

TECHNICAL NOTE 3

DATE:	19 September 2025	CONFIDENTIALITY:	Public
SUBJECT:	Thermal Imaging Report		
PROJECT:	Cambourne to Cambridge TWAO	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

BACKGROUND

Barbastelle are known to be present in the vicinity of the Cambourne to Cambridge TWAO (hereafter referred to as 'the Scheme'). Barbastelle maternity roosts are present within the following woodlands and wider area:

- Madingley Wood Site of Special Scientific Interest (SSSI), approximately 0.25km north of the Scheme;
- Hardwick Wood SSSI, approximately 1.7km south of the Scheme; and
- Eversden and Wimpole Special Area of Conservation (SAC), approximately 6km south of the Scheme.

Surveys for the Scheme identified commuting and foraging routes for barbastelle and, in response, mitigation in the form of landscape features has been incorporated into the Scheme design [for locations, see **CD26-01-APP-W12-2: Appendix 3.3 Technical Note 1 PDF p64-97**]. The landscape features have been designed using best practice to encourage bats to fly at a 'safe' height when crossing the new road at known commuting routes [refer to **CD26-01-APP-W12-4, Annex 1: Technical Note 4**].

Part 3 of Natural England's Scheme Representation [CD2-REP-11], stated:

The design of mitigation would also be aided by further investigation into the current road crossing behaviour of bats in the area, particularly where crossings are likely to be close to roost sites and therefore used before full darkness. There is currently a lack of knowledge around how some bat species cross roads, including barbastelles, and populations in different locations may exhibit different behaviours and adaptations. Questions of both how local bats are crossing, and where they are crossing should seek to be answered, particularly close to Madingley Wood SSSI. A review of satellite imagery looking for likely points, such as at bridges and where tree canopies are close together, followed by the use of infra-red camera technology, would facilitate this. If it can be shown that bats from the local populations exhibit specific behaviours at existing roads, or are used to particular crossing features, it would give more confidence in the likely effectiveness of similar features incorporated into these proposals. It would also highlight where compensatory landscape enhancements could be most valuable, if they improve connectivity to or provide additional foraging habitat close to existing road crossings.

TECHNICAL NOTE 3

DATE:	19 September 2025	CONFIDENTIALITY:	Public
SUBJECT:	Thermal Imaging Report		
PROJECT:	Cambourne to Cambridge TWAO	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

METHODOLOGY

Aims and Objectives

This technical note demonstrates the results of the requested monitoring and provides information on how barbastelles cross the A1303 and A428 to demonstrate how barbastelles interact with the existing road and neighbouring vegetation in the local context. This is to help inform the design of the Landscape Treatment Mitigation.

Stage 1 – Desk-based analysis

A review of the radio-tracking reports of local barbastelle maternity colonies surrounding the Eversden and Wimpole SAC [CD25-53 and CD25-54] and from Bourne Airfield reported by Davidson-Watts Ecology [Desk study summary provided within CD1-11.05 and CD1.11.05 TR5.11] was completed to select suitable targeted survey locations. Additional supplementary data from the Scheme’s existing crossing-point (CP) and static-detector surveys were also taken into consideration.

Stage 2 – Defra CP Surveys

In total, four survey locations were selected. These are located within the core foraging areas and home ranges of local barbastelle bat maternity colonies which are already severed by the A1303 and A428. At these locations, bats were observed flying across gaps between canopies/vegetation either side of the road (See Annex 1).

- Survey Location 1 and 2: 5m gap (A1303) at Madingley; see Plate 1.
- Survey Location 3: 28m gap (A428 at Cambridge Road); see Plate 9.
- Survey Location 4: 34m-50m gap (A428 at Childerley); see Plate 12.

Each location was surveyed at least twice to Defra Local Scale CP Guidelines¹ between June and August 2025 to coincide with the maternity period.

Two surveyors were positioned at each survey location to observe the behaviour of bats crossing the road and to assess how they interacted with the landscape and road network. Hand-held bat detectors (M2 bat loggers© Elekon AG) along with thermal-imaging cameras (FLIR (© Teledyne FLIR LLC) were used to record and aid observations of bat movements from sunset until midnight. Thermal cameras were used in preference to infrared, as they have a wider field of view, better resolution without the need for additional illumination, and can be used with analytical software (see below).

¹ Berthinussen, A., & Altringham, J. (2015). *Development Of A Cost-Effective Method For Monitoring The Effectiveness Of Mitigation For Bats Crossing Linear Transport Infrastructure*. University of Leeds and DEFRA.

TECHNICAL NOTE 3

DATE:	19 September 2025	CONFIDENTIALITY:	Public
SUBJECT:	Thermal Imaging Report		
PROJECT:	Cambourne to Cambridge TWAO	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

The cameras were fitted with a 95-degree lens enabling viewing for at least 100m along the road. Static bat detectors (SM4, © Wildlife Acoustics, Inc.) were placed at 50m intervals along the road being crossed by bats to capture echolocation calls in order to facilitate identification of the bat species observed on film.

During the surveys, the bat flight-lines detected (height and direction) were recorded on a proforma. Bat behaviour and how they reacted to changes in the ground/vegetation height were recorded, along with any avoidance behaviour exhibited when vehicles/lights were approaching.

Stage 3 – Data Analysis

The data was analysed using FLIR Thermal Studio Suite (© Teledyne FLIR LLC). High-resolution settings were used to detect and track bat flight-lines. These analytical tools enable bat activity to be detected that would otherwise be invisible to the user when manually reviewing footage (another advantage over infrared techniques).

All barbastelle static detector registrations were manually verified for accuracy, and the earliest (first) recorded barbastelle call was noted at each location.

A comparison was completed between the barbastelle echolocation registrations from the static detector/hand-held detector registrations and the thermal-imaging footage. Time-stamps were used to synchronise detector registrations with footage, such that observations within 30 seconds either side of a barbastelle recording were deemed likely to be a barbastelle.

Notes and Limitations

Due to access and H&S constraints, fewer surveys were completed at Location 3 and 4 than at Locations 1 and 2. However, all locations were surveyed at least twice, in line with (minimum) DEFRA CP Guidance¹. All locations registered barbastelle on static detectors, and all locations captured thermal-imaging footage of bats within +/- 30 seconds of a barbastelle registration; so this is not considered a significant limitation.

As noted above, observations within 30 seconds either side of a barbastelle recording were deemed likely to be a barbastelle; however, the presence of (and confusion with) other species could not be fully excluded on every occasion, and there were often several bats observed (filmed) within that +/- 30 seconds of a barbastelle registration.

