Norwich Western Link

Environmental Statement

Chapter 11: Bats

Appendix 11.7 Outline Bat Monitoring Strategy

Author: WSP UK Limited

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Glossary of Abbreviations and Defined Terms

Term	Definition
BAG	An independent Bat Advisory Group (BAG) was formed during 2021 to provide independent review and assessment of survey effort and approach, mitigation and compensation design, and share best practice, current research, and worked examples of mitigation and compensation during the pre-planning stages of the Proposed Scheme. The BAG will continue to serve during the planning, construction and operational phases of the Proposed Scheme. The group will review the results of monitoring and advise on, and agree, any remedial actions that may be required.
BCT	The Bat Conservation Trust (BCT) is a registered charity which works for the conservation of bats and their habitats within the UK. The BCT produces best practice guidance, notably for bat survey methodologies and standards.
BNG	Biodiversity Net Gain (BNG) is an approach to development and land management which aims to leave the natural environment in a measurably better state than before. Under the Environment Act 2021, most developments will be required to achieve a minimum 10% net gain for biodiversity, demonstrated using the Biodiversity Metric as published by Natural England.

Term	Definition
BNMMP	The Bat Noise Monitoring and Management Plan (BNMMP) for the Proposed Scheme will detail relevant measures and buffers to avoid and/or reduce the effects of higher-risk activities during construction, such as piling. This will include individual assessments for sensitive areas across the Proposed Scheme.
CEMP	The Construction Environmental Management Plan (CEMP) sets out effective site-specific procedures and mitigation measures to control and monitor environmental impacts throughout construction of the Proposed Scheme.
CIEEM	Chartered Institute of Ecology and Environmental Management is a membership body for ecologists and environmental managers within the UK and Ireland. CIEEM has produced best practice guidance relating to Environmental and Ecological Impact Assessments (EIA and EcIA), the production of Environmental Statements (ES).
CLMP	A Construction Lighting Management Plan (CLMP) will describe the measures that will be implemented to minimise the potential impacts on bats from lighting in line with best practice guidance. This is likely to include avoidance of night-time working in important areas, controlling the location and direction of lighting, and avoiding light spill over important bat habitats.

Term	Definition
Compensation Extent	The areas of environmental mitigation, compensation and enhancement, which fall within the Red Line Boundary and outside of the Site Boundary. This includes the land required for habitat creation, habitat improvement and installation / creation of bat mitigation features including bat boxes and veteran features and includes a number of existing woodland blocks, areas of arable / grass fields and existing hedgerows which will be subject to habitat improvement works. The compensation extent discussed within this chapter and associated appendices focuses on bat mitigation, compensation and enhancement. However, this bat Compensation Extent, falls within the Essential Environmental Mitigation Plan (detailed below).
Control Group	The Control Group refers to seven automated static detector locations (R1 to R7) that were installed in a range of habitats outside of the Site Boundary for the Proposed Scheme. The aim of these detectors was to collect data on habitats not directly impacted by the Proposed Scheme, to allow a comparison with habitats directly impacted.
CPO	A Compulsory Purchase Order (CPO) is a legal order which allows relevant authorities to acquire land or property without the consent of the owner, to support the delivery of developments in the public interest.

Term	Definition
EPS	European Protected Species (EPS) are those protected under the Conservation of Habitats and Species Regulations 2017 (as amended). Under this legislation it is an offence to deliberately capture, injure or kill any EPS, deliberately disturb an EPS, or to damage or destroy a breeding site or resting place. All UK Bat species are European Protected Species.
EPSML	A European Protected Species Mitigation Licence (EPSML) is required to be sought from Natural England for any activities reasonably likely to affect EPS in a manner that will result in an offence under the Conservation of Species and Habitats Regulations 2017 (as amended). The licence makes legal what would otherwise be an illegal activity.
EIA	An Environmental Impact Assessment (EIA) is a process for identifying and assessing the potential impacts of a proposed project or development. The requirement for an EIA is set out in the Town and Country Planning (Environmental Impact Assessment) Regulations 2017. Where an EIA is required, an Environmental Statement must be produced assessing the likely significant effects arising from the proposed scheme.
Essential Environmental Mitigation	Areas of environmental mitigation, outside the Site Boundary, as part of the overall package of environmental mitigation as part of the Proposed Scheme, as shown on the 'Essential Environmental Mitigation' plan (Document reference: 2.11.00)

Term	Definition
ES	An Environmental Statement (ES) summarises the findings of the EIA process. The ES produced for the Proposed Scheme details the likely significant effects arising from the Proposed Scheme.
FCS	Favourable Conservation Status (FCS) describes the situation in which a habitat or species is thriving throughout its natural range and is expected to continue to thrive in the future. At a local level, this is best viewed as the contribution to wider FCS for the species concerned (Natural England, 2021).
Fission-fusion behaviour	A widely reported behaviour in mammals, including bats, where social groups frequently split into subgroups (fission) and then regroup (fusion). In bats, this results in frequent roost-switching.
KPI	Key Performance Indicators (KPI) are a set of objectives and targets used to measure the success of the Proposed Scheme. In the context of the Proposed Scheme, KPIs are used to measure adherence to the Landscape Ecological Management Plan (LEMP),
LEMP	Landscape Ecological Management Plan (LEMP) sets out site specific procedures and processes for management for ensuring that habitats are created/enhanced according to programme and are establishing as expected.
NCC	Norfolk County Council (NCC) is the Local Planning Authority (LPA) for the Proposed Scheme.

