



NDR Ecological Post- Construction Monitoring - Bats

February 2019

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Executive summary

The Norwich Northern Distributer Road is a 22km dual carriageway which runs between Fakenham Road (A1067), west of the city (near Attlebridge) to the A47 east of the city (near Postwick). Construction was completed overwinter 2017/2018 and the design included a number of different mitigation measures for roosting and commuting bats. The post-construction monitoring of these measures are a requirement of the DCO process.

Bats are protected under the Wildlife and Countryside Act 1981 and the Conservation (Natural Habitats &c) Regulations 1994. This report provides information on the 2018 post-construction monitoring of the bat crossing points, known bat roosts, bat boxes and bat houses.

The various bat crossings to date have been partially successful, and it is predicted that results will improve as landscaping/connecting vegetation becomes established. Four out of the 16 roosts within 50m of the Scheme were recorded to have bats roosting and one of the bat houses has had soprano pipistrelles recorded roosting. Bat boxes had good uptake with 11 out of the 23 boxes containing bats or evidence of bats.

1 Introduction

1.1 Project description

Mott MacDonald Ltd was appointed by Norfolk County Council to undertake the monitoring of bats as part of the Norwich Northern Distributor Route (NDR) post-construction surveys detailed in the Development Consent Order (DCO) mitigation table. The NDR runs from the Fakenham Road (A1067) to the west of the city (near Attlebridge) and passes eastwards around the north of the city to join with the A47 at Postwick. The route is approximately 22km in length. A map of the route is provided in Figure 1.



Figure 1 NDR route

1.2 Baseline data

As part of the environmental impact assessment, extensive bat surveys were undertaken over a six year period (between 2008 and 2013), by a team of experienced surveyors comprised of ecologists from Mott MacDonald and various sub-consultancies; 2008 (EcoGraphics, Mott MacDonald and Kepwick Ecological Surveys), 2009 and 2010 (Mott MacDonald and BSG, with Greena Ecological Consultancy, Geckoella and Corylus Ecology) and 2012 (Mott MacDonald and Greena Ecological Consultancy). These surveys were to support the assessment of the potential impacts of the NDR scheme on local bat populations and to determine required mitigation and licencing requirements. Detailed information can be found in the Norwich Northern Distributor Road – Technical Appendix for Bats from the Environmental Statement (available on the PINS website).

1.3 Study area

Due to the nature of the surveys, the study areas differ between tasks. The survey locations for each task are listed in Table 1.1:

Table 1.1 Survey type and location for 2019 monitoring surveys

Survey	Locations
Manned static monitoring of bat crossings	12 bat crossing points, both inside and outside of the NDR.
Un-manned static monitoring of bat crossings	12 bat crossing points, both inside and outside of the NDR.
Roost counts of known bat roosts	Known roosts identified in baseline surveys within 50m of the Scheme.
Roost counts of bat houses	Two bat house locations.
Bat box occupancy checks	All bat boxes locations. Bat box locations were originally chosen to mitigate for the loss of tree roosts associated with the Scheme. These are all within 150m of the Scheme.
Bat vehicle collision checks	12 bat crossing points, both inside and outside of the highway, 30m either side of the crossing point.

The locations of each of the 12 crossing points can be found in Figures 7.4 to 7.6. The names of the crossing points are as follows:

- G1 – Gantry 1 (Shooting school access, near Attlebridge)
- G2 – Gantry 2 (Glebe Farm access, near Horsford)
- G3 – Gantry 3 (St Faith’s Road, near Spixworth)
- G4 – Gantry 4 (near Beeston Hall cottages)
- G5 – Gantry 5 (near Beeston Hall)
- G6 – Gantry 6 (access off Middle Road, near Great Plumstead)
- G7 – Gantry 7 (Smee Lane, near Great Plumstead)
- GB1 – Green Bridge 1 (Marriot’s Way, near Taverham)
- GB2 – Green Bridge 2 (Middle Road, near Great Plumstead)
- DC1 – Dark Corridor 1 (Buxton Road, near Spixworth)
- DC2 – Dark Corridor 2 (Newman Road, near Rackheath)
- UN1 – Underpass, (near Rackheath)

1.4 Scope of the report

Mott MacDonald has been commissioned to undertake post-construction ecological monitoring surveys, including bat surveys, in surrounding areas of the NDR. The objectives of this report are:

- To present the results of the surveys
- To provide a post-construction baseline for future surveys, informing the levels of usage of the mitigation measures over time
- To identify any possible impacts to bats from the scheme
- To provide recommendations for further mitigation and enhancement

1.5 Legislation

All bats in the UK are protected under Schedule 5 of the Wildlife and Countryside Act 1981. Since 2007, the effective protection for bats now comes from Schedule 2 of the Conservation (Natural Habitats &c) Regulations 1994. This makes all bats a European Protected Species (EPS). In effect, this legal protection makes it an offence to:

- Deliberately capture, injure or kill a bat.
- Damage or destroy a breeding or resting place of a bat.
- Obstruct access to a bat's resting or sheltering places.
- Possess, sell, control or transport live or dead bats.
- Intentionally or recklessly disturb a bat while it is in a structure or place of shelter or protection.
- Intentionally or recklessly disturb a bat at a roost.

2 Methodology

All surveys were undertaken in accordance with the DCO mitigation table for ecological post-construction monitoring surveys with specific methods being based on BCT Bat Surveys for Professional Ecologists: Good Practice Guidelines 3rd Edition (2016), hereafter referred to as the 'BCT guidelines'.

2.1 Manned static monitoring of bat crossings

Dusk and dawn crossing surveys were undertaken on all 12 crossing points (Figures 7.4 to 7.6). For each of the crossings, it was ensured that both dusk and dawn surveys were included. Dusk surveys began 15 minutes before sunset and ended 90 minutes after and dawn surveys began 90 minutes before sunrise, ending 15 minutes after.

Surveys were completed with a space of at least two weeks between each survey and were conducted in suitable weather conditions. Those being:

- Temperatures above 10°C
- No or sporadic light rain
- Low wind speeds

Dates and weather conditions for each survey can be found in Appendix 6.1.

At each crossing point a surveyor was positioned on the verge either side of the road, equipped with time synchronised Batlogger Ms (handheld bat detectors) with built in temperature recording capability. Vertical distance from the crossing, horizontal distance from the crossing, direction of travel and time of crossing were recorded for each bat. Records were then combined, with duplicate recordings being removed. Measured points of reference were used to encourage more precise distance estimations, which were given to the nearest metre. For all bat gantries, the flight height from the road was then calculated from taking the vertical distance from the gantry away from the overall height of the gantry (bottom wire which crosses the road at the lowest point).

Activity of bats not crossing the road was also recorded.

2.1.1 Data analysis

Based on methodology used in Berthinussen & Altringham (2012), 'safe' and 'unsafe' crossing heights were defined as being greater or less than 5m from the road surface. This is due to the maximum height of heavy goods vehicles being 4.9m in the UK (Department of Transport, 2011). Bats crossing at unsafe heights are therefore at risk of collision.

For bats which were crossing at a safe height, two definitions of using the gantries were used, bats flying within either 2m or 5m of the gantry (Berthinussen & Altringham, 2012). These classifications are based on species observations within the literature. Holderied *et al.* (2006) observed whiskered bats *Myotis mystacinus* flying within 1.7m of a hedgerow and Schaub & Schnitzler (2007) found that Daubenton's bat *Myotis daubentonii* flew within 2.1 - 4.5m from a linear feature.

Noctules were not included within analysis as individuals always flew at heights greater than 15m. Noctules were also not a target species for the bat gantries as they generally forage and commute at heights greater than 5m.

Data analysis was carried out using R version 3.5.2. The Wilcoxon sign test from the package *coin* (Hothorn *et al.*, 2008) was used to find differences for three separate tests: between bats crossing at a safe heights and bats crossing at unsafe heights, bats using the bat gantries with the 2m classification and bats not using the gantry and bats using the gantries with the 5m classification and bats not using the gantry.

2.2 Un-manned static monitoring of bat crossings

Static acoustic detectors were deployed at the 12 bat crossing locations along the Scheme. At each location, detectors were deployed on both sides of the NDR. Where possible, detector microphones were attached at the bat crossing facing away from the road. In areas where there is public access, or if works (i.e. landscaping) were ongoing in the immediate area then detectors were placed close to the crossing. The 12 locations can be found Figures 7.4 to 7.6.

At each location, detectors were deployed for four consecutive nights on three separate occasions between May and September.

2.2.1 Data analysis

Once call analysis was completed, the total number of passes were calculated for each location for each species. Due to the failure of some detectors while out in the field, detectors were deployed for a differing number of days across the 12 locations (Section 2.8.4), a daily level of bat activity was calculated by dividing the passes by the number of full nights they were deployed. This allowed for a more accurate comparison of bat activity between the static detector locations.

Ecobat (Lintott *et al.*, 2017) was used to provide a standardised method to interpret bat activity data. Once call analysis was complete and nightly data was submitted to Ecobat, the organisation provided percentiles for each species for each night of survey across all sites based on a large reference dataset.

The reference dataset was stratified to include:

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

Results therefore provided a comparison against bat activity in the surrounding area.

2.3 Roost counts of known bat roosts

Dusk emergence surveys were undertaken on all known roosts within 50m of the Scheme boundary. Surveys were completed by a team of experienced ecologists under the guidance of at least one licenced bat specialist.

Two surveys were undertaken between May and September for each of the roosts. As detailed in Section 2.2, surveys were only conducted in suitable weather conditions. Dates and weather conditions for each survey can be found in Appendix 6.2.

Surveyors were positioned around the tree or structure to provide coverage of all Potential Roost Features (PRFs), and bat activity was recorded using a combination of visual observation and aural full spectrum bat detectors. Each surveyor used a Batlogger M with built in GPS, clock and temperature recording capability. Bat activity, including emergence from roosting locations, passes and foraging activity were recorded as were bat species and numbers.

Dusk emergence surveys started 15 minutes before sunset and ended between 1.5 to 2 hours after sunset.

Locations for each of the known roosts can be found in Figures 7.1 to 7.3.

2.4 Roost counts of bat houses

Two dusk surveys were undertaken on each bat house. Surveys were undertaken in July and again in August. As detailed in Section 2.2, surveys were only conducted in suitable weather conditions.

Surveyors were positioned around the bat houses to provide coverage of all the PRFs and bat activity was recorded using a combination of visual observation and aural full spectrum bat detectors. Each surveyor used a Batlogger M+ with built in GPS, clock and temperature recording capability. Bat activity, including emergence from roosting locations, passes and foraging activity were recorded as were bat species and numbers.

Dusk emergence surveys started 15 minutes before sunset and ended between 1.5 to 2 hours after sunset.

Locations for the two bat houses can be found in Figure 7.12.

2.5 Bat box occupancy checks

23 bat boxes across four separate sites were surveyed for bat activity. The four sites were all located within 150m of the scheme (Figure 7.7 to 7.11) and are as follows:

- Fakenham Road – Boxes 1 - 3
- Spring Farm – Boxes 4 - 6
- Quaker Farm – Boxes 7 - 11
- Spixworth Plantation – Boxes 12 - 23

Fakenham Road, Spring Farm and Quaker Farm bat boxes were surveyed on 01/10/18 and Spixworth Plantation bat boxes were surveyed on the 02/10/18. Surveys involved experienced ecologists opening each box and checking for bats or any evidence for bats (i.e. droppings).

2.6 Bat vehicle collision

Two bat vehicle collision surveys were undertaken at each of the crossing points (Figures 7.4 to 7.6) between May and August. Surveys began approximately 20 minutes after sunrise and involved a pair of surveyors slowly searching the hard shoulder and bank vegetation for bat remains 30m either side of the crossing on both sides of the road.

2.7 Call analysis

A bat call was identified as a series of individual pulses in quick succession as a bat passes the detector. Recordings would stop after one second of no pulses.

All call analysis was undertaken by an experienced bat ecologist using Kaleidoscope Pro 4.0 to identify calls to species level where possible. Where needed, British Bat Calls: A Guide to Species Identification (Ross, 2012) was used to aid in analysis.

2.8 Survey limitations

2.8.1 Manned static monitoring

G2 was only able to be surveyed from inside of the NDR highway boundary during the manned surveys as land access was restricted. On these surveys a pair of surveyors positioned themselves on either side of the gantry to provide best possible coverage.

When light levels became low, bats became harder to see, especially when bats were flying in front of a dark landscape (e.g. woodland). It is therefore possible that some bats were missed during the surveys.

2.8.2 Un-manned static monitoring

Due to the proximity to the road, static detectors would often record the noise from traffic resulting in memory cards becoming full before completion of the full survey period. Larger memory cards were purchased to combat this issue but on rare occasions a card would become full before the end of the allotted survey time. Two units malfunctioned during the surveys (UN1 inside and G1 outside) resulting in incorrectly recorded data. Two microphones were vandalised on GB2 on the final survey, therefore no data was recorded for either inside or outside locations for that survey. Table 2.1 shows the total number of survey nights for each detector location.

Table 2.1. Number of survey nights each survey location received

Location	Inside	Outside
G1	12	8
G2	10	8
G3	10	12
G4	8	10
G5	12	12
G6	8	8
G7	12	12
GB1	12	12
GB2	7	8
DC1	12	12
DC2	12	12
UN1	8	12

2.8.3 Roost counts of known bat roosts

Roost 8 - W11B was recorded within the 2013 pre-construction bat report as being found felled by a third party, so could not be included in the surveys.

2.8.4 Bat vehicle collision

Long bank vegetation in some crossing areas made it difficult to effectively search for bat remains.

2.8.5 Call analysis

In some bat species there is considerable overlap between call parameters, i.e. *Myotis*. This results in calls sometimes only being identified to genus level.

3 Results

3.1 Bat Species

Across all 2019 bats surveys, nine species were recorded using the study area:

Common pipistrelle <i>Pipistrellus pipistrellus</i>	Widespread and common throughout Britain. Common pipistrelles forage across a range of habitats including deciduous woodland, parkland, gardens and fresh water.
Soprano pipistrelle <i>Pipistrellus pygmaeus</i>	Widespread and common throughout Britain. Soprano pipistrelles are generally more specific in their habitat choice when compared to common pipistrelles, often choosing to forage over freshwater habitats.
Nathusius' pipistrelle <i>Pipistrellus nathusii</i>	An uncommon species although relatively widespread throughout England. Forages along woodland edges and over freshwater.
Daubenton's bat <i>Myotis daubentonii</i>	Common and widespread throughout Britain. Daubenton's bats will regularly forage over fresh water where they trawl insects from the water's surface. They can also be found in other habitats such as open woodland and tree lines.
Natterer's bat <i>Myotis nattereri</i>	Widespread throughout England. Natterer's bats can be found foraging close to vegetation gleaning insects from surfaces. Will often forage in deciduous woodland, along treelines and above water.
Barbastelle <i>Barbastella barbastellus</i>	A rare species generally confined to the southern half of Britain. Forages both beneath and over the tree canopy, often flying lower earlier in the night and moving higher later. Main foraging habitat is deciduous woodland but does forage in other areas.
Brown long-eared bat <i>Plecotus auratus</i>	Common and widespread throughout Britain. Brown long-eared bats will forage by gleaning insects off surfaces of vegetation. They are found in habitats that include deciduous and coniferous woodland, parkland and gardens.
Serotine <i>Eptesicus serotinus</i>	An uncommon species generally restricted to the south and south-east of England. Serotines generally forage between 4 and 12m from the ground. They will often feed along linear features including woodland edges and large hedgerows.
Noctule <i>Nyctalus noctule</i>	Widespread throughout England. The UK's largest bat, noctules will generally feed between 10 and 50m from the ground. They feed over a range of habitats including deciduous woodland, parkland and freshwater.

3.2 Manned static monitoring of bat crossings

Excluding noctules, five species were observed using the bat crossings during the surveys. Those being; common pipistrelle, soprano pipistrelle, barbastelle, brown long-eared and *Myotis*. 87 bats were observed crossing the NDR across all surveys. Information regarding bats crossing during these surveys can be found in Sections 3.1.1 and 3.1.2. Information regarding other bat activity during these surveys can be found in Appendix 6.4.

3.2.1 Bat gantries

G5 was the only gantry to have no observations of crossing bats across all surveys. G4 was the most active crossing with 19 recorded crossings across all three surveys. Below there is a summary on crossing activity for each of the gantries across all three surveys:

- Gantry 1 – A total of three bats were recorded crossing at G1, two of those crossing at a safe height. Both soprano and common pipistrelles were recorded crossing.
- Gantry 2 – A total of nine bats were recorded crossing at G2, five of those crossing at a safe height. Soprano pipistrelle, common pipistrelle, brown long-eared bat and barbastelle were recorded crossing.
- Gantry 3 – A total of 11 bats were recorded crossing at G3, five of those crossing at a safe height. Soprano pipistrelle, common pipistrelle, brown long-eared bat and barbastelle were recorded crossing.
- Gantry 4 – A total of 18 bats were recorded crossing at G4, 14 of those crossing at a safe height. Soprano pipistrelle, common pipistrelle, and *Myotis* were recorded crossing.
- Gantry 5 – No bats were recorded crossing the road.
- Gantry 6 – A total of seven bats were recorded crossing at G6, six of those crossing at a safe height. Soprano pipistrelle, common pipistrelle, and barbastelle were recorded crossing.
- Gantry 7 – A total of ten bats were recorded crossing at G7 (excluding noctules, which fly at a height that cannot be considered as using the gantry), four of those crossing at a safe height. Soprano and common pipistrelles were both recorded crossing.

Table 3.1 shows a full list of gantry survey results.