The purpose of the exercise was to understand how barbastelle cross gaps; analysis therefore focused on thermal imaging footage +/- 30 seconds of each barbastelle static recording. Downloading, uploading and screening large video files (each camera each night required a 256GB SD card) is very time-consuming (more than one week for one person to analyse barbastelle calls only). Thus, **in line with the objectives of this study** (to investigate barbastelle crossing-behaviour), only footage likely to contain barbastelle observations has been reviewed. This also means barbastelle calls are only a relatively small percentage of the recorded camera footage available.

TECHNICAL NOTE 3

DATE:	19 September 2025	CONFIDENTIALITY:	Public
SUBJECT:	Thermal Imaging Report		
PROJECT:	Cambourne to Cambridge TWAO	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Height estimates of canopies and flying bats are difficult to assign; a bat tree-climbing specialist estimated heights of canopies and the at-risk boundary height of 3m (bus height) using a ranging pole at the start of the survey at each location. Handwarmers were attached to trees at 3m to indicate the 'at risk' height, but this did not help; all height estimates are therefore by eye. A consistency exercise was carried out (agreeing heights of canopies and heights of bats relative to canopies) between surveyors to minimise surveyor differences. Surveyors experienced in CP surveys were used here to minimise this source of error. Note also that each bat may fly at a range of heights; where that happened, the range was similarly estimated.

RESULTS

Stage 1

Descriptions of each of the locations are as follows:

- Locations 1 and 2: canopy-to-canopy, the gap was 5m at the western end and up to 15m at the eastern end², with trees approximately 12m high either side of road. The road is at grade throughout.
- Location 3: canopy-to-canopy, the gap was 28m, with trees 15m high either side of the road. The road is within a sloping wooded cutting approximately 15m wide on the north bank and 9m wide on the southern bank.
- Location 4: canopy-to-canopy, the gap here was 34m (though the distance of the gap where a radio-tracked bat previously crossed was estimated at 50m). The road here is within a grassland cutting approximately 4m high, approximately 10m wide on the north side and 5m wide on the south side with tree/shrub planting at the top of the embankment approximately 10m high.

LOCATIONS 1 AND 2

Two CP monitoring locations were selected along the A1303 at the eastern- and western-most extents of Madingley Wood SSSI. The north side of the A1303 is bordered by a narrow buffer along the edge of the SSSI, presenting a vertical woodland edge bordered by a narrow grass verge (approximately 1m wide).

The southern boundary comprises a low height (1m) intensively managed box hedgerow bordering a field with regularly spaced large mature standard trees (approximately 30m spacings). Barbastelle have previously recorded along the two linear features running perpendicular from this southern hedgerow, which fan out into the wider landscape. Plate 1 illustrates the two survey locations.

² Assessed using aerial imagery.

TECHNICAL NOTE 3

DATE:	19 September 2025	CONFIDENTIALITY:	Public
SUBJECT:	Thermal Imaging Report		
PROJECT:	Cambourne to Cambridge TWAO	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

LOCATION 3

The A428 dual carriageway is within a cutting. Madingley 800 wood, to the north of Madingley Wood SSSI, is located on the southern side of the A428. To the north of the carriageway is mature woodland, which adjoins the Madingley Hall and Gardens Estate.

LOCATION 4

The A428 (dual carriageway) sits within a cutting. The north side of the road's soft estate is an approximately 10m wide, 4m high, grassland slope, with mature shrubs and trees standing at approximately 10m. The Hardwick bat maternity roost is approximately 1.73km to the south of Location 4.

Stages 2 and 3

A full account of all static detector and night vision aid video analysis is detailed within Annex 2. Summarised accounts are provided in Table 1, Table 2 and Table 3. Photographs of the video footage is presented on Plates 1 to 4.

In summary, the following bats were contained within footage analysed at each of the locations:

- Locations 1 and 2: 185 bats recorded in total, of which a single bat was recorded crossing the road potentially at an 'at risk' height.
- Location 3: 26 bats recorded in total; NONE were recorded crossing the road at risk height.
- Location 4: 9 bats recorded in total; NONE were recorded crossing the road at risk height.

Therefore, a total of 220 bats were observed across all locations, with one bat recorded crossing potentially at an 'at risk' height.

TECHNICAL NOTE 3

DATE:	19 September 2025	CONFIDENTIALITY:	Public
SUBJECT:	Thermal Imaging Report		
PROJECT:	Cambourne to Cambridge TWAO	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

SURVEY LOCATION 1 AND 2– A1303 MADINGLEY

Table 1: Summary of results for Location 1 and 2, A1303 Madingley Road

Date	Total No. of bats ³	No. of bats that crossed the road	No. of bats crossing road at risk height	No. of bats crossing road recorded outside of risk height	Comments on behaviour recorded
23/06/25	51	48	0	48 (5m – 12m), 42 bats were recorded at 12m and above; 1 bat flew at 8-12m; 1 bat flew at 8-10m; 2 bats flew at 6-8m; and 2 bats flew at 5-12m.	All bats whether they crossed the road or not were travelling at a safe height.
24/06/25	11	10	1 (3-6m)	9 (4m-12m) 1 bat flew at 4-10m; 1 bat flew at 5-12m; 1 bat flew at 7m; with the remaining 6 bats flying at 12m+.	One bat crossed potentially within the risk zone.
25/06/25	25	17	0	17 (4m - 12m+) 2 bats flew at 4 -5m; 1 bat flew at 6- 8m; 2 flew at 10-12m and 12 bats fly at 12m+:	All bats whether they crossed the road or not were travelling at a safe height.
28/07/25	40	26	0	26 (12 - 15m) 1 bat flew at 5m; 2 bats flew at 10m; 16 bats flew at 15m; 1 bat flew at 16m; and 6 bats flew at 20m and above.	All bats whether they crossed the road or not were travelling at a safe height.
29/07/25	58	32	0	58 (5 - 20m) 1 bat flew at 5m; 2 bats flew at 7m; 2 bats flew at 12m; 22 bats flew at 15m, 1 bat flew at 18m; and 4 flew at 20m+.	All the bats whether crossing the road or returning flew at safe heights.

