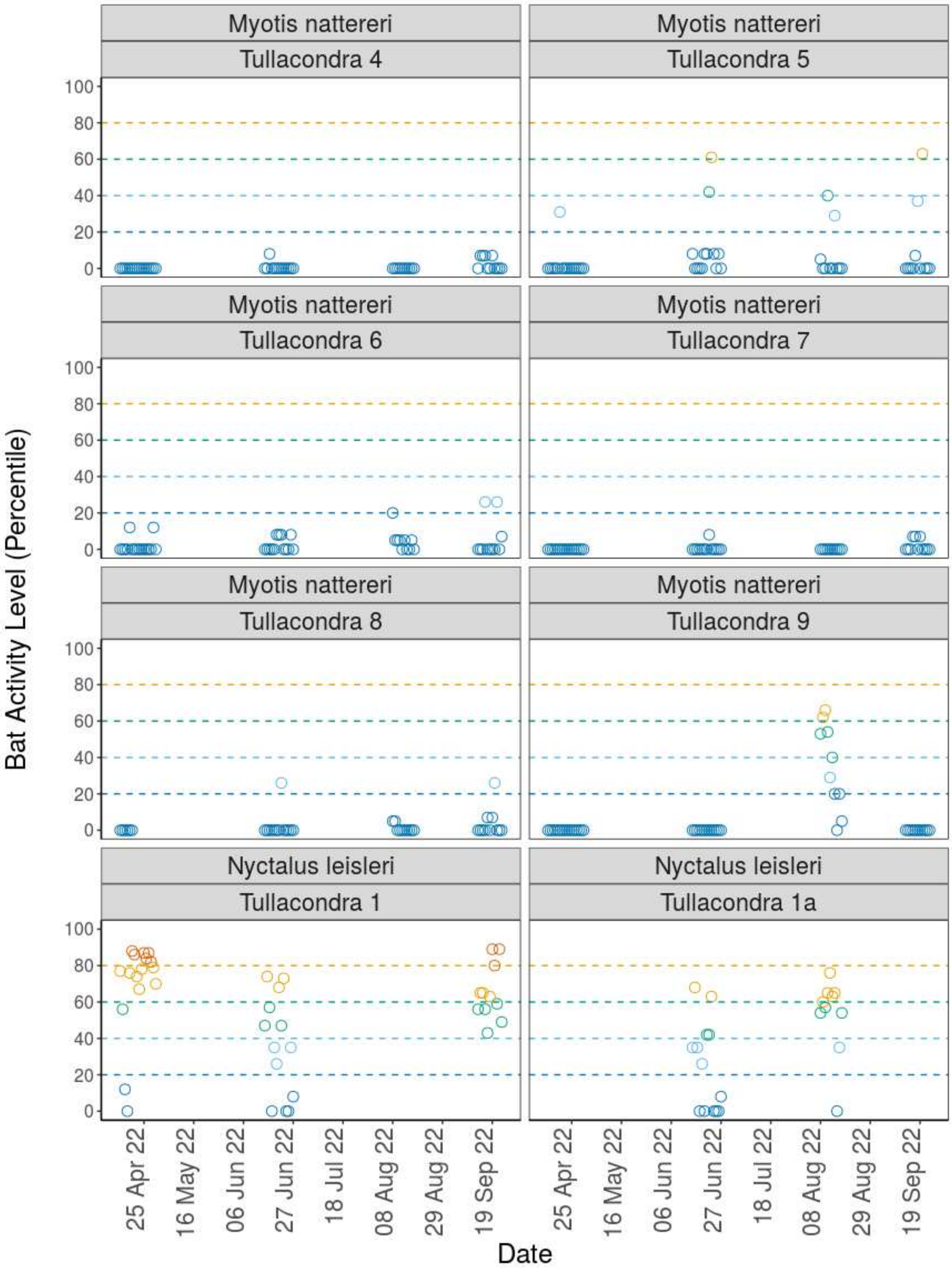
08 Aug 22
29 Aug 22
19 Sep 22
Date



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Tullacondra 4
Myotis nattereri
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Myotis nattereri
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Myotis nattereri
Tullacondra 7
Myotis nattereri
Tullacondra 8
Myotis nattereri
Tullacondra 9
Nyctalus leisleri
Tullacondra 1
Nyctalus leisleri
Tullacondra 1a
Bat Activity Level (Percentile)
100
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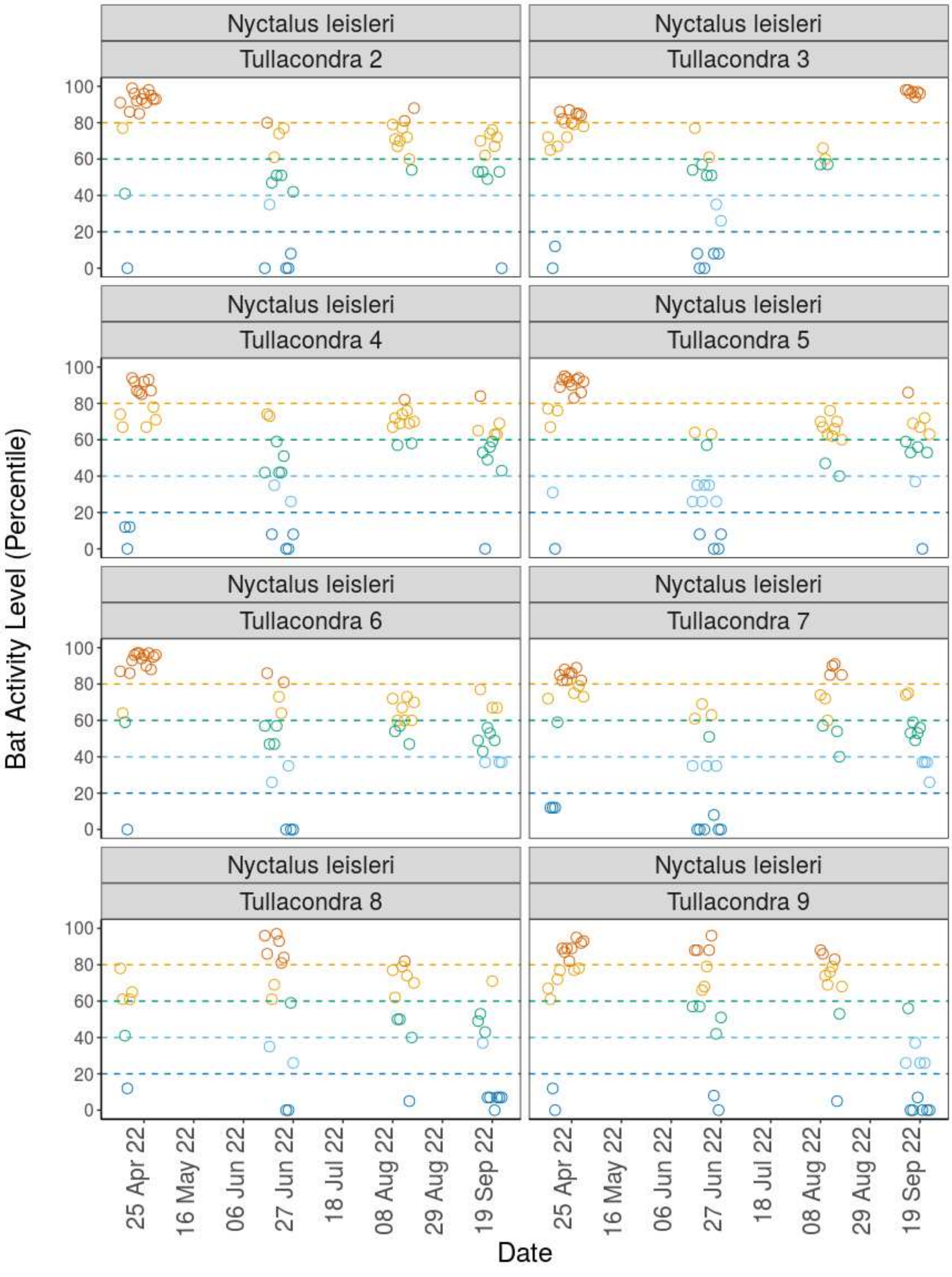
06 Jun 22
27 Jun 22
18 Jul 22
08 Aug 22
29 Aug 22
19 Sep 22
Date



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Nyctalus leisleri
Tullacondra 3
Nyctalus leisleri
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Nyctalus leisleri
Tullacondra 5
Nyctalus leisleri
Tullacondra 6
Nyctalus leisleri
Tullacondra 7
Nyctalus leisleri
Tullacondra 8
Nyctalus leisleri
Tullacondra 9
Bat Activity Level (Percentile)
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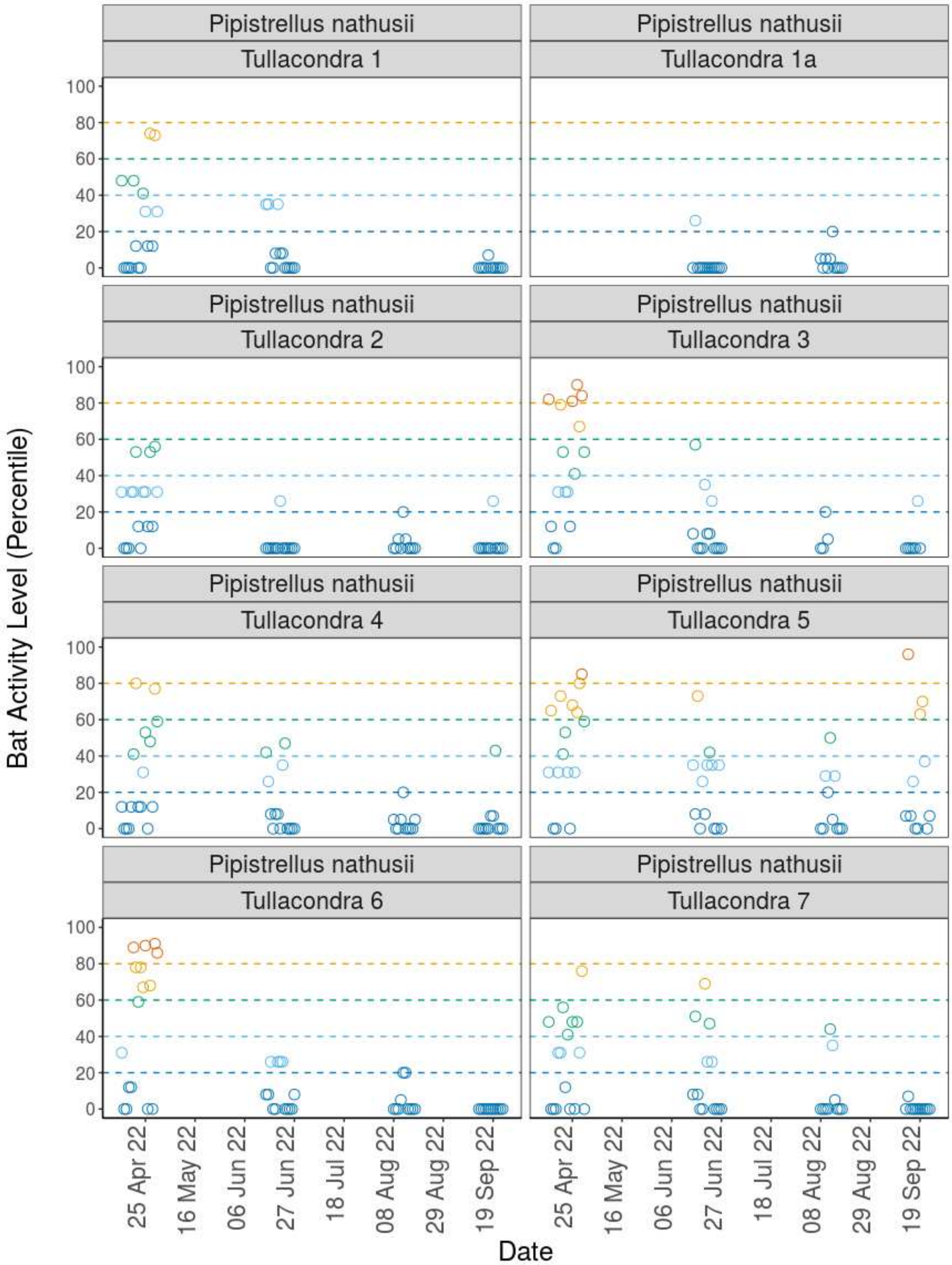
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Tullacondra 3
Pipistrellus nathusii
Tullacondra 4
Pipistrellus nathusii
Tullacondra 5
Pipistrellus nathusii
Tullacondra 6
Pipistrellus nathusii
Tullacondra 7
Bat Activity Level (Percentile)
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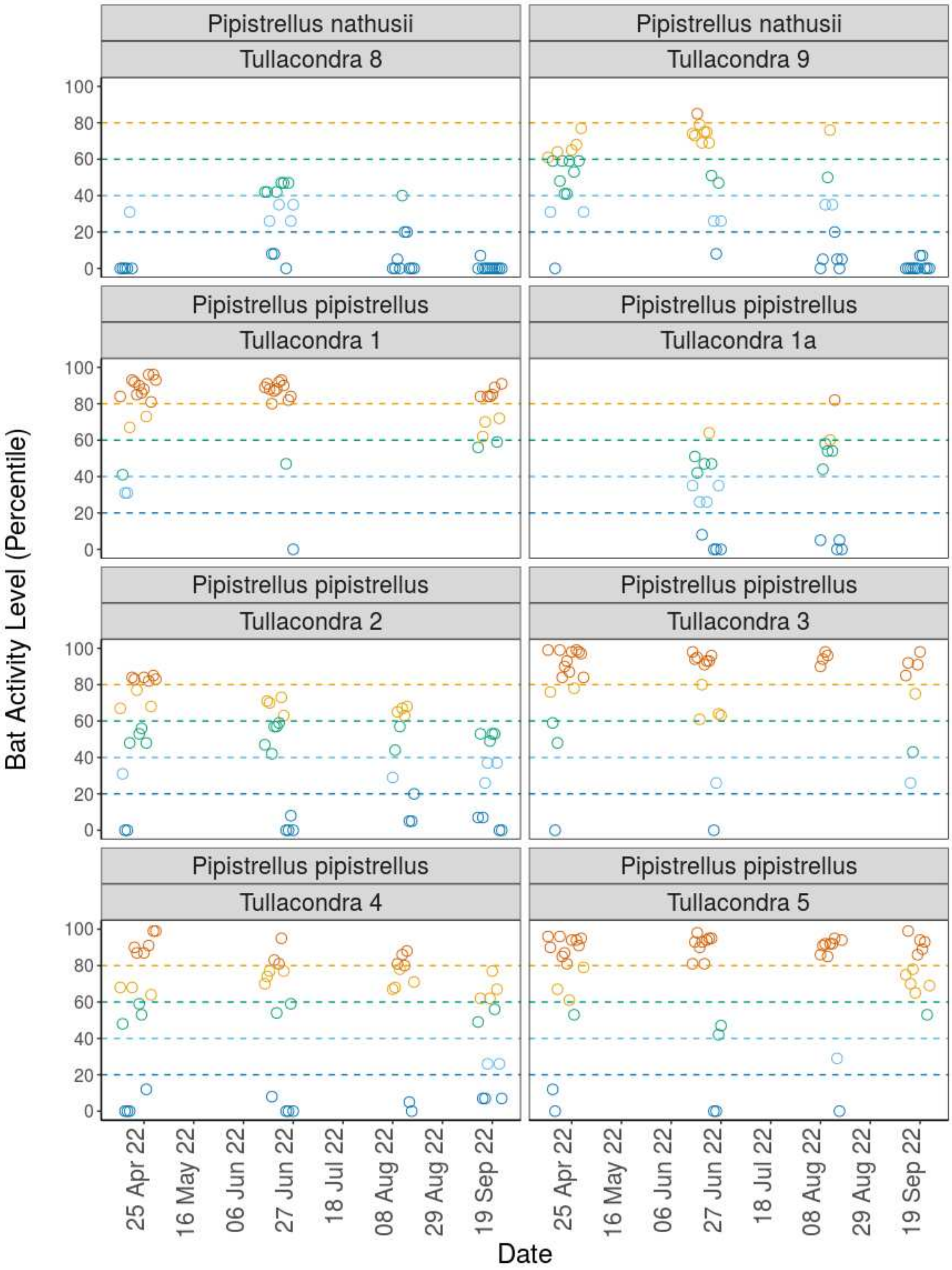
Date



Pipistrellus nathusii
Tullacondra 8
Pipistrellus nathusii
Tullacondra 9
Pipistrellus pipistrellus
Tullacondra 1
Pipistrellus pipistrellus
Tullacondra 1a
Pipistrellus pipistrellus
Tullacondra 2
Pipistrellus pipistrellus
Tullacondra 3
Pipistrellus pipistrellus
Tullacondra 4
Pipistrellus pipistrellus
Tullacondra 5
Bat Activity Level (Percentile)
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06 Jun 22
27 Jun 22
18 Jul 22
08 Aug 22
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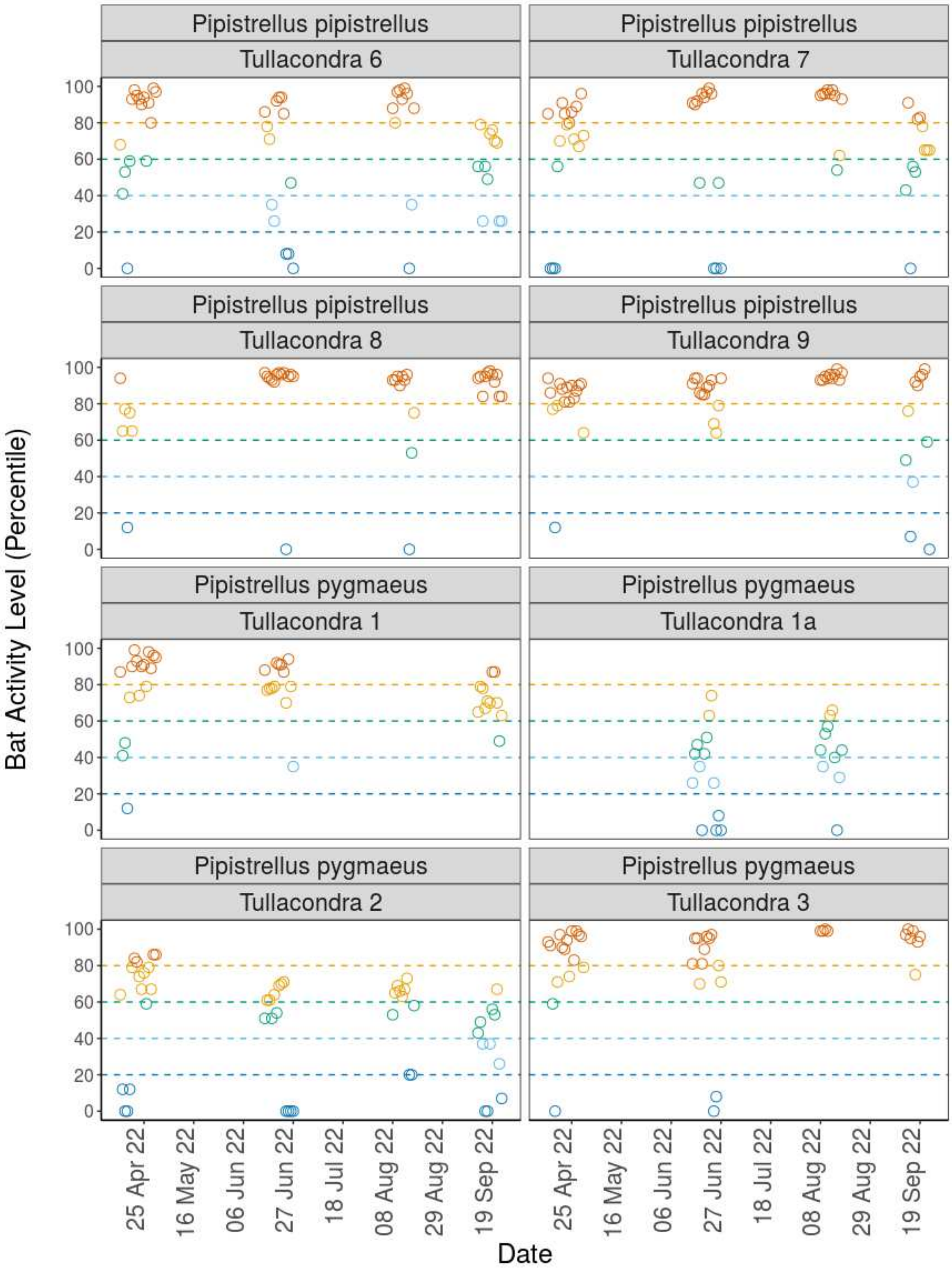
19 Sep 22
Date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Tullacondra 9
Pipistrellus pygmaeus
Tullacondra 1
Pipistrellus pygmaeus
Tullacondra 1a
Pipistrellus pygmaeus
Tullacondra 2
Pipistrellus pygmaeus
Tullacondra 3
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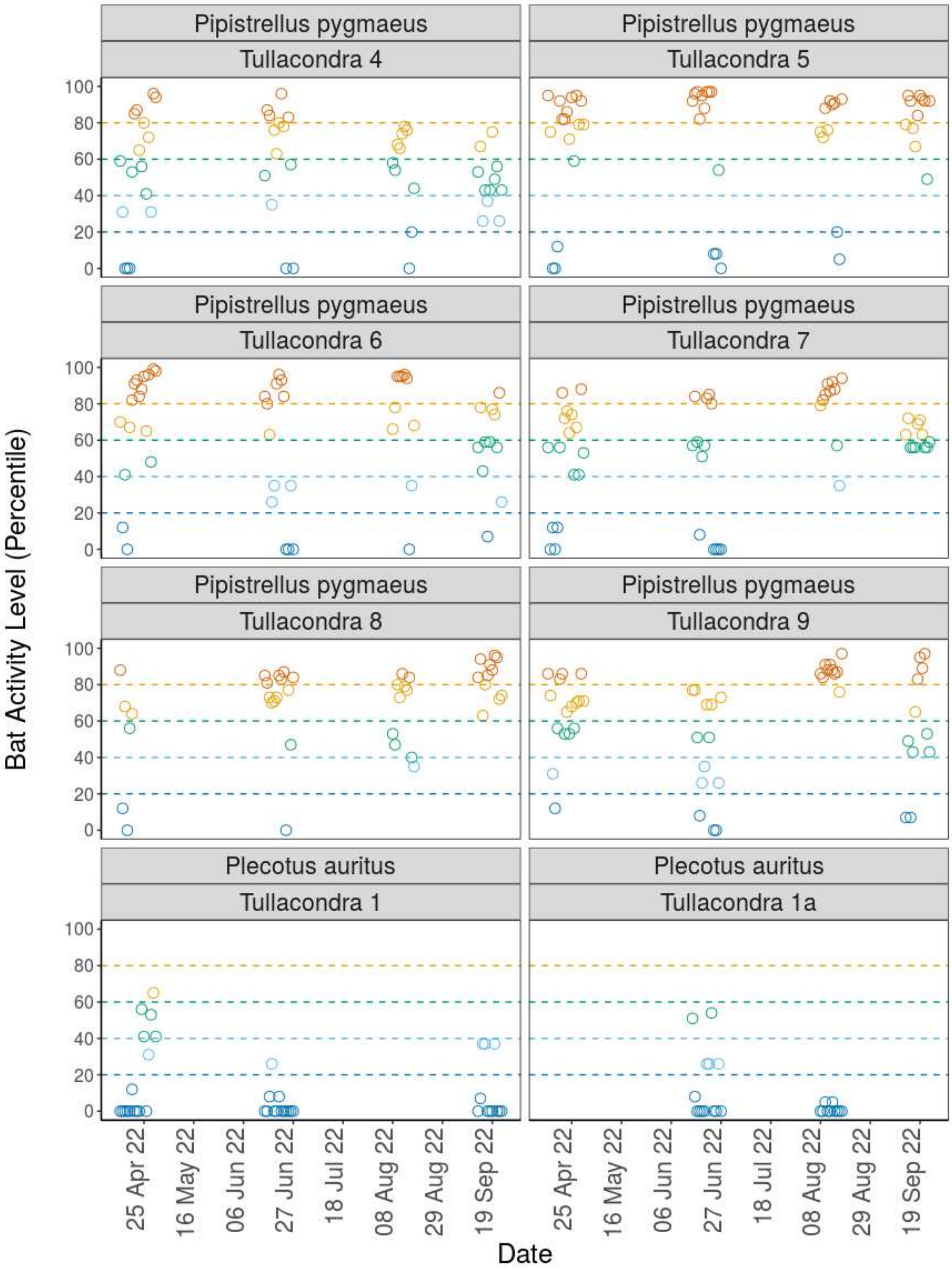
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Tullacondra 7
Pipistrellus pygmaeus
Tullacondra 8
Pipistrellus pygmaeus
Tullacondra 9
Plecotus auritus
Tullacondra 1
Plecotus auritus
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Bat Activity Level (Percentile)
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29 Aug 22
19 Sep 22
Date

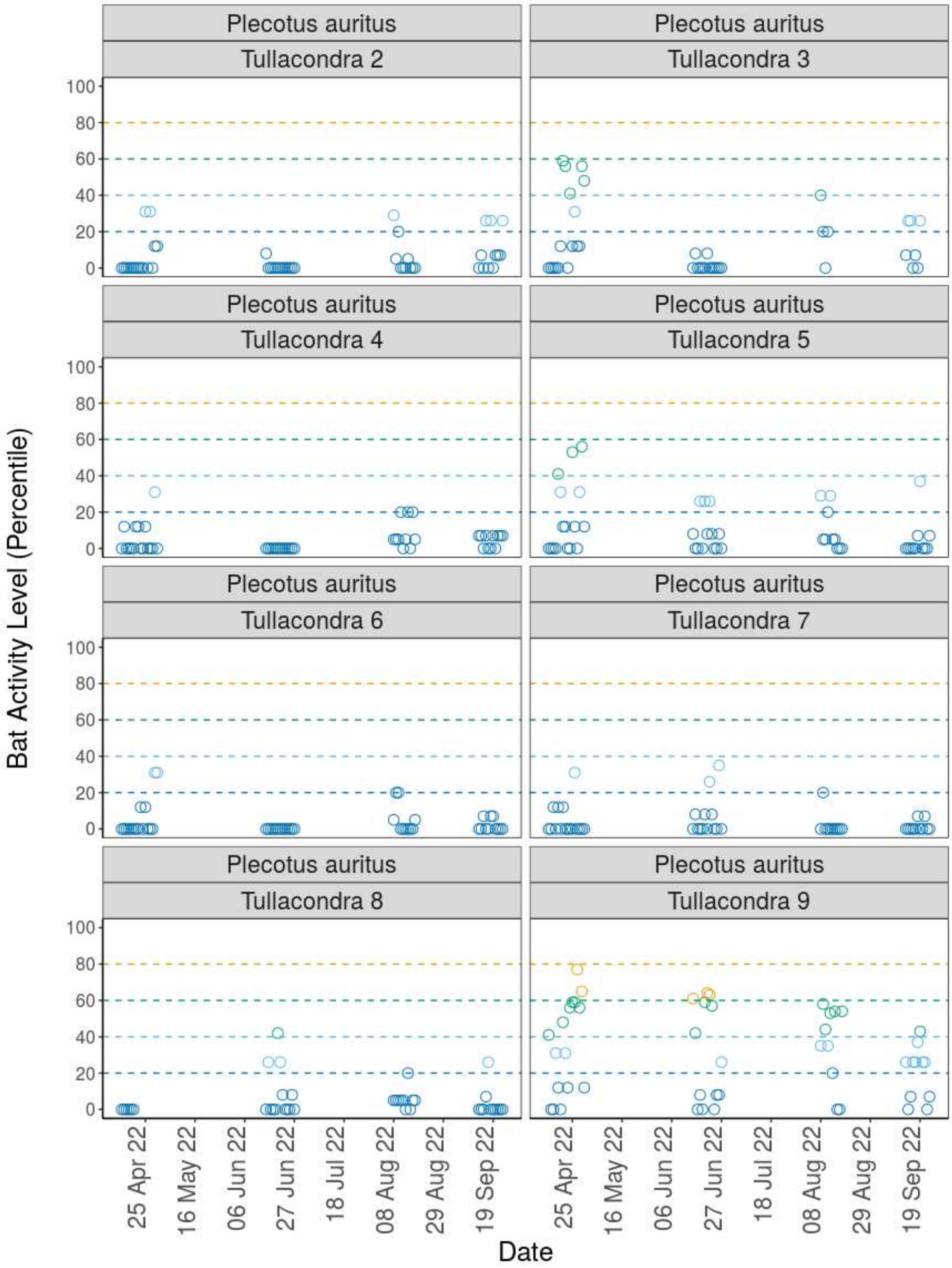

Chart 2. The activity level (percentile) of bats recorded across each night of the bat survey, split by location and species.

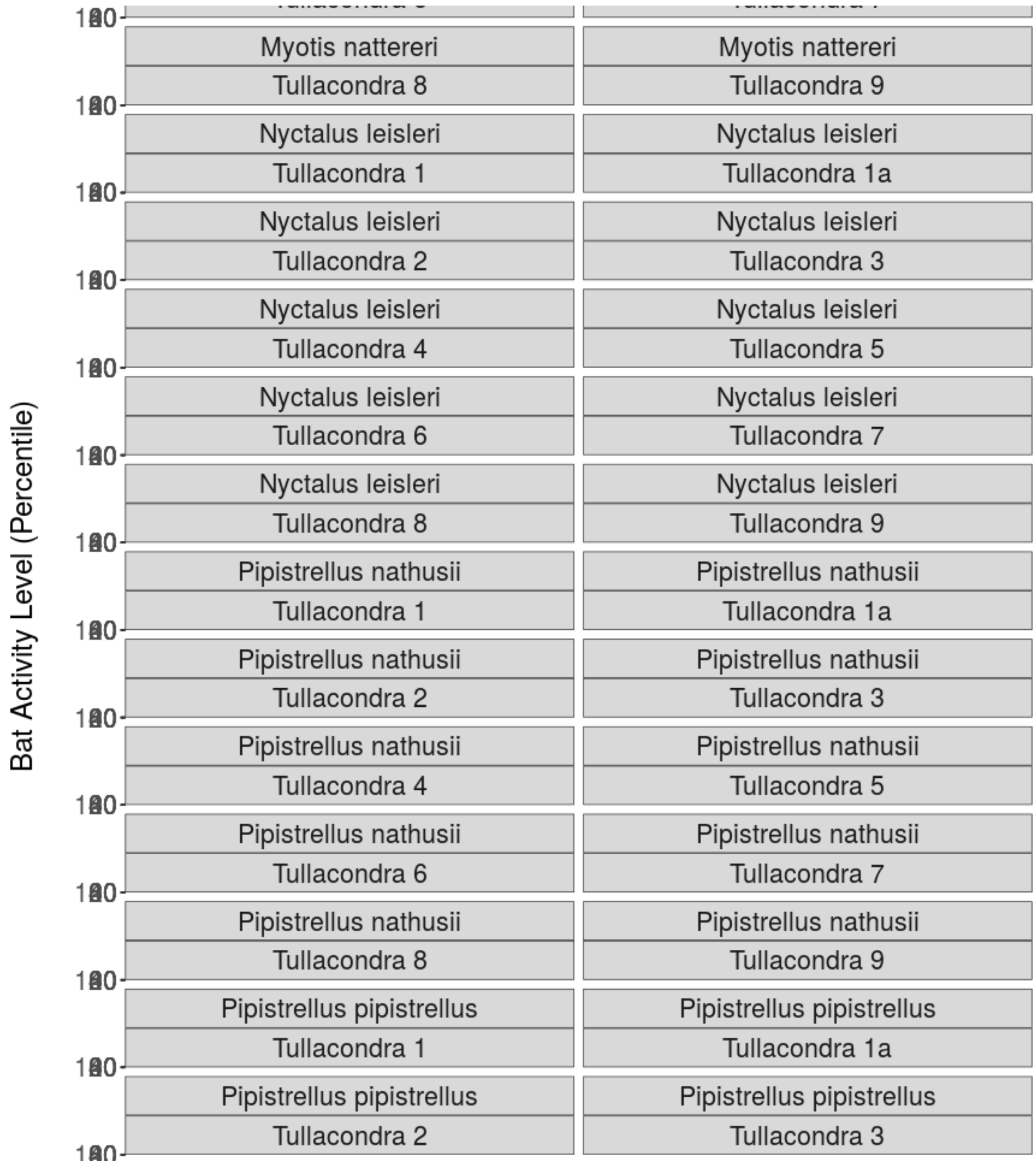

Chart 3. The relationship between recorded bat activity (percentile) and the temperature at sunset, split by species and location.