Table 3.1. Data for all bats recorded crossing the NDR during the manned crossing surveys

Location	Date	Species	Horizontal distance (m)	Distance above road	Direction	Safe crossing ?	Crossing within 2m	Crossing within 5m	Height of gantry (m)	Notes
G1	06.07.18	Soprano pipistrelle	1	4.923	In -> Out	unsafe	No	No	7.923	
G1	06.07.18	Soprano pipistrelle	0	5.923	In -> Out	safe	Yes	Yes	7.923	
G1	06.07.18	Common pipistrelle	2	4.923	Out -> In	unsafe	No	No	7.923	
G2	06.06.18	Common pipistrelle	1	4.42	Out -> In	unsafe	No	No	8.42	
G2	06.06.18	Common pipistrelle	0	5.42	In -> Out	safe	Yes	Yes	8.42	
G2	06.06.18	Common pipistrelle	1	4.42	Out -> In	unsafe	No	No	8.42	
G2	06.06.18	brown long-eared bat	4	4.42	In -> Out	unsafe	No	No	8.42	
G2	06.06.18	Barbastelle	6	7.42	In -> Out	safe	No	No	8.42	
G2	06.06.18	Soprano pipistrelle	2	7.42	In -> Out	safe	Yes	Yes	8.42	
G2	25.07.18	Common pipistrelle	1	7.92	In -> Out	safe	Yes	Yes	8.42	Common pipistrelle flew up gantry structure but not right to the top
G2	25.07.18	Common pipistrelle	2	5.42	In -> Out	safe	Yes	Yes	8.42	
G2	25.07.18	Common pipistrelle	10	4.42	In -> Out	unsafe	No	No	8.42	
G3	08.06.18	brown long-eared bat	0.5	7.519	Out -> In	safe	Yes	Yes	8.519	brown long-eared bat flew up gantry structure but not right to the top
G3	08.06.18	Soprano pipistrelle	0.5	7.519	Out -> In	safe	Yes	Yes	8.519	Soprano pipistrelle flew up gantry structure but not right to the top

Location	Date	Species	Horizontal distance (m)	Distance above road	Direction	Safe crossing ?	Crossing within 2m	Crossing within 5m	Height of gantry (m)	Notes
G3	08.06.18	Common pipistrelle	7	3.519	Out -> In	unsafe	No	No	8.519	
G3	08.06.18	Common pipistrelle	4	2.519	Out -> In	unsafe	No	No	8.519	
G3	14.06.18	Barbastelle	0	8.519	Out -> In	safe	Yes	Yes	8.519	Barbastelle flew along the top of the gantry
G3	14.06.18	Common pipistrelle	2	4.519	In -> Out	unsafe	No	No	8.519	
G3	14.06.18	Common pipistrelle	2	6.519	In -> Out	safe	Yes	Yes	8.519	
G3	04.07.18	Soprano pipistrelle	1	8.519	Out -> In	safe	Yes	Yes	8.519	Soprano pipistrelle flew along the top of the gantry
G3	04.07.18	Common pipistrelle	0.5	1.019	Out -> In	unsafe	No	No	8.519	
G3	04.07.18	Soprano pipistrelle	0	1.519	Out -> In	unsafe	No	No	8.519	
G3	04.07.18	Common pipistrelle	6	3.519	Out -> In	unsafe	No	No	8.519	
G4	07.06.18	Soprano pipistrelle	4	5.95	In -> Out	safe	No	Yes	8.95	
G4	07.06.18	Soprano pipistrelle	3	4.95	In -> Out	unsafe	No	No	8.95	
G4	07.06.18	Soprano pipistrelle	3	4.95	In -> Out	unsafe	No	No	8.95	
G4	07.06.18	Soprano pipistrelle	7	4.95	In -> Out	unsafe	No	No	8.95	
G4	07.06.18	Common pipistrelle	3	4.95	In -> Out	unsafe	No	No	8.95	
G4	07.06.18	Common pipistrelle	7	4.95	In -> Out	unsafe	No	No	8.95	
G4	03.07.18	Myotis	6	7.95	In -> Out	safe	No	No	8.95	
G4	03.07.18	Pipistrelle	5	5.95	Out -> In	safe	No	Yes	8.95	
G4	03.07.18	Soprano pipistrelle	3	8.95	Out -> In	safe	No	Yes	8.95	

Location	Date	Species	Horizontal distance (m)	Distance above road	Direction	Safe crossing ?	Crossing within 2m	Crossing within 5m	Height of gantry (m)	Notes
G4	03.07.18	Common pipistrelle	15	7.95	Out -> In	safe	No	No	8.95	
G4	03.07.18	Common pipistrelle	5	6.95	In -> Out	safe	No	Yes	8.95	
G4	03.07.18	Common pipistrelle	10	6.95	In -> Out	safe	No	No	8.95	
G4	03.07.18	Common pipistrelle	6	7.95	In -> Out	safe	No	No	8.95	
G4	03.07.18	Common pipistrelle	1	7.95	Out -> In	safe	Yes	Yes	8.95	
G4	23.07.18	Common pipistrelle	1	6.95	Out -> In	safe	Yes	Yes	8.95	
G4	23.07.18	Common pipistrelle	1	5.95	Out -> In	safe	Yes	Yes	8.95	
G4	23.07.18	Soprano pipistrelle	1	6.95	Out -> In	safe	Yes	Yes	8.95	
G4	23.07.18	Soprano pipistrelle	1	6.95	Out -> In	safe	Yes	Yes	8.95	
G4	23.07.18	Soprano pipistrelle	1	6.95	In -> Out	safe	Yes	Yes	8.95	
G6	02.07.18	Common pipistrelle	3	8.35	In -> Out	safe	No	Yes	8.35	
G6	02.07.18	Common pipistrelle	3	8.35	Out -> In	safe	No	Yes	8.35	
G6	02.07.18	Soprano pipistrelle	2	8.35	In -> Out	safe	Yes	Yes	8.35	
G6	02.07.18	Soprano pipistrelle	5	5.35	In -> Out	safe	No	Yes	8.35	
G6	25.07.18	soprano pipistrelle	4	6.35	In -> Out	safe	No	Yes	8.35	
G6	25.07.18	soprano pipistrelle	0	4.35	In -> Out	unsafe	No	No	8.35	
G6	25.07.18	Barbastelle	2	5.35	Out -> In	safe	Yes	Yes	8.35	

Location	Date	Species	Horizontal distance (m)	Distance above road	Direction	Safe crossing ?	Crossing within 2m	Crossing within 5m	Height of gantry (m)	Notes
G7	03.07.18	Common pipistrelle	0	4.087	In -> Out	unsafe	No	No	7.087	
G7	03.07.18	Common pipistrelle	5	5.087	In -> Out	safe	No	Yes	7.087	
G7	03.07.18	Common pipistrelle	0	5.087	In -> Out	safe	Yes	Yes	7.087	
G7	03.07.18	Common pipistrelle	3	5.087	Out -> In	safe	No	Yes	7.087	
G7	03.07.18	Common pipistrelle	2	4.087	In -> Out	unsafe	No	No	7.087	
G7	24.07.18	Common pipistrelle	1	4.087	Out -> In	unsafe	No	No	7.087	
G7	24.07.18	Soprano pipistrelle	2	4.087	Out -> In	unsafe	No	No	7.087	
G7	24.07.18	Common pipistrelle	4	4.087	In -> Out	unsafe	No	No	7.087	
G7	24.07.18	Soprano pipistrelle	2	3.087	In -> Out	unsafe	No	No	7.087	
G7	24.07.18	Noctule	25	22.087	In -> Out	safe	No	No	7.087	
G7	24.07.18	Common pipistrelle	2	4.087	Out -> In	unsafe	No	No	7.087	

Across all bat gantries, significantly more bats were observed to be crossing at safe heights than unsafe heights (58%; $Z = 6.6528$, $P < 0.01$). Significantly more bats were observed to be not using the gantry under the 2m classification (68%; $Z = 6.6842$, $P < 0.01$). There was minimal difference between the numbers of bats using the gantry with the 5m classification and not using the gantry (48%, 52%) illustrating that approximately half of the crossing bats were using that gantries. Figure 3.2 shows the height from the road and horizontal distances from the gantries of crossing bats.

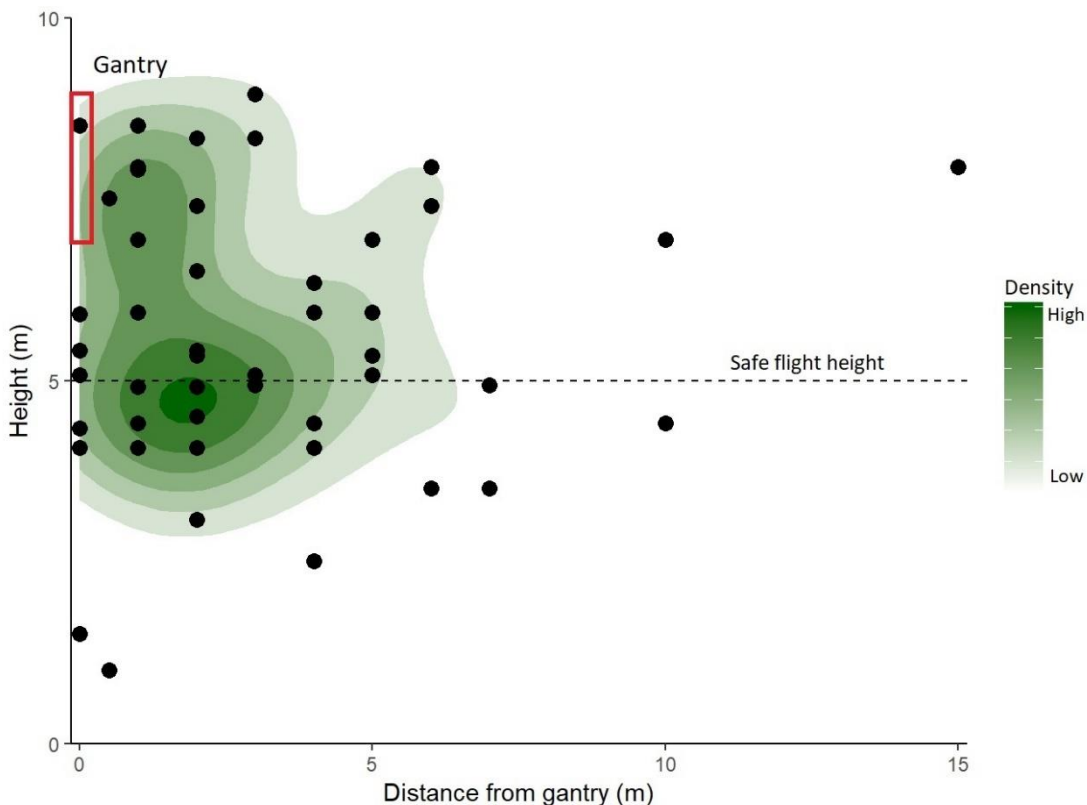


Figure 3.2. Height from the road and horizontal distance from gantries for all crossing bats (big bats excluded) for Gantries 1 to 7. The range in gantry height from the road is highlighted with the red box and the safe flight height is highlighted. Kernel density estimations have been applied.

While significantly more bats were observed to be flying at a safe height rather than an unsafe height, this does not necessarily mean that gantries are working in an effective manner. The impact on local bat populations depends on the proportion of bats killed while crossing at unsafe heights, and not the proportion of bats crossing safely.

As much of the vegetation surrounding the gantries was newly planted and not yet established, at some crossings there was not yet a natural guide (established vegetation) in raising up the flight height for bats before they reached the gantries. As vegetation becomes more established and increases in height, bats may be guided into flying at greater heights across the NDR, along the gantries.

3.2.2 Green bridges, dark corridors and underpass

Dark Corridor 1 was the only crossing to have no observed bats crossing. Underpass1 was also unsuccessful with three observed above road crossings but no bats flying through the underpass. Green Bridge1 performed the best of these bat crossings, with a total of 13 observed crossings. All bats which were observed crossing using Green Bridge1 were either common or soprano pipistrelles. Pipistrelles were also observed flying part way up the structure and then flying back down. See Table 3.2 for full details of survey results.

Table 3.2. Survey results for crossing bats at the green bridges, dark corridors and underpass

Location	Date	Species	Horizontal distance (m)	Vertical distance (m)	Direction
GB1	26.04.18	Common pipistrelle	0	4	In -> Out
GB1	26.04.18	Common pipistrelle	0	2	Out -> In
GB1	26.04.18	Common pipistrelle	0	3	Out -> In
GB1	26.04.18	Common pipistrelle	0	3	In -> Out
GB1	26.04.18	Common pipistrelle	0	4	Out -> In
GB1	04.07.18	Soprano pipistrelle	0	3	In -> Out
GB1	04.07.18	Common pipistrelle	0	2	Out -> In
GB1	04.07.18	Common pipistrelle	0	2	Out -> In
GB1	04.07.18	Common pipistrelle	0	3	Out -> In
GB1	04.07.18	Common pipistrelle	0	1	Out -> In
GB1	04.07.18	Common pipistrelle	0	2	Out -> In
GB1	27.07.18	Soprano pipistrelle	0	0	Out -> In
GB1	27.07.18	Common pipistrelle	0	3	Out -> In
GB2	22.05.18	Noctule	0	20	Out -> In
GB2	22.05.18	Noctule	10	30	Out -> In
GB2	02.07.18	Soprano pipistrelle	0	5	In -> Out
GB2	02.07.18	Common pipistrelle	0	2	In -> Out
GB2	25.07.18	Noctule	0	5	In -> Out
GB2	25.07.18	Noctule	2	4	In -> Out
DC2	13.06.18	Common pipistrelle	0	8	
DC2	26.07.18	Noctule	0	15	
DC2	26.07.18	Noctule	20	5	
DC2	26.07.18	Common pipistrelle	0	1	
DC2	26.07.18	Common pipistrelle	0	1	
UN1	03.07.18	Noctule	10	2	Out -> In
UN1	26.07.18	Soprano pipistrelle	50	4	Out -> In
UN1	26.07.18	Soprano pipistrelle	50	10	Out -> In

Much of the vegetation associated with the green bridges and dark corridors was newly planted. As there was considerable clearance of hedgerows and tree lines during construction it is predicted that numbers of bats using these crossings will increase as new vegetation becomes established.

As drainage and landscaping work was still being undertaken close to the underpass) during the survey period, the outside edge had not yet been planted. The underpass was flooded with approximately 15cm gap between the water and the top of the underpass due to works continuing downstream. The total clearance in the underpass when unimpeded is 1.8 metres, therefore this year's monitoring has not tested the effectiveness of this crossing.

3.2.3 Barbastelles

Three barbastelles were observed crossing the NDR during the manned crossing surveys. Barbastelles were observed crossing the road at G2, G3 and G6 and at all locations they were seen crossing at a safe height. Barbastelles crossing at G3 and G6 were also recorded crossing using the gantries within both the 2m and 5m classification. The barbastelle crossing at G2 crossed the road approximately 6m from the gantry.

3.3 Un-manned static monitoring of bat crossings

There is expected to be some variance in activity due to differences in foraging intensity, for the majority of species, most crossings showed relatively even numbers of bat calls between inside and outside NDR locations (Appendix 6.3 for full results). Table 3.3 shows static detectors results with calls being grouped into broader bat groups.

Table 3.3 Static detector results for all bat crossing locations. Calls have been grouped into five species groups.

Location	Species	Total count (inside)	Total count (outside)	Nightly count (inside)	Nightly count (outside)
G1	Barbastelle	1	4	0.08	0.50
	Big bats	136	58	11.33	7.25
	Brown long-eared bat	48	68	4.00	8.50
	Pipistrelle	302	270	25.17	33.75
	Myotis	13	20	1.08	2.50
G2	Barbastelle	69	101	6.90	12.63
	Big bats	35	52	3.50	6.50
	Brown long-eared bat	31	41	3.10	5.13
	Pipistrelle	539	838	53.90	104.75
	Myotis	20	5	2.00	0.63
G3	Barbastelle	5	129	0.50	10.75
	Big bats	23	70	2.30	5.83
	Brown long-eared bat	6	64	0.60	5.33
	Pipistrelle	1873	552	187.30	46.00
	Myotis	4	17	0.40	1.42
G4	Barbastelle	1	18	0.13	1.80
	Big bats	39	24	4.88	2.40
	Brown long-eared bat	4	7	0.50	0.70
	Pipistrelle	710	2154	88.75	215.40
	Myotis	19	36	2.38	3.60
G5	Barbastelle	10	12	0.83	1.00

Location	Species	Total count (inside)	Total count (outside)	Nightly count (inside)	Nightly count (outside)
	Big bats	40	32	3.33	2.67
	Brown long-eared bat	4	7	0.33	0.58
	Pipistrelle	397	402	33.08	33.50
	Myotis	6	4	0.50	0.33
	Barbastelle	17	18	2.13	2.25
G6	Big bats	108	33	13.50	4.13
	Brown long-eared bat	23	12	2.88	1.50
	Pipistrelle	350	251	43.75	31.38
	Myotis	10	6	1.25	0.75
	Barbastelle	51	11	4.25	0.92
G7	Big bats	51	52	4.25	4.33
	Brown long-eared bat	16	6	1.33	0.50
	Pipistrelle	3591	3882	299.25	323.50
	Myotis	23	15	1.92	1.25
	Barbastelle	3	4	0.25	0.33
GB1	Big bats	57	58	4.75	4.83
	Brown long-eared bat	33	27	2.75	2.25
	Pipistrelle	1353	1244	112.75	103.67
	Myotis	9	8	0.75	0.67
	Barbastelle	2	2	0.29	0.25
GB2	Big bats	166	275	23.71	34.38
	Brown long-eared bat	4	5	0.57	0.63
	Pipistrelle	71	138	10.14	17.25
	Myotis	2	6	0.29	0.75
	Barbastelle	9	7	0.75	0.58
DC1	Big bats	55	36	4.58	3.00
	Brown long-eared bat	24	21	2.00	1.75
	Pipistrelle	673	503	56.08	41.92
	Myotis	4	7	0.33	0.58
	Barbastelle	4	6	0.33	0.50
DC2	Big bats	639	1441	53.25	120.08
	Brown long-eared bat	165	151	13.75	12.58
	Pipistrelle	564	529	47.00	44.08
	Myotis	28	17	2.33	1.42
	Barbastelle	1	6	0.13	0.50
UN1	Big bats	115	155	14.38	12.92
	Brown long-eared bat	17	8	2.13	0.67
	Pipistrelle	556	673	69.50	56.08
	Myotis	34	51	4.25	4.25

G3, G4 and G7, however, all showed large differences between bat activity for certain species. G3 had 22 times the number of barbastelle calls on the outside of the NDR when compared to the inside. A similar pattern is shown in brown long-eared bats with nine times as many calls having been recorded on the outside of the NDR when compared to the inside. Due to the detector being located in a relatively open area on the embankment on the outside of G3 it is

unlikely that the increased level of activity for these species is due to foraging. Such differences could be for one of three reasons: 1) Bats are flying across the road but flying along the opposite side of the hedge to G3, resulting in the inside detector (attached to the gantry) being unable to pick up their echolocation calls. 2) Bats are reaching the road and turning around. 3) Bats are crossing the NDR away from G3 but passing the outside detector.