³ Observed/filmed within +/- 30 sec of barbastelle registration

TECHNICAL NOTE 3

DATE:	19 September 2025	CONFIDENTIALITY:	Public
SUBJECT:	Thermal Imaging Report		
PROJECT:	Cambourne to Cambridge TWAO	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

SURVEY LOCATION 3 – A428 CAMBRIDGE ROAD

Table 2: Summary of Results for Location 3 A428 Cambridge Road

Date	Total No. of bats ³	No. of bats that crossed the road	No. of bats crossing road at risk height	No. of bats crossing road recorded outside of risk height	Comments on behaviour recorded
17/07/25	9	4	0	4 (12m to 25m) 1 bat flew at 12m, 1 bat flew at 13m, 1 flew at 18m and 1 bat flew at 20m.	Not all bats crossed the road, but all flew at a safe height of 25m.
30/07/25	17	9	0	9 (12m to 20m+) 1 bat flew at 12m, 8 flew at 20m+	Not all bats crossed the road, but all flew at a safe height of 20m +.

SURVEY LOCATION 4 – A428 CHILDERLEY

Table 3: Summary of Results for Location 4 A428 Childerley

Date	Total No. of bats	No. of bats that crossed the road	No. of bats crossing road at risk height	No. of bats crossing road recorded outside of risk height	Comments on behaviour recorded
16 th July	8	6	0	6 (8m- 20m+) 1 bat flew at 8m; and 5 bats flew at 10m;	All of the bats crossed at a safe height, even those that did not cross road.
31 st July	1	1	0	1 (6m above road)	1 bat was observed on thermal imaging flying at a safe height across the road.

TECHNICAL NOTE 3

DATE:	19 September 2025	CONFIDENTIALITY:	Public
SUBJECT:	Thermal Imaging Report		
PROJECT:	Cambourne to Cambridge TWAO	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Behaviour Exhibited

LOCATIONS 1 AND 2

Over five nights of CP surveys at Locations 1 and 2 combined, 185 bats were observed on the thermal imaging footage within +/-30 seconds of a barbastelle static detector registration and therefore assumed to be probable barbastelle. One hundred and thirty-three of these bats (72%) were observed (filmed) to fully cross the road; 52 bats (28%) either flew parallel to the road or returned to the canopy they flew from. Some bats were noted to be foraging.

Of the 133 bats that crossed the road - a gap of between 5 and 15m, almost all (132 bats or >99%) crossed at a safe height of between 4m and 20m+. The lowest estimated height one bat was observed to fly at was between 3 and 6m. This height estimate includes 'at risk' heights, so a single bat (less than 0.5% of those observed) may have been at risk from collision (had a vehicle been passing at that time).

LOCATION 3

Of the 26 bats observed within 30 seconds of a barbastelle registration at Location 3, 19 bats (73%) fully crossed the road. Other bats either flew parallel to the road, returned to the same side, or the field of view was not wide enough when the bat was near to the camera to determine their flight-lines or behaviour.

Of the bats crossing the road, the lowest flight heights recorded were at 12m and 13m, with the remaining bats crossing at between 18 and 20m.

LOCATION 4

Of the nine bats recorded over two nights of thermal-imaging footage within +/-30 seconds of a static detector barbastelle registration; seven (77%) crossed the road covering a minimum gap of 34m. All bats crossed the road at a safe height. The lowest flight heights of two of the bats observed on thermal imaging footage was 6m and 8m, with five bats flying at canopy height (10m).

Earliest Barbastelle Recorded

Table 13 in Annex 3 shows the earliest barbastelle registrations (from static detectors) for each night at each location.

Of the 18 static detectors deployed over nine nights, the earliest (i.e. first recorded) barbastelle recorded was 0.43 hours after sunset at Location 3: A428 Cambridge Road, with the latest first-recorded barbastelle at 2.64 hours after sunset at Location 1&2: Madingley). The mean earliest barbastelle registration across all locations was at 1.40 hours post sunset.

Across all barbastelle registrations (Table 1, 2 and 3) during the survey (which covers the maternity period) 11 of 212 registrations are before 1 hour post sunset.

TECHNICAL NOTE 3

DATE:	19 September 2025	CONFIDENTIALITY:	Public
SUBJECT:	Thermal Imaging Report		
PROJECT:	Cambourne to Cambridge TWAO	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Of note, the earliest barbastelle static recording was at 0.43h (26 minutes) post sunset at Location 3: A428 Cambridge Road. The associated camera footage (V1-V5) shows seven bats flying at heights of 14 to 20m across a gap of 28m, before it was fully dark. Of these seven bats: two bats crossed the road and five bats either flew parallel to the road, did not cross, or surveyors could not be sure if the bats fully crossed the road.

CONCLUSIONS

This data verifies the desk-based review of radio-tracking results [CD1-11.05 TR5.11, para 6.1.11 p54]: that is, that bats are crossing the existing road network, both single carriage A-roads (A1303) and dual carriage A-roads (A428), where gaps between canopies are between 5m and 38m. At two of the four CP locations, the gaps which bats are crossing are significantly wider (28m, 34m) than will be the case for the CtoC Scheme (below 20m).

At Locations 1&2 (Madingley), where the canopy either side of the road is at least 12m high and the gap is between 5 and 15m, 132 bats (99 %) of the bats observed within 30 seconds of a barbastelle registration flew at a safe height, mostly in keeping with the height of the vegetation or flying above it.

At Location 3 (Cambridge Road Bridge), where the A428 is within a cutting and the gap to be crossed is a minimum distance of 28m canopy-to-canopy (at 15m height), all the bats observed within 30 seconds of a barbastelle registration flew at a safe height. The lowest height recorded was 13m.

At Location 4 (Childerley) where the A428 is within a cutting and there is a canopy-to-canopy gap of at least 34m, all bats recorded on thermal-imaging footage within +/-30 seconds of a static detector barbastelle registration crossed the road at a safe height. The lowest flight heights of the bats observed on thermal imaging footage was 6m.

It is noteworthy that the earliest recorded barbastelle registration was at 0.43h (26 minutes) post-sunset, recorded at Location 3 (Cambridge Road) and, at that time, there was footage of bats flying across a gap of 28m, at a safe height at 20m (17 m above the height of the buses to be used on the Scheme).

Only eleven of 212 barbastelle registrations were recorded before one hour post sunset during the maternity period. This is consistent with previous assessments of the earliest recorded barbastelles [CD26-01-APP-W12-2, Technical Note 1 PDF pp 73-76], in which bats are infrequently leaving their home woodlands prior to full darkness.

The single bat observed to fly between 3 and 6m *may* have been flying at an 'at risk' height. It is noteworthy that bats between 3m and 5m are at risk from HGVs/taller vehicles on the existing road but not at risk of direct collision with the Scheme's new buses (maximum 3m).

