Appendix 6.5

Bat Activity Survey Report

Springwell Solar Farm

Bat Activity Survey Report

July 2023 v0.0
Springwell Energyfarm Ltd

Quality information:

Prepared by	Checked by	Verified by	Approved by
TC Associate Director	**PR** **Director**	FL Principal Ecologist	**PR** **Director**

Prepared for:

Springwell Energyfarm Ltd

Prepared by:

RSK Biocensus
Spring Lodge, 172, Chester Road, Helsby, Frodsham, WA6 0AR
www.rskbiocensus.com

Table of Contents

1. Introduction

1.1. Purpose of this report

1.1.1. This report describes the results of static detector bat surveys undertaken to obtain baseline ecological information. This information has been used to inform the Ecological Impact Assessment (EcIA) and Environmental Statement (ES) for the proposed Springwell Solar farm (the Proposed Development). RSK Biocensus was commissioned by the applicant to carry out the surveys.

1.1.2. The report presents the methods and results of the static detector bat surveys undertaken in 2022 and 2023. The purpose of the surveys was to obtain detailed information regarding bat activity within the Proposed Development. The aims of the surveys were to:

- identify the bat species present;
- assess relative activity levels;
- assess relative abundance.

1.1.3. The following terminology is used throughout this report:

- Site Area – The Solar farm development outlined by the red line boundary including all infrastructure, cables and Solar PV module areas.

1.1.4. The Site Area red line boundary was amended during the course of the surveys; therefore, further bat static detector surveys are being undertaken in spring, summer and autumn of 2023 to collect data on the additional areas – two field parcels at the north-west edge of the Site (adjacent to Gorse Hill covert) and several field parcels near Brauncewell at south-west edge of the Site.

1.1.5. At the time of writing, detailed design information is not available, nor has all data been collected (the additional areas added to the Site boundary are outstanding). Assessment of likely significant effects is therefore not included in this report.

1.1.6. This report will be updated once further surveys have been completed.

1.2. Project proposals

1.2.1. The Proposed Development comprises the construction, operation and maintenance of solar photovoltaic (PV) generating modules, energy storage facilities, and grid connection infrastructure, across a proposed site in North Kesteven, Lincolnshire.

1.2.2. The Proposed Development is located within the administrative boundary of North Kesteven District Council and Lincolnshire County Council.

1.3. Ecological context

1.3.1. The Site Area covers approximately 1,772 ha and is located close to the villages of Blankney, Scopwick, and Ashby de la Launde in the district of

North Kesteven, Lincolnshire. The central section of the site is centred on OS National Grid Reference TF 06151 56947.

1.3.2. The Site is dominated by agricultural land, broadleaved woodland, and hedgerows, and includes a number of ponds, stream and ditches.

1.3.3. The surrounding landscape is largely arable with a mixture of villages, farm complexes, an RAF base, pockets of woodland and some scattered residential properties. Arable fields are bounded by a mixture of hedgerows, lines of trees, stone walls and fences.

1.3.4. A preliminary ecological appraisal (PEA), including a background data search (BDS), was completed by RSK in April and May 2022, with additional parcels surveyed in January 2023 (RSK Biocensus, 2023). Records for at least nine species of bat were received from the BDS.

1.3.5. Habitats within the Site Area were identified as suitable for foraging, commuting and roosting bats during the PEA. However, the overall Site Area was considered to have low suitability for bats.

2. Legislation

2.1. General

2.1.1. This section briefly describes the legal protection afforded to the protected species referred to in this report. It is for information only and is not intended to be comprehensive or to replace specialised legal advice. It is not intended to replace the text of the legislation but summarises the salient points.

2.2. Bats

2.2.1. All species of bats are protected by The Wildlife and Countryside Act (WCA) 1981 (as amended), extended by the Countryside and Rights of Way Act 2000. Under Section 9 of the WCA, for 'European Protected Species' (EPS; see below) listed on Schedule 5, which includes bats, it is an offence to:

- intentionally or recklessly obstruct any place that a wild bat uses for shelter or protection;
- intentionally or recklessly disturb any wild bat while it is occupying a structure or place that it uses for shelter or protection; or
- publish, or cause to be published, any advertisement likely to be understood as conveying that they buy or sell, or intend to buy or sell, any live or dead wild bat or any part of, or anything derived from a wild bat.

2.2.2. Bats are also EPS listed on The Conservation (Natural Habitats, & c.) Regulations 2017 (as amended). This legislation makes it an offence to:

- deliberately capture, injure or kill such a bat;
- deliberately disturb bats, including in particular any disturbance which is likely (a) to impair their ability – (i) to survive, to breed or reproduce, or to rear or nurture their young; or (ii) hibernate or migrate, where relevant; or (b) to affect significantly the local distribution or abundance of the species to which they belong;
- damage or destroy a breeding site or resting place of a bat; or
- possess, control, transport, sell, exchange, or offer for sale or exchange any live or dead bat or part of a bat or anything derived from a bat or any part of a bat.

2.2.3. Additionally, certain species are afforded additional protection as an Annex II species (under the Habitats Directive) for which Special Areas of Conservation (SACs) may be designated. Of these, only barbastelle (*Barbastella barbastellus*) are present in Lincolnshire.

3. Methodology

3.1. General

3.1.1. The work described below was undertaken following current best practice guidance within Bat Conservation Trust: Good Practice Guidelines 3rd edition (Collins, 2016). Where methodologies deviate from Collins (2016), then this has been detailed and fully justified below.

3.2. Background Data Search

3.2.1. To provide context for the results of the bat surveys, a background data search (BDS) was carried out for biological records from the Greater Lincolnshire Nature Partnership. The BDS was undertaken in April 2022 for the production of a PEA report (RSK Biocensus, 2023). A search was made for information on statutory designated sites and non-statutory designated (local wildlife) sites within 2 km of the survey area boundary. The search was extended to 10 km for internationally designated sites i.e., Ramsar sites, Special Areas of Conservation (SAC), Special Protection Areas (SPA). The search included a 2 km radius for notable species such as bats.

3.3. Static Detector Surveys

3.3.1. The Site Area was determined to have 'low' suitability to support foraging and commuting bats during the PEA (RSK Biocensus, 2023), and therefore surveys were timed to cover the three active seasons of spring (April – May), summer (June – August), and Autumn (September - October).

3.3.2. Due to the size of the Site Area and project proposals, it was determined that the emphasis of the survey should be on collecting data across as much of the Site as possible; therefore the detector locations changed during each deployment.

3.3.3. Full spectrum Wildlife Acoustics Song Meter 4 (SM4) detectors with omnidirectional microphones were deployed within the study area. Each microphone was mounted at a minimum height of 2 m to maximize the probability of recording bat calls and reduce the likelihood of noise interference from insects and moving vegetation.