Both common and soprano pipistrelles had considerably more calls recorded on the inside location of G3 when compared to the outside location. As the inside location is ideal for foraging with an established hedgerow and some standing water down the track, it is likely that the differences in activity between the outside and inside detector locations are due to foraging.

G4 had 4.5 times the number of common pipistrelles calls on the outside detector when compared to the inside. The outside location was a foraging area for common pipistrelles as this was observed during the manned surveys.

3.3.1 Percentiles

Results from percentile analysis suggest that common pipistrelles, soprano pipistrelles and noctules are the species least affected by the Scheme with percentile medians often over 50% with some locations being in the top 80%. This is not a finite conclusion however as without previous percentile data we are unable to compare. Brown long-eared bats are the next species found in the higher percentiles across the crossing locations followed by barbastelles. It is likely that Daubenton's bats and Natterer's bats have been underrepresented within results due to a large proportion of *Myotis* only being identified to genus level and therefore excluded from percentile analysis. Figure 3.1 shows differences in species activity between static detector locations for percentiles. For individual species plots see Figures 7.12 to 7.22.

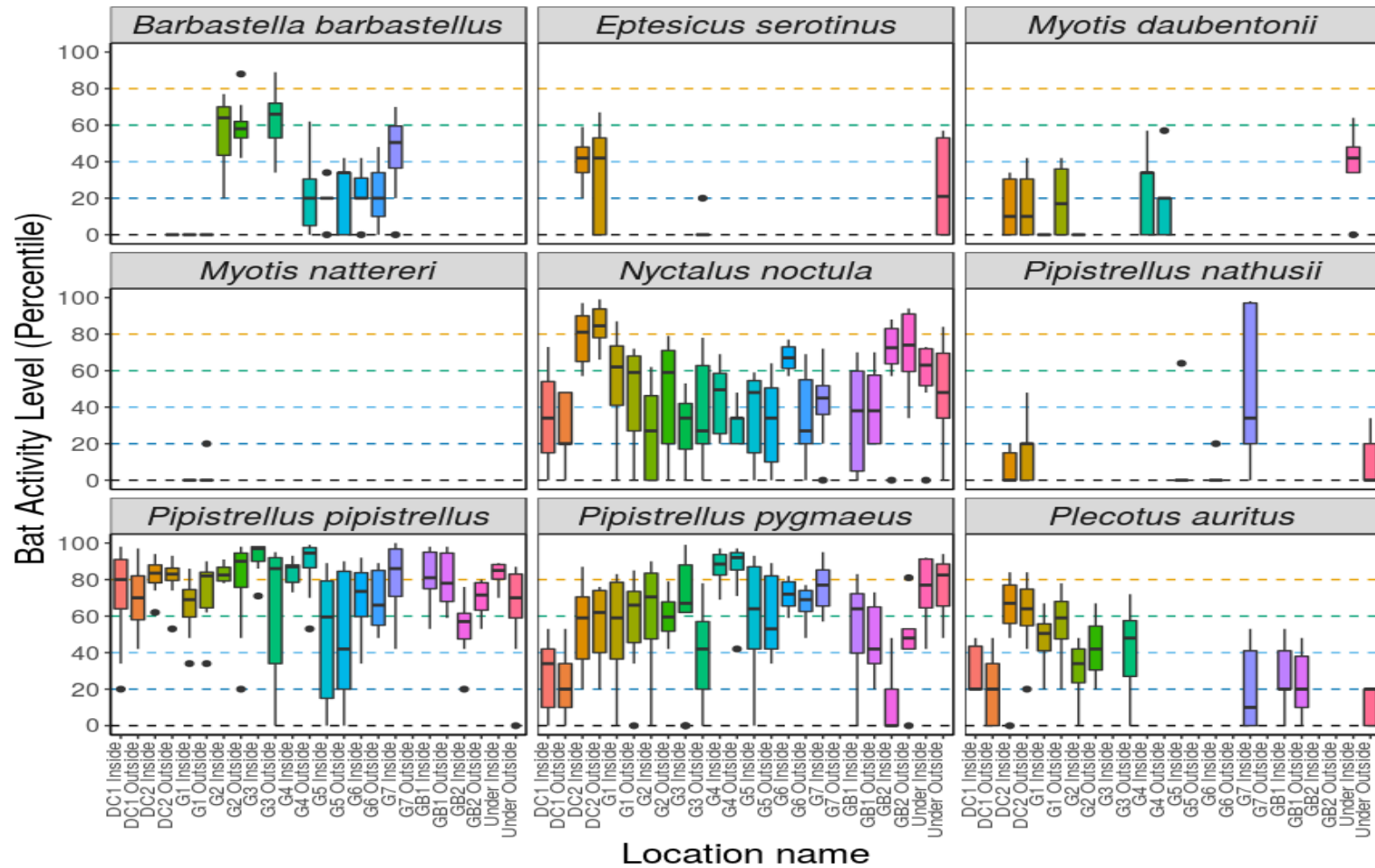


Figure 3.1 Differences in activity between static detector locations, split by species and location. The centre line indicates the median activity level whereas the box represents the interquartile range (the spread of the middle 50% of nights of activity).

3.4 Roost counts of known bat roosts

Pre-construction bat surveys which took place during the environmental impact assessment (between 2008 and 2013) identified 17 bat roosts located within 50m of the Scheme. Roost 8 - W11B was found felled. Four of the remaining 16 roosts were found to have roosting bats during the 2018 summer surveys. See Table 3.2 for full survey results for all roosts.

Table 3.2. Survey results for known bat roosts

Roosts	Date	Bats roosting?	Roosting species	Bat activity recorded
Roost 1 - B5	12/06/2018	No		Barbastelle, brown long eared, common pipistrelle, soprano pipistrelle, myotis
	30/08/2018	No		Barbastelle, Daubenton's bat, Natterer's bat, noctule, common pipistrelle, soprano pipistrelle
Roost 2 - B55	13/06/2018	Yes	9 brown long-eared bats	Noctule, common pipistrelle, soprano pipistrelle, brown long-eared bat
	25/07/2018	Yes	2 common pipistrelle, 3 brown long-eared bat	Noctule, common pipistrelle, soprano pipistrelle, brown long-eared bat
Roost 3 - GB5	14/06/2018	Yes	1 common pipistrelle	Serotine, noctule, common pipistrelle, soprano pipistrelle
	17/09/2018	Yes	2 common pipistrelle	Noctule, common pipistrelle, soprano pipistrelle
Roost 4 - B81	05/07/2018	No		Serotine, noctule, common pipistrelle, soprano pipistrelle
	03/09/2018	No		Noctule, common pipistrelle, soprano pipistrelle
Roost 5 - B82	05/07/2018	No		Noctule, common pipistrelle, soprano pipistrelle
	03/09/2018	Yes	2 common pipistrelle, 2 soprano pipistrelle	Noctule, common pipistrelle, soprano pipistrelle
Roost 6 - B85	04/07/2018	No		Serotine, noctule, common pipistrelle, soprano pipistrelle, brown long-eared
	18/09/2018	No		Noctule, common pipistrelle, soprano pipistrelle, brown long-eared
Roost 7 - B90	04/07/2018	No		Serotine, Natterer's bat, noctule, common pipistrelle, soprano pipistrelle
	15/08/2018	No		Noctule, common pipistrelle, soprano pipistrelle
Roost 8 - W11B	TREE FELLED			
	TREE FELLED			
Roost 9 - W11D	11/06/2018	No		Noctule, common pipistrelle, soprano pipistrelle, Daubenton's bat
	16/08/2018	No		Serotine, noctule, soprano pipistrelle, common pipistrelle
Roost 10 - W11N	11/06/2018	No		Noctule, common pipistrelle, soprano pipistrelle, Daubenton's bat
	16/08/2018	No		Serotine, noctule, soprano pipistrelle, common pipistrelle

Roosts	Date	Bats roosting?	Roosting species	Bat activity recorded
Roost 11 - 475B	24/07/2018	No		Noctule, common pipistrelle, soprano pipistrelle
	06/09/2018	No		Common pipistrelle, brown long-eared bat
Roost 12 - 490	23/07/2018	No		Noctule, common pipistrelle, soprano pipistrelle
	16/08/2018	No		Noctule, soprano pipistrelle
Roost 13 - 290	15/08/2018	No		Soprano pipistrelle, noctule
	04/09/2018	Yes	3 soprano pipistrelle	Myotis, noctule, common pipistrelle, soprano pipistrelle
Roost 14 - 511	16/08/2018	No		Serotine, noctule, common pipistrelle, soprano pipistrelle, brown long-eared, Daubenton's bat, barbastelle
	06/09/2018	No		Common pipistrelle, soprano pipistrelle, brown long-eared bat
Roost 15 - 380	24/07/2018	No		Noctule, serotine, common pipistrelle, soprano pipistrelle
	14/08/2018	No		Noctule, serotine, common pipistrelle, soprano pipistrelle
Roost 16 - 415	26/07/2018	No		Myotis, noctule, common pipistrelle, soprano pipistrelle
	04/09/2018	No		Myotis, noctule, common pipistrelle, soprano pipistrelle
Roost 17 - 451	26/07/2018	No		Noctule, common pipistrelle, soprano pipistrelle
	04/09/2018	No		Common pipistrelle, soprano pipistrelle

3.5 Roost counts of bat houses

On the final survey on the small bat house, two soprano pipistrelles were observed emerging from the apex of the roof on the southern face. Such quick uptake, considering the Scheme was only completed during 2018 is encouraging. No bats were found to be roosting in the larger bat house. For full survey results see Table 3.3.

Table 3.3. Result of bat box checks

Roosts	Date	Bats roosting?	Roosting species	Feature	Other Activity
Rackheath bat house - large	30.07.18	No			Noctule, common pipistrelle, Daubenton's bat, serotine, <i>Myotis</i>
Rackheath bat house - small	31.07.18	No			Noctule, common pipistrelle, brown long-eared bat, soprano pipistrelle, <i>Myotis</i>
Rackheath bat house- large	28.08.18	No			Noctule, Daubenton's bat, common pipistrelle. serotine

Roosts	Date	Bats roosting?	Roosting species	Feature	Other Activity
Rackheath bat house - small	29.08.18	Yes	2 soprano pipistrelles	Apex of roof (semi-circle access tile) on southern face	Noctule, soprano pipistrelle, common pipistrelle, <i>Myotis</i>

3.6 Bat box occupancy checks

Out of the four surveyed locations, Quaker Farm was the only area to have no uptake in any of the bat boxes. 11 bats were found in total across 23 boxes, all being either soprano or common pipistrelles. Nine out of the 23 boxes were either in use or showed evidence of use. Table 3.4 shows results for all boxes.

Table 3.4. Result of bat box checks

Location	Box number	Activity	Notes
Fakenham Rd	1	One common pipistrelle and one soprano pipistrelle	
Fakenham Rd	2	Brown long-eared bat droppings	
Fakenham Rd	3		Inactive birds nest removed
Spring Farm	4	Pipistrelle droppings	
Spring Farm	5	Pipistrelle droppings	
Spring Farm	6		
Quaker Farm	7		
Quaker Farm	8		
Quaker Farm	9		
Quaker Farm	10		Inactive birds nest removed
Quaker Farm	11		
Spixworth Plantation	12		
Spixworth Plantation	13		
Spixworth Plantation	14		
Spixworth Plantation	15	Six soprano pipistrelles	
Spixworth Plantation	16		Hornet nest
Spixworth Plantation	17		
Spixworth Plantation	18	Two common pipistrelles	
Spixworth Plantation	19		
Spixworth Plantation	20	Pipistrelle droppings	
Spixworth Plantation	21	Pipistrelle droppings	
Spixworth Plantation	22		
Spixworth Plantation	23	One common pipistrelle	

3.7 Bat vehicle collision

No bats were found during any of the bat vehicle collision surveys.

4 Conclusions

While more bats are crossing the NDR at a safe height than those crossing at an unsafe height, there is still a large proportion of bats crossing unsafely, these are at risk of vehicle collision mortality. As the effect on local bat populations will be dependent on the number of bats hit by moving vehicles, it is essential that as many bats as possible are guided to fly over the road at a safe height. It is therefore important that all planting of vegetation is monitored and replaced if needed, so that trees and shrubs grow to a height that can help to increase the elevation of bats in flight crossing the road.

Another impact the NDR may be having on local bats, is the reduction in permeability through the landscape, especially for low flying species which rely on linear features. This seems evident at some of the crossing locations where the number of crossing bats is especially low. Both Abbott *et al.* (2012) and Bennet & Zurcher (2013) have found that the absence of substantial vegetation can be a determining factor in whether bats cross the road. It is therefore possible that as current vegetation becomes more established, the numbers of bats using the crossing locations will increase.

Although few barbastelles crossing the road were observed throughout the surveys, it is encouraging that all observed were flying at a safe height. Relatively low levels of additional mortality in rare species has the potential to impact on the long-term sustainability of local populations.

Continued monitoring will be essential in analysing the levels of bat use in 2019 survey season for all crossing points. As planting has now been completed, it will be important to determine, how the establishment of vegetation changes how bats use the crossing points.

The quick uptake of soprano pipistrelles in using the small bat house for roosting is encouraging and shows the potential for the structures to be an important roosting facility for local species. If there is no bat activity observed during the 2019 monitoring for the larger house, it may become necessary to make small changes to the inside of the structure to make it more attractive for roosting bats.

5 References

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6 Appendix

6.1 Survey conditions for manned static surveys of crossings

Location	Date	Time	Starting temperature (°C)	Weather conditions	Cloud cover
G1	14.06.18	AM	15	Moderate breeze, intermittent light rain.	8/8
	06.07.18	AM	17	Dry, misty	8/8
	24.07.18	PM	23	Still, dry	0/8
G2	06.06.18	PM	13	Slight breeze, dry	3/8
	25.07.18	AM	17	Slight breeze, dry	2/8
	29.08.18	AM	14	Slight breeze	4/8
G3	08.06.18	AM	12	Slight breeze, dry	8/8
	14.06.18	PM	21	Slight breeze, intermittent light rain.	8/8
	04.07.18	AM	11	Still, dry	6/8
G4	07.06.18	PM	15	Still, dry	4/8
	03.07.18	AM	15	Still, dry	0/8
	23.07.18	PM	27	Slight breeze, dry	0/8
G5	07.06.18	PM	12	Dry, slight breeze	7/8
	03.07.18	AM	16	Slight breeze, dry	0/8
	23.07.18	PM	26	Dry	0/8
G6	07.06.18	AM	12	Slight breeze, dry	0/8
	02.07.18	PM	17	Slight breeze	0/8
	25.07.18	AM	20	Still, dry	0/8
G7	03.07.18	PM	19	Still, dry	1/8
	24.07.18	PM	24	Slight breeze	7/8
	27.08.18	AM	20	Still	0/8
GB1	26.04.18	PM	13	Slight breeze, dry	2/8
	04.07.18	AM	16	Still, dry	1/8
	27.07.18	AM	19	Slight breeze, dry	2/8
GB2	22.05.18	PM	14	Dry	0/8
	02.07.18	AM	20	Still, dry	4/8
	25.07.18	AM	17	Dry	0/8
GB3	08.06.18	AM	12	Slight breeze, dry	0/8
	04.07.18	AM	12	Dry	2/8
	24.07.18	PM	19	Slight breeze, dry	1/8
DC1	13.06.18	AM	12	Slight breeze, dry	0/8
	03.07.18	PM	18	Slight breeze, dry	7/8
	26.07.18	AM	19	Slight breeze, dry	4/8
UN1	13.06.18	AM	12	Dry	0/8
	03.07.18	PM	17	Dry, moderate breeze	7/8
	26.07.18	AM	12	Still, dry	1/8

6.2 Survey conditions for roost counts

Roosts	Survey	Date	Starting temperature (°C)	Weather	Cloud Cover
Roost 1 - B5	1	12/06/2018	15	Still	7/8
	2	30/08/2018	18	Slight breeze	4/8
Roost 2 - B55	1	13/06/2018	19	Moderate breeze, dry	8/8
	2	25/07/2018	20	Slight breeze, dry	6/8
Roost 3 - GB5	1	14/06/2018	16	Still, dry	1/8
	2	17/09/2018	21	Slight breeze, dry	1/8
Roost 4 - B81	1	05/07/2018	20	Slight breeze, dry	0/8
	2	03/09/2018	19	Still, dry	1/8
Roost 5 - B82	1	05/07/2018	21	Still, dry	8/8
	2	03/09/2018	19	Still, dry	1/8
Roost 6 - B85	1	04/07/2018	19	Still, dry	3/8
	2	18/09/2018	21	Slight breeze, dry	4/8
Roost 7 - B90	1	04/07/2018	19	Still, dry	1/8
	2	15/08/2018	19	Still, dry	4/8
Roost 8 - W11B	1	TREE FELLED			
	2	TREE FELLED			
Roost 9 - W11D	1	11/06/2018	17	Slight breeze, dry	4/8
	2	16/08/2018	19	Still, dry	4/8
Roost 10 - W11N	1	11/06/2018	17	Slight breeze, dry	4/8
	2	16/08/2018	19	Still, dry	4/8
Roost 11 - 475B	1	24/07/2018	23	Slight breeze, dry	6/8
	2	06/09/2018	16	Slight breeze, dry	2/8
Roost 12 - 490	1	23/07/2018	27	Slight breeze, dry	4/8
	2	16/08/2018	16	Moderate breeze, humid	4/8
Roost 13 - 290	1	15/08/2018	24	Slight breeze, dry	7/8
	2	04/09/2018	16	Slight breeze, dry	1/8
Roost 14 - 511	1	16/08/2018	18	Moderate breeze, dry	2/8
	2	06/09/2018	15	Still, dry	4/8
Roost 15 - 380	1	24/07/2018	24	Slight breeze, dry	2/8
	2	14/08/2018	23	Slight breeze, dry	3/8
Roost 16 - 415	1	26/07/2018	23	Still, dry	0/8
	2	04/09/2018	17	Slight breeze, dry	2/8
Roost 17 - 451	1	26/07/2018	25	Slight breeze, dry	2/8
	2	04/09/2018	17	Slight breeze, dry	2/8

