Appendix 9.4
BAT SURVEYS AT HEIGHT

OVER HILL PROPOSED WIND FARM, EAST AYRSHIRE

CLIENT: ENERGIEKONTOR UK LTD

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1. INTRODUCTION

1.1 Scope of the study

This report presents results of height surveys for bats during the 2015 bat activity season at Over Hill proposed wind farm in East Ayrshire. The survey was commissioned by Energiekontor UK Ltd following the results of year 1 bat surveys undertaken by Land Use Consultants and subsequent recommendations for height surveys (Appendix 9.3). Bat surveys at height were recommended specifically to further assess the potential impact of the proposed development to Leisler's bat *Nyctalus leisleri* which had been identified at low levels during the first year of bat surveys.

Scoping was undertaken in April 2015 with Scottish Natural Heritage (Dave Lang, Operations Officer – Strathclyde and Ayrshire) on the requirement for height survey at Over Hill. The site was confirmed to be of medium potential risk to bats based on the balance of risks associated with several measures of value of the site to bats set down in industry guidance (Table 10.1 of Hundt, 2012). A suite of height surveys for bats was agreed, utilising balloon surveys within the site.

1.2 Height surveys for bats at proposed wind farm developments in the UK

Bat surveys at height are generally required only where high risk bat species are likely to be present, or else are confirmed within the developable area of the proposed wind farm site (Hundt, 2012). Many bat species in the UK are unlikely to come into contact with turbine blades during their normal movements. This is because UK bats are not known to migrate at high altitude and many UK species such as *Myotis* species rarely fly at heights that would intersect with the rotor-swept area. However, some species are considered to be at higher risk and frequent passes at height by *Pipistrellus* and *Nyctalus / Eptesicus* species have been recorded by Collins and Jones (2009). Based on available information of example flight heights, speeds, hunting techniques, habitat preference and migration (although not specifically in relation to behaviour near wind turbines) Natural England (2014) has produced guidance which puts species of UK bats into different risk categories (high, medium, low):

Table 1. Scottish species of bats likely to be at risk from wind turbines

Low Risk	Medium Risk	High Risk
Myotis species	Common pipistrelle	Noctule
Brown long-eared bat	Soprano pipistrelle	Leisler's bat
-	-	Nathusius' pipistrelle

Table 1 does not take into account the conservation risks that wind turbines pose to bats, as it does not account for the size of the population of the species, or the ability of the population to recover from loss of these individual bats. When this is taken into account, the following table represents the risk of wind turbines to populations of different species of bat found in Scotland:

Table 2. Scottish bat populations likely to be threatened due to impacts from wind turbines

Low Risk	Medium Risk	High Risk
Myotis species	-	Noctule
Brown long-eared bat	-	Leisler's bat
Common pipistrelle	-	Nathusius' pipistrelle
Soprano pipistrelle	-	-

In the first instance, ground based surveys should aim to identify the presence of high risk bat species at the site, or high numbers of low risk species that could be affected and require mitigation to avoid contravening legal protection they are afforded. The requirement for surveys at height should be determined by the results of these ground based assessments. Ideally, year one should comprise ground based assessments, and the requirement for surveys at height would then be determined from these results.

2. METHODOLOGY

2.1 Survey methodology

Hundt (2012) states that for balloon surveys "a lower number of nights of (non-consecutive) recording is required" (compared to the higher number of consecutive nights of recording for ground based surveys) and therefore the initial proposal was to undertake one survey each month in April, May, June, July, August, September and October 2015 from one hour before sunset until half an hour after sunrise. Due to difficulties timetabling surveys during suitable weather in April, no survey was completed for this month. Instead, an additional survey was completed in September. Due to the very difficult ground conditions at the site, with hagged blanket bog and moorland, the surveyors deployed the balloon at two locations, rotating between surveys. The balloon was flown at heights of up to 60m[1], and was tethered to the ground when in use. An additional bat detector was deployed to simultaneously record bats from ground level.

Two locations were chosen to deploy the balloon, both on moorland with scattered compartments of young conifer plantation. In each location the balloon was tethered at a distance of 100m from the nearest woodland edge.

[1] Balloons flying above 60m from the ground require permission from the Civil Aviation Authority.

Photo 1. Balloon being flown on the 22nd June 2015. The bat detector is visible hanging below the balloon.