All other bats observed (filmed), i.e. >99%, crossed at safe heights. The surveys demonstrated that bats successfully crossed canopy-to canopy at grade and where the road was in a cutting. Both these

TECHNICAL NOTE 3

DATE:	19 September 2025	CONFIDENTIALITY:	Public
SUBJECT:	Thermal Imaging Report		
PROJECT:	Cambourne to Cambridge TWAO	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

topographies (at grade and within cutting) are present where mitigation will be implemented on the Scheme.

The results of these surveys are consistent with the Elmeros *et al.* (2016) [CD26-01-APP-W12-2 PDF p11-12] observation of barbastelles flying at height with no clear tendency to lower flight, and support Natural England’s own published position (as set in their Favourable Conservation Status Report on the status of barbastelle [CD-43, PDF p21]), which notes that ‘roads, motorways, and other clearings in natural vegetation do not appear to be a major barrier to movement or dispersal in the landscape and so probably do not restrict habitat accessibility to a significant extent’.

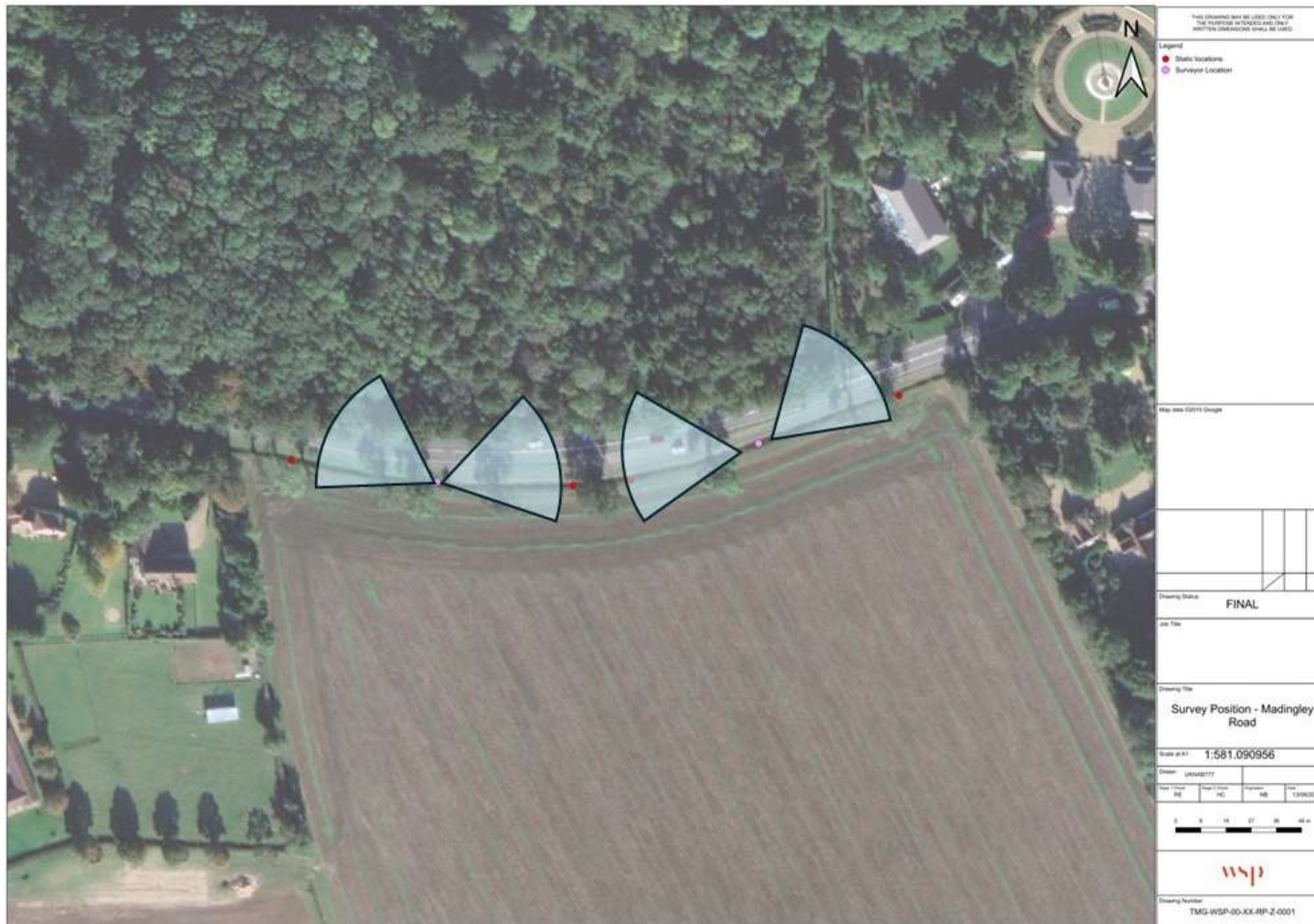
The results from this study will be used to refine the landscape treatments proposed (see CD26-01-APP-W12-4 Annex 1: Technical Note 4).

TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Survey locations are depicted by white dots and the indicative field of view of the thermal imaging cameras illustrated by white polygons.