6.3 Static detector results

Location	Species	Inside total count	Outside total count	Inside nightly mean	Outside nightly mean
G1	Barbastelle	1	4	0.08	0.50
G1	Serotine	2	3	0.17	0.38
G1	Daubenton's bat	4	9	0.33	1.13
G1	Natterer's bat	3	6	0.25	0.75
G1	Myotis	6	5	0.50	0.63
G1	Noctule	134	55	11.17	6.88
G1	Nathusius' pipistrelle	2	1	0.17	0.13
G1	Common pipistrelle	156	173	13.00	21.63
G1	Soprano pipistrelle	144	96	12.00	12.00
G1	Brown long-eared bat	48	68	4.00	8.50
G2	Barbastelle	69	101	6.90	12.63
G2	Serotine	6	3	0.60	0.38
G2	Daubenton's bat	5	3	0.50	0.38
G2	Natterer's bat	6	2	0.60	0.25
G2	Myotis	9	0	0.90	0.00
G2	Noctule	29	49	2.90	6.13
G2	Nathusius' pipistrelle	0	2	0.00	0.25
G2	Common pipistrelle	339	755	33.90	94.38
G2	Soprano pipistrelle	200	81	20.00	10.13
G2	Brown long-eared bat	31	41	3.10	5.13
G3	Barbastelle	5	129	0.50	10.75
G3	Serotine	1	6	0.10	0.50
G3	Daubenton's bat	1	4	0.10	0.33
G3	Natterer's bat	1	2	0.10	0.17
G3	Myotis	2	11	0.20	0.92
G3	Noctule	22	64	2.20	5.33
G3	Nathusius' pipistrelle	1	1	0.10	0.08
G3	Common pipistrelle	1300	481	130.00	40.08
G3	Soprano pipistrelle	572	70	57.20	5.83
G3	Brown long-eared bat	6	64	0.60	5.33
G4	Barbastelle	1	18	0.13	1.80
G4	Serotine	3	9	0.38	0.90
G4	Daubenton's bat	15	16	1.88	1.60
G4	Natterer's bat	0	2	0.00	0.20
G4	Myotis	4	18	0.50	1.80
G4	Noctule	36	15	4.50	1.50
G4	Nathusius' pipistrelle	1	2	0.13	0.20
G4	Common pipistrelle	254	1436	31.75	143.60
G4	Soprano pipistrelle	455	716	56.88	71.60
G4	Brown long-eared bat	4	7	0.50	0.70
G5	Barbastelle	10	12	0.83	1.00
G5	Serotine	4	4	0.33	0.33
G5	Daubenton's bat	4	2	0.33	0.17
G5	Natterer's bat	2	0	0.17	0.00

Location	Species	Inside total count	Outside total count	Inside nightly mean	Outside nightly mean
G5	Myotis	0	2	0.00	0.17
G5	Noctule	36	28	3.00	2.33
G5	Nathusius' pipistrelle	14	4	1.17	0.33
G5	Common pipistrelle	128	203	10.67	16.92
G5	Soprano pipistrelle	255	195	21.25	16.25
G5	Brown long-eared bat	8	1	0.67	0.08
G6	Barbastelle	17	18	2.13	2.25
G6	Serotine	4	3	0.50	0.38
G6	Daubenton's bat	4	3	0.50	0.38
G6	Natterer's bat	1	0	0.13	0.00
G6	Myotis	5	3	0.63	0.38
G6	Noctule	104	30	13.00	3.75
G6	Nathusius' pipistrelle	6	5	0.75	0.63
G6	Common pipistrelle	207	153	25.88	19.13
G6	Soprano pipistrelle	137	93	17.13	11.63
G6	Brown long-eared bat	23	12	2.88	1.50
G7	Barbastelle	51	11	4.25	0.92
G7	Serotine	5	7	0.42	0.58
G7	Daubenton's bat	11	0	0.92	0.00
G7	Natterer's bat	0	0	0.00	0.00
G7	Myotis	12	15	1.00	1.25
G7	Noctule	56	45	4.67	3.75
G7	Nathusius' pipistrelle	838	11	69.83	0.92
G7	Common pipistrelle	2308	3057	192.33	254.75
G7	Soprano pipistrelle	445	814	37.08	67.83
G7	Brown long-eared bat	16	6	1.33	0.50
GB1	Barbastelle	3	4	0.25	0.33
GB1	Serotine	5	4	0.42	0.33
GB1	Daubenton's bat	0	0	0.00	0.00
GB1	Natterer's bat	0	0	0.00	0.00
GB1	Myotis	9	8	0.75	0.67
GB1	Noctule	52	53	4.33	4.42
GB1	Nathusius' pipistrelle	20	31	0.00	2.58
GB1	Common pipistrelle	1211	1134	100.92	94.50
GB1	Soprano pipistrelle	122	79	10.17	6.58
GB1	Brown long-eared bat	33	27	2.75	2.25
GB2	Barbastelle	2	2	0.29	0.25
GB2	Serotine	3	5	0.43	0.63
GB2	Daubenton's bat	1	0	0.14	0.00
GB2	Natterer's bat	0	0	0.00	0.00
GB2	Myotis	1	6	0.14	0.75
GB2	Noctule	163	270	23.29	33.75
GB2	Nathusius' pipistrelle	5	4	0.71	0.50
GB2	Common pipistrelle	56	93	8.00	11.63
GB2	Soprano pipistrelle	10	41	1.43	5.13
GB2	Brown long-eared bat	4	5	0.57	0.63

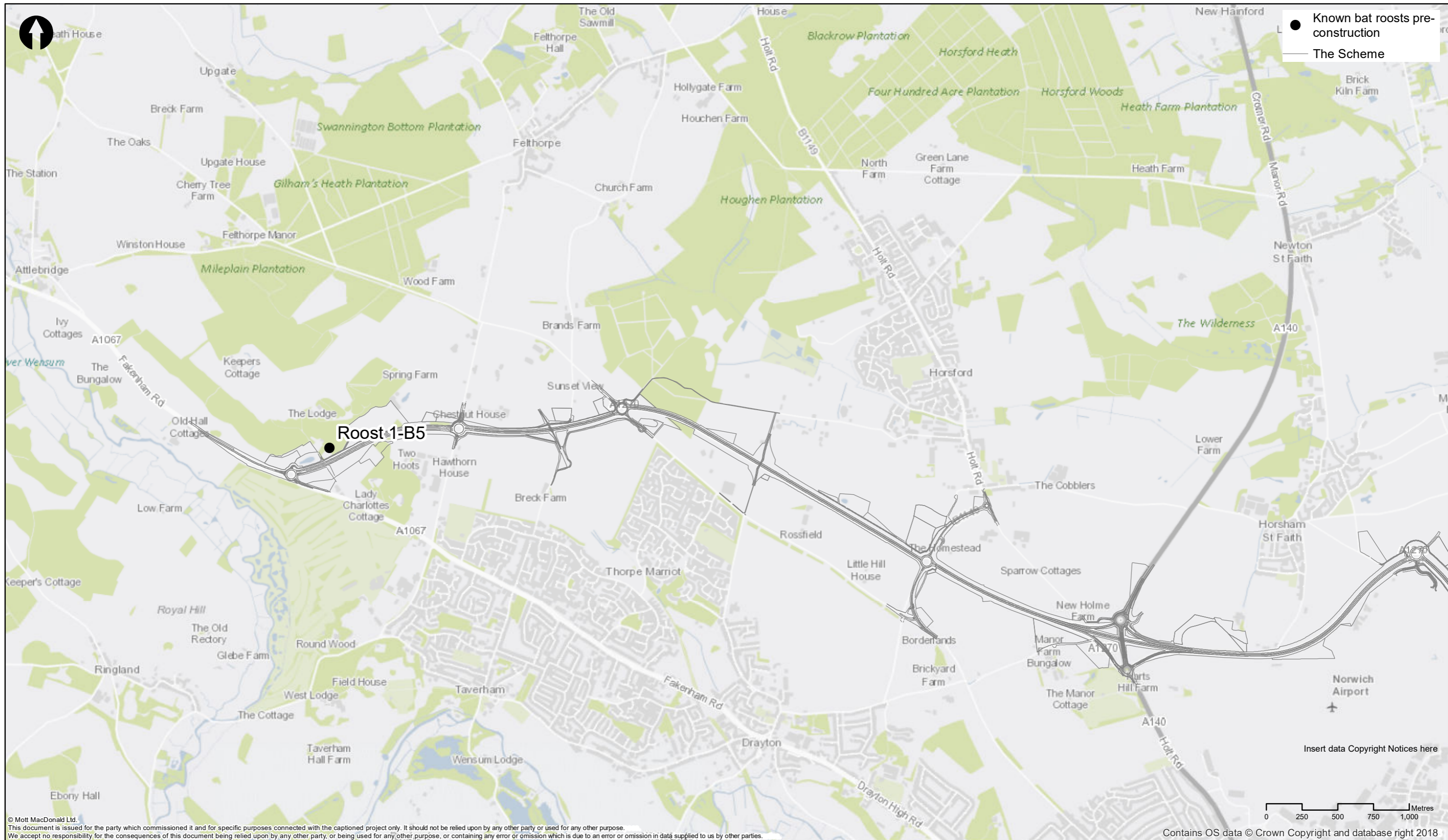
Location	Species	Inside total count	Outside total count	Inside nightly mean	Outside nightly mean
DC1	Barbastelle	9	7	0.75	0.58
DC1	Serotine	0	2	0.00	0.17
DC1	Daubenton's bat	1	4	0.08	0.33
DC1	Natterer's bat	1	0	0.08	0.00
DC1	Myotis	2	3	0.17	0.25
DC1	Noctule	55	34	4.58	2.83
DC1	Nathusius' pipistrelle	4	4	0.33	0.33
DC1	Common pipistrelle	637	472	53.08	39.33
DC1	Soprano pipistrelle	32	27	2.67	2.25
DC1	Brown long-eared bat	24	21	2.00	1.75
DC2	Barbastelle	4	6	0.33	0.50
DC2	Serotine	22	39	1.83	3.25
DC2	Daubenton's bat	11	12	0.92	1.00
DC2	Natterer's bat	7	2	0.58	0.17
DC2	Myotis	10	3	0.83	0.25
DC2	Noctule	617	1402	51.42	116.83
DC2	Nathusius' pipistrelle	8	14	0.67	1.17
DC2	Common pipistrelle	426	396	35.50	33.00
DC2	Soprano pipistrelle	130	119	10.83	9.92
DC2	Brown long-eared bat	165	151	13.75	12.58
UN1	Barbastelle	1	6	0.13	0.50
UN1	Serotine	34	27	4.25	2.25
UN1	Daubenton's bat	23	15	2.88	1.25
UN1	Natterer's bat	1	5	0.13	0.42
UN1	Myotis	10	31	1.25	2.58
UN1	Noctule	81	128	10.13	10.67
UN1	Nathusius' pipistrelle	4	8	0.50	0.67
UN1	Common pipistrelle	279	219	34.88	18.25
UN1	Soprano pipistrelle	273	446	34.13	37.17
UN1	Brown long-eared bat	17	8	2.13	0.67

6.4 Bat activity for manned crossing surveys

Location	Date	Species recorded inside	Species recorded outside
G1	14.06.18	8 noctules, 1 soprano pipistrelle, 3 common pipistrelle, 1 barbastelle, 3 brown long-eared bat	1 brown long-eared bat, 2 soprano pipistrelle, 14 noctule
G1	06.07.18	3 common pipistrelle, 5 soprano pipistrelle, 4 brown long-eared bat, 1 Daubenton's bat, 5 noctule	10 noctule, 20 common pipistrelle, 8 soprano pipistrelle, 3 brown long-eared bat
G1	24.07.18	5 common pipistrelle, 3 soprano pipistrelles	2 50 pipistrelles, 3 noctule, 3 common pipistrelle, 4 soprano pipistrelle
G2	06.06.18	26 common pipistrelle, 3 soprano pipistrelle, 1 brown long-eared bat, 1 barbastelle	No access
G2	25.07.18	7 common pipistrelle, 2 soprano pipistrelle	No access
G2	29.08.18	6 soprano pipistrelle, 1 brown long-eared bat	No access
G3	08.06.18	1 brown long-eared bat, 1 soprano pipistrelle, 5 common pipistrelle, 1 noctule, 1 myotis	1 brown long-eared bat, 1 soprano pipistrelle, 2 common pipistrelle, 3 noctule
G3	14.06.18	1 barbastelle, 5 common pipistrelle, 1 soprano pipistrelle	1 barbastelle, 9 common pipistrelle, 1 soprano pipistrelle, 2 brown long-eared bat
G3	04.07.18	2 soprano pipistrelle, 3 brown long-eared bat, 12 common pipistrelles	7 soprano pipistrelle, 6 common pipistrelles
G4	07.06.18	5 soprano pipistrelle, 2 noctule, 1 barbastelle, 2 brown long-eared bat, 1 Natterer's bat	60+ common pipistrelle, 20+ soprano pipistrelle, 4 brown long-eared bat, 3 noctule, 1 barbastelle
G4	03.07.18	2 50 pipistrelles, 1 myotis, 6 noctules, 7 common pipistrelle, 1 soprano pipistrelle	4 soprano pipistrelle, 4 noctule, 40+ common pipistrelle,
G4	23.07.18	10 soprano pipistrelle, 11 common pipistrelles	5 soprano pipistrelle, 8 common pipistrelle
G5	07.06.18	2 50 pipistrelles, 1 soprano pipistrelle, 4 noctule	2 soprano pipistrelle, 4 common pipistrelle, 5 noctule
G5	03.07.18	3 soprano pipistrelle	3 noctule, 1 soprano pipistrelle
G5	23.07.18	4 noctule, 1 50 pipistrelle, 4 soprano pipistrelle	3 soprano pipistrelle, 3 noctule
G6	07.06.18	2 50 pipistrelles, 2 soprano pipistrelle, 5 noctule, 9 common pipistrelle	1 barbastelle, 1 nathusius pipistrelle, 3 noctule, 6 soprano pipistrelle, 7 common pipistrelle

Location	Date	Species recorded inside	Species recorded outside
G6	02.07.18	5 soprano pipistrelle, 35 common pipistrelle, 1 noctule, 1 serotine	2 serotine, 3 soprano pipistrelle, 15 common pipistrelle
G6	25.07.18	2 barbastelle, 4 noctule, 5 common pipistrelle, 7 soprano pipistrelle	1 barbastelle, 5 noctule, 8 common pipistrelle, 5 soprano pipistrelle
G7	03.07.18	4 soprano pipistrelle, 2 noctule, 50+ common pipistrelle	3 soprano pipistrelle, 4 noctule, 30+ common pipistrelle
G7	24.07.18	1 50 pipistrelle, 5 soprano pipistrelle, 6 noctule, 30+ common pipistrelle.	Detector malfunction
G7	27.08.18	4 soprano pipistrelle, 7 common pipistrelle, 4 noctule 1 serotine	20+ soprano pipistrelle, 20+ common pipistrelle, 1 natterers, 2 noctule
Green Bridge 1 - Marriots Way	26.04.18	1 Noctule, 5 common pipistrelle	1 Noctule, 7 common pipistrelle
	04.07.18	5 common pipistrelle, 1 soprano pipistrelle	6 common pipistrelle, 1 soprano pipistrelle
	27.07.18	1 soprano pipistrelle, 1 noctule, 1 common pipistrelle	1 soprano pipistrelle, 1 noctule, 1 common pipistrelle
Green Bridge 2- Middle Road	22.05.18	4 noctules, 1 soprano pipistrelle	5 noctules, 1 soprano pipistrelle
	02.07.18	6 common pipistrelle, 1 soprano pipistrelle, 4 noctule	6 common pipistrelle, 1 soprano pipistrelle, 4 noctule
	25.07.18	1 soprano pipistrelle, 4 noctule	2 soprano pipistrelle, 4 noctule
Dark Corridor 1 - Buxton Road	08.06.18	Myotis 1, 1 Noctule, 1 Barbastelle	
	04.07.18	Noctule 3	
	24.07.18	common pipistrelle 1 , soprano pipistrelle 3, noctule 3	
Dark Corridor 2 - Newman Road	13.06.18	1 brown long-eared bat, 1 serotine, 1 common pipistrelle, 2 Myotis, 2 Noctule	1 noctule, 1 serotine, 1 brown long-eared bat, 1 common pipistrelle,
	03.07.18	1 noctule, 1 soprano pipistrelle, 11 common pipistrelle.	1 noctule, 8 common pipistrelle
	26.07.18	3 noctule, 4 soprano pipistrelle, 2 brown long-eared bat	2 Serotine, 2 Daubenton's, 16 noctule, 11 common pipistrelle, 2 soprano pipistrelle, 4 brown long-eared bat,
Underpass	13.06.18	No bats recorded	1 soprano pipistrelle, 1 noctule
	03.07.18	7 noctule, 3 common pipistrelle, 1 soprano pipistrelle	5 noctule, 5 common pipistrelle, 2 soprano pipistrelle
	26.07.18	5 noctule, 5 soprano pipistrelle, 1 common pipistrelle	3 noctule, 4 soprano pipistrelle, 1 brown long-eared bat