3.3.4. Detectors were deployed across the study area to cover different habitats and topographical features including improved grassland, arable crop, hedgerows and woodland edges. Detectors were deployed in suitable weather conditions for bats where possible. Each detector recorded bats from sunset to sunrise with detectors starting 30 minutes before sunset and finishing 30 minutes after sunrise. Table 1 provides dates of deployments, Table 2 provides weather conditions during deployments and Figure 1 shows the location of the monitoring points.

3.3.5. Detectors were deployed for a minimum of five complete nights of good weather, (in line with Collins, 2016). Survey dates were spaced out where possible between deployments at each monitoring point. In addition,

detectors were deployed when the predicted weather forecast indicated suitable weather conditions for foraging and commuting bats (i.e., air temperature above 8°C, wind speed below 5 m/s and light or no precipitation).

3.3.6. Collins (2016) states the minimum level of pre-application survey required using static detectors is five nights in each of: spring (April-May), summer (June-mid-August) and autumn (mid-August-October). Dates and environmental conditions are set out in Table 1 below.

Table 1: Survey dates for each static detector deployment

Month	Start date	End date	Notes
August	09/08/2022	15/08/2022	12 detectors deployed, (although two failed so only 10 recorded)
October	05/10/2022	10/10/2022	12 detectors deployed
April	19/04/2023	24/04/2023	10 detectors deployed

Table 2: Weather conditions for each static detector deployment

Month of monitoring	Minimum temperature at sunset (˚C)	Maximum temperature at sunset (˚C)	General weather during monitoring period	Number of nights with rain
August 2022	18	24	Warm and dry throughout period	0
October 2022	14	16	Cloudy but dry with warm spells	0
April 2023	7	9	Clear and dry at start of deployment, scattered light showers in last two nights	2

3.4. Data analysis and quality assurance

3.4.1. Due to the large volume of static data, the manual identification of recorded calls was not considered a practicable or efficient use of time. Consequently, the British Trust for Ornithology's Acoustic Pipeline (BTO AP) auto-identification software was used with additional manual auditing applied as necessary.

3.4.2. The BTO AP recommends that recordings with probabilities lower than 0.5, as discussed by Barré *et al.* (2019), are discarded (after checking as appropriate) and are therefore not included within this report.

3.4.3. Manual quality assurance was undertaken on all calls that were auto-identified as being from non-pipistrelle or *Myotis* species, with the exception of Nathusius' pipistrelle *Pipistrellus nathusii* calls, which were also manually checked.

3.4.4. The BTO pipeline software is highly efficient at identifying bat calls from the genus *Pipistrellus* due to the extensive library of bat calls stored within the software. It is also currently the only system that considers the sound identification of bat social calls, reducing the chance of social calls being mis-identified as the wrong bat species.

3.4.5. Echolocation calls were identified down to species wherever possible; however, depending on the type of bat encountered and call recorded, it is not always possible to reliably identify all bats beyond their genus. In particular, because of the similarities of their frequency-modulated calls, *Myotis* bat species cannot always be reliably separated.

3.4.6. For this reason, *Myotis* calls were not manually checked, as they are difficult to accurately differentiate.

3.4.7. All manual quality assurance (QA) of recorded calls was carried out by experienced bat ecologists using sound analysis software (R Shiny).

3.4.8. Note that it can also be difficult to separate some calls of *Plecotus* (long-eared) bats as well as separating some *Plecotus* calls from *Myotis* bats - although only one species of *Plecotus* (*P. auratus)*, the brown long-eared bat) is present in Lincolnshire. It can also be difficult to distinguish between the two bats in the *Nyctalus* genus (noctule *N. noctula* and Leisler's bat *N. leisleri*), with those of serotine (*Eptesicus serotinus*). Some calls of common pipistrelle (*Pipistrellus pipistrellus*) also overlap with either Nathusius' pipistrelle or soprano pipistrelle (*P. pygmaeus*). Analysis of cryptic calls can also be more difficult with faint or poor-quality recordings.

3.4.9. It should be noted that there are a number of variables that affect the 'detectability' of a bat call, ranging from their biology and ecology, to the environmental conditions and condition of the equipment, and so there are limitations in drawing certain conclusions about bat activity on a site from the use of bat detectors / sound analysis alone. Given the different detectability between different species of bats i.e. from a few meters (for the quietest species such as brown long-eared bats) up to 100m (for noctule), the percentage distributions of units of activity (recordings containing a particular species' calls) detected should not be extrapolated to estimate abundance or compare levels of relative activity between species groups.

3.4.10. Caution should be exercised when reviewing the results as the number of recordings does not equate to the number of individual bats, and therefore assumptions cannot be made about species populations.

3.5. Validity of Data

3.5.1. Data collected is usually valid for two years following the field survey, to provide evidence that is material to the planning determination. Should consent not be awarded within two years of the completed surveys, then

it may be necessary to confirm that there have not been material changes before planning is determined.

3.6. Survey Constraints

3.6.1. It was not considered that walked transect surveys would provide data of value for this project given the low suitability of the habitat, scale of the Site Area and lack of suitable roosting locations within majority of the Site. This is a deviation from the current survey guidance (Collins, 2016), but it is justified by significant levels of remote monitoring data, and the subsequent findings. In addition, further night time surveys are proposed to ground-truth results of interest generated from the static detector surveys to provide further data. This is discussed in Chapter 6.

3.6.2. As the detectors moved location each month, it was not possible to do a direct seasonal comparison of locations. However, moving the detectors allowed for a greater coverage of the Site Area and the results collected are considered sufficient to inform a robust risk assessment when required.

3.6.3. Two detectors failed during deployment in Locations 7 and 9 during deployment in August, with no recordings made. In April, only ten detectors deployed. This is not considered a significant constraint given the assemblage of bats that was recorded across the surveys and the objective of the surveys.

3.6.4. While presence/ absence of different species in the genera *Myotis*, *Plecotus* and *Nyctalus* is now becoming easier to ascertain where high-quality calls have been collected, there are always calls where certainty is not possible and therefore levels of bat activity by species (rather than genus) must be interpreted with a degree of caution.

3.6.5. *Myotis* spp. and some large bat calls were only identified to genus level. It is possible that some of these recordings could represent species not identified in the analysis of the recorded data.

3.6.6. Due to passive (static) monitoring methodologies depending on sound reaching the microphone, the detection rate of bat calls varies with a bias towards loud bat calls; with quieter calls, namely brown long-eared bats potentially being under-recorded.