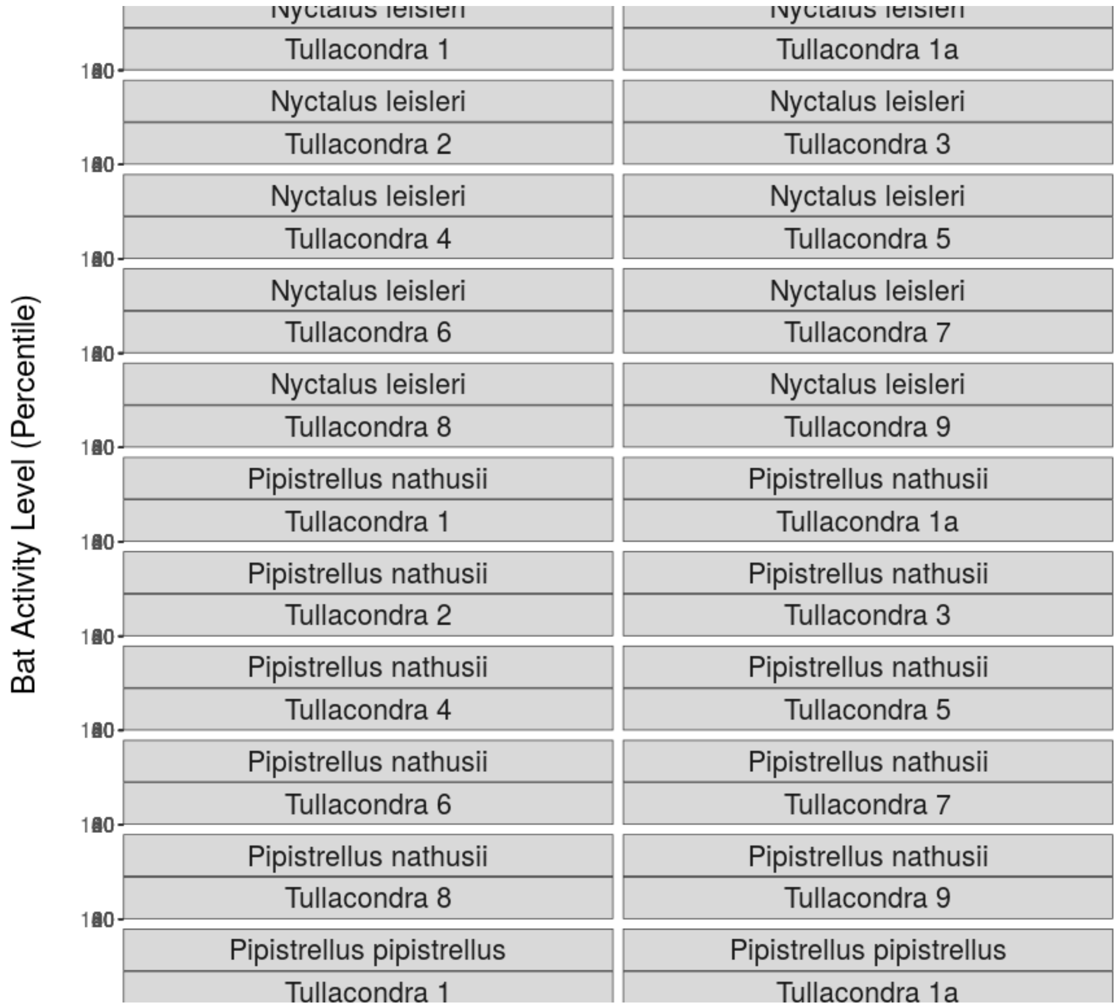

Chart 4. The relationship between recorded bat activity (percentile) and the temperature at sunset, split by location and species.

ANNEX 7 – CURTAILMENT CASE STUDY

EIAR VOLUME III
Appendices

CHAPTER 7 – BIODIVERSITY

Appendix 7.2: Aquatic Ecology Baseline Report

Tullacondra Green Energy Limited

Appendix 7.2 – Aquatic Ecology Baseline Report

Tullacondra Green Energy Project

604162

MARCH 2023

RSK GENERAL NOTES

Project No.: 604162

Title: Appendix 7.2 - Aquatic Ecology Report – Tullacondra Green Energy Project

Client: Tullacondra Green Energy Limited

Date: March 2023

Office: Dublin

Status: Rev00

Author	Rory Dalton	**Technical reviewer**	Nick Henson
Date:	24/02/2023	Date:	06/03/2023
Project manager	Aisling McParland	**Quality reviewer**	Nick Henson
Date:	06/03/2023	Date:	06/03/2023

CONTENTS

TABLES

FIGURES

1 INTRODUCTION

1.1 Purpose of this report

This report presents the methodology and findings of a baseline Aquatic Ecology Study in association with the proposed Tullacondra Wind Farm Project (hereafter referred to as 'the project'). This report forms a technical appendix to Chapter 7 of the Environmental Impact Assessment Report (EIAR) for the project. This study was undertaken by Ecology Research and Solutions Ltd. for RSK on behalf of Tullacondra Green Energy Limited.

The study presented in this report includes desk studies and field surveys completed in 2022 to inform the project, specifically:

- A desk-based review of relevant designated sites and ecological records.
- Stream walkover surveys.
- Biological water quality analysis.
- Targeted surveys for crayfish, freshwater pearl mussel, and fish.

1.2 Site Overview

The proposed wind farm (hereafter referred to as 'the site') is located approximately 2km south of Lisgriffin Cross, Co. Cork. The site is rural in nature, with land cover predominantly comprising mixed agricultural land interspersed with rural settlements. The site is in a lowland location with elevation ranging from approximately 120-130 metres (m) Above Ordnance Datum (AOD) across the site.

Various designated sites for nature conservation value are present within 15km of the site, notably: Kilcolman Bog Special Protection Area (SPA), 9.1km north-east of the site; and Blackwater River (Cork/Waterford) Special Area of Conservation (SAC), 6.2km north-east of the site at its nearest point.

1.3 Key Guidance

This Aquatic Ecology baseline study has been prepared in reference to current key industry standard guidance including the following:

- Anon (2004) *Margaritifera margaritifera*. Stage 1 and Stage 2 survey guidelines. Irish Wildlife Manuals, No. 12. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
- Crisp, D.T., (2000) Trout and Salmon. Ecology, Conservation and Rehabilitation. Blackwell Science: Oxford.
- Environment Agency's '*River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003*' (EA, 2003).
- Gardiner, R., 2003. Identifying Lamprey. A Field Key for Sea, River and Brook Lamprey. Conserving Natura 2000 Rivers Conservation Techniques Series No. 4. Peterborough: English Nature.
- Holdich D (2003). "Ecology of the White-clawed Crayfish. Conserving Natura 2000 Rivers Ecology Series No. 1. English Nature, Peterborough.

- IFI (2010) IFI Biosecurity Protocol for Field Survey Work. Inland Fisheries Ireland.
- Johnson, D.H., Shrier, B. M., O'Neal, J. S., Knutzen, J. A., Augerot, X, O'Neil, T. A., Pearsons, T. N. (2007) Salmonid Field Protocols Handbook: Techniques for Assessing Status and Trends in Salmon and Trout Populations. American Fisheries Society, Bethesda, Maryland.
- Maitland PS (2003). Ecology of the River, Brook and Sea Lamprey.Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.
- Nairn, R. and J. Fossitt (2004) The Ecological Impacts of Roads, and an Approach to their Assessment for National Road Schemes. In: J. Davenport and J.L Davenport (eds) The Effects of Human Transport on Ecosystems: Cars and Planes, Boats and Trains, 98-114. Dublin. Royal Irish Academy.
- National Road Authority (NRA) (2008) Environmental Impact Assessment of National Road Scheme—A Practical Guide. Revision 1, 20 November 2008.
- National Roads Authority (2009). Guidelines for Assessment of Ecological Impacts of National Roads Schemes Rev. 2. Dublin.
- National Roads Authority National Roads Authority. (2005). Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes. Dublin: National Roads Authority.
- Skinner et al., 2003. A. Skinner, M. Young, L. Hastie. Ecology of the Freshwater Pearl Mussel Conserving Natura 2000 River Ecology Series No. 2 English Nature, Peterborough.
- Slaney, P. A., and A. D. Martin. 1987. Accuracy of underwater census of trout populations in a large stream in British Columbia. North American Journal of Fisheries Management 7:117–122.

2 METHODOLOGIES

2.1 Desk study

2.1.1 Background data search

A desktop study was carried out to collate information available from previous studies relevant to the study site in question. A number of papers, documents and articles relevant to the study site as well as a range of online resources utilised in accessing a variety of information were reviewed; these included the EPA website, the NPWS website, the OPW, the National Biodiversity Data Centre website, the IFI website, the Water Matters website, The GSI website, and ViewrangerGPS. Electronic resources were reviewed prior to fieldwork being undertaken in order to get an overview of the study site and to inform how best to carry out the fieldwork in terms of on-site methods, health and safety issues, potential limitations and pitfalls, and the context of the site within the greater area. The online resources were again reviewed during the writing of this report in order to assess the specifics on a variety of parameters and compile them, along with the findings of the site visit, in order to attain an accurate appraisal of the study site.

2.2 Field Surveys

2.2.1 Overview

Fieldwork was carried out in Spring, Summer and Autumn of 2022. Lead ecologist for the fieldwork was Rory Dalton; Tadhg Healy joined Rory in the field in accordance with best practice in terms of health and safety, and to help capture the data. Reporting, data analysis and digital mapping was carried out by Rory Dalton. On both the OSI mapping, and on the EPA web portal, there are no streams indicated within the site of the proposed wind farm or in its immediate vicinity, and when viewed on mapping, the whole area is devoid of watercourses. As such, the majority of the focus was on streams and rivers in the wider area, including those that could potentially be intercepted by the proposed Turbine Delivery Routes and/or the proposed grid connection routes.

2.2.2 Stream Walkover

Following the findings of the initial desktop study outlined above, a site walkover was carried out in line with relevant best practice guidelines (*e.g.* NRA 2005a, NRA 2008). Three watercourses are present within the wider catchment of the site, which eventually flow into the River Blackwater. These watercourses were walked, with surveys carried out at various areas in each catchment that could be accessed easily, particularly near bridges. Although complete coverage was not feasible, this approach provides a valuable overview of the ecology of the watercourses. Similarly, stretches of the main Blackwater channel downstream of the confluence with each of these three watercourses were walked. The aim of the walkover was to assess the aquatic habitats, the riparian habitats, the physical and hydromorphological characteristics, to look for signs of species of interest, to identify issues pertaining to the aquatic environment and determine their causes and effects where possible. Notes were taken and linked to a field map. Evaluation of the aquatic/fisheries habitats present in terms of their ecological value was assessed using criteria amended after NRA 2009 and Nairn & Fossitt 2004. Aquatic habitat assessment was conducted in line with the methodology given in the Environment Agency's '*River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003'* (EA, 2003). Habitats of use to the various life stages of salmonids are assessed based on the information provided in the book "*Trout and Salmon. Ecology, Conservation and Rehabilitation*." Crisp (2000). Lamprey ammocoete[1] habitat quality as well as the suitability of adult spawning habitat is assessed based on the information provided in Maitland (2003) and Gardiner (2003).

2.2.3 Biological water quality analysis

Attaining a Q-value is the standard methodology of assessing the biological water quality of a watercourse in Ireland. It is the biotic index utilised by EPA staff and sub-consultants to score watercourses as part of the Water Framework Directive and is an effective tool for aquatic ecologists in determining the condition of aquatic environments. The method involves placing a kick-sample net (250mm width, 500µm mesh size) in a suitable riffle and kicking (vigorously disturbing) the riverbed for a standard duration of time (two minutes). Aquatic invertebrates from the sample are then identified and classified according to their sensitivity to pollution; Groups A, B, C, D and E (where Group A are the most sensitive and group E are the most tolerant of pollution). As per Toner *et al* 2005, relative numbers of each individual taxa are compiled and analysed such that each sampling site is then assigned a Q-value, a nationally recognised number that denotes water quality (*Table 1*).

Table 1. Corresponding categories of water quality.

Q Value	WFD Status	Pollution Status	Condition
Q5 or Q4-5	High Status	Unpolluted	Satisfactory
Q4	Good Status	Unpolluted	Satisfactory
Q3-4	Moderate Status	Slightly polluted	Unsatisfactory
Q3 or Q2-3	Poor Status	Moderately polluted	Unsatisfactory
Q2, Q1-2 or Q1	Bad Status	Seriously polluted	Unsatisfactory

A number of survey sites were selected in order to carry out Q-value assessments. The sites were selected based on the footprint of the proposed development in combination with the topography and hydrology of the area, as well as taking into account the project within the context of the greater catchment.

2.2.4 Crayfish

Surveying for white-clawed crayfish (*Austropotamobius pallipes*), henceforth "crayfish", was carried out following the guidance set out by Peay (2003). The watercourse reaches examined were subject to a presence/absence survey which involved searching refuges[2] using a snorkel set and dry suit. The survey also involved checking for the presence of

[1] The word ammocoete describes lamprey *spp* in their larval stage

[2] The white-clawed crayfish typically occupies cryptic habitats or "refuges" under rocks and submerged logs, among tree roots, algae and macrophytes, although it usually emerges to forage for food. Juveniles in particular may also be found among cobbles and detritus such as leaf litter

exoskeleton in otter spraint; this is not a standard methodology but works particularly well in watercourses with lower concentrations of crayfish (pers. obs.), as otter will be adept at finding crayfish within its range.

The river condition and habitat features at each survey stretch were noted. The potential for crayfish to occur along each stretch was assessed with reference to Holdich (2003). The survey was carried out under Licence No. C133/2022 from NPWS.

2.2.5 Freshwater pearl mussel

Surveying for freshwater pearl mussel (*Margaritifera margaritifera*), hereafter "FPM", was carried out following the NPWS guidance "*Margaritifera margaritifera Stage 1 and Stage 2 survey guidelines, Irish Wildlife Manuals, No. 12*" (Anon, 2004). The watercourse reaches examined were subject to a presence/absence survey, which involved wading in the river while viewing the substrate and looking for FPM with the aid of a bathyscope and with polarised sunglasses, or a snorkel set. The survey also involved checking for the presence of dead shells, particularly in depositing areas. Transect surveys were carried out, with the location of each recorded by GPS. Searches for FPM were also carried out when walking between transect locations when access and water depth allowed.

The river condition and habitat features at each survey stretch were noted. The potential for FPM to occur along each stretch was assessed with reference to Skinner *et al*. (2003). The habitat was evaluated with reference to Environmental Quality Objectives (EQOs) as specified in Schedule 4 of the 'European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations', S.I. 296 of 2009 (*Table 2*):

Table 2. Environmental Quality Objectives.

Element	Objective	Notes
Filamentous algae (Macroalgae)	Absent or Trace (<5%)	Any filamentous algae should be wispy and ephemeral and never form mats
Phytobenthos (Diatoms)	*EQR 0.93*	*High status*
Macrophytes - Rooted higher plants	Absent or Trace (<5%)	Rooted macrophytes should be absent or rare within the mussel habitat
Siltation	No artificially elevated levels of siltation	No plumes of silt when substratum is disturbed

The survey was carried out under Licence No. C134/2022 from NPWS and was led by accredited FPM surveyor and project aquatic ecologist Rory Dalton. Tadhg Healy, ecologist, carried out the duties on the bank which included safety, ensuring all areas were covered by the surveyor in the water, note taking and grid coordinates.

The proposed development is within a catchment listed in the NPWS *Margaritifera* Sensitive Areas Map. This catchment is identified as a 'Catchments of SAC populations listed in S.I. 296 of 2009'. The areas surveyed were selected on the basis of accessibility (incl. safety), proximity to the proposed development site, size and suitability within the receiving environment.

2.2.6 Fish Survey

The methodology for fish surveying by snorkelling given in Johnson *et al*. (2007) was used to assess fish presence. Snorkel surveys are widely used to monitor fish populations in streams and to estimate both relative and total abundance (Slaney and Martin, 1987). A variety of fish species can be assessed using snorkel surveys; however, salmonids, due to their territorial nature in freshwater and propensity for using habitats with high water clarity, are the group for which snorkel surveys are most frequently conducted. Snorkelling is often feasible in places where other methods are not; for example, deep clear water with low conductivity makes electrofishing prohibitive (Johnson et al., 2007). Snorkelling can be used to assess fish distribution, presence/absence surveys, species assemblages (i.e., diversity), some stock characteristics (e.g., length estimation), and habitat use.

3 RESULTS

3.1 Desk Study

3.1.1 General

The proposed development site is within the Munster Blackwater catchment (*Figure 1*) and is drained by three main watercourses within that catchment; the Awbeg (Kanturk), the Finnow [also known as the Ballyclogh stream] and the Awbeg (Buttevant). The project site is situated atop a limestone plateau which is a significant driver in terms of the characteristics of watercourses in the area. On both the OSI mapping, and on the EPA web portal, there are no streams indicated in the vicinity of the proposed development site, and when viewed on mapping, the whole area is devoid of watercourses; a trait which is peculiar in an Irish setting.

A number of existing pressures on the local waterbodies were identified, further details of which are provided in *Annex 2*:

- Agriculture
- Abstraction
- Historically Polluted Sites
- Windfarms
- Forestry
- Hydromorphology
- Urban waste water
- Industry
- Urban run-off
- Domestic waste water
- Mines & Quarries
- Other unknown anthropogenic pressures.

3.1.2 Species

The National Biodiversity Data Centre have records of freshwater pearl mussel (FPM) throughout the Blackwater Catchment[3]. These records are blurred to a 10km x 10km grid square resolution as a conservation measure, and so precise locations are not available. However, the grid square within which Reach 1 lies contains no records and the grid square within which Reach 2 lies contains a record from 2006.

Within the Blackwater catchment upstream of the reaches surveyed, the underlying bedrock south of the main channel is classified as “ORS, sandstone, conglomerate & mudstone” while north of the main channel is “Namurian shale, sandstone, siltstone & coal” according to the GSI Bedrock Geology 1:1 Million mapping. This geology indicates that the Blackwater main channel within the study area is suitable for FPM.

[3] https://maps.biodiversityireland.ie/Species/123483

3.2 Field Surveys

3.2.1 Stream Walkover

Drainage on this plateau is good and, in dry conditions, water leaves the site via underground limestone aquifers. During wet weather, small intermittent[4] and ephemeral[5] flows are present in drains on the plateau, draining excess water not taken by the aquifers. To get a good understanding of this project in relation to aquatic ecology, it is helpful to categorise two zones of influence:

1. The inner zone, which consists of the small drains on the plateau.

- The middle zone, which consists of the Awbeg (Kanturk), the Finnow [Ballyclogh stream] and the upper Awbeg (Buttevant).

These zones are not only grouped by distance from the proposed development site, but by similarities in ecological and physical character.

The inner zone

The majority of the drains which interact with the proposed turbine stands and associated infrastructure are part of a network that drain to the southwest, converging in Derryorgan and crossing the unnumbered local road south of the site (*Figure 2*). This drain was essentially dry during the summer of 2022, though this was a very dry summer. During times of higher precipitation, this drain flows southwest until it turns into a “losing watercourse”[6] between the townlands of Scart and Cecilstown, and eventually completely disappears to the ground. This is significant in terms of aquatic ecology, as it represents a complete barrier to fish passage, and when a drain dries out, this essentially renders the drain unsuitable to fish and other target aquatic species such as crayfish and mussels. Two small drains head east from the site and are within the Awbeg (Buttevant) catchment; again, these were dry in summer 2022, and they only drain a small section of the proposed development site with one turbine and a small section of access road in each. As such they are of little interest in terms of aquatic ecology, aside from the fact that they convey water to areas downstream. Finally, there is a small section of the south of the proposed development site within the Finnow stream catchment, also known as the Ballyclogh stream catchment. There are no turbines within this catchment, only a short section of existing access road; however, it was included at scoping stage to allow for design flexibility, and to ensure a good radial baseline understanding given the potential for karst geology at the site.

The middle zone

The majority of the turbine hardstands and associated infrastructure are situated within the Lisduggan North subcatchment of the Awbeg (Kanturk). The Lisduggan North[7] subcatchment is made up of one main first order stream and one small first order stream which converge at Ardine Bridge, then flow 1.5km southwest before they flow into the Awbeg (Kanturk) 2km upstream of the confluence with the Blackwater (*Figure 3*).

[4] A watercourse that occurs only in a certain time of the year when it receives ample water

[5] A watercourse that only flows in direct reaction to rainfall, and whose channel is always above the water table

[6] A stream or reach of a stream which shows a net loss of water to groundwater or evaporation

[7] Known as the Ketra river in OSI mapping

Generally, riparian cover is good, with an almost 70% cover along the length of the channel, including a 1.5km length of woodland through which the stream flows between Sheepmount and Ardine Bridge. This riparian shade, where present, is keeping at bay the luxuriant growths of macrophytes, which can be found in areas more exposed to the sun, such as Ardine bridge, which during low water is choked with emergent macrophytes to the point that it appears to be impeding fish passage. There is a dam/reservoir in Sheepmount. On one hand, this is attenuating silt and nutrients and creating pond habitat for creatures adapted to that habitat, but on the other hand, it is blocking fish passage. There is another fish passage issue below Ardine bridge in the form of a man-made concrete structure. In the 1.5km stretch between Sheepmount bridge and Ardine bridge, the Lisduggan stream gains a significant amount of water from the limestone aquifers; this is particularly evident in low flow, where the stream increases in volume approximately 8-fold. The water here is cold in the height of summer, confirming its subterranean pathways.

In the middle reaches, a visit in winter 2022 revealed the presence of a good number of spawning salmon in the vicinity of the Awbeg-Lisduggan confluence, evidenced by the remains of individuals having been eaten by otter, as well as remains in large heaps of otter spraints containing large amounts of salmon scales. This evidence, combined with optimal spawning and holding habitat indicated that the middle section of this river is an important area for salmonid spawning.

In the lower reaches of the Awbeg (Kanturk), above the confluence with the Blackwater, the river exhibits mainly flat laminar glides and riffles with very few thalwegs and very little pooling. As a result, in low water, the river is shallow all the way across, and offers very little in the way of habitat for adult salmonids. In general, the riverbed and banks are very stable. At the confluence with the Blackwater, silt was backing up along the channel as the Awbegs sediment load is dropped due to the rising of Blackwater floods. This infill of silt was over 150m long, over 1.5m deep in places, and was emitting gas.

At the upper reaches of the Awbeg (Kanturk) main channel, above the Lisduggan confluence, and hence not hydrologically connected to the proposed wind farm, the stream was heavily silted. This siltation may be caused by a large tillage farm upstream of Assolas bridge, or a quarry adjacent to the stream in Ballyhest West, or it may have another cause. At Assolas bridge, the stream is heavily modified, most likely by previous proprietors of the nearby gentry house and estate. There is a weir with a steep wall and no plunge pool, which is blocking fish passage; this is most likely the upward limit of any migrating fish except eels. Behind the weir is a pond, the bed of which is heavily silted and anoxic.

This river is part of The Waters of LIFE Project, which is an EU LIFE Integrated Project (IP) aiming to help reverse the deterioration of Irish waters. The project involves six catchments spread across the country and will act as a catchment-scale demonstration project to test and validate the effectiveness of implementing locally tailored ‘best practice’ measures across a range of landscapes and land-uses typically associated with the catchments of high-status waters. The project will trial and validate the implementation of measures at the catchment scale across a number of pilot catchments. The catchment involved is the Blackwater (Munster)_090 catchment which includes the Lisduggan and the Awbeg (Kanturk) streams as well as part of the main channel of the Blackwater from Rosskeen bridge up to Ballymaquirk bridge. From what information can be gleaned from the Waters of LIFE website[8], this catchment was selected based on water quality data from Rosskeen bridge on the Blackwater main channel, rather than data from the Awbeg (Kanturk) river itself, as the national Water Quality Monitoring Stations on the Awebeg (Kanturk) were only tested in 1990[9]; however, the Rosskeen bridge data corresponds to the selection criteria.

The southern tip of the proposed development site is within the Finnow, or Ballyclogh, catchment. This watercourse consists of two main legs which converge at Ballyclough village; one from the east, and one from the west (*Figure 4*). The leg from the east rises in New Twopothouse and flows for 6.5km to Ballyclough village. The stream from the west rises near Cecilstown and flows for 2.5km to Ballyclough village. Despite the difference in channel length, the streams are of similar volume at their confluence. This is explained by a series of springs that were seen welling up into the western stream in the wooded section west of Ballyclough village.

Downstream of the confluence the stream had varied instream habitats. There were deep pools with glides and riffles in short succession. The watercourse has a winding nature with stable banks which allows deep pools to be scoured out without infilling gravel from bank erosion. As a result, there were ample pools for holding adult salmonids. There was reasonable rearing habitat, and some spawning habitat. For a small river, this watercourse contained relatively large trout. There was a good amount of lamprey ammocoete[10] habitat, with some suitable spawning habitat also. There was a medium to high degree of refuges which would be suitable for eel and crayfish, particularly with tree roots, but also with large flat stones. Riparian vegetative cover was generally very good, and this helped keep algal and macrophyte growths low. Land use in the catchment is approximately 55% pastures, 35% tillage, and 10% divided between conifer plantation, broadleaf woodland and human habitations. The usual agricultural drainage network is in place draining to the watercourse and are no doubt contributing to a moderate dusting of silt on the riverbed during summer lows. The intragravel voids are generally quite silted, as is the case with most agriculturally dominated catchments in Ireland at the moment.

Two small drains head east from the site and are within the Awbeg (Buttevant) catchment; again these were dry in summer 2022, and they only drain a small section proportion of the proposed development, with one turbine and a small section of access road in each (*Figure 5*). These streams flow into the Awebeg (Buttevant) either side of Buttevant village. The Awbeg (Buttevant) would be classified as a lowland meandering river. It is a low gradient river which sits, for the most part, in a wide flat valley. As with most rivers of this nature, this river was subject to severe mechanical modification by the OPW[11] as part of a “Drainage District Scheme”[12] which has altered the hydromorphology and ecology of the river and the surrounding flatlands. These flatlands were most likely a mosaic of callows and other wetland habitats, while the river itself would have contained diverse instream habitats, clean gravels and thriving populations of vertebrates and

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8 https://www.watersoflife.ie/

9 As per information displayed in https://gis.epa.ie/EPAMaps/ and https://epawebapp.epa.ie/qvalue/webusers/PDFS/HA18.pdf?Submit=Get+Results

10 Juvenile or larval lamprey

11 See https://www.floodinfo.ie/map/drainage_map/

12 Drainage Districts Schemes were carried out by the Commissioners of Public Works under a number of drainage and navigation acts from 1842 to the 1930s, they were the precursor to the equally destructive Arterial Drainage Schemes which were/are carried out under the Arterial Drainage Act, 1945

invertebrates. The current watercourse sits in a widened and silted channel surrounded by intensive agriculture. Macrophyte growth in general was quite heavy, with islands of emergent plants forming braided channels in places as a natural physiobiological response to over-widening. In terms of arterially drained river, the instream habitats were in reasonably good condition. In general, the bed was gravelly and sandy in nature. There were deep pools to hold adult salmonids, however, quality spawning and rearing habitat was scarce in general. There was plenty of lamprey ammocoete habitat. There were short sections of the coarser rocks used by eels and crayfish as refuge, however, vegetative cover for crayfish is plentiful. Riparian cover was generally poor to very poor upstream of Buttevant, with an improvement downstream. Connectivity with the floodplain was poor. There was plenty of nesting habitat for kingfisher and sand martin.

3.2.2 Biological water quality analysis

A total of seven biological water quality sample sites were selected for the proposed site to augment existing information from the EPAs water quality monitoring programme (*Figure 6*). The Derryorgan site was immediately south-west of the wind farm site on a stream that was almost completely dry in summer 2022. This site was in the Lisduggan North subcatchment of the Awbeg (Kanturk) and achieved a rating of Q3. The Kilmaclenine site was 0.5km east of the proposed development site where a small unmapped stream crosses the Lisgriffin to Mallow road. Again, this stream was dry during the summer of 2022. It is within the Awbeg (Buttevant) catchment and attained a rating of Q2-3. The Q-values at the two previous sites (Derryorgan and Kilmaclenine sites) are likely not a reflection of true water quality as the macroinvertebrate assemblage would be shaped strongly by the pressures associated with the streams drying out during times of lower precipitation. The Ardine Bridge site was also in the Lisduggan North subcatchment of the Awbeg (Kanturk) and achieved a rating of Q3-4. Downstream of this, the Lisduggan Lower site scored Q4. The main channel of the Awbeg (Kanturk) above the confluence with the Lisduggan North watercourse had a rating of Q4. An unnamed stream within the Awbeg Buttevant catchment which drains the north of the proposed wind energy site scored Q3 at Lisgriffin Crossroads[13]. The Ballyclough site, which is on a short tributary of the Finnow that increases dramatically in volume due to springs from the north, scored Q3-4.

In terms of the rest of the Awebeg (Kanturk) subcatchment, there are seven EPA water quality monitoring stations (*Figure 7*). There is a trend of increasing water quality value from upstream to downstream, with the uppermost scoring Q2, the next four scoring Q2-3, and the lowest two scoring Q4; it should be noted however that these surveys were carried out in 1990 and haven't been repeated since, so they are only included here to provide context. On the Finnow stream, there are five EPA water quality monitoring stations, with the upper four attaining Q3, and the lower site attaining Q3-4; only two of these are in date however with the lowest site (Q3-4) and the Ballyclough village site (Q3) being surveyed in 2020, the other three were only surveyed in 1990. In the Awebeg (Buttevant), there are four EPA water quality monitoring stations in the vicinity of Buttevant village which scored Q3-4, and there are a further six EPA water quality monitoring stations downstream towards the Blackwater confluence; one of these has a rating of Q3, and the other five have a rating of Q4. In the Blackwater main channel within

[13] Note that there are two bridges within 30m of eachother at Lisgriffin Cross; the southern of the two bridges drains the proposed wind energy site and it is easily overlooked as it is heavily overgrown

the vicinity of the proposed development site[14] there are ten EPA water quality monitoring stations; of these, two are Q4-5, six are Q4, one is Q3-4 and one is Q3.

A full list of invertebrates recorded for water quality analysis can be found in *Annex 4*.

3.2.3 Crayfish

The watercourses close to the site which are not shown on OSI maps or on the EPA website were found to be all but dry during the summer visits; as a result, they were assessed to be unsuitable for crayfish. Suitable habitat for crayfish was only found at distance from the site. A total of eight sites were surveyed for crayfish; these sites ranged from 2.5km to 10km from the site (*Table 3; Figure 8*). Two sites were within the Awbeg Buttevant catchment, one was within the Ballyclogh catchment, and the remaining five were within the Awbeg Kanturk catchment. Observations of crayfish were made at two freshwater pearl mussel sites surveyed in Section 0.

Table 3. Sites surveyed for crayfish.