Term	Definition
NVA	Night Vision Aids (NVAs) are tools which are used to assist with night vision during bat surveys. These may include night-vision cameras, infra-red cameras and thermal imaging. NVAs are used to aid views of potential roost features in the dark and provide clarity on emergence points and bat counts.
NWL	The Norwich Western Link (NWL) Road. The Proposed Scheme is a highway scheme linking the A1270 Broadland Northway from its junction with the A1067 Fakenham Road to the A47 trunk road near Honingham.
PRoW	Public Rights of Way (PRoW) are routes which the public has a legal right to pass along at all times, as defined under the Public Rights of Way Act 1990. Footpaths, bridleways, restricted byways and byways are examples of PRoWs.
Red Line Boundary	The Red Line Boundary incorporates the Site Boundary, the Essential Environmental Mitigation, and No Work Zones not within the Site Boundary, as shown on the 'Red Line Boundary Plan' (Document reference: 2.02.00).
Site Boundary	The areas within which all construction and operational activities for the Proposed Scheme will take place, including areas for temporary use during construction and No Work Zones within this boundary, but not including Essential Environmental Mitigation.

Term	Definition
'the Proposed Scheme'	This is a proposed new highway to link the A1270 Broadland Northway, from its junction with the A1067 Fakenham Road (to the north) to the A47 trunk road near Honingham (to the south).
TFL	Temporary Flightlines (TFLs) are structures put in place during construction to replace linear features that aided bats to move around the landscape and will be temporarily removed/disrupted. TFLs may take the form of planted hedgerows and tree lines, or the combined use of fencing and vegetation.

1 Introduction

1.1.1 This strategy sets out the monitoring required, as detailed within **Chapter 11: Bats** (Document Reference: 3.11.00) and to form the basis of what will be required to be undertaken as part of the EPSML for the Proposed Scheme. Relevant measures within this Strategy will also form part of the LEMP to be approved pursuant to a planning condition for the Proposed Scheme, where the monitoring will also assist in the achievement of monitoring outcomes above and beyond those required for licensing purposes.

1.1.2 Following approval of the LEMP by the CPA, the monitoring requirements will be agreed with Natural England during the application for the EPSML and form part of the EPSML conditions. The information submitted within this document is therefore for information purposes only.

1.2 Scope

1.2.1 This monitoring strategy identifies and / or provides guidance on the following, to ensure that the monitoring proposed is achievable:

- details of monitoring requirements, and how these will be undertaken (timings, methods, survey equipment and effort) to allow data collected to inform a predefined set of objectives;
- triggers for remedial action, and details of what these measures may be; and
- details of who will be responsible for completion of monitoring, and where and when results are to be reported.

2 Aims and objectives

2.1 Aims

2.1.1 This monitoring strategy aims to establish whether mitigation and compensation measures will be effective in maintaining the bat species present, including woodland specialists, at a favourable conservation status (FCS).

2.1.2 Details of the proposed mitigation and compensation measures are provided within **Appendix 11.6 Outline Bat Mitigation Strategy** (Document Reference: 3.11.06).

2.1.3 During- and post-construction monitoring are included in this strategy, and the results will be used to determine if remedial measures are required to ensure mitigation and compensation measures are effective and functioning as proposed. Any remedial measures will be implemented under the direction of the EPSML Named Ecologist and in consultation with Natural England as appropriate.

2.1.4 Monitoring methods and requirements should be reviewed periodically by the BAG and the Named Ecologist in light of future research findings, and amended where appropriate, subject to agreement with Natural England.

2.2 Objectives

2.2.1 To achieve the aims of the monitoring strategy, five objectives have been set, with details of how these will be achieved, as set out below.

- **Objective 1**: To ensure the distribution and breeding status of bat populations within the Red Line Boundary are stable (or improved) compared to pre-construction;
- **Objective 2**: To ensure that the mitigation ensures landscape permeability and safe crossing of the Proposed Scheme;

- **Objective 3**: To ensure that four currently known barbastelle colonies (confirmed as present during baseline surveys) remain or improve post-construction;
- **Objective 4**: To ensure that the bat populations within the Site Boundary are not adversely affected by the changes in the environmental conditions associated with the Proposed Scheme during and post-construction; and
- **Objective 5**: To ensure the effects of habitat change within the Red Line Boundary are beneficial to bat populations in the longer term.

2.2.2 The data collected to measure the achievement of these objectives will be analysed through a combination of statistical analysis and interpretation of data. Further details are provided below.

Table 2-1 Objectives and tests

Objective	Planned action	Success indicators	Survey methods
1. To ensure the distribution and breeding status of bat populations within the Site Boundary is stable (or improved) compared to pre-construction	Monitor the local occurrence, distribution, and breeding status of bat populations within the Red Line Boundary	• the baseline assemblage of bat species recorded using bat boxes and other mitigation features remains consistent with baseline data; and • species composition, distribution, and breeding status of the bat assemblage remains consistent with baseline data.	• bat box checks; • monitoring veteran feature creation in trees, inclusive of hand netting a small number of individuals to assess breeding status; • bat trapping and radio-tracking; • roost counts of retained roosts; and • automated static detector monitoring.
2. To ensure that the mitigation ensures landscape permeability and safe crossing of the Proposed Scheme	Monitor the crossing structures/features created, and the associated flightlines and commuting route usage	• bats are using each feature / structure ('use' defined in later text), in numbers which are similar to baseline use; and • bats are crossing the road at a 'safe' height, as confirmed using a night vision aid (NVA).	• vantage / crossing point surveys.
3. To ensure that four currently known barbastelle colonies (confirmed as present during baseline surveys) remain or improve post-construction	Monitor any changes in use of the wider landscape by the extant bat population	• continuation of barbastelle use of core and peripheral zones and core sustenance zones recorded during the baseline; • no decline in the proportion of captured barbastelle identified as breeding in any year; and • no decline in barbastelle using the River Wensum for foraging and commuting (relative activity levels are consistent with baseline).	• bat trapping and radio-tracking surveys; and • automated static detector monitoring.