Table 3 describes the weather and survey locations for each deployment:

Table 3. Survey parameters

Date	Grid reference	Sunset/sunrise and survey start/end	Temp start/end °C	Wind start/end
30/05/2015	NS 51701 11057	21:43/04:46	8/7	0-1.4 ms^{-1} SW / 0-1.4ms^{-1} SW
22/06/2015	NS 51701 11057	22:02/04:35	13/11	nil/nil
14/07/2015	NS 51924 11703	21:52/04:54 20:51/05:54	10/9	0-1.4ms^{-1} NW/2.8-5.6ms^{-1} NW
17/08/2015	NS 51701 11057	20:48/05:53 19:48/06:53	14/10	0-1.4ms^{-1} SW/nil
02/09/2015	NS 51924 11703	20:13/06:21 19:13/07:21	10/8	0-2.8ms^{-1} W/ 1.4-2.8ms^{-1} WNW
07/09/2015	NS 51701 11057	20:00/06:31 19:00/07:31	12/6	nil/nil
02/10/2015	NS 51924 11703	18:56/07:18 17:56/08:18	11/5	0-1.4ms^{-1} W/0-1.4ms^{-1} W

2.2 Survey limitations

The balloon can only be flown on calm, dry nights meaning that the conditions during this survey were optimal for bats. Due to the nature of the survey, a limited number of nights of data can be collected as indicated in current guidance (Hundt, 2012). There are therefore resultant limitations in the accuracy of predictions when extrapolating from such a small number of records. If bats are simultaneously recorded on both the detector at the ground as well as the detector on the balloon, it must be assumed that they are flying at rotor-swept height in the absence of any other information to the contrary.

3. RESULTS

Four species of bat were identified during the survey. These were common pipistrelle *Pipistrellus pipistrellus*, soprano pipistrelle *P. pygmaeus*, Daubenton's bat *Myotis daubentonii* and Leisler's bat *Nyctalus leisleri*. In addition two unidentified *Myotis* contacts were recorded. All species were recorded by detectors placed at ground level whereas only Leisler's bat was recorded by the detector at balloon level. Numbers of contacts of each

species at ground level and balloon level detectors are presented in tables 4 and 5 respectively.

On two occasions in July simultaneous Leisler's bat contacts were recorded at height and at ground level detectors, indicating that the records were likely to be of an individual flying at a height between ground level and 60m.

Table 4. Bat contacts recorded at ground level (0m)

Date	Common pipistrelle	Soprano pipistrelle	Daubenton's bat	*Myotis sp.*	Leisler's bat	**Total**
30/05/2015	0	0	0	0	0	**0**
22/06/2015	1	2	0	0	0	**3**
14/07/2015	0	0	0	0	2*	**2**
17/08/2015	0	0	0	0	0	**0**
02/09/2015	1	1	1	1	0	**4**
07/09/2015	0	2	0	1	0	**3**
02/10/2015	2	1	0	0	0	**3**
TOTAL	**4**	**6**	**1**	**2**	**2**	**15**
AVERAGE	**0.57**	**0.86**	**0.14**	**0.29**	**0.29**	**2.14**

* These two bat contacts were recorded simultaneously at balloon and ground level detectors. It is therefore deemed likely that the bat (or bats) were recorded when flying at heights between the two detectors.

Table 5. Bat contacts recorded at balloon level (≤60m above ground level)

Date	Common pipistrelle	Soprano pipistrelle	Daubenton's bat	*Myotis sp.*	Leisler's bat	**Total**
30/05/2015	0	0	0	0	0	**0**
22/06/2015	0	0	0	0	0	**0**
14/07/2015	0	0	0	0	2*	**2**
17/08/2015	0	0	0	0	1	**1**
02/09/2015	0	0	0	0	0	**0**
07/09/2015	0	0	0	0	0	**0**

02/10/2015	0	0	0	0	0	**0**
TOTAL	**0**	**0**	**0**	**0**	**3**	**3**
AVERAGE	**0**	**0**	**0**	**0**	**0.43**	**0.43**

* These two bat contacts were recorded simultaneously at balloon and ground level detectors. It is therefore deemed likely that the bat (or bats) were recorded when flying at heights between the two detectors.

4. DISCUSSION

4.1 Summary of results

Only Leisler's bat was recorded at height, with three bats recorded from the balloon level detector during the seven nights of survey. Two of these three contacts were recorded simultaneously at the ground level detector meaning that these contacts were probably of a bat or bats flying at a height between the two detectors. It therefore follows that these contacts are likely to have been from bats flying at potential rotor-swept heights. This survey therefore recorded Leisler's bat contacts at potential rotor-swept heights at an activity index of 0.43 contacts per night, on calm, dry nights.

It is noteworthy that no other species (in particular noctule, common pipistrelle or soprano pipistrelle) were recorded at height during the survey. This may be because of the small number of nights of recording at height. Although these species have been shown to fly at rotor-swept heights at other sites, activity at height at Over Hill by these species was too low to have been detected by this survey.