Site	Subcatchment	Method	Result	Notes
Ardine	Awbeg Kanturk	50 refuges and vegetation sweep	No Crayfish	
Assolas	Awbeg Kanturk	20 refuges	No Crayfish	
Sheepmount	Awbeg Kanturk	20 refuges	No Crayfish	
Subulter	Awbeg Kanturk	Dry	No Crayfish	Dry
Ketra	Awbeg Kanturk	50 refuges	No Crayfish	
Gortnagross	Ballyclogh	50 refuges	Crayfish present	1 found in search and remains in otter spraint
Lisgriffin	Awbeg Buttevant	20 refuges and vegetation sweep	No Crayfish	Poor habitat heterogeneity
Botharascru b	Awbeg Buttevant	vegetation sweep	No Crayfish	This section of stream likely dries out
Reach 1	Blackwater main Channel	Observations during FPM survey	Crayfish present	One Juvenile
Reach 2	Blackwater main channel	Observations during FPM survey	Crayfish present	3 juvenile, one large adult and one dead adult

3.2.4 Freshwater pearl mussel

Two “reaches” of the Blackwater main channel were surveyed for FPM (*Figure 9*). Reach 1 was selected 150m downstream of the Awbeg (Kanturk) confluence, within suitable FPM habitat; this reach began at Rosskeen bridge and continued for 750m downstream. Reach 2 was situated within suitable habitat immediately downstream of the Finnow

[14] From the Awbeg Kanturk confluence to Ballyhooly just downstream of the Awbeg Buttevant confluence

confluence, skipped approximately 300m of unsuitable habitat and then resumed in the vicinity of Longsfield Bridge; a total of 750m. Ten cross-river transects were carried out at each reach, giving a total of 20 transects within a total of ~1.5km of channel length. A linear transect (upstream-downstream) was also carried out within each reach which equated to ~1.5km of linear transect. Streams closer to the proposed development site were considered too small and too base rich in terms of water chemistry to support a population of FPM, and so no transects were carried out within them. Additionally, the snorkel surveys targeting crayfish and fish were carried out within these streams revealed no FPM.

One live mussel and six dead mussel shells were found in a small patch of what would be considered optimal habitat in Reach 2, in a run downstream of Longfields Bridge (see Photograph 1 in Annex 1). No FPM were observed during the survey of Reach 1. The stretches examined were deemed the most suitable areas of that section of the river as a whole and a variety of microhabitats were surveyed (e.g. clean substrates in riffle, glide and pool under partial and full shade). No evidence of FPM in the form of shells washed out onto banks of deposited gravel were recorded during the field investigations, despite extensive searches on deposits at the leeward side of bends.

The Blackwater catchment is categorised as “catchments of SAC populations listed in S.I. 296 of 2009.” However, the proposed development site sits atop a plateau of limestone, and the watercourses that drain it for the most part flow over limestone rocks. Thus, using criteria in Anon (2004), the Awbeg (Kanturk), the Ballyclogh and the Awbeg (Buttevant) classified as low priority rivers for FPM, i.e. “ rivers with either igneous or sandstone bedrock for less than one third of their length.” Again, according to Anon 2004 “Rivers which fall into [this category] are probably unsuitable for *Margaritifera margaritifera.*” Additionally, during bathyscope and snorkel surveys targeted at crayfish within the Awbeg Kanturk(incl Lisduggan North), the Ballyclogh and the Awbeg Buttevant, no FPM or evidence of FPM were found.

3.2.5 Fish

The methodology for fish surveying by snorkelling given in Johnson et al. (2007) was used to assess fish presence. The plateau upon which the proposed wind energy site sits has no streams and the drainage network dries out during dry spells. When this drainage network is re-wetted following precipitation, there are fish passage issues because the drainage network drains to the groundwater aquifers and there is no direct connectivity to a watercourse through which fish can pass to repopulate the previously dried out drain. As such, the construction and operation of the proposal was seen as posing very little risk to fish populations and it was decided to observe them by snorkelling rather than putting them through the unnecessary risk and stress of electrofishing, particularly given the warm weather conditions during the survey season of 2022.

Juvenile and adult salmon *Salmo salar* and trout *Salmo trutta* were seen in the main channel of the Blackwater, with one particularly big trout seen in a nice run at the lower end of Reach 2, and adult salmon resting in the pool gouged out by the drop off of the apron of Longfields Bridge. A number of European eel *Anguilla anguilla* were seen. River/brook lamprey *Lampetra sp* were plentiful in pockets of suitable habitat (caught with dip net). Three-spined stickleback *Gasterosteus aculeatus* and minnow *Phoxinus phoxinus* were also present. Shoals of dace *Leuciscus leucisus* were seen in impressive numbers in the shallows; the Blackwater is thought to be the first river in the country to receive this non-native invasive fish.

The Ballyclogh river contained a strong population of trout, with some rather large individuals given the size of this watercourse. Eel were also present as well as lamprey *Lampetra sp.* The Awbeg Kanturk contained salmon and trout. A visit in winter 2022 revealed the presence of a good number of spawning salmon in the vicinity of the Awbeg-Lisduggan confluence as evidenced by the remains of individuals having been eaten by otter as well as remains in large heaps of otter spraints; this, combined with magnificent spawning and holding habitat indicated that the middle section of this river is an important area for salmonid spawning. Eel, lamprey (sp) and three-spined stickleback were also present in this system. Only trout were seen in the unnamed stream passing through Lisgriffin, and the Awbeg Buttevant was not snorkelled/surveyed with bathyscope.

Twaite Shad and Lamprey

The three native lamprey species[15] as well as the twaite shad *Alosa fallax fallax* all occur in the Blackwater catchment. They are addressed here as they are designated species of the Blackwater River (Cork/Waterford) SAC 002170. The juveniles of all three lamprey species are similar in appearance and behaviour. One of the main pressures on lamprey populations is the presence of weirs.

The main river channel has two weirs, large by Irish standards at approx. 2.5m head height, in the first 30km of channel upstream of the tidal limit. The first weir (Clondulane) is approx. 25km upstream of the upper tidal limit and the second weir (in Fermoy) is approximately 5km upstream of Clondulane. The first weir impounds water almost all the way up to the second weir at Fermoy, drowning out potential spawning and rearing areas in the 5km between the weirs. Both weirs were built to power mill wheels for agricultural actions – milling etc. over 150 – 200 years ago. Both are now derelict from that point of view. Both had fish pass structures in them – essentially for upstream-migrating salmon only.

These weirs are thought to be preventing the upstream migration of twaite shad and river lamprey completely and stopping a large percentage of the sea lamprey population from gaining passage. This essentially relegates twaite shad and river lamprey to the lower reaches of the Blackwater. It also brings the sea lamprey population far below its potential for the river. Brook lamprey are essentially ubiquitous in the Blackwater, existing, as long as suitable spawning and nursery habitat is present, in all but the steep headwater streams, stretches of small streams above barriers to passage and ephemeral streams within the catchment. This statement is echoed in a high-resolution survey of 50 sites within two subcatchments of the Blackwater (the Owentagrlin and the Upper Blackwater [i.e. the Blackwater upstream of Rathmore]) carried out by the author of this report for the IRD Duhallow Raptor LIFE Project (Dalton and Reidy, 2020).

3.2.6 New culverts and infrastructure within the proposed site

The majority of the drains which interact with the proposed turbine stands and associated infrastructure are part of a network of drains that drain to the southwest converging in Derryorgan and crossing the unnumbered local road south of the site. This drainage

[15] *Petromyzon marinus* (sea lamprey), *Lampetra planeri* (brook lamprey) and *Lampetra fluviatilis* (river lamprey)

network was essentially dry during the site visit in the summer of 2022. During times of higher precipitation, this drain flows southwest until it turns into a “losing watercourse” between the townlands of Scart and Cecilstown, and eventually completely disappears to the ground. This is significant in terms of aquatic ecology, as it represents a complete barrier to fish passage, and when a drain dries out, this essentially renders the drain unsuitable to fish and other target aquatic species such as crayfish and mussels. Two small drains head east from the site and are within the Awbeg (Buttevant) catchment; again, these were dry in summer 2022, and they only drain a small section proportion of the proposed development with one turbine and a small section of access road in each. As such they are of little interest in terms of aquatic ecology, aside from the fact that they convey water to areas downstream which are more important from an aquatic ecology perspective.

3.2.7 Watercourse crossings along the cable routes

The cable route crosses one watercourse (WFD ID: Blackwater (Munster_140)) along it’s ~13.5km length (*Figure 10*). This stream varies between 1.4m and 2.6m in width. It is subject to spate floods, owing to a fan of 4 steep headwater tributaries. The bed is silted, and the water, during both visits, had a murky silty look to it; this may be due to its proximity to the N72 or to the large percentage of its catchment given over to tillage, or a combination of the two. There are trout in this stream. Salmon are almost certainly absent due to the fact that it is forced under mallow town for at least 500m. The banks are stable and well vegetated.

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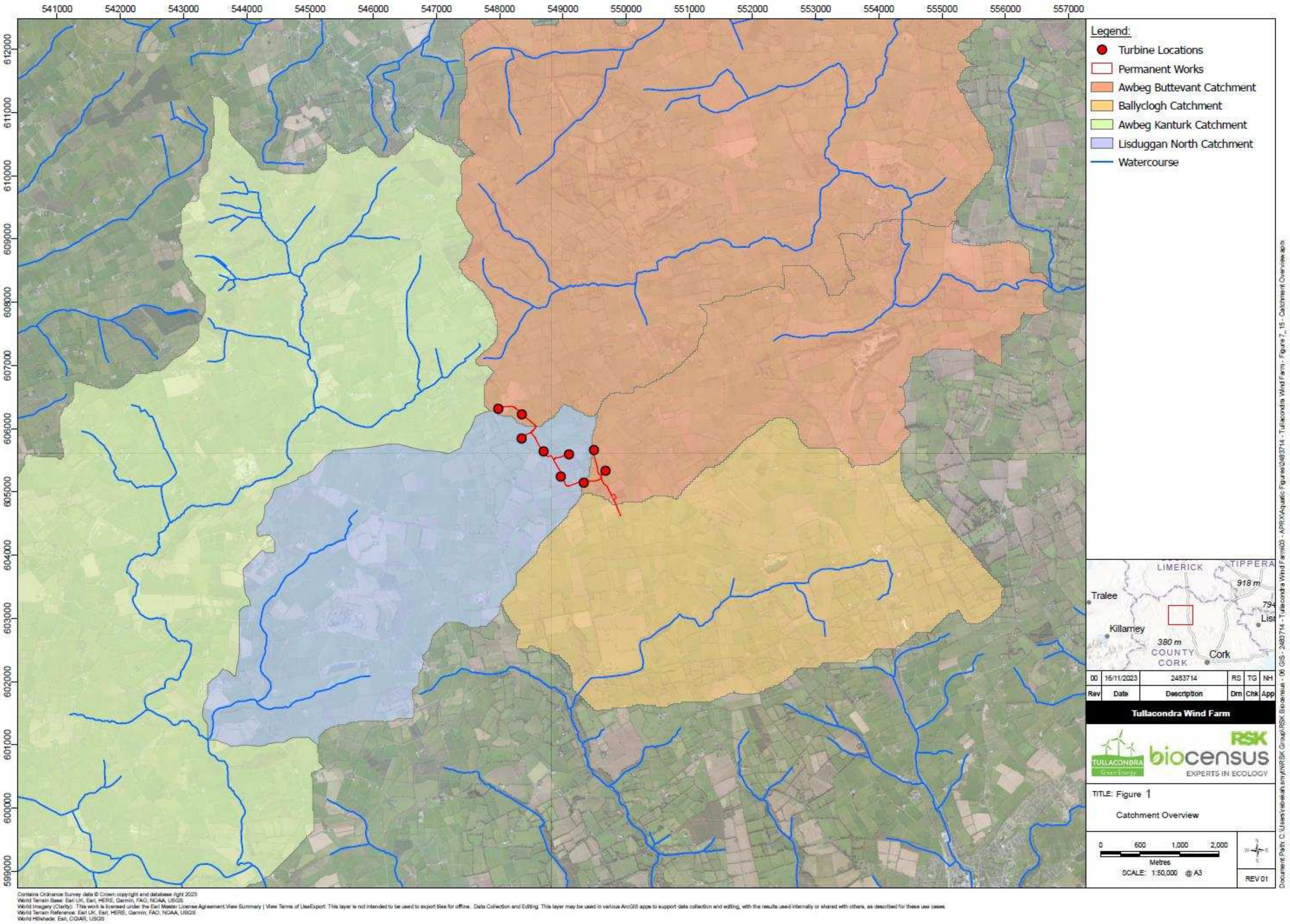

