



Warren Hall
Broughton, Flintshire
Bat Surveys 2018

TEP Ref 7016.004

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1.0 General Details

Site Name	Warren Hall, Broughton, Flintshire		
Job Number	7016	Doc. Ref	7016.004
Site Location	Broughton	Central Grid Reference	SJ 32408 62514
Survey Location	The site is bordered to the north by the A5104, to the east by Lesters Lane, and the west and south by Kinnerton Lane. The latter two are relatively small country lanes. The habitats surrounding the site are arable and grazed fields. The warren hall estate lays encompassed in the central northern boundary of the site.		
Transect Dates	21 st May 2018 (Visit 1), 16 th July 2018 (Visit 2), 10 th September 2018 (Visit 3),		
Seasonal Constraints	No seasonal constraints encountered. With a good spread across the survey season to identify activity on site throughout the yearly cycle of bats.		
Drawing Ref:	G7016.009 Bat Activity Transect and Static Detector Locations G7016.007 Bat Activity Transect Visit 1 21.05.2018 G7016.005 Bat Activity Transect Visit 2 16.07.2018 G7016.008 Bat Activity Transect Visit 3 10.09.2018 G7016.001.1-5 Phase 1 Habitat Survey.		

2.0 Introduction

- 2.1 TEP was commissioned by Welsh Assembly Government in April 2018, to carry out bat activity surveys as part of a series of phase 1 and phase 2 ecological surveys at Warren Hall, Broughton, Wales, hereafter referred to as 'the site'.
- 2.2 The bat survey forms part of a suite of ecology services to provide input into an Ecological Impact Assessment of the site.
- 2.3 The site is not currently part of a planning proposal and these surveys are to inform the local plan in terms of future development.

Site Location and Description

- 2.4 The site is located east of Penymynydd, south of the A55 and Broughton. The central grid reference is SJ 32408 62514. The site is immediately bounded by the A5104 to the north, Kinnerton Lane to the south and west, and Leicester Lane to the east. The site border dips around the grounds of Warren Hall to the north. Farmland surrounds the site.
- 2.5 The site consists of a series of poor semi-improved grassland fields, with an area of plantation mixed woodland in the north of the site and an area of plantation broad-leaved woodland in the south of the site. The plantation broad-leaved woodland has numerous patches of bluebells, an ancient woodland indicator species in the west with a body of running water running west to east through this. A body of standing water lies within the site south of Warren Hall. This standing water surrounded by plantation broad-leaved woodland and is connected to the mixed plantation woodland by an area of marsh/marshy grassland. Most of the fields are bordered by species-poor intact hedgerows, with some fencing and the site perimeter bordered mostly by native species-rich intact hedgerow. There are scattered trees across the site, mostly along the field boundaries.
- 2.6 The surrounding landscape is farmland with some small developments with Broughton town over the north side of the A55.

3.0 Methods

Desktop Study

- 3.1 Desktop records of protected or notable species recorded within a 1km radius of the site were gathered from the COFNOD North Wales Environmental Information Services in June 2018.

Ground Based Assessment Survey

- 3.2 The trees and one structure on site (as set out in G7016.001.1-5) were assessed for their bat roosting suitability. The structure was assessed for its potential to support roosting bats. Trees were viewed from the ground with the aid of binoculars (where necessary) and were categorised in accordance with the current Bat Conservation Trust (BCT) guidelines (Collins, 2016¹).
- 3.3 Tree roosting suitability is categorised using the criteria in Table 4.

Table 1: Categorisation of tree roost potential (from Table 4.1 of BCT Guidelines 2016)

Roost Suitability	Description of roosting habitat	Action required in respect of bat roosts in tree
Negligible	No PRF present.	No further action required.
Low	A tree of sufficient size and age to contain PRFs but with none seen from the ground, or features seen with only very limited roosting potential (as per BS 8596:2015)	Precautionary measures may be appropriate during felling or pruning activities.
Moderate	A tree with one or more PRF that could be used by bats due to their size, shelter, protection, conditions (i.e. temperature, light levels, humidity, height above ground or disturbance levels) and surrounding habitat but unlikely to support a roost of high conservation status (with respect to roost type only, irrespective of species conservation status)	Presence/absence survey required. Subject to findings of presence/absence survey, roost characterisation surveys required.
High	A tree with one or more PRF that are obviously suitable for use by larger numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, conditions and surrounding habitat.	

- 3.4 The ground based assessment of trees and assessment of the structure was carried out on by ecologist Dale Mortiboys 7th November 2018.

Limitations

- 3.5 The optimum survey window, according to the BCT guidance, is between December to March (inclusive) when trees are not in leaf and features that could support bats

¹ Collins, J. (ed) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London

such as crevices, can be more easily seen. The survey was carried out in November, close to the optimum survey window and the tree foliage had largely dropped allowing good visual access to the canopies.

Manual Transect Survey

- 3.6 Three dusk transects have been completed across the site from May to September 2018, following the Bat Conservation Trust Guidelines 2016. Drawings G7016.007 (Visit 1), 7016.005 (Visit 2), 7016.008 (Visit 3) illustrate the pre-defined transect routes walked on each survey visit.
- 3.7 Dusk surveys commenced at sunset and continued for approximately 2 hours. The route was reversed on the second visit to reduce sampling bias. Table 2: Manual walked transects (April to September 2018) survey conditions summarises dates, times and start/end weather conditions for each of the transects completed.

Table 2: Manual walked transects (April to September 2018) survey conditions

10.5	Start Time	End Time	Sunset	Weather at Start				Weather at End			
				Temp. °C	Rain	Wind ²	Cloud ³	Temp. °C	Rain	Wind	Cloud Cover
21/05	21:14	23:48	21:14	22.0	Dry	2	7	18.0	Dry	2	7
16/07	21:34	23:51	21:34	15.0	Dry	1	6	14.0	Dry	1	0
10/09	19:40	23:26	19:40	16.0	Dry	4	7	13.0	Dry	3	7

- 3.8 Each walked transect of the site included monitoring points, at which surveyors remained stationary for a standardised 3 minute period. Walked sections of the transect between each monitoring point were walked at a slow steady pace. Surveyors carried a broadband frequency division detector (Anabat Express, set to transect mode) supplemented by heterodyne detectors. Bat passes at each walk and monitoring point were recorded with the maximum number of bats observed, species and any other contextual data such as flight direction, social calling or feeding buzzes.
- 3.9 The transect route and monitoring points were designed to sample the range of habitats present, across the site focussing on those most likely to be affected by the Masterplan.
- 3.10 The transects were completed by trained TEP surveyors lead by TEP licensed principal bat ecologist John Crowder (licence number 2015-10700-CLS-CLS) or experienced principal ecologist Anne Pritchard.
- 3.11 Sonogram analysis was undertaken at TEP by licenced bat ecologist Dale Mortiboys (licence number 2016-15414-CLS-CLS), trained to Advanced Level 3 Analook Analysis.

² Wind strength is reported using the Beaufort Scale of Wind Force, this scale runs from 0 to 12, information on the conditions experienced during surveys are as follows: 0 – Calm (vertical smoke); 1 – Light Air (slight smoke drift); 2 – Light Breeze (leaves gently rustle).

³ Cloud cover is reported in oktas or eighths (i.e. 0 oktas represents the complete absence of cloud, 1 okta cloud cover of 1 eighth or less, and so on to 8 oktas which represents full cloud cover), with the additional convention that 9 oktas represents sky obscured by fog or mist.

Limitations

- 3.12 All three transects were carried within the appropriate survey dates, times and weather conditions. No equipment failure was noted during the surveys or subsequent analysis. Therefore, no limitations have been incurred for this element.

Static Remote Monitoring

- 3.13 Static remote monitoring bat detectors (Anabat Express, set to night mode) were deployed at two fixed locations within the site commencing in May 2018. Static remote monitoring was repeated in these two fixed locations, repeated twice more up to and including September 2018.
- 3.14 Each detector was deployed for a minimum of five consecutive nights in accordance with survey guidelines. Detectors were deployed with standardised sensitivity settings.
- 3.15 Recorded data was analysed following completion of the static recording periods using AnaLook 4.1k. Data analysis was completed by Dale Mortiboys (AnaLook, level 3 certification).

Table 3: Static locations and recording periods

Location	Dates of Deployment	Nr. Nights Deployed	Nr. Nights of Activity	Description of Location
Northern Woodland (A)	31/05-04/06*	5	5	Detector was set up within hedgerow along woodland boundary with microphone facing southward.
	17/07-21/07	5	5	
	11/09-15/09	5	5	The surrounding area consists of broad-leaved mixed woodland to the north. Fields with hedgerows to the east, west, and south. <i>* Microphone failed on the initial deployment (24/05-30/05)</i>
Southern Woodland (B)	24/05-30/05	5	5	Detector was set up within hedgerow with microphone facing westward.
	17/07-21/07	5	5	
	11/09-15/09	5	5	The surrounding area consists of woodland and dense hedgerows surrounded by a graveyard. The church is disrepair but maintained structurally. <i>* Microphone failure</i>

Limitations

- 3.16 Static detectors recorded data for a minimum of five consecutive nights with the exception of the Church location Visit 2 - 16/05 - 21/05 which recorded three nights of data due to microphone failure. The northern woodland location (A) visit 1 initially didn't work due to microphone failure. This location was immediately redeployed. Although this allows spring data to still be analysed, it limits the direct comparison to location B (southern woodland) for this visit 1.