Plate 1: Survey Locations 1 and 2: Madingley Road Camera Placements



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

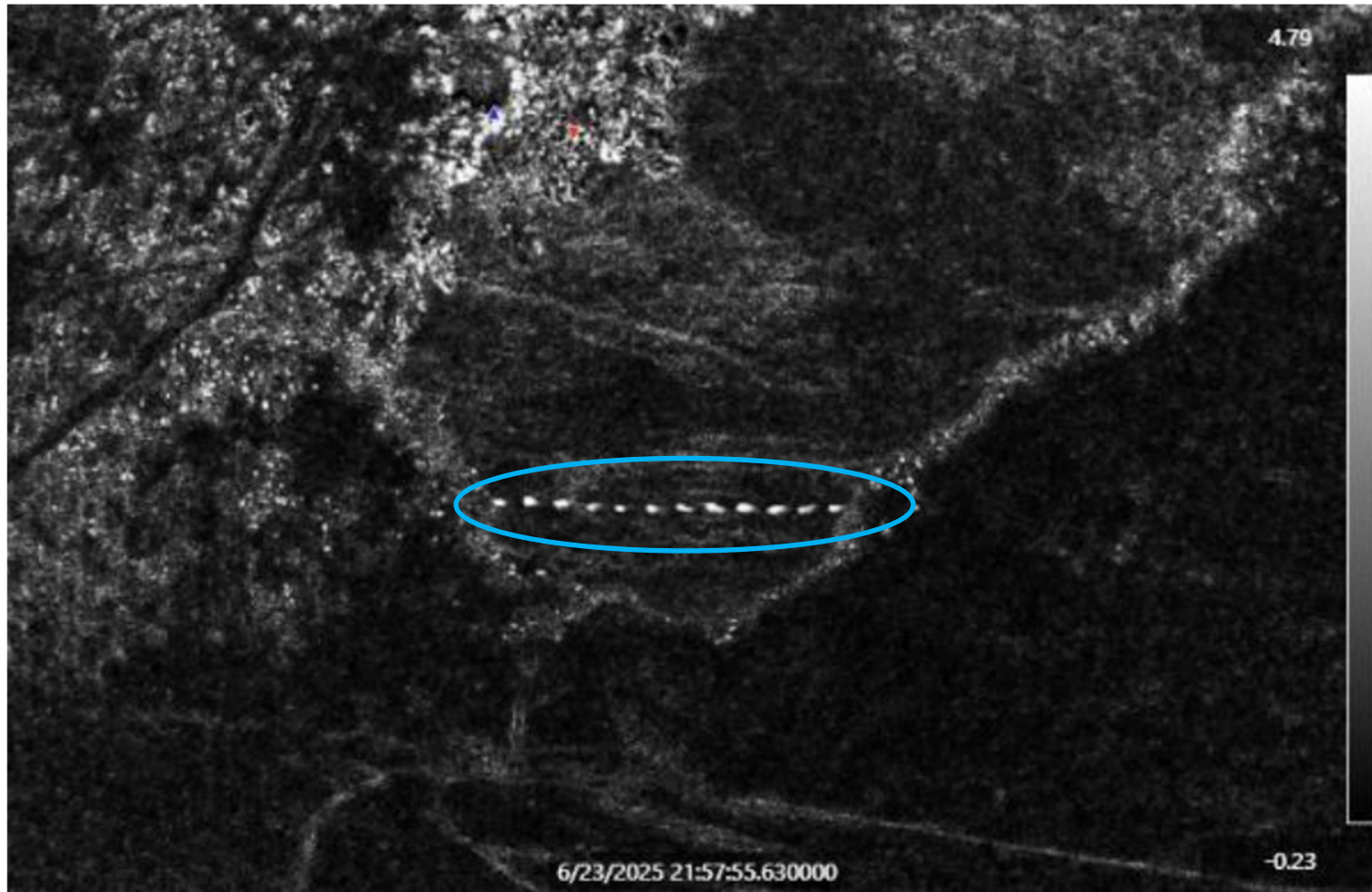
Plate 2: Photographs from Camera Placements Madingley West (looking west)



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

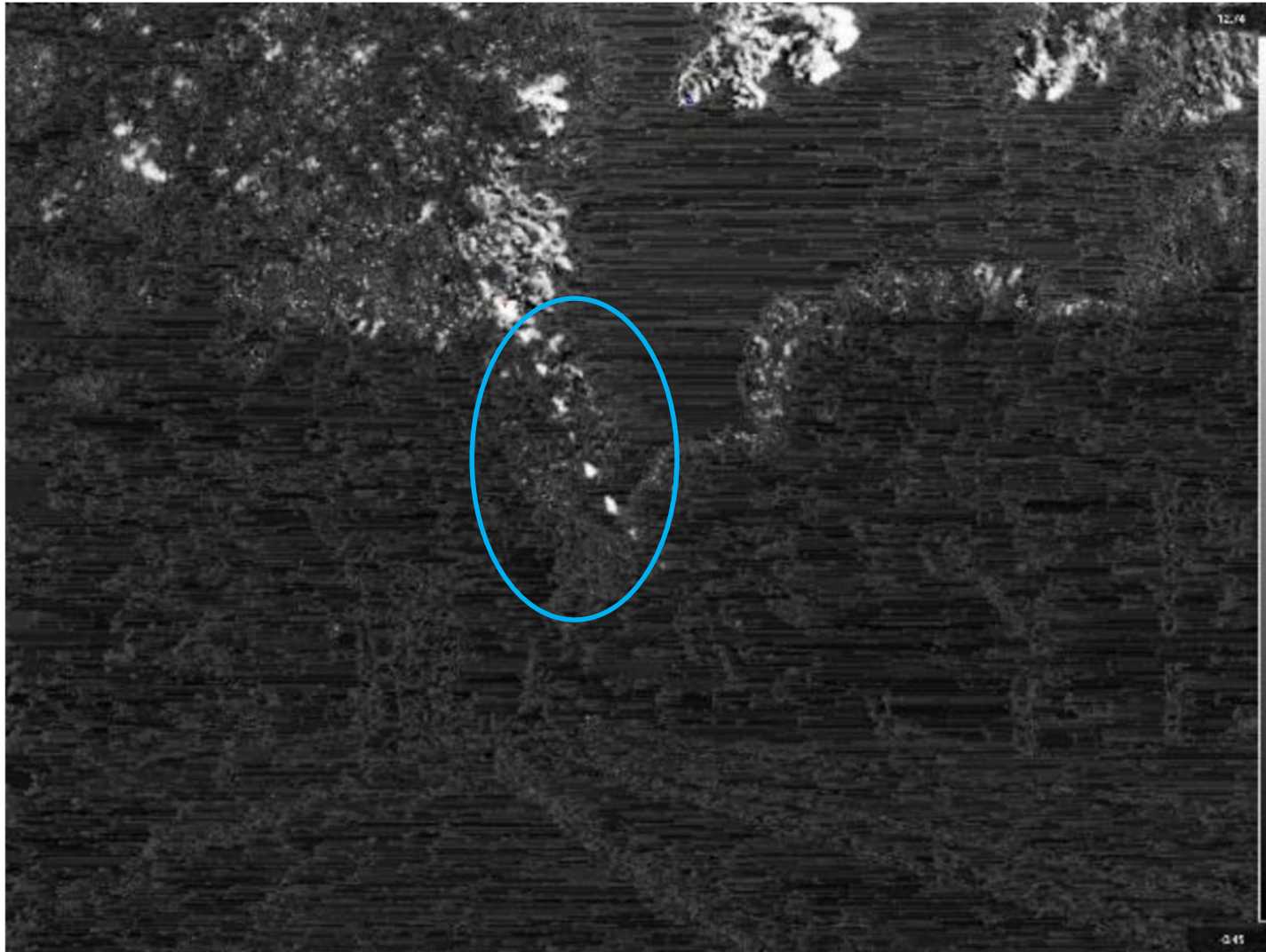
Plate 3 shows a bat crossing the road (white tracked bat flight-line using (FLIR Thermal Studio Suite (© Teledyne FLIR LLC)) between canopies at Madingley. The bottom of the canopy is approximately 5m above the ground level and this bat is approximately 10m high. Bat tracking is circled in blue.