Figure 1: Catchment Overview

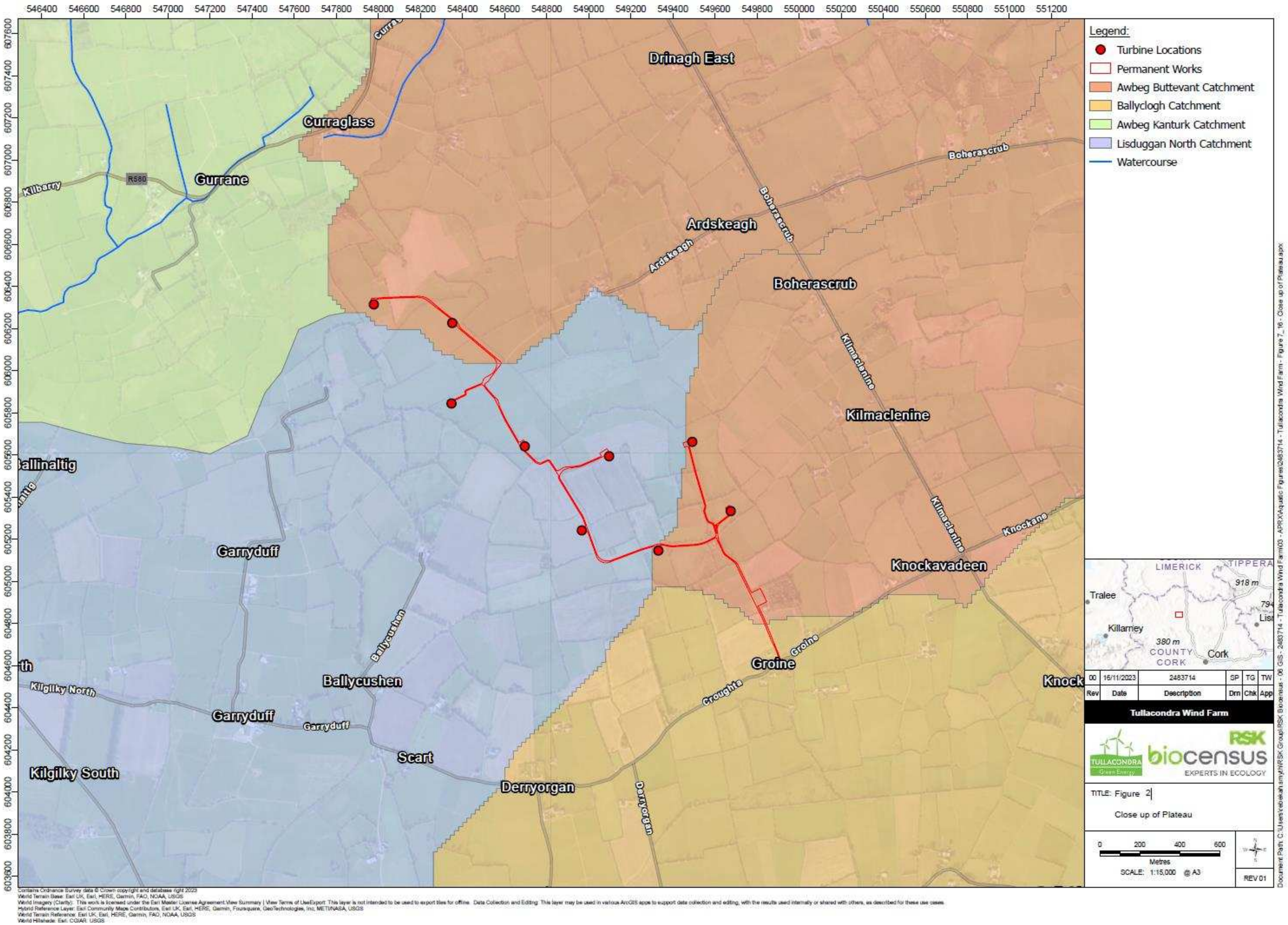

Figure 2: Close up of Plateau

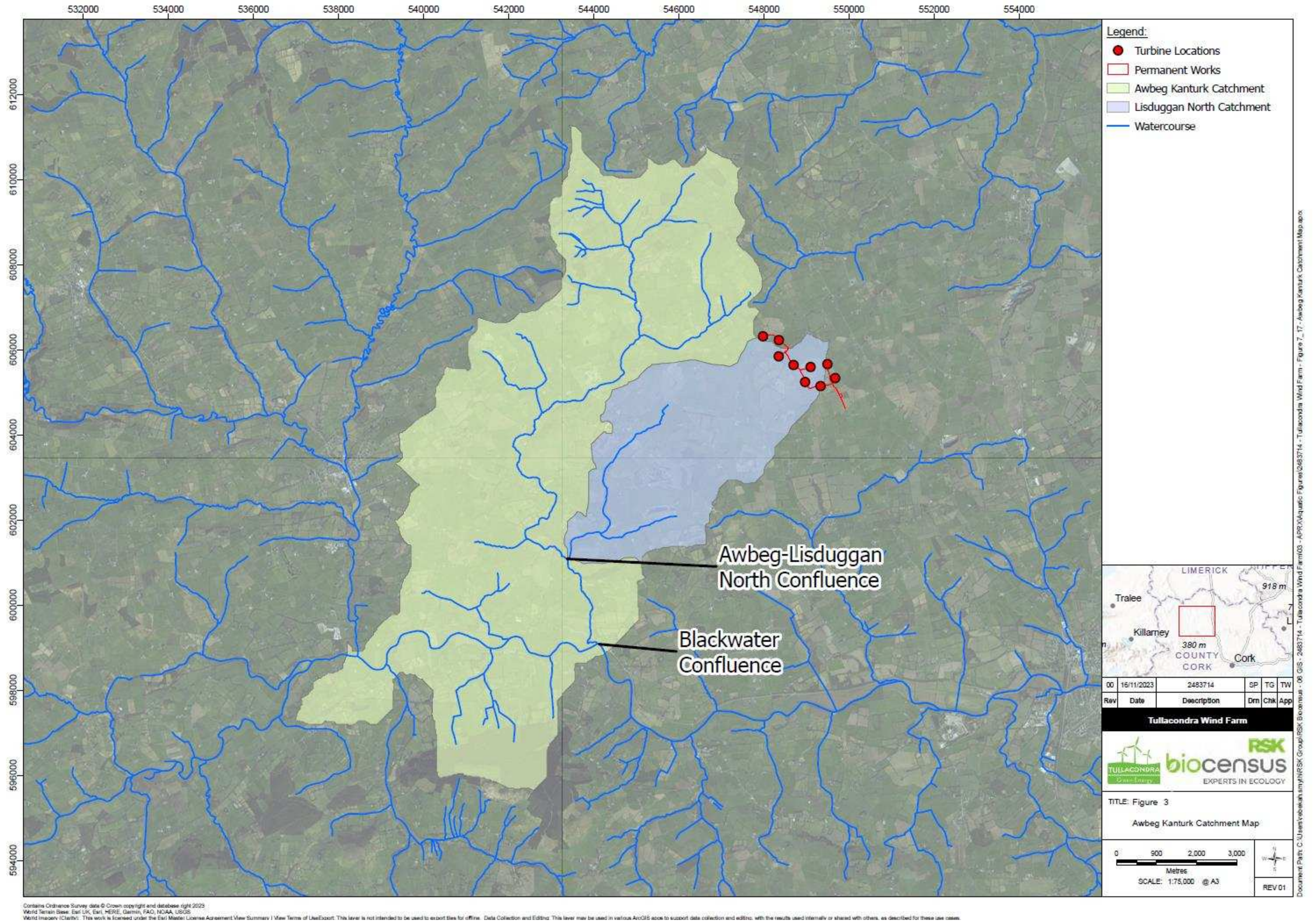

Figure 3: Awbeg Kanturk Catchment Map

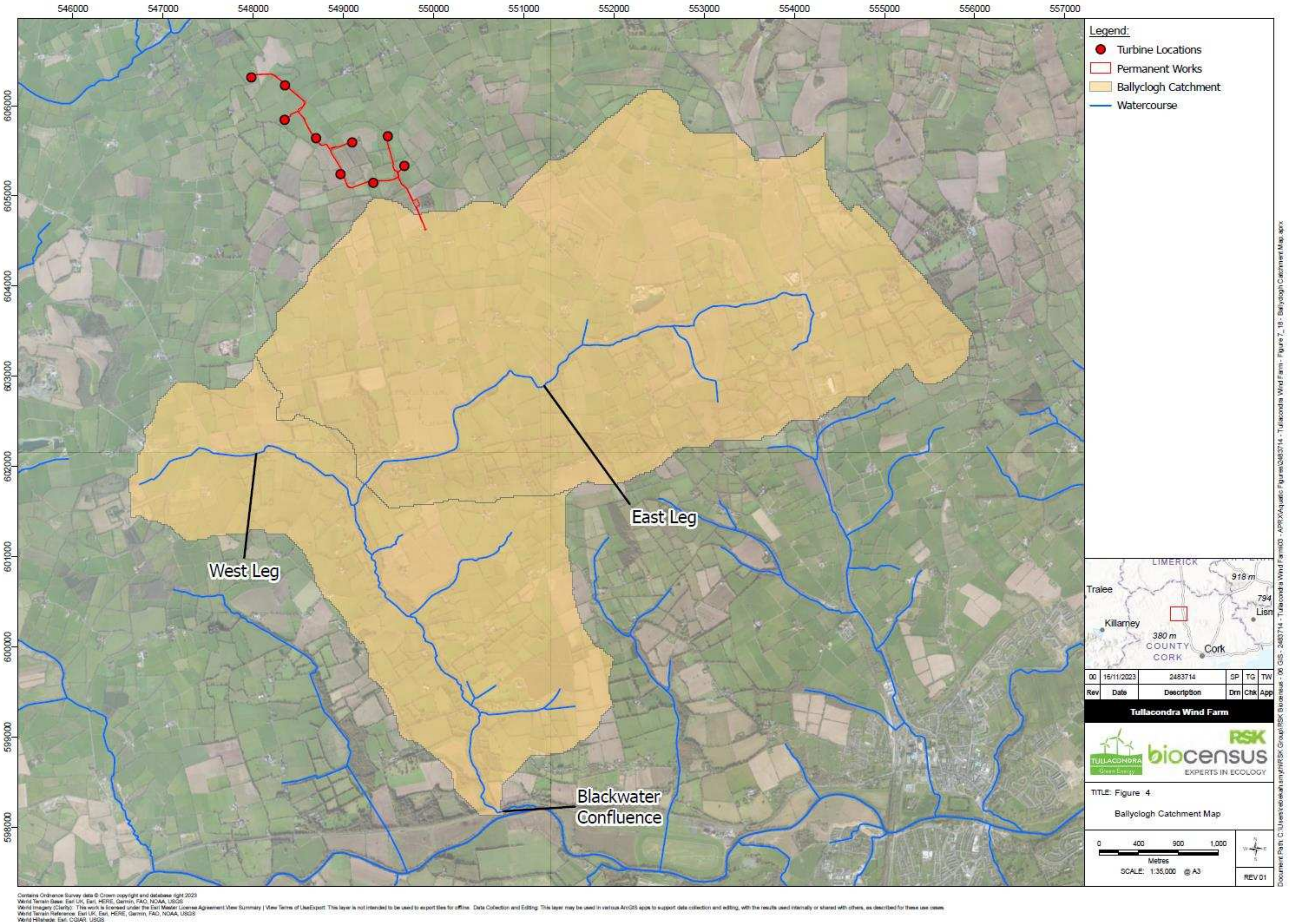

Figure 4: Ballyclough Catchment Map

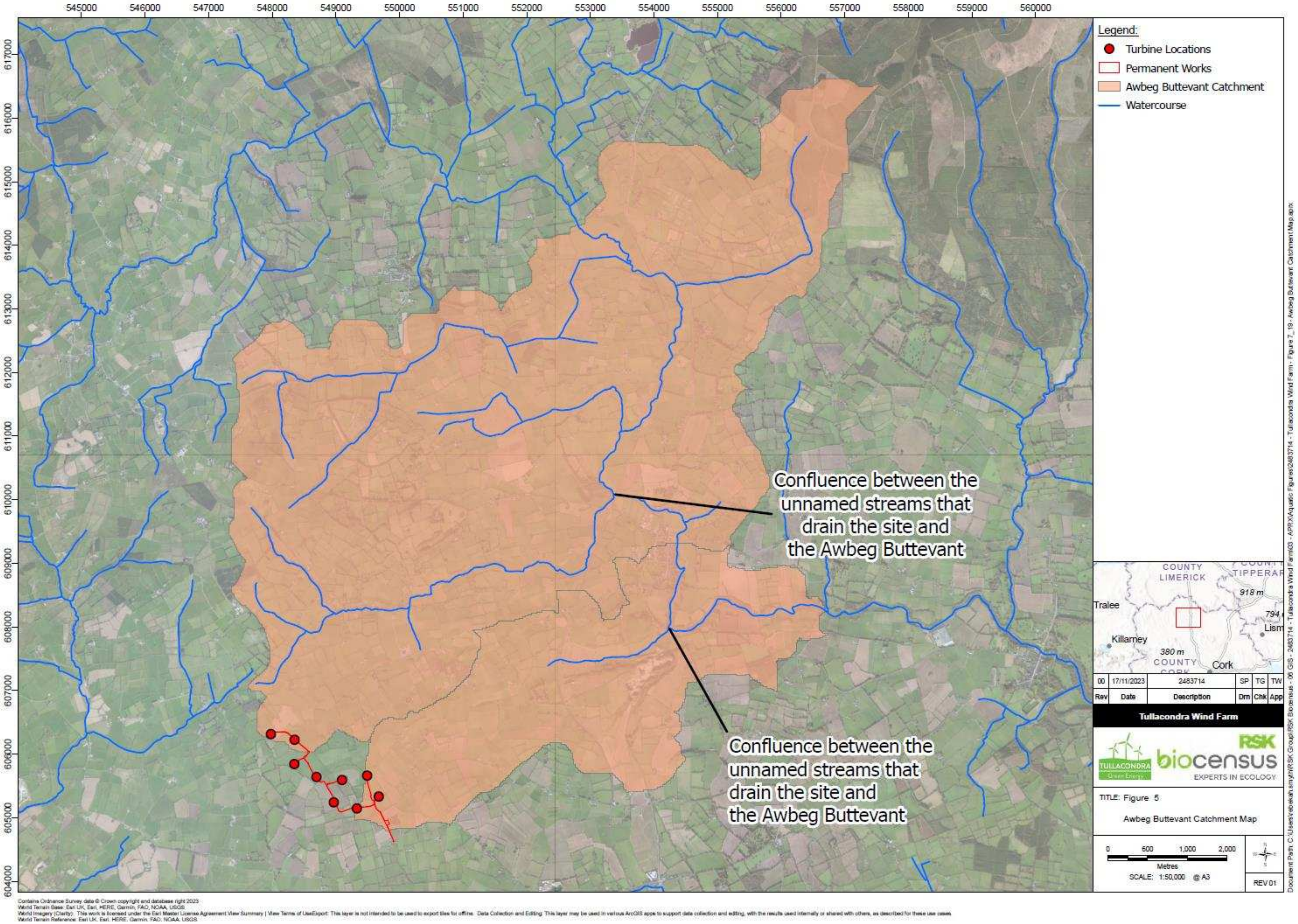

Figure 5: Awbeg Buttevant Catchment Map

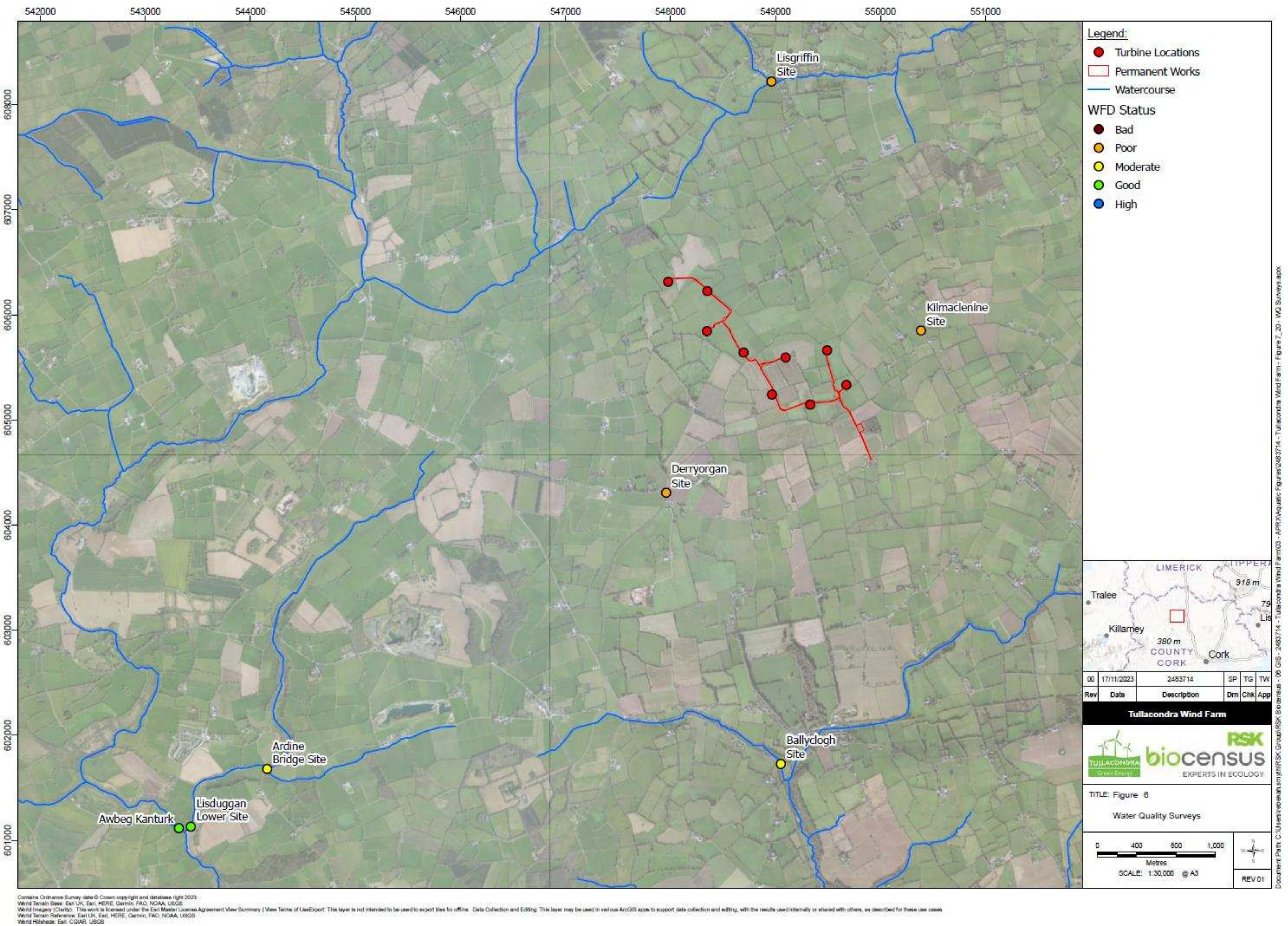

Figure 6: Water Quality Surveys

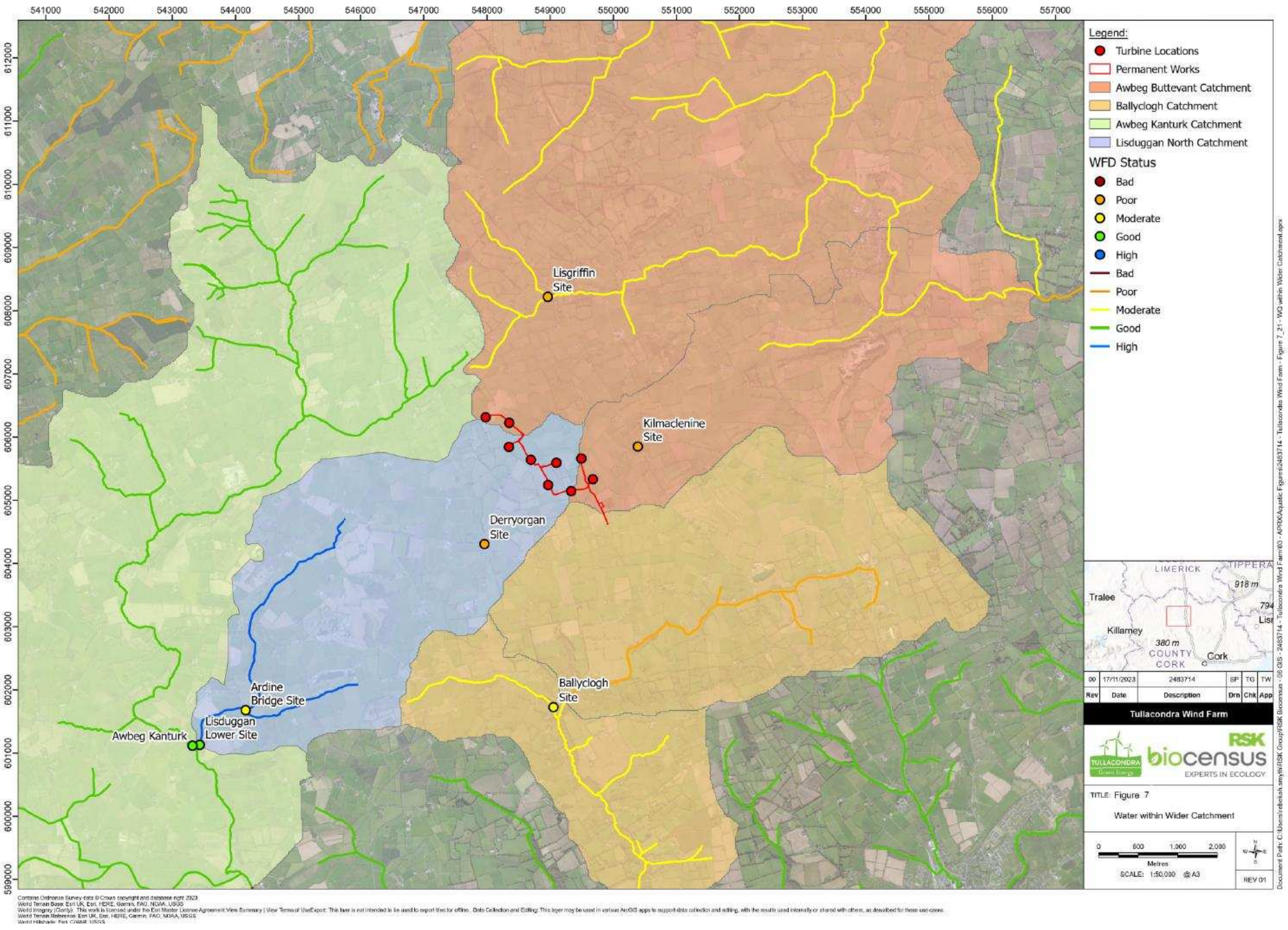

Figure 7: Water Within Wider Catchment

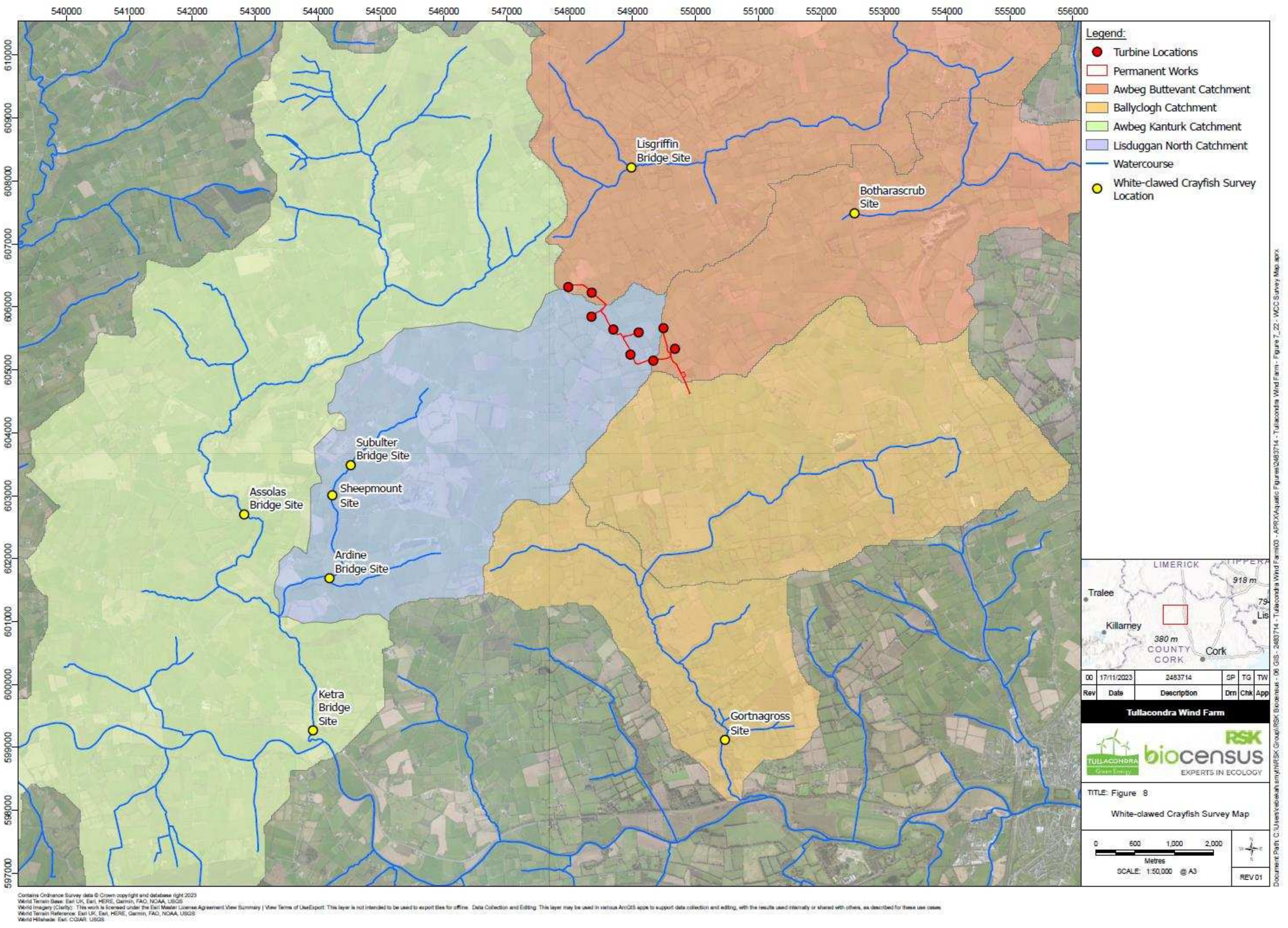

Figure 8: White-Clawed Crayfish Survey Map

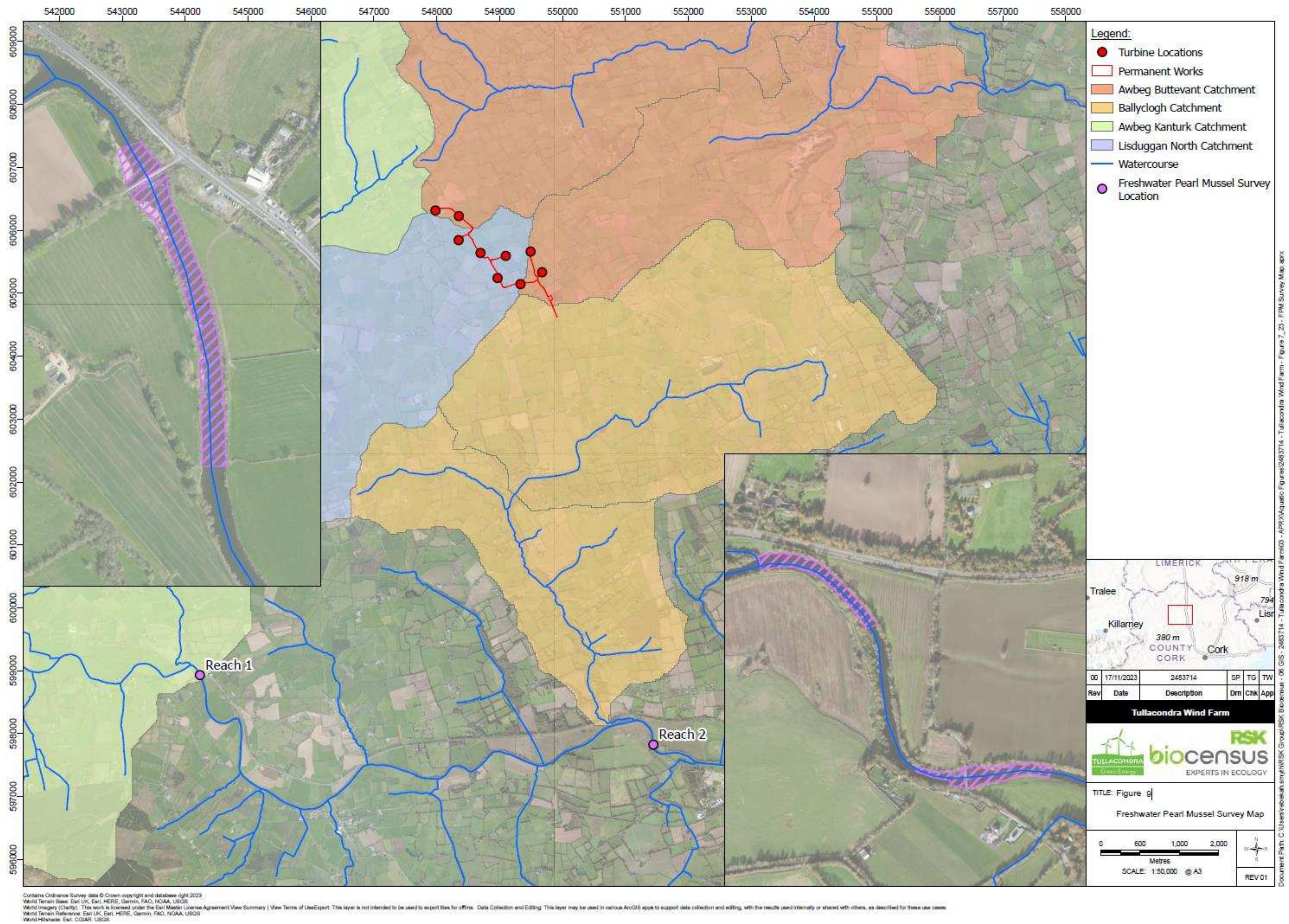

Figure 9: Freshwater pearl Mussel Survey Map

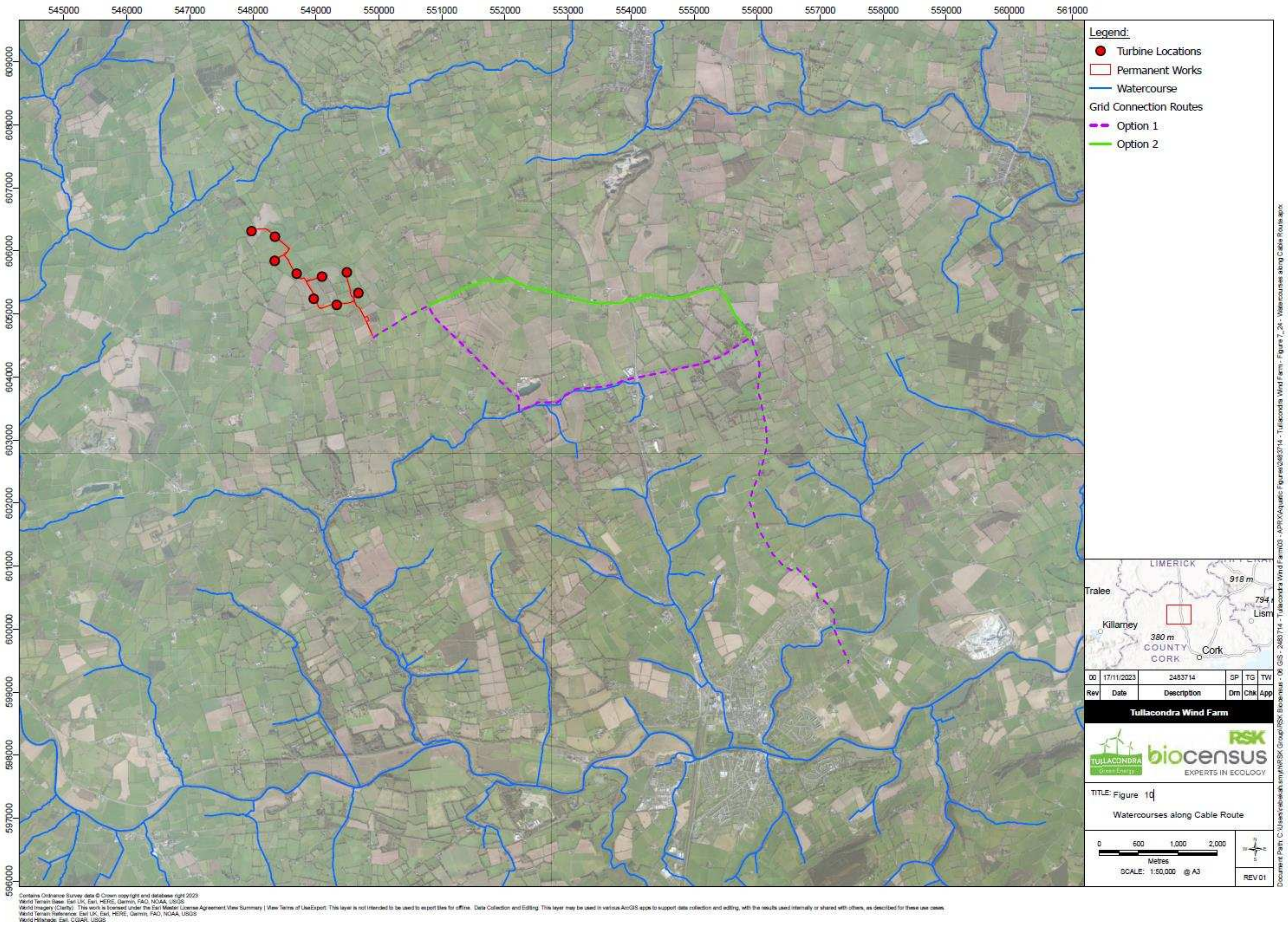

Figure 10: Watercourses along Cable Routes

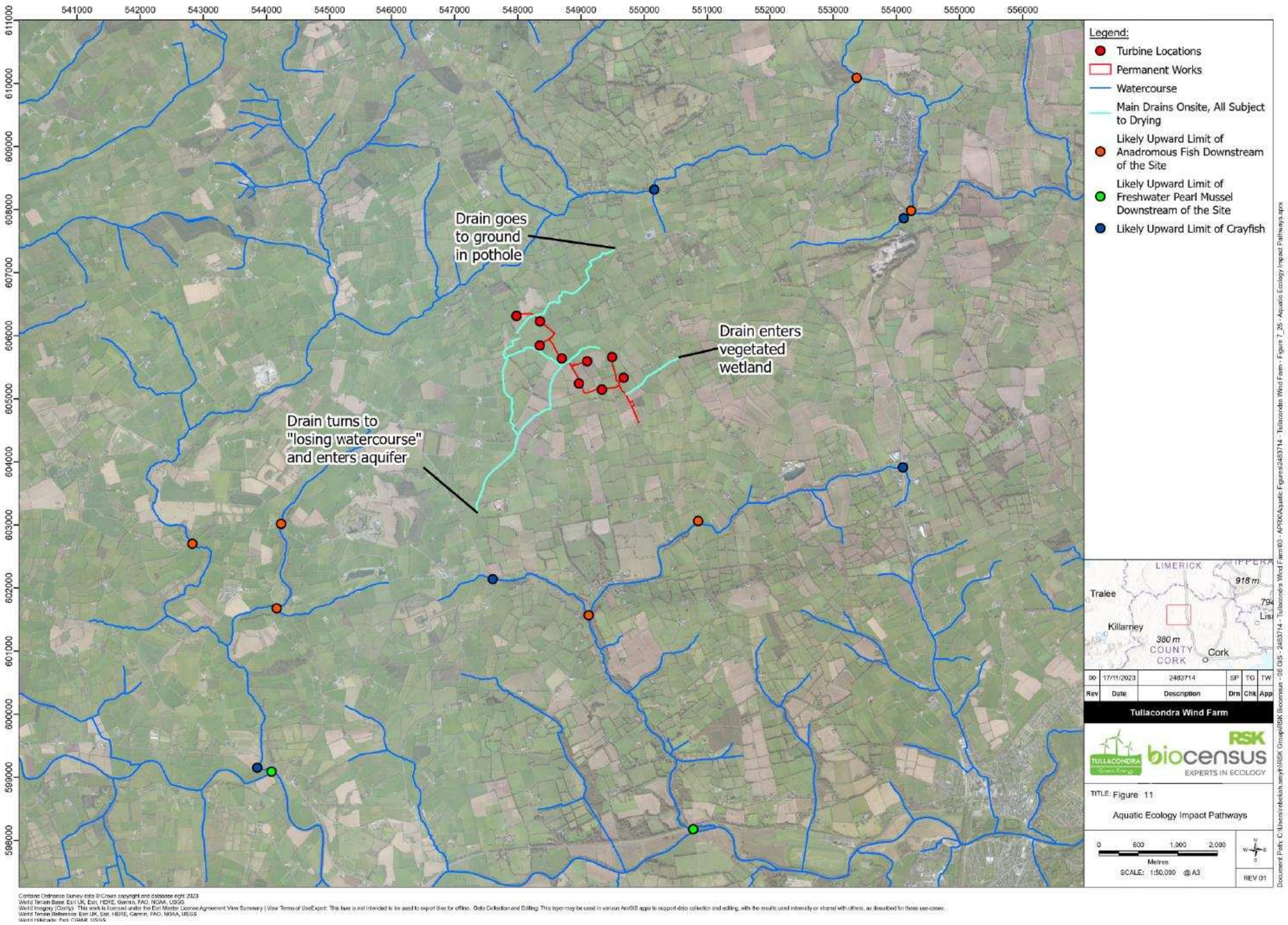

Figure 11: Aquatic Ecology Impact Pathways

ANNEX 1 PHOTOGRAPHS

Photograph 1. An empty FPM shell and a crayfish found beside each other in the Blackwater main channel

ANNEX 2 EXISTING PRESSURES ON WATERCOURSES

Agriculture

Agriculture is a significant pressure in 19 river waterbodies. Phosphorus loss to surface waters from, for example, direct discharges; or runoff from yards, roadways or other compacted surfaces, or runoff from poorly draining soils remains an issue since Cycle 2. High nitrates concentrations have been identified many in waterbodies across the catchment in Cycle 3, which has contributed to an increase in the number of waterbodies effected by nutrient pollution from agricultural sources. Sediment can also be a problem from land drainage works, bank erosion from animal access or stream crossings.

Other significant pressures:

Abstraction

Abstractions for Allow Regional public water supply was identified as significant pressure in two river waterbodies (Allow_050 & Allow_060) with altered habitat due to hydrological changes identified as the primary issue.

Historically Polluted Sites

There has been a history of elevated Ammonia concentrations from a historical landfill (S22-02773) in the upper reaches of the subcatchment and Funshion River and is likely to be a significant source of Ammonia in Gradoge_010.

Windfarm

The construction of a large windfarm in proximity to Blackwater (Munster)_010 river waterbody was identified as a source of sediment contributing to the decline in status of the waterbody since Cycle 2.

Unknown anthropogenic

The significant pressures impacting 10 river waterbodies three groundwater bodies (Ballinhassig East, Cappoquin Kiltorcan & Mitchelstown) are unknown.

Forestry

Forestry remains a significant pressure in 15 waterbodies (13 rivers and two groundwater bodies) in Cycle 3. The issues are a range of forestry activities taking place that include clearfelling and drainage, which have resulted in heavy siltation and excess nutrients in surface water bodies. Losses of sediment from access roads and during road construction; losses of nutrients during aerial fertilisation and impacts from public access were also identified in Cycle 2.

Hydromorphology

Hydromorphology is a significant pressure in nine river waterbodies. Channelisation is the dominant hydromorphology subcategory in the catchment with three river waterbodies (Awbeg (Buttevant)_030, Awbeg (Buttevant) (West)_020 & Clyda_010) within the catchment subject to extensive modification mainly due to drainage schemes. Land drainage, riverbank erosion, dams/barriers/ weirs and embankments are each impacting two river waterbodies. Land drainage was identified as the pressure subcategory in Allow_060 and Glenlara_010 river waterbodies impacting habitats due to hydrological and morphological changesin the rivers. Riverbank erosion in Awbeg (Buttevant)_030 and Blackwater (Munster)_060 are causing hydrological and morphological impacts. The completed flood scheme in Blackwater (Munster)_190 and the weir in Ballylough Stream_010 are potentially impacting the morphology within the rivers which in turn are having a negative impact on habitats. Embankments have been identified as the hydromorphological sub category impacting habitats in Blackwater (Munster)_090 and Owennashad_020 river waterbodies.

Urban waste water

Urban waste water agglomerations have been identified as a significant pressure in six At Risk river waterbodies including Kanturk on the Allow river and Buttevant on the Awbeg Buttevant.

Industry

Industry is considered a significant pressure in five river waterbodies and one groundwater body, Industrial Facility (P0404-01) in Cycle 3. These point source discharges, causing mainly nutrient and organic issues, arise from industrial discharges.

Urban run-off

Diffuse urban pressures, caused by misconnections, leaking sewers and runoff from paved and unpaved areas, have been identified as a significant pressure in five river waterbodies are impacted by Mitchelstown, Buttevant, Doneraile, Fermoy and Tallow urban areas. Nutrient and organic pollutions are the significant issues.

Domestic waste water

Domestic waste water has been identified as a significant pressure in two river waterbodies (Owenbaun (Rathcool)_020 & Blackwater (Munster)_160) and Ballinhassig East groundwater body. This is due to a concentration of domestic waste water treatment systems in close proximity to the waterbodies located on areas of high susceptibility to phosphate transport via near surface pathways and areas of high susceptibility to nitrate transport via sub-surface pathways. The significant issue is excess nutrients and ammonia entering surface waters.

Mines & Quarries

A quarry has been identified as a pressure in Blackwater (Munster)_220 due to excess sediment impacting on habitat morphology.

ANNEX 3 DESIGNATED SPECIES

Table 4. Relevant designated species.

Designated Species	Article 17 Pressures/Threats	Article 17 Pressures/Threats associated with the proposed wind energy development
Sea Lamprey	D02 Hydropower (dams, weirs, run-off-the-river), including infrastructure (H) N03 Increases or changes in precipitation due to climate change (H) A19 Application of natural fertilisers on agricultural land (M) A20 Application of synthetic (mineral) fertilisers on agricultural land (M) A31 Drainage for use as agricultural land (M) G01 Marine fish and shellfish harvesting (professional, recreational) causing reduction of species/prey populations (M) Xo Threats and pressures from outside the Member State (M)	None
Brook Lamprey	Brook A19 Application of natural fertilisers on agricultural land (M) A20 Application of synthetic (mineral) fertilisers on agricultural land (M) A31 Drainage for use as agricultural land (M) B09 Clear-cutting, removal of all trees (M) D02 Hydropower (dams, weirs, run-off-the-river), including infrastructure (M) F11 Pollution to surface or ground water due to urban runoffs (M) F12 Discharge of urban waste water (excluding storm overflows and/or urban run-offs) generating pollution to surface or ground water (M)	None
River lamprey	D02 Hydropower (dams, weirs, run-off-the-river), including infrastructure (H) N03 Increases or changes in precipitation due to climate change (H) A19 Application of natural fertilisers on agricultural land (M) A20 Application of synthetic (mineral) fertilisers on agricultural land (M) A31 Drainage for use as agricultural land (M) E03 Shipping lanes, ferry lanes and anchorage infrastructure (e.g. canalisation, dredging) (M)	None
Twaite shad	A19 Application of natural fertilisers on agricultural land (M) A20 Application of synthetic (mineral) fertilisers on agricultural land (M) D02 Hydropower (dams, weirs, run-off-the-river), including infrastructure (M) E03 Shipping lanes, ferry lanes and anchorage infrastructure (e.g. canalisation, dredging) (M) G01 Marine fish and shellfish harvesting (professional, recreational) causing reduction of species/prey populations (M) G06 Freshwater fish and shellfish harvesting (recreational) (M) G12 Bycatch and incidental killing (due to fishing and hunting activities) (M) I02 Other invasive alien species (other than species of Union concern) (M) N03 Increases or changes in precipitation due to climate	None

Designated Species	Article 17 Pressures/Threats	Article 17 Pressures/Threats associated with the proposed wind energy development
	change (M)	
Salmon	A26 Agricultural activities generating diffuse pollution to surface or ground waters (H) G19 Other impacts from marine aquaculture, including infrastructure (H) K05 Physical alteration of water bodies (H) J01 Mixed source pollution to surface and ground waters (limnic and terrestrial) (H) A25 Agricultural activities generating point source pollution to surface or ground waters (M) B23 Forestry activities generating pollution to surface or ground waters (M) D02 Hydropower (dams, weirs, run-off-the-river), including infrastructure (M) G11 Illegal harvesting, collecting and taking (M) G20 Abstraction of water, flow diversion, dams and other modifications of hydrological conditions for freshwater aquaculture (M) L06 Interspecific relations (competition, predation, parasitism, pathogens) (M)	J01 Mixed source pollution to surface and ground waters (limnic and terrestrial) (H)
Freshwater learl mussel	A31 Drainage for use as agricultural land (H) B27 Modification of hydrological conditions, or physical alteration of water bodies and drainage for forestry (including dams) (H) F31 Other modification of hydrological conditions for residential or recreational development (H) A26 Agricultural activities generating diffuse pollution to surface or ground waters (H) B23 Forestry activities generating pollution to surface or ground waters (H) F12 Discharge of urban waste water (excluding storm overflows and/or urban run-offs)generating pollution to surface or ground water (M) C05 Peat extraction (M) F28 Modification of flooding regimes, flood protection for residential or recreational development (M) D02 Hydropower (dams, weirs, run-off-the-river), including infrastructure (M) F33 Abstraction of ground and surface waters (including marine) for public water supply and recreational use (M)	Potentially: Modification of hydrological conditions, or physical alteration of water bodies and drainage for forestry (including dams) (H) And F31 Other modification of hydrological conditions for residential or recreational development (H)
Crayfish	I05 Plant and animal diseases, pathogens and pests (H) I01 Invasive alien species of Union concern (H)	None

ANNEX 4 LIST OF INVERTEBRATES FOR BIOLOGICAL WATER QUALITY ASSESSMENT

Table 5. Invertebrate List for Biological Water Quality Sampling.

Fauna	Pollution sensitivity group	Functional group	Kilmaclinine site	Derryorgan site	Ballyclough	Ardine Bridge site	Awebeg Kanturk confluence main	Lisduggan lower	Lisgriffin
MAYFLIES (Uniramia, Ephemeroptera)									
Family Heptagenidae									
Yellow may dun *Heptagenia sp.*	A	Scraper & gathering collector					few	few	
Yellow evening dun *Seratella sp*	C	Gathering collector				few	few	common	
Baetidae									
Large dark olive *Baetis rhodani*	C	Scraper & gathering collector			few		common	few	
Iron blue dun *Baetis muticus*	B	Scraper & gathering collector					few		
STONEFLIES (Order Plecoptera)									
Brown stoneflies (Nemouridae)									
Amphinemoura sp.	A	Shredder							few
CASED CADDIS FLIES (Tricoptera)									
Northern caddisflies (Limnephilidae)	B	Shredder							

Fauna	Pollution sensitivity group	Functional group	Kilmaclinine site	Derryorgan site	Ballyclough	Ardine Bridge site	Awebeg Kanturk confluence main	Lisduggan lower	Lisgriffin
Limnephilus flavicornis	B	Shredder		few	common		common	few	common
Cinnamon sedge *Limnephilus lunatus*	B	Shredder		few		few	few	few	few
Glossosomatidae									
Little black caddisfly *Agapetus fuscipes*	B	Scraper			few	dominant		dominant	
Family Goeridae									
Goera pilosa	B	Scraper					few		
CASELESS CADDIS FLIES (Trichoptera)									
Grey flags (Hydropsychidae)									
Hydropsyche siltalai	C	Filtering collector			common		common		
Green sedges (Rhyacophilidae)									
The sandfly *Rhyacophila dorsalis*	C	Predator					few	common	
Trumpet-net caddisflies (Polycentropodidae)									
Polycentropus sp.	C	Filtering collector	common				few	few	
TRUE FLIES (Diptera)									
Blackfly (Simulidae)									
Simulium sp.	C	Filtering collector		common	common	common	common	few	numerous
Craneflies (Tipulidae)	C	Shredder	few			few			

Fauna	Pollution sensitivity group	Functional group	Kilmaclinine site	Derryorgan site	Ballyclough	Ardine Bridge site	Awebeg Kanturk confluence main	Lisduggan lower	Lisgriffin
Family Chironomidae									
Bloodworm *Chironomous sp*.	E	Filtering collector	common	numerous					
Green chironomid	C	Filtering collector	few					few	
BEETLES (Coleoptera)									
Diving beetles (Dytiscidae)				few					
Riffle Beetle (Elmidae)									
Elmis sp.	C	Predator			common			few	
SNAILS (Mollusca, Gastropoda)									
Family Lymnaeidae									
Ramshorn *Planorbis planorbis*	C	Scraper	few	few				few	few
Family Hydrobiidae									
Jenkin's spire shell *Potamopyrgus antipodarium*	C	Scraper			few				
Family Physidae									
Bladder Snail *Physa fontinalis*	D	Shredder		few					few
Family Ancylidae									
River limpet *Ancylus fluviatilis*	C	Scraper					few		
MUSSELS (Mollucsa, Bivalva)									

Fauna	Pollution sensitivity group	Functional group	Kilmaclinine site	Derryorgan site	Ballyclough	Ardine Bridge site	Awebeg Kanturk confluence main	Lisduggan lower	Lisgriffin
Orb/Pea Mussels (Sphaeridae)	D	Filtering collector							
Pisidium sp.	D	Filtering collector		few					
CRUSTACEANS (Crustacea)									
Amphipods (Amphipoda, Gammaridae)									
Freshwater shrimp *Gammarus duebeni*	C	Shredder			common	common	common	common	common
Isopods, Asellidae									
Asellus aquaticus	D	Shredder	numerous			few	few	few	numerous
LEECHES (Hirudinae)									
Erpobdellidae	D					few	few		few
SPIDERS (Crustacea, Arachnida)									
Water mite (Order Hydracarina)	C	Predator		few			few		
SEGMENTED WORMS (Annelida, Clitellata)									
Aquatic earthworm (Lumbricidae)	D	Gathering collector	few	few	few	few	few	few	few
Q-rating			Q2-3	Q3	Q3-4	Q3-4	Q4	Q4	Q3
Corresponding WFD Status			Poor	Poor	Poor	Poor	Good	Good	Poor

EIAR VOLUME III
Appendices

CHAPTER 7 – BIODIVERSITY

Appendix 7.3: Habitat and Species Management Plan

Tullacondra Green Energy Limited.

Appendix 7.3 – Habitat Management Plan

Tullacondra Green Energy Project

604162

FEBRUARY 2024

RSK GENERAL NOTES

Project No.: 604162

Title: Appendix 7.3 - Habitat Management Plan

Client: Tullacondra Green Energy Limited

Date: 26 February 2024

Office: Dublin

Status: Rev00

Authors	Ellis Perry and Thomas Webb	**Technical reviewer**	Nick Henson
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Date:	19/02/2024	Date:	26/02/2024
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Signature		Signature	
Date:	26/02/2024	Date:	26/02/2024

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1 INTRODUCTION

1.1 Purpose of this report

This report presents the proposals for biodiversity offsetting and enhancement in the form a Habitat Management Plan (HMP) for the proposed Tullacondra Green Energy Project (hereafter referred to as 'the Project'). This report forms a technical appendix to Chapters 7 and 8 of the Environmental Impact Assessment Report (EIAR) for the Project, which were produced by RSK on behalf of Tullacondra Green Energy Limited.

