2022

Bat Assessment: Spicer's Bakery, Rampart's Car Park & Andy Brennen Park Project, Navan, Co. Meath.

Dr Tina Aughney

Bat Eco Services

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Licensed Bat Specialist: Dr Tina Aughney (tina@batecoservices.com, 086 4049468)
NPWS licence C13/2020 (Licence to handle bats, expires 31st December 2022);
NPWS licence 08/2020 (Licence to photograph/film bats, expires 31st December 2022) ;
NPWS licence DER/BAT 2022-36 (Survey licence, expires 24th March 2025).

Statement of Authority: Dr Aughney has worked as a Bat Specialist since 2000 and has undertaken extensive survey work for all Irish bat species including large scale development projects, road schemes, residential developments, wind farm developments and smaller projects in relation to building renovation or habitat enhancement. She is a monitoring co-ordinator and trainer for Bat Conservation Ireland. She is a co-author of the 2014 publication *Irish Bats in the 21st Century.* This book received the 2015 CIEEM award for Information Sharing. Dr Aughney is a contributing author for the Atlas of Mammals in Ireland 2010-2015.

All analysis and reporting is completed by Dr Tina Aughney. Data collected and surveying is completed with the assistance of a trained field assistant.

Mr. Shaun Boyle (Field Assistant) NPWS licence DER/BAT 2022-37 (Survey licence, expires 24th March 2025).

Applicant Name: Meath County Council.

Project Title: Spicer's Bakery, Rampart's Car Park & Andy Brennan Park Project.

Application Address: Navan, Co. Meath.

Report Revision History

Date of Issue	Draft Number	Issued To (process of issuing)
16th December 2022	Draft 1	By email to Meath Co. Co.
22nd December 2022	Final	By email to Meath Co. Co.

Purpose

This document has been prepared as a Report for Meath Co. Co. Only the most up to-date report should be consulted. All previous drafts/reports are deemed redundant in relation to the named site.

Bat Eco Service accepts no responsibility or liability for any use that is made of this document other than by the client for the purposes for which it was originally commissioned and prepared.

Carbon Footprint Policy

It is the policy of Bat Eco Services to provide documentation digitally in order to reduce carbon footprint. Printing of reports etc. is avoided, where possible.

Bat Record Submission Policy

It is the policy of Bat Eco Services to submit all bat records to Bat Conservation Ireland database one year post-surveying. This is to ensure that a high level bat database is available for future desktop reviews. This action will be automatically undertaken unless otherwise requested, where there is genuine justification.

Executive Summary

Project Title: Spicer's Bakery, Rampart's Car Park & Andy Brennan Park Project.

Application Address: Navan, Co. Meath.

Proposed work: An array of works.

Bat Survey Results - Summary

Bat Species	Roosts	Foraging	Commuting
Common pipistrelle *Pipistrellus pipistrellus*		√	√
Soprano pipistrelle *Pipistrellus pygmaeus*	√	√	√
Nathusius' pipistrelle *Pipistrellus nathusii*			
Leisler's bat *Nyctalus leisleri*		√	√
Brown long-eared bat *Plecotus auritus*	√	√	√
Daubenton's bat *Myotis daubentonii*		√	√
Natterer's bat *Myotis nattereri*			
Whiskered bat *Myotis mystacinus*			
Lesser horseshoe bat *Rhinolophus hipposideros*			

Bat Survey Duties Completed (Indicated by red shading)

Tree PBR Survey	◯	Daytime Building Inspection	◯
Static Detector Survey	◯	Daytime Bridge Inspection	◯
Dusk Bat Survey	◯	Dawn Bat Survey	◯
Walking Transect	◯	Driving Transect	○
Trapping / Mist Netting	○	IR Camcorder filming	◯
Endoscope Inspection	◯	Other (thermal imagery)	◯

Citation: Bat Eco Services (2022) Bat Assessment: Spicer's Bakery, Rampart's Car Park & Andy Brennan Park Project, Navan, Co. Meath. Unpublished report prepared for Meath Co. Co.

Contents

1. Introduction

Bat Eco Services was commissioned by Meath Co. Co. to undertake a bat survey of buildings located within Spicer's Bakery, Rampart's Car Park & Andy Brennan Park, Navan, Co. Meath. A tree survey and general inspection of tall vegetation within the proposed development area and The Ramparts were also surveyed. The bat survey entailed daytime inspection of the buildings, dusk and dawn surveys, walking transects and static surveillance.

1.1 Relevant Legislation & Bat Species Status in Ireland

1.1.1 Irish Statutory Provisions

A small number of animals and plants are protected under Irish legislation (Nelson, *et al.,* 2019). The principal statutory provisions for the protection of animal and plant species are under the Wildlife Act 1976 (as amended) and the European Communities (Birds and Natural Habitats) Regulations 2011, as amended. The Flora (Protection) Order 2015 (S.I. no. 356 of 2015) lists the plant species protected by Section 21 of the Wildlife Acts. See www.npws.ie/ legislation for further information.

The codes used for national legislation are as follows:

- WA = Wildlife Act, 1976, Wildlife (Amendment) Act, 2000 and other relevant amendments
- FPO = Flora (Protection) Order, 2015 (S.I. No. 356 of 2015)

1.1.2 EU Legislation

The Birds Directive (Directive 2009/147/EC) and Habitats Directive (Council Directive 92/43/EEC) are the legislative instruments which are transposed into Irish law, *inter alia,* by the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) ('the 2011' Regulations), as amended.

The codes used for the Habitats Directive (Council Directive 92/43/EEC) are:

- Annex II Animal and plant species listed in Annex II
- Annex IV Animal and plant species listed in Annex IV
- Annex V Animal and plant species listed in Annex V

The main aim of the Habitats Directive is the conservation of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes to the Directive at a favourable conservation status. These annexes list habitats (Annex I) and species (Annexes II, IV and V) which are considered threatened in the EU territory. The listed habitats and species represent a considerable proportion of biodiversity in Ireland and the Directive itself is one of the most important pieces of legislation governing the conservation of biodiversity in Europe.

Under Article 11 of the Directive, each member state is obliged to undertake surveillance of the conservation status of the natural habitats and species in the Annexes and under Article 17, to report to the European Commission every six years on their status and on the implementation of the measures taken under the Directive. In April 2019, Ireland submitted the third assessment of conservation status for 59 habitats and 60 species. There are three volumes with the third listing details of the species assessed.

Article 12 of the Habitats Directive requires Member States to take measures for the establishment of a strict protection regime for animal species listed in Annex IV(a) of the Habitats Directive within

the whole territory of Member States. Article 16 provides for derogation from these provisions under defined conditions. These provisions are implemented under Regulations 51 and 54 of the 2011 Regulations.

1.1.3 IUCN Red Lists

The International Union for the Conservation of Nature (IUCN) coordinates the Red Listing process at the global level, defining the categories so that they are standardised across all taxa. Red Lists are also produced at regional, national and subnational levels using the same IUCN categories (IUCN 2012, 2019). Since 2009, Red Lists have been produced for the island of Ireland by the National Parks and Wildlife Service (NPWS) and the Northern Ireland Environment Agency (NIEA) using these IUCN categories. To date, 13 Red Lists have been completed. The Red Lists are an assessment of the risk of extinction of each species and not just an assessment of their rarity. Threatened species are those species categorised as Critically Endangered, Endangered or Vulnerable (IUCN, 2019) – also commonly referred to as 'Red Listed'.

1.1.4 Irish Red List - Mammals

Red Lists in Ireland refer to the whole island, i.e. including Northern Ireland, and so follow the guidelines for regional assessments (IUCN, 2012, 2019). The abbreviations used are as follows:.