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Plate 4 shows a bat crossing the road (white tracked bat flight-line using (FLIR Thermal Studio Suite (© Teledyne FLIR LLC)) between canopies at Madingley. This bat flight-line was the one bat recorded at the probable risk height of between approximately 3-6m above ground level as it flew through the field of view. Bat tracking is circled in blue



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Plate 5: Photographs from Camera Placements - Madingley West (looking east)



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Plate 6: Photographs from Camera Placements Madingley East (looking east)



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Plate 7: Photograph of video at Madingley of a bat (white tracked bat flight-line using (FLIR Thermal Studio Suite (© Teledyne FLIR LLC)) crossing at approximately 15m. Bat tracking is circled in blue.



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Plate 8: Photograph of Camera placement at Madingley East (looking west)



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Plate 9: Survey Location 3: Cambridge Road Bridge over A428 Camera Placement



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

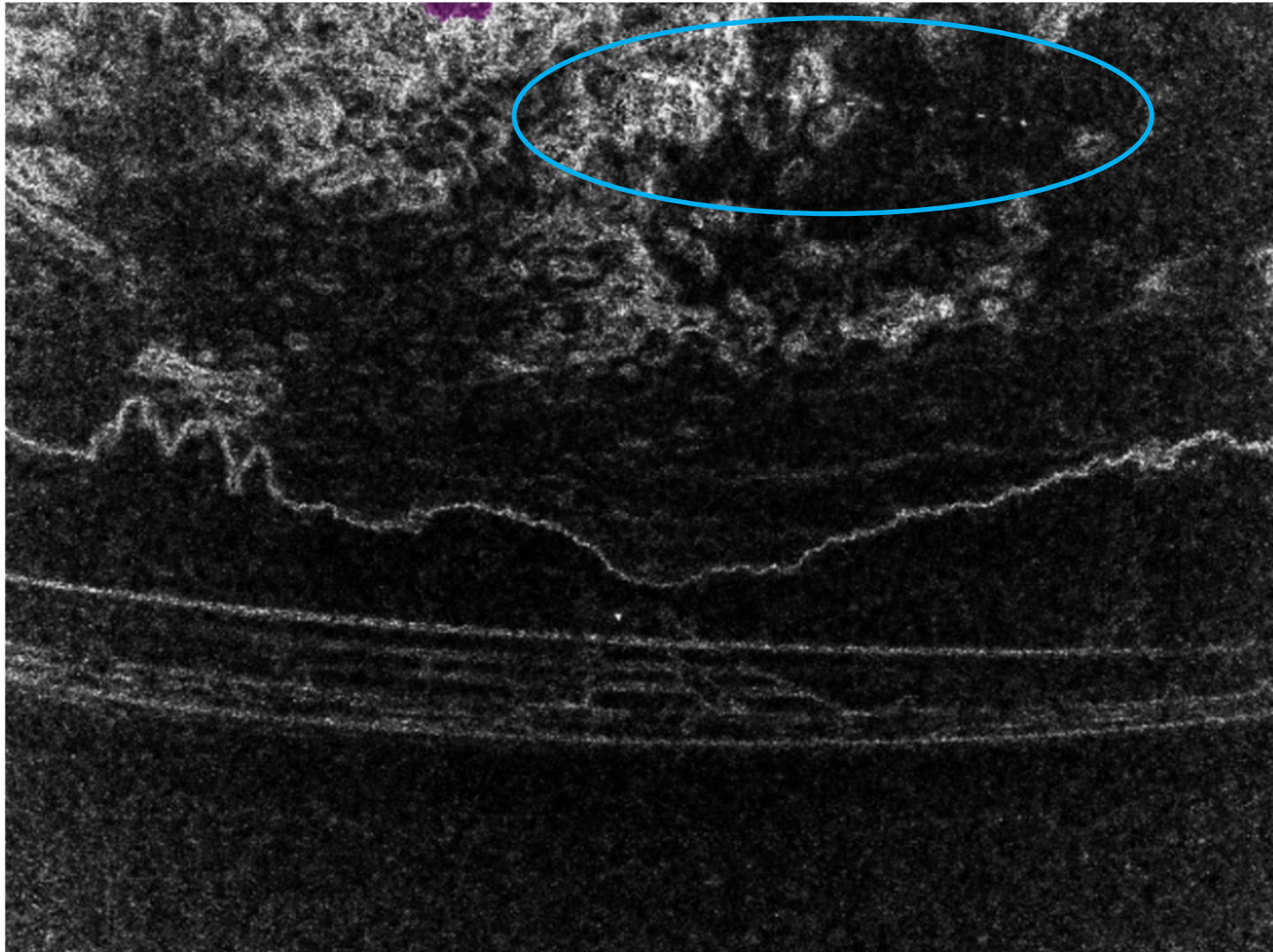
Plate 10: Plate 2b Photograph from Cambridge Road Bridge over A428 Camera Placement



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Plate 11 showing bat crossing road (white tracked bat flight-line using (FLIR Thermal Studio Suite (© Teledyne FLIR LLC)) at well over canopy height, 20m+. Bat tracking is circled in blue



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Plate 12: Survey Location 4: A428 and Childerley Camera Placements



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Plate 13: Photographs from Childerley A428 Camera Placements (looking east)



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Plate 14 Plate 3 shows two bats crossing the road in opposite directions (white tracked bat flight-lined using (FLIR Thermal Studio Suite (© Teledyne FLIR LLC)). Both bats are crossing at higher than canopy height (10m+)



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Plate 15 shows bat crossing the road (white tracked bat flight-line using (FLIR Thermal Studio Suite (© Teledyne FLIR LLC)) at least 8m above ground level



TECHNICAL NOTE 3: Annex 1 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Plate 16: Photographs from Survey Location 4: Childerley A428 Camera Placements (looking west)



TECHNICAL NOTE 3: Annex 2 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Table 4: Survey Results for 23rd June – Madingley Road