This HMP has been guided by the various ecological surveys carried out by RSK and is intended to build on the information contained within the EIAR. The measures contained in the HMP uphold the principle of providing a net gain for biodiversity at the local level. This HMP includes:

- Details of the current condition and status of the wind farm site and outlines those features that are of ecological interest.
- Identifies specific objectives and measurable targets relating to the management of the wind farm site to maintain and enhance its wildlife interest.
- Lists those activities which will be undertaken to manage the land to achieve the objectives and targets.
- Outlines the mechanisms to monitor progress and plan reviews to ensure the management plan remains up-to-date and relevant throughout its duration.

It is proposed that this is a working document which will evolve following discussions between the developer, the landowners, the Ecological Clerk of Works (ECoW) and organisations with responsibility for and an interest in key wildlife species, including Cork County Council.

This document should be read in conjunction with the following figures:

- Figure 1 – Phase 1 Habitat Map
- Figure 2 – Biodiversity Enhancements with permanent Works.

1.2 Project background

The Project includes the construction, operation and decommissioning of a wind energy development consisting of nine wind turbines with foundations and crane pad hardstanding areas; a permanent meteorological mast; an on-site 38kV substation, underground cabling connecting the turbines to the on-site substation; and underground grid connection to the boundary of the Mallow 110kV substation; along with all associated site works including site clearance, temporary compounds and storage areas; a new temporary entrance and upgrade of an existing entrance; upgrade of existing site tracks and construction of new site tracks; site drainage; and ancillary developments including security gates and fencing, lighting and signage; and biodiversity mitigations and enhancements.

RSK have a comprehensive understanding of the ecological conditions on the wind farm site following a suite of surveys conducted between 2020 and 2023, with further details provided in Volume II Chapters 7 and 8 (Biodiversity and Ornithology) of the EIAR. The baseline surveys and subsequent ecological impact assessments identified the presence of a small number of ecologically sensitive features which are of material consideration to the Project.

Current Irish legislation requires developments to consider the impacts of the Project to any protected and priority ecological features identified during the baseline surveys. It was identified that to adhere to such obligations, a detailed habitat management plan will be required, which will detail offsetting and enhancement measures to reduce the overall ecological impact of the Project and contribute towards a net gain for biodiversity.

2 SITE DESCRIPTION

2.1 Site overview

The proposed wind farm (hereafter referred to as ‘the wind farm site’) is located approximately 2km south of Lisgriffin Cross, Co. Cork. The wind farm site is rural in nature, with land cover predominantly comprising mixed agricultural land interspersed with rural settlements. The wind farm site is in a dry location with elevation ranging from approximately 120 -130 metres (m) Above Ordnance Datum (AOD) across the wind farm site.

In the context of this report, the wind farm site comprises the redline boundary of the Project where the proposed development will be located, as well as the wider landholding (blue line boundary) where proposals for habitat creation and enhancements are made. The redline and blue line boundaries to which this report relates are indicated, as relevant, on the figures referenced above in Section 1.1.

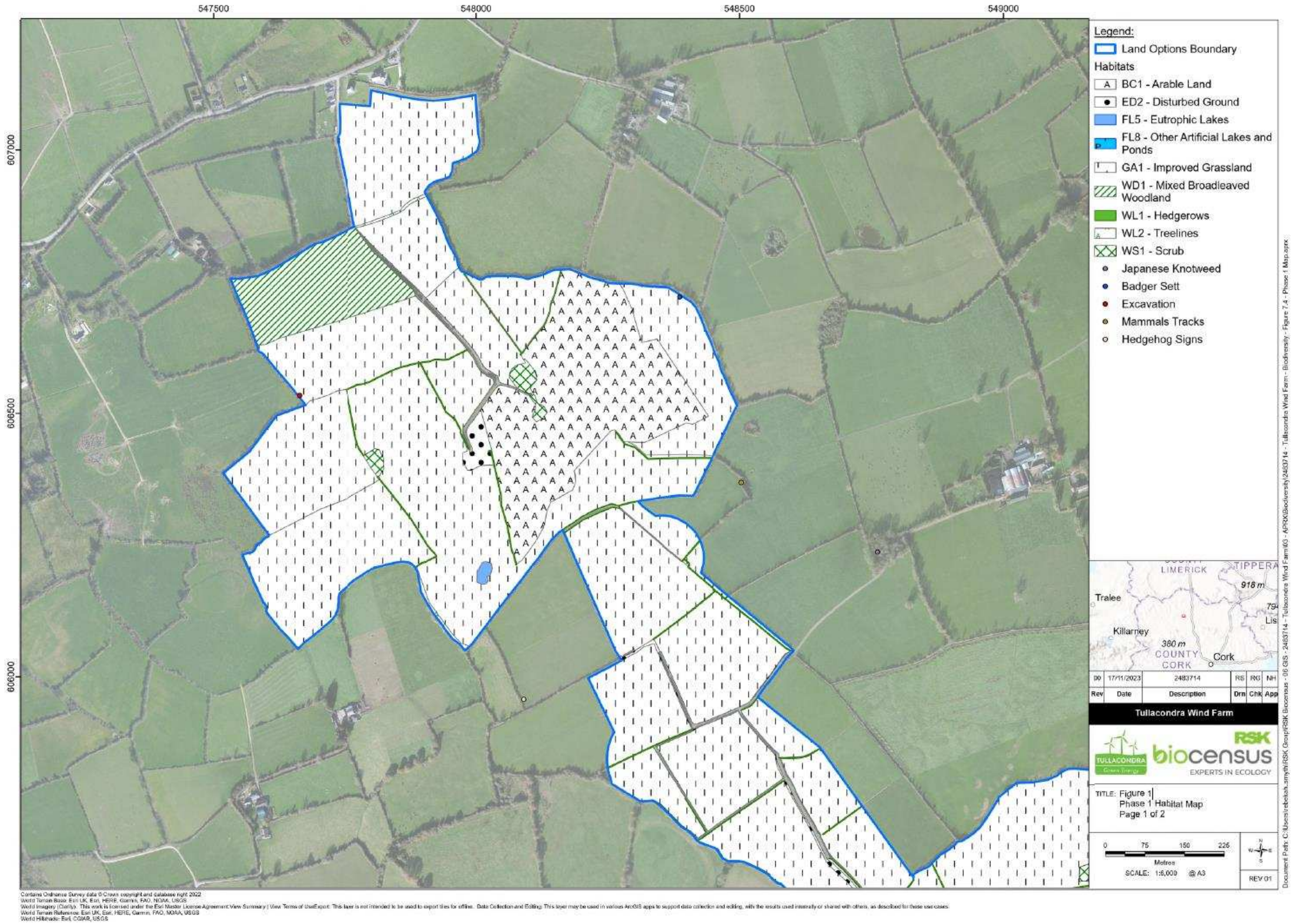
2.2 Designated and non-designated sites

Internationally designated sites (i.e., Natura 2000 sites) sites within the Zone of Influence (ZoI) of this Project, such as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) have been identified as part of the Environmental Impact Assessment. A separate Natura Impact Statement (NIS) has been prepared to appraise the potential impacts on these sites and specify mitigation measures to avoid any likely significant effect on the integrity of such sites.

Designated sites identified comprised two SACs and one SPA. A further seven non-statutory designated sites classified as Proposed Natural Heritage Areas (pNHA) were also recorded. However, the nearest statutory and non-statutory designated site is over 6.2km from the wind farm site and, as noted in the EIAR, the Project is unlikely to significantly adversely affect any designated sites due, in part, to the significant distances from the wind farm site and the lack of sufficient impact pathways between them.

2.3 Habitats

The wind farm site (i.e., blue line boundary area) is comprised predominantly of modified habitat types associated with intensive farming systems and includes improved agricultural grassland, tilled earth, and arable land, although semi-natural habitat such as hedgerows and treelines, emerging scrub and wet grassland habitat occur to a lesser extent (see Figure 1). Treelines and hedgerows run along field boundaries around the majority of the wind farm site but have been predominantly intensively managed. In total, 12 habitat types were identified (see Table 1), as categorised by Fossitt (2000). One Annex 1 priority habitat (Residual alluvial woodland) was identified during the desk study within 4.8km of the wind farm site boundary. However, none of the habitat types identified within the wind farm site were Annex 1 and no habitats exceeded ‘Local (Higher value)’ importance as ecological features in the EIAR Biodiversity chapter (Volume II Chapter 7 - Biodiversity).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Land Options Boundary
Habitats
BC1 - Arable Land
ED2 - Disturbed Ground
FL5 - Eutrophic Lakes
FL8 - Other Artificial Lakes and Ponds
GA1 - Improved Grassland
WD1 - Mixed Broadleaved Woodland
WL1 - Hedgerows
WL2 - Treelines
WS1 - Scrub
Japanese Knotweed
Badger Sett
Excavation
Mammals Tracks
Hedgehog Signs
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Phase 1 Habitat Map
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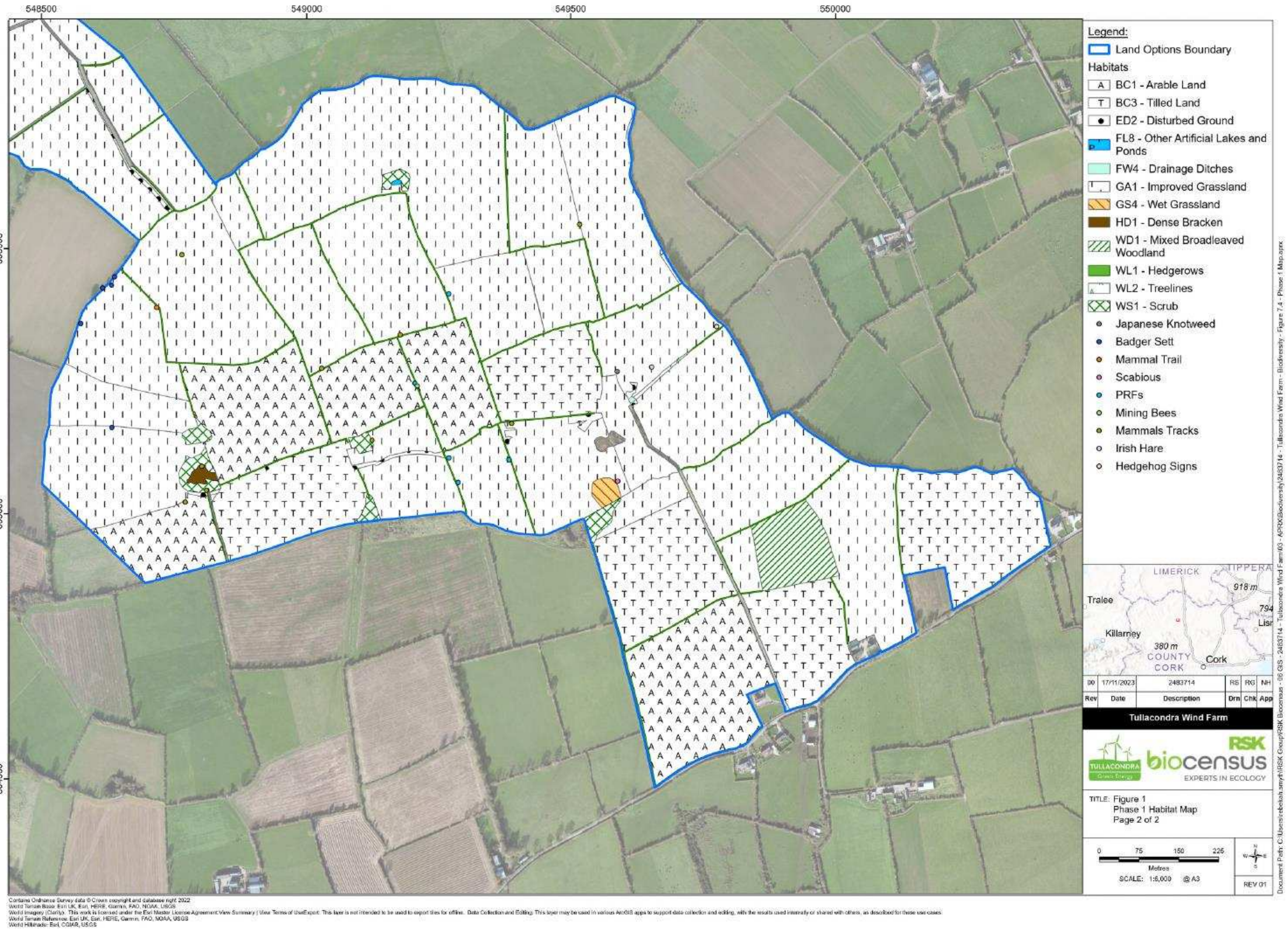


Figure 1: Phase 1 Habitat Map

Table 1. Habitat types on site and their ecological valuation.

Habitat code	Habitat type	Extent (Ha)	Ecological valuation
BC1	Arable Land	29.07	Negligible
BC3	Tilled Land	20.41	Negligible
BL3	Buildings and Artificial Surfaces	0.45	Negligible
ED2	Disturbed Ground – informal farm lanes	0.97	Local importance (higher value)
	Disturbed Ground – cattle rubs		
FL5	Eutrophic Lakes	0.09	Local importance (higher value)
FL8	Artificial Lakes and Ponds	0.01	Local importance (higher value)
FW4	Drainage Ditches	0.01	Local importance (higher value)
GA1	Improved Agricultural Grassland	135.90	Local importance (lower value)
GS4	Wet Grassland	0.23	Local importance (higher value)
HD1	Dense Bracken	0.13	Local importance (lower value)
WL1	Hedgerow	14.4 (km)	Local importance (higher value)
WL2	Treelines	598 (m)	Local importance (higher value)
WS1	Scrub	1.52	Local importance (higher value)
WD1	Mixed Broadleaved Woodland	6.02	Local importance (higher value)

These habitats are linked to varying degrees, both within and beyond the wind farm site. The ditches running throughout the field boundaries of the wind farm site provide connectivity with the wider hydrological network, and also with the terrestrial habitats they intersect and abut. Similarly, the network of hedgerows, treelines, and woodland edge also ultimately connect all habitats present onsite, and those in the wider landscape.

Descriptions of the habitats present within the wind farm site are provided in the EIAR Biodiversity chapter (Volume II Chapter 7 – Biodiversity).

2.3.1 Invasive non-native species

Japanese knotweed was identified in two locations on wind farm site (see Figure 1). The first location occurs throughout an entire field boundary northeast of farm sheds to the west of Turbine 9, and the second stand was identified in a field adjacent to an area of woodland within the southern part of the wind farm site near to the proposed substation location. It was also recorded at Boherash Cross on TDR Option 1 and near to the turn off after Mallow Hospital on TDR Option 2. A further five non-native plants were recorded from the desk study within 10km of the wind farm site: black currant (*Ribes nigrum*), cherry laurel (*Prunus laurocerasus*), Indian balsalm (*Impatiens glandulifera*), sycamore and rhododendron (*Rhodendron ponticum*). These species were not however noted as being present on the wind farm site.

2.4 Fauna

2.4.1 Invertebrates

Two red-listed invertebrate species were recorded during ecological surveys on the wind farm site: the red-tailed bumblebee (*Bombus lapidaries*) and the buff mining bee (listed as near threatened and vulnerable respectively on the Irish Red List). Both species appeared to utilise the available habitat with the red-tailed bumble bee foraging along hedgerows and buff mining bee recorded on cattle rubs. The habitats available on site and existing invertebrate species recorded during the surveys provides indication of a significant opportunity for further enhancement measures.

2.4.2 Amphibians

Evidence of amphibians was identified during ecological surveys on site that confirm the presence of smooth newt and common frog within the existing ponds. However, the unconnected ponds, field margins and wet grassland habitats on site lack the parcel size and connectivity to support notable populations of amphibians. Improving the condition of the habitat for amphibians will provide opportunities for population expansion and colonisation of amphibians into additional areas on site.

2.4.3 Reptiles

No evidence of reptiles was recorded during ecological surveys. The habitats on site are composed of open arable farmland with suitable habitat restricted to field margins and hedgerows, which lacks in extent and quality. The wind farm site is unlikely to support notable populations, but measures outlined within the management plan are likely to provide further suitable habitat that may potentially increase the opportunities for colonisation of the wind farm site.

2.4.4 Bats

The ecological desk study returned five species of bats within 10km of the wind farm site of which the majority were common species e.g., common pipistrelle (*Pipistrellus pipistrellus*), Daubenton's bat (*Myotis daubentonii*) and Leisler's bat (*Nyctalusn leisleri*). The closest records of which were common pipistrelle and soprano pipistrelle (*Pipistrellus pygmaeus*) recorded 2.3km from the wind farm site. The lack of records in close proximity could be due to the rural nature of the wind farm site but may also be attributed to the lack of voluntary bat groups in the area and lack of associated survey effort. Bat Conservation Ireland (BCI) landscape modelling identified the northern section of the wind farm site, where turbines are proposed had lower suitability for bats than the southern section.

Roost assessments recorded 49 trees and seven built structures with potential for bats; however, many were a significant distance from the Project so were able to be scoped out of impacts. However, one such building within 160m south-west of Turbine 9 recorded a brown-long eared bat (*Plecotus auritus*) transition roost. Due to the nature of the Project, available suitable habitat, and likely impact to bats across the wind farm site, further enhancement measures will be undertaken to ensure the wind farm site does not significantly impact bats and provides replacement habitat. Spatial distribution of enhancement measures will be carefully considered to limit the potential of collision risk.

2.4.5 Badgers

The desk study returned records of European badger (*Meles meles*) within 10km of the wind farm site boundaries, with a number of badger setts along with mammal paths recorded during surveys undertaken by RSK around the periphery areas of the wind farm site within suitable improved grassland and hedgerow habitat. Habitat potential for badgers will be considered further within the management plan strategies, with the aim of improving foraging areas for the species and enhancing connectivity between areas of more suitable habitat.

2.4.6 Birds

As mentioned in Section 2.2 there are multiple internationally designated sites, of which Kilcolman Bog SPA is of ornithological interest. Kilcolman Bog is designated due to its internationally important populations of shoveler (*Spatula clypeata*), teal (*Anas crecca*) and whooper swan (*Cygnus cygnus*). The desk study returned records of notable bird species including 12 species of conservation concern; common kestrel (*Falco tinnunculus*) and yellowhammer (*Emberiza citronella*) were the only two 'Red Listed' species.

Surveys between 2020-2023 recorded a total of 54 species during breeding bird surveys and 56 species during wintering bird surveys. Certain species which are particularly sensitive to the proposed development plans, are of conservation concern, and qualifying interest species for ornithological statutory designated sites were designated as target species. There were 11 and 13 target species recorded during the breeding and wintering bird surveys respectively. Many of these species were recorded in low numbers or didn't appear to use the wind farm site. Only a small number were notable target species including kestrel, buzzard (*Buteo buteo*), peregrine falcon (*Falco peregrinus*) and golden plover (*Pluvialis apricaria*). However, none of the populations of target species within the wind farm site were considered of international or national importance and instead were considered to be of Local (Higher value) importance. Ornithological features are considered for further enhancement measures within this management plan.

2.4.7 Otter

The desk study returned ten records of European otter (*Lutra lutra*) within 10km of the wind farm site boundaries. However, during the ecological surveys on site no evidence of otters was identified. Furthermore, the habitat recorded during the initial Phase 1 habitat survey provides limited opportunity to support otters. Potentially suitable waterbodies were isolated from the wind farm site or unsubstantial with all being unsuitable to support otter populations. The limited opportunity for otters, with no significant watercourses present within the wind farm site, indicates that potential enhancement within the wind farm site would have little benefit for riparian mammals, as so otters are not considered further within this management plan.

2.4.8 Other mammals (species of principal importance)

The desk study recorded five records of hedgehog (*Erinaceus europaeus*) and a number of records of other terrestrial mammals including red squirrel (*Sciurus vulgaris*) and pygmy shrew (*Sorex minutus*) with 10km of the wind farm site. Desk study records and presence of suitable habitat within the wind farm site including woodland, field margins and grassland habitat means that these priority mammal species will be taken into consideration within the enhancement recommendations of this management plan.

2.5 Animal-aided design

The concept of 'animal-aided design' (AAD) has been incorporated during the production of this HMP (Weisser and Hauck, 2017). AAD integrates conservation into design by the use of specific receptor species in environments which are targeted within the development proposal. The life stages of target species are incorporated into the initial design of the Project to provide enhancement of target species within the wind farm site. Typically, these species are of certain conservation concern, at risk from the Project or allow other species to thrive. Despite the application of the AAD model being primarily in urban habitats, there is potential for adaption of this approach to a rural environment.

From the established baseline conditions and published documentation, three species were chosen as target species for AAD for the Project (Table 2). This concept has been adapted for the design of enhancement measures for the Project, with target species fact sheets annexed to this report (see Annex A). These provide background information on the ecology, lifecycle requirements, as well as the impacts and benefits associated with the Project for those target species.

Table 2. Target species.

Common name	Species name	Ecological valuation	Target justification
Common pipistrelle	*Pipistrellus pipistrellus*	Local (Higher value)	Recorded on site at local level of importance during transect and static surveys. Grassland, woodland, scrub, hedgerows and arable farmland on site is suitable for common pipistrelle. Enhancement measures will benefit this species as well as provide opportunities for other bat species.
Buff mining bee	*Andrena nigroaenea*	Local (Higher value)	Recorded on site and is a vulnerable species according to the Irish Red List. Grassland and arable farmland habitat on site is suitable for the mining bees but enhancement measures could be made to ensure the life stages of the buff mining bee are maintained. The development is also likely to result in habitat loss and disturbance / displacement effects.

Common name	Species name	Ecological valuation	Target justification
Yellowhammer	*Emberiza citrinella*	Local (Higher value)	Recorded on site at a local level of importance, red listed and Annex I species. Grassland, hedgerows and arable farmland on site is suitable for yellowhammer, and enhancement measures will benefit this species as well as provide opportunities for other wintering and breeding farmland birds e.g. Skylark (*Alauda arvensis*).

3 MANAGEMENT OBJECTIVES

Following a review of the habitats and species identified during ecological surveys as well as the assessments made from Volume II Chapter 7 and 8 (Biodiversity and Ornithology) of the EIAR, 11 measures have been identified to provide ecological mitigation and enhancements for biodiversity. These were recognised as being capable of achieving considerable enhancements to biodiversity in the local area, whilst also being sufficiently pragmatic that onerous maintenance, management and monitoring regimes will not be required to ensure their success. Objectives and targets are set for each measure to quantify the success of the enhancements. Details for each measure are included in Table 3.

Measures chosen for enhancement are:

- Woodland planting and enhancement
- Dry meadow creation
- Wet grassland management
- Hedgerow and tree planting and enhancement
- Field margin development
- Scrub planting and enhancement
- Pond enhancement
- Species shelter habitat creation
- Invasive non-native species (INNS) management
- Bat mitigation.

Table 3. Management objectives and targets

Feature	Objective	Measurable targets
Woodland planting and enhancement	Establish and enhance new areas of woodland on site for the benefit of birds, bats, invertebrates, and non-volant mammals.	Creation of a minimum 1.04ha of woodland habitat.
		Establish a management and monitoring programme to ensure effective establishment.
Meadow creation	To convert the existing GA1 Improved Grassland into GS2 Dry Meadow, improving biodiversity value of the enhancement area for invertebrates, birds, and mammals.	Creation of at least 7.24ha of dry meadow grassland habitat within the wind farm site.
		Establish a management and monitoring programme to determine effective establishment.
Wet grassland management	To enhance and create biodiverse Wet Grassland (GS4) within the context of available habitat for the benefit of invertebrate and botanical species.	Ensure the enhancement and creation of 0.74ha of wet grassland.
		Establish a management and monitoring programme to ensure effective establishment.

Feature	Objective	Measurable targets
Hedgerow planting and enhancement	To improve the condition of existing hedgerows and increase the extent of high-quality hedgerows within the wind farm site, for the benefit of bats, birds, invertebrates, and non-volant mammals	Creation of at least 2.89km of hedgerow habitat.
		Enhancement of at least 1.04km of low-quality hedgerow within the wind farm site through a coppicing and planting regime.
		Establish a management and monitoring programme to ensure effective establishment.
Field margin development	To establish and develop field margins for the benefit of invertebrates, birds, and reptiles.	Creation of at least 282m of field margin habitat.
		Establish a management and monitoring programme to ensure effective establishment.
Scrub enhancement	To enhance scrub habitat by increasing species and structural diversity and controlling bracken.	Enhance the existing scrub habitat within the northern and southern parts of the wind farm site.
		Control bracken within the enhancement areas.
		Establish a management and monitoring programme to ensure effective establishment.
Pond enhancement	To increase the quality and extent of pond habitat on site for the benefit of amphibians, invertebrates, birds, bats, reptiles, and non-volant mammals.	Reduce eutrophication and increase species diversity of existing ponds.
		Establish a management and monitoring programme to ensure effective establishment.
Species shelter habitat creation	To increase the extent and availability of shelter habitat for a number of species, including bees, birds, bats, non-volant mammals, reptiles, and amphibians.	Construct at least two bee banks and four bee poles to provide additional nesting opportunities for mining bees.
		Erect at least ten bird boxes and 10 bat boxes in suitable retained habitats to provide additional nesting/roosting opportunities and shelter for various species of birds and bats.

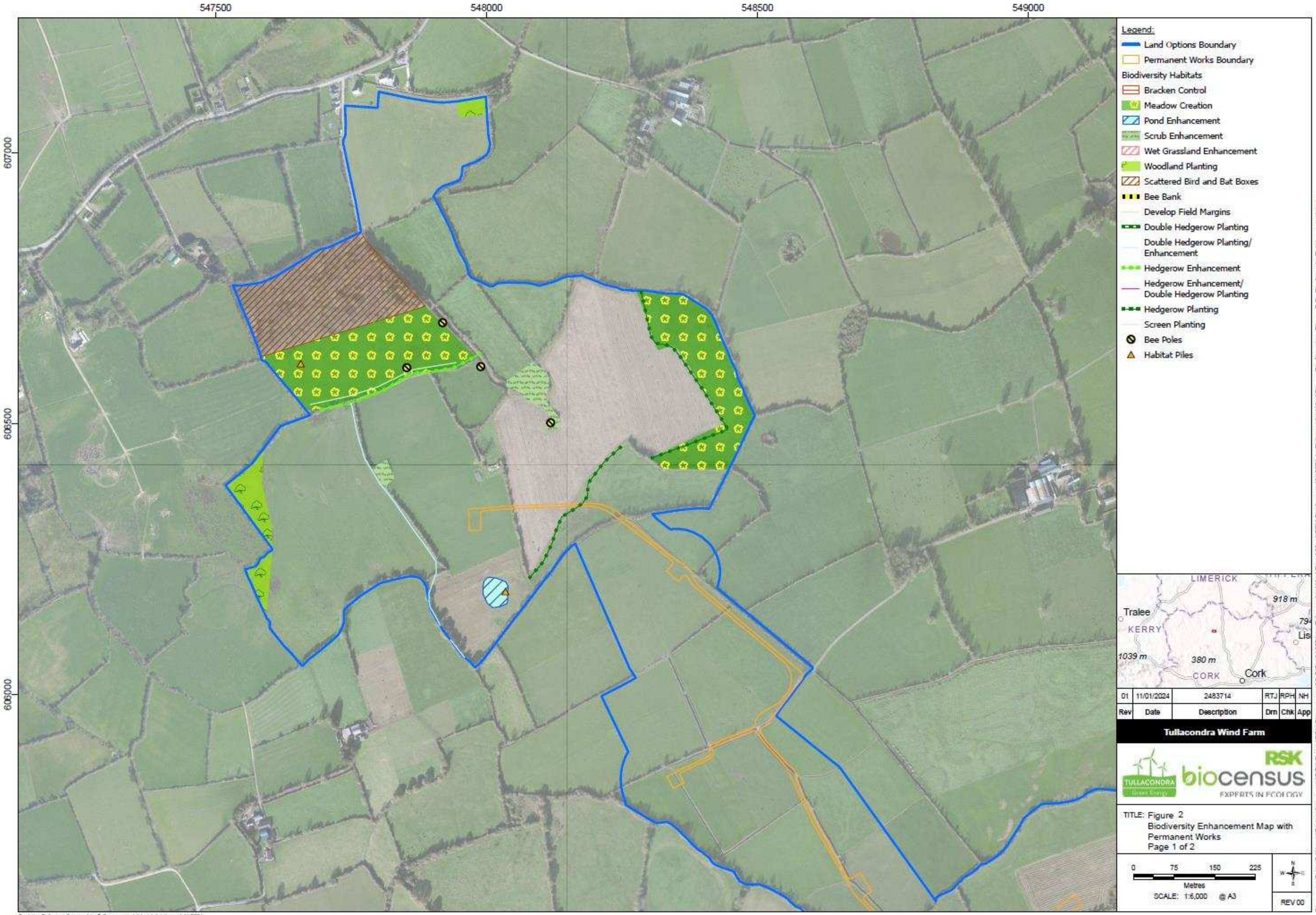
Feature	Objective	Measurable targets
		Construct at least seven habitat piles to provide additional shelter for amphibians, hedgehogs, invertebrates, and other species.
		Designation of a monitoring programme to determine success.
INNS Management	To identify existing areas of invasive species and to remove and control their presence.	To remove and control the extent of invasive species on site.
		Establish a management and monitoring programme to ensure effective control.
Bat mitigation management	To control and prevent mortality of bats through collision with turbines	Develop a feathering and curtailment strategy that is agreed with relevant stakeholders (i.e. Cork County Council).
		Establish a monitoring regime for bat activity and fatalities to inform the mitigation strategies.

As a result of the mitigation and enhancement measures proposed above, and further detailed within this management plan, effective management will lead to the provision of a net gain for biodiversity. More habitat will be created and enhanced than those that will be impacted as part of the Project proposals (refer to Volume II Chapter 7 (Biodiversity) of the EIAR). Creating further diversity and quality of habitats within the wind farm site will increase heterogeneity leading to increased suitability for a greater number of species. Table 4 details the extent of habitat creation and enhancement proposed, as described within this management plan and shown on Figure 2.

Table 4. Habitat creation and enhancement figures.

Habitat type/feature	Area (ha)
Bracken control	0.15
Meadow creation	7.21
Pond enhancement	0.38
Scrub enhancement	0.97
Wet grassland enhancement	0.74
Woodland planting	1.04
Total	**10.49**

Habitat type/feature	Length (m)
Bee bank	89
Field margin development	282
Hedgerow planting	2,911
Hedgerow enhancement	1,046
Screen planting	135
Total	**4,463**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Permanent Works Boundary
Biodiversity Habitats
Bracken Control
Meadow Creation
Pond Enhancement
Scrub Enhancement
Wet Grassland Enhancement
Woodland Planting
Scattered Bird and Bat Boxes
Bee Bank
Develop Field Margins
Double Hedgerow Planting
Double Hedgerow Planting/ Enhancement
Hedgerow Enhancement
Hedgerow Enhancement/ Double Hedgerow Planting
Hedgerow Planting
Screen Planting
Bee Poles
Habitat Piles
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Figure 2: Biodiversity Enhancements Map with Permanent Works

4 MANAGEMENT PRESCRIPTIONS

4.1 Feature 1: Woodland planting and enhancement

Across Ireland the management of woodland has been largely semi-natural and for the production of timber, which typically provides limited opportunity for biodiversity. Woodland habitat within the wind farm site is composed of mixed broadleaved woodland (WD1). Altering the management and extent of this existing woodland will greatly increase the biodiversity value of this habitat. Therefore, planting will be undertaken in the north-eastern and western extent of the wind farm site to provide more opportunities for species such as badger, hedgehog, bats, and woodland bird species, which were all recorded as being present locally during the baseline assessments for the Project.