Table 4: Weather conditions during recording periods (red text indicates suboptimal weather conditions)

Location	Dates of Deployment	Max Temp °C	Min Temp °C	Strongest Winds <12mph	Rain	Description
Northern Woodland (A)	31/05-04/06	21.2	11.4	23NE	1h	Sub optimal weather conditions had limited effect on bat contacts throughout all survey periods. Low temperatures were recorded during the dawn.
	17/07-21/07	23.5	11.0	18 SE	3h	
	11/09-15/09	22.7	11.2	20 SE	0h	
Southern Woodland (B)	24/05-30/05	21.5	10.5	23 NE	1h	Sub optimal weather conditions had limited effect on bat contacts throughout all survey periods. Low temperatures were recorded during the dawn.
	17/07-21/07	22.5	9.0	18 SE	3h	
	11/09-15/09	22.0	11.5	20 SE	0h	

Limitations

- 3.17 Individual static detectors recorded the temperatures for each location, the temperatures on the whole were within an optimal survey range as defined in the BCT guidelines. The sub optimal temperatures <10°C were only recorded during the dawns and this was for a limited period of 1 to 2 hours on any given occasion. The heavy winds <12mph and rain caused no significant impacts for recording bat contacts, with good numbers noted. It should be noted that the wind and rain events were limited to a few days across the survey season of 2018.

Evaluation Method

- 3.18 For the purposes of this assessment and of assigning value to bat activity or bat potential, the guidance set out in (Wray *et. al.* 2010) has been followed.
- 3.19 The guidance provided by Wray *et. al.* (2010) includes a framework for identifying the importance of bats in the landscapes through the evaluation of bat roosts and habitats. Applying this framework, bat roosts can be valued according to species rarity (Table 5) and roost status (Table 6).

*Table 5: Species rarity in England (adapted from Wray *et. al* 2010)*

Rarity	Species*		
Common (population over 100,000)	Common pipistrelle Soprano pipistrelle	Brown long-eared	
Rarer (population 10,000 to 100,000)	Lesser horseshoe bat Daubenton's bat Natterer's bat	Whiskered bat Leisler's bat Noctule	Nathusius' pipistrelle Serotine Brandt's bat
Rarest (population under 10,000)	Greater horseshoe Bechstein's bat Barbastelle	Grey long-eared Alcathoe bat Greater mouse-eared bat	

Table 6: Valuation of roosts

Geographic Scale Of Importance	Roost Type
Negligible	-
Site	-
Local	Feeding perches (common species) Individual bats (common species) Small numbers of non-breeding bats (common species) Mating sites (common species)
County	Maternity sites (common species) Small numbers of hibernating bats (common and rarer species) Feeding perches (rarer/rarest species) Individual bats (rarer/rarest species) Small numbers of non-breeding bats (rarer/rarest species)
Regional	Mating sites (rarer/rarest species) including well used swarming sites Maternity sites (rarer species) Hibernation sites (rarest species) Significant hibernation sites for rare/rarest species or all species assemblages
National	Maternity sites (rarest species) Sites meeting Sites of Special Scientific Interest (SSSI) guidelines based on bats
International	Special Area of Conservation (SAC) sites with bats as qualifying species

- 3.20 Wray et. al (2010) identifies a numerical scoring system which can be applied to foraging habitat (Table 7) and commuting habitat (Table 8). The score derived from these evaluations is then applied to the geographical scale proposed by the CIEEM EcIA *guidelines*.

Table 7: Valuing commuting habitat for bats

Species (Score)	Number Of Bats (Score)	Roosts/Potential Roosts Nearby (Score)	Type And Complexity Of Linear Features (Score)
Common (2)	Individual bats (5)	None (1)	Absence of (other) linear features (1)
	Small number of bats (10)	Small number (3)	Un-vegetated fences and large field sizes (2)
Rarer (5)	Large number of bats (20)	Moderate number/not known (4)	Walls, gappy or flailed hedgerows, isolated well-grown hedgerows, and moderate field sizes (3)
	Individual bats (5)	Large number of roosts, or close to a SSSI for the species (5)	Well-grown and well connected hedgerows, small field size (4)
Rarest (20)	Small number of bats (10)	Close to or within a SAC for the species (20)	Complex network of mature well established hedgerows, small fields and rivers/streams (5)

Table 8: Valuing foraging habitat for bats

Species (Score)	Number Of Bats (Score)	Roosts/Potential Roosts Nearby (Score)	Type And Complexity Of Features (Score)
Common (2)	Individual bats (5)	None (1)	Industrial or other site without established vegetation (1)
Rarer (5)	Small number of bats (10)	Small number (3)	Suburban areas or intensive arable land (2)
Rarest (20)	Large number of bats (20)	Moderate number/not known (4)	Isolated woodland patches, less intensive arable and/or small towns and villages (3)
		Large number of roosts, or close to a SSSI for the species (5)	Larger or connected woodland blocks, mixed agriculture, and small villages/hamlets (4)
		Close to or within a SAC for the species (20)	Mosaic of pasture, woodlands and wetland areas (5)

Table 9: Scoring system for commuting and foraging habitats

Score	Geographic Value
1 – 10	Not important
11 – 20	Local
21 – 30	County
31 – 40	Regional
41 – 50	National

4.0 Results

Desktop Study

- 4.1 Desktop records were gathered in August 2018 from COFNOD North Wales Environmental Information Services. Records of common pipistrelle *Pipistrellus pipistrellus*, soprano pipistrelle *Pipistrellus pygmaeus*, brown long-eared bats *Plecotus auritus*, noctules *Nyctalus noctula* and a number of unidentified bat species were returned from within 1km. It is unknown whether these records are of roosts or bat activity, as desktop records do not state this.

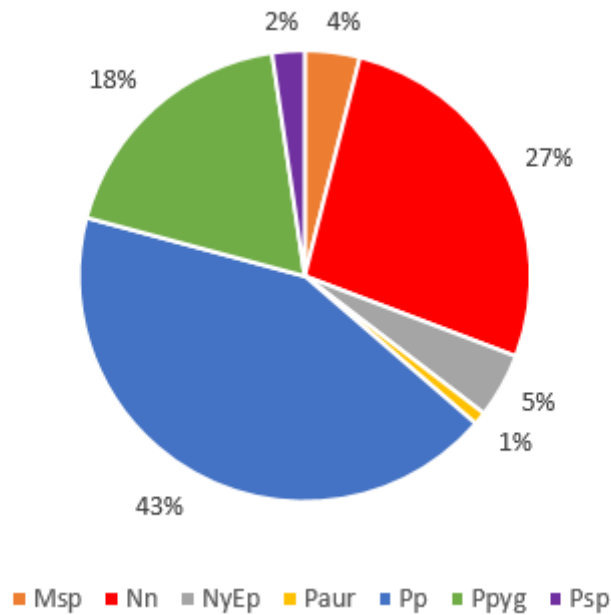
Ground Based Assessment

- 4.2 Findings from the ground based assessment indicate that an assemblage of at least 38 trees with bat roosting potential on site can be seen in Appendix A. These trees are found across site along woodland blocks, hedgerows and site boundaries as shown in G7016.001.1-5
- 4.3 These trees are categorised as Low (12), Moderate (14) and High (12) and are found in a range of habitats across site. The northern and southern blocks of woodland contain several bat potential trees. Mature trees, particularly oak exist within the internal hedgerows of the site. The North West boundary has a number of trees that have bat roosting potential. Below the area of the Pond (pond 7) that is south of Warren Hall is a row of four mature oaks that are standing in the field. This would historically have been a field boundary, but now the trees exist in isolation.
- 4.4 There is a single concrete structure on site. The structure appears to be a water tank with an open top. The structure has no potential to support roosting bats.

Manual Transects

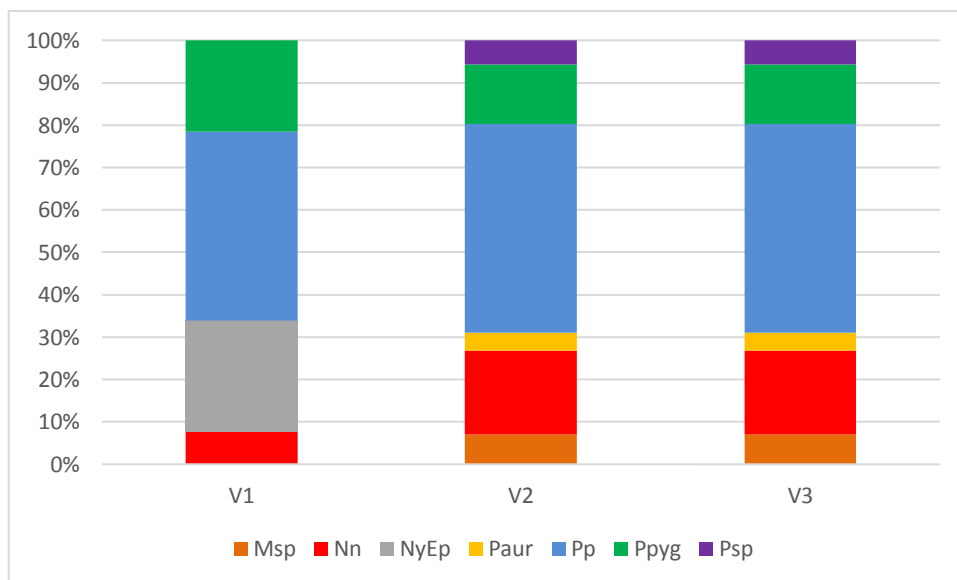
- 4.5 Manual transects across the site recorded a species assemblage of at least five species: common pipistrelle; soprano pipistrelle; noctule; brown long-eared; and 'Myotis species. Common pipistrelle produced 43% of the contacts recorded during transects. Figure 1 summarises the composition of the species assemblage recorded over the three transect surveys.