- RE Regionally Extinct
- CR Critically Endangered
- EN Endangered
- VU Vulnerable
- NT Near Threatened
- DD Data Deficient
- LC Least Concern
- NA Not Assessed
- NE Not Evaluated

There are 27 terrestrial mammals species in Ireland, which includes the nine resident bat species listed. The terrestrial mammal, according to Marnell *et al.,* 2019, list for Ireland consists of all terrestrial species native to Ireland or naturalised in Ireland before 1500. The IUCN Red List categories and criteria are used to assess that status of wildlife. This was recently completed for the terrestrial mammals of Ireland. Apart from the two following two mammal species (grey wolf *Canis lupus* (regionally extinct) and black rat *Rattus rattus* (Vulnerable)), the remaining 25 species were assessed as least concern in the most recent IUCN Red List publication by NPWS (Marnell *et al*., 2019).

1.1.5 Irish Bat Species

All Irish bat species are protected under the Wildlife Act (1976) and Wildlife Amendment Acts (2000 and 2010). Also, the EC Directive on The Conservation of Natural habitats and of Wild Fauna and Flora (Habitats Directive 1992), seeks to protect rare species, including bats, and their habitats and requires that appropriate monitoring of populations be undertaken. All Irish bats are listed in Annex IV of the Habitats Directive and the lesser horseshoe bat *Rhinolophus hipposideros* is further listed under Annex II. Across Europe, they are further protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982), which, in relation to bats, exists to conserve all species and their habitats. The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983) was instigated to protect migrant species across all European boundaries. The Irish government has ratified both these conventions.

Also, under existing legislation, the destruction, alteration or evacuation of a known bat roost is an offence. The most recent guidance document is "Guidance document on the strict protection of animal species of Community interest un the Habitats Directive (Brussels, 12.10.2021 C(2021) 7391 final".

Regulation 51(2) of the 2011 Regulations provides –

(*"(2) Notwithstanding any consent, statutory or otherwise, given to a person by a public authority or held by a person, except in accordance with a licence granted by the Minister under Regulation 54, a person who in respect of the species referred to in Part 1 of the First Schedule—*

(a) deliberately captures or kills any specimen of these species in the wild, (b) deliberately disturbs these species particularly during the period of breeding, rearing, hibernation and migration,

(c) deliberately takes or destroys eggs of those species from the wild,

(d) damages or destroys a breeding site or resting place of such an animal, or

(e) keeps, transports, sells, exchanges, offers for sale or offers for exchange any specimen of these species taken in the wild, other than those taken legally as referred to in Article 12(2) of the Habitats Directive,

shall be guilty of an offence."

The grant of planning permission does not permit the commission of any of the above acts or render the requirement for a derogation licence unnecessary in respect of any of those acts.

Any works interfering with bats and especially their roosts, may only be carried out under a derogation licence granted by National Parks and Wildlife Service (NPWS) pursuant to Regulation 54 of the European Communities (Birds and Natural Habitats) Regulations 2011 (which transposed the EU Habitats Directive into Irish law).

There are eleven recorded bat species in Ireland, nine of which are considered resident on the island. Eight resident bat species and one of the vagrant bat species are vesper bats and all vespertilionid bats have a tragus (cartilaginous structure inside the pinna of the ear). Vesper bats are distributed throughout the island. Nathusius' pipistrelle *Pipistrellus nathusii* is a recent addition while the Brandt's bat has only been recorded once to-date (Only record confirmed by DNA testing, all other records has not been genetically confirmed). The ninth resident species is the lesser horseshoe bat *Rhinolophus hipposideros*, which belongs to the Rhinolophidea and has a complex nose leaf structure on the face, distinguishing it from the vesper bats. This species' current distribution is confined to the western seaboard counties of Mayo, Galway, Clare, Limerick, Kerry and Cork. The eleventh bat species, the greater horseshoe bat, was only recorded for the first time in February 2013 in County Wexford and is therefore considered to be a vagrant species. A total of 41 SACs have been designated for the Annex II species lesser horseshoe bat (1303), of which nine have also been selected for the Annex I habitat 'Caves not open to the public' (8310).

Irish bat species list is presented in Table 1 along with their current status.

Table 1: Status of the Irish bat fauna (Marnell *et al.,* 2019).

Species: Common Name	Irish Status	European Status	Global Status
Resident Bat Species ^			
Daubenton's bat *Myotis daubentonii*	Least Concern	Least Concern	Least Concern
Whiskered bat *Myotis mystacinus*	Least Concern	Least Concern	Least Concern
Natterer's bat *Myotis nattereri*	Least Concern	Least Concern	Least Concern
Leisler's bat *Nyctalus leisleri*	Least Concern	Least Concern	Least Concern
Nathusius' pipistrelle *Pipistrellus nathusii*	Least Concern	Least Concern	Least Concern
Common pipistrelle *Pipistrellus pipistrellus*	Least Concern	Least Concern	Least Concern
Soprano pipistrelle *Pipistrellus pygmaeus*	Least Concern	Least Concern	Least Concern
Brown long-eared bat *Plecotus auritus*	Least Concern	Least Concern	Least Concern
Lesser horseshoe bat *Rhinolophus hipposideros*	Least Concern	Least Concern	Least Concern
Possible Vagrants ^			
Brandt's bat Myotis brandtii	Data deficient	Least Concern	Least Concern
Greater horseshoe bat *Rhinolophus ferrumequinum*	Data deficient	Near threatened	Near threatened

^ Roche *et al.,* 2014

1.2 Relevant Guidance Documents

This report will draw on guidelines already available in Europe and will use the following documents:

- National Roads Authority (2006) Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes
- Collins, J. (Editor) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition). Bat Conservation Trust, London
- McAney, K. (2006) A conservation plan for Irish vesper bats, Irish Wildlife Manual No. 20 National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
- Marnell, F., Kelleher, C. & Mullen, E. (2022) Bat mitigation guidelines for Ireland v2. Irish Wildlife Manuals, No. 134. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland (Version 1: Kelleher & Marnell, 2006).
- The status of EU protected habitats and species in Ireland: Conservation status in Ireland of habitats and species listed in the European Council Directive on the Conservation of Habitats, Flora and Fauna 92/43/EEC. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.
- Bat Conservation Trust (2018) Bats and artificial lighting in the UK: bats and the built environment series. Guidance Note 08/2019. BCT, London.
- Guidance document on the strict protection of animal species of Community interest un the Habitats Directive (Brussels, 12.10.2021 C(2021) 7391 final.
- EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports.

Collins (2016) is the principal document used to provide guidance in relation to bat survey effort required but the level of surveying is assessed on a case-by-case basis taking into consideration the historical bat records for the survey area, presence of built, structures and trees potentially suitable for roosting bats and the presence of suitable bat habitats for foraging and commuting. Additional reference is made to this document in relation to determining the value of buildings, trees etc. as bat roosts. The tables referred to from this document are described in the following section and in the section on methodology.

Marnell *et al.* (2022) is referred to for guidance in relation to survey guidance (timing and survey design), derogation licences and mitigation measures.

1.2.1 Bat Survey Requirements & Timing

With reference to Collins (2016) and Marnell *et al.* (2022), the information presented in this section is used to determine the bat survey requirements for the proposed development site. Collins (2016) provides a trigger list in relation to determining if a bat survey is required and this is presented Appendix 3 (Figure B) for reference. In addition, Chapter 2 of Collins (2016) discusses that a bat survey is required when proposed activities are likely to impact on bats and their habitats. The level of surveying is to be determined by the ecologist and these are influenced by the following criteria:

- Likelihood of bats being present;
- Type of proposed activities;
- Scale of proposed activities;
- Size, nature and complexity of the site;
- Species concerned;
- No. of individuals.

Collins (2016) also provides the following table detailing when different survey components should be undertaken.