4. Results

4.1. Background Data Search (BDS)

4.1.1. There were no internationally protected nature conservation sites within 10 km of the site boundary nor nationally protected statutory designated nature conservation sites within 2km.

4.1.2. The results of the 2 km search for bat species are provided in Table 3 below.

4.1.3. At least nine species of bats have been recorded within 2 km of the Site Area, with additional records also returned which were not identified to species level. All species have been recorded within the past 10 years, although number of records includes all records for the species / genus held by the records centre.

Table 3: BDS bat results

Scientific name	Common name	Number of records	Most recent record
Barbastella barbastellus	Western barbastelle	15	2016
Chiroptera	Unidentified bat	468	2020
Myotis daubentonii	Daubenton's	5	2015
Myotis mystacinus / brandtii	Whiskered / Brandt's	4	2019
Myotis nattereri	Natterer's	8	2016
Myotis species	Unidentified Myotis species	17	2017
Nyctalus noctula	Noctule	28	2019
Pipistrellus nathusii	Nathusius's pipistrelle	5	2017
Pipistrellus pipistrellus	Common pipistrelle	76	2019
Pipistrellus pygmaeus	Soprano pipistrelle	34	2020
Pipistrellus species	Unidentified pipistrelle species	108	2020
Plecotus auritus	Brown long-eared bat	83	2019

4.1. Static detector results

4.1.1. Tables 4-6 below show the combined static data recorded from each location. Locations for each deployment are show in Figure 1.

4.1.2. A total of 20,239 call registrations were recorded over the survey period, from at least ten species. These were common pipistrelle (69.9% of total call registrations), soprano pipistrelle (9%), species in the *Myotis* genus (9.7%), barbastelle (5%), noctule (4.4%), brown long-eared bat (0.7%),

Leisler's (0.9%), un-confirmed large bat species (0.2%) and Nathusius' pipistrelle (0.04%).

4.1.3. Whilst species within the *Myotis* genus were not counted separately during data analysis due to the similarity and overlapping parameters of their calls, the BTO AP is designed to work at a species level, and the following species were auto-ID'd with probabilities of greater than 0.9, and can be assumed to be present.; Daubenton's *Myotis daubentonii*, Natterer's *M. nattereri*, whiskered / Brandt's *M. mystacinus / m. brandtii*.

4.1.4. Common and soprano pipistrelle accounted for 78.9% of the total calls across the three months. Common pipistrelle was the species with the most call registrations in every month (August 75% of total calls, October 56% and April 92%).

4.1.5. Soprano pipistrelle had the second highest call registrations in October (25.6% of total) and April (5%), whilst *Myotis* species were second highest in August (11.2% of total).

4.1.6. Barbastelle was the only species recorded that is listed under Annexe II of the Habitats Directive, with 1,035 call registrations across the three survey months (5% of total call registrations). Of these 75% of calls were recorded in August, 24% in October and 1.9% in April.

Table 4: August 2022 remote monitoring data

Static #	Bbar	Unconfirmed big bat	Myotis sp.	Nlei	Nnoc	Ppip	Ppyg	Pnat	Paur	TOTAL
S1	3	-	38	2	15	887	5	-	-	**950**
S2	68	12	87	32	126	206	28	1	52	**612**
S3	2	5	16	1	21	506	69	-	-	**620**
S4	12	3	441	14	85	971	4	0	17	**1547**
S5	52	9	365	22	120	1321	13	-	3	**1905**
S6	283	6	275	26	148	2082	14	1	4	**2839**
S8	118	-	22	-	31	407	16	2	16	**612**
S10	42	4	108	1	38	1347	229	-	8	**1777**
S11	176	10	159	5	182	1427	306	-	11	**2276**
S12	9	-	45	-	48	439	88	-	3	**632**
Grand Total	**765**	**49**	**1556**	**103**	**814**	**9593**	**772**	**4**	**114**	**13770**

Note: Bbar = Barbastelle. Unconfirmed big bat = call from the genus *Eptesicus or Nyctalus,* not identified to species level. Myotis sp = Species in Myotis genus. Nlei = Leisler's. Nnoc = Noctule. Ppip = Common pipistrelle. Ppyg = Soprano pipistrelle. Pnat = Nathusius pipistrelle. Paur = Brown long-eared.

Statics 7 and 9 did not record in this month so are not respresented here.

Table 5: October 2022 remote monitoring data

Static #	Bbar	Unconfirmed big bat	Myotis sp.	Nlei	Nnoc	Ppip	Ppyg	Pnat	BLE	TOTAL
S1	89	-	87	20	-	948	7	-	3	**1154**
S2	3	-	13	-	3	8	2	-	-	**29**
S3	4	-	6	-	14	9	1	-	5	**39**
S4	3	-	15	-	-	6	-	-	-	**24**
S5	1	-	6	4	16	69	8	-	-	**104**
S6	6	1	13	-	7	30	3	-	12	**72**
S7	27	-	16	4	6	34	3	-	1	**91**
S8	6	-	8	1	1	17	-	-	1	**34**
S9	21	-	16	2	7	46	-	-	11	**103**
S10	7	-	26	2	12	263	116	1	-	**427**
S11	42	-	16	-	2	301	286	-	2	**649**
S12	41	-	20	2	1	345	508	-	1	**918**
Grand Total	**250**	**1**	**242**	**35**	**69**	**2076**	**934**	**1**	**36**	**3644**

Note: Bbar = Barbastelle. Unconfirmed big bat = call from the genus *Eptesicus or Nyctalus,* not identified to species level. Myotis sp = Species in Myotis genus. Nlei = Leisler's. Nnoc = Noctule. Ppip = Common pipistrelle. Ppyg = Soprano pipistrelle. Pnat = Nathusius pipistrelle. Paur = Brown long-eared.

Table 6: April 2023 remote monitoring data

Static #	Bbar	Unconfirmed big bat	Myotis sp.	Nlei	Nnoc	Ppip	Ppyg	Pnat	BLE	TOTAL
S4	4	-	6	-	2	85	-	-	-	**97**
S5	-	-	1	-	-	42	1	-	-	**44**
S6	7	-	5	-	-	139	-	-	-	**151**
S7	-	-	1	4	1	68	-	2	-	**76**
S8	-	-	5	-	-	-	-	-	-	**5**
S9	-	-	35	-	-	136	-	1	1	**173**
S10	2	-	16	-	2	11	-	-	-	**31**
S11	1	-	7	2	1	37	2	-	-	**50**
S12	1	-	7	-	-	1751	64	-	1	**1824**
S13	5	-	43	1	13	246	66	-	-	**374**
Grand Total	**20**	**0**	**126**	**7**	**19**	**2515**	**133**	**3**	**2**	**2825**

Note: Bbar = Barbastelle. Unconfirmed big bat = call from the genus *Eptesicus or Nyctalus,* not identified to species level. Myotis sp = Species in Myotis genus. Nlei = Leisler's. Nnoc = Noctule. Ppip = Common pipistrelle. Ppyg = Soprano pipistrelle. Pnat = Nathusius pipistrelle. Paur = Brown long-eared.
The 10 detectors deployed this month are numbers 4 -13 during this deployment.