Figure 1: Species assemblage recorded – average representation across all transects



(Species Key: Msp – Myotis Species, Nn – Noctule, NyEp - Big Bat Species, Paur – Brown Long Eared Bat, Ppyg – Soprano Pipistrelle, Pp – Common Pipistrelle, Psp – Pipistrelle Species)

Figure 2: Species assemblage recorded – average representation across each transect



- 4.6 The relative abundance of common pipistrelle recorded during each of the three transects remained generally consistent between surveys, while relative abundance of other species/species groups varied slightly as shown in Figure 2.
- 4.7 The spatial distributions of species recorded during the transect surveys are illustrated on Drawings G7016.007 (visit 1), G7016.005 (visit 2), G7016.008 (visit 3).

- 4.8 Foraging passes was recorded frequently along the transect during each survey. The majority of passes that were recorded was by common pipistrelle. The key focal areas where foraging was recorded included the central hedgerows and the corresponding woodland edge and in habitats to the middle and south of the site.
- 4.9 There are a number of habitats that should be retained on site. The transect activity results highlighted a number of areas where bat activity was noted. The woodland blocks to the south and north were consistently found to have bat presence, particularly in the third visit. The hedges associated with the southern, north western, and north eastern boundaries were frequently used by commuting bats. The hedges in the centre of site between the two woodland blocks had several bat passes, potentially highlighted valuable commuting paths. This should be further investigated with future surveys.

Static Remote Monitoring

- 4.10 Initial findings from the static remote monitoring data indicates an assemblage of at least six species: common and soprano pipistrelles, noctule, lesser horseshoe, brown long-eared and Myotis species based on call characteristics; it should be noted that accuracy of call diagnostics for Myotis species is variable within the data and for the purposes of evaluating the species assemblage at this preliminary state, Myotis species have been grouped.
- 4.11 Figure 3 illustrates the overall bat assemblage currently recorded from data analysed.

Figure 3: Species assemblage recorded during static remote monitoring

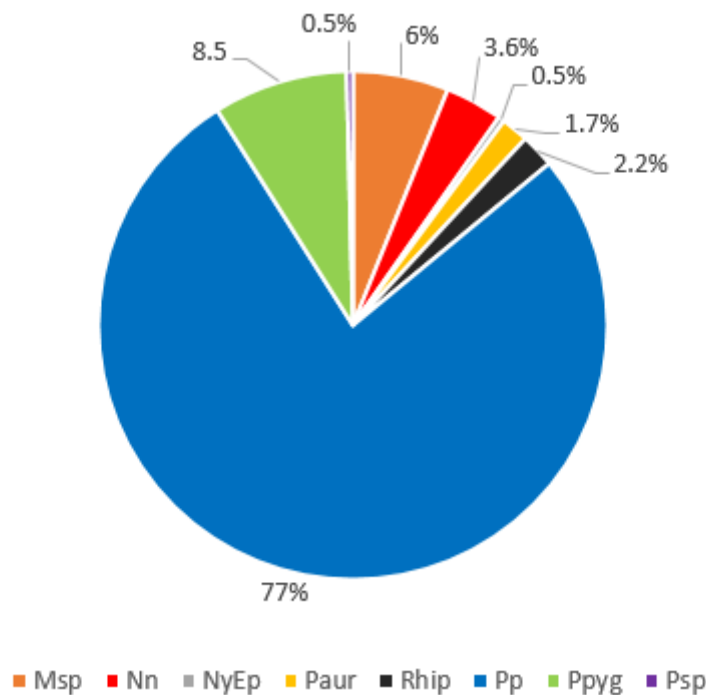
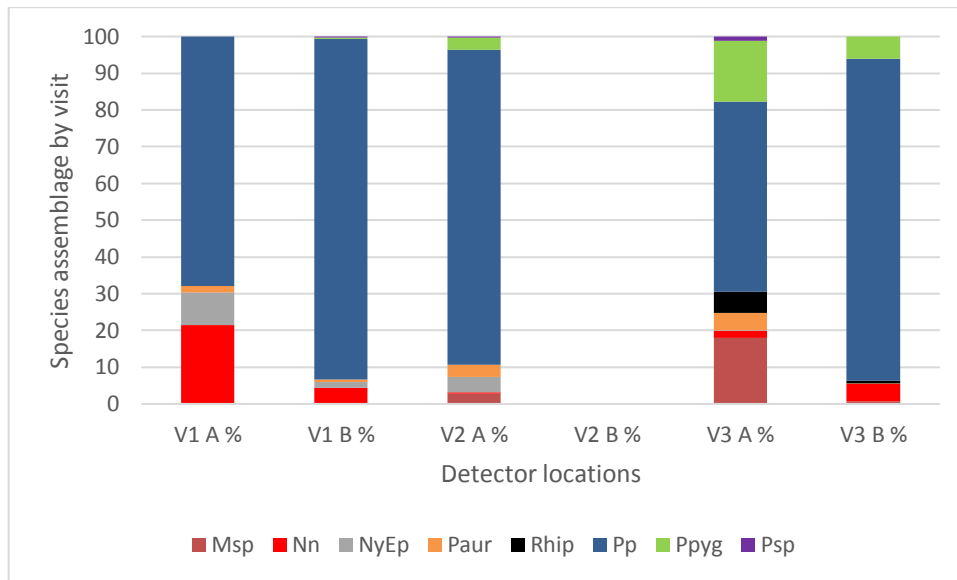


Figure 4: Species assemblage by visit



- 4.12 Common pipistrelle are the most prevalent species throughout all months, with a slight decrease in August relative to other species numbers. In September (Visit 3) there was an increase in relative numbers of soprano pipistrelles. Brown long-eared bats are constant as a proportion of the assemblage throughout all months, at approximately 3%. Myotis species bats as a percentage of all bats, are inconsistent May though to August with a notable increase in September and Location A recording consistently more passes. Noctule vary in their relative abundance, representing an average of 4% of the assemblage, although there were less passes during September. Location A in May had a large number of noctule passes with 20% of the total passes recorded..

5.0 Evaluation and Recommendations

- 5.1 A number of trees across the site are categorised as Low (12), Moderate (14) and High (12) and are found in a range of habitats across site. These trees should ideally be retained. If this is not possible further surveys will be required. For trees with low potential they will need to be section felled under the supervision of a licensed bat ecologist. For trees with moderate bat potential single dusk and single dawn nocturnal survey between May and September. For trees with high potential two dusks and a dawn survey between May and September. If bats are found to be roosting then a licence from Natural Resources Wales will be required to permit felling of trees.
- 5.2 Twelve data records for multiple species (including roosts) have been returned within 1km of the Warren Hall site. Taking these roost sites into account, and based on preliminary data analysis completed, the evaluation of the site is of **Regional** importance commuting for, overall. For foraging the site is assessed as being of **County** importance Tables 10 and 11 summarise this evaluation for commuting and foraging bats respectively, applying the framework set out in Section 3.0.

Table 10: Evaluation of the Site for commuting bats

Species (Score)	Number Of Bats (Score)	Roosts/Potential Roosts Nearby (Score)	Type And Complexity Of Linear Features (Score)	Value (Score)
Common (2)	Large number of bats (20)	Moderate number of roosts/ unknown. (4)	Complex network of mature well established hedgerows, small fields and rivers/streams (5)	Regional (31)
Rarer (5)	Small number of bats (10)	Moderate number of roosts/ unknown. (4)	Complex network of mature well established hedgerows, small fields and rivers/streams (5)	Regional (34)

Table 11. Evaluation of the site for foraging bats

Species (Score)	Number Of Bats (Score)	Roosts/Potential Roosts Nearby (Score)	Type And Complexity Of Linear Features (Score)	Value (Score)
Common (2)	Large number of bats (20)	Moderate number of roosts/ unknown. (4)	Isolated woodland patches, less intensive arable and/or small towns and villages (3)	County (29)
Rarer (5)	Small number of bats (10)	Moderate number of roosts/ unknown. (4)	Isolated woodland patches, less intensive arable and/or small towns and villages (3)	County (22)

Mitigation

- 5.3 No planning proposals exist for the site currently. However, the below is included for consideration by the local planning authority to inform the local plan.

Construction

- 5.4 There may occasionally be the need to undertake some works outside of daylight hours. A Sensitive Lighting Strategy should set out the lighting proposals during both construction and operation to ensure potential adverse effects on bats are avoided. This Strategy will also benefit other wildlife including birds. The Strategy will address four design principles and would be effective immediately:
- Use of unnecessary lighting will be avoided. This applies to both existing and proposed habitat features of value to bats;
 - Spatial spread of lighting – the horizontal and vertical spread of artificial light will be minimised, particularly to avoid spill of light off the construction site, and take into account both primary and reflected light sources. Directional lighting can be achieved by angle and orientation of beam, use of a cowl, louvre or other light shield, or a combination of these;
 - Timing and duration of lighting – timers and bespoke dimming regimes may be used to ensure that luminaires are reduced at times of predicted low use. These can be set to change with the seasons and therefore reflect the shifting time of dusk and dawn throughout the year. Motion sensors provide further control to ensure that areas are illuminated only when required; and
 - Intensity and colour of lighting – light intensity will be designed to be as low as possible whilst meeting the objectives of the intended function. The colour of lighting will need to take into account the sensitivity of the ecological receptors on site. Light sources selected should emit zero ultra-violet light wherever possible. Interim guidance from the Bat Conservation Trust (2016) recommends that white and blue spectrum light should be avoided or where white lights are required these should be of warm/neutral colour and have a peak wavelength above 550 nanometres. Narrow spectrum light sources will be used to lower the range of species affected by lighting.

Post Construction

- 5.5 Artificial lighting can also affect the foraging behaviour of bats. Most bat species display two peaks of nocturnal activity – one after sunset and one just before dawn, which correspond with the peak in insect flight times. All UK bats are insectivorous and are entirely dependent upon nocturnal flying insects. Night-time lighting may disrupt insect flight behaviour, which in turn will affect bat foraging.