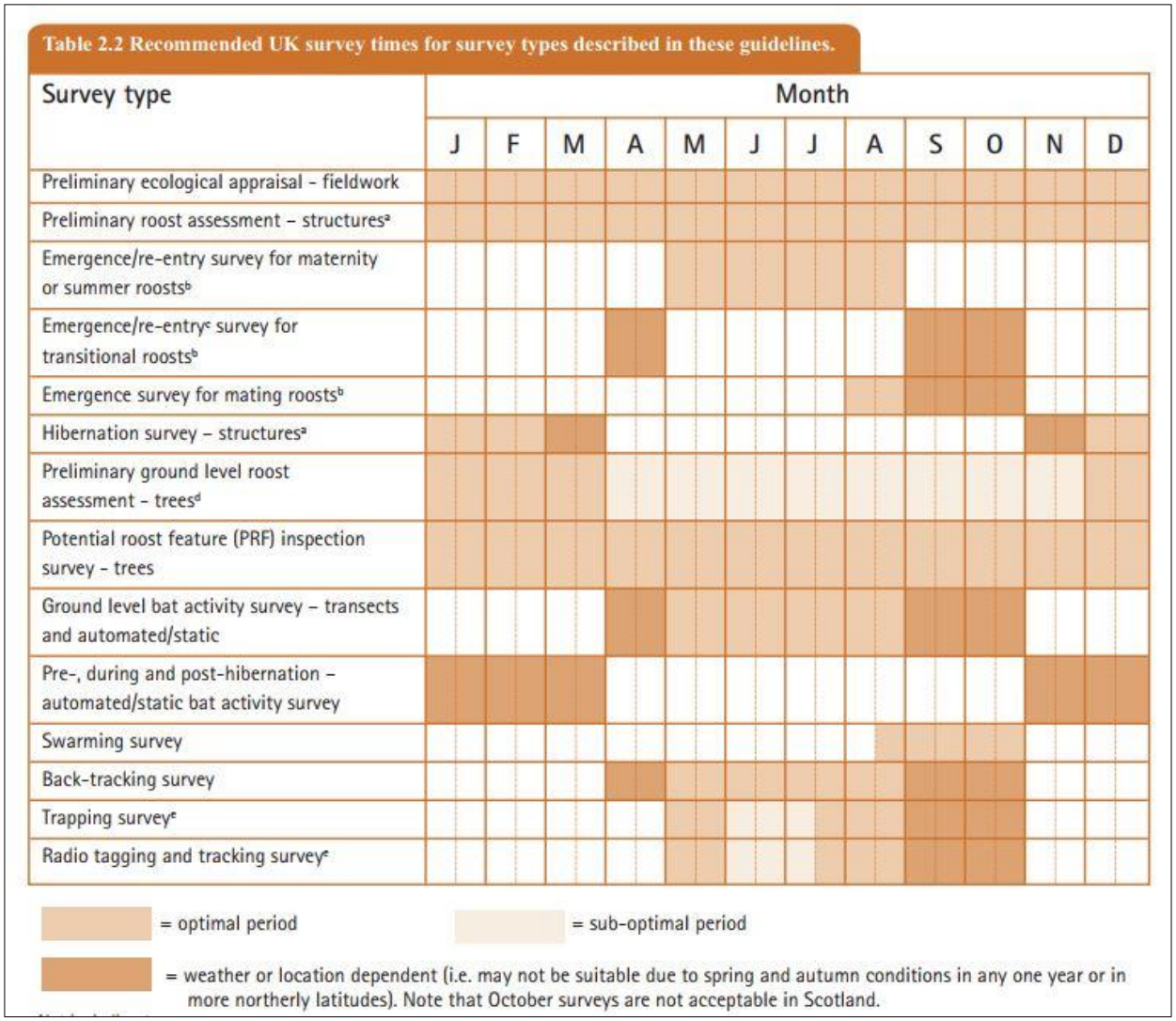

Table 2.2 Recommended UK survey times for survey types described in these guidelines.

Survey type	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Preliminary ecological appraisal - fieldwork												
Preliminary roost assessment – structures[a]												
Emergence/re-entry survey for maternity or summer roosts[b]												
Emergence/re-entry[c] survey for transitional roosts[b]												
Emergence survey for mating roosts[b]												
Hibernation survey – structures[a]												
Preliminary ground level roost assessment - trees[d]												
Potential roost feature (PRF) inspection survey - trees												
Ground level bat activity survey – transects and automated/static												
Pre-, during and post-hibernation – automated/static bat activity survey												
Swarming survey												
Back-tracking survey												
Trapping survey[e]												
Radio tagging and tracking survey[e]												

= optimal period

= sub-optimal period

= weather or location dependent (i.e. may not be suitable due to spring and autumn conditions in any one year or in more northerly latitudes). Note that October surveys are not acceptable in Scotland.

Figure 1a: Table 2.2 reproduced from Collins (2016).

1.2.1.1 Buildings & Structures

In Marnell *et al.* (2022), Table 3 (The applicability of survey methods) provides information on the type of surveys that can be undertaken according to the different seasons.

Marnell *et al.* (2022) states that it is more suitable to survey buildings in the summer months. The following is a summary of the principal points:

1. The presence of a significant bat roost (invariably a maternity roost) can normally be determined on a single visit at any time of year, provided that the entire structure is accessible and that any signs of bats have not been removed by others. However, a visit during the summer or autumn has the advantage that bats may be seen or heard.
2. Roosts used by a small number of bats, as opposed to maternity sites, can be particularly difficult to detect and may require extensive searching backed up (in summer) by bat detector surveys or emergence counts.
3. If the entire building is not accessible or signs of bats may have been removed by others, or by the weather, bat detector or exit count methodologies may be required to back up a limited search.

Table 3. The applicability of survey methods.

Season	Roost type	Inspection	Bat detectors and emergence counts
Spring (Mar – May)	Building	Suitable (signs, perhaps bats)	Limited, weather dependent
	Trees	Difficult (best for signs before leaves appear)	Rarely useful
	Underground	Suitable (signs only)	Static detectors may be useful
Summer (June-August)	Building	Suitable (signs and bats)	Suitable
	Trees	Difficult	Limited; use sunrise survey
	Underground	Suitable (signs only)	Rarely useful
Autumn (September –November)	Building	Suitable (signs and bats)	Limited, weather dependent
	Trees	Difficult	Rather limited weather dependent; use sunrise survey?
	Underground	Suitable (signs, perhaps bats)	Static detectors may be useful
Winter (December-February)	Building	Suitable (signs, perhaps bats))	Rarely useful
	Trees	Difficult (best for signs after leaves have gone)	Rarely useful
	Underground	Suitable (signs and bats)	Static detectors may be useful

Figure 1b: Table 3 reproduced from Marnell *et al.* (2022).

The following table is used to determine the level and timing of surveys for buildings/structures with reference to the surrounding habitat. Buildings are assessed to determine their suitability as a bat roost and are described using the parameters Negligible, Low, Medium or High suitability in view of Table 2 from Marnell *et al.* (2022). The level of suitability informs the level of surveying and timing of surveys required based on Table 7.3 of Collins, 2016 (Note: These two tables are presented in Appendix 1 but a summary is provided in the table below).

Table 2a: Building Bat Roost Classification System & Survey Effort (Adapted from Collins, 2016 and Marnell *et al.*, 2022).

Suitability Category	Description (examples of criteria)	Survey Effort (Timings)
Negligible	Building have no potential as a roost site Urban setting, heavily disturbed, building material unsuitable, building in poor condition etc.	No surveys required.
Low	Building has a low potential as a roost site. No evidence of bat usage (e.g. droppings)	One dusk or dawn survey.
Medium	Building with some suitable voids / crevices for roosting bats. Some evidence of bat usage Suitable foraging and commuting habitat present.	At least one survey in May to August, minimum of two surveys (one dusk and one dawn).
High	Building with many features deemed suitable for roosting bats. Evidence of bat usage. Largely undisturbed setting, rural, suitable foraging and commuting habitat, suitable roof void and building material.	At least two surveys in May to August, with a minimum of three surveys (at least one dusk survey and one dawn survey).