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
R1	22:48	21:24	1.40	V1	6-8m above ground level	Possible avoidance of car light
				V2, V3 and V4	12m+	
				V5 and V6	12m	
R2	22:52	21:24	1.47	V1, V4 and V8	12m	
				V2	10m	
				V3	6-8m	Possible avoidance of car
				V5, 6 and 7	12m+	
				V9	12m	2 bats
				V10	12m & >5m (5-12m given)	2 bats
R3	23:08	21:24	1.73	Bat 1, 3 and 4	12m	V1 - 2 bats above canopy with car
				Bat 2, 5 and 6	12m+	V6 - Cars in view
R4	23:20	21:24	1.93	Bat 1, 3 and 4	12m+	
				Bat 2	8-10m	Bat travelling along centre of road
R5	23:43	21:24	2.32	Bat 1	8-12m	
				Bat 2 and 5	12m+	V5 - 2 bats
				Bat 3 and 4	12m	
R6	00:05	21:24	2.68	Bat 1 and 6	12m	
				Bat 2, 3, 4, 5 and 7	12m+	
R7	00:07	21:24	2.72	Bat 1, 2, 5, 6, 7 and 9	12m+	V6 - 3 bats
				Bat 3, 4 and 8	12m	V3 and V4 - Travelling along road

TECHNICAL NOTE 3: Annex 2 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Table 5: Survey Results for 24th June Madingley Road.

Static recording numbers 5 to 9 are not included within Table 5 as no footage was available. W = west; E = east.

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
R1	22:25	21:24	1.02	V1	8m	Does not cross road
				V2, V3, V5 and V7	12m+	V5 and V6 - Two bats
				V4	7m at lowest point	
R2	22:50 (SM4 W)	21:24	1.43	V1	12m+	
R3	23:27	21:24	2.22	V2	3-6m above ground level	Within risk height
R4	22:50 (SM4 E)	21:24	1.43	V1	4-10m	
				V2	5-12m	

Table 6: Survey Results for 25th June Madingley Road.

Static recording numbers 2 and 10 are not included within Table 6 as no footage was available. W = west; E = east.

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
R1	22:33	21:24	1.15	V1 and V2	4-5m	V2 - Crossed the road
R3	22:15 (SM4 W)	21:24	0.85	V1	12m+	Crossed the road
R4		21:24	1.82	V1, V2 and V3	12m+	Crossed the road

TECHNICAL NOTE 3: Annex 2 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
	23:13 (SM4 W)			V4		Crossed the road at canopy height
R5	23:31 (SM4 W)	21:24	2.12	V1	8-10m	Travelling along the road
				V2	5m above ground level	Travelling along the road
				V3	12m+	Travelling along the road
				V4 and V5	8-10m	Travelling along the road
				Bat 6	6m	Travelling along the road
R6	00:21 (SM4 W)	21:24	2.95	Bat 1	6-8m	Crossed the road
				Bat 2	10-12m	Travelling along the road
				Bat 3	10-12m	Crossed the road
R7	23:22 (SM4 E)	21:24	1.97	Bat 1 and 2	12m+	Crossed the road
R8	23:50 (SM4 East)	21:24	2.43	Bat 1, 2 and 3	12m+	V1 - Travelling along the road. Bats 2 and 3 - above the road
R11	00:20 (SM4 East)	21:24	2.93	Bat 1, 2 and 3	12m+	V1 – Crossed the road. V2 and V3 - above the road
				Bat 4	10-12m	Above the road

TECHNICAL NOTE 3: Annex 2 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Table 7: Survey Results for 28th July Madingley Road.

Static recording numbers 15, 17 to 21 and 23 are not included within table as no footage was available

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
R1	21:41	20:56	0.75	V1	15m	Doesn't cross the road
R3	21:58	20:56	1.03	V1 and V2	15m	Crossed road
				V3	15m+	Crossed road
R4	22:01	20:56	1.08	V1, V2, V3 and V5	15m+	Doesn't cross the road
				V4	10m	Crossed road
				V6	15m+	Crossed road
R5	22:02	20:56	1.10	V1, V2 and V3	15m+	V1 and 13 - Crossed the road. V2 - Doesn't cross the road
				V2	15m	Doesn't cross the road
R6	22:12	20:56	1.27	V1 and V2	15m	Crossed road
R7	22:16	20:56	1.33	V1	15m	Crossed road
R8	22:18	20:56	1.37	V1	15m	Crossed road
R9	22:18	20:56	1.37	V1	12m	Doesn't cross the road
R10	22:18	20:56	1.37	V1	15m+	Crossed road
R11	22:18	20:56	1.37	V1	15m	Crossed road
R12	22:19	20:56	1.38	1	12m	Doesn't cross the road
				V2	15m	Crossed road
				V3, V4 and V5	20m+	Crossed road
R13	22:23	20:56	1.45	V1	10m	Crossed road
R14	22:36	20:56	1.67	V1 and V2	20m+	Doesn't cross the road
				V3	15m+	Crossed road

TECHNICAL NOTE 3: Annex 2 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
R16	23:12	20:56	2.27	V1	16m	Crossed road
				V2 and V4	20m	V2 - Crossed the road. V4 - Doesn't cross the road
				V3	15m	Doesn't cross the road
R22	23:26	20:56	2.50	V1 and V2	20m	V1 -Crossed the road. Bat 2 - Doesn't cross the road
				V3	15m	Crossed road
R24	23:40	20:56	2.73	V1	20m+	Crossed road
R25	23:47	20:56	2.85	V1	15m	Crossed road
				V2	5m	Crossed road

Table 8: Survey Results for 29th July Madingley Road.

Static recording numbers 1 to 10, 23, 28, 26, 27 and 39 to 44 are not included within Table 9 as no footage was available.