4.1.1 Planting

Woodland planting will follow best practice guidance (The Woodland Trust, 2022a, 2022b, Cross & Collins, 2017 and Cross & Lynn, 2012). It is recommended that for successful woodland development the desired composition of species and structure should be considered. This will be achieved through naturalised development where the existing seed bank is rich with tree species. Where regeneration isn't achievable, tree planting will supplement or create woodland habitat. To determine the viability of the habitat, an initial soil test will be undertaken to evaluate the soil conditions as well as the potential for natural regeneration to occur. Such tests will determine an appropriate species mix of trees and shrubs where planting is required. The enhancement sites are currently within areas of arable fields and will be highly enriched, which may prevent tree establishment due to the proliferation of undesirable competitive species including common nettle (*Urtica dioica*), bramble (*Rubus sps.*), or cleavers (*Gallium aparine*). Prior to planting, soil management, wherever necessary, will take place and involve the process of mulching, herbicide treatment, soil inversion or cover crops, helping to improve soil conditions. Fertility reduction measures will facilitate the proliferation of annual wildflowers during the woodland growth improving the available seedbank for open woodland areas.

The efficacy of woodland enhancement depends on a variety of factors, one such factor is species selection. If possible, locally resourced juvenile trees or seeds of desired native species will be implemented into the planting regime. Locally resourced tree saplings will have a natural resistance to local factors in periods of environmental strain. If locally resourced saplings cannot be feasibly sourced, then an indicative species mix of appropriate native tree and shrub species will be included, as described in Table 5.

Table 5. Common tree and shrub species of the Republic of Ireland (Cross, 2012).

Common name	Species name	Type
Pedunculate oak	*Quercus robur*	Tree
Downy birch	*Betula pubescenens*	Tree
Ash	*Fraxinus excelsior*	Tree
Hazel	*Corylus avellana*	Tree & shrub

Common name	Species name	Type
Silver birch	*Betula pendula*	Tree
Aspen	*Populus tremula*	Tree
Alder	*Sambucus nigra*	Tree
Hawthorn	*Crataegus monogyna*	Tree & shrub
Blackthorn	*Prunus spinosa*	Shrub
Holly	*Ilex aquifolium*	Shrub
Spindle	*Euonymous europaeous*	Tree & shrub

Environmental conditions of the habitat need to be considered to improve habitat creation success. Appropriate spacing of saplings within the habitat will allow for less dominant species (i.e. aspen) to establish with more dominant pioneer species (i.e. birch) capable of being planted closer to one another. Tree planting will be spaced with approximately three trees per square metre with densities of 1,600 to 2,500 stems per hectare, which will allow more open areas to generate. Open areas such as glades will support a variety of notable ancient woodland botanical indicator species, variability of tree age classes, canopy variation and habitat for foraging bats, birds, and invertebrates (especially butterfly species). Other areas of more dense woodland will also be created, since a dense understorey is vital for other bat species including leisler's (*Nyctalus leislerii*) and pipistrelles (*Pipistrellus sps.*) (Hill and Greenaway, 2008), both of which are present on site. Ensuring there is heterogeneity between open areas for ground flora and invertebrate species and a well-developed understory will be a key objective for the tree planting areas.

When introduced to the habitat, vulnerable saplings will be controlled by active management. Eliminating competition at these stages by ground preparation, weeding of undesirable species and protection of shrubs through tree guards will allow for juvenile trees to establish within the habitat. Further measures can be implemented to control excessive grazing if this becomes necessary, including installing fencing.

Planting will follow appropriate best guidance for juvenile saplings which will usually follow slot/notch or pit planting methodologies. Trees will be organised into rows within a total of 1.04 ha of planting. Between saplings there will be between 1.5m – 3.5m which will generate open space within the woodland. More intensive weeding will be required to ensure tree growth to generate the open areas within the woodland. The gap distance when planting will change depending on the desired density of woodland within the habitat. During growth, weeding will be undertaken to remove undesirable species and tree thinning and coppicing between 5 – 15 years will facilitate greater light penetration to the ground level where needed during the initiation and establishment phases. Active management of woodland can also include the retention of deadwood within the habitat, removal of weak diseased trees and monitored grazing to generate habitat variation or management of glades, rides and scallops within the woodland areas.

4.2 Feature 2: Dry meadow creation

Abundant GA1 improved agricultural grassland within the wind farm site was selected to be enhanced to provide greater biodiversity value. The habitat is predominantly managed for dairy and beef farming, which subsequently limits the diversity of the botanical species present and structural heterogeneity of the habitat. Two parcels of land in the northern section of the wind farm site totalling 7.21ha are proposed within this management plan to be enhanced into areas of dry meadow, providing an area of greater botanical diversity in benefit for protected bee species, farmland birds (particularly ground nesting birds such as skylark), hedgehogs, badgers, and foraging bats.

Management will follow best practice guidance for the creation of dry meadow grassland (The National Biodiversity Data Centre, 2023a; Habitat Aid, 2011a & 2011b; Farm Advisory Service, 2017; Emorsgate, 2023). This will be achieved through the implementation of a sensitive grazing regime of the current habitat within the wind farm site to allow for natural regeneration. Further efforts will be undertaken for conversion of the GA1 grassland habitat present to produce a dry wildflower meadow. An initial soil test will identify the conditions required for grazing level management or more intensive wildflower meadow conversion and management.

4.2.1 Grazing levels

Minimizing grazing efforts to the recommended stocking unit per hectare will be established for management of established meadow grassland habitat. The stocking unit will be represented by the presence of a maximum of six native sheep (excluding lambs) per hectare which will graze short sward grassland. If tall sward vegetation is present within the habitat a single cow per hectare can be used to appropriately graze the habitat. Reducing grazing efforts during vital botanical growth periods between 1st March – 1st July will be implemented by removing livestock to allow for the established seedbank in the soil to develop. Between 1st July – 1st September a hay cut could be undertaken, after which grazing efforts can then increase to an appropriate stocking density (six sheep or one cow per hectare). Alteration of the grazing levels to produce wildflower meadow will provide suitable habitat for farmland birds, mammals, reptiles, and invertebrates. Once a grazing management schedule is implemented further management will be introduced for the creation of dry meadow habitat by natural regeneration and additional sowing of seed if necessary.

4.2.2 Wildflower meadow conversion

Species rich wildflower meadows are defined by certain species existing within the seedbank such as yellow rattle (*Rhinanthus minor*), birds-foot trefoil (*Lotus corniculatus*), ragged robin (*Silene flos-cuculi*), common knapweed (*Centaurea nigra*) or oxeye daisy (*Leucanthemum vulgare*). If a plethora of these species are already present, the area is likely already suitable for wildflower meadow natural regeneration, which can be determined by the soil test or allowing a year of growth with reduced grazing and monitoring efforts. Invasive species may also be present within the seed bank. Further management of invasive species may therefore be necessary, which could include removal of individual plants by hand and scattering of grass parasitising yellow rattle in October, to further help reduce soil fertility and improve wildflower seed establishment in the spring (Plantlife, 2023).

If the seedbank is limited and natural regeneration isn’t possible, as indicated after a year of growth, overturning of topsoil by ploughing and spreading of a commercial wildflower mix prior to the growing season in autumn for yellow rattle and early spring for other wildflowers will facilitate the growth of the perennial species within the mix. A good quality mix should consider the locale it will be spread in as well as the environmental conditions of the habitat including soil composition, hydrology, light availability, invasive non-native species presence and temperature. An indicative commercial seed mix containing native species that may be suitable for the wind farm site is described in Table 6.

Table 6. Recommended indicative seed composition for wildflower meadow grassland, Tussock Mixture EM10 (Emorsgate Seeds, 2023).

Common name	Species name	Proportion (%)
Wildflowers – 20%		
Yarrow	*Achillea millefolium*	0.8
Agrimony	*Agrimonia eupatoria*	0.6
Lesser burdock	*Arctium minus*	0.1
Common knapweed	*Centaurea nigra*	1.0
Greater knapweed	*Centaurea scabiosa*	1.6
Rough chervil	*Chaerophyllum temulum*	1.2
Woolly thistle	*Cirsium eriophorum*	0.1
Wild carrot	*Daucus carota*	0.6
Wild teasel	*Dipsacus fullonum*	1.6
Meadowsweet	*Filipendula ulmaria*	0.4
Hedge bedstraw	*Galium album*	1.2
Field scabious	*Knautia arvensis*	0.8
Meadow vetchling	*Knautia arvenis*	0.4
Birdsfoot trefoil	*Lotus corniculatus*	0.4
Musk mallow	*Malva moschata*	1.6
Salad burnet	*Poterium sanguisorba*	1.6
Ribwort plantain	*Plantago lanceolata*	1.8
Meadow buttercup	*Ranunculus acris*	0.8
Yellow rattle	*Rhinanthus minor*	1.2
Red campion	*Silene dioica*	2.0
Tufted vetch	*Vicia cracca*	0.2
Grasses – 80%		
Crested dogstail	*Cynosurus cristatus*	36.0
Tall fescue	*Festuca arundinacea*	16.0
Tufted hair-grass	*Deschampsia cespitosa*	4.0
Cocksfoot	*Dactylis glomerata*	8.0
Red fescue	*Festuca rubra*	8.0

First year management after the natural regeneration or sowing of seed will include invasive species management and hay cutting. Any removal of undesirable species will be undertaken in mid-late summer. First year management will also include a hay cut at varying times of the year, depending on the management requirements. A summer cut would benefit certain wildflowers such as knapweeds (*Cirsum sps.*), scabious' (*Scabiosa sps.*) and lady's bedstraw (*Galium verum*), whereas an autumn cut would help supress certain undesirable species. Once established, the vegetation will then be appropriately grazed following a sensitive regime that prescribes appropriate stocking densities, depending on the livestock used. This vegetation will be kept short until the following March. Once established, management of the grassland will include the removal of perennial undesirable species, cutting and bramble or scrub if developing, and further rotational cutting every 2-3 years between October and February. Any arisings from scrub or bramble cutting will be added to habitat piles that are included as features for certain species (see Section 4.8). Grazing will be used within the enhancement areas, but if mechanical mowing is required the timing will be restricted to between November and February, to avoid disturbance to breeding birds such as yellowhammer (see Annex A) and skylark, solitary bees and other notable invertebrate species that may be present.

4.3 Feature 3: Wet grassland management

In the south-eastern part of the wind farm site lies small sections of GA4 wet grassland characterised by glaucous sedge (*Carex flacca*), devil's bit scabious (*Succisa pratensis*), silverweed (*Potentilla anserina*) and meadowsweet (*Filipendula ulmaria*). Good condition wet grassland provides considerable biodiversity value for botanical, invertebrate and bird species. The area is currently grazed by livestock, which impedes the establishment of further wet grassland habitat within the nearby improved grassland. This small section of habitat indicates the surrounding area could regenerate from the pre-established seed bank available in the soil with appropriate management. In total a 0.74 ha area of wet grassland enhancement and creation is proposed, utilising the surrounding wet areas, incorporating a sensitive grazing regime and hydrological management.

Incorporating management into the wet grassland area infers similar management to wildflower meadow with alterations relevant to the control of the soil hydrology. Similarly, to dry meadow a soil test will be required to analyse the present seedbank, pH, composition, and hydrology. Management will follow best practice guidance available (Farm Advisory Service, 2017; Farm Wildlife, 2023a & 2023b; DEFRA, 2023a & 2023b; Emorsgate, 2023).

4.3.1 Grazing

Management will follow similar grazing restrictions to the dry meadow habitat with a recommended stocking unit (up to six sheep or one cow) per hectare. Cattle will preferably be used within this area to generate a varied sward of short grassland and areas of taller tussocks. Grazing will be avoided during the periods of 1st March – 1st July to avoid disturbance to breeding birds and perennial wildflowers. Livestock also supply dung which can be important habitat features for beetles and flies. Levels of grazing achieved by the livestock will be adjusted to prevent excessive grazing or overgrowth of undesirable vegetation.

4.3.2 Wet grassland management

Management of wet grassland will follow similar management styles to the dry meadow creation with short cutting throughout the winter, growth in spring – summer, hay cut in late summer and autumn to spring mowing/grazing. However, since the existing field surveys identified a plethora of indicator species for wet grassland within the locality, natural regeneration of this habitat can occur and so will likely require less management intervention than the habitat creation for the dry meadow.

The composition of the wet grassland habitat will be primarily influenced by the local hydrology, which alters the species present within the grassland sward. Creation of a diverse botanical sward can be achieved by retention and promotion of existing wet ditches within the wind farm site, blocking of drains and enhancing existing ditches.

Ditches will be managed by digging to a depth of 70cm to 1m along their existing alignment, creating varied depths, which will benefit a wider variety of species. This enhancement measure will utilise drainage ditches present within the existing landscape and will not increase flood risk to the wider environment or damage sites of ecological interest. Once created maintenance of weeds, water quality and silt concentration will be undertaken to ensure the habitat quality of the ditch is maintained. Rotational bankside vegetation management by grazing and weeding between September to April every two years within similar periods to the meadow grassland management will allow for botanical development and avoid nesting wildlife, while removing nuisance species. Since natural processes will result in the filling in of the ditches with silt over time, removal of silt between 1st September to 1st April, when required, will maintain the original profile of the ditch, improve water quality, and prevent undesired alterations to the water table.

If natural regeneration is unsuccessful further measures will be required. The planting of an appropriate seed mix collected locally to the wind farm site could be incorporated into the management, as well as additional actions such as further restrictions on grazing and mowing and avoiding use of artificial fertilizers, to further promote the success of natural regeneration. Use of commercially-sourced seed mixes will be avoided where possible (National Biodiversity Data Centre, 2023b). However, should this not be possible then an indicative seed mix as described within Table 7 will be considered. Once established, management should follow the wet grassland grazing rota and year-round ditch management recommended.

Table 7. Recommended indicative species mixture composition for wet grassland, meadow mixture for wetlands EM8 (Emorsgate Seeds 2023)

Common name	Species name	Proportion (%)
Wildflowers – 20%		
Yarrow	*Achillea millefolium*	0.8
Betony	*Betonica officinalis*	0.1
Common knapweed	*Centaurea nigra*	1.0
Wild carrot	*Daucus carota*	0.1
Meadowsweet	*Filipendula ulmaria*	0.4
Lady’s bedstraw	*Galium verum*	0.2
Hedge bedstraw	*Galium album*	1.2
Meadow vetchling	*Knautia arvenis*	0.4
Birdsfoot trefoil	*Lotus corniculatus*	0.4
Oxeye daisy	*Leucanthemum vulgare*	0.3

Common name	Species name	Proportion (%)
Greater birdsfoot trefoil	*Lotus pedunculatus*	0.4
Black medick	*Medicago lupulina*	0.2
Ribwort plantain	*Plantago lanceolata*	1.8
Cowslip	*Primula veris*	0.1
Meadow buttercup	*Ranunculus acris*	0.8
Yellow rattle	*Rhinanthus minor*	1.2
Common sorrel	*Rumex acetosa*	0.1
Pepper saxifrage	*Silaum silaus*	0.1
Ragged robin	*Silene flos-cuculi*	1.6
Devil's-bit scabious	*Succisa pratensis*	0.1
Grasses – 80%		
Common bent	*Agrostis capillaris*	2.0
Sweet vernal-grass	*Anthoxanthum odoratum*	2.0
Quaking grass	*Briza media*	4.0
Crested dogstail	*Cynosurus cristatus*	36.0
Tufted hair-grass	*Deschampsia cespitosa*	4.0
Red fescue	*Festuca rubra*	8.0

4.4 Feature 4: Hedgerow and tree planting and enhancement

The condition of the existing hedgerows present within the wind farm site varies greatly with some being described as poor with presence of large gaps, limited structural diversity and the lack of suitable native species such as hawthorn (*Crataegus monogyna*) or blackthorn (*Prunus spinosa*) (Foulkes, *et al*., 2013). The composition of much of the existing hedgerows is evident of management measures typical for agricultural environments, which can often limit habitat value. Some hedgerows were of more suitable condition due to a lack of intensive management, where the hedgerow had become taller, thicker, and provided transitional corridors to treeline habitat. Limited management can also lead to unsuitable hedgerow condition as the valuable scrub layer can be lost or overgrowth and can lead to collapse.

To accommodate the Project, 431m of hedgerows will be removed, primarily due to accommodating temporary works at Turbines 4 and 8 as well as maintaining safe sightlines for vehicles exiting the wind farm site. To offset for these losses, 2,911m of new hedgerow habitat will be planted across the wind farm site as detailed in Figure 2. This will create further benefit to species of farmland birds, bats, hedgehogs, badgers, and invertebrates as well as provide significant beneficial environmental services including regulating hydrology, pesticide infiltration, climate, and wind erosion (Hedgelink, 2023).

To achieve the targets for hedgerow habitat condition around the wind farm site, hedgerows will be planted and enhanced in accordance with best practice guidance (DEFRA, 2011; Hedgelink, 2013a & 2013b; The Tree Council, 2021, BRIDE Project, 2023). Improving the management of existing hedgerows to provide species-rich habitat can also be achieved by appropriate methods, such as those detailed below.

4.4.1 Planting

Planting is proposed to be distributed across the wind farm site in areas where potential enhancement will provide significant benefits to the heterogeneity of the area, and improve connectivity to foraging, commuting, and roosting areas along other hedgerows and woodlands off-site for species of bats, birds and other fauna. Planting will ensure that collision risk to birds and bats does not increase by strategically placing these newly created habitats away from proposed turbine locations. Hedgerow planting will be arranged following both single row and double row planting methodologies, utilising old field boundaries wherever possible and incorporating hedgerow trees to offset the unavoidable losses of treeline habitat.

Single row hedgerow will be planted within a single line with a density of five plants per metre. Arrangement in a single row produces a more compact, albeit less biodiverse hedgerow, which is beneficial for areas with limited space available. Double hedgerow planting is the preferential option whereby hedgerows are staggered along two rows with 4 - 6 plants 30 - 40cm apart per 1m length. Double hedgerow planting provides a wider hedgerow with internal gaps within which can be highly beneficial for nesting birds, bats and invertebrates.

Pre-planting groundwork will break up the soil by inversion if needed and remove any competing vegetation, which may prevent growth. In deep soil, slot planting or T-notch planting can be undertaken whereas if the soil is composed of heavy clay or difficult soils pit or trenching planting methods will be required. Groundwork will be completed prior to the establishment of the hedgerows in spring.

Species composition within the hedgerows will reflect nearby hedgerows with a minimum of five structural native species. Due to the removal of some trees throughout the wind farm site, hedgerow enhancement will retain and enhance existing trees where possible. Further planting of trees within the hedgerows will also be included. Management efforts will allow trees to develop vertically with periodic trimming alongside the hedgerow management schedule.

Once the hedgerow is planted in early spring, protection from grazing livestock and wildlife will be required to allow for the immature plants to grow. Stock proof fencing may be required if intensive grazing is present, although plastic mesh guards will prevent damage where low stock density grazing is taking place. Along arable fields where soil enrichment will likely be an issue, weed control will be necessary. Mulch will be spread along the base of the hedge to a 10cm depth, once applied in summer this can be replaced in subsequent years. After establishment, trimming and eventual coppicing cycles can be undertaken to retain consistent biodiversity value across the lifecycle of the hedgerows.

4.4.2 Trimming and Coppicing

Poor condition hedgerows throughout the wind farm site are overgrown, lack species diversity and have significant canopy gaps. By cutting down to the base stumps of such hedgerows and subsequent appropriate management or filling of gaps with saplings of native species, the canopy structure can be reformed. Coppicing allows for the canopy gaps or woody overgrowth to regrow at an appropriate density to provide a thick but traversable growth for species which utilise the habitat. Once an immature hedgerow is established, regular light trimming gradually increasing in cutting height will allow for the canopy to slowly develop in height. Once the hedgerow is established with a trimming cycle, fruiting structural species within the hedgerow will provide significant wintering resources for bird species such as redwing (*Turdus iliacus*) and fieldfare (*Turdus pilaris*).

Once established, trimming frequency of hedgerows will reduce to every three years. Hedgerows will increase in size, improve structure, and will allow for structural hedgerow species such as hawthorn and blackthorn to fruit. Care should be taken to avoid frequent trimming to the same cutting level, since this can form a dense woody aggregation that limits the internal space within the hedgerow for nesting or refuge. This can be avoided by raising the cutting height above the previous cutting level after 2 - 3 trimming cycles. Infrequent trimming management will continue until restarting the coppicing cycle after 20 years of hedgerow growth.

Biodiversity value will be improved by incorporating trees of variable ages within the hedgerow, encouraging out-growths of shrub species (i.e. *Rosa sps*.), management of base gap ditches and encouragement of a soft-margin around the base of the hedgerows. Additionally, tree planting of native species around the peripheries of the proposed new substation will help to compensate for the loss of trees as a result of the Project. Further management of field margins, dry meadow grassland, ditches, woodland, and scrub will provide significant heterogeneity across the enhancement areas, which will be linked by hedgerows.

4.5 Feature 5: Field margin development

Across the blue line boundary, there is over 174 ha of arable fields and semi-improved grassland. Field margins within these areas provide similar benefits to the creation of dry meadow habitat within a limited space. Introduction of field margins can provide wildflower grassland habitat facilitating a soft barrier to woodland and hedgerow habitats. This habitat can provide valuable nesting habitat or resources to species including ground nesting bird species such as yellowhammer (see Annex A), whitethroat (*Sylvia communis*) and skylark. Similar benefits will be afforded to invertebrates which utilise tussocky and wildflower margins for pollination and shelter, particularly bee species (such as the buff mining bee (see Annex A)). Field margins extend the wildlife corridor and reduce fragmentation if deployed in conjunction with hedgerows. Introducing field margins of tussocky grass or wildflowers greatly benefits rural wildlife and provides a valuable soft barrier between agricultural practices and enhancement habitat.

The creation of 282m of field margins will follow best practice guidance across the wind farm site (RSPB, 2014; DEFRA, 2023c; Farm Wildlife, 2023c; BRIDE Project, 2023). Margins will be between two and six metres in width and will be created in sunny areas next to hedges, ditches, and waterbodies. Areas selected for field margin management are shown on Figure 2.

4.5.1 Management

Prior to the creation of the field margins a soil test will be undertaken to analyse existing soil conditions whereby management can be adjusted to accommodate for variable soil types. Where possible field margins will be allowed to naturally regenerate if the existing seedbank is desirable, in accordance with the recommendations of the National Biodiversity Data Centre (2022). If after a year of monitoring the naturally regenerated field margins remain undesirable, then the enhancement measure will be supplemented by the sowing of wildflower seed that is, where possible, locally sourced. Commercial seed mixes will only be considered as a last resort where natural regeneration is unsuccessful and locally sourced seed unavailable. It is recommended for field margins a seed mix composition of between 5 – 20% wildflowers mixed with 80% grasses is used. A similar composition of species to the Emorsgate EM10 seed mix will be considered, as shown in Table 6. To facilitate the introduction of this seed, soil management will be required to promote germination and the establishment of the wildflowers after sowing.

A weeded, firm, fine and level tilth will be established prior to sowing. Soil for sowing will be ploughed and chain harrowed, with any undesirable vegetation being removed. Soil management will be undertaken prior to sowing of the seed mix in autumn or early spring prior to the breeding bird season. Recommendations for managing undesirable competitive botanical species as described in Section 4.2.2 will be implemented before sowing, if necessary. Once seed has been sown, rolling of the soil will be undertaken to create better contact between the seeds and the soil, for more successful germination.

First year management will focus on good weed control to prevent undesirable species from dominating. A hay cut between August and September will be undertaken to remove dense vegetation after wildflowers had seeded. Moving into early spring (March), the field margins will be mown again to reduce shading of germinating wildflowers and suppress competition from grasses. An annual cut in autumn will then be repeated throughout the management period, with arisings being removed to reduce fertility levels and prevent smothering of the sward underneath.

4.6 Feature 6: Scrub planting and enhancement

Scrub within the wind farm site is limited to 0.45ha in the northern part of the wind farm site and surrounding patches of bracken to the south of the wind farm site. Scrub provides beneficial habitat for farmland birds, invertebrates, bats and other mammals for nesting, foraging and commuting if managed correctly. If left unkempt this habitat can become overgrown, overly dense and shaded, preventing access for scrub dependent species. Within the wind farm site, one hectare of scrub has been identified for enhancement, to improve the value of this fragmented habitat within the wind farm site.

Management prescriptions within the wind farm site will utilise the existing habitat available and appropriately alter the existing maintenance regime to improve species diversity, composition and density following best practice guidance (National Biodiversity Data Centre, 2022; Natural England, 2006; Farm Wildlife, 2023d).

4.6.1 Natural regeneration

This technique regenerates scrub by using the existing seedbank present within the habitat to increase the scrub extent. As a result, this will mean that only those species that are already locally present will develop, though some may have only been present as buried seeds. Natural regeneration creates scrub of varying age profiles within the stand and generates variable spatial composition within the scrub habitat.

Management of ground conditions will increase the success of scrub establishment by improving the germination conditions. Ground preparation can be introduced by a short period of intense grazing to greatly reduce sward height, scarification or the removal of competitive vegetation and subsequent disposal of undesirable species that will limit scrub regeneration. Small-scale ground preparation can be carried out by hand, but machinery such as turf lifters, rotovators, roto buriers or excavators can be used to minimise effort. Any management involving the use of ground altering machinery will consider root protection zone impacts to mature trees.

Intensive grazing can limit the development of diverse communities of the more valuable structural species preventing scrub regeneration. Isolating livestock from natural regeneration areas in spring and summer when seedlings are most palatable allows seedling development, helping to encourage the establishment and reduction of fragmented scrub habitat. More intensive grazing in the winter can then be used to reduce the presence of unwanted scrub, prevent overgrowth, and facilitate openings for seedling growth in the spring.

4.6.2 Coppicing and trimming

Coppicing allows for the canopy gaps or woody overgrowth to regrow at an appropriate density to provide a thick but traversable growth for species which utilise the habitat. Initial coppicing of existing scrub will leave open areas for natural regeneration to take place. After three years of natural regeneration growth, light trimming will take place every three years. Scrub habitat will improve in structure and will allow for structural species such as hawthorn and blackthorn to fruit.

4.6.3 Bracken control

The southern extent of the enhancement area contains significant areas of dense bracken which can prevent establishment of scrub due to over competition and shading of ground flora. Bracken is a highly successful species which can provide a significant limitation to the proposed natural regeneration of scrub habitat but can also be a valuable habitat for certain invertebrates and mammals. Subsequently, management will include the retainment of this feature within its current area and controlling its spread and outgrowth. Management of bracken will be achieved by the cutting of vegetation to ground level and the removal of vegetation in August on a monthly basis until October, where necessary. The cutting cycle will weaken the plant and prevent regrowth, as the canopy declines in extent this will facilitate regrowth of scrub within the habitat and limit the outreach of bracken. This management should be included continually to prevent spread of bracken outside of the desired area.

4.7 Feature 7: Pond enhancement

The enhancement and management of ponds can be vitally important for a variety of wildlife taxa (Sayer & Greaves 2019). Ponds act as transition zones between land and water, providing food and habitat for many aquatic, semi-aquatic, and terrestrial species as well as providing an area for breeding amphibians, invertebrates, and birds. Ponds and wetland areas also provide landscape connectivity and, if created and managed correctly, can reduce the impacts of habitat fragmentation on populations and be pivotal in the long-term conservation of species populations and overall biodiversity (Ribeiro *et* *al*., 2011). Therefore, the enhancement of existing ponds within the wind farm site will help in delivering a positive legacy for biodiversity post-development. The enhanced pond habitats will provide further habitat for species such as snipe (*Gallinago gallinago*), which rely on wetland areas within farmland such as these and are known to be present locally. As large populations of Odonata were recorded within one of the ponds on site these enhancements will act to increase this population whilst also providing more habitat for other invertebrate species as well as further food sources for many other species (including birds, bats, and amphibians). The enhancement of pond habitats described below is based on best available guidance from the BRIDE Project (2023) and Freshwater Habitat Trust (2023).

4.7.1 Pond enhancement

There are two ponds and a small lake present within the wind farm site boundaries, all of which are in sub-optimal condition, with the small lake being eutrophic. To enhance these features, shallow extensions incorporating broad and wide drawdown zones (2 - 4 m) with gently sloping sides (less than 1:5 (12°)) will be created, providing areas of shallow water (see Plate 1). This will allow a wide band of emergent vegetation to become established around the margins and provide varying habitats for invertebrates, birds, and amphibians.

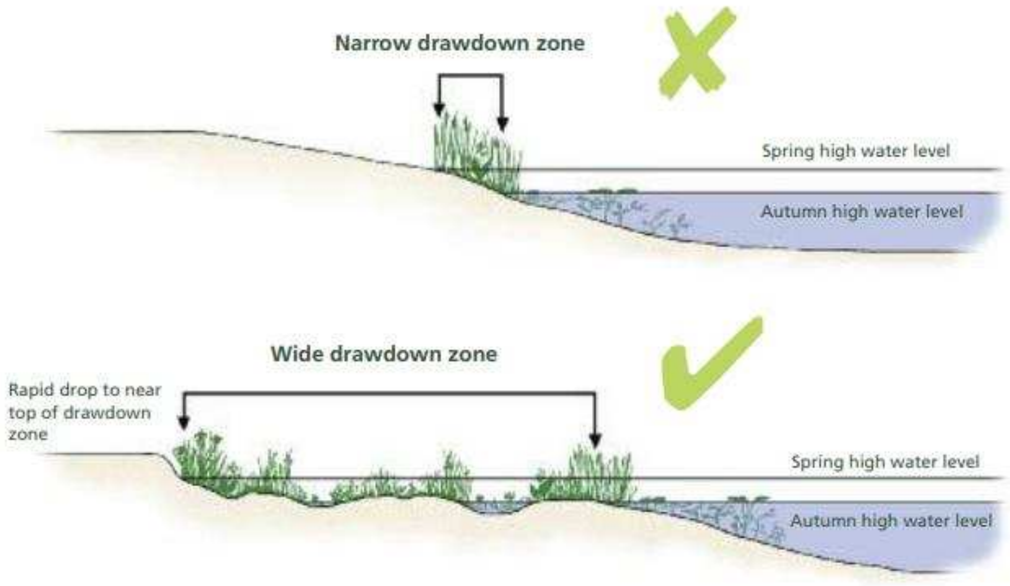

Plate 1. Broad undulating drawdown zones are the most valuable for wildlife (Freshwater Habitats, 2023).

To treat and prevent eutrophication, algal vegetation will be removed from the surface and common reed, and soft rush will be planted in the drawdown zones to filtrate the water and remediate algal blooms. Further to this, buffer strips of dense vegetation will be planted around the two waterbodies to act as an interface between the aquatic ecosystems and the high nutrient levels of the surrounding intensive agricultural land. This will aim to reduce the run-off reaching the waterbodies whilst also providing a wildlife habitat. Natural regeneration will be promoted and supplemented with planting of an appropriate pond edge species mix only where necessary (BRIDE Project, 2023). An indicative prescription of this species mix is given in Table 8. In the first year after planting, weed growth will be cut back to encourage the development of a good perennial ground cover. Management in subsequent years will focus on creating a variety of vegetation structures from dense tussock stands to bare and recently colonised mud. Variation in structure will be achieved by cutting back and removing short sections of vegetation every 2 - 3 years in rotation, removing vegetation as a wedge.

Other methods to prevent eutrophication that will be implemented where appropriate include the minimisation of shading over the ponds by scaling back tall vegetation and the creation of bunds to act as another barrier to nutrient run-off. Excavated spoil from the construction of the new pond will be used to create these bunds to minimise the extensive time and cost associated with moving spoil off-site. As described above, particular attention will also be made to the control of invasive species around these ponds and any invasive species will be removed if found to be present.