1.2.1.2 Trees

Marnell *et al.* (2022) recommends the following in relation to detecting roosts in trees:

- "The best time to carry out surveys for suitable cavities is between November and April, when the trunk and branches are not obscured by leaves. If inspection suggests that the tree has suitable cavities or roost sites, a bat detector survey at dusk or dawn during the summer may help to produce evidence of bats, though the nomadic nature of most tree-dwelling species means that the success rate is very low.
- It can also be difficult to pinpoint exactly which tree a bat emerged from. A dawn survey is more likely to be productive than a dusk one as swarming bats returning to the roost are much more visible than those leaving the roost. Because tree-dwelling bats move roosts frequently, a single bat-detector survey is unlikely to provide adequate evidence of the absence of bats in trees that contain a variety of suitable roosting places.
- Several dawn or dusk surveys spread over a period of several weeks from June to August will greatly increase the probability of detecting significant maternity roosts and is recommended where development proposals will involve the loss of multiple trees".

As a consequence, the BTHK (2018) Potential Roost Features (PRFs) list and the classification system adapted from Collins (2016) is recommended as part of the daytime inspection of trees to determine their PBR or Potential Bat Roost value. Details of the methodology followed is presented in Section 3.2.2.

1.2.1.3 Underground Structures

Marnell *et al.* (2022) recommends the following in relation to underground structures:

1. Underground structures are used mainly for hibernation, so surveys should generally be carried out during the winter.

1.2.2 Evaluation & Assessment Criteria

Based on the information collected during the desktop studies and bat surveys, an ecological value is assigned to each bat species recorded based on its conservation status at different geographical scales (Table 2b). For example, a site may be of national ecological value for a given species if it supports a significant proportion (e.g. 5%) of the total national population of that species.

Table 2b: The six-level ecological valuation scheme used in the CIEEM Guidelines (2016) Ecological Value

Ecological Value	Geographical Scale of Importance
International	International or European scale
National	The Republic of Ireland or the island of Ireland scale (depending on the bat species)
Regional	Province scale: Leinster
County	County scale: County Dublin
Local	Proposed development and immediate surroundings
Negligible	None, the feature is common and widespread

If bat roosts are recorded, their roost status is determined using Figure 20 from Marnell *et al.* (2022). This figure is presented below (Figure 1c). This figure is also used to determine the conservation significance of the roost in order to prepare appropriate bat mitigation measures.

Impacts on bats can arise from activities that may result in:

- Physical disturbance of bat roosts e.g. destruction or renovation of buildings
- Noise disturbance e.g. increase human presence, use of machinery etc.
- Lighting disturbance
- Loss of roosts e.g. destruction or renovation of buildings
- Modifications of commuting or foraging habitats
- Severance or fragmentation of commuting routes
- Loss of foraging habitats.

It is recognised that any development will have an impact on the receiving environment, but the significance of the impact will depend on the value of the ecological features that would be affected. Such ecological features will be those that are considered to be important and potentially affected by the proposed development.

The guidelines consulted recommend that the potential impacts of a proposed development on bats are assessed as early as possible in the design stage to determine any areas of conflicts. In particular the Table 4 (presented as Figure 1d below) and Figure 20 (presented as Figure 1c) from Marnell *et al.* (2022) are referenced during this process.

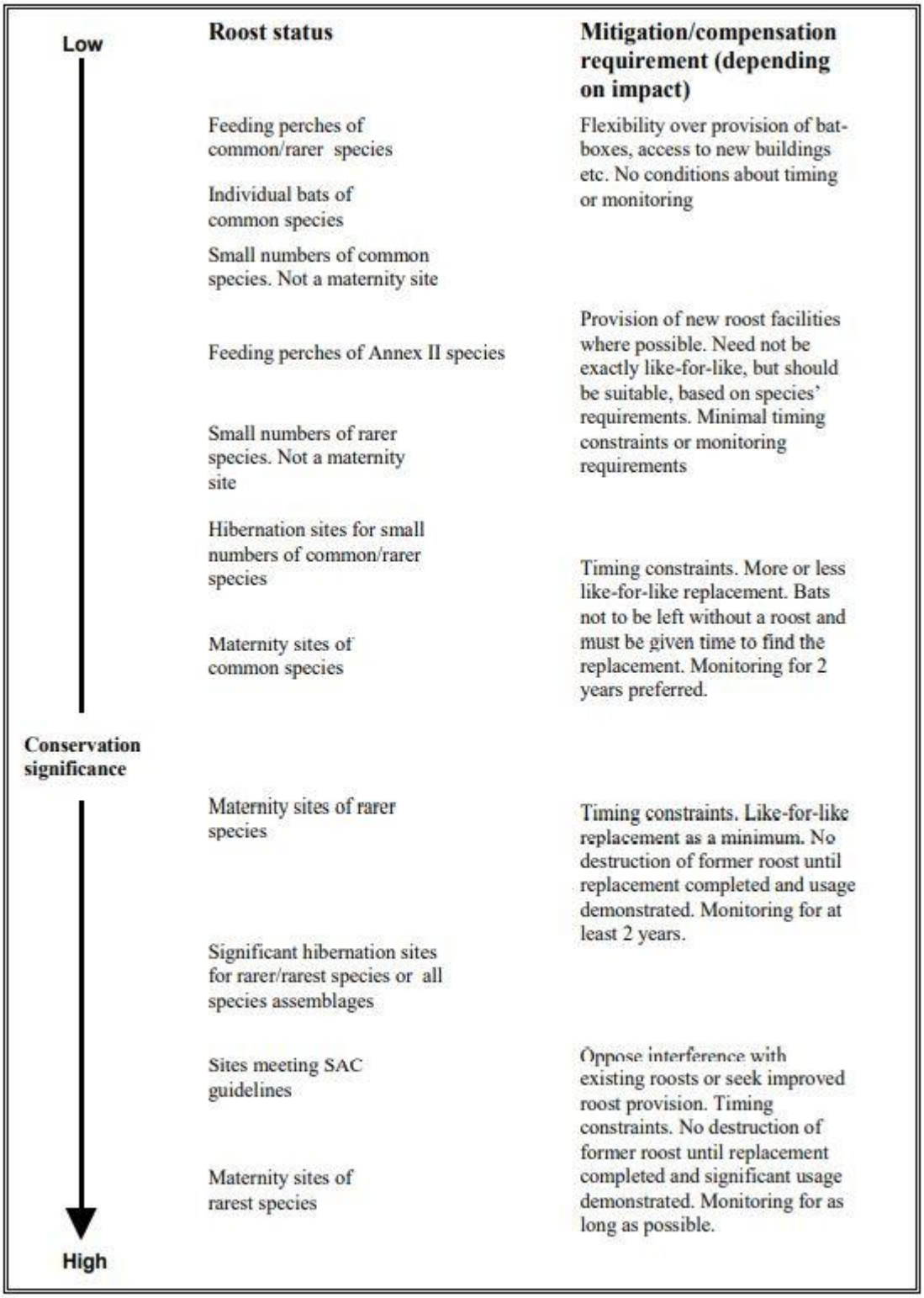

Figure 20 Guidelines for proportionate mitigation. The definition of common, rare and rarest species requires regional interpretation.

Figure 1c: Figure 20 (p 46) Reproduced from Marnell *et al.* (2022).

Table 4 The scale of main impacts at the site level on bat populations. [**NB** This is a general guide only and does not take into account species differences. Medium impacts, in particular, depend on the care with which any mitigation is designed and implemented and could range between high and low.]