5. Evaluation

5.1. Activity levels

5.1.1. The surveys recorded a total of 20,239 call registrations across three months of deployment covering three seasons.

5.1.2. Bat activity (based on number of call registrations) peaked in August, with 68% of the total recordings from the three months. This is despite two of the detectors, at Locations 7 and 9, failing during this deployment.

5.1.3. October recorded 18% of total call registrations, whilst April was the quietest month with only 13.9% of call registrations. It should be noted that October was the only month with 12 operating detectors. If detectors 7 and 9 are removed to emulate August data, October still remains the second busiest month with 17.2% of total call registrations.

5.1.4. October and April are transitional months and, on an open site, are normally quieter than the summer months. The weather in April consisted of cool temperatures with intermittent rain showers, and this may have impacted recorded activity levels.

5.1.5. Activity was recorded in similar levels across the Site Area.

5.2. Species assemblage

5.2.1. At least ten species were recorded across the Site Area. Common pipistrelle had the highest number of call registrations across the survey period, with 69.9% of total calls, and was the most recorded species in each month (this is not unusual). October was the month with the fewest recorded call registration for this species (2,076) and the lowest percentage of total calls (56%). In April, which had the lowest levels of overall activity, common pipistrelles made up 92% of all call registrations.

5.2.2. Soprano pipistrelle made up 9% of the total recordings, and was the second most recorded species in October and April.

5.2.3. These two species account for 78.9% of total call registrations (this should not be conflated to individuals or individual species).

5.2.4. *Myotis* species recorded included Daubenton's, Natterer's and whiskered/Brandts bats. However, the BTO Acoustic Pipeline software attributed only one call to Brandt's, and 191 call registrations to whiskered bats. For the purposes of this report, they are not distinguished.

5.2.5. Call registrations from *Myotis* species, when grouped together, accounted for 9.7% of the total across the survey period. Activity for this group peaked in August, with 1556 call registrations attributed to *Myotis* species, 11.2% of total calls for the month. The BTO Acoustic Pipeline software allocated the majority of these calls (905) to Daubenton's bat, although this has not been verified manually.

5.2.6. Barbastelle was recorded in all three seasons, and on every static detector in August and October. August accounted for 75% of the total calls for the species. Barbastelle accounted for 5% of the total call registrations across the survey periods.

5.2.7. Static 6, located at TF 03906 56089, accounted for 36% of all the barbastelle call registrations in August. This detector was located on a farm track bordered by a low dry stone wall, surrounded by arable fields, which would be considered sub-optimal habitat for barbastelle, although it lies between two parcels of woodland (630m west and 1.7km east respectively). The earliest recorded call was at 22:10, approximately 1.5 hours after sunset, and the latest was 04:03, approximately 1.5 hours prior to sunrise. Average calls per night was 55 (range 88 – 56).

5.2.8. In August the earliest calls after sunset were recorded at detectors 10 and 11, approximately 68 minutes after sunset. The latest calls were at the same two locations and were recorded between 70 and 79 minutes before sunrise.

5.2.9. Barbastelle can range up to 20km per night to forage, and emergence times are normally within 60 minutes of sunset (range of 12-36 minutes after sunset within woodland), whilst roost return times are highly variable (range of 194 – 59 minutes before sunrise) (Zeale et al. 2012).

5.2.10. The data shows that barbastelle are commuting across the Site Area, and there will be at least one roosting location within the vicinity. The calls closest to sunrise at detectors 10 and 11 in August would suggest a roost nearby, although due to the variability in roost return times, roosting locations in or adjacent to other locations can't be ruled out.

5.2.11. Low numbers of noctule registrations were recorded on all surveys, with August accounting for 90% of recordings.

5.2.12. Leisler's bat was also recorded in low numbers in all months, and from detectors located across the Survey Area.

5.2.13. The BTO Acoustic Pipeline software attributed 50 calls to serotine. Many of the serotine call parameters overlap with those of Leisler's bat, and to some extent, with those of noctule. Serotine are thought to be absent from Lincolnshire (GLNP, 2013; LBP, 2011; Matthews *et al.*, 2018) and, as none of the calls could be consistently identified as serotine, those calls have been labelled as unconfirmed big bat species within the report. It is likely that they are in fact Leisler's bat calls.

5.2.14. Small numbers of brown long-eared calls were recorded across the survey periods, totalling 151 call registrations (0.7% of total registrations). Of these 114 (75%) were recorded within August. Brown long-eared bats are a very quiet bat with a directional call. It is therefore likely that this is an under-representation of their presence within the Site Area.

5.2.15. Nathusius' pipistrelles were recorded at very low numbers at statics across the Site Area, within the three survey periods. In total they accounted for 0.04% of the total call registrations and four was the highest number of registrations recorded, in August.

5.3. Site appraisal

5.3.1. The combined results of the static surveys confirm the site is of high importance for foraging and commuting bats. The surveys recorded a high diversity of species across the site; with at least 10 of the 12 species

considered to be present within Lincolnshire having being positively identified.

5.3.2. Although the landscape is mostly intensively farmed arable, which is normally considered to offer sub-optimal foraging habitat, the hedgerows, (where bat activity was mostly recorded), are of value to bats.

5.3.3. In an agricultural landscape with limited natural features, those that are present can have greater importance. The hedgerows, woodland edges and watercourses on Site are used as foraging and commuting corridors for bats, and likely offer key commuting routes in between natural features such as pockets of woodland.

5.3.4. In line with the updated (due to be published in 2023) version of the Bat Mitigation Guidelines, the assemblage of species within this geographic region of the UK could be considered of national importance (the likely low numbers of some species would indicate at least regional importance).

5.3.5. Given the relatively high barbastelle activity, the fact that this species was recorded across the Site Area and the significant peak in August (around the maternity season) it is considered that the area could be of regional importance for this species.

5.3.6. The Site Area is assessed as of local value for the remaining species identified.

5.4. Solar farms and bat risks

5.4.1. There is limited UK-specific research into the impacts of solar farms on bats; however studies in other countries suggest that there are several potential impacts.