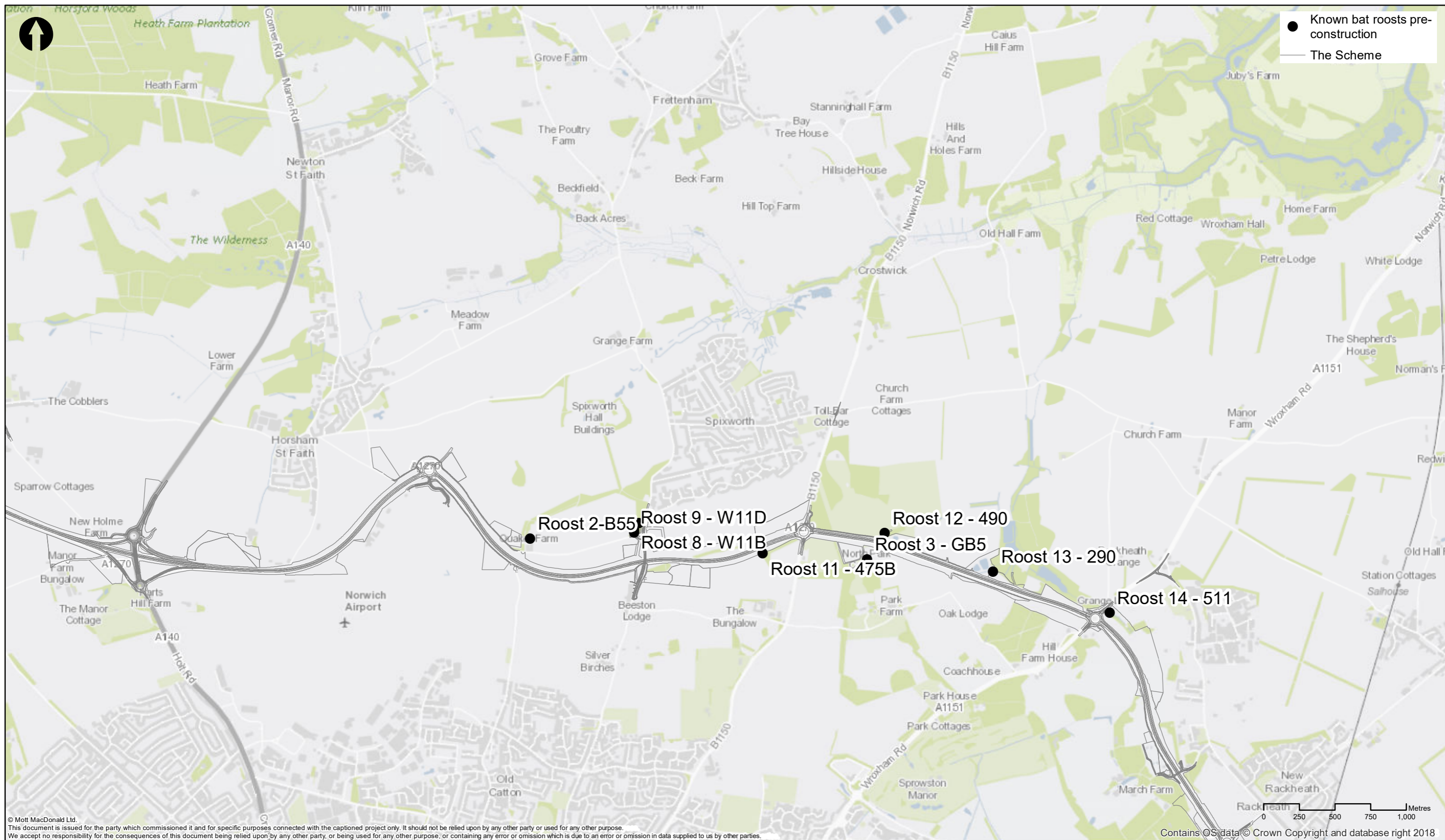
7 Figures



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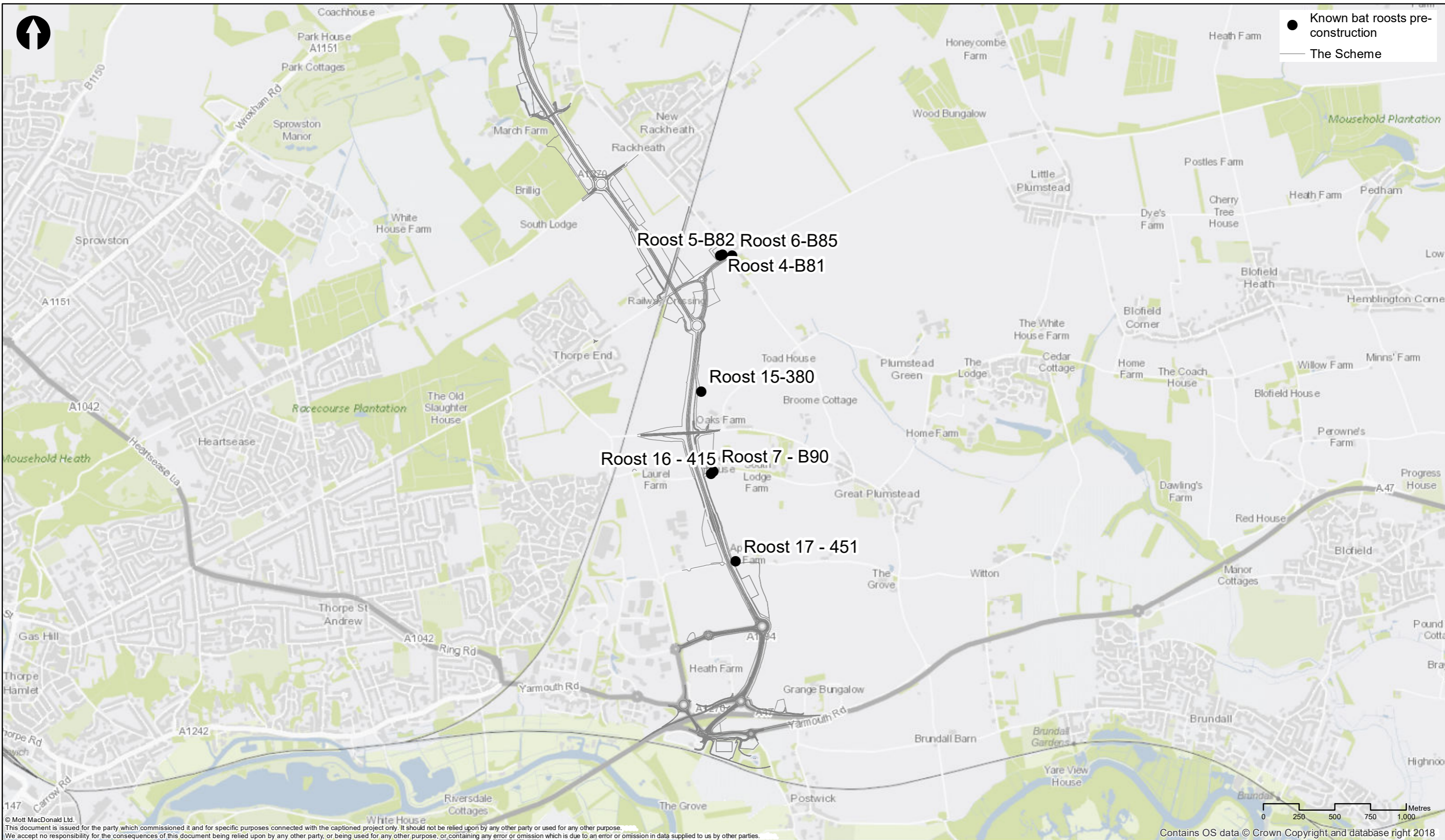
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			P01	16/01/19	BOH	First Draft	AG	SA		Checked	A Gagen	
									Approved	S Allen		
									Scale at A3 1:25,000			
									Drawing Number	Security	Status	Rev
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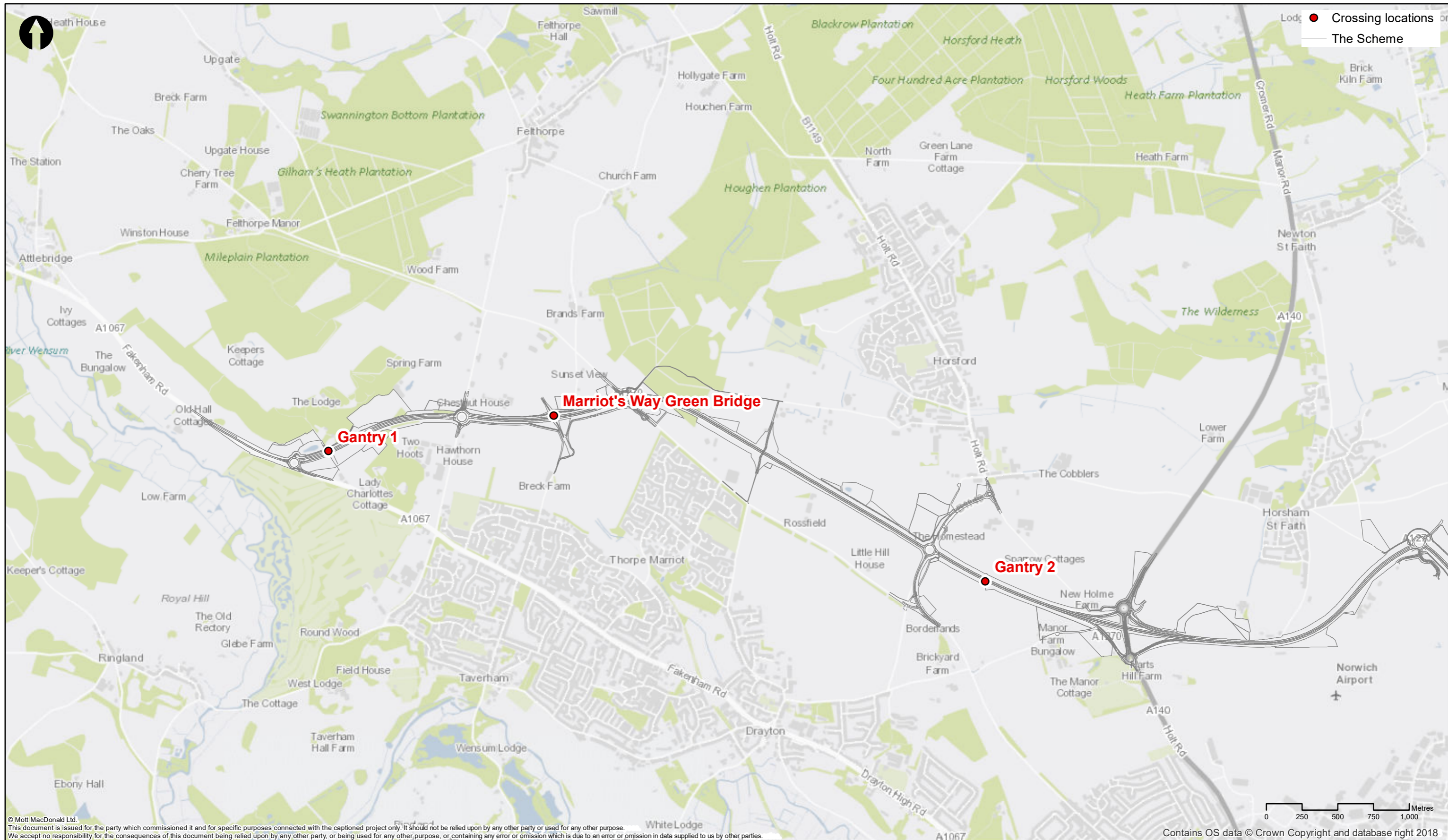
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									Approved	S Allen		
									Scale at A3 1:25,000			
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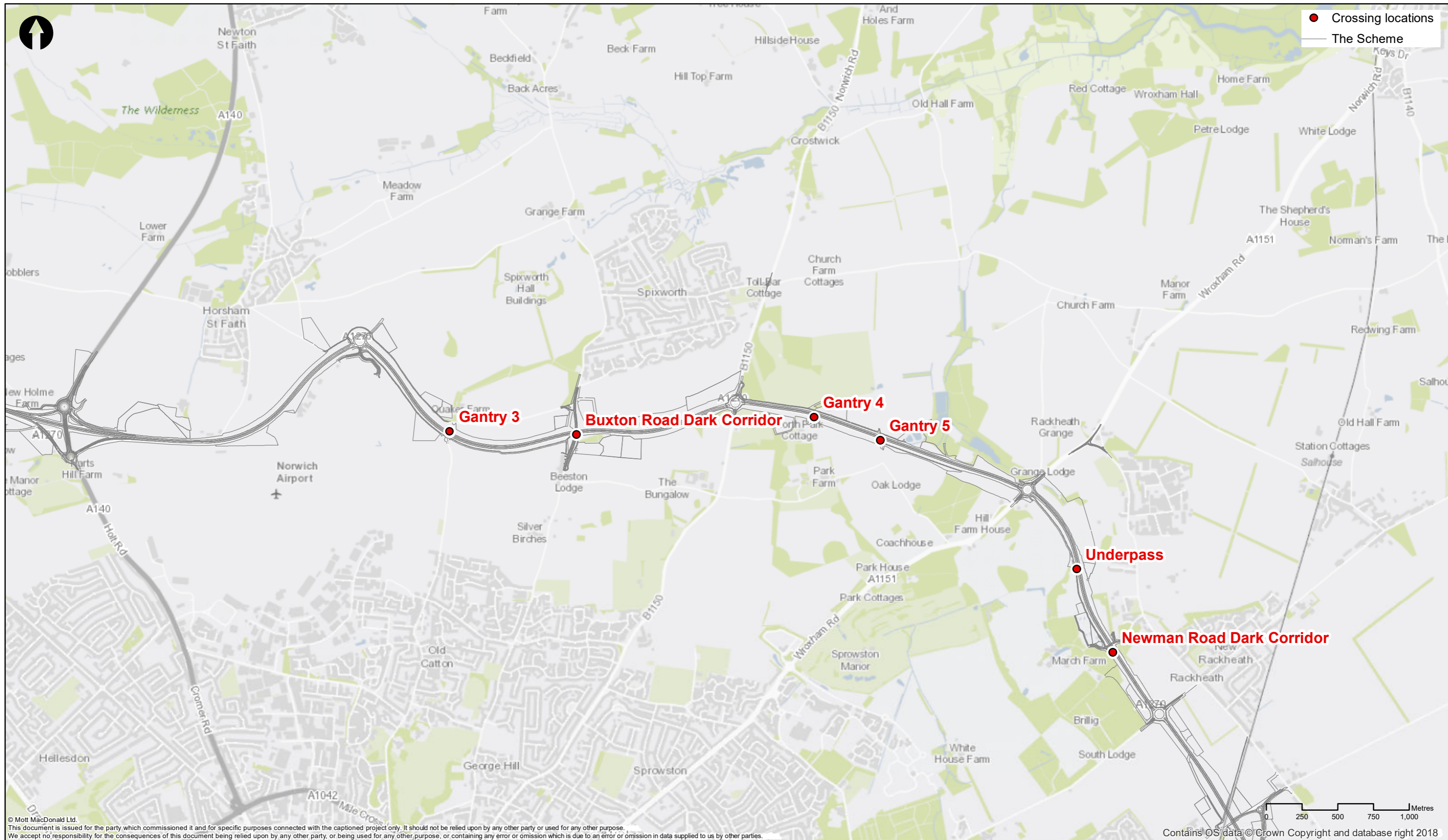
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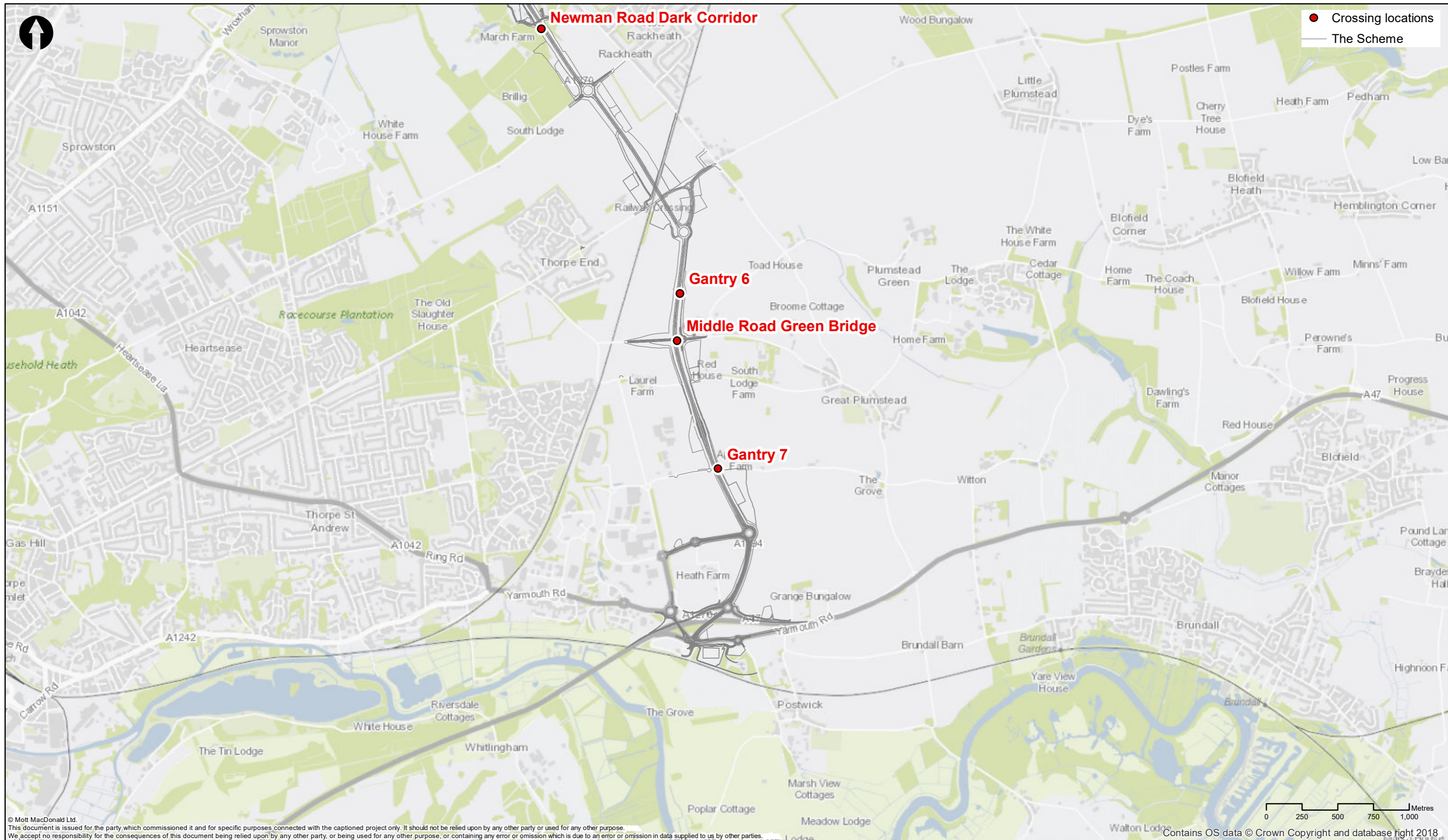
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			P01	16/01/19	BOH	First Draft	AG	SA		Checked	A Gagen	
									Approved	S Allen		
									Scale at A3 1:25,000			
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									Approved	S Allen		
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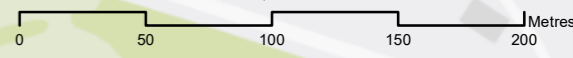
 <p>Mott MacDonald House 8-10 Sydenham Road Croydon, CR0 2EE United Kingdom</p> <p>T +44 (0)20 8774 2000 F +44 (0)20 8681 5706 W mottmac.com</p>	<p>Client</p> 	Rev	Date	Drawn	Description	Ch'k'd	App'd	<p>Title</p> <p>Figure 7.6</p> <p>Bat Crossings - Eastern Extent</p>	Drawn	B O'Hickey				
		P01	16/01/19	BOH	First Draft	AG	SA		Checked	A Gagen				
										Approved	S Allen			
		<p>Drawing Number</p> <p>366431-MMD-00-GIS-Y-0006</p>									Security	STD	Status	PRE