Objective	Planned action	Success indicators	Survey methods
4. To ensure that the bat populations within the Site Boundary are not impeded by the changes in the environmental conditions associated with the Proposed Scheme both during and post-construction	Monitor the environmental conditions associated with the Proposed Scheme both during construction and post-construction	• no decline in the baseline bat species assemblage due to lighting, noise and/or vibration during construction and operation.	• weather monitoring; and • lighting, noise, and vibration monitoring at Temporary Flightlines (TFL), crossing structures, landscape treatment areas and retained roosts.
5. To ensure the effects of habitat change within the Red Line Boundary are beneficial to bat populations within the Site Boundary in the longer term	Monitor changes in retained and created habitat within the Red Line Boundary	• Habitat creation in place and meeting Key Performance Indicators (KPIs) as described in the Landscape Ecological Management Plan (LEMP)	• habitat monitoring as outlined in the LEMP.

2.3 Survey methods

2.3.1 Survey methods listed within **Table 2-1** will be completed in line with the baseline surveys (as far as is practicable during construction), to generate comparable data. Survey methods are detailed within **Appendix 7a** (Document Reference: 3.11.07a).

Future-proofing

2.3.2 As monitoring surveys will take place over a span of ten years post-construction, it is likely that new survey technologies, methodologies and guidance will emerge. This monitoring strategy has been produced in line with current guidance, technology, and accepted methods at the time of writing. As changes are introduced, these will be adopted if they are considered more appropriate or cost-effective, at the discretion of the EPSML Named Ecologist and Natural England. At the time of writing, revisions to bat survey guidelines (general and infra-red specific), bat mitigation guidelines, bats and lighting guidance and a EUROBATS publication on bats and roads are all anticipated in 2023. When changes are proposed that affect equipment capabilities, efforts will be made to calibrate new results against old, to ensure comparability (this may require an element of doubling-up using two sets of equipment).

3 Timeframes

3.1.1 A summary of the monitoring proposed is provided in **Table 3-1** below, and the locations of all features to be monitored are shown on **Figure 11.27, Appendix 10 (Document Reference: 3.11.10)**.

3.1.2 To set a baseline for the high-frequency noise monitoring, the collection of high-frequency unweighted noise measurements will be considered in 2024, ahead of construction commencing. This will be specified within the BNMMP.

3.1.3 Monitoring will commence during the construction stage and will continue for a minimum of ten years post-construction; monitoring activities may start at different times during this period. For this monitoring strategy, the post-construction monitoring timeframe will commence following the completion of all landscape planting.

Potential for extension

3.1.4 The results gathered during the ten-year post-construction monitoring period will inform the requirement for any monitoring beyond this. The need for any extension (and the scope required) should be established within three months of the Year 10 survey being reported.

3.1.5 A continuation of the bat survey methods specified here would only be required if any objectives remained unmet and/or remedial actions to address this had not been satisfactorily implemented.

3.1.6 It should be noted that habitat condition monitoring will be required over a longer duration where this contributes towards Biodiversity Net Gain (BNG) requirements.

Table 3-1 Monitoring timeframes

Objective	Monitoring activity	C0	C1	C2	O1	O2	O3	O4	O5	O10
1	Bat box validation / counts	Yes	Yes	Yes	Yes	Not applicable	Yes	Not applicable	Yes	Yes
1	Veteran features validation / counts	Yes	Yes	Yes	Yes	Not applicable	Yes	Not applicable	Yes	Yes
1	Retained roost monitoring	Not applicable	Yes	Yes	Yes	Not applicable	Yes	Not applicable	Yes	Yes
1, 3	Trapping	Not applicable	Not applicable	Yes	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
1, 2, 3	Trapping and radio-tracking	Not applicable	Not applicable	Not applicable	Yes	Not applicable	Yes	Not applicable	Yes	Yes
3	Habitat condition (from year of habitat creation)	Not applicable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	Automated detector monitoring – all locations	Not applicable	Not applicable	Yes	Yes	Not applicable	Yes	Not applicable	Yes	Yes
2	Manned crossing point surveys – TFLs (from year of feature creation). To extend into operation if still in place.	Yes	Yes	Yes	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
2, 3	Manned crossing point survey – permanent	Not applicable	Not applicable	Not applicable	Yes	Yes	Yes	Yes	Yes	Yes
4	Noise Monitoring Baseline - Ad hoc monitoring of construction activities where unweighted high-frequency data are not available from other sources.	Yes	Yes	Yes	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
4, 5	Environmental monitoring	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Monitoring Year (C=Construction, O=Operation)

3.2 Construction monitoring

3.2.1 The locations of all features to be monitored are shown on **Figure 11.27 (Document Reference: 3.11.10)**.

Year C0

3.2.2 Year C0, the first calendar year in which construction activities occur, includes enabling works such as advanced vegetation clearance, haul road construction and compound installation.