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
R11	22:01	20:54	1.12	V1	15m	Crossed the road
				V2	20m	Doesn't cross the road
				V3	15m+	Doesn't cross the road
				V4 and V6	20m+	V4 - Doesn't cross the road. V6 - Crossed the road
				V5	10m	Doesn't cross the road
R12	22:09	20:54	1.25	V1, V4 and V5	20m+	V1 - parallel to road. V4 and V5 - Doesn't cross the road
				V2 and V3	15m	V2 - Doesn't cross the road. V3 - Crossed the road
R13	22:18	20:54	1.40	V1, V2 and V3	15m	V1 - Doesn't cross the road. V2 and V3 - Crossed the road

TECHNICAL NOTE 3: Annex 2 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
				V4	5m	Unclear if crossed
R14	22:24	20:54	1.50	V1	15m	Crossed the road
R15	22:26	20:54	1.53	V1	15m	Doesn't cross the road
R16	22:30	20:54	1.60	V1	18m+	Crossed the road
				V2	15m+	Crossed the road
R17	22:35	20:54	1.68	V1	15m	Crossed the road
R18	22:35	20:54	1.68	V1	15m	Crossed the road
R19	22:40	20:54	1.77	V1	7m	Crossed the road
				V2	15m	Doesn't cross the road
R20	22:54	20:54	2.00	V1, V3 and V7	15m+	V3 - Crossed the road
				V2	15m	Doesn't cross the road
				V4	12m	Doesn't cross the road
				V5 and V6	15m	V5 - Doesn't cross the road
R21	22:59	20:54	2.08	V1 and V2	15m+	Crossed road
R22	23:01	20:54	2.12	V1	15m	Crossed road
R25	23:09	20:54	2.25	V1	16m	not clear if bat crosses road.
				V2	5m	Crossed road
				V3	15m	Crossed road
R26	23:09	20:54	2.25	V1	15m	Potentially crossing road
R27	23:15	20:54	2.35	V1 and V3	15m+	V1 - Doesn't cross the road. Bat 3 - Crossed road
				V2	15m	Crossed the road

TECHNICAL NOTE 3: Annex 2 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
R29	23:36	20:54	2.70	V1	12m	Crossed the road
R30	23:37	20:54	2.72	V2 and V3	15m+	V2 - Doesn't cross the road. Bat 3 - Crossed the road
R31	23:41	20:54	2.78	V1	15m+	Crossed the road
				V2 and V3	15m	V2 - unclear if bat crosses road. V3 – Crossed the road
				V4	canopy height	Crossed the road
R32	23:41	20:54	2.78	V1	20m+	Unclear if bat crosses road
				V2, V3 and V4	20m+	Crossed the road
				V5	7m	Crossed the road
				V6	15m	Crossed the road
R33	23:42	20:54	2.80	V1	18m	Doesn't cross the road
R34	23:43	20:54	2.82	V1	18m	Unclear if bat crosses road
R35	23:43	20:54	2.82	V1	18m+	
R38	23:55	20:54	3.02	V1	18m	Unclear if bat crosses road
				V2	15m+	Crossed the road

Table 9: Survey Results for 16th July Childerley

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
R1	22:18	21:13	1.08	V1	20m+	Canopy height is 10m. Does not cross the road
				V2	15m	Bat does not cross the road

TECHNICAL NOTE 3: Annex 2 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
R2	23:36	21:13	2.38	V1	10m+	Two bats crossing road in opposite direction
				V2	8m	Bat crosses road
				V3	10m+	Bat crosses road
				V4	12m	Bat does not cross the road
				V5	10m+	Bat crosses road

Table 10: Survey Results for 31st July Childerley

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
R1	22:43	20:52	1.85	V1	0.5m rising to 6m	Footage shows a bat flight across the road at an initial height of near ground level (0.5m), rising to 6m above ground level. [NB the road is in a cutting so 0.5m is above the height of the highest point of the sloping soft estate]

Table 11: Survey Results for 17th July A428 Cambridge Road Bridge.

Static recording numbers 3 and 5 (some footage available but not all) are not included within Table 11 as no footage was available

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
R1	22:08	21:11	0.95	V1	20m	Canopy 15m high, Bat crosses road

TECHNICAL NOTE 3: Annex 2 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
R2	23:21	21:11	2.17	V1 and V3	25m	V1 - Does not cross the road flies parallel. V3 - Bat does not cross the road
				V2	18m	Bat crosses the road
R4	23:38	21:11	2.45	V1 and V2	25m	V1 - Bat does not cross the road. v2 - Does not cross the road, flies parallel
				V3	13m	Bat crosses the road
R5	23:44	21:11	2.55	V1	20m	Bat crosses the road
				V2	12m	Not clear if bat crosses the road

Table 12: Survey Results for 30th July A428 Cambridge Road Bridge

Static recording numbers 4, 7, 8 & 10 are not included within Table 12 as no footage was available.

Static Recording Number	Barbastelle Static Recording Time	Sunset	Recording Time Relative to Sunset	Video pass of bat on Thermal Imaging camera footage +/-30 secs per static registration	Bat Flight Height	Comments
R1	21:18	20:53	0.43	V1 & V2	14m & 20m	Unclear if bats cross the road
				V3, V4 and V5	20m+	V3 - 2 bats, one crosses, one loops back, not clear if crosses road. V4- Bat crosses road. V5 - 2 bats cross the road.
R2	21:26:00	20:53	0.55	V1	20m+	V1 - 2 bats Cross the road; V2- not clear if crosses road; V3 - 2 bats flying parallel to road;
R3	21:39:09	20:53	0.77	V1	20m+	V1 – 2 bats cross the road,
R5	22:34:47	20:53	1.27	V1	20m+	Crosses the road
R6	22:44	20:53	1.85	V1	20m+	Bat crosses the road
R9	23:33:33	20:53	2.68	V1	12m	Crosses the road

TECHNICAL NOTE 3: Annex 3 Thermal imaging report

DATE:	19 September 2025	CONFIDENTIALITY:	Public
PROJECT/SUBJECT:	Cambourne to Cambridge TWAO Thermal imaging report	AUTHOR:	Gemma Cookson
CHECKED:	Sarah Proctor	APPROVED:	Paola Reason

Table 13: Summary of earliest barbastelles recorded by each static detector

Location No.	Location	Date	Earliest Times	Sunset	Time After Sunset in hours
1	Madingley Road East	23/06/2025	22:48:28	21:24:00	1.41
			22:52:31	21:24:00	1.48
		24/06/2025	00:02:40	21:24:00	2.64
			22:25:28	21:24:00	1.02
		25/06/2025	22:33:34	21:24:00	1.16
			22:15:41	21:24:00	0.86
			23:22:38	21:24:00	1.98
2	Madingley Road West	28/07/2025	21:41:01	20:56:00	0.75
			22:18:04	20:56:00	1.37
		29/07/2025	21:44:35	20:54:00	0.84
			21:32:09	20:54:00	0.64
3	A428 Cambridge Road Bridge	17/07/2025	22:08:43	21:11:00	0.96
			23:21:28	21:11:00	2.17
		30/07/2025	21:39:10	20:53:00	0.77
			21:18:41	20:53:00	0.43
4	A428 Childerley	16/07/2025	23:36:23	21:12:00	2.41
			23:36:33	21:12:00	2.41
		31/07/2025	22:43:12	20:51:00	1.87