- Bat box locations
- The Scheme
- Lagoons



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Title	Figure 7.7
Bat Box Locations - Fakenham Road	
Drawing Number	366431-MMD-00-GIS-Y-0007

Drawn	B O'Hickey
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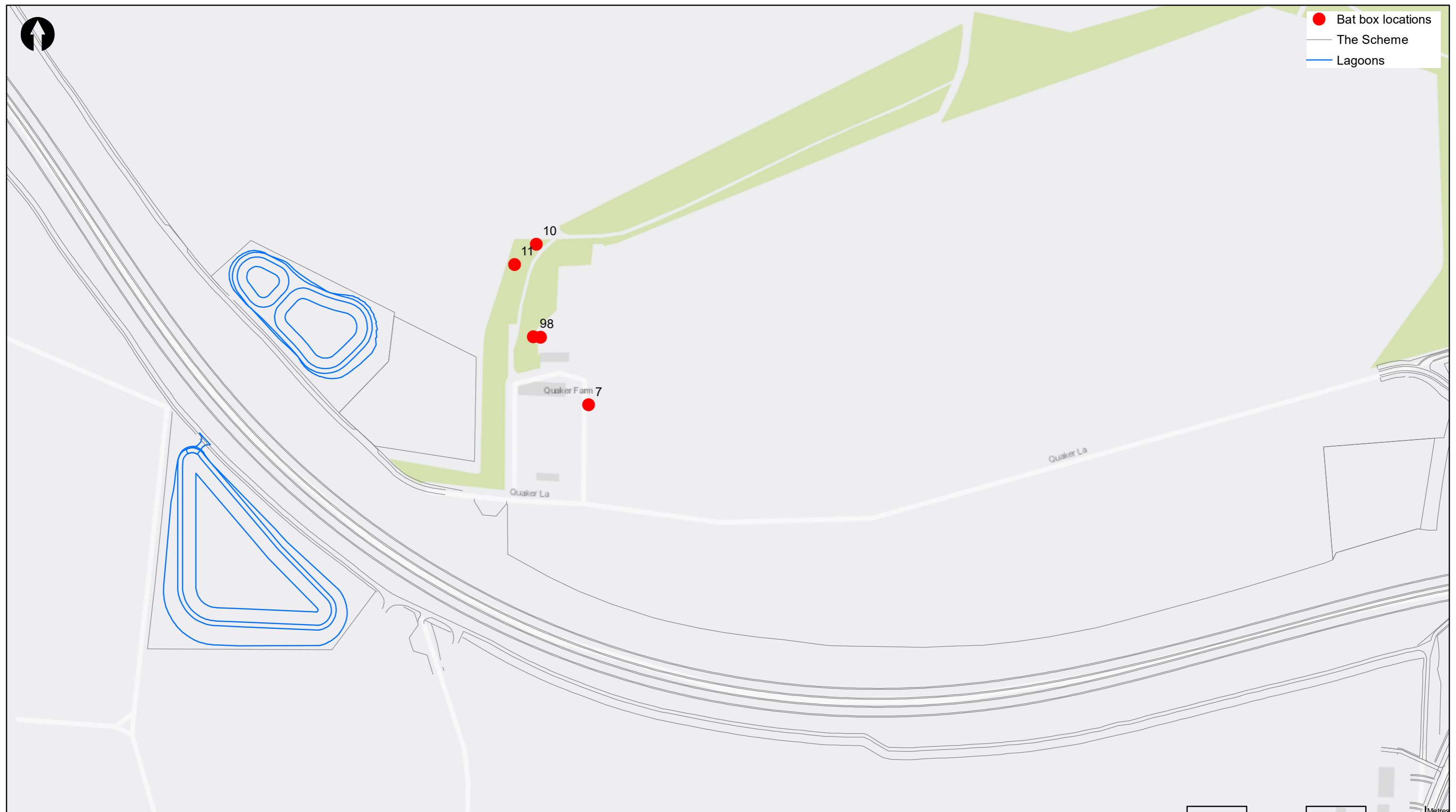
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P01	16/01/19	BOH	First Draft	AG	SA

Title	Figure 7.8
Bat Box Locations - Spring Farm	
Drawing Number	366431-MMD-00-GIS-Y-0008

Drawn	B O'Hickey	
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P01	16/01/19	BOH	First Draft	AG	SA

Title

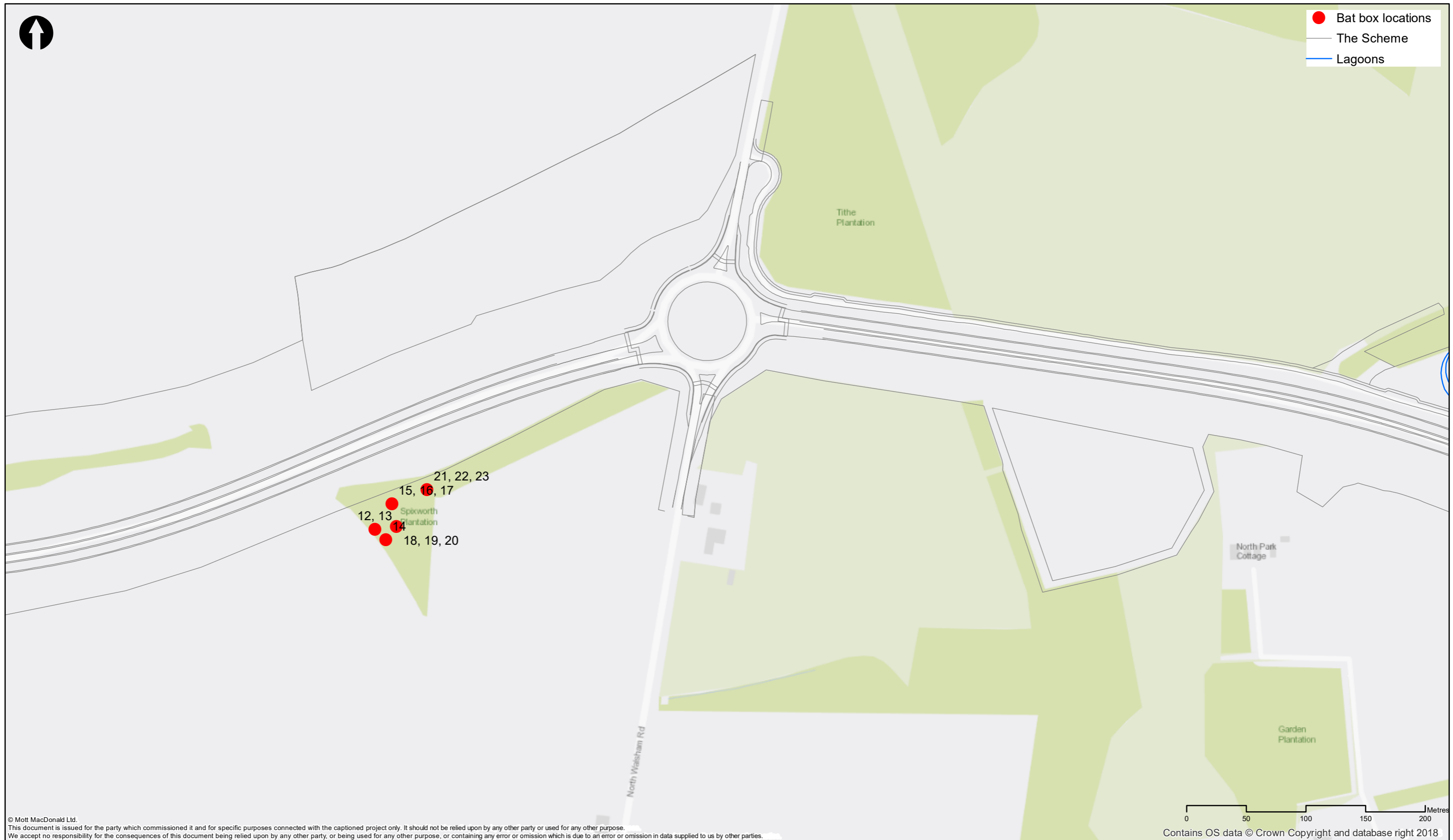
Figure 7.9
Bat Box Locations - Quaker Farm

Drawing Number
366431-MMD-00-GIS-Y-0009

Drawn	B O'Hickey	
Checked	A Gagen	
Approved	S Allen	
Scale at A3 1:3,000		
Security	Status	Rev
STD	PRE	P1



- Bat box locations
- The Scheme
- Lagoons





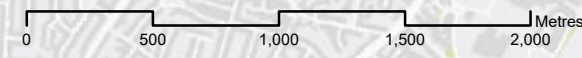
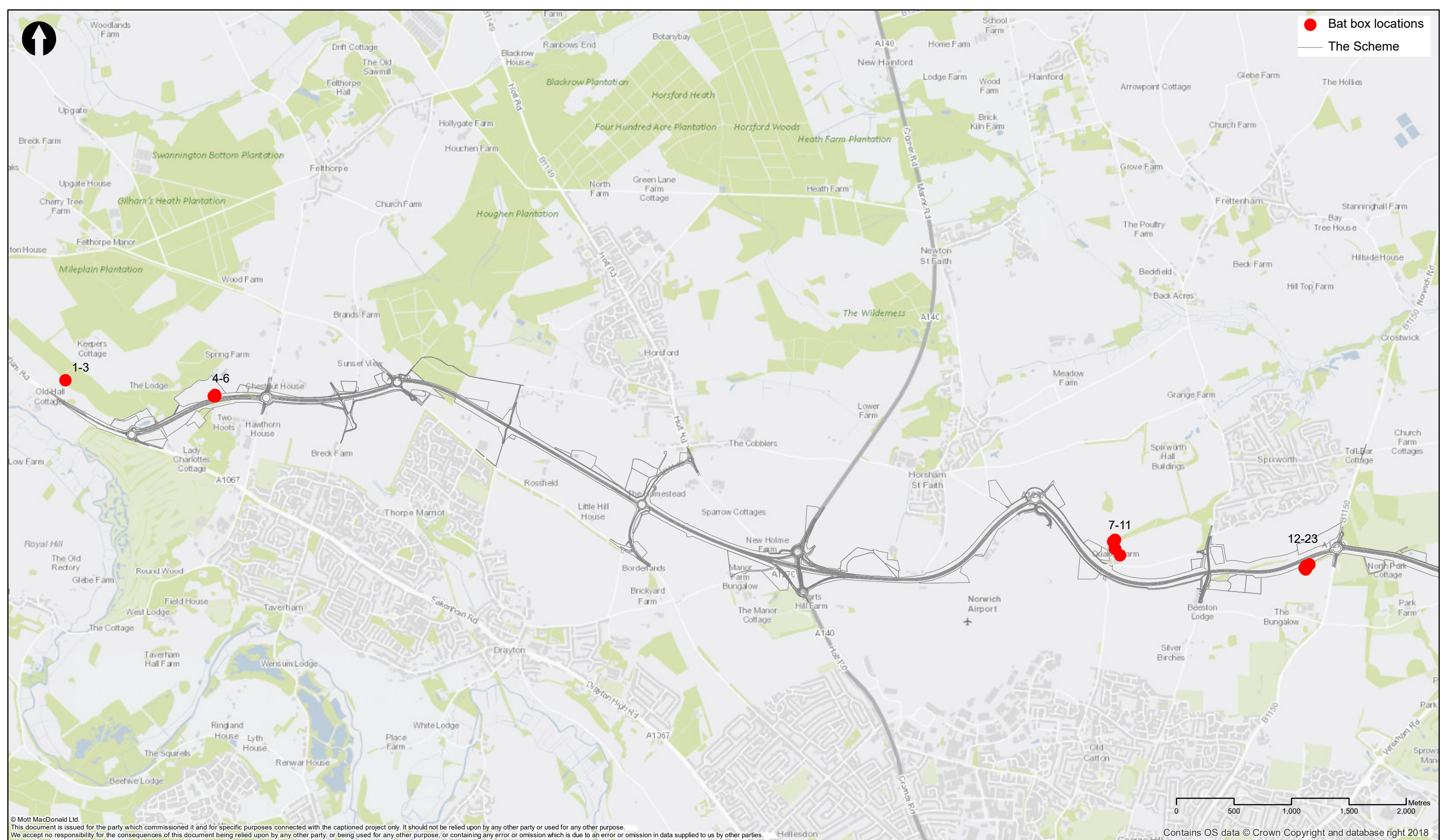
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			P01	16/01/19	BOH	First Draft	AG	SA		Checked	A Gagen	
										Approved	S Allen	
										Scale at A3 1:3,000		
										Security	Status	Rev
										STD	PRE	P1



 Bat box locations
 The Scheme



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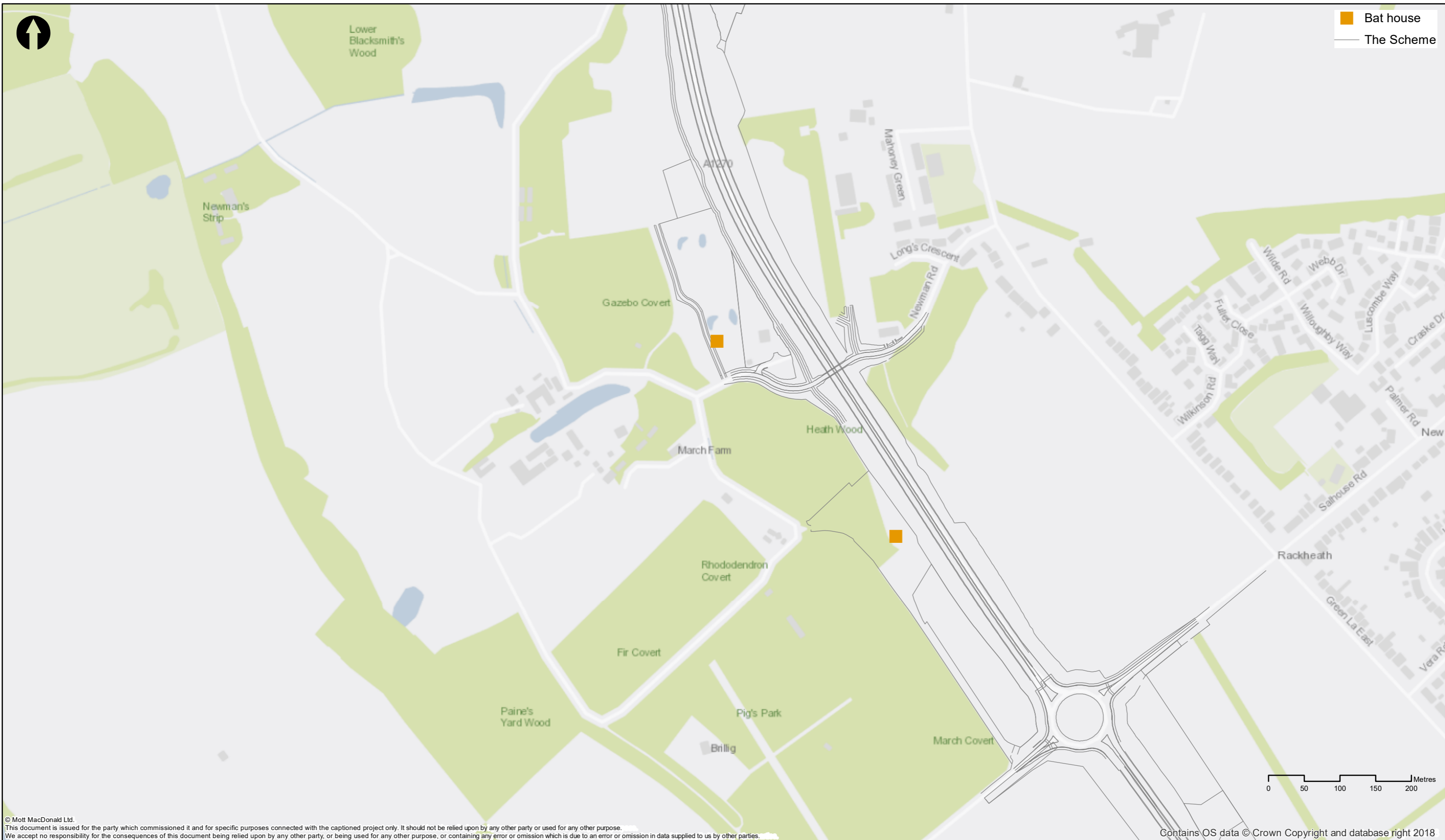
Client