The number of Leisler's bat contacts recorded during the height survey is within the range previously recorded during ground based surveys conducted by LUC in 2014 (between 0.0 and 1.4 Leisler's bat contacts per night when averaged across all sample locations; between 0.2 and 0.9 Leisler's bat contacts per night when averaged across six survey months) and is therefore considered representative of the results for the wider site. The number of contacts by other species is the same or lower than those recorded in 2014 (overall average of 1.08 contacts per night attributed to soprano pipistrelle; 0.83 contacts per night of common pipistrelle; 0.18 contacts per night of *Myotis* bats; 0.37 contacts per night of Daubenton's bat; 0.05 contacts per night of whiskered bat; and 0.03 contacts per night of Noctule).

4.2 Potential impacts to bats resulting from the operation of turbines at Over Hill wind farm

The main potential effects to bats from the operation phase of wind farms are from injury or death to bats through collision or barotrauma. Barotrauma injuries occur when bats fly near to a moving turbine blade and suffer internal haemorrhaging as a result of the rapidly decreasing air pressure in the lee of the turning blade (Baerwald *et al.,* 2008). There is evidence from North America and continental Europe that both single large wind turbines and multiple turbine wind farms can have direct effects on bats and bat populations (Hundt, 2012). There is little current evidence of the impacts of wind turbines on bats in the UK,

although soprano pipistrelle, common pipistrelle, Nathusius' pipistrelle and noctule bats have been found dead beneath on-shore turbines (Fiona Mathews[2] pers comm.).

The ecology of Leisler's bats may predispose them to interactions with turbine blades because they typically fly in open habitats for both foraging as well as commuting (Harris and Yalden, 2008). As relatively large-winged bats they are capable of flying in windier conditions than smaller species, meaning that they may be in the collision risk zone when turbines are operational. However, whilst capable of flying in open habitats at height, studies have shown that typically 90% of *Nyctalus* bat flights are near to the ground (Jones *et al* 2009, Mathews *et al* 2012). Additionally, FDM Ecology has identified the same pattern when surveying for wind farms in South West Scotland: a metmast study conducted over 87 nights in 2012 recorded 55 *Nyctalus* contacts at ground level compared to 5 recorded at 77.5m.

Korner-Nievergelt *et al* (2013) studied bat carcasses at 30 wind turbines from 15 wind facilities in Germany and showed that the maximum mortality occurred at wind speeds between 3.5 and 5.7ms^{-1}. Other studies in the USA have shown that the majority of injurious bat activity around turbines occurs at wind speeds of below 5.5ms^{-1} (Baerwald *et al*, 2009) and 5ms^{-1} (Arnett *et al*, 2011).

All surveys at Over Hill were completed when wind speeds were up to 5.6ms^{-1} (measurements taken at approximately 2m above ground level).

4.3 Recommendations for mitigating potential impacts to Leisler's bat at Over Hill wind farm

Mitigation is likely to be required to prevent injury or injury to bats at Over Hill, in particular by ensuring a suitable standoff between woodland edge and turbine blades. Guidelines (Natural England 2014) stipulate a minimum of 50m between the rotor swept area and high value bat habitat (woodland edge, rivers and hedgerows), although this may be greater in some situations. For example, FDM Ecology have shown in one previous study conducted in South West Scotland during 2014 that the number of *Nyctalus* species contacts measured at ground-level detectors at 70m from plantation edge was 44% of that measured at the plantation edge. Activity by *Nyctalus* bats levelled at between 32% and 34% of that recorded at plantation edge at distances of 100m, 200m and 300m from the plantation edge. A minimum stand-off distance of 100m between the rotor swept area and plantation edge at Over Hill is therefore recommended in respect of known flight behaviour of Leisler's bat in this part of Scotland.

In addition, to ensure that the potential for bats to be injured or killed by the operation of a wind farm at Over Hill, a wind turbine cut-in speed should be considered. This would involve shutdown of turbines at lower wind speeds to limit potential impacts to bats. The periods to such measures would be applied would be limited to dusk and night-time periods at particular times of year, likely to be between July and September inclusive. A cut in speed of 6ms^{-1} measured at 25m above ground level would limit potential impacts to Leisler's bat at Over Hill.

[2] Research Project Leader, University of Exeter: Effects of wind turbines on bat populations in the UK (Defra, Scottish Natural Heritage, Countryside Council for Wales, RenewableUK)

The full suite of any required mitigation should consider the results of this height survey, together with spatial data collected in 2014 within the full Environmental Impact Assessment.

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