- 5.6 Stone (2014) describes the impact on roosts dependent on the species and status of roost. Lighting of non-maternity roosts, foraging and/or commuting habitat of the brown long-eared bat is classed as High impact. Lighting of such roosts for pipistrelles is classed as a Medium impact, and of foraging and/or commuting as Low.
- 5.7 Lamps that emit an ultra-violet component can attract insects which can cause displacement of insect concentrations from adjacent dark habitats. Some species of bat have been known to feed on the insects attracted by artificial lighting; pipistrelles (*Pipistrellus* species) for example are known to fly through lit areas when foraging. The slower flying long-eared (*Plecotus* species) bats are however more light adverse and will avoid street lighting. These more light-averse species are therefore restricted to foraging in unlit areas with reduced insect abundance.
- 5.8 Bats use echolocation for navigation but are also reliant on vision when travelling and for certain types of feeding. Owing to the physiology of the bat eye, bat vision works best in dim, as opposed to bright, light. Sensitivity to light levels varies between species. Pipistrelles typically emerge approximately 30 minutes after sunset and are considered in relative terms to be the more light-tolerant of the UK species. The brown long-eared emerge c.1 hour after sunset.
- 5.9 Emergence of pipistrelle has been recorded at light levels of 14lux. This figure provides a useful indication of tolerance levels but should be taken with consideration of habituation.
- 5.10 Bat activity varies throughout the year. The impact of lighting on a local bat population may be exacerbated where, for example, bats are unable to forage efficiently when accruing body reserves prior to hibernation, prior to/during the maternity season or when young are on the wing.

Summary of Habitat Features Requiring Protection

- 5.11 Table 12 below identifies all habitat features which will require protection from during any development.

Table 12. Habitat features to be protected from artificial lighting

Feature	Location
Linear boundary features	Trees and hedgerow areas that are located across the site as set out at G7016.001.1-5
Woodland	The northern and southern woodland areas across the site as set out at G7016.001.1-5
Trees	Trees along the south west, north west and north east of the site as set out at G7016.001.1-5
Waterbodies	Pond 1 in the east of the site and the stream to the south as set out at G7016.001.1-5

Retention

- 5.12 There are a number of habitats that should be retained on site. The transect activity results highlighted a number of areas where bat activity was noted. The ground based

assessment also highlighted a number of trees with bat roosting potential. The results have been considered and are listed in Table 12 above. This retained habitat should be enhanced where possible and are discussed below.

5.13 The retained habitat constraints:

- Mature trees- maintain an unlit 10 m buffer from the canopy
- Hedgerows- The native hedgerows that both border sections of the site and lie internally sectioning pastures, qualify as priority habitat. The hedgerows should be largely retained within significant and interconnecting linear greenspaces, thus benefiting a range of species including nesting birds and foraging bats. Small losses of hedgerow habitat would likely occur to facilitate the site access requirements.

5.14 The retained habitat opportunities:

- Bat boxes to be installed on remaining trees and incorporated in new builds where appropriate.
- Additional planting of hedgerows, ponds and stream enhancement.
- New hedgerow planting should be provided using locally appropriate native species (e.g. hawthorn, English oak, blackthorn, ash, alder, elder).
- Swathes either side the hedgerows in these areas should be enhanced with native shrub, bulb and/or wildflower planting to create further species and structural diversity. This would strengthen current internal wildlife links and provide extra habitat for any amphibians, small mammals, birds and insects to utilise the site.

Lighting

5.15 Best practice guidance on sensitive lighting continues to evolve, as does the technology of light products themselves. The advice below is based upon current knowledge and is provided in accordance with the 'mitigation hierarchy': firstly to avoid adverse impacts; where this is not possible to mitigate impacts; and as a last resort to compensate for impacts (offset).

5.16 The key areas that may be affected by lighting and the principles to inform a sensitive Lighting Strategy are set out under the subheadings below.

Street Lighting and hard landscaping

5.17 Construction across the site must minimise light spillage onto woodland belts, tree lines, hedgerows and the stream and Pond 1 (TN3 in G7016.001), if negative effects on bats are to be avoided.

5.18 Minimal lighting is likely to be required to these areas; however, if security lights are to be fitted, these should be orientated to light up a small area only and not to overspill to retained good bat habitat, as many areas on the boundaries of the site are tree-lined. Additionally, any proposed street or pedestrian lighting around the site boundary should be aimed away from tree lines and woodland edge habitat. This can be

achieved by orientation and angle of beam, by use of a cowl, louvre or other light shield, or a combination of these. The lighting should also be motion activated or timed so that during the peak activity periods for bats (dusk and dawn), the lighting level is kept to between 1 and 5 lux.

- 5.19 Any lighting around the site boundary, woodland habitat or retained hedgerows should be kept below the tree canopy and away from the hedgerows.. Light spill on site will be minimised by the following:
- Spacing of columns increased to reduce overall number of columns
 - Use of cowls or hoods to direct light to the road and reduce light spill.

Further Surveys

- 5.20 The habitats on site are a mix of woodland blocks, agricultural fields and hedgerows, with a stream running through the southern woodland block. This habitat is assessed as highly suitable for bat habitats and further surveys should be completed at this level of survey effort. This is supported by the evidence of rarer (lesser horseshoe) species using the site and the high levels of activity picked up in the 2018 survey season.
- 5.21 There are currently no planning proposals for the site, therefore there are no impacts to assess. Future proposals should require a high level of survey effort to correctly inform the local planning authority of the use of the site bat species.
- 5.22 An evaluation of potential impacts can be made once the results of further surveys are known. The survey requirements for a site with High suitability habitats such as this include:
- Transects: Up to two survey visits per month (April to October) in appropriate weather conditions for bats. At least one of the surveys should comprise dusk and pre-dawn (or dusk to dawn) within one 24 hr period.
 - Static detector surveys: Three locations per transect, data to be collected on five consecutive nights per month (April to October) in appropriate weather conditions for bats.

6.0 References

- Bat Conservation Trust (2014) *Artificial Lighting & Wildlife Interim Guidance: Recommendations to help minimise the impact artificial lighting*
- Bat Conservation Trust & Institute of Lighting Engineers (2008) *Bats and Lighting in the UK. Bats and the Built Environment Series*
- DEFRA (2011) *A Review of Local Authority Road Lighting Initiatives Aimed at Reducing Costs, Carbon Emissions & Light Pollution*
- Fure, A. (2006) *Bats and Lighting*. The London Naturalist, 85.
- Fure, A. (2012) *Bats and Lighting - six years on*. The London Naturalist, 91.
- Gunnell, K, Grant, G. & Williams, C. (2012) *Landscape & Urban Design for Bats & Biodiversity*. Bat Conservation Trust
- Kuijter, D.P.J, Shut, J., Van Dulleman, D., Toorman, H., Goosens, N., Ouweland, J. & Limpens, H.J.G.A (2008) *Experimental Evidence of Light Disturbance along the Commuting Routes of Pond Bats Myotis dasycneme*. Lutra 51(1):37-49
- Life at Night (2011) *How Does the Light at Night Affect Animals? Life at night project 2011* (project LIFE09 NAT/SI/000378)
- Institute of Lighting Professionals (2011) *Guidance Notes for the Reduction of Obtrusive Light* GN01:2011
- Stone, E.L. (Ed.) (2014) *Bats and Lighting: Overview of current evidence and mitigation*. Bats and lighting research project, University of Bristol
- Stone, E.L., Jones, G., & Harris, S. (2012) *Conserving Energy at a Cost to Biodiversity? Impacts of LED lighting on bats*. Global Change Biology
- Stone, E.L., Jones, G., & Harris, S. (2009) *Street Lighting Disturbs Commuting Bats*. Current Biology 19:1-5

DRAWINGS

- G7016.001.1-5. Phase 1 Habitat Map
- G7016.009. Bat Activity Transect and Static Detector Locations
- G7016.007 Bat Activity Transect Visit 1 21.05.2018
- G7016.005 Bat Activity Transect Visit 2 16.07.2018
- G7016.008 Bat Activity Transect Visit 3 10.09.2018