Rev	Date	Drawn	Description	Ch'k'd	App'd
P01	16/01/19	BOH	First Draft	AG	SA

Figure 7.11	Drawn	B O'Hickey
Bat Boxes - Overview	Checked	A Gagen
	Approved	S Allen
Drawing Number	366431-MMD-00-GIS-Y-00011	
Security	STD	Status PRE
Rev	P1	

Scale at A3	1:30,000
Security	STD
Status	PRE
Rev	P1

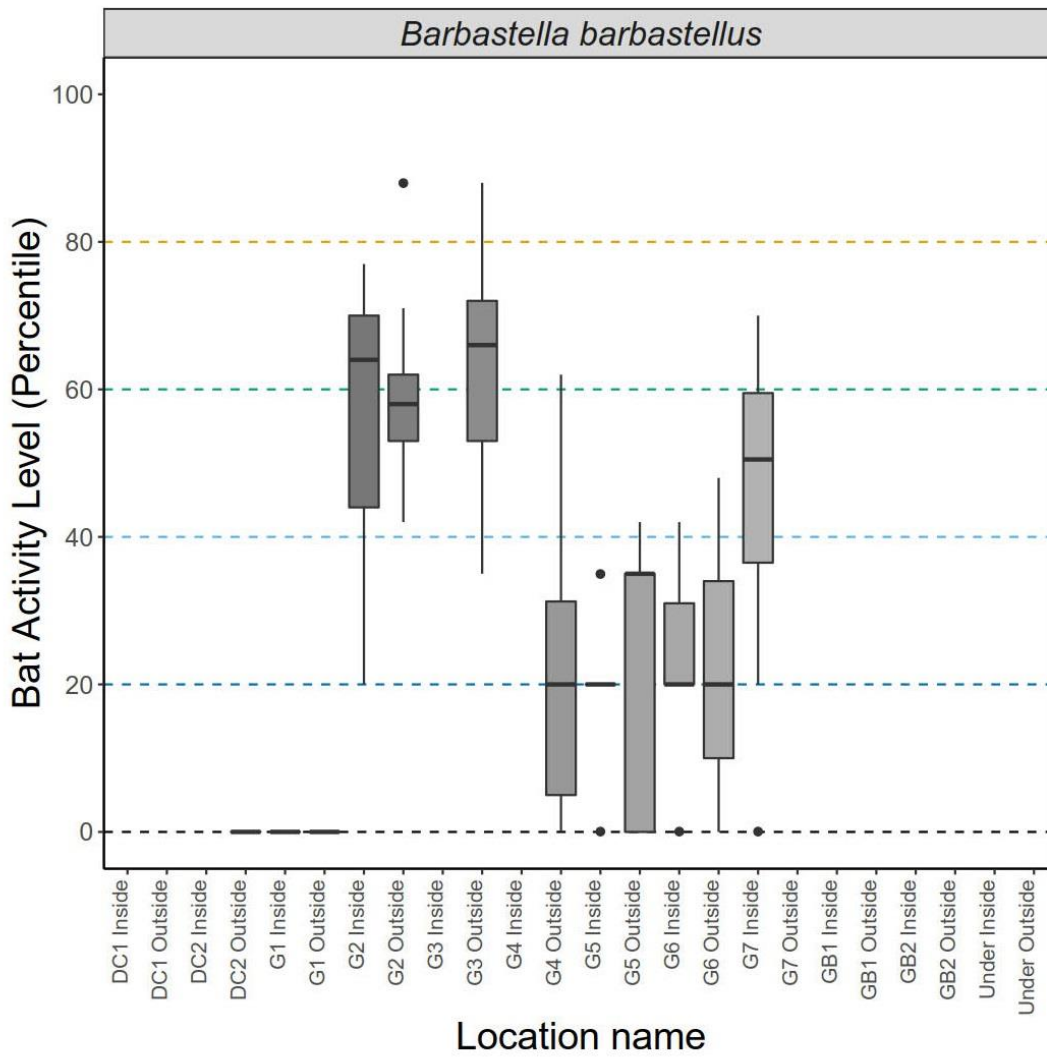


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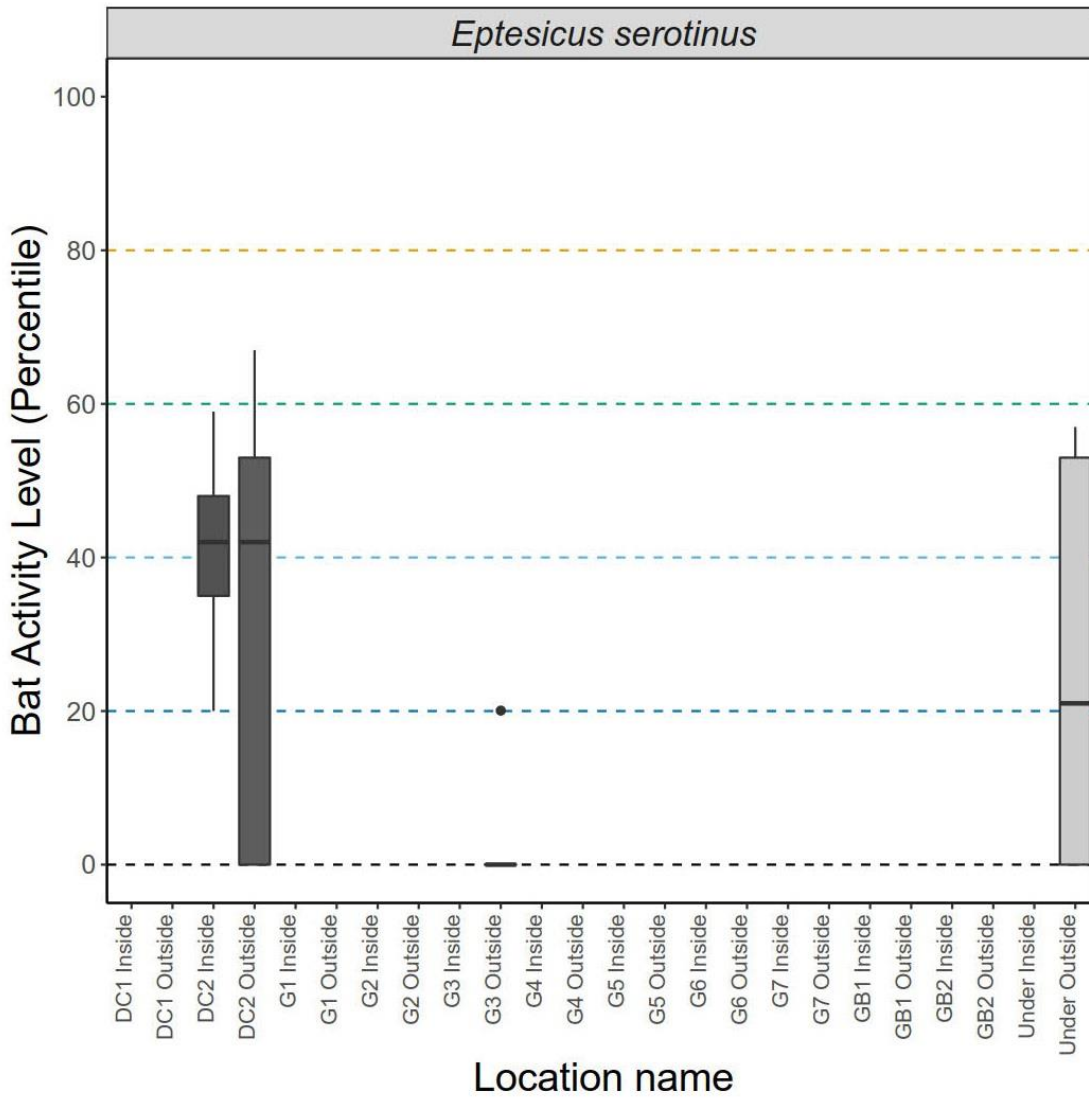
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			P01	16/01/19	BOH	First Draft	AG	SA		Checked	A Gagen	
									Approved	S Allen		
									Scale at A3 1:5,000			
									Drawing Number	Security	Status	Rev
									366431-MMD-00-GIS-Y-0012	STD	PRE	P1

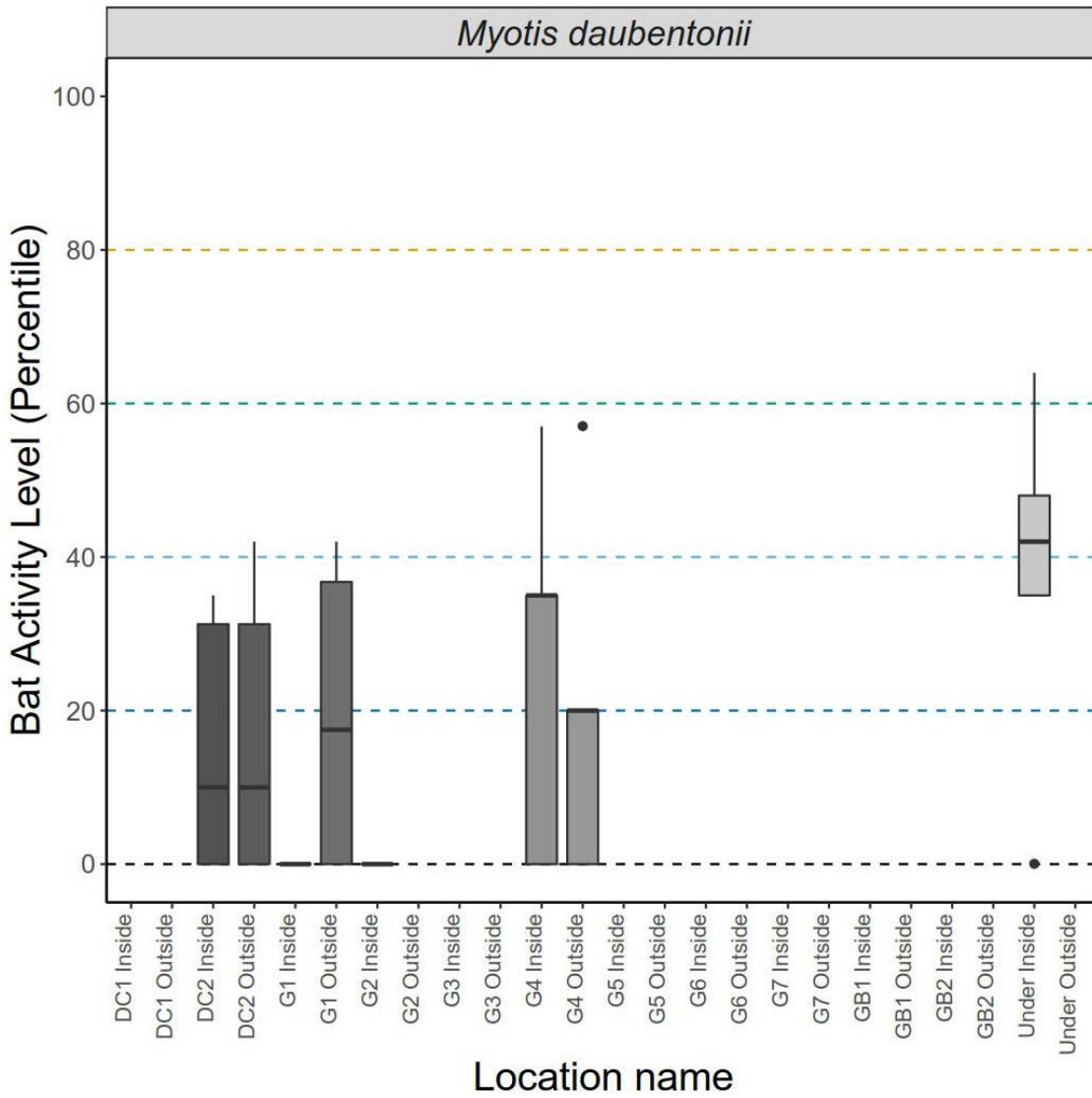
7.13 Differences in activity between static detector locations for barbastelles



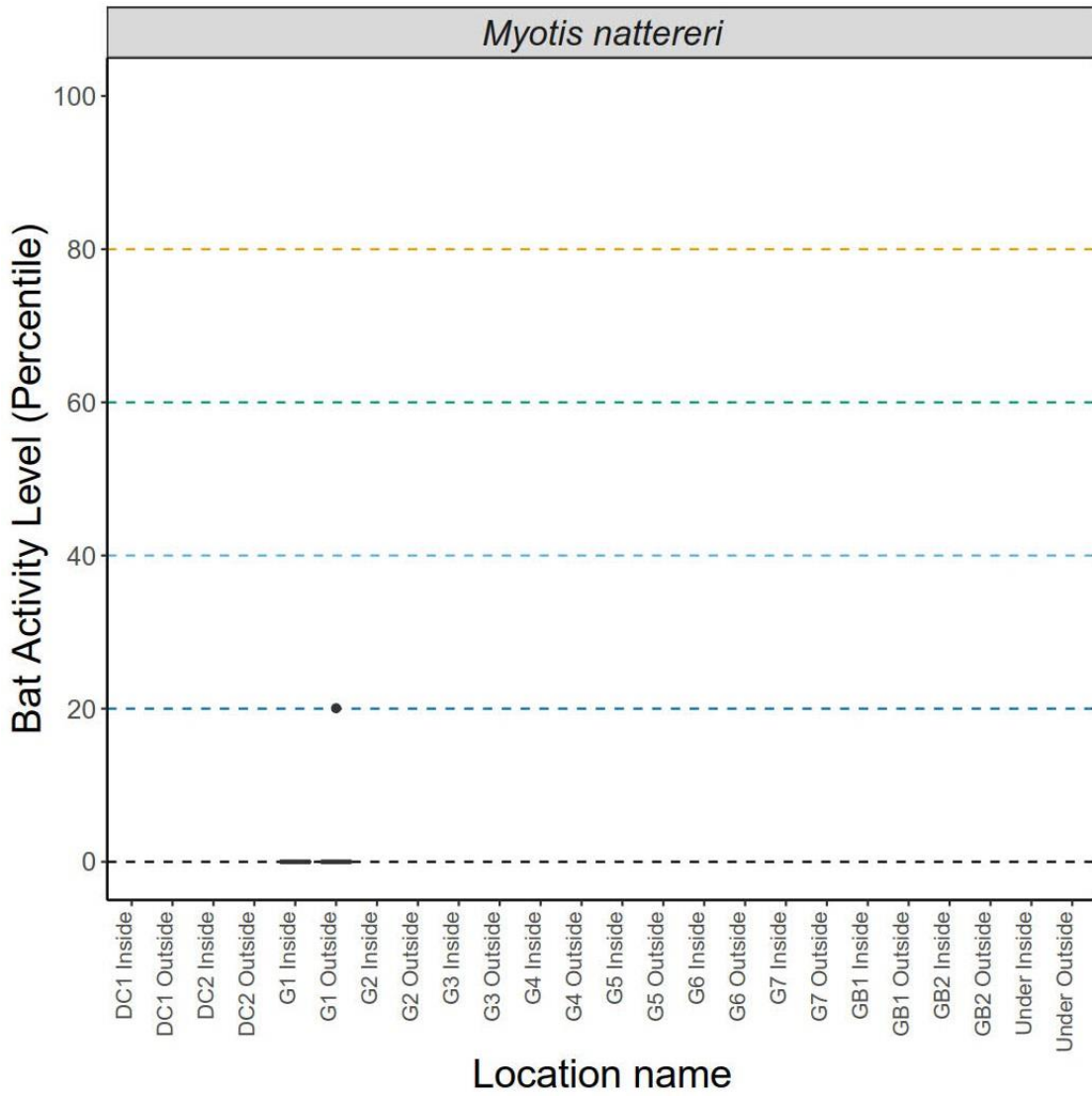
7.14 Differences in activity between static detector locations for serotines