Roost type	Development effect	Scale of impact		
		Low	Medium	High
Maternity	Destruction			✓
	Isolation caused by fragmentation			✓
	Partial destruction; modification		✓	
	Temporary disturbance outside breeding season	✓		
	Post-development interference			✓
Major hibernation	Destruction			✓
	Isolation caused by fragmentation			✓
	Partial destruction; modification		✓	
	Temporary disturbance outside hibernation season	✓		
	Post-development interference			✓
Minor hibernation	Destruction			✓
	Isolation caused by fragmentation			✓
	Partial destruction, modification		✓	
	Modified management		✓	
	Temporary disturbance outside hibernation season	✓		
	Post-development interference		✓	
	Temporary destruction, then reinstatement	✓		
Mating	Destruction		✓	
	Isolation caused by fragmentation		✓	
	Partial destruction	✓		
	Modified management	✓		
	Temporary disturbance	✓		
	Post-development interference	✓		
	Temporary destruction, then reinstatement	✓		
Night roost	Destruction	✓		
	Isolation caused by fragmentation	✓		
	Partial destruction	✓		
	Modified management	✓		
	Temporary disturbance	✓		
	Post-development interference	✓		
	Temporary destruction, then reinstatement	✓		

Figure 1d: Table 4 (p 44) Reproduced from Marnell *et al.* (2022).

Different parameters are considered for the overall assessment of the potential impact(s) of a proposed development on local bat populations.

The overall impacts of the proposed project on local bat populations is assessed using the following criteria:

- Impact Quality using the parameters Positive, Neutral or Negative Impact (based on EPA, 2022, Table 3.4)

Table 2c: Criteria for assessing impact quality based on EPA, 2022,

Quality of Effect	Criteria
Positive	A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
Neutral	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
Negative	A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).

- Impact Significance of potential impact parameters on specific bat species in relation to particular elements (e.g. roosting sites, foraging area and commuting routes) are assessed with reference to the following:
    - Table 4 of Marnell *et al.* (2022) (Figure 1a);
    - the known ecology and distribution of the bat species in Ireland;
    - bat survey results including type of roosts (if any recorded), pattern of bat usage of the survey area, level of bat activity recorded etc.
    - and bat specialist experience.
- Impact Significance of the proposed development on local bat populations maybe determine, where applicable, using the parameters listed in Table 2d (based on EPA, 2022, Table 3.4).

Table 2d: Criteria for assessing significance of effects based on EPA, 2022.

Significance of Effects	Definition
Imperceptible	An effect capable of measurement but without significant consequences.
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound	An effect which obliterates sensitive characteristics

The following terms will be used, where possible and applicable, when quantifying the probability and duration of the potential effects (selected from EPA, 2022, Table 3.4):

Describing the Probability of Effects Descriptions of effects should establish how likely it is that the predicted effects will occur so that the CA can take a view of the balance of risk over advantage when making a decision.	**Likely Effects** The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
	Unlikely Effects The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Describing the Duration and Frequency of Effects 'Duration' is a concept that can have different meanings for different topics – in the absence of specific definitions for different topics the following definitions may be useful.	**Momentary Effects** Effects lasting from seconds to minutes.
	Brief Effects Effects lasting less than a day.
	Temporary Effects Effects lasting less than a year.
	Short-term Effects Effects lasting one to seven years.
	Medium-term Effects Effects lasting seven to fifteen years.
	Long-term Effects Effects lasting fifteen to sixty years.
	Permanent Effects Effects lasting over sixty years.
	Reversible Effects Effects that can be undone, for example through remediation or restoration.
	Frequency of Effects Describe how often the effect will occur (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually).

Figure 1e: Criteria for assessing significance of effects based on EPA, 2022 (Taken from Table 3.4),

This table continues to provide terminology in relation to "Describing the Types of Effects" as presented below.

Describing the Types of Effects	**Indirect Effects (a.k.a. Secondary or Off-site Effects)** Effects on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.
	Cumulative Effects The addition of many minor or insignificant effects, including effects of other projects, to create larger, more significant effects.
	'Do-nothing Effects' The environment as it would be in the future should the subject project not be carried out.
	'Worst-case' Effects The effects arising from a project in the case where mitigation measures substantially fail.
	Indeterminable Effects When the full consequences of a change in the environment cannot be described.
	Irreversible Effects When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.
	Residual Effects The degree of environmental change that will occur after the proposed mitigation measures have taken effect.
	Synergistic Effects Where the resultant effect is of greater significance than the sum of its constituents (e.g. combination of SOx and NOx to produce smog).

Figure 1f: Criteria for assessing significance of effects based on EPA, 2022 (Taken from Table 3.4),

1.2.3 Bat Mitigation Measures

1.2.3.1 Bat Lofts

The NPWS Survey and Mitigation Guidelines (Marnell *et al.* 2022) provides some general guidelines in relation to the provision of alternative roosts but states that critical issues "are the size and suitability of the final roost and the disposition of the entrances and flight paths, including the location of any exterior lighting or vegetation". As part of this development proposal, bat mitigation measures recommended include the incorporation of a bat loft in a house in the courtyard and the construction of a bat house. These have been designed to address the critical issues stated above with reference to the ecological needs of the bat species recorded roosting buildings within the survey area.

1.2.3.1.1 Bat Lofts – Effective Mitigation Measures

The principal bat species that the bat lofts are to be designed for is soprano pipistrelles. Provision will also be made for the other bat species recorded roosting (i.e. brown long-eared bat).

In relation to ensuring that the bat house caters for bat species recorded in the study area, the effectiveness of bat houses/lofts was researched. Collins *et al.* (2020) investigated the implementation and effectiveness of bat roost mitigation in building developments completed between 2006 and 2014 in England and Wales. The bat species studied were: common and soprano

pipistrelle, brown long-eared bat and *Myotis* species, all of which are present in Ireland. A summary of the main points relating to the construction of bat roosts was that the internal height and internal volume was important for bat occupancy. Lintott & Mathews (2018) reported that median internal volume of bat roosts used by brown long-eared bats was 37m^3 and for *Pipistrellus* species, it was 24m^3. This bat house is catering for day roosts roost of soprano pipistrelles and common pipistrelles. Pipistrelles were reported to be generally found in smaller volume roosts with lower heights because Pipistrelles need less internal space. Lintott & Mathews (2018) reported that the greater number of bat access points, the greater the occupancy for both common pipistrelles and brown long-eared The bat loft will take into consideration all of the above points and consultation will be undertaken with the conservation architects on the final designs.

1.2.3.2 Bats & Lighting

All European bat species, including Irish bat species, are nocturnal. Light levels as low as typical full moon levels, i.e. around 0.1 LUX, can alter the flight activity of bats (Voigt *et al.* 2018). Any level of artificial light above that of moonlight can mask the natural rhythms of lunar sky brightness and, thus, can disrupt patterns of foraging and mating and might, for instance, interfere with entrainment of the circadian system.

Artificial light pollution is an increasing global problem (Rich and Longcore, 2006) and Artificial light at night (ALAN) is considered a major threat to biodiversity, especially to nocturnal species. As urbanisation expands into the landscape, the degree of street lighting also expands. Its ecological impacts can have a profound affect the behaviour of nocturnal animals including impacts on reproductive behaviours, orientation, predator-prey interaction and competition among others, depending on the taxon and ecosystem in question (Longcore and Rich 2004). It is considered by Hölker *et al.* (2010) to be a key biodiversity threat to biodiversity conservation. In relation to bats, the potential impacts of artificial night lighting can result in habitat fragmentation (Hanski, 1998), delay in roost emergence (Downs *et al.,* 2003) and a reduction in prey items.

In the context of behavioural ecology, lights can work to attract or repel certain animals. Many groups of insects, including moths, lacewings, beetles, bugs, caddisflies, crane flies, midges, hoverflies and wasps, can be attracted to artificial light (Eisenbeis and Hassel 2000; Frank 1988; Kolligs 2000). Attraction depends on the spectrum of light. In the context of street lights, white (mercury vapour) lamps emit a white light that includes ultraviolet. High pressure sodium lights (yellow) emit some ultraviolet, while low pressure sodium lamps (orange) emit no ultraviolet light (e.g. Rydell 2006). As a result of the attractiveness of lights to aerial invertebrates, swarms of insects often occur in and around street lights and, particular bat species such as aerial insect predators, can exploit the swarming insects to their advantage. Such attraction can also take prey items away from dark zones where light sensitive species are foraging, thus reducing their likelihood of feeding effectively.