3.2.3 During C0, monitoring will consist of the following:

- as existing flightlines are cleared, TFLs to provide temporary crossing features will be installed, and monitored with the aid of night vision aids (NVA) (from the start of the next 'bat active' season, if bats not active at the time of installation). This will comprise manned crossing point surveys once per week once installed, between May and September, or until 'use' has been confirmed or an alternative commuting route identified. The Named Ecologist will monitor the results, design and wider bat movements, allowing the survey commitment to be defined;
- validation surveys for bat boxes and veteran features, to ensure they have been installed / created as specified; and
- collection of environmental data targeted as required and defined by the EPSML Named Ecologist, inclusive of the decision on the locations of any weather monitoring stations.

Year C1

3.2.4 During C1, monitoring will consist of the following:

- TFL surveys, as set out in C0, unless use has been demonstrated and no wider changes to habitat have occurred. Monitoring will be reinstated if the context around a TFL has significantly changed and could compromise effectiveness (e.g. additional vegetation removal);

- surveys of retained maternity, hibernation and Annex II retained roosts to determine if used by bats, for the same purpose and by similar numbers of bats;
- validation surveys for any additional bat boxes and veteran features, to ensure they have been installed / created as specified;
- environmental data collection; and
- assessments of areas of habitat creation, to ensure planting is establishing as per LEMP.

Year C2

3.2.5 During C2, monitoring will consist of the following:

- TFL surveys, as set out in C1;
- automated detector surveys of pre-determined areas within the Red Line Boundary, and control ('R') locations located outside of Red Line Boundary;
- bat trapping at pre-determined locations, including bat ringing. No radio-tracking surveys will be undertaken due to construction constraints that will impede safe passage of surveyors;
- monitoring of maternity, hibernation and Annex II retained roosts, as set out in C1;
- monitoring of bat boxes installed as compensation for the Proposed Scheme, to undertake counts for presence of bats and / or evidence of bats;
- inspection of veteran features to verify they have all been created, and look for evidence of use;
- environmental data collection; and
- assessment of areas of habitat creation as for C1.

3.3 Operation monitoring

Year O1

3.3.1 During O1, monitoring will consist of the following:

- manned crossing-point surveys at all relevant mitigation structures once per month between May and September (inclusive). This will include the monitoring of any TFLs still in place, where vegetation is not fully established;
- automated detector surveys as set out for C2;
- bat trapping and radio-tracking surveys at pre-determined locations, including bat ringing and bat roost counts;
- monitoring of maternity, hibernation and Annex II retained roosts, as set out for C1;
- monitoring of bat boxes, as set out for C2;
- monitoring of environmental conditions; and
- assessment of areas of habitat creation, as for C1.

Year O2

3.3.2 During O2, monitoring will consist of the following:

- manned crossing-point surveys at all relevant mitigation structures once per month between May and September (inclusive). This will include the monitoring of any TFLs still in place, where vegetation is not fully established;
- environmental data collection; and
- areas of habitat creation will be monitored to ensure planting is establishing as per Landscape Ecological Management Plan (LMEP) specification.

Year O3

3.3.3 During O3, monitoring will consist of the following:

- manned crossing-point surveys at all relevant mitigation structures once per month between May and September (inclusive). This will include the monitoring of any TFLs still in place, where vegetation is not fully established;
- bat trapping and radio-tracking surveys at pre-determined locations, including bat ringing and bat roost counts;
- automated detector surveys, as set in for C2;
- monitoring of maternity, hibernation and Annex II retained roosts, as set out in C1;
- monitoring of bat boxes, as set out for C2;
- monitoring of environmental conditions; and
- assessment of areas of habitat creation, as for C1.

Year O4

3.3.4 During O4, monitoring will consist of the following:

- manned crossing-point surveys at all relevant mitigation structures once per month between May and September (inclusive). This will include the monitoring of any TFLs still in place, where vegetation is not fully established;
- monitoring of environmental conditions; and
- assessment of areas of habitat creation, as for C1.

Year O5

3.3.5 During O5, monitoring will consist of the following:

- manned crossing-point surveys at all relevant mitigation structures once per month between May and September (inclusive). This will include the monitoring of any TFLs still in place, where vegetation is not fully established;
- automated detector surveys, as set out for C2;
- monitoring of maternity, hibernation and Annex II retained roosts, as set out in C1;
- monitoring of bat boxes, as set out for C2;
- monitoring of the development of veteran features;
- monitoring of environmental conditions; and
- assessment of areas of habitat creation, as set out for C1.

Year O10

3.3.6 During O10, monitoring will consist of the following:

- manned crossing-point surveys at all relevant mitigation structures once per month between May and September (inclusive). This will include the monitoring of any TFLs still in place, where vegetation is not fully established;
- automated detector surveys, as out for C2;
- bat trapping and radio-tracking surveys at pre-determined locations, including bat ringing and bat roost counts;
- monitoring of maternity, hibernation and Annex II retained roosts, as set out in C1;
- monitoring of bat boxes, as set out for C2;

- monitoring of veteran features to check for use by bats;
- monitoring of environmental conditions; and
- assessment of areas of habitat creation as for C1.

4 Constraints

4.1 Access

4.1.1 Locations for monitoring, particularly trapping, automated static monitoring, and emergence surveys, may not be available in all the years in which it is proposed to carry out these surveys. Refusal of access may reduce the amount of biometric data, information on breeding conditions, information on long-term patterns in roost occupancy and how bats are utilising the landscape, as well as roost sizes.