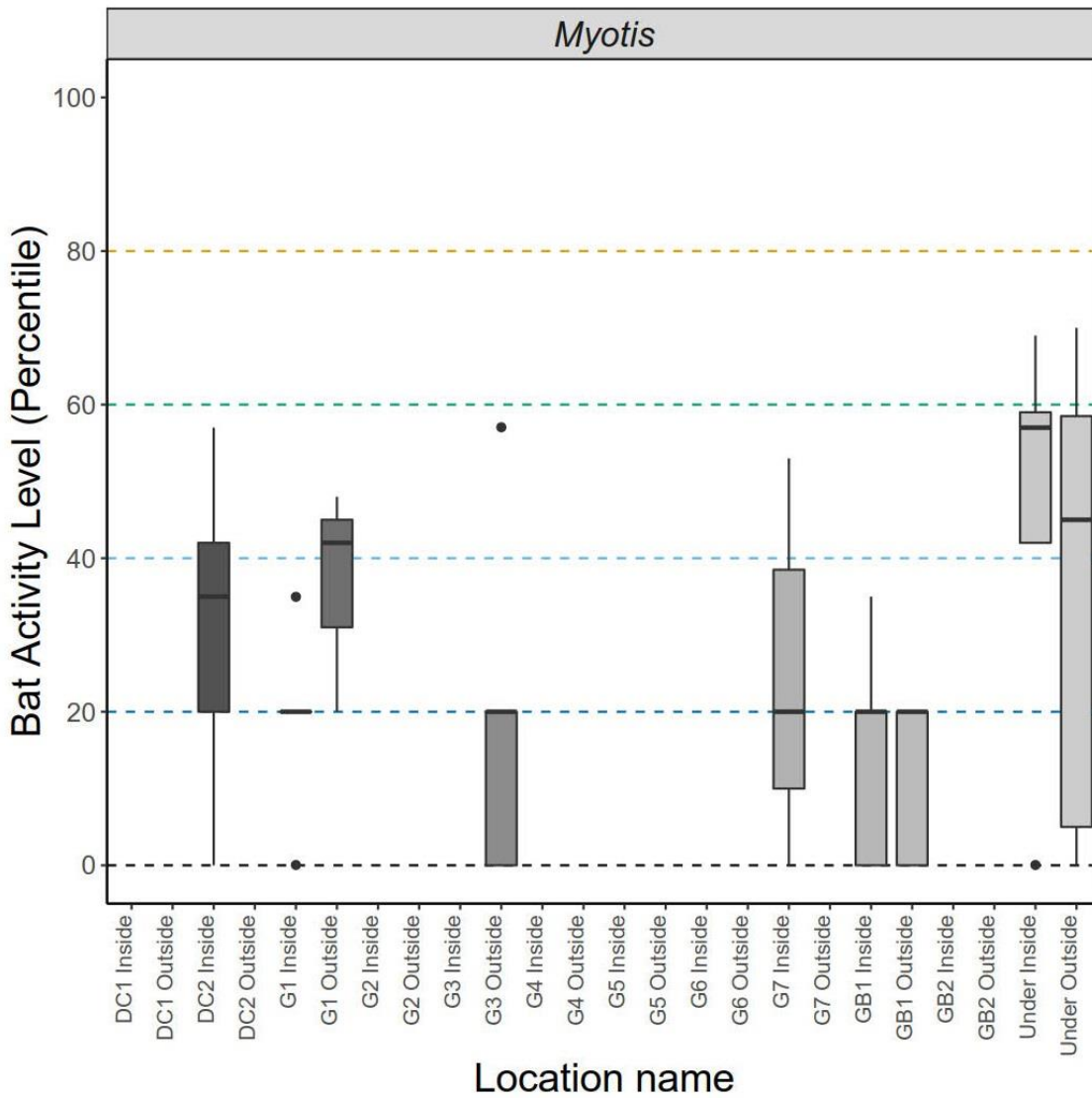
7.15 Differences in activity between static detector locations for Daubenton's bat



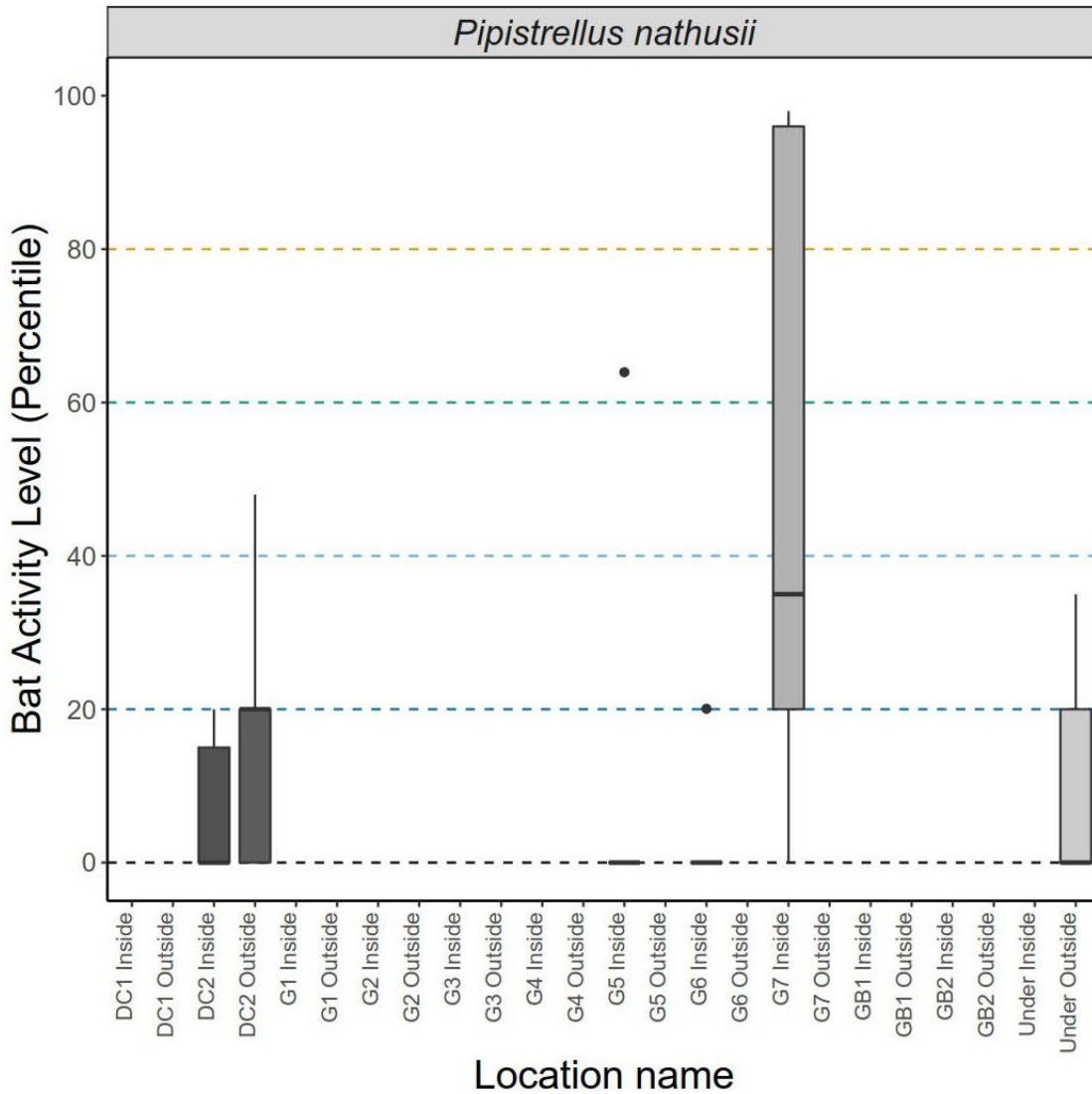
7.16 Differences in activity between static detector locations for Natterer's bat



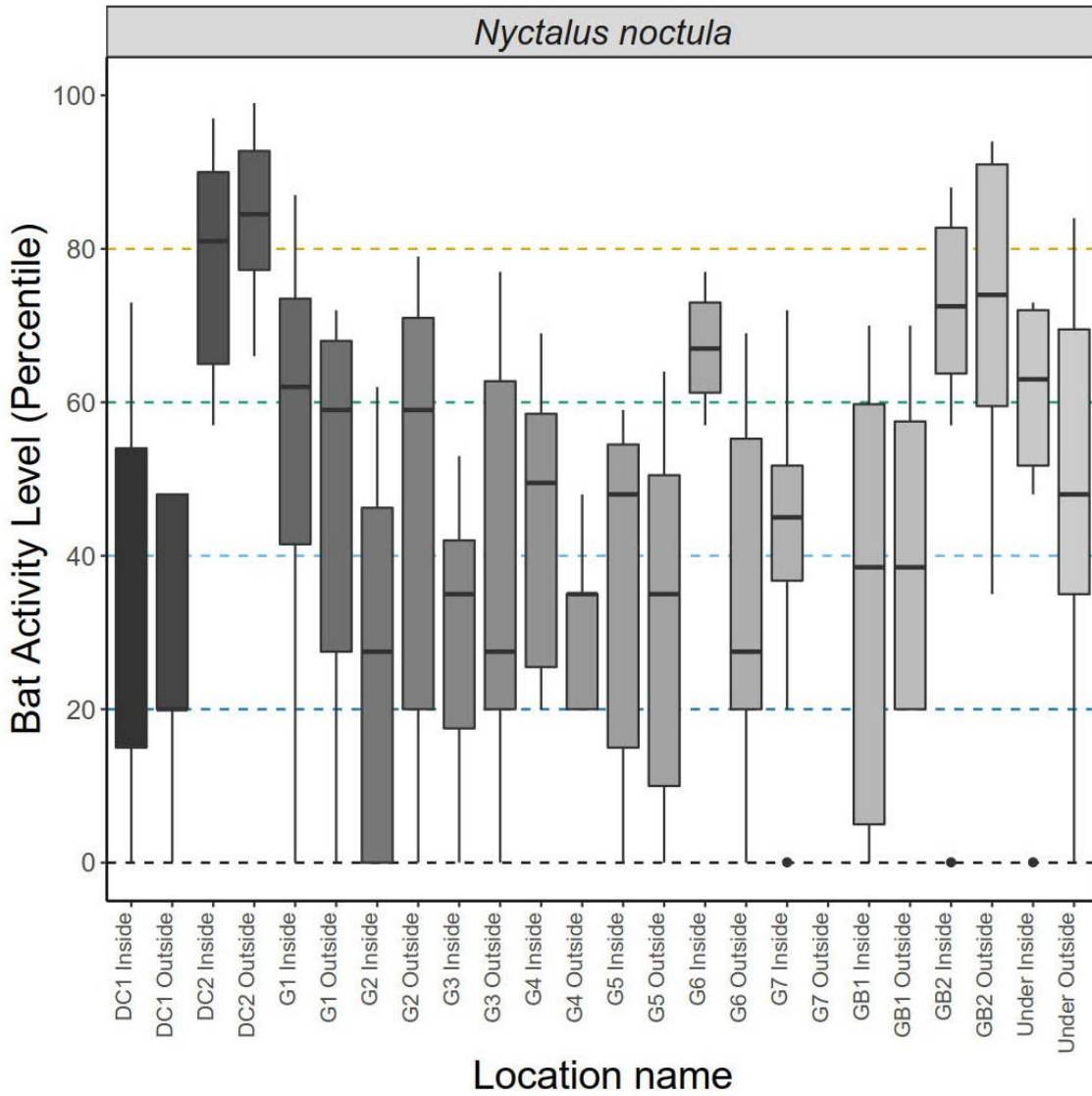
7.17 Differences in activity between static detector locations for *Myotis*



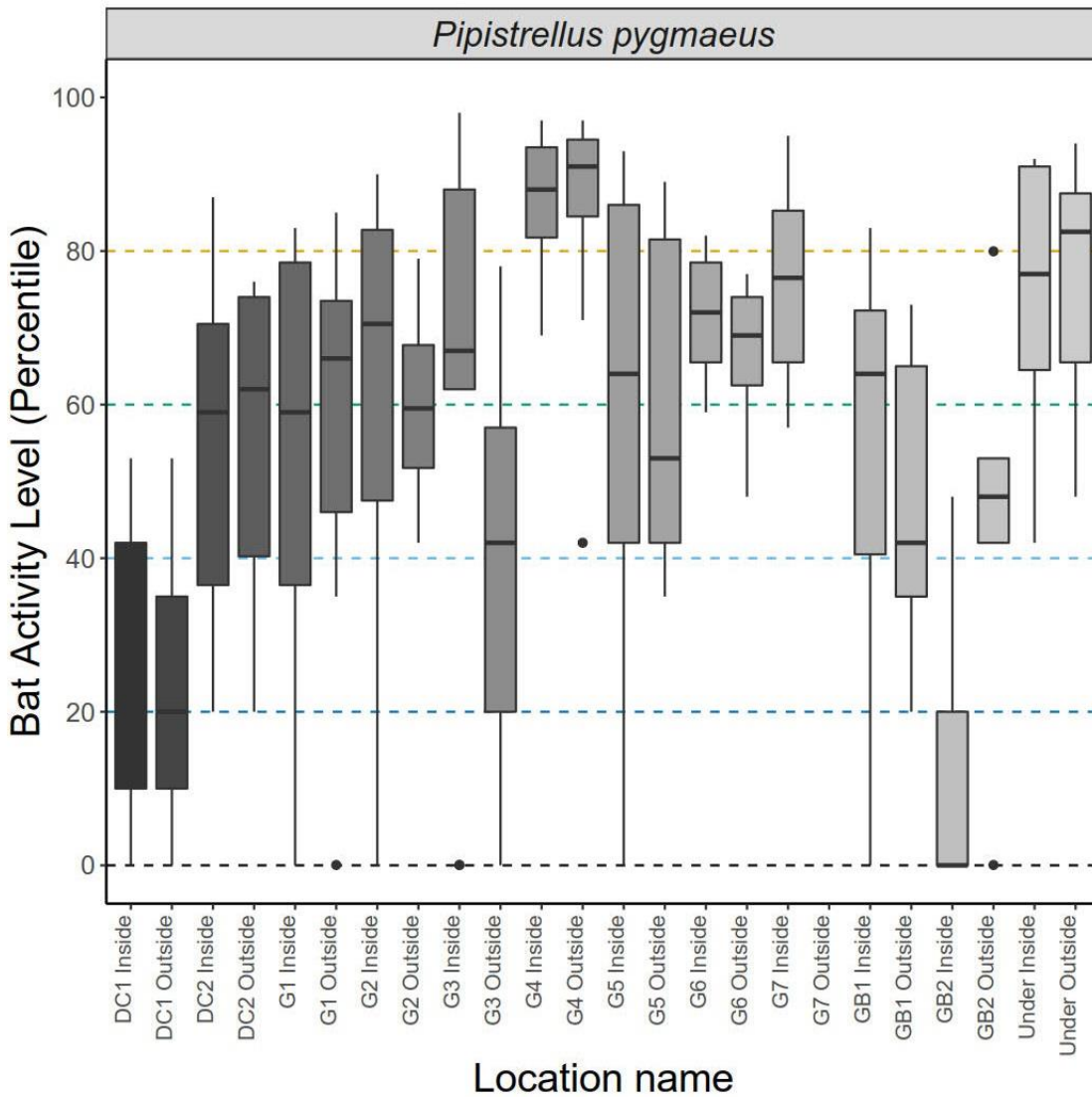
7.18 Differences in activity between static detector locations for *Nathusius' pipistrelle*



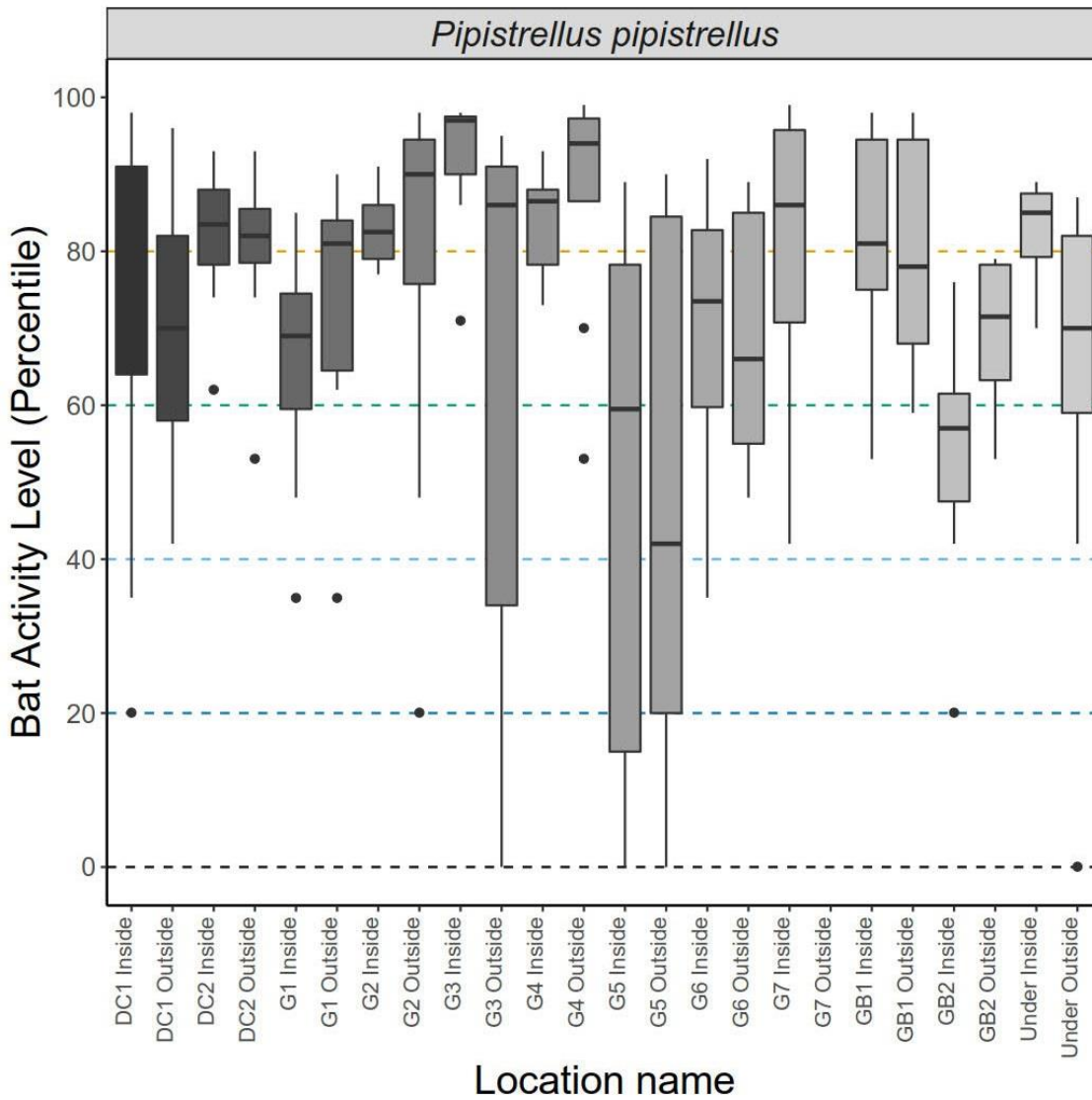
7.19 Differences in activity between static detector locations for noctule



7.20 Differences in activity between static detector locations for soprano pipistrelles



7.21 Differences in activity between static detector locations for common pipistrelles



7.22 Differences in activity between static detector locations for brown long-eared bats