Table 8. Recommended indicative pond edge species mix

Common name	Species name	Proportion (%)
Wildflowers – 20%		
Grey sedge	*Carex divulsa ssp divulsa*	2.0
Pendulous sedge	*Carex pendula*	0.4
Common knapweed	*Centurea nigra*	2.0
Crosswort	*Cruciata laevipes*	2.0
Wild teasel	*Dipsacus fullonum*	0.4
Meadowsweet	*Filipendula ulmaria*	2.0
Hedge bedstraw	*Galium album*	0.5
Hedge crane's-bill	*Geranium pyreniacum*	1.0
Water avens	*Geum rivale*	0.3
Yellow iris	*Iris pseudacorus*	2.6
Gypsywort	*Lycopus europaeus*	0.4
Corky-fruited water-dropwort	*Oenanthe pimpinelloides*	0.2
Selfheal	*Prunella vulgaris*	0.1
Yellow rattle	*Rhinanthus minor*	0.5
Red campion	*Silene dioica*	2.6
Ragged robin	*Silene flos-cuculi*	3.0
Grasses – 80%		
Common bent	*Agrostis capillaris*	2.0
Sweet vernal grass	*Anthoxanthum odoratum*	2.0
Quaking grass	*Briza media*	4.0
Crested dogstail	*Cynosurus cristatus*	48.0

Common name	Species name	Proportion (%)
Tufted hair-grass	*Deschampsia cespitosa*	2.0
Red fescue	*Festuca rubra*	22.0

4.8 Feature 8: Shelter habitat creation

Incorporating natural and artificial shelter habitats within a site helps to contribute towards increasing biodiversity. These specifically constructed or installed features provide breeding and hibernating areas and shelter from inclement weather conditions for many different species.

4.8.1 Bee bank creation and bee poles

Due to the presence of a Red-list solitary mining bee on the wind farm site (buff-mining bee – see Annex A), two bee banks will be constructed in the field adjacent to the southern area of woodland (see Figure 2). The proposed locations at this stage are indicative and will be finalised at the time of construction. The bee banks are best placed in this field where the creation of the dry meadow will provide a nearby source of nectar and pollen through wildflowers.

Material from the construction of the Project (such as subsoil) will be shaped into a crescent-shaped mound with slopes, hollows, and various angles (Plate 2) facing direct sunlight. This will help to trap warmth and create a variety of conditions that will benefit many different invertebrates. A trench in the shape of the bank will be dug out (around 30cm deep) before the turf is then placed on top. It is best that the material used to create the bank is low in nutrients and because of the current land management in this field, it is likely that nutrient levels within the topsoil will be high. Therefore, sand, or subsoil will be used. Sand and/or subsoil will cap the mound and border the bank to supress weeds and create additional habitat for ground nesting bees. Vegetation will remain sparse, as bare ground provides nesting opportunities; clifflets will also be incorporated that will cut into the bee bank and create vertical nesting spaces.

Banks will require yearly, sectional clearance to minimise disturbance and to ensure bare areas remain present on the bank. Additional sand/soil may need to be added if the bank has become disturbed or damaged.

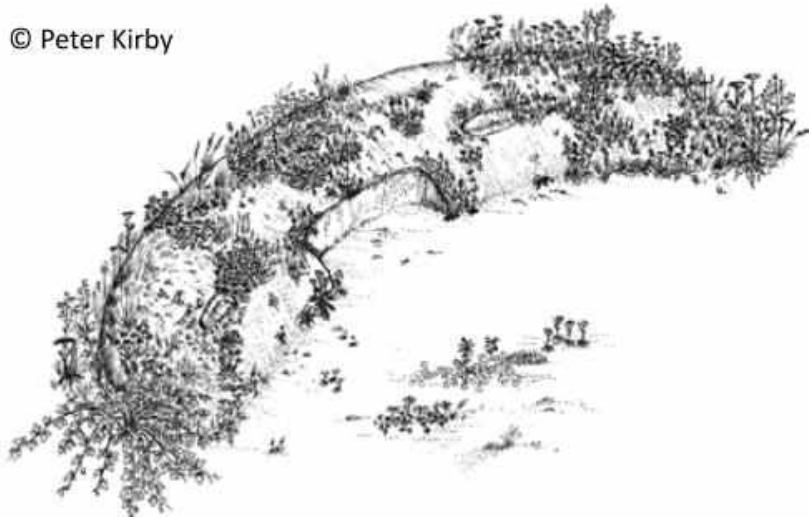

Plate 2. Bee bank design © Buglife Peter Kirby

Bee poles provide additional habitat for hole-nesting species; poles can be made of dead wood stumps with drilled holes (minimum 8cm long, 4 - 10mm diameter). Four bee poles are to be positioned facing southwards, in direct sunlight and ensuring that no vegetation covers the pole. The locations of their instalment have been proposed based on their proximity to features of interest to bee species such as wildflowers, and hedgerows (see Figure 2).

4.8.2 Bird and bat boxes

Bird boxes will be installed throughout both pockets of woodland within the wind farm site to increase nesting habitat for bird species. Boxes will be positioned sensitively so as to avoid increasing the risk of collisions with turbines, although it is recognised that the species for which the boxes will primarily be aimed at (i.e. passerines) are not particularly susceptible to high levels of collision risk with turbines. The material of the boxes will be made from an insulating wood/concrete compound that is long-lasting and waterproof.

Bird boxes, such as the 2M Schwegler nest box with 32mm hole (as shown in Plate 3), will be installed 4 - 6m off the ground, avoiding positions that are prone to strong sunlight and strong winds. The manufacturer's instructions will be followed for installation.

Plate 3. 2M Schwegler nest box with 32mm hole (NHBS, 2023)

Where it is necessary to clean, repair or replace damaged or broken bird boxes on monitoring visits, this will be undertaken during October to January inclusive when birds are highly unlikely to be nesting in them. If nesting birds are found, cleaning/repairs will be postponed until the chicks have fledged. If broken or damaged, they will be replaced with boxes with the same or a similar design. Should additional information or advice for the ongoing maintenance and / or replacement of these boxes be required, this will be obtained from the manufacturer.

Bat boxes and tubes will be erected in areas of high bat activity and away from proposed turbine locations. ‘Self-cleaning’ bat boxes such as the 1FF Schwegler bat box (as shown in Plate 4) and the 2FR Schwegler bat tube (as shown in Plate 5), will be mounted on large mature retained trees, c.4 - 6m off the ground facing different directions to provide a variety of micro-habitats. This will increase the roost resource for the area within the existing natural features of the wind farm site. The boxes are to be designed to maintain a stable, warm environment and allow bats to roost in clusters. The manufacturer’s instructions will be followed for installation.

Plate 4. 1FF Schwegler bat box (NHBS, 2023)

Plate 5. 2FR Schwegler bat tube (NHBS, 2023)

Self-cleaning bat boxes and tubes generally require no maintenance (they have a tilted base to allow droppings to fall out). However, if broken or damaged, they will be replaced during regular monitoring visits. Bat boxes will first be checked by a bat-licensed ecologist before removal to confirm there are no roosting bats present.

4.8.3 Habitat piles

Seven habitat piles will be incorporated into quiet and varied habitats within the enhancement areas to offer refuge for amphibians, hedgehogs, invertebrates, and other species. The placement of these piles will be in strategic locations where such species are likely to be present, i.e., adjacent to woodland, hedgerows, ponds, scrub etc. The central core of the feature will be compacted and formed from material of varying sizes, including larger logs and smaller branches. Habitat piles can be any size, but it is recommended that they are built to be at least 1m across at the base and 1m tall. Logs will be placed on the ground in four to six perpendicular layers (see Plate 7). Larger materials go into the lowest layers that form the base and help to provide habitat and commuting corridors for smaller animals. The outer layers of the pile will be laid loosely on top of the compacted core. Wherever possible, they will be created using any logs generated from vegetation clearance, or from native and local woods.

New material will be added every 2 - 3 years as the older materials decay, or if they are disturbed/destroyed.

Plate 6. Design of habitat piles (NNR, 2023)

4.9 Feature 9: INNS management

The presence of INNS species (i.e., Japanese knotweed (*Reynoutria japonica*)) recorded within the wind farm site poses the risk for the spread of such species, potential delays to project programme, potential biodiversity consequences and future baseline impacts throughout the development (National Biodiversity Data Centre, 2021; NNSS, 2016). Japanese knotweed is subject to legislation under the European Communities (Birds and Natural Habitats) Regulations 2011 and the Regulation on the prevention and management of the introduction and spread of invasive alien species [1143/2014] (the

Invasive Alien Species (IAS) Regulation). The IAS Regulation conveys the rules to prevent, minimise and mitigate the adverse impacts of the introduction and spread (both with and without intention) of invasive alien species on biodiversity and related ecosystem services, as well as other adverse impacts on human health or the economy (European Commission, 2017).

Japanese knotweed spreads through two methods: direct root growth or via new plant growth produced from fragments of the parent plants' stem. Fragment growth can be produced from pieces weighing 0.7 grams which is the key feature for the invasive nature of Japanese knotweed. The implementation of an INNS management plan, that will be included within the Construction Environmental Management Plan (CEMP) (as detailed within **Volume III Appendix 5.1**) will reduce the potential for other invasive species and outline targeted management of Japanese knotweed.

4.9.1 INNS management plan

Prior to construction of the Project commencing, an Invasive Species Survey using best practice guidance (National Biodiversity Data Centre, 2021; Environmental Protection Agency, 2021; Booy, Wade and Roy, 2016) will be undertaken within the wind farm site to map the presence of Japanese knotweed as well as any other invasive species encountered. The results of this survey will update the baseline presented in **Volume II Chapter 7 – Biodiversity** of the EIAR and inform the requirement for any additional management to control such species.

After establishing precise locations where Japanese knotweed is present, management decisions will be made. The primary management technique will be establishment of a herbicide spraying regime of Glyphosate, which will aim to eradicate the present stands of knotweed (National Biodiversity Data Centre, 2021; INNSA, 2017). It should be noted that any use of certain pesticides will require an individual certified for competence for herbicide use or under direct supervision of a certificate holder, a Control of Substances Hazardous to Health assessment and appropriate Personal Protective Equipment.

Most spraying regimes use Glyphosate due to the approved use near water, limited 48 - hour persistence, cost efficiency and effectiveness. The herbicide is absorbed directly through the leaves and destroys the rhizome of the plant preventing subsequent regrowth for active knotweed. However, this substance is non-discriminatory to other plants so any use of Glyphosate will be used exclusively during periods of low wind speed avoiding surrounding vegetation. A chemical spraying regime will be undertaken twice yearly in spring after 1m vegetative growth and between July to October. Spraying will be undertaken during peak growth and nutrient retention seasons for Japanese knotweed where resources are directed towards and across the plant or towards the rhizome. Over spraying will be avoided and only spraying within the defined periods is vital for maximum herbicidal uptake once the plant is in these specific growth periods as the chemical is ineffective on seedling growth. Spraying can continue for three years on average to remove all presence of Japanese knotweed within an area, this may vary depending on extent and accessibility of infestation. Direct stem injection can be used in areas where the infestation is limited, bordering running water or within a protected conservation area. This may be preferential in certain contexts within the wind farm site. Stem injection management can be undertaken in September or early October.

If any management involves the disturbance of infested soil or plant material, it is a required that an application of a license to the NPWS will be carried out as detailed under Section 49 of the European Communities (Birds and Natural Habitats) Regulations 2011. This legislation dictates that any person without license who breeds, reproduces, releases, disperses, or allows dispersal of an invasive non-native species is guilty of an offence and subject to further prosecution or a fine. This will be applied to the NPWS where relevant management will be used to avoid the potential of prosecution from any of the measures detailed.

4.10 Feature 10: Bat mitigation

Habitat management for bats has been identified as a requirement to reduce the risk of bat mortality through barotrauma and collision with the operational turbines, including predicted impacts on common pipistrelle, which is a species targeted within this management plan for animal-aided design (see Section 2.5 and Annex A). This is outlined within the impact assessment described within **Volume II Chapter 7 – Biodiversity** of the EIAR. Management will include avoiding the reinstatement of hedgerows and treelines that need to be removed to accommodate construction of the Project, where they fall within identified ‘bat buffer zones’.

As described in **Volume II Chapter 7 – Biodiversity** of the EIAR, the proposed wind turbines will have a hub height of 100m and a blade length of 73.66m, which have resulted in a typical buffer of 98m from the turbine base where treelines are impacted and an 89m buffer from the turbine base when hedgerows are impacted being identified. Where sections of treeline and hedgerow that fall within these bat buffers are to be removed by necessity to facilitate construction of the Project, then those features will not be reinstated in-situ post-construction. Instead, their losses will be offset by planting elsewhere, as described in Section 4.4.

Table 13 in **Volume II Chapter 7 – Biodiversity** of the EIAR details the loss and retainment of hedgerow and treeline habitats within the identified bat buffers. Given the necessity of keeping portions of hedgerow and treeline habitats within the buffer zones, since their removal is not otherwise a necessity to accommodate the construction of the Project, additional mitigation strategies (turbine curtailment and feathering strategies) have been proposed, as discussed in Sections 6 and 7 of **Volume II Chapter 7 – Biodiversity** of the EIAR.

The vegetation within the bat buffer zones identified around turbines will be managed and maintained during the operation of the wind farm. These areas will be kept clear by mechanical means (mowing) only and maintained on an annual basis in the same condition as during the first clearance. The immediate surroundings of individual turbines will be managed and maintained so that they do not lead to bat collision or attract bats through the increase of prey or vegetation.

5 MAINTENANCE TASKS

This section of the management plan sets out the actions required for the initial period of maintenance for the first five years after completion of construction as well as the long-term maintenance requirements for those newly created or enhanced habitats described above in Section 4. Table 9 below provides for each feature (habitat or species) a description of the initial management to be undertaken, the rationale for it, and frequency. Table 10 then outlines the long-term management prescriptions that are to be implemented for the lifetime of the Project (35 years) after the initial management period has concluded.

Table 9: Initial maintenance tasks

Subject	Task	Management to be undertaken	Rationale	Timing	Year				
					Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Habitats									
Woodland and other tree planting	Watering	Assuming that guidance periods for planting trees and shrubs are adhered to no watering of trees/shrubs will be required.	Tree planting to be undertaken outside of the summer months. Large scale watering of planted trees is unlikely to be feasible. Any losses of planted material will be replaced.	-	-	-	-	-	-
	Check tree guards	Check and secure tree guards and fencing. Re-firm planted trees and stakes by treading around the base. To be undertaken 3 times per year for at least the first three years, and after storm events. At end of year 3 consider requirement for ongoing checks and maintenance. Continue where necessary. Remove when appropriate.	Ensure tree protection is maintained during the period it is required.	March, July and October	✓	✓	✓	✓	✓
	Plant inspections and replacements	Plant replacement inspections shall be made in August/September annually for all planted tree stock, to identify dead, diseased and dying tree stock. Plant replacements shall be carried out annually between the start of November and end of March. Priority shall be given to completing replacement planting before the end of December each year. Through monitoring the establishment of tree species it may be necessary to consider tailoring replacements in	Inspect planting to identify dead, diseased and dying plants.	Check: August/September. Replacement planting: November to end of March (ideally by end of December)	✓	✓	✓	✓	✓

Subject	Task	Management to be undertaken	Rationale	Timing	Year				
					Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
		response to success/failure of individual species. Replacement plants to match size of adjacent or nearby plants of same species or match original specification, whichever is the greater.							
	Control of grass and weeds within areas of tree planting	During first five years maintain a 1m diameter clear of vegetation around the base of planted trees, or a 1m free strip where rows occur. Mechanical, chemical or mulching methods of vegetation control acceptable, assuming that they act to maintain a 1m free strip. Where chemical methods are used select an appropriate selective herbicide. Where using mechanical methods ensure weeds are removed prior to setting seed. Remaining vegetation except trees and coppice shoots to be cut annually and arisings removed, avoiding damage to planting and associated tree guards etc. Cut to height of 100mm twice annually in late April/early May and August/September.	Reduce competition from weeds and grasses and encourage establishment of tree planting.	Late April/early May and August/September	✓	✓	✓	✓	✓
Grassland (dry meadow, wet grassland and field margins)	Watering	During Year 1 only water seeded areas if unseasonal conditions result in a lack of adequate rainfall to aid germination of seed, water as necessary to ensure the establishment and continued thriving of all seeding.	Watering to be undertaken if required to ensure establishment of grassland sward.	May to September	✓				
	Initial grassland cut to height of 50mm	For seeded areas of new grassland creation no grazing will be undertaken during at least the first three years following sowing. During Year 1 commence cutting in seeded areas once the sward has	Initial cutting will be required to ensure that seedlings of newly sown species are not shaded out by remnants of the original sward or	May, June, July, August, September (cut in each month as soon as trigger height has been reached)	✓				

Subject	Task	Management to be undertaken	Rationale	Timing	Year				
					Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
		reached a height of 100-150mm. Once this trigger point has been reached undertake single cut to 50mm during each month stated. Cuts during Year 1 should leave a 6m uncut margin around the field (s). Cut material from the remaining grassland areas should be removed.	undesirable weed species.						
	Control of undesirable species	Cover of undesirable species including docks, thistles and ragwort should be reviewed annually and spot treatment with herbicide and suitable portable applicator (or pulling where appropriate) to be undertaken to maintain overall presence in the Mitigation Site at 5% or less.	Aims to prevent undesirable species gaining dominance within the grassland sward.	August	✓	✓	✓	✓	✓
	Cut grassed areas to height of 150mm	No grazing will be undertaken during at least the first three years following sowing. During Years 2 to 5 inclusive, all grassland areas except a 6m field margin will be subject to a single cut to a height of 150mm during mid-July. Cuttings are either to be used to provide habitat piles where the original ones have deteriorated with any excess collected and removed.	Cutting aims to ensure structural diversity in the sward and provide habitat that is suitable for invertebrates, reptiles and amphibians.	Mid-July		✓	✓	✓	✓
Hedgerows / Hedgerow trees	Control grasses and weeds in vicinity of new hedgerow planting	Keep a 1m strip either side of hedgerow planting free of grasses and weeds. Use suitable herbicide or hand pulling (as appropriate). Where utilising herbicide allow recommended period for herbicide to take effect before clearing dead weeds.	During the establishment period the strip of ground adjoining hedgerows will be managed to limit competition from weeds and grasses.	March, July and October	✓	✓	✓	✓	✓

Subject	Task	Management to be undertaken	Rationale	Timing	Year Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
	Check rabbit guards and tree shelters on new hedge planting	Checks and secure tree guards and fencing. Re-firm planted trees and stakes. To be undertaken 3 times per year for at least the first three years. At end of year 3 consider requirement for ongoing checks and maintenance. Continue where necessary. Remove when appropriate.	Ensure hedgerow protection and limit competition during establishment period.	March, July and October	✓	✓	✓	✓	✓
	Plant inspections and replacements	Plant replacement inspections shall be made on an annual basis for all newly planted hedgerows (or infilling of existing hedgerows) in August/ September for the first five years after planting. Plant replacements shall be carried out annually between the start of November and end of March. Priority shall be given to complete replacement planting before the end of December each year.	Inspect planting to identify dead, diseased and dying plants	Inspections - August-September. Replacement planting - November to March	✓	✓	✓	✓	✓
	Cut new hedgerows	New hedgerow planting shall not be cut during Years 1 to 3 inclusive. Pre-existing hedgerows (and planted hedgerows from Yr 4 onwards) to be cut every two years using a side-arm mounted flail during dormant period from November to February. Do not cut hedgerow trees. Where possible adjacent lengths of hedge shall be cut in different years leaving short sections of shrubs untrimmed.	Promote growth of flowers, nuts and berries.	November to February				✓	
	Watering	Assuming that guidance periods for hedgerow planting are adhered no watering of trees/shrubs will be required.	Hedgerow planting to be undertaken outside of the summer months. Large scale watering of	-	-	-	-	-	-

Subject	Task	Management to be undertaken	Rationale	Timing	Year				
					Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
			planting is unlikely to be feasible. Any losses will be replaced.						
	Pruning of hedgerow trees	• Do not prune whips or feathered trees. • Do not prune during the late winter/early spring sap flow period, unless specified otherwise. • Crown prune young trees up to 4m high by removing dead branches and reducing selected side branches by one third to preserve a well-balanced head, ensuring the development of a single strong leader and the removal of duplicated branches and potentially weak or tight forks. In each case cut back to live wood.	Pruning to promote development of healthy hedgerow trees.	Inspect: January and July. Pruning (as required avoiding later winter/early spring sap flow period)	✓	✓	✓	✓	✓
Scrub/shrub planting	Check guards on new shrub planting	Checks and secure shrub guards and fencing. Re-firm planted shrubs and stakes. To be undertaken 3 times per year for at least the first three years. At end of year 3 consider requirement for ongoing checks and maintenance. Continue where necessary. Remove when appropriate.	Ensure shrub protection and limit competition during establishment period.	March, July and October	✓	✓	✓	✓	✓
	Plant inspections and replacements	Plant replacement inspections shall be made on an annual basis for all newly planted shrubs in August/ September for the first five years after planting. Plant replacements shall be carried out annually between the start of November and end of March. Priority shall be given to complete replacement planting before the end of December each year.	Inspect planting to identify dead, diseased and dying plants	Inspections - August-September. Replacement planting - November to March	✓	✓	✓	✓	✓
	Watering	Assuming that guidance periods for shrub planting are adhered no watering of trees/shrubs will be required.	Shrub planting to be undertaken outside of summer months. Large scale watering of	-	-	-	-	-	-

Subject	Task	Management to be undertaken	Rationale	Timing	Year				
					Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
			planting is unlikely to be feasible. Any losses will be replaced.						
	Pruning of shrubs/trees	• Do not prune whips or feathered trees. • Do not prune during the late winter/early spring sap flow period, unless specified otherwise. • Crown prune young trees up to 4m high by removing dead branches and reducing selected side branches by one third to preserve a well-balanced head, ensuring the development of a single strong leader and the removal of duplicated branches and potentially weak or tight forks. In each case cut back to live wood.	Pruning to promote development of healthy shrubs and trees.	Inspect: January and July. Pruning (as required avoiding later winter/early spring sap flow period)	✓	✓	✓	✓	✓
Ponds	Check initial aquatic plant establishment	During Years 1-3 of establishment check the natural regeneration of aquatic plants annually in September. If sufficient vegetation has not established to achieve the objective of 10-50% open water three years after construction of the ponds then the requirement for supplementary planting of appropriate aquatic species should be considered by an ecologist.	Ensure ponds establish so that they are suitable for amphibians and invertebrates.	Check establishment of aquatic plants in September. Replacement planting under suitable conditions as required	✓	✓	✓		

Subject	Task	Management to be undertaken	Rationale	Timing	Year				
					Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
	Manage marginal vegetation	Marginal plants will be managed with the aim of maintaining marginal vegetation over 50% pond margins and no encroachment of marginal vegetation beyond 3m inward of original pond edge. Marginal vegetation shall be cut and removed as required between September and January from 60% of the pond margin. The areas cleared each year should be varied in rotation (i.e. a different 60% will be cleared each year) to ensure a diversity of age structures in the marginal vegetation. Planting of supplementary marginal vegetation shall to be undertaken if there is insufficient establishment after the initial 3 years to meet the target of 50% cover.	Prevent overgrowth of pond and maintain suitability for invertebrates and amphibians	Annual check of marginal vegetation in June Clearance of marginal vegetation September to January (as required).		✓	✓	✓	✓

Subject	Task	Management to be undertaken	Rationale	Timing	Year				
					Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
	Manage aquatic vegetation	Undertake annual check of aquatic vegetation cover in June. Management activities to commence when annual check indicates that one or more of the following criteria are to be exceeded the following year (expected unlikely before year 3). - less than 50% open water habitat and/or - no encroachment of marginal vegetation beyond 3m inward of original pond edge. When trigger for management is reached each September, vegetation clearance should be undertaken during the following September to January (ideally Sept to Nov). Sufficient clearance should be undertaken to achieve 10% to 50% open water for the following season. Aquatic vegetation to be hand pulled to avoid rapid re-growth. Vegetation shall be placed on the pond edge for a minimum of 2 days to allow any trapped fauna to escape and then removed from the vicinity of the pond and disposed of. Requirement for additional planting to be considered if target 50% cover of marginal plants is not achieved within three years. Where replanting is undertaken avoid puncturing of any waterproof membrane (where present).	Prevent clogging up of pond and increasing nutrient levels.	Yrs 2 to 5 - Annual check of marginal vegetation in June Yrs 2 to 5 - pulling of aquatic vegetation. Sept to Jan (ideally Sept to Nov).		✓	✓	✓	✓
	Ensure continued absence of fish	Annual visual check for the presence of fish to be undertaken.	Maintain suitability for a diverse assemblage of	March to June	✓	✓	✓	✓	✓

Subject	Task	Management to be undertaken	Rationale	Timing	Year Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
		If fish are found to be present, organise removal using appropriate best practice methods.	invertebrates and amphibians						
	De-silting and clearance of leaf fall	Pond depth to be recorded during April of Year 5. If pond depth is less than 1m at point of greatest depth then silt/leaf litter to be extracted from base on pond using an excavator during subsequent September/October period. Excavated material will be placed close to the pond for a minimum of 2 days to allow any trapped fauna to escape and then removed from the vicinity of the pond and disposed of.	Maintain suitability for a diverse assemblage of invertebrates and amphibians	Check depth: April Extract material: Sept/Oct (as required)					✓
	Check water levels	If water levels are unexpectedly low check for signs of potential disturbance or failure of pond liner (if used). Repair or replace liner where required. Monitoring to continue into Yrs 4 and 5 if any problems are identified within Years 1 to 3.	Check during early years of establishment that pond is holding water and providing conditions suitable for a diverse assemblage of invertebrates and amphibians	March - July	✓	✓	✓		

Subject	Task	Management to be undertaken	Rationale	Timing	Year Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
	Keep ponds free of invasive non-natives	Annual check for presence of invasive non-native species to be undertaken by an appropriately qualified ecologist. If detected, non-native plant species shall be removed from ponds as soon as possible after detection. They may be removed manually, mechanically or treated with an appropriate herbicide for use in ponds (e.g. with formulations not containing polyethoxylated tallow amine (POEA)). The removed vegetation shall be placed on suitable sheeting (plastic/Terram – to reduce risk of propagule spread) at the edge of the water body edge for a minimum of 2 days and then removed from the vicinity of the pond and appropriately disposed of.	Keep ponds free of invasive non-natives	Annual check: June Species removal (as required)	✓	✓	✓		
	Ensure absence of pollution and litter	Annual inspections of water bodies shall be undertaken to check for the presence of obvious signs of pollution and litter. Check for any potential pollution sources and stop (or appropriately divert) them at source as soon as possible.	Ensure pond remains suitable for a diverse assemblage of invertebrates and amphibians.	March	✓	✓	✓	✓	✓
	Use Barley Straw as necessary to address filamentous algae growth	Undertake checks for the growth of filamentous algae. Where algae is present at potentially detrimental levels add a bale of barley straw as necessary to control algal growth. Where barley straw is utilised remove or replace every 3 months.	Use barley growth to restrict algal blooms that can have a detrimental effect on success of other aquatic plants, invertebrates and amphibians.	May and August	✓	✓	✓	✓	✓
Species									

Subject	Task	Management to be undertaken	Rationale	Timing	Year				
					Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Invertebrates, amphibians and reptiles	Maintain bee banks and habitat piles	Undertake annual check that bee banks and habitat piles remain in place and of at least 90% of original size. Also check for signs of waterlogging. Habitat piles shall be managed by replacing or depositing additional stones, logs or soil cap (or other suitable material) to maintain the original dimensions. Clear bee banks of excess vegetation such that at least 70% of the surface is bare earth.	Ensure bee banks and habitat piles remain suitable for use.	March	✓	✓	✓	✓	✓
Invertebrates, birds and bats	Maintain bee poles, bird boxes and bat boxes	Undertake annual check that bee poles, bird boxes and bat boxes remain in place and repair or replace any missing/damaged poles and boxes.	Ensure habitat features remain suitable for use.	March	✓	✓	✓	✓	✓
Invasive non-native species and species covered by the European Communities (Birds and Natural Habitats) Regulations 2011 and the IAS Regulation	Undertake an annual check for the presence of invasive non-native species	Pre-construction walkover to identify and map all INNS to ensure no additional spread / new growth has taken place from the time of the baseline surveys. Implement INNS management plan in sufficient time ahead of any site clearance to remove any potential for spread of INSS during the pre-construction phase. Annual walkover survey to be undertaken alongside other survey/maintenance tasks by a suitably qualified ecologist. Where invasive non-native species are identified then an appropriate	Ensure biosecurity protocols during construction have been successfully implemented and identify any invasive species issues at an early stage.	May to September	✓	✓	✓	✓	✓

Subject	Task	Management to be undertaken	Rationale	Timing	Year				
					Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
		management regime should be agree with the wind farm operator.							

Table 10: Long-term maintenance tasks

Subject	Task	Management to be undertaken	Rationale	Timing	Years
Habitats					
Woodland	Thinning	Thinning and felling of selected woodland trees shall remove the less healthy or less desirable trees and give the remaining trees more space to develop. Cut to ground level. Cut some of the material into 1m lengths and create brash piles to promote invertebrate habitat. Prolific colonisers shall be removed to favour desired species to establish or to maintain designated open areas. A mixed age class across the species with reduced canopy cover will create light for the field layer to develop; however, drastic interventions which cause abrupt changes in light regimes should be avoided Requirement for thinning to be considered after ten years, and periodically at five-year intervals thereafter.	Create a diverse woodland structure and promote development.	Sep to March	10, 15, 20, 25, 30 & 35.