KEY

Survey Boundary

Target Note

Scattered Scrub

Scattered Broad-leaved Trees

Broad-leaved Tree with Moderate Bat Potential

Broad-leaved Tree with High Bat Potential

Japanese Knotweed

Rhododendron Ponticum

Native Species-rich Intact Hedge

Species-poor Intact Hedge

Fence

Earth Bank

Semi-natural Broad-leaved Woodland

Plantation Broad-leaved Woodland

Plantation Mixed Woodland

Semi-improved Neutral Grassland

Marsh/Marshy Grassland

Poor Semi-improved Grassland

Tall Ruderal

Standing Water

Buildings

Bare Ground

Hardstanding

Species Code
Qr European Oak

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Site Map

Rev	Description	Drawn	Approved	Date

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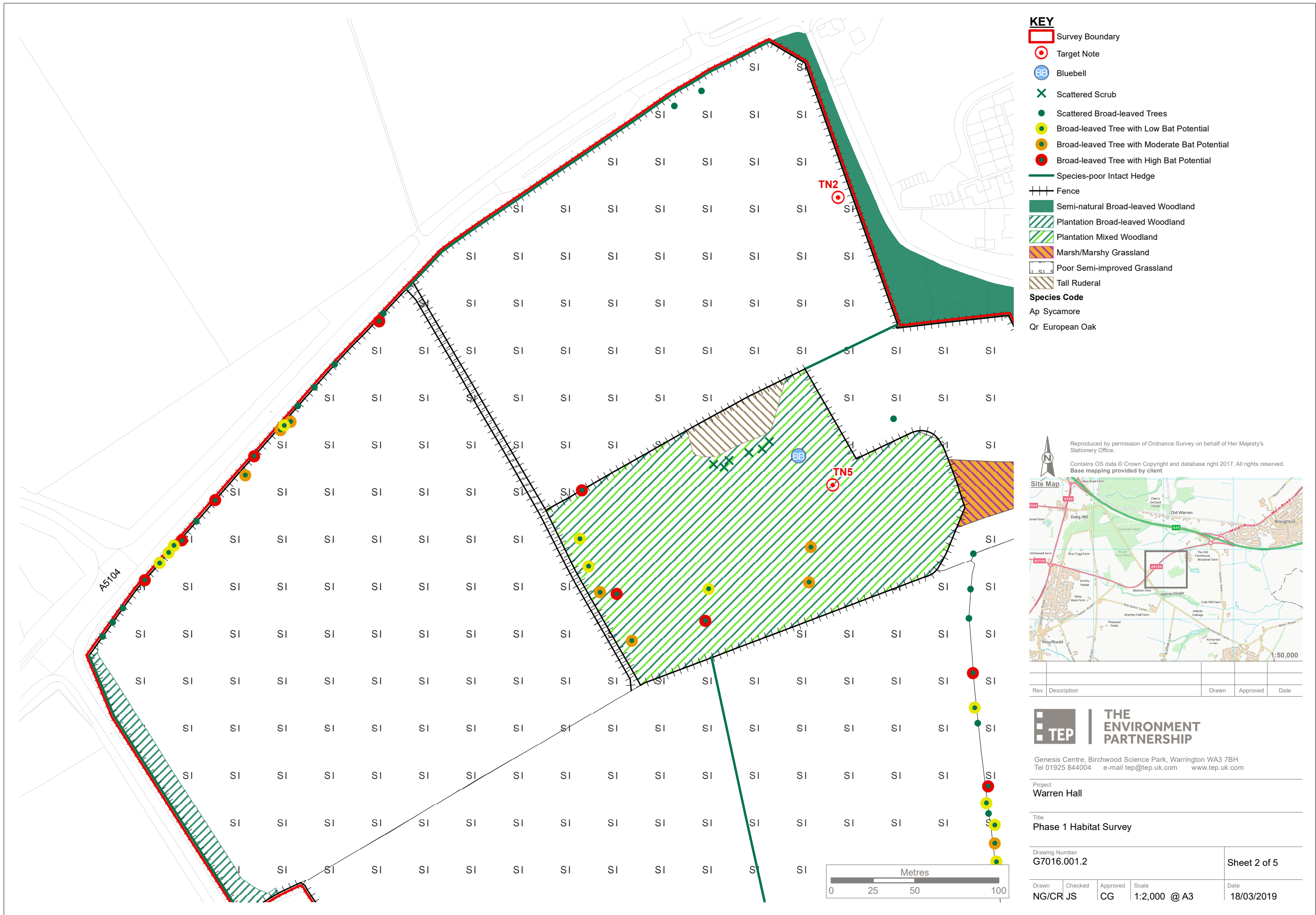
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Project
Warren Hall

Title
Phase 1 Habitat Survey

Drawing Number	Sheet 1 of 5
G7016.001.1	Sheet 1 of 5

Drawn	Checked	Approved	Scale	Date
NG/CR	JS	CG	1:2,000 @ A3	18/03/2019

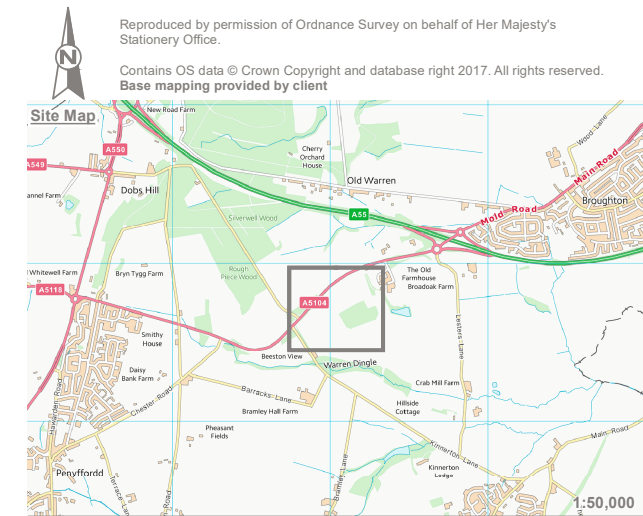


KEY

- Survey Boundary
- Target Note
- Bluebell
- Scattered Scrub
- Scattered Broad-leaved Trees
- Broad-leaved Tree with Low Bat Potential
- Broad-leaved Tree with Moderate Bat Potential
- Broad-leaved Tree with High Bat Potential
- Species-poor Intact Hedge
- Fence
- Semi-natural Broad-leaved Woodland
- Plantation Broad-leaved Woodland
- Plantation Mixed Woodland
- Marsh/Marshy Grassland
- Poor Semi-improved Grassland
- Tall Ruderal

Species Code

- Ap Sycamore
- Qr European Oak



Rev	Description	Drawn	Approved	Date

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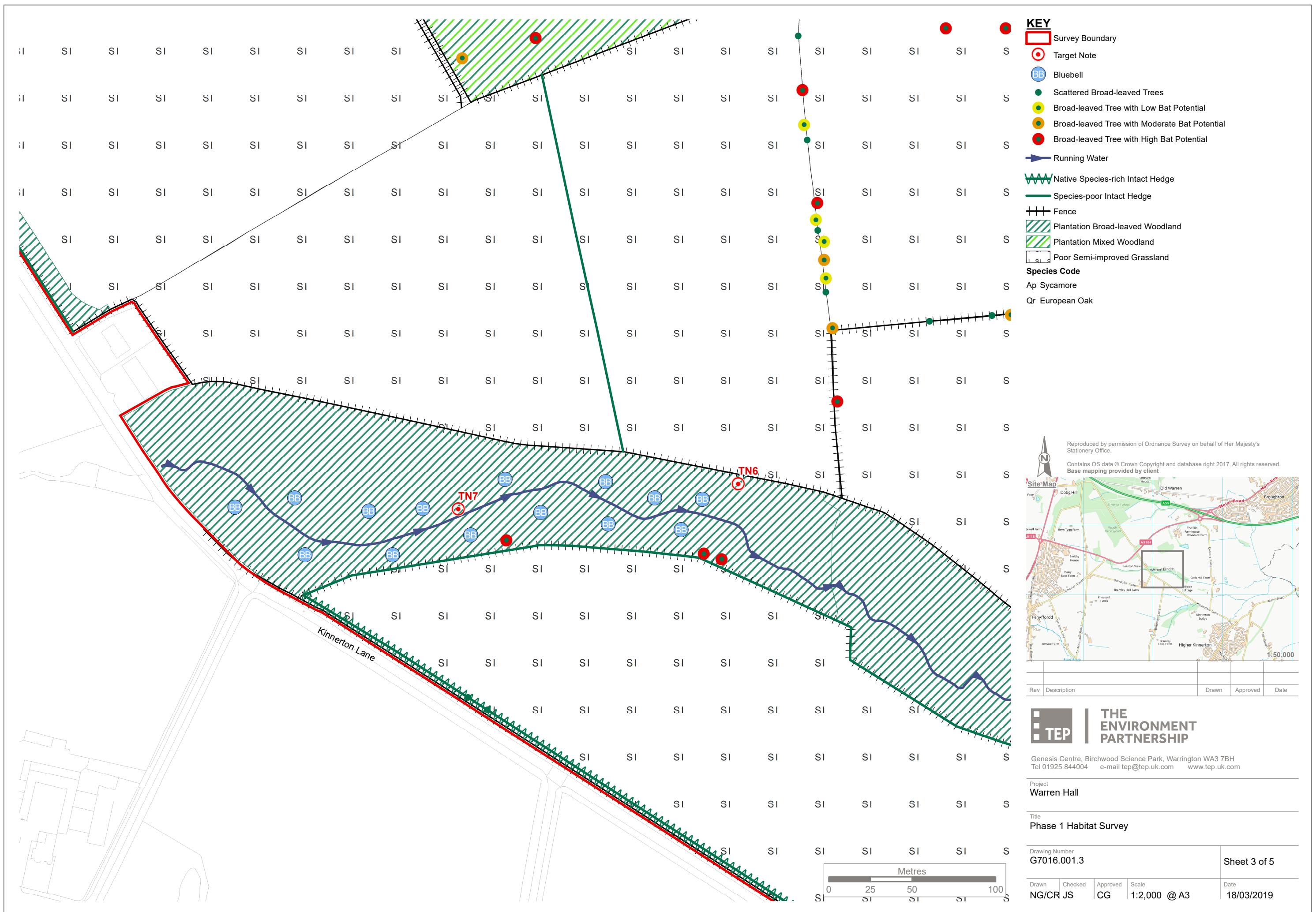
Project
Warren Hall