4.1.2 Limited access could also reduce the confidence of the triangulated position of bats during radio-tracking surveys, resulting in some roosting locations not able to be identified, and lower numbers of more accurate joint fixes when radio-tracking. This would also occur where the radio signal of tagged bats is lost due to bats being out of range on third-party land.

4.1.3 All locations proposed for monitoring have been accessible during the baseline surveys, with no new areas of land proposed for monitoring. However due to the long-term nature of this monitoring strategy, there may be changes in land ownership. Norfolk County Council (NCC) will undertake all reasonable effort to maintain relations with landowners to enable monitoring to continue, and agreements are to be secured as part of the planning application for the Proposed Scheme, including CPO powers being utilised if necessary. These agreements are to include land access for monitoring, management and maintenance requirements over the period detailed within this document.

4.1.4 Risks associated with access constraints have been minimised through the following elements of the monitoring strategy:

- a number of locations for each survey type has been recommended to obtain representative information on bat behaviour should part of the Red Line Boundary be inaccessible for a period of time;
- multiple survey methods are proposed to monitor bat behaviour, distribution, and abundance in different ways to complement and provide context for each of the other surveys (important as all provide different 'snapshots');
- radio-tracking data will be obtained by undertaking multiple joint bearings and triangulating the points from outside any inaccessible areas using accessible areas and public roads. This will provide a reasonably accurate estimate of the bat location and flight; and
- environmental data can be obtained from meteorological measurements at local weather stations.

4.2 Weather

4.2.1 All monitoring surveys are to be undertaken in suitable weather conditions, with surveys terminated and rearranged if unsuitable, based on BCT best practice guidance (Collins 2016, or future revisions) and professional judgement of the EPSML Named Ecologist.

5 Roles and responsibilities

5.1.1 The EPSML Named Ecologist will be responsible for:

- overseeing implementation of mitigation measures;
- ensuring licence commitments are met;
- reviewing monitoring results and ensuring that data has been collected as per the methodology (or sufficient justification provided for any deviation);
- providing a summary of the monitoring results to the Licensee, along with recommendations for any remedial measures that may be required; and
- reporting monitoring results to Natural England, as per agreed reporting timeframes.

5.1.2 The EPSML Licensee is responsible for:

- ensuring that all activities carried out on site comply with the terms and conditions of the licence;
- ensuring that the monitoring is implemented in full, by ensuring funding and securing access; and
- ensuring any remedial measures are funded and implemented under guidance from the EPSML Named Ecologist.

5.1.3 The Contractors are responsible for:

- ensuring that bat mitigation is installed as **per Appendix 11.6 Outline Bat Mitigation Strategy**, or subsequent EPSML updates;
- ensuring that environmental conditions, in particular noise and light spill during construction, are measured, and any restrictions adhered to as per the standards set out within the Outline Construction Environmental Management Plan (OCEMP), Construction Lighting Management Plan

(CLMP) and, for noise, within the Bat Noise Management and Monitoring Plan (BNMMP);

- ensuring that temporary lighting during construction is as per the CEMP; and
- complying with the related LEMP.

5.1.4 Private landowners, where mitigation is installed by agreement, are responsible for adhering to any agreements made.

5.1.5 In the event that any land parcel that was subject to the Compulsory Purchase Order (CPO) is transferred back to the landowner or a third party prior to the completion of the initial maintenance period, then the requirement to undertake these maintenance tasks and allow access for monitoring will be similarly transferred by legal agreement.

5.1.6 The Applicant (or their appointed agent) will otherwise be responsible for long-term habitat management within the Red Line Boundary.

5.1.7 All of the aforementioned parties will be responsible for understanding what the licensable works and commitments entail once the EPSML is granted, and for compliance with those requirements relevant to them. If a breach occurs, Natural England must be informed by the EPSML Named Ecologist (or their delegate) within 48 hours of the Licensee becoming aware of a breach occurring. Following this, unless advised otherwise by Natural England, the Licensee will take the necessary steps to address any breaches or poor practice identified as soon as practicable.

6 Analysis and review

6.1.1 Data collected from monitoring surveys will be reviewed and analysed statistically, where appropriate, in accordance with the objectives outlined above in Section 2. Clear objectives have been set below, and these will be tested through statistical analysis of monitoring data.

6.2 **Objective 1: To ensure the distribution and breeding status of bat populations within the Red Line Boundary are stable (or improved) compared to pre-construction**

6.2.1 Roost count data from bats radio-tracked back to roosts will provide an indicator of the status of species tracked. This method is the most reliable, given that woodland bats (which includes barbastelle) are known to exhibit roost switching and fission-fusion behaviour (temporary splitting into subgroups). However, numbers of bats often remain consistent when switching during the breeding season, and the overall results will be used to estimate population size within the roost resource ('the woodland') rather than identifying individual roosts 'lost' should no bats be recorded in any one tree at any one time.

6.2.2 Surveys at known maternity roosts and bat box counts may also give an indication of the number of juveniles in the colony, and from these, a measure of reproductive success estimated. Multiple years of data will be plotted to show long-term trends.

6.2.3 Bat trapping surveys will provide data on species composition, distribution, and breeding status of the bat assemblage. Changes between the data collected and baseline data may show long-term trends. Additionally, the radio-tracking surveys will aid in finding maternity roost trees and inform data collection on roost counts, feeding into the information detailed above.

6.2.4 Static detector recordings will give an indication of the species composition and relative activity levels pre- and post-construction. Multiple years of data will be plotted to show long-term trends.