Rydell (2006) divides bats into four categories in terms of their characteristic behaviours at street lamps. The four categories are based on bat size, wing morphology and echolocation call characteristics which were highlighted by Norberg and Rayner (1987) to determine flight speed, manoeuvrability, and prey detection capabilities of bats. Rydell (2006) stated that the large, fast flying bats, which are confined to open airspace, fly high over lit areas and are rarely observed near ground level. None of these, typically large free-tailed bats (e.g. large species of the family Molossidae), are found in Ireland. The second category are the medium-sized fast flying species, including the *Nyctalus* species, which patrol the street well above the lights and can be seen occasionally as they dive for prey into the light cone. This group includes the Leisler's bat, which is found in Ireland. Rydell's third category describes the small but fast flying bats that are manoeuvrable enough to forage around light posts or under the lights, and includes the small *Pipistrellus* species of the old

world, three of which are found in Ireland. The fourth category includes broad-winged slow flyers, most of which are seldom or never observed at lights. Slow flying bat species may be more vulnerable to predation by diurnal birds of prey and this may restrict their exploitation of insects around artificially illuminated areas (e.g. Speakman 1991). There are also the concerns that some bat species are more light sensitive and therefore actively avoid lit up areas. This is particularly relevant for lesser horseshoe bats. Therefore from this, we can categorise the suite of Irish bats species as follows (please note that the sensitivity category is the author's description):

Table 3: Potential light sensitivity of the Irish bat fauna using categories described by Rydell, 2006.

Species: Common Name	Rydell Category	Sensitivity
Daubenton's bat *Myotis daubentonii*	Category 4	Light sensitive
Whiskered bat *Myotis mystacinus*	Category 4	Light sensitive
Natterer's bat *Myotis nattereri*	Category 4	Light sensitive
Leisler's bat *Nyctalus leisleri*	Category 2	Light tolerant
Nathusius' pipistrelle *Pipistrellus nathusii*	Category 3	Semi-tolerant
Common pipistrelle *Pipistrellus pipistrellus*	Category 3	Semi-tolerant
Soprano pipistrelle *Pipistrellus pygmaeus*	Category 3	Semi-tolerant
Brown long-eared bat *Plecotus auritus*	Category 4	Light sensitive
Lesser horseshoe bat *Rhinolophus hipposideros*	Category 4	Light sensitive

The ability of different bat species to exploit insects gathered around street lights varies greatly. Gleaning species such as *Myotis* bats rarely forage around street lights (Rydell and Racey, 1995). The ecological effects of illuminating aquatic habitats are also poorly known. Moore *et al.* (2006) found that light levels in an urban lake, subject simply to sky glow and not direct illumination from lights, reached the same order of magnitude as full moonlight.

All European bat species, including Irish bat species, are nocturnal. As a consequence, the scientific literature provides evidence that artificial lighting does impacts on bats. The degree of impact depends on the light sensitivity of the bat species and the type of luminaire. Lesser horseshoe bats are light sensitive and therefore adversely effected by the presence of lighting in all aspects of their life strategies (e.g. foraging, commuting, drinking and roosting).

The potential impacts of street lighting can be summarised as follows:

- Attracting Prey Items

Lights can work to attract or repel certain animals. Many groups of insects can be attracted to artificial light and this attraction depends on the spectrum of light. As a result of the attractiveness of lights to aerial invertebrates, swarms of insects often occur in and around street lights. Such attraction can also take prey items away from dark zones where light sensitive species, such as lesser horseshoe bats, are foraging, thus reducing their likelihood of feeding effectively.

- Reducing Foraging Habitat

The research documents that there is less bat species diversity foraging in habitats lit up by artificial lighting. Only bat species considered to be light tolerant are generally able to exploit habitats with lighting present, but overall, all bat species activity tends to be less in lit up habitats compared to non-lit up habitats.

- Fragmenting The Landscape

Scientific evidence shows that lighting is a barrier to the movement of light sensitive bat species, such as lesser horseshoe bats. Light sensitive bat species will actively seek dark corridors to commute along and therefore the presence of lighting in commuting habitats will restrict their movement of such species in the landscape.

- Reducing Drinking Sites

There is increasing evidence that drinking sites for bats is an essential component for local bat population survival and that the presence of artificial lighting at waterbodies prevents bats from availing of this resource.

Lighting, including street lights come in an array of different types but for street lights they typically include High Pressure Sodium, Low Pressure Sodium, Mercury Vapour and the more modern Light Emitting Diodes (LED). An array of field-based research has been undertaken to document the potential impact of lighting on bat flight activity. LED lighting is predicted to constitute 70% of the outdoor and residential lighting markets by 2020. While the use of LEDs promotes energy and cost savings relative to traditional lighting technologies, little is known about the effects these broad-spectrum "white" lights will have on wildlife, human health, animal welfare, and disease transmission. As a consequence, a large array of research has been undertaken recently on the potential impact of LED on bats.

Stone *et al.* (2012) undertook research in relation to "Cool" LED street lights on an array of local bat species in England. Overall the presence of LED street lights had a significant negative impact on lesser horseshoe bats and *Myotis* spp. for all light treatments investigated while there was no sign impact of light treatment type on *Pipistrellus pygmaeus* (soprano pipistrelle – a common Irish bat species) or *Nyctalus* (Leisler's bats is part of this bat family and is a common Irish bat species)/*Eptesicus* species. This research paper also documented behavioural changes for the different bat species. Lesser horseshoe bats and *Myotis* spp. did not avoid lights by flying along the other side of the hedge but altered their commuting behaviour altogether. It was concluded that LEDs can fragment commuting routes causing bats to alter their behaviour with potentially negative conservation consequences. Lesser horseshoe bat activity was significantly lower during high intensity treatment than medium, but at all treatment levels (even as low as 3.6 LUX), activity was significantly lower than unlit control (LUX level measurements were taken at 1.7m at the hedge below the light).

Russo *et al.* (2017) investigated the impact of LED lighting on drinking areas for bats in Italy. Drinking sites are considered to be important components for the survival of local bat populations. Drinking sites were illuminated with a portable LED outdoor light emitting (48 high-power LEDs generated a light intensity of 6480 lm (4000–4500 K) at 25°C, two peaks of relative luminous flux at 450 and 590 nm). *Plecotus auritus* (brown long-eared bat – resident in Ireland), *Pipistrellus pygmaeus* (soprano pipistrelle – resident in Ireland) and *Rhinolophus hipposideros* (lesser horseshoe bat – resident in Ireland) did not drink when troughs were illuminated.

Rowse *et al.* (2018) researched the impacts of LED lights (portable lights, 97W 4250K LED on 10m high poles) in England on local bat populations. Treatments were either 100% light intensity; dimmed

(using pulse width modulation) at 50% or 25% light intensity; and unlit. Sites were in suburban areas along busy roads but with vegetation and tree lines adjacent. High light levels (50% & 100% light treatments) increased activity of opportunistic *Pipistrellus pipistrellus* (common pipistrelle – resident in Ireland) but reduced activity of *Myotis* species group. Conversely 25% and unlit sites had no difference from each other. The research paper conclude that dimming could be an effective strategy to mitigate ecological impacts of street lights.

Wakefield *et al.* (2017) stated that an important factor to be aware of in relation to LED is the direction of the light projected. Therefore it is recommended that highly focused/shielded LEDS designed to filter out short wavelengths of light may should be used as they attract relatively fewer insects. Less insects attracted to street lights means less insects leaving dark zones where light sensitive bat species primarily feed.

Martin *et al.* (2021) showed that LED street lights lead to a reduction in the total number of insects captured with light traps in a wide range of families. Coleoptera and Lepidoptera orders were the most sensitive groups to ecological light pollution in the study area. The paper suggested that LED was the least attractive light system for most of the affected groups both because of its very little emitted short-wavelength light and because of its lower light intensity. They also concluded that reduction in insect attraction to LED could be even larger with current LED technologies emitting warmer lights, since other research showed that LED emitting “warmer white” colour light (3000 K) involves significantly lower attraction for insects than “colder white” LED (6000 K).