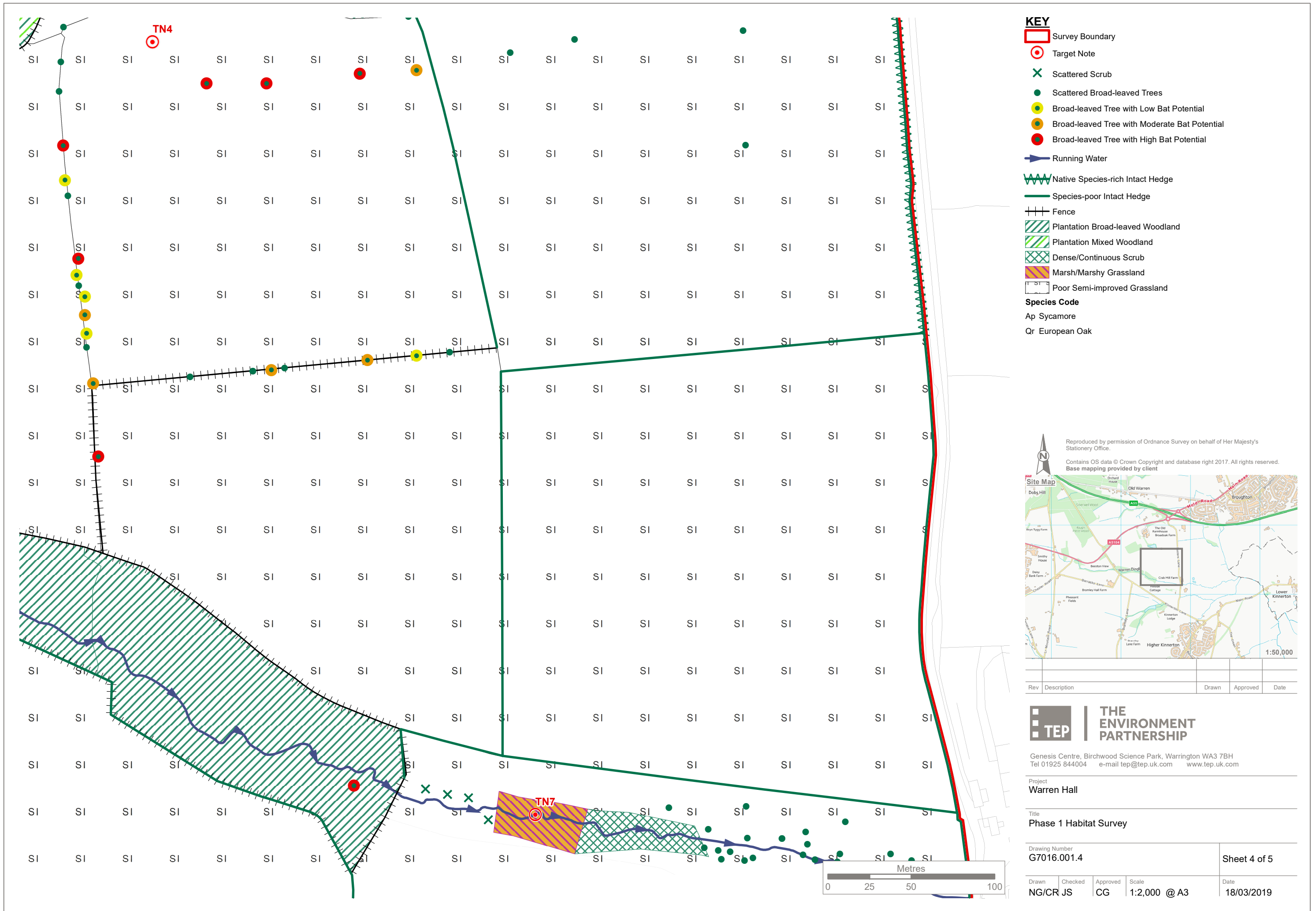
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Phase 1 Habitat Survey

Drawing Number
G7016.001.2

Sheet 2 of 5

Drawn NG/CR JS	Checked JS	Approved CG	Scale 1:2,000 @ A3	Date 18/03/2019
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KEY

- Survey Boundary
- Target Note
- Scattered Scrub
- Scattered Broad-leaved Trees
- Broad-leaved Tree with Low Bat Potential
- Broad-leaved Tree with Moderate Bat Potential
- Broad-leaved Tree with High Bat Potential
- Running Water
- Native Species-rich Intact Hedge
- Species-poor Intact Hedge
- Fence
- Plantation Broad-leaved Woodland
- Plantation Mixed Woodland
- Dense/Continuous Scrub
- Marsh/Marshy Grassland
- Poor Semi-improved Grassland

Species Code
 Ap Sycamore
 Qr European Oak

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 Base mapping provided by client

Site Map

1:50,000

Rev	Description	Drawn	Approved	Date

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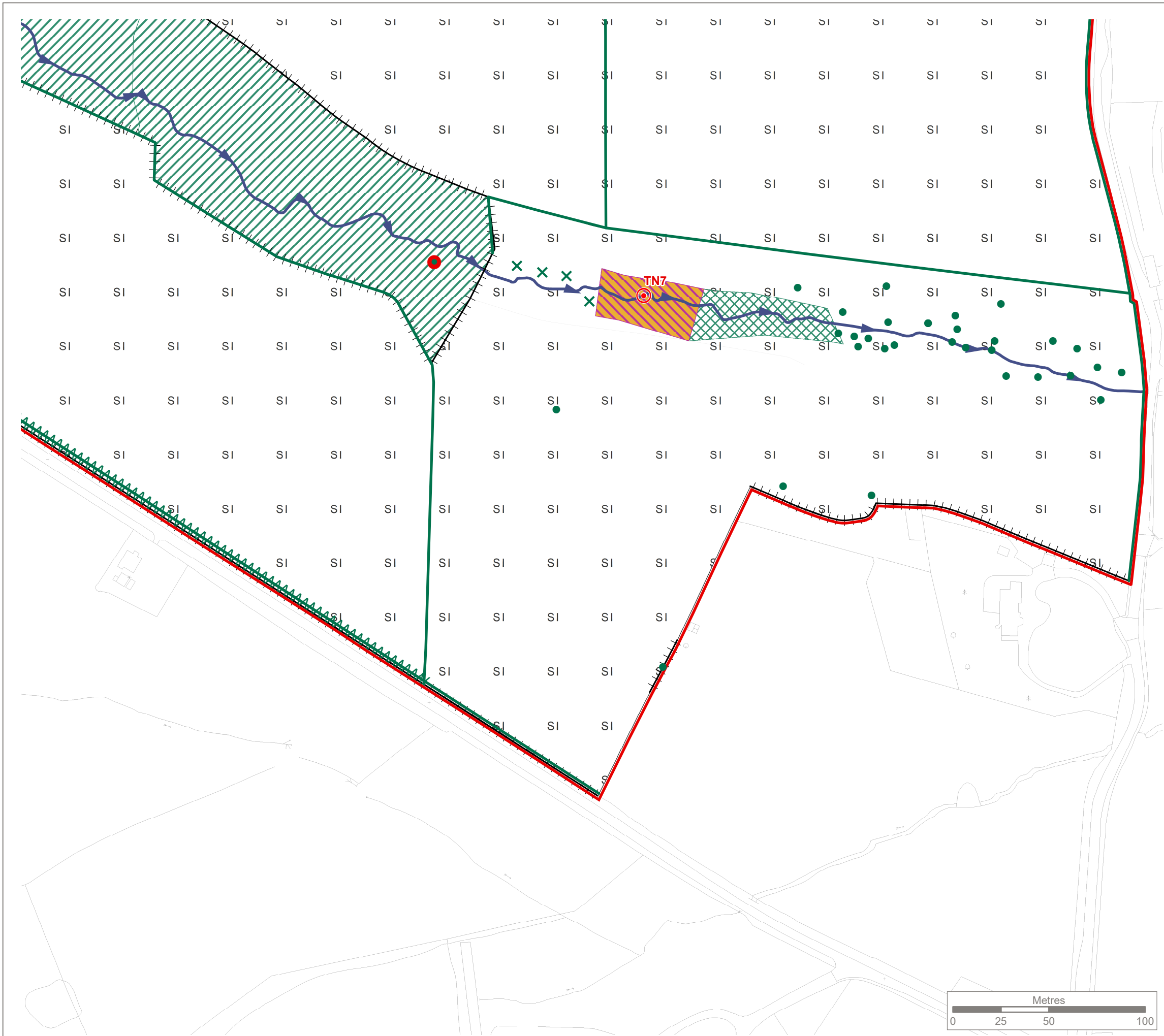
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Title
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Drawing Number				Sheet 4 of 5
G7016.001.4				

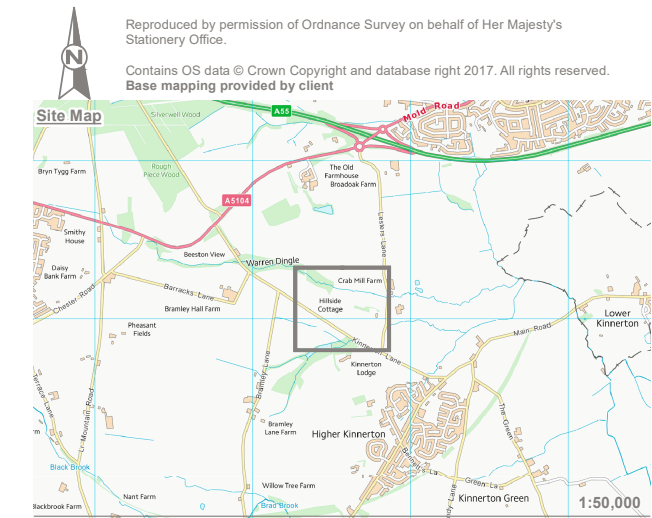
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KEY

- Survey Boundary
- Target Note
- Scattered Scrub
- Scattered Broad-leaved Trees
- Broad-leaved Tree with High Bat Potential
- Running Water
- Native Species-rich Intact Hedge
- Species-poor Intact Hedge
- Fence
- Plantation Broad-leaved Woodland
- Dense/Continuous Scrub
- Marsh/Marshy Grassland
- Poor Semi-improved Grassland