6.2.5 Where changes in bat assemblage suggest a decline year-on-year compared with pre-construction baseline levels, and where the decline cannot be explained by other environmental variables, such as temperature or changes in land use or management, then this may indicate an adverse effect on populations of the target species because of the Proposed Scheme. However, such changes are only likely to be discernible over a number of years. It is important to note that adverse weather (e.g. extreme heat) may have more severe and immediate effects on breeding success over shorter timescales but are likely to be apparent from data collected across the UK.

6.3 Objective 2: To ensure that the mitigation ensures landscape permeability and safe crossing of the Proposed Scheme

6.3.1 Bat use of TFLs during construction and safe crossing-points during operation will establish the effectiveness of mitigation in maintaining connectivity at key points. The use of night vision aids will allow for numbers and species of bats using the flightlines to be collected, to include an indication of behaviour (flight height etc). Information on barbastelle home ranges and core foraging areas will be assessed through radio-tracking.

6.3.2 Data obtained will answer questions such as:

- Are bats using flightlines (TFLs or permanent) to cross the Proposed Scheme in similar numbers (and species) in comparison to the baseline at each key location?
- Is a high proportion of bats crossing the Proposed Scheme safely, i.e., in a way that is unlikely to result in vehicle collisions?

6.3.3 Bat ‘use’ of flightpaths will be as described within the Defra Protocol (Berthinussen and Altringham, 2015). This is defined as bats flying over or within 5m of a green bridge, or bats flying through an underpass to commute. For areas where landscape features have been designed to aid bat crossing, definitions of ‘use’ detailed above would not apply (given the extent of each treatment, there is no specific point at which a definition of ‘use’ can be

applied). Data collected through radio-tracking will indicate broad locations of where bats have crossed the Proposed Scheme, however no information on whether bats have safely crossed the Proposed Scheme can be indicated through radio-tracking data.

6.3.4 'Safe' and 'unsafe' crossing heights are defined as being greater and less than 5m above the road surface respectively for green bridge and areas of landscape treatments designed for bat crossings. The maximum height for heavy goods vehicles in the UK is 4.95 metres (The Road Vehicle (Construction and Use) Regulations 1986); bats crossing the road below 5 metres are therefore at risk of collision (Berthinussen and Altringham, 2015). For underpasses, 'Safe' and 'Unsafe' is defined as bats using the underpass structure to cross under the road, or flying above the road, regardless of height of the crossing.

6.3.5 The 'use' of features will be assessed for all bats, and for each 'species' group, through cross referencing NVA-supported results with recording handheld bat detectors.

6.3.6 Statistical tests will follow those outlined within the Defra Protocol for monitoring landscape-scale effects of linear infrastructure (Berthinussen and Altringham, 2015).

6.4 Objective 3: To ensure that four currently known barbastelle colonies (confirmed as present during baseline surveys) remain or improve post-construction

6.4.1 Changes in how the barbastelle colonies are using the habitats present within and outside of the Red Line Boundary will be assessed using radio-tracking surveys, crossing-point surveys, and automated static monitoring surveys.

6.4.2 Data obtained will seek to answer the following questions:

- Are all the pre-construction barbastelle colonies still present, including breeding individuals?
- Are core sustenance and peripheral zones broadly unchanged? Or:

  - Has there been a reduction in size, or a shift of important foraging areas?
  - Have the core sustenance and peripheral zones increased in size?
  - Have new key commuting routes been adopted, and are these 'safe' or 'unsafe')?

- Are retained habitats still being used to the same extent as pre-construction?
- Are newly created habitats being used for foraging, commuting and / or roosting?
- Are bats continuing to utilise the River Wensum for foraging and commuting to the same extent as pre-construction?

6.5 **Objective 4: To ensure that the bat populations within the Site Boundary are not adversely affected by the changes in the environmental conditions associated with the Proposed Scheme both during construction and post-construction**

6.5.1 Variables such as humidity, temperature, rain, and wind will be continually monitored at locations to provide accurate data. Environmental changes that occur early in the year can have an impact on bat populations later in the year, for example, a very cold and wet spring could have implications on breeding success / productivity. Very hot weather can cause juvenile mortality.

6.5.2 Other environmental variables such as light levels, noise and vibration are likely to have more localised effects, and measurements will be more targeted to certain times or during certain activities, such as piling works. This data will be used to check whether any changes in environmental parameters are correlated and possibly causative to any significant changes in behaviour or activity levels.

6.5.3 Unweighted high-frequency noise (~5kHz and above) data will be collected at sensitive locations during construction activities likely to generate high levels of noise, primarily to check that noise impact assessment assumptions remain valid. These details will be defined within the BNMMP.

6.5.4 No monitoring of lighting will be undertaken as part of this strategy. Lighting during construction will be agreed within the CLMP, and details are to be provided by the contractor. Prior to construction, the lighting detail within the CLMP will be reviewed by the EPSML Named Ecologist and will form part of the EPSML. Where an assessment of light levels is required for remedial measures, information from the contractor will be required (see Table 6-1).

6.6 Objective 5: To ensure the effects of habitat change within the Red Line Boundary are beneficial to bat populations within the Site Boundary in the longer term

6.6.1 Changes to habitats will be both negative (i.e., habitat loss) and positive (i.e., habitat creation / enhancement), but in the longer term there will be an overall increase in available foraging resource. These changes will be aided by maintenance of connectivity / landscape permeability through the replacement / establishment of flightlines.

6.6.2 Adherence to the LEMP will ensure that habitats are created / enhanced according to programme and establish as expected to meet the LEMP KPIs.