Wilson *et al.* (2021) investigate the impact of LED on biting insects and concluded because LED is highly malleable with regard to spectral composition, they can be tailored to decrease or increase insect catches, depending on situation. Therefore this design control of LED could greatly assist in reducing impact of street lighting on local bat populations.

Stone *et al*. (2015) reviewed the impacts of ALAN on bat roosts and flight paths in order to provide recommendations in relation to street lighting. The principal recommendations were to avoid lighting places where bats are present and to ensure that there are interconnected light exclusion zones and variable light regimes with reduced intensity of light in specific areas (e.g. important foraging and commuting habitats) as responses to street lighting may vary between species. It recommends that there should be a 'light threshold'.

1.2.3.2.1 Lighting Guidelines – Effective Mitigation Measures

As a consequence of this extensive amount of research there are two principal guideline documents available for best practice for effective mitigation relating to outdoor lighting.

EUROBATS (Voigt *et al.,* 2018) guidelines recommends the following:

- ALAN should be strictly avoided, and artificial lighting should be installed only where and when necessary coupled with the following:
    - Dynamic lighting schemes, where possible.
    - Use a minimal number of lighting points and luminaires on low positions in relation to the ground for minimising light trespass to adjacent bat habitats or into the sky.
    - Use focused light, e.g. by using LED or shielded luminaires which limit the light flux only to the required areas and prevent light trespass into adjacent bat habitats.
    - Create screens, either by erecting walls or by planting hedgerows or trees, to prevent light trespass, e.g. from illuminated roads, to surrounding bat habitats.
    - Exits of bat roosts and a buffer zone around them should be protected from direct or indirect lighting to preserve the natural circadian rhythm of bats.

This BCT (2018) guidelines provides a list of recommendations in relation to luminaire design, which is based on the extensive research completed to-date on the potential impact of lighting on bats, and therefore provides best practice mitigation measures. These recommendations are the basis of mitigation measures pertaining to bats listed in this report and are summarised as follows:

- All luminaires used should lack UV/IR elements to reduce impact.
- A warm white spectrum (<2700 Kelvins should be used to reduce the blue light component of the LED spectrum).
- Luminaires should have a peak wavelengths higher than 550nm to avoid the component of light most disturbing to bats.
- Only luminaires with an upward light ratio of 0% and with good optical control should be used.
- Luminaires should be mounted on the horizontal, i.e. no upward tilt.
- Column heights should be carefully considered to minimise light spill. The shortest column height allowed should be used where possible.
- Bollard lighting should be considered for pedestrian, parks and greenway areas, if deemed necessary.

1.2.3.3 Bat Box Schemes

Bat Boxes are frequently used as part of bat mitigation to retain local bat populations within an area proposed to be development. The NPWS Bat Mitigation Guidelines (Marnell *et al.* 2022) considers that where roosts of low conservation significance (Figure 20, Marnell *et al.* (2022)) are to be lost due to a development, bat boxes may provide an appropriate form of mitigation and the effectiveness depends on the type of bat box provided, which should be appropriate to the bat species.

Table 7 The types of bat box used by different species.

Species	Summer/ maternity	Summer/non breeding	Hibernation*	Notes
Rhinolophus hipposideros	N/A	N/A	N/A	Horseshoe bats cannot use bat boxes
Myotis daubentonii	H	H		
Myotis mystacinus	H	H		
Myotis nattereri	H	?		
Pipistrellus nathusii	H	H		
Pipistrellus pipistrellus	C	C/H	C	H are rarely used as maternity roosts.
Pipistrellus pygmaeus	C	C/H	C	
Nyctalus leisleri	H	H	H?	
Plecotus auritus	H	H		Maternity roosts

Key

* Large well-insulated hibernation boxes may be more successful

N/A -not applicable; bat boxes should not be considered as replacement roosts

H – tree hollow-type box, providing a void in which bats can cluster

C – tree crevice-type box, with 25-35mm crevices

? – few data on which to base an assessment

Figure 1g: Table 7 (p 58) Reproduced from Marnell *et al.* (2022).

1.2.3.3.1 Effectiveness of Bat Boxes as a Mitigation Measure

Two publications that provide good scientific advise in relation to the effectiveness of bat boxes are presented below. McAney & Hanniffy (2015) reviewed the use of bat boxes in Ireland in relation to the bat usage of the following bat box schemes: 62 Schwegler boxes of three models erected in Portumna Forest Park (Bat box scheme consisted of 30x 1FF design, 30x 2FN design and 2x 1FW design); 50 2FN boxes erected in Coole-Garryland Nature Reserve and 50 2FN boxes erected in Knockma Nature Reserve of which 40 were later transferred to Glengarriff Nature Reserve County Cork. The bat box schemes were set up in March 1999 and data was collected up to 2015. Eight of the nine resident bat species were recorded roosting in bat boxes (lesser horseshoe bats cannot use bat boxes due to their need to fly, rather than crawl, into roosts). The main summary points are as follows:

- Leisler's, brown long-eared and *Pipistrellus* spp. were recorded in boxes at all three Galway woods, Daubenton's bat was only recorded in Garryland, Natterer's bat was only recorded in Glengarriff and whiskered/Brandt's was recorded just twice.
- There was a 31% chance of encountering a bat at Portumna Forest Park compared to 11.5% and 10% at Coole-Garryland Nature Reserve and Knockma Nature Reserve respectively.
- Pipistrellus spp. preferred 1FF boxes as this bat box design offer crevice-like roosting conditions. This species group also showed a seasonal preference with more bats present later in the season (visual observations confirmed the bats were using the boxes as mating roosts) and their numbers increased from the time that the bat box scheme was originally established.
- Brown long-eared bats preferred 2FN boxes that mimic holes in trees, the natural roosting sites for this species. This species also showed no seasonal pattern to their occurrence in the boxes. However one aspect of 2FN boxes that this report mentions is the high occupancy by birds which can be an issue in relation to nesting material reducing the availability of bat boxes for roosting bats.
- Leisler's bat showed no preference for box model but showed a seasonal preference with more bats present later in the season.
- Aspect was not a significant factor for occupancy but most boxes received dappled sunshine for part of the day.
- The other factor that proved significant was the length of time the boxes were in place, with occupancy rates increasing for all three species, although in the case of pipistrelles this increase appears to have stabilised. So, although the boxes were occupied very quickly, it took several years before they were regularly occupied and before clusters of bats were formed and breeding was confirmed.

Collins *et al.* (2020) investigated the implementation and effectiveness of bat roost mitigation, which included bat boxes, in building developments completed between 2006 and 2014 in England and Wales. The bat species studied were: common and soprano pipistrelle, brown long-eared bat and *Myotis* species, all of which are present in Ireland. A summary of the main points relating to bat boxes are as follows:

- Bat boxes were the most frequently deployed roosting provision (i.e. alternative roosts), being installed at 64% (n = 71) of sites surveyed as a compensation or enhancement measure.
- Box frequencies ranged from 1 to 41 at sites where they were installed, with an average of 6.6 boxes per site.
- Bats, or evidence of bats, were recorded in 20% of these bat boxes.

- Bat boxes mounted externally on buildings showed the highest occupation rate regardless of species while Common pipistrelle showed a preference for these over tree mounted boxes; the opposite was true for soprano pipistrelle.
- The four most popular bat box models used by consultants in the study were all Schwegler woodcrete bat boxes. Bat presence was highest in the 1FF bat box design (32%, n = 53) and lowest for birds (8%). The tree-mounted 2F and wall-integrated 1FR/2FR models both demonstrated similar bat presence rates of 23% (n = 43) and 25% (n = 32) respectively. The 2FN tree-mounted model showed the lowest presence rate for bats (11%, n = 19) and the highest for birds (58%). There were also 26 timber bat boxes, none of which were used by bats.