5.4.2. A study in Hungary (Szabadi *et al*., 2023) identified that solar farms had similar bat activity and species assemblages to intensely cultivated arable land, implying that they are similar to the poorest rural landscape for bats. In addition, solar farms appeared to have reduced species diversity when compared to natural habitats, with species found to use solar farms generally those that are also successful in urbanised or intensive agricultural habitats such as species from the genus *Nyctalus* and *Pipistrellus*. Species such as barbastelle and those from the *Myotis* genus were found to use solar farms less frequently.

5.4.3. It was noted that the presence of linear features such as hedgerows or lines of trees can have a positive effect on bat activity, when managed appropriately (Froidevaux *et al*., 2019).

5.4.4. Solar panels can horizontally polarize light and reflect sound in a similar way to water; this may lead to bats mistaking panels for waterbodies when using echolocating, encouraging them to attempt to drink from the panel surfaces, which can cause collisions and potential injuries (Greif and Siemers, 2010). Fortunately, studies have found that bats tend to land on the panels to drink rather than colliding (i.e. non-fatal interaction), they also show signs of learnt behaviour by eventually avoiding the panels following several unsuccessful drinking attempts (Greif and Siemers, 2010; Russo *et al.,* 2012).

5.4.5. Collisions between bats and solar panels may also occur for other reasons. Vertically aligned plates can induce higher collision risk during flight as the smooth vertical surfaces can be interpreted as open flight paths due to acoustic mirror properties interfering with echolocation (echoes not returned to the bat but reflected between the panels). There is a possibility that bats could learn to navigate these 'holes' in the landscape; however tilting the panels is likely to provide a more effective preventative measure (Greif et al., 2017; Montag et al., 2016; Toussaint, 2016).

5.4.6. The horizontal polarization of light by solar panels could also impact a bat's insect prey, as several aquatic insect species show strong attraction to panels and subsequently exhibit oviposition on the surfaces, leading to inviable offspring and increasing predation risk (Egri *et al*., 2016; Farkas *et al*., 2016; Gibson *et al*., 2017; Horvath *et al*., 2010). The population-level effects of solar farms on aquatic insects are currently unknown. If they do prove to lead to population declines, then UK bats could be at risk as several species are highly reliant on aquatic insects as a food source (e.g. *Myotis* spp., *Pipistrellus* spp. and *Nyctalus leisleri*) (Wickramasinghe *et al*. 2004).

5.4.7. Other general potential impacts of solar farms on bats include disturbance during construction and operation of solar farms due to noise and light pollution, as well as habitat degradation and fragmentation as a result of water and soil pollution, tall panels interrupting flight paths, vegetation clearance and water body drainage, which can reduce bat insect prey availability, drinking water sources and bat socialising and commuting habitat (Toussaint, 2016). There may also be indirect effects to bats via solar farms inducing environmental change over the long-term, for example, the formation of microclimates, reductions in plant biomass (particularly under the panels) and top soil destabilisation (Armstrong *et al.*, 2016; Fthenakis *et al.,* 2011; Gibson *et al.,* 2017; Montag *et al*., 2016; Toussaint, 2016; Tsoutos *et al.,* 2005).

5.4.8. Cumulative impacts, due to any number of the above reasons, may have the potential to impact an individuals ability to survive or breed in the long term, and could be significant to the local, regional and even national populations. This is because bats are long-lived, and their reproductive rate is low.

5.5. Potential Impacts of the Scheme

5.5.1. The design details are currently at an early stage and therefore it is not possible to fully assess likely significant effects. Potential impacts which may occur include removal of hedgerows, which could disrupt flight paths and foraging areas, removal of trees used as roosts or, if not mitigated, disturbance to roosts during works and installation of artificial lighting.

Recommendations

5.5.2. At this stage, it is not possible to provide definitive recommendations for the scheme in relation to mitigation for bats . The recommendations that are provided below are in relation to the observations noted during the survey carried out in 2022 / 2023, with the intention of supporting the development of the outline design and scoping for future work stages.

5.5.3. The recommendations detailed thereafter are high-level based on the current understanding of the bats' use of the site

Hedgerow removal

5.5.4. Any hedgerow removal required to facilitate construction should be kept to a minimum. Where hedgerow removal is required, this should be of a temporary nature wherever possible, and artificial screens may need to be installed to ensure continuity of bat flight lines during construction.

Further surveys

5.5.5. Further targeted survey effort is recommended to ground-truth certain areas of the Site. Targeted night-time walkovers (similar to a transect survey) should be completed on those areas where barbastelle activity was highest, and areas where greatest impacts are proposed (i.e. if any significant removal of hedgerows is required or other features used by commuting or foraging bat). These walkover surveys should take place at times to match levels of peak bat activity recorded on the Site.

5.5.6. Once further information is available on the proposed design, additional surveys may be required to inform on specific features. These surveys may include targeted nighttime walkovers, inspections of trees to be impacted (felled or disturbed) and additional remote monitoring of specific locations / features.

Lighting

5.5.7. All UK bat species are nocturnal and adapted to low-light conditions and the artificial lighting of areas in which they are active affects their activities. Artificial lighting can affect the entire composition of local bat communities at the ecosystem level (Rydell, 1992), having a large impact on light-averse species (such as *Myotis*).

5.5.8. Ultimately, there is no "light threshold" where adverse effects on bats from artificial light are negligible (Stone, 2013) and so it is important to achieve the minimal possible illumination levels, particularly when bats are most active from April to October, and particularly where 'light-averse' species are recorded.

5.5.9. A full moon under clear, natural conditions is 0.1 to 0.3 lux, and so where complete 'natural' darkness cannot be ensured on a site, illumination levels should aim to fall within this range wherever possible.

5.5.10. It is understood that no permanent lighting is proposed and that any manually operated lighting would only be used infrequently, in welfare or

compound areas when needed to work during the hours of darkness. This lighting would be directed downwards and away from hedgerows, woodland and watercourses to avoid impact to bats which may use them for foraging/commuting and any trees which they may use for roosting. Any such lighting, being of short-term and infrequent use, should also not cause significant loss of invertebrate prey from hedgerows (i.e. by causing them to be attracted to the light).

6. References

6.1.1. Armstrong, A., Ostle, N. J., & Whitaker, J. (2016). Solar park microclimate and vegetation management effects on grassland carbon cycling. Environmental Research Letters, 11(7), 074016. https://doi.org/10.1088/1748-9326/11/7/074016

6.1.2. Barré, K., Le Viol, I., Julliard, R., Pauwels, J., Newson, S.E., Julien, J., Claireau, F., Kerbiriou, C., Bas, K. (2019) Accounting for automated identification errors in acoustic surveys. *Methods Ecol Evol*. 2019; 10,1171-1188.