6.6.3 The response of bats to these changes will be measured as part of Objectives 1, 2 and 3.

6.6.4 This objective is set out separately to ensure that any remedial actions required to address adverse effects on bat populations (in addition to any required in the LEMP)) are recognised and implemented.

6.7 Assessing success

6.7.1 The success of different mitigation measures will be evident at different stages of the project. It may be possible to determine that TFLs are effective (or conversely, require immediate remedial action) in a very short timeframe. However, most measures will require consideration at bi-annual intervals, i.e., in the context of seasonal data. That said, monitoring data should be analysed regularly and reported annually, with the need for remedial measures determined under the direction of the EPSML Named Ecologist.

6.7.2 The independent Bat Advisory Group (BAG) will review the monitoring results and agree remedial actions (unless minor). The BAG will meet with the EPSML Named Ecologist at least biannually during construction and within Years 1 and 2 of operation, and annually during the remaining years of monitoring until year of operation 5. The BAG will also reconvene in year 10 of operation to consider the performance of the bat mitigation measures.

6.7.3 Assessment of success will be fed back to Natural England through interim licence returns. **Table 6-1** below outlines possible scenarios and remedial measures.

Table 6-2 Preliminary proposals for remedial measures to address changes in bat behaviour

Objective	Success measure	Survey methods	Expectations / tests	Indicative proposed remedial measures if tests not met
Objective 1: To ensure the distribution and breeding success status of bat populations within the Red Line Boundary is stable (or improved) compared to pre-construction	• the baseline assemblage of bat species recorded using bat boxes and other mitigation features remains consistent with baseline data • species composition, distribution, and breeding status of the bat assemblage remains consistent with baseline data.	• bat box checks	• bat box checks to record the same species as pre-construction; encounter rates increase over time as the boxes are adopted	• review the locations (and, over time, the condition) of bat boxes, and move them if appropriate. This remedial action would be informed by other survey techniques / findings. NB: it will take time for boxes to become adopted, so the remedial action should only be considered after boxes have been in place for at least three years.
Objective 1: As above	Success Measures as above	• veteran feature monitoring in trees, inclusive of hand netting a small number of individuals to assess breeding status	• veteran features are being used; at least some are used by breeding bats	• compare use of bat boxes with use of veteran features and levels of relative activity (static detectors) to ensure features are in the right areas of woodland. • If not, consider additional boxes and / or veteranisation. NB: it will take time for veteran features to become adopted, so the remedial action should only be considered after features have been in place for at least ten years.
Objective 1: As above	Success Measures as above	• bat trapping	• trapping records the same species as pre-construction with similar encounter rates	• if species are 'missing', or much more rarely encountered than at pre-construction, consider widening the area trapped. Use levels of relative activity (static detectors) to inform trapping location decisions; and • if species are present, but breeding appears less successful (smaller proportion of pregnant females or juvenile recruitment), review national / regional trends and environmental data to see if this is a scheme issue or a broader issue (in particular, climate-related).

Objective	Success measure	Survey methods	Expectations / tests	Indicative proposed remedial measures if tests not met
Objective 1: As above	Success Measures as above	• roost counts of retained roosts	• use of retained roosts is consistent with pre-construction levels of use [note – this would be assessed across the roost resource, as not all tree roosts will be consistently re-used, particularly where features used were fragile]	Woodland bats often exhibit fission-fusion behaviour, switching between roosts within the overall roost resource available. Therefore, the lack of reoccupation of a previously known roost should not be seen as a loss of roost as they may be roosting in the wider roost resource, but can be used as a confirmation of presence. Therefore, loss of a singular roost should not be seen as a requirement for remedial action. Given the above, an assessment of roost resource across the Site Boundary should completed. • an assessment by the EPSML Named Ecologist of working methodologies and working hours in proximity to a higher conservation significance roost (to be revised if appropriate); • contractor to provide specific information in relation to noise from works in the vicinity of an important roost to the EPSML Named Ecologist for review; • review by the EPSML Named Ecologist of the changes in conditions surrounding an important roost pre-construction and during construction, to understand the extent of vegetation clearance to review if this has been undertaken in agreement with buffers and flightlines; and • TFLs may be installed to rectify temporary changes in roost access. NB: High conservation significance roosts are considered to be any Annex II species roost (excluding feeding perch), maternity or hibernation roost.

Objective	Success measure	Survey methods	Expectations / tests	Indicative proposed remedial measures if tests not met
Objective 1: As above	Success Measures as above	• automated static detector monitoring	• static detectors record the same suite of species and similar levels of relative activity as pre-construction	• review of data to determine factors that may have decreased bat activity in particular location(s). Where a decrease has been noted, activity will be reviewed throughout the Red Line Boundary to establish if there are increases in activity at some locations that may account for decreases in others; • review of construction activities, to determine factors that may have deterred bat activity in affected locations; and • a review of noise data collected to provide assurance that noise levels are as predicted by the noise impact assessments and determine if any associated mitigation / restrictions are adequate or need modifying.