Species Code
Qr European Oak



Rev	Description	Drawn	Approved	Date



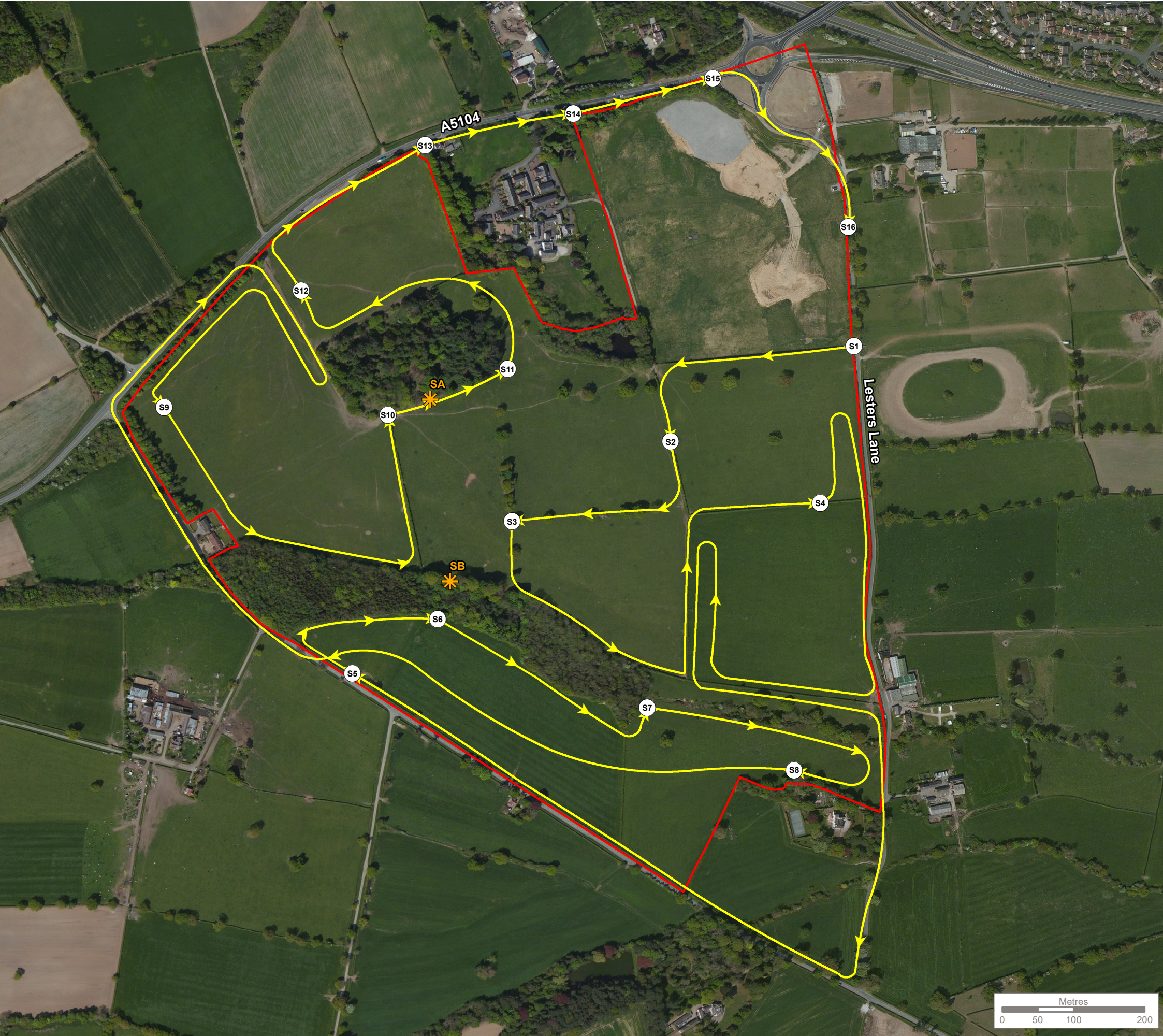
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Drawing Number G7016.001.5				Sheet 5 of 5
Drawn NG/CR	Checked JS	Approved CG	Scale 1:2,000 @ A3	Date 18/03/2019

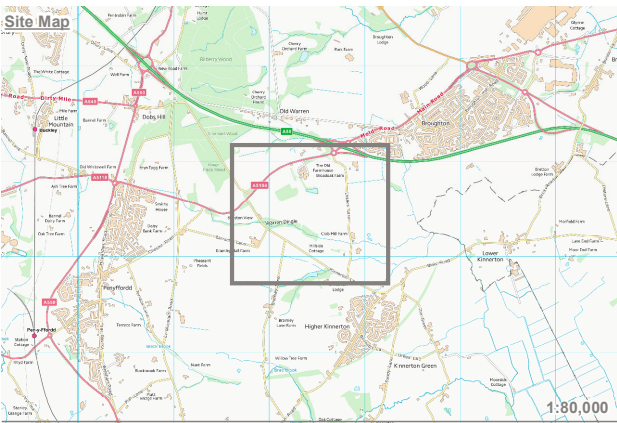


KEY

- Survey Boundary
- ✱ Static Detector Location
- S# Survey Stop Reference
- ➡➡➡ Transect Route



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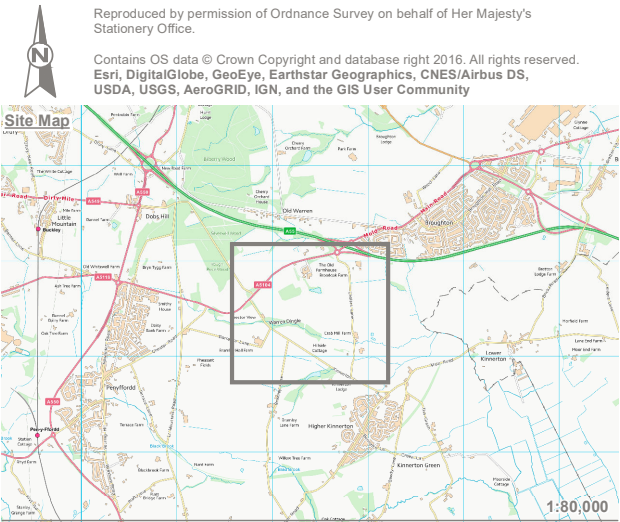
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Bat Transect Route and Static Detector Locations

Drawing Number
G7016.009

Drawn	Checked	Approved	Scale	Date
CR	JS	JC	1:5,500 @ A3	24/01/2019



- KEY**
- Survey Boundary
 - Noctule
 - Brown Long-Eared
 - Soprano Pipistrelle
 - Common Pipistrelle



Rev	Description	Drawn	Approved	Date

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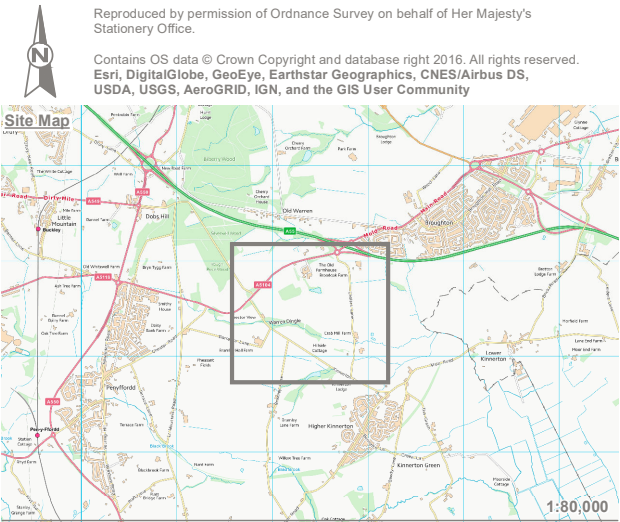
Title
Bat Activity Transect Survey
Visit 1 - 21st May 2018

Drawing Number
G7016.007

Drawn	Checked	Approved	Scale	Date
CR	JS	JC	1:5,500 @ A3	24/01/2019



- KEY**
- Survey Boundary
 - Myotis Species
 - Noctule
 - Brown Long-Eared
 - Soprano Pipistrelle
 - Common Pipistrelle
 - Pipistrelle Species