Subject	Task	Management to be undertaken	Rationale	Timing	Years
	Coppicing (woodland edge)	Once tree planting has begun to establish coppice management should be undertaken. Commence coppicing of woodland edge planting in Yr 10. Divide woodland edge habitats into sections of 20-30m in length. Clear non-adjacent areas on a 5-10 year rotation. Cut stumps to height of 150mm using chain saw or bow saw. Cut should be at 45 degrees to allow run-off and promote regrowth. Clear compartments year in rotation to develop a diverse age structure.	Promote variation in the age structure and provide suitability for a range of faunal species.	Sep to March Woodland edge - consider from Yr 10.	10, 15, 20, 25, 30 & 35.
	Coppicing (main woodland areas)	Main areas of woodland planting to be coppiced from around year 15 onwards under a 7-10 year regime in rotation. Divide woodland into suitable management parcels and clear in rotation to create a chequerboard effect. Dependent on rate of establishment it may not be suitable to commence coppice management of main woodland areas until later in the establishment period.	Promote variation in the age structure and provide suitability for a range of faunal species.	Sep to March Main woodland - consider from Yr 15 onwards	15-35

Subject	Task	Management to be undertaken	Rationale	Timing	Years
Grassland (dry meadow, wet grassland and field margins)	Maintain grassland sward	From Years 6 onwards grassland areas shall be managed through either cutting or grazing (preferable). Where grazing is proposed consideration should be given to the requirement for fencing around water bodies (this could be temporary in nature) in order to prevent excessive grazing and/or poaching of marginal vegetation. Cutting Each year grassland areas will be subject to a single cut to a height of 150mm between July and September, with the following exceptions: - a 6m uncut margin will be retained around the field margins to maximise structural complexity. Cuttings are to be removed or (where applicable) used to replenish habitat piles where the original ones have deteriorated with any excess collected and removed.	Manage grassland to maintain grassland diversity and provide suitable habitat for amphibians and reptiles.	Cutting mid-July. Grazing only All year. Cut & aftermath grazing Cut: Mid-July. Graze: August to end-October.	Each year from Yr 6 onwards

Subject	Task	Management to be undertaken	Rationale	Timing	Years
		Grazing only Where grazing only it shall be light (maximum of six sheep or one cow per hectare) and extend throughout the year to provide a mosaic of sward structures and prevent the grassland sward from becoming rank. Annual reviews of the grazing regime shall be carried out to get the timing and numbers of stock to a level where the grassland is maintained in good condition, but excessive natural regeneration of scrub is prevented.			
		Cut and graze Where treated as hay meadow (mowing and aftermath grazing) then all areas will be subject to a single cut in July-September with light aftermath grazing until the beginning of March. No grazing to take place between march and July during the main botanical growth period. Annual reviews of the grazing regime shall be carried out to get the timing and numbers of stock to a level where the grassland is maintained in good condition, but excessive natural regeneration of scrub is prevented.			
	Control of undesirable species	Cover of undesirable species including docks, thistles and ragwort should be reviewed annually and spot treatment with herbicide and suitable portable applicator (or pulling where appropriate) to be undertaken to maintain overall presence in the at 5% or less.	Aims to prevent undesirable species gaining dominance within the grassland sward.	June	Each year from Yr 6 onwards

Subject	Task	Management to be undertaken	Rationale	Timing	Years
Hedgerow/ Hedgerow Trees	Cut hedgerows	Hedgerows are to be cut every two years during dormant period January to February using a tractor mounted side arm flail. Adjacent lengths of hedge shall be cut in different years. Hedgerow trees shall not be cut. Where appropriate short sections of hedgerow should be left untrimmed to promote diversity.	Ensure ongoing management of hedgerows that will maintain and enhance value for wildlife.	January/February (N.B. Cutting in rotation - each hedge to be cut every other year)	Each year in rotation from Yr 6 onwards
	Lay new hedge	Target hedge laying to be carried out 10 years post-planting, depending on soil and climatic conditions. Only to be undertaken once untrimmed stems reach 2.5m - 4m high with a stem diameter at base of between 50mm - 100mm. All hedge laying to be undertaken by an experienced hedge laying contractor. Hedgerow trees to be retained and method to match local and historic hedgerow characteristics.	Maintain structural diversity within hedgerow network	November to February	Yr 10 onwards
Scrub/shrub planting	Thinning	Thinning and felling of selected shrubs/trees shall remove the less healthy or less desirable plants and give the remaining plants more space to develop. Cut to ground level. Cut some of the material into 1m lengths and create brash piles to promote invertebrate habitat. Prolific colonisers shall be removed to favour desired species to establish.	Create a diverse scrub habitat and promote development.	Sep to March	Yr 10 onwards

Subject	Task	Management to be undertaken	Rationale	Timing	Years
	Coppicing	Once shrub planting has begun to establish, coppice management should be undertaken. Commence coppicing of shrub planting in Yr 10. Divide scrub habitats into sections of 10-20m in length. Clear non-adjacent areas on a 5-10 year rotation. Cut stumps to height of 150mm using chain saw or bow saw. Cut should be at 45 degrees to allow run-off and promote regrowth. Clear compartments year in rotation to develop a diverse age structure.	Promote variation in the age structure and provide suitability for a range of faunal species.	Sep to March Consider from Yr 10.	Yr 10 onwards
Ponds	Manage aquatic vegetation	Vegetation clearance should be undertaken during period September to January (ideally Sept to Nov). Sufficient clearance should be undertaken to achieve 10% to 50% open water for the following season. Aquatic vegetation to be hand pulled to avoid rapid regrowth. Vegetation shall be placed on the pond edge for a minimum of 2 days to allow any trapped fauna to escape and then removed from the vicinity of the pond and disposed of.	Prevent clogging up of pond and increasing nutrient levels.	Pulling of aquatic vegetation during period Sept to Jan (ideally Sept to Nov).	Annually as required

Subject	Task	Management to be undertaken	Rationale	Timing	Years
	Manage marginal vegetation	Marginal plants will be managed with the aim of maintaining marginal vegetation over 50% pond margins and no encroachment of marginal vegetation beyond 3m inward of original pond edge. Marginal vegetation shall be cut and removed as required between September and January from 60% of the pond margin. The areas cleared each year should be varied in rotation (i.e. a different 60% will be cleared each year) to ensure a diversity of age structures in the marginal vegetation. Planting of supplementary marginal vegetation shall be undertaken if insufficient establishment to meet the target of 50% cover has not been achieved three years after construction (i.e. June 2021).	Prevent overgrowth of pond and maintain suitability for great crested newt.	Clearance of marginal vegetation September to January (as required).	Annually as required
	Ensure continued absence of fish	Annual visual check for the presence of fish to be undertaken during vegetation monitoring. If fish are found to be present, organise removal using appropriate best practice methods.	Maintain suitability for a diverse assemblage of invertebrates and amphibians	March to June (alongside vegetation monitoring)	Annually as required

Subject	Task	Management to be undertaken	Rationale	Timing	Years
	De-silting and clearance of leaf fall	Pond depth to be recorded during April. If pond depth is less than 1m at point of greatest depth then silt/leaf litter to be extracted from base of pond using an excavator during subsequent September/October period. Excavated material will be placed close to the pond for a minimum of 2 days to allow any trapped fauna to escape and then removed from the vicinity of the pond and disposed of.	Maintain suitability for a diverse assemblage of invertebrates and amphibians	Check depth: April Extract material: Sept/Oct (as required)	10, 15, 20, 25, 30 & 35.
	Ensure absence of pollution and litter	Check for any potential pollution sources and stop (or appropriately divert) them at source as soon as possible.	Maintain suitability for a diverse assemblage of invertebrates and amphibians	Jan to December (time to coincide with other monitoring visits)	Annually
	Manage tree and scrub cover surrounding ponds	Tree and scrub cover not to exceed 25% of pond perimeter. Removal of shading vegetation around pond margins where it exceeds 25% or more of the perimeter or shades the southern side of the pond. Clear in rotation to provide regrowth with varied age structure. Shading vegetation shall be removed as required during winter months to a height of 300m above ground level to avoid ground disturbance and potential impacts on hibernating fauna.	Avoid excessive overshading and ensure that suitable conditions are maintained.	Check tree and scrub cover: June (alongside other surveys). Clearance; November to February (as required)	10, 15, 20, 25, 30 & 35.
Species					

Subject	Task	Management to be undertaken	Rationale	Timing	Years
Invertebrates, amphibians and reptiles	Maintain bee banks and habitat piles	Undertake annual check that bee banks and habitat piles remain in place and of at least 90% of original size. Also check for signs of waterlogging. Habitat piles shall be managed by replacing or depositing additional stones, logs or soil cap (or other suitable material) to maintain the original dimensions. Clear bee banks of excess vegetation such that at least 70% of the surface is bare earth.	Ensure bee banks and habitat piles remain suitable for use.	March	10, 15, 20, 25, 30 & 35.
Invertebrates, birds and bats	Maintain bee poles, bird boxes and bat boxes	Undertake annual check that bee poles, bird boxes and bat boxes remain in place and repair or replace any missing/damaged poles and boxes.	Ensure habitat features remain suitable for use.	March	10, 15, 20, 25, 30 & 35.
Invasive non-native species and species covered by the European Communities (Birds and Natural Habitats) Regulations 2011	Undertake an annual check for the presence of invasive non-native species	Annual walkover survey to be undertaken alongside other survey/maintenance tasks by a suitably qualified ecologist. Where invasive non-native species are identified then an appropriate management regime should be agree with the wind farm operator.	Ensure biosecurity protocols during construction have been successfully implemented and identify any invasive species issues at an early stage.	May to September	10, 15, 20, 25, 30 & 35.

6 MONITORING

6.1 Monitoring of management measures

Monitoring is necessary to measure the extent to which the objectives of the management plan are being met and to allow any remedial action to be implemented if appropriate. During monitoring visits, the status of the habitats created, enhanced, and controlled will be assessed by the monitoring regime identified in Table 9 and Table 10. Commencing in the first year after construction, general habitat condition assessments of all the management features will be undertaken to confirm whether habitats have successfully established. Remedial measures will be implemented wherever necessary according to the prescriptions and feedback loops described within Section 4. Before decommissioning takes place, a final assessment of the condition and success of the various habitat prescriptions will be undertaken (in year 35).

A short annual report will be produced following the monitoring visits to ensure documentation of the ongoing success of the HMP, and to identify and communicate any necessary and required actions. These reports will be submitted for the attention of the Planning Authority and other relevant stakeholders.

6.2 Bat monitoring

Monitoring will take place to provide sufficient data to detect any significant changes in bat activity relative to pre-construction surveys. This will aim to assess changes in bat activity patterns and the efficacy of mitigation, to inform any required changes to the proposed mitigation. Further details regarding the proposed bat monitoring are provided within **Volume II Chapter 7 – Biodiversity** of the EIAR.

6.3 Bird and Bat fatality monitoring

Published guidance on assessing the impacts on wind farms on birds and bats recommends the implementation of an agreed post-development monitoring programme as a best practice mitigation measure (Drewitt and Langston, 2006). Although curtailment is a mitigation strategy proven to lower bird and bat fatalities, a fatality monitoring programme will be implemented during the operation of the wind farm. This will aim to confirm the accuracy of the collision risk assessment to birds and bats and further refine the curtailment strategy as described in **Volume II Chapter 7 – Biodiversity** of the EIAR. Monitoring will involve monthly searches of carcasses within monitoring years (January-December), ensuring that bat carcasses are discovered during periods of time when bats are active (between March-October), and within the wintering and breeding seasons for birds. Monitoring will take place within the first three years of operation and subsequently in years 5,7,10,15,20,25, and 30 as part of the curtailment monitoring schedule. All carcasses will be photographed and logged in an annual fatality search report, which will be submitted to relevant stakeholders (i.e., the NPWS) and the Planning Authority for consultation to inform any remedial actions that may be necessary. It is possible a change in the curtailment strategy will be required if it is reported that bat mortality is deemed at an unacceptable level due to the wind farm development or if the curtailment strategy proves to be overly precautionary. A comprehensive onsite fatality monitoring programme will follow best practice guidance and examples (Grunkorn, 2011; Fijn *et al*., 2012; SNH, 2021) and include:

a) Carcass removal trials to establish levels of predator removal of possible fatalities. This should be done following recommended best practice and with due cognisance of published effects such as predator swamping, whereby excessive placement of carcasses increases predator presence and consequently skews results. At the time of publication predation trials set using trail cameras following guidance set out in (Smallwood, 2010) provides the most accurate results.

b) Turbine searches for fatalities should be undertaken with the use of conservation dogs following best practice in terms of search area (minimum radius hub height) and at intervals selected to effectively sample fatality rates as determined by carcass removal trials in (a) above. At the time of publication, the typical search area surrounding the turbine bases follow (Edkins, 2014) *Impacts Of Wind Energy Developments On Birds And Bats: Looking Into The Problem*, who recommends the ''search width should be equal to the maximum rotor tip height'', e.g. proposed turbines for the Project have a max tip height of 175m thus the spread of the searched area, as a rectangle, square or circle, should be 87.5m in either direction form the turbine base.''

c) Search intervals will follow (SNH, 2021).

d) Recorded fatalities should be calibrated against known predator removal rates to provide an estimate of overall fatality rates. The analysis tool Evidence of Absence V2 (Dalthorp, Huso and Dail, 2017) is recommended as a minimum, or other equivalent guidance as dictated by up-to date standards and practices.

e) Monitoring reports to be submitted to Cork County Council and NPWS following each year of monitoring (i.e. during each of the first three years of operation and subsequently in years 5,7,10,15,20,25, and 30).

7 RESPONSIBILITIES

The management and monitoring strategies laid out within this document will be the responsibility of the wind farm operator to implement. It is their obligation to uphold the objectives and targets included in this management plan and to be accountable for the maintenance of the habitats that will be created. The specified management prescriptions under each management feature will be carried out by the wind farm operator in conjunction with the relevant landowners, for which agreement to these prescriptions has been secured as part of the legal agreement and associated letters of consent for the making of the planning application.

A reporting schedule will be agreed with Cork County Council. A HSMP implementation report should be compiled at the end of each monitoring year detailing the findings of all management and monitoring activities, The HSMP monitoring report should present a summary of the activities undertaken over the course of each monitoring year, stating whether these activities meet the requirements of the HSMP and relevant planning conditions. The HSMP should be considered as a dynamic document and it should be reviewed at the end of each monitoring year and modified as required, pending submission to and approval by the Cork County Council and NPWS.

Monitoring and reporting on the HSMP measures will be undertaken by independent, suitably experienced and qualified ecologists employed by the wind farm operator and submitted to Cork County Council and the NPWS on behalf of the wind farm operator.

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ANNEX A – SPECIES FACTSHEETS

Buff mining bee
Andrena nigroaenea

Classification

Family: Andrenidae (Mining bees). Order: Hymenoptera (Bees and Wasps), Class: Insecta (Insects).

General appearance

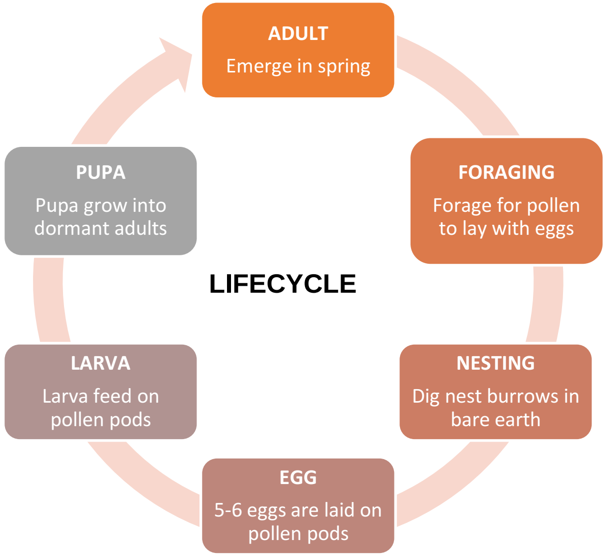
The buff mining bee is a large species of bee. It is 13-16mm long along the head-and-body. The species is characteristic by a black hairless head, dark orange-tinged brown hairs on the thorax and abdomen with the tail covered by black hairs.

Distribution

The buff mining bee is primarily distributed along the southern and eastern coasts of Ireland.

Behaviour

- Dormant in winter
- Active in limited periods of the year (March - July)
- Excellent pollinators
- Ground nesting in well-drained soil



Habitat Characteristics

Females construct ground nest chambers in well-drained soil in early spring to early June. This leads to association of mining bees with arable farmland and cattle rubs, which provide suitable soil conditions for mining bees. However, this species can be found in a wide variety of temperate habitat types such as coastal undercliffs, dunes, modified grassland and urban gardens. Habitats with bare, well-drained soils close to flower-rich habitats with species such as buttercup (*Ranunculus sps.*), dandelion (*Taraxacum sps.*), red clover (*Trifolium repens*) will provide suitable conditions (Irish Naturalist, n.d.).

Natural predators

Predated by wasp species directly but many mining bees are also subject to 'cuckoo species' (which lay their eggs in the nests of other species), kleptoparasites (steal resources from the bee i.e *Nomada* bees) and parasitoids (parasites which kill the host i.e. Ichneumonid wasps).

Threats and conservation status

For many bee species the threats are predominantly by non-native species, habitat loss, land use change, climate change and pesticides. Buff mining bee is not protected under any Irish legislation but is classified as vulnerable according to the most recent assessment of Irish Bee species in 2006, due to significant declines across the country (Fitzpatrick *et al.,* 2006).

Impact from Development

The proposed development requires land use change which will remove habitat and potentially alter areas of significance for mining bees noted during the baseline surveys, such as cattle rubs for example. However, the EIAR Biodiversity chapter recognised the potential impact to invertebrate species to be of little significance. Nonetheless, the limited invertebrate species recorded during the baseline surveys is indicative of the wind farm site providing little opportunity for invertebrates. Improving the habitat potential for mining bee will benefit other solitary bees and the invertebrate community as a whole.

Management plan benefits

1. *Bee poles and Bee banks*

Bee poles and banks provide nesting opportunities for solitary cavity nesting bees such as mining bees (Buglife, 2023). They provide shelter in periods of inclement weather, resting opportunities during the day and a stable undisturbed shelter throughout the year. This habitat can also be vital for dormant hibernating invertebrates. These measures will benefit buff mining bees as well as carpenter, mason, leafcutter and other solitary bees.

2. *Creation of wildflower meadow*

Wildflower meadows provide significant foraging habitat for buff mining bee as well as other invertebrate species. Pollination opportunities for solitary bees will greatly increase, improving the viability for pollinated botanical species. Associating this habitat with planned bee banks is incorporated into the design as solitary bees will typically only travel a few hundred metres to foraging grounds (Biodiversity Ireland, 2019). Habitat creation will also benefit invertebrate density and biodiversity within the habitat for birds, mammals and reptiles. Improving the habitat across the wind farm site is vital for solitary bees as viable habitat within the existing site area is very limited for solitary bees.

3. *Hedgerow and Field margin management*

Hedgerows can be incredibly important for solitary bees. Flowering structural species such as hawthorn (*Crataegus monogyna*) and blackthorn (*Prunus spinosa*) provide excellent foraging grounds during buff mining bee activity. Creation of tussocky soft buffers or wildflower field margins with a wide variety of botanical species will provide resources in crop and hedgerow downtime. Furthermore, enhanced field margins will provide commuting routes for invertebrate species and provide sustenance for populations in periods of low resources. Implementation of these management measures will consider the critical life cycles of mining bees by providing flowering resources in early spring when buff mining bees will be actively searching for resources.

4. *Pesticides*

Within the designated enhancement areas there will be no use of pesticides. Limiting the use of pesticide during critical periods of mining bee activity will reduce disturbance to the species population. Recognition of pests currently inhibiting farmland productivity and subsequent application of more specific measures for each species will better maintain invertebrate life in the surrounding area.

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Common Pipistrelle
Pipistrellus pipistrellus

Classification

Vespertilionidae (simple nosed bats). Order: Chiroptera (Bats and Flying Foxes), Class: Mammalia (True mammals).

General appearance

The common pipistrelle is a small species of bat. It is 3.5–5.2cm long along the head-and-body, with the tail adding 2.3–3.6cm. The body mass can range from 3.5 to 8.5g, with the wingspan ranging from 18 to 25cm. Its brown fur is variable in tone. It has a 'scrunched up' face, black skin tone and short ears.

Distribution

The Palearctic is the main distribution range of the common pipistrelle. Comprising the majority of Europe, sections of northern Africa and western Middle east. Within Ireland the species is widespread primarily along eastern and southern Ireland.

Behaviour

- Mostly inactive in winter
- Nocturnal
- Variable roost types
- Breeding spring to autumn but mainly in September - November
- Low-flying

Habitat Characteristics

This species is common in woodland and farmland using hedgerows for commuting and foraging routes. Roosting can occur in mature trees with woodpecker holes, loose bark, lost limbs and also rural structures including barns or sheds. The species is also found in urban environments, where roosts can form in residential housing in tile cracks, loose fascia, gaps in wooden planks, roof apexes or guttering (Bat Conservation Ireland, 2023).

Natural predators

Within the UK domestic cats are the main predators for bat species. Natural native predators include birds of prey such as barn owls, kestrels or sparrowhawks.

Threats and conservation status

As with many bat species the threats to common pipistrelle include predation by non-native species, habitat loss, land use change, persecution, climate change and decline of invertebrates. Due to these threats populations of common pipistrelle have declined significantly. As a result, common pipistrelle was listed on the Wildlife Act 1976/2000 and Annex IV of the European Habitats Directive.

Impact from Development

The proposed development requires the removal of significant sections of suitable hedgerow and treeline habitat for commuting and feeding bats. Despite there being a significant quantity of retained hedgerows, the removal of this habitat would likely cause a significant impact to the viability of the wind farm site for bat species at a local level (RSK, 2023). Further temporary displacement may stem from light disturbance, increased human activity and noise disturbance; however this will be monitored within the Construction Environmental Management Plan (CEMP) for the Project. The impact of the Project could lead to a permanent reduction in the viability of bat species as a whole as well as common pipistrelle specifically. Similar to many bat species, common pipistrelle are dependent on hedgerow and treeline habitat for foraging in rural environments across the entire lifecycle of an individual (Bat Conservation Trust, 2016).

Management plan benefits

1. *Habitat creation*

Further creation of suitable habitat will offset the potential impacts of the development and enhance the habitat within the wind farm site. The habitat management plan sets out the plans for the creation of further hedgerow, woodland and scrub habitat. Creation of hedgerows would provide linear pathways for common pipistrelle to disperse within and beyond the wind farm site to new roosting and foraging areas. Creation of wider extents of species diverse woodland habitat and scrub, preservation of deadwood, diverse and developed understory and retention of veteran trees improves foraging habitat as well as increasing potential roosting features for common pipistrelle and other woodland associated species such as Natterer's bat (*Myotis natteri*) (Hill and Greenway, 2008).

Habitat creation across the wind farm site aims to provide new habitat as well as enhance connectivity between existing hedgerow, woodland and aquatic habitat present. This will aim to reduce habitat fragmentation and also improve the interaction between wider populations of common pipistrelle likely inhabiting other habitats in the surrounding area. Interlinking habitat by improving the commuting routes for bats will improve the habitat availability during the summer breeding season. More food will be available for foraging bats to feed pups, more potential nesting sites will be available and easier access between roosting and foraging grounds provided. Bat breeding success within the wind farm site will be expected to improve from these targeted habitat management proposals.

2. *Pond enhancement*

Pond enhancement provides benefits to common pipistrelle as they are directly associated with waterbodies. Pipistrelles frequently feed along the surfaces of waterbodies with a specific preference for areas with a smooth water surface such as ponds (Warren *et al.,* 2000). Enhancement of the existing ponds on site aims to increase aquatic plant diversity, water quality and extent and subsequently will improve the invertebrate communities which utilise the habitat, for which bats forage on. The management aims to create a wider network of waterbodies connected by hedgerow which will connect foraging grounds for common pipistrelle.

3. *Bat boxes*

Bat boxes will be strategically placed in areas of high bat activity where collision risk is limited. This measure will improve the roosting capacity of areas for bats. Uptake of bat boxes can be inconsistent in woodland with areas of uptake being more successful in mature woodland, areas associated with water and shading by canopy (Bat Conservation Trust, 2003, Russo *et al.,* 2007). Furthermore, roost switching between individuals is common between bats, and therefore creating a network of roost boxes will facilitate this behaviour.

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Yellowhammer
Emberiza citronella

Classification

Family: Emberizidae Order: Passeriformes (Passerines). Class: Aves (Birds).

General appearance

Male yellowhammers are unmistakeable with a bright yellow head and underparts, brown back with black streaks, and red/brown rump. Females are similar in appearance with more defined black/brown streaks along the breast and face and a duller brown appearance. They are roughly 16cm in length with a 23-29.5cm wingspan and weigh between 25-36g.

Distribution

Declines in yellowhammer have limited distribution generally along the eastern coast throughout counties including Cork, Waterford, Tipperary, Kilkenny, Wexford and many more along the east to Louth (Birdwatch Ireland, 2023).

Habitat Characteristics

This species is common in woodland and farmland using hedgerows for commuting and feeding routes and mature trees or rural structures for roosting. There is strong association with cereal cultivation in farmland, low cut hedgerow and gorse (*Ulex europaeus*).

Behaviour

Yellowhammer is a resident species to Ireland. Birds are frequently seen perched on top of scrub, bushes or hedgerow singing. Between September – March adult birds will join mixed flocks of buntings, finches and sparrows to feed in farmland areas. Between April - August adults will pair and breed together (RSPB, n.d.).

Natural predators

Yellowhammer are predated by domestic cats and birds of prey. Eggs are predated by corvids, mustelids, grass snake (*Natrix natrix*) and occasionally broods are parasitised by cuckoo (*Cuculus canorus*).

Threats and conservation status

As with many bird species the threats to yellowhammer include predation by non-native species, habitat loss, arable field management change and climate change. Yellowhammer is listed on the Wildlife Act 1976/2000 and Annex IV of the European Habitats Directive.

Impact from Development

The proposed development requires creation of wind turbines within a significant area of farmland habitat for yellowhammer. During the construction phase increased anthropogenic disturbance caused by increased machinery use, noise, vibration and light changes could cause temporary disruption to yellowhammer lifecycles. The removal of extensive sections of suitable hedgerow habitat to facilitate the construction of the Project will cause a permanent reduction in habitat for yellowhammer. Due to the association of yellowhammer to arable farmland the impact would likely be significant. This may lead to the decline of yellowhammer within the local area as assessed in the EIAR Ornithology chapter (RSK, 2023). The yellowhammer was chosen as a target for enhancement measures due to the close association with farmland habitats, similar requirements to other farmland bird species and its conservation status.

Management plan benefits

1. Hedgerow and scrub

Planting and enhancement of hedge and scrub habitat will provide significant additional foraging and sheltering habitat for yellowhammer throughout the year, once those habitats have established. Management of such habitat is also considered for the benefit of this species. Hedgerows should be short and thick, trimmed between September and February to avoid the breeding bird season between March and August inclusive. Within areas of scrub any gorse present should be retained, especially along ditch banks. Hedgerows near to unmanaged grassland including the proposed wildflower meadow area to the north of the wind farm site will be managed appropriately for yellowhammer.

2. Field margins and dry meadow

A feature identified throughout studies of yellowhammer spatial distribution and habitation preferences identifies the importance of providing foraging grounds throughout the year for resident birds (Bradbury *et al.,* 2000, Whittingham *et al.,* 2005). In a study conducted by McHugh *et al.* (2016) field margins were identified as significantly important farmland habitat features for yellowhammer. Field margins which are adjacent to hedges provided invertebrate foraging grounds during the breeding season for their chicks. A diverse wildflower assemblage within enhanced field margins and lowland meadow provides resources for invertebrates throughout variable periods of the year which are predated by yellowhammer.

Within the breeding season yellowhammer will use the grass margins alongside hedgerow and lowland meadow for nest building as females utilise moss and grass to construct nests (The Wildlife Trusts, 2023). Providing consistent habitat, food resources and breeding sites throughout the year through better lowland meadow and field margin management will improve the use of the wind farm site by yellowhammer. As a primarily sedentary species most individuals are recorded within 5km of their nesting site (Lack, 1987). Ensuring a closely associated supply of good habitat throughout the seasons is therefore vital for yellowhammer breeding. Planned rotational hay cutting within lowland meadow habitat will provide refuge after the breeding season and potential seed foraging resources not provided by nearby arable farmland.

Field margins will also benefit other declining farmland birds such as linnet (*Linaria cannabina*), skylark (*Alauda arvensis*) and brambling (*Fringilla montifringilla*).

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EIAR VOLUME III
Appendices

CHAPTER 7 – BIODIVERSITY

Appendix 7.4: Technical Note on Site Access Track Separation Distances

Technical Note

Project	Tullacondra Wind Farm		
Subject	Site Access Track Separation Distances from Vegetation		
To:	Larry O'Halloran		
Cc:	Tomás Leen	**Doc Ref.:**	23010-BFA-TC-XX-RP-C-1001-F2.docx
Date:	02/11/2023	**Rev:**	F-2
Rev Code:	Planning = "P"; For Information = "F"; Issue for Construction = "C"; Tender = "T"; As-Built = "AB"; Review and Comment = "R"; Coordination = "CO"		

1 Overview

The purpose of this report is to outline some of the key design considerations used when determining an appropriate set-back distance between a proposed site access track and existing vegetation on Tullacondra Wind Farm.

In order to establish this minimum setback distance, the following industry standard documents where reviewed and adopted:

- National Joint Utilities Group (NJUG) publication Volume 4 "*Guidelines for the Planning, Installation and Maintenance of Utility Apparatus in Proximity to Trees*".
- BS5837:2012 "*Trees in Relation to Design, Demolition and Construction*".

2 Vehicle Zone of Influence

"Pressure Bulbs" or "Stress Isobars" are used to determine the load and stress distribution through the soil beneath a ground bearing structure.

In the case of Tullacondra Wind Farm's site access tracks, the source of these pressure bulbs will be vehicles trafficking the proposed tracks.

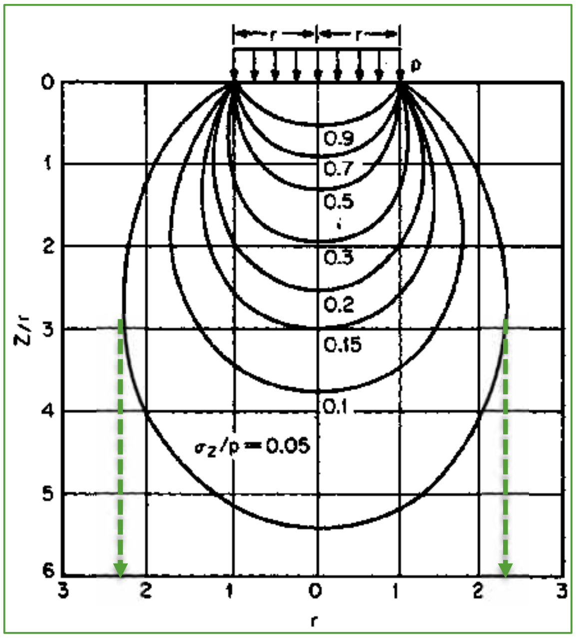

Figure 2.1 – Example of ground stress isobars beneath a loaded circular area.

As per Figure 2.1 above, it can be seen that the lateral extent of the zone of influence relative to 5% of the load being applied, is approximately 2.2 times "r". Ground stresses less than the 5% of the load being applied are deemed negligible and have been discounted.

In the case of Tullacondra Wind Farm, the applied load on an access track has been assumed to be a tracked excavator with a typical track width of 800mm.

Therefore, the extent of the zone of influence (D_{ZI}) is:

$$r = \frac{800mm}{2} = 400mm$$

$$D_{ZI} = 2.2\ x\ 400mm = 880mm$$

Therefore, a zone of influence (D_{ZI}) of 880mm will be applied to the wheel paths of the proposed site access tracks of Tullacondra Wind Farm. The established Roots Protect Zone (RPZ) at a given location will incorporate this zone of influence when calculating the total required setback distance.

3 Root Protection Zones

The industry standard document for establishing set-back distances to vegetation is the National Joint Utilities Group (NJUG) publication Volume 4 "*Guidelines for the Planning, Installation and Maintenance of Utility Apparatus in Proximity to Trees*". In Ireland, this publication is referenced by several State bodies including Irish Water (referenced for utility installation elements of the project) and Transport Infrastructure Ireland (referenced for road construction elements of the project) as the best practice guidelines for works adjacent to trees. Therefore, this document will be adhered to in it's entirety at Tullacondra Wind Farm.

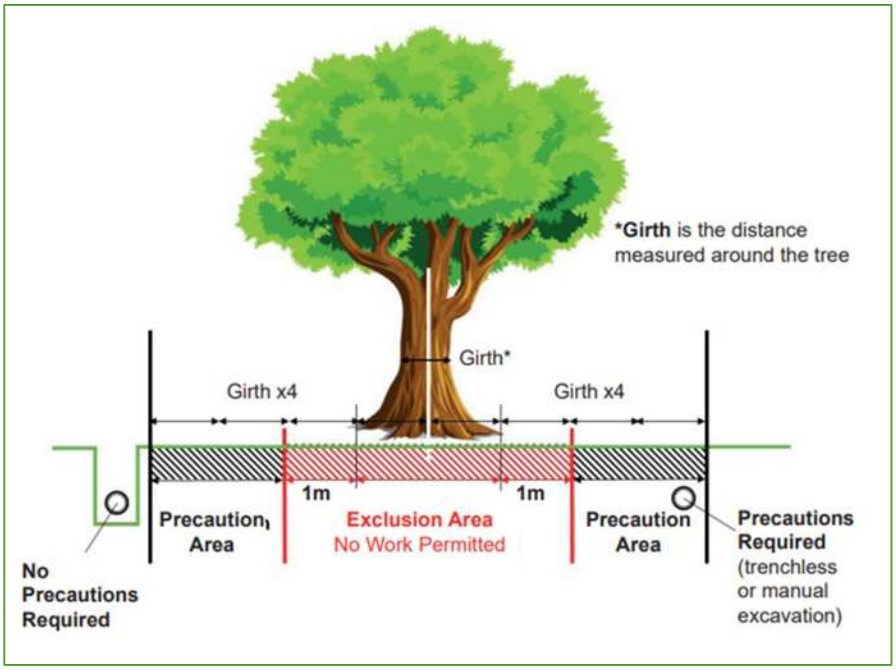

Figure 3.1 – Setback distances from existing tree (Source: TII CC-PAV-04007)

Based on Figure 3.1 above, no works, including the zone of influence as calculated in Section 2 of this report, will take place within a distance of 4x Girth of an existing tree. A tree survey will take place at the Detailed Design stage of the project and the site access track alignments will be designed such that no ground disturbance takes place within the RPZ.

For hedgerows, a minimum separation distance of 1.5m from all works will be applied.

Figure 3.2 – Setback distance from hedgerow (Source: Irish Water STD-W-12A).

4 Conclusion

A minimum setback distance of 2.4m (≈1.5m + 880mm) will be maintained from all vegetation to the wheel path of the proposed site access tracks of Tullacondra Wind Farm.

Furthermore, tree surveys will be undertaken to ensure that no designed wheel paths encroach on an exclusion zone of 4x Tree Girth + 880mm. This setback distance will be incorporated into the site access track design layout for the wind farm.