Objective	Success measure	Survey methods	Expectations / tests	Indicative proposed remedial measures if tests not met
Objective 2: To ensure that the mitigation ensures landscape permeability and safe crossing of the Proposed Scheme	• bats are using each feature / structure ('use' defined), in numbers which are similar to baseline use • bats are crossing the road at a 'safe' height, as confirmed using an NVA	• vantage / crossing point surveys	• bats are following the TFLs and therefore their commuting routes are maintained noting that: • bat activity varies, even in the absence of construction; and • bats may prefer to use alternative (existing) commuting routes that they are familiar with in preference to TFLs.	Assess reasons for TFLs not being used, such as: • TFL is not installed as designed or connected to adjacent habitats; • TFL is subject to noise or lighting disturbance (contractor to provide data); and / or • bats are using alternative existing commuting route (requires additional survey). If either or both of the first reasons apply: • a review of the type(s) of TFL in use, and if alterations are required; • review of working hours and construction methodology in the vicinity of the TFL. If there are no deficiencies or likely sources of disturbance, consider augmenting the TFL design / height / location. Otherwise, consider revised or further survey to determine how / where bats are commuting during construction, and complete further analysis if required to inform permanent mitigation measures.

Objective	Success measure	Survey methods	Expectations / tests	Indicative proposed remedial measures if tests not met
Objective 2: As above	• bats are using each feature / structure ('use' defined), in numbers which are similar to baseline use • bats are crossing the road at a 'safe' height, as confirmed using an NVA	• vantage / crossing point surveys	• 90% of bats are recorded / observed using the green bridges / underpasses. This test could be failed in two ways: • bats are not using the green bridge and underpass, but are not crossing unsafely (i.e., bats are no longer using this commuting route); and / or • bats are using this commuting route but crossing unsafely	Assess reasons for <90% bats observed not 'using' the green bridge and underpass, such as: • green bridge is not installed as designed; • vegetation is in place but not sufficiently mature and / or not adequately connected; • green bridge and underpass are subject to noise and lighting disturbance because construction is not complete (contractor to provide data); and / or • bats are using alternative existing commuting route (requires additional survey). The remedial actions will be determined by the reasons for failure of the specified test. This may include: • rectifying deficiencies in planting or establishment (replacing dead plants); • amending maintenance to account for weather, e.g., watering regime; • strengthening of landscape planting to augment connectivity; and / or • removal of barriers to crossing (sources of disturbance).

Objective	Success measure	Survey methods	Expectations / tests	Indicative proposed remedial measures if tests not met
Objective 3: To ensure that four currently known barbastelle colonies (confirmed presence during baseline surveys) remain or improve post-construction	• retention of barbastelle use of core and periphery zones and core sustenance zones recorded during the baseline; • no decline in barbastelle breeding status; and • no decline in barbastelle using the River Wensum for foraging and commuting (relative activity levels are consistent with baseline).	• radio-tracking surveys	• trapping records barbastelle in the same locations and approximately the same encounter rates as pre-construction; • baseline core sustenance and peripheral zones are largely unchanged, and there is no evidence that any colony has 'disappeared'; • breeding barbastelle are trapped; and • barbastelle are continuing to use the River Wensum for foraging and commuting (relative activity levels are consistent with baseline).	• review of data collected and comparisons between core and peripheral zones, review alongside weather and other environmental factors (Objective 4 and 5); and • review data alongside crossing point monitoring results, to determine whether trends are present across both Objective 2 and Objective 3. Remedial measures are as per Objectives 2, 4 and 5.
Objective 3: As above	Success Measures as above	• automated static detector monitoring.	• static detectors record similar levels of barbastelle relative activity as pre-construction	Remedial measures as per automated static detector monitoring in Objective 1

Objective	Success measure	Survey methods	Expectations / tests	Indicative proposed remedial measures if tests not met
Objective 4: To ensure that the bat populations within the Red Line Boundary are not impeded by the changes in the environmental conditions associated with the Proposed Scheme both during construction and post-construction	• no overall decline in the baseline bat species assemblage due to lighting, noise and / or vibration during construction and operation.	• weather monitoring; and • lighting, noise, and vibration monitoring at TFLs, crossing structures, landscape treatment areas and retained roosts.	• weather is not considered to have negatively influenced the outcome of Objectives 1 – 3; and • review of noise impact assessments and any associated mitigation / restrictions to determine that these are adequate • lighting is being completed as per the agreed approach during construction and has not negatively influenced the outcome of Objectives 1 – 3.	An assessment of Objective 4 will be undertaken in relation to Objectives 1 to 3. Implementation of changes would be subject to the below assessment and changes recommended where considered appropriate by the Named Ecologist. • assess if weather condition recorded during the monitoring period could account for the variances / changes recorded; • review measures provided within Bat Noise Monitoring and Management Plan (BNMMP), to assess changes in control measures with contractor input; and • review lighting used at each mitigation / compensation measure, inclusive of type of lighting, direction, level of light spill, etc.
Objective 5: To ensure the effects of habitat change within the Red Line Boundary are beneficial to bat populations within the Red Line Boundary in the longer term**.**	• habitat creation in place and meeting Key Performance Indicators (KPIs) as described in the LEMP	• habitat monitoring as outlined in the LEMP.	• habitat changes within the Red Line Boundary are considered to have positively influenced the outcomes of Objective 1 – 3.	• corrective management of vegetation; • review, and amendment of, irrigation systems / watering; • additional / replacement planting that may include replacement of failures, firming of stakes, ties, and guards; and • additional use of TFLs for commuting until vegetation develops. If planting failure is associated with severe weather events, a review of the landscape maintenance and management plan will be undertaken to ensure any lessons learned are applied to management during future severe weather events.

7 References

- Berthinussen, A & Altringham, J (2015) WC1060 development of a cost-effective method for monitoring the effectiveness of mitigation for bats crossing linear transport infrastructure: Appendix G.
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