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

6.1.4. Egri, Á., Farkas, A., Kriska, G., & Horváth, G. (2016). Polarization sensitivity in Collembola: An experimental study of polarotaxis in the water-surface-inhabiting springtail *Podura aquatica*. Journal of Experimental Biology, 219(16), 2567–2576. https://doi.org/10.1242/jeb.139295

6.1.5. Farkas, A., Száz, D., Egri, Á., Barta, A., Mészáros, Á., Hegedüs, R., Horváth, G., & Kriska, G. (2016). Mayflies are least attracted to vertical polarization: A polarotactic reaction helping to avoid unsuitable habitats. Physiology and Behavior, 163, 219–227. https://doi.org/10.1016/j.physbeh.2016.05.009

6.1.6. Fthenakis, V., Blunden, J., Green, T., Krueger, L., & Turney, D. (2011). Large photovoltaic power plants: Wildlife impacts and benefits. Conference Record of the IEEE Photovoltaic Specialists Conference, 002011–002016. https://doi.org/10.1109/PVSC.2011.6186348#

6.1.7. Froidevaux, J., Boughey, K., Hawkins, C., Broyles, M., Jones, G. (2019). Managing hedgerows for nocturnal wildlife: Do bats and their insect prey benefit from targeted agri-environment schemes? Journal of Applied Ecology, 56, 1610-1623.

6.1.8. Gibson, L., Wilman, E. N., & Laurance, W. F. (2017). How Green is 'Green' Energy? In Trends in Ecology and Evolution (Vol. 32, Issue 12, pp. 922–935). Elsevier Ltd. https://doi.org/10.1016/j.tree.2017.09.007

6.1.9. Greater Lincolnshire Nature Partnership (2013). Bats: An assessment of current status in Greater Lincolnshire. https://glnp.org.uk/images/uploads/news/status-of-bats-in-lincolnshire-march-2013.pdf

6.1.10. Greif, S., & Siemers, B. M. (2010). Innate recognition of water bodies in echolocating bats. Nature Communications, 1(8). https://doi.org/10.1038/ncomms1110

6.1.11. Greif, S., Zsebok, S., Schmieder, D., & Siemers, B. M. (2017). Acoustic mirrors as sensory traps for bats. Science, 357(6355), 1045–1047. https://doi.org/10.1126/science.aam7817

6.1.12. Horváth, G., Blahó, M., Egri, Á., Kriska, G., Seres, I., & Robertson, B. (2010). Reducing the maladaptive attractiveness of solar panels to polarotactic insects. Conservation Biology, 24(6), 1644–1653. https://doi.org/10.1111/j.1523-1739.2010.01518.x

6.1.13. Lincolnshire Biodiversity Partnership (2011). Lincolnshire Biodiversity Action Plan 2011 – 2020 (3rd edition). http://www.southkesteven.gov.uk/CHttpHandler.ashx?id=7371&p=0

6.1.14. Mathews F, Kubasiewicz LM, Gurnell J, Harrower CA, McDonald RA, Shore RF. (2018) A Review of the Population and Conservation Status of British Mammals: Technical Summary. A report by the Mammal Society under contract to Natural England, Natural Resources Wales and Scottish Natural Heritage. Natural England, Peterborough

6.1.15. Montag, H.B., Guy Parker, D., Clarkson, T., & Montag, H. (n.d.). The effects of solar farms on local biodiversity: a comparative study.

6.1.16. RSK Biocensus (2023). 2483765 Springwell Solar Farm Preliminary Ecological Appraisal Report.

6.1.17. Russ, J. (2012). British Bat Calls: *A guide to species Identification*. Pelagic Publishing.

6.1.18. Russo, D., Cistrone, L., & Jones, G. (2012). Sensory Ecology of Water Detection by Bats: A Field Experiment. PLoS ONE, 7(10). https://doi.org/10.1371/journal.pone.0048144

6.1.19. Rydell, J., (1992) Exploitation of insects around streetlamps by bats in Sweden. Functional Ecology 6, 744-750.

6.1.20. Stone, E.L. (2013) Bats and lighting: Overview of current evidence and mitigation guidance. University of Bristol.

6.1.21. Szabadi, K., Kurali, A., Rahman, N., Froidevaux, J., Tinsley, E., Jones, G., Görföl, T., Estók, P., Zsebők, S. (2023). The use of solar farms by bats in mosaic landscapes: Implications for conservation. Global Ecology and Conservation. https://doi.org/10.1016/j.gecco.2023.e02481

6.1.22. Toussaint, D. C. (2016). Chiropteran Specialist Report for the Proposed Soventix Solar Power Plant, Hanover, Northern Cape.

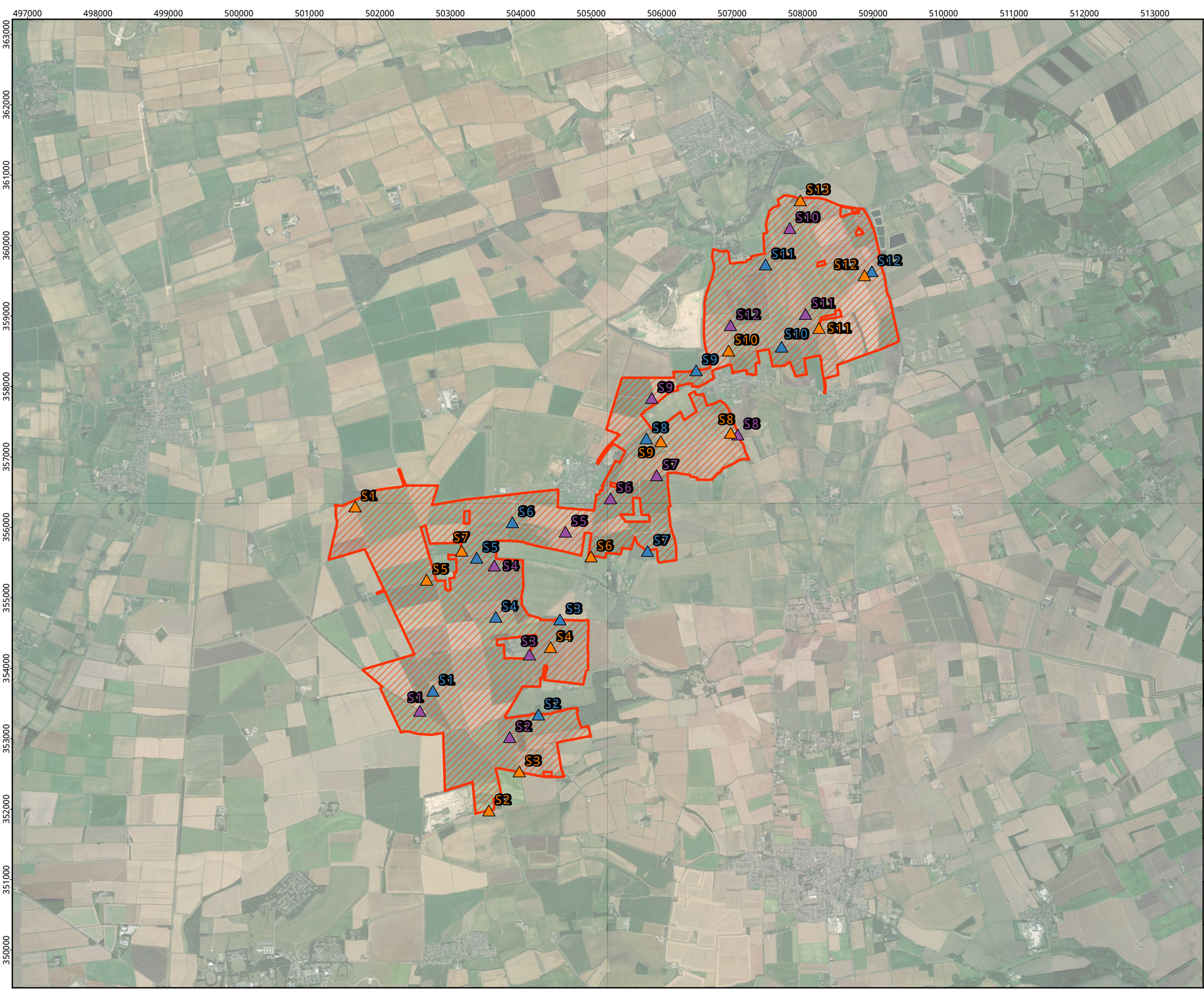
6.1.23. Tsoutsos, T., Frantzeskaki, N., & Gekas, V. (2005). Environmental impacts from the solar energy technologies. Energy Policy, 33(3), 289–296. https://doi.org/10.1016/S0301-4215(03)00241-6