Rev	Description	Drawn	Approved	Date

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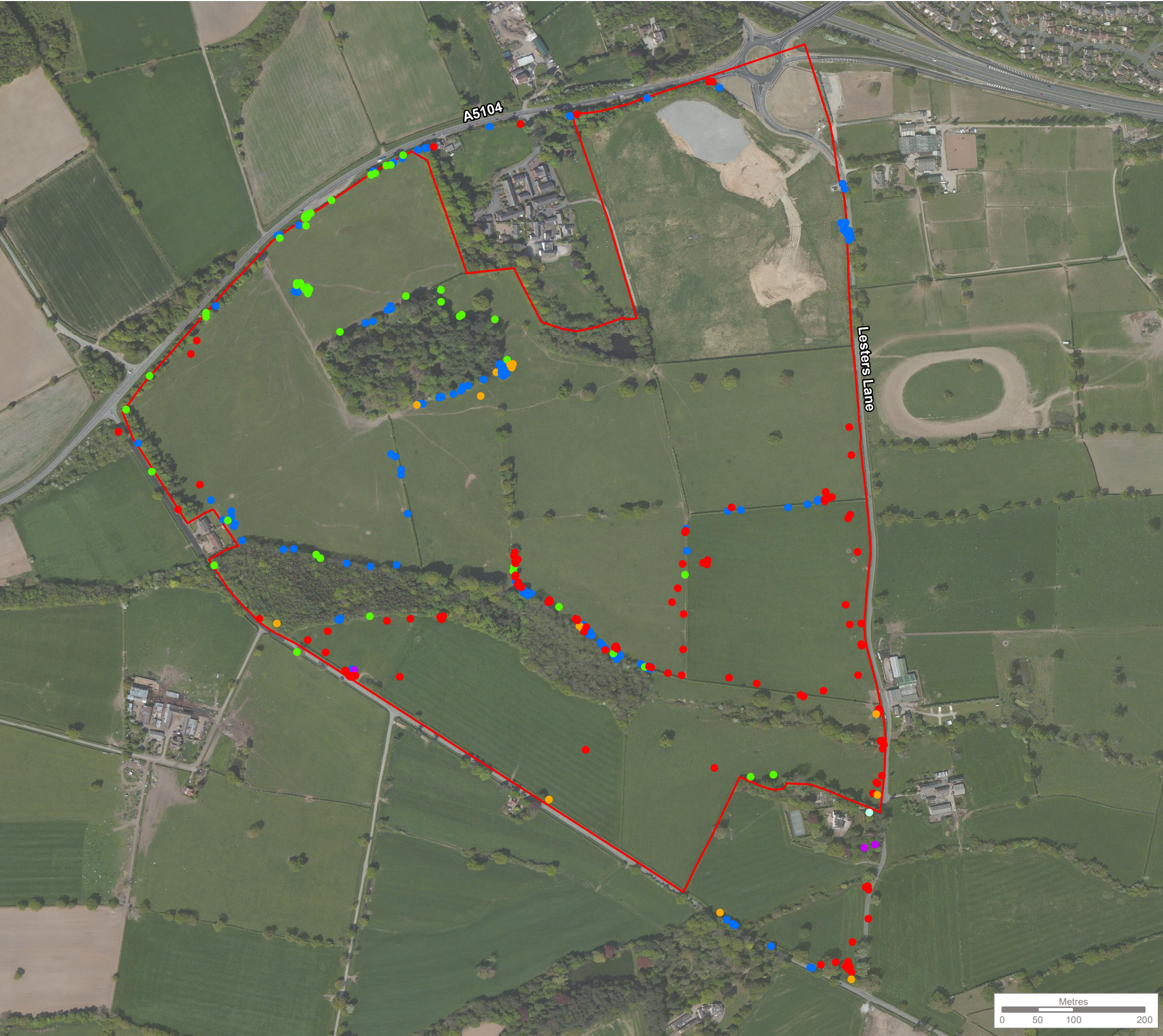
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Project
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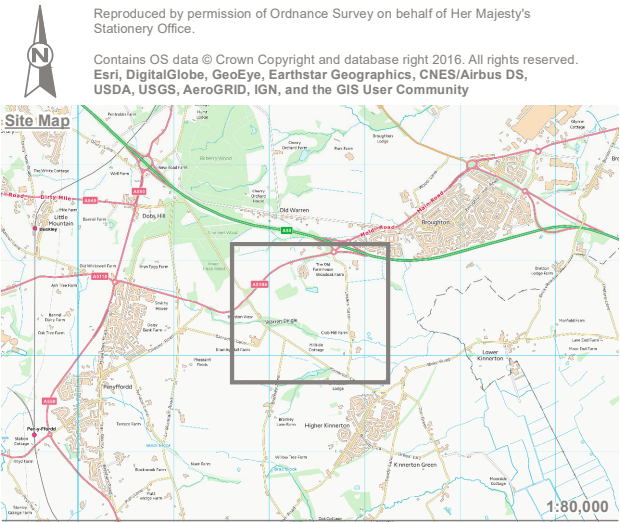
Title
Bat Activity Transect Survey
Visit 2 - 16th July 2018

Drawing Number
G7016.005

Drawn	Checked	Approved	Scale	Date
CR	JS	JC	1:5,500 @ A3	15/01/2019



- KEY**
- Survey Boundary
 - Myotis Species
 - Noctule
 - Brown Long-Eared
 - Soprano Pipistrelle
 - Common Pipistrelle
 - Pipistrelle Species



Rev	Description	Drawn	Approved	Date

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Title
Bat Activity Transect Survey
Visit 3 - 10th September 2018





Drawing Number
G7016.008



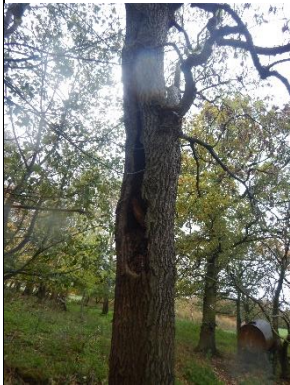
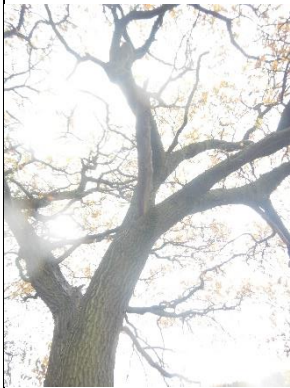
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APPENDIX A GROUND BASED ASSESSMENT RESULTS



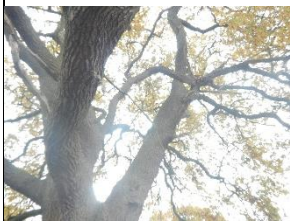


Grid Ref	Description	Photo	Roost Suitability/ Further specialist survey
SJ 31955 62795	Mature sycamore. Southern aspect has large trunk cavity that extends up.		High
SJ 31902 62735	Sycamore with dead but thick ivy cover up the trunk of a diameter that represents potential roosting opportunities		Moderate-climb
SJ 31896 62730	Sycamore with a snapped limb and potential cavity on the western side		Low-climb



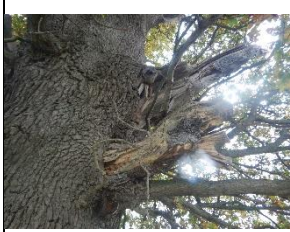


Grid Ref	Description	Photo	Roost Suitability/ Further specialist survey
SJ 31896 62730	Mature sycamore with dead limb with potential cavity on east. Southern aspect has large trunk cavity that extends up.		Moderate
SJ 31875 62703	Sycamore with several dead limbs on all aspects and a small trunk cavity to the south		Moderate
SJ 31832 62661	Holly tree with dense ivy (>5cm) cover		Low-Climb
SJ 31824 62650	A cluster of five tree immature sycamore with lifted bark and trunk cavities.		Low
SJ 31857 62688	Dead monolith with trunk cavity and woodpecker holes.		High



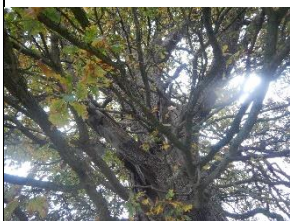


Grid Ref	Description	Photo	Roost Suitability/ Further specialist survey
SJ 31837 62664	Sycamore with trunk cavity on the south eastern side.		High
SJ 31829 62657	Cherry tree with lifted bark on all aspects.		Low-Climb
SJ 32076 62694	Ash with several PRFs. Limb scar on the western aspect at 6m shows potential for a bark lip. Also on the western aspect is a woodpecker hole. A trunk cavity on the southern side has potential		High. Climb
SJ 32075 62665	Oak with limb scar on the south western aspect at 6m		Low-climb



Grid Ref	Description	Photo	Roost Suitability/ Further specialist survey
SJ 32087 62633	Oak with a dead limb on the northern aspect at 8m. This limb shows some sign of a potential cavity.		Moderate-Climb
SJ 32080 62649	Oak with several dead limb cavities on the southern and western aspects.		Low-Climb
SJ 32097 62632	Mature ash with a trunk cavity on the northern face. Endoscoped, but cavity went beyond reachable limit		High
SJ 32106 62604	Oak with a dead limb on the northern aspect at 4m.		Moderate-Climb

Grid Ref	Description	Photo	Roost Suitability/ Further specialist survey
SJ 32150 62616	Dead tree with a woodpecker hole on the southern aspect		High
SJ 32152 62635	Beech with a lateral split in a limb on the northern aspect.		Low-Climb
SJ 32212 62639	Beech with a trunk scar leading to a possible cavity on the northern aspect at 5m		Moderate-Climb
SJ 32213 62660	Sycamore with extensive trunk cavity on the south western aspect.		Moderate

Grid Ref	Description	Photo	Roost Suitability/ Further specialist survey
SJ 32396 62622	Oak with numerous PRFs. A split limb is on the western aspect at 5m. On the southern aspect at 4m there is a cavity in a branch. The eastern aspect has three dead branches with possible cavities.		High-Climb
SJ 32432 62622	Oak with a trunk cavity on the western aspect. On the western aspect there is a lateral branch split.		High
SJ 32488 62628	Oak with several broken and dead limbs. These have opportunities for cavities and bark scarring lips		High-Climb
SJ 32522 62630	Oak with broken and dead limbs on all aspects.		Moderate-Climb
SJ 32510 62689	Sycamore with dead limb on the western aspect at 6m.		Moderate-Climb

Grid Ref	Description	Photo	Roost Suitability/ Further specialist survey
SJ 32517 62714	Holly tree with dense ivy foliage covering the majority of the tree. Several dead limb protruding from the foliage representing good potential for features beneath the foliage.		Moderate Climb
SJ 32513 62696	Alder with a woodpecker hole on the northern aspect at 6m.		High
SJ 32311 62564	Oak with dead limbs on the southern aspect.		Low
SJ 32319 62517	Mature oak with trunk cavity on the northern aspect.		High
SJ 32318 62507	Oak with a dead limb on the eastern aspect		Low-Climb
SJ 32323 62494	Sycamore with a dead limb on the western aspect	?	Low-Climb

Grid Ref	Description	Photo	Roost Suitability/ Further specialist survey
SJ 32323 62483	Oak with dead limbs with potential cavities on the eastern and western aspects		Moderate
SJ 32324 62472	Oak with a dead limb on the southern aspect		Low
SJ 32328 62442	Oak with a dead limb on the southern aspect at 8m		Moderate
SJ 32331 62398	Oak with dead limbs and a cavity in the trunk		High
SJ 32493 62456	Oak with dead limb on the eastern aspect		Moderate - Climb

Grid Ref	Description	Photo	Roost Suitability/ Further specialist survey
SJ 32435 62450	Oak with dead limbs on all aspects		Moderate
SJ 32522 62459	Oak with a dead limb scar on the southern aspect.		Low



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