6.1.24. Wickramasinghe, L. P., Harris, S., Jones, G., & Jennings, N. V. (2004). Abundance and Species Richness of Nocturnal Insects on Organic and Conventional Farms: Effects of Agricultural Intensification on Bat Foraging 1284 Insects on Organic and Conventional Farms Wickramasinghe et al. In Conservation Biology (Vol. 18, Issue 5).

6.1.25. Zeale, M., Davidson-Watts, I., & Jones, G. (2012). Home range use and habitat selection by barbastelle bats (*Barbastella barbastellus*): implications for conservation. Journal of Mammalogy 93(4): 1110-1118

Figure 1

Static Detector Locations



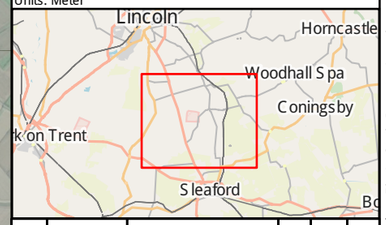
LEGEND:

Site Boundary

Survey

- August 2022
- October 2022
- April 2023

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



Rev	Date	Description	Drn	Chk	App
00	09/08/2023	First Draft	RJ	EC	TC

Springwell Solar Farm

DOCUMENT:
Appendix 5.4 Bat Activity Report

TITLE:
Static Detector Locations

FIGURE NUMBER:
1

0 0.5 1
Kilometers

Scale: 1:50,000 @ A3

REV 00

Path: RSK Group\RSK Biocensus - 06 GIS - 2483765 - EDF Solar Springwell\03 - APRX \2483765 - Springwell Solar - Fig 1 - Static Detector Locations - Rev 00.aprx

Figure 2

Bat species diversity per static in August 2022

500000 501000 502000 503000 504000 505000 506000 507000 508000 509000 510000

360000 359000 358000 357000 356000 355000 354000 353000 352000

S11 (8)
S12 (6)
S10 (8)
S8 (7)
S6 (9)
S5 (8)
S4 (8)
S3 (7)
S1 (6)
S2 (9)

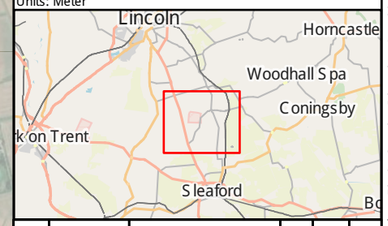
LEGEND:

Site Boundary

Species Count

1
2
3
4
5
6
7
8
9

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



Rev	Date	Description	Drn	Chk	App
00	09/08/2023	First Draft	RJ	EC	TC

Springwell Solar Farm

DOCUMENT:
Appendix 5.4 Bat Activity Report

TITLE:
Species Diversity - August 2022

FIGURE NUMBER:
2

0 0.5 1
Kilometers

Scale: 1:33,000 @ A3

REV 00

Path: RSK Group \ RSK Biocensus - 06 GIS - 2483765 - EDF Solar Springwell \ 03 - APRX \ 2483765 - Springwell Solar - Fig 2 - Species Diversity - Aug 22 - Rev 00.aprx

Figure 3

Bat species diversity per static in October 2022

500000 501000 502000 503000 504000 505000 506000 507000 508000 509000 510000

360000 359000 358000 357000 356000 355000 354000 353000 352000

S10 (7)
S11 (6)
S12 (7)
S9 (6)
S8 (6)
S7 (7)
S6 (7)
S5 (6)
S4 (3)
S3 (6)
S1 (6)
S2 (5)

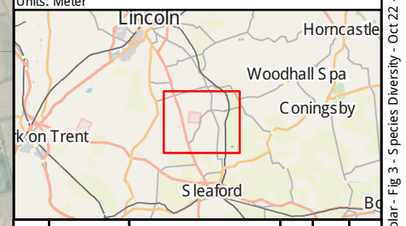
LEGEND:

Site Boundary

Species Count

1
2
3
4
5
6
7
8
9

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



Rev	Date	Description	Drn	Chk	App
00	09/08/2023	First Draft	RJ	EC	TC

Springwell Solar Farm

DOCUMENT:
Appendix 5.4 Bat Activity Report

TITLE:
Species Diversity - October 2022

FIGURE NUMBER:
3

0 0.5 1
Kilometers

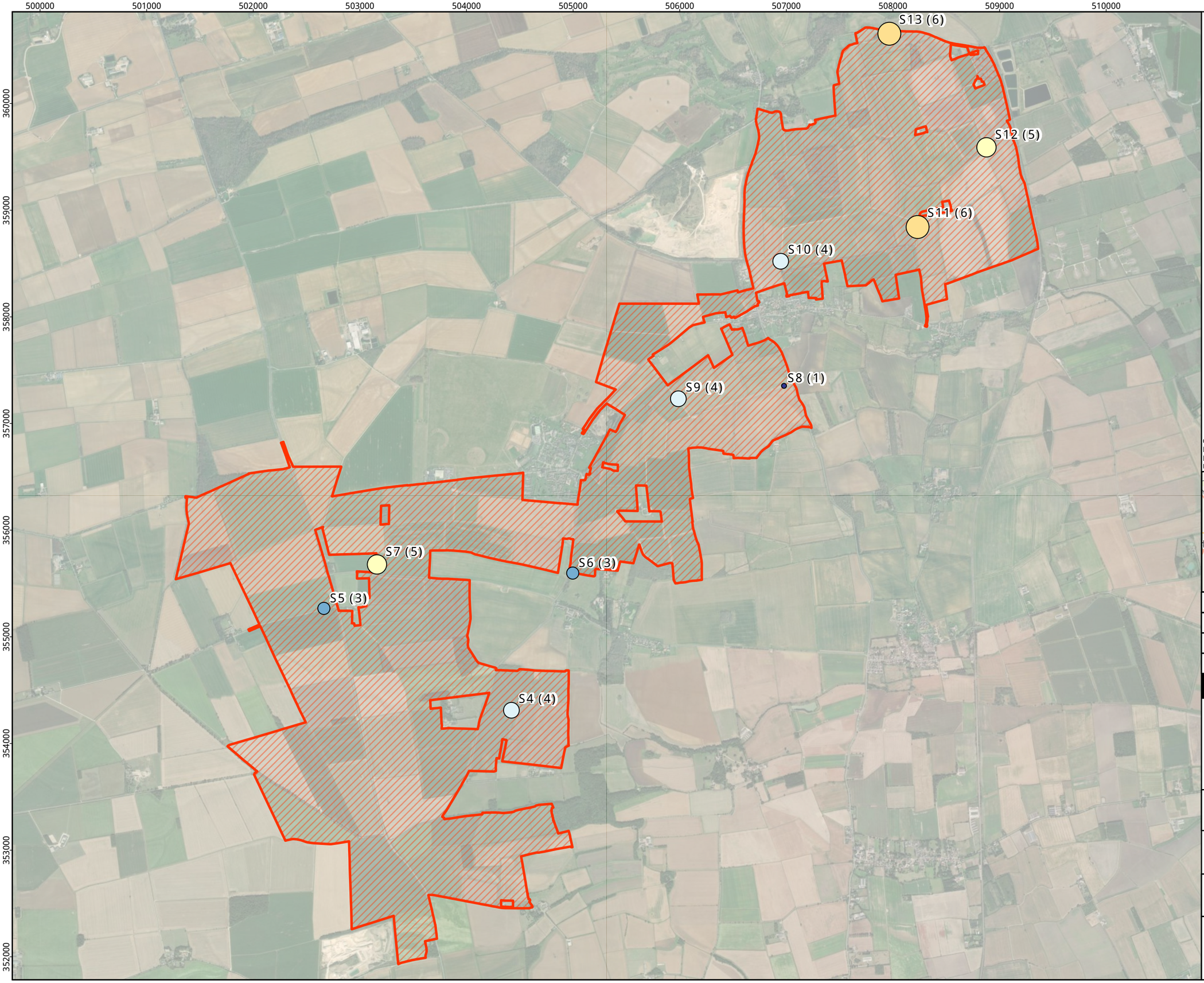
Scale: 1:33,000 @ A3

REV 00

Path: RSK Group \ RSK Biocensus - 06 GIS - 2483765 - EDF Solar Springwell \ 03 - APRX \ 2483765 - Springwell Solar - Fig 3 - Species Diversity - Oct 22 - Rev 00.aprx

Figure 4

Bat species diversity per static in April 2023



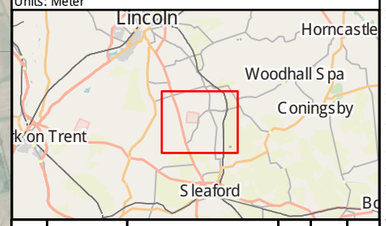
LEGEND:

Site Boundary

Species Count

1
2
3
4
5
6
7
8
9

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



Rev	Date	Description	Drn	Chk	App
00	09/08/2023	First Draft	RJ	EC	TC

Springwell Solar Farm

DOCUMENT:
Appendix 5.4 Bat Activity Report

TITLE:
Species Diversity - April 2023

FIGURE NUMBER:
4

0 0.5 1
Kilometers

Scale: 1:33,000 @ A3

REV 00

Path: RSK Group \ RSK Biocensus - 06 GIS - 2483765 - EDF Solar Springwell \ 03 - APRX \ 2483765 - Springwell Solar - Fig 4 - Species Diversity - Apr 23 - Rev 00.aprx

Figure 5

Barbastelle activity

500000 501000 502000 503000 504000 505000 506000 507000 508000 509000 510000

360000 359000 358000 357000 356000 355000 354000 353000 352000

S13 (5)
S10 (7)
S11 (176)
S12 (9)
S12 (1)
S11 (42)
S12 (41)
S11 (1)
S10 (2)
S10 (42)
S9 (21)
S8 (118)
S8 (0)
S8 (6)
S9 (0)
S7 (27)
S6 (283)
S6 (6)
S5 (1)
S7 (0)
S6 (7)
S5 (52)
S4 (3)
S5 (0)
S4 (12)
S3 (2)
S4 (4)
S3 (4)
S1 (3)
S2 (68)
S1 (89)
S2 (3)

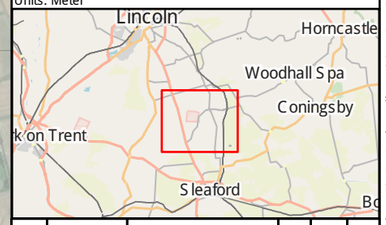
LEGEND:

Site Boundary

Survey
- August 2022
- October 2022
- April 2023

Call Registrations
- Proportional Symbology
  - 1
  - 10
  - 50
  - 100
  - 0 (no registrations)

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



Rev	Date	Description	Drn	Chk	App
00	09/08/2023	First Draft	RJ	RG	TC

Springwell Solar Farm

DOCUMENT:
Appendix 5.4 Bat Activity Report

TITLE:
Barbastelle Activity

FIGURE NUMBER:
5

0 0.5 1
Kilometers

Scale: 1:33,000 @ A3

REV 00

Path: RSK Group\RSK Biocensus - 06 GIS - 2483765 - EDF Solar Springwell\03 - APRX \2483765 - Springwell Solar - Fig 5 - Barbastelle Activity - Rev 00.aprx

Springwell
Solar Farm

springwellsolarfarm.co.uk