The author has also erected a number of bat box schemes and, where possible, has completed occasional monitoring visits. One such example is a bat box scheme erected in Kileshandra, Co. Cavan which consists of 8 Schwegler woodcrete bat boxes of various designs. The bat boxes were erected on mature trees located in a linear woodland adjacent to a river. This bat box scheme was erected in 2012 as part of mitigation for the demolishment of a large derelict building where small satellite roosts were recorded for *Pipistrellus* spp. and Daubenton's bat. Two site visits have been completed since 2012 and during these visits the bat boxes were checked for evidence of bat usage. The first site visit was on 25/8/2015 and one bat box was occupied by a single Leisler's bat while the additional seven bat boxes had evidence of bat droppings (*Pipistrellus* spp. and *Myotis* spp.). During the second site visit (27/7/2019) four bat boxes were occupied by bats (Soprano pipistrelle x1 individual (adult male), Leisler's bat x1 individual (adult male) and two bat boxes with x16 Daubenton's bats and x10 Daubenton's bats respectively). Biometrics was recorded for the 12 of the bats (which included 10 of the Daubenton's bats recorded in the bat box with 16 individuals) and five of these Daubenton's bats were lactating females with the remaining five Daubenton's bats recorded as juveniles, thereby indicating that this bat box was used as a maternity roost. The remaining four bat boxes all had droppings within for *Pipistrellus* spp and Leisler's bats. This bat box scheme, while just one example, demonstrates that when bat boxes are erected in an area with good bat habitat (bat survey documented a high level of bat activity for the named bat species), a high level of occupancy of bat boxes will occur.

In relation to bat boxes, Marnell *et al.* (2022), a document that provides guidelines that are considered to be practical and effective based on past experience, recommends that the design life of potential bat boxes, including essential maintenance, should be about 10 years, as this would be comparable with the lifespan of the tree roosts that bat boxes are designed to mimic. The guidelines continues by stating that the "This lifespan can be achieved with good quality wooden boxes and exceeded by woodcrete bat boxes or other types of construction that ensure any softwoods are protected from the weather and attack by squirrels" (note – this includes woodstone bat boxes).

In relation to the number of bat boxes recommended to be erected, Lintott & Mathews (2018) found that the greater the number of bat boxes deployed, the greater the probability of at least one of the boxes becoming occupied and that the odds of bats occupying at least one box increased by approximately 7% with each additional bat box that was deployed.

Therefore woodcrete bat boxes are recommended as a bat mitigation measure and the author's preference to use 1FF designs as this box is open at the bottom which reduces build-up of droppings (i.e. it is a self-cleaning bat box). Both McAney & Hannify (2015) and Collins *et al.* (2020) demonstrated that usage of this bat box design by bat species recorded in this survey report. This bat box is also less likely to be used by birds and therefore retaining it for bat usage between monitoring visits. To increase occupancy of bat boxes by bats it is important to erect bat boxes 4m or higher (to ensure that bat boxes are out of reach from disturbance by humans and predation by

other mammals) and that they should be located where bats have been documented foraging and commuting. The aspect of the bat box is not an influencing factor in relation to occupancy. These recommendations have all been included in this report.

1.2.3.4 Landscaping For Bats

Bats depend on the landscape for foraging, roosting and commuting. Different bat species will travel different distances, to and from their principal roosting sites, depending on their morphology, life stage and preferred foraging areas. Bats in Ireland are insect eating mammals and feed on an array of insects, whose populations are ultimately supported by vegetation. Areas of rich vegetation habitat tend to support higher abundances of insect populations and therefore a higher abundance of bats. In addition, many bat species rely on continuous linear habitats (e.g. treelines and hedgerows) to commute along. As a consequence landscaping as part of a proposed development project is an important element to the goal of retaining local bat populations.

The Bat Conservation Trust publication "Landscape and Urban Design for bats and biodiversity" (Gunnell *et al.,* 2012) is a resource for planning landscape design in our urban areas. This resource encourages measures to enhance existing bat foraging habitat, create water features such as ponds (drinking sites for bats and as a source of emerging insects), manage species rich grassland and planting of tall vegetation to ensure that exiting treelines and hedgerows are linked. It also recommends that use of landscaping as a means to creating dark zones or dark corridors for this mammal group to fly along in our lit urban areas. This is also support by the BCT Lighting Guidelines (BCT, 2018) where landscape design can be utilised to buffer potential light spillage from developments.

1.2.3.5 Seasonality of Bat Mitigation Measures

The NPWS Bat Mitigation Guidelines (Marnell *et al.* 2022) provides best practice guidance in relation to the timing of bat mitigation measures. It states that the most common and effective method of avoiding potential harm to a bat is to carry out the work at an appropriate time of the year. The following table provides a summary of timings.

Table 5 Optimum season for works in different types of roosts.

Bat usage of site	Optimum period for carrying out works (some variation between species)
Maternity	1st October – 1st May
Summer (not a proven maternity site)	1st September – 1st May
Hibernation	1st May – 1st October
Mating/swarming	1st November – 1st August

Figure 1h: Table 5 (p 50) Reproduced from Marnell *et al.* (2022).

Timing of bat mitigation measures is relevant to the proposed tree felling of Potential Bat Roosts (PBRs). Felling is recommended outside the principal maternity season and during mild weather conditions (to avoid cold weather that would encourage bats to hibernate). This coupled with dusk/dawn surveys and additional daytime inspections is best practice to ensure that tree felling is completed without causing harm to potentially roosting bats. The preferred tree felling months also avoids the bird nesting season.

1.3 Project Description

1.3.1 Site Location

The survey site is located within the grounds of Spicer's Bakery and the Andy Brennan Park, Navan, Co. Meath. The survey area was primarily focused on buildings within named areas as well the immediate area of the River Boyne and Boyne Canal adjacent to the bakery and The Ramparts.

Figure 2a: Principal survey area – within red line boundary (Source: Meath Co. Co).

1.3.2 Proposed Project

The main elements of the plans for the proposed development area include:

Former Bakery Site

1. The preservation and conservation of the former Spicer's Bakery Protected Structure.
2. Demolition of associated sheds in yard.
3. Renovation and extension of 2 storey former office building associated with Spicer's Bakery for the purposes of a café.

Ramparts Car Park

4. Reconfiguration of the Ramparts Car Park and proposed new and improved access and egress proposals.
5. Provision of open space passive recreation areas (including a band stand).
6. Improve permeability and visibility to the Ramparts.

Andy Brennan Park

7. Demolition of the derelict terraced dwellings fronting the Athlumney Rd.
8. New stepped plaza at entrance of Andy Brennan Park.
9. A redesign of the Andy Brennan Park primarily for the purposes of an Active Recreational Play Area.

The following figure depicts the proposed works for buildings located within the proposed development area:

Figure 2b: Layout of proposed development of Spicer's Bakery & Andy Brennan Park, Navan, Co. Meath.

The planning notice is as follows:

MEATH COUNTY COUNCIL
Notice of Application to An Bord Pleanála for Approval
Proposed development at the Former Spicer's Bakery, Ramparts Car Park and Andy Brennan Park, Athlumney, Navan, Co. Meath.

Pursuant to Section 177AE of the Planning & Development Act 2000-2022 and the requirements of the Planning & Development Regulations 2001-2022 notice is hereby given that Meath County Council intends to make an application for approval to An Bord Pleanála to carry out development at the formers Spicer's Bakery (Registered Protected Structure), the ramparts car park and Andy Brennan Park in the townland of Athlumney, Navan, Co. Meath. The application site includes a protected structure no. 90881 The Former Spicer's Bakery.

The proposed development comprises of the following;

1. The preservation and conservation of the former Spicer's Bakery (PS) and the demolition of associated outbuildings and sheds.

2. The renovation and extension of the former Spicer's Bakery 2 Storey Office Building as a café with an associated public realm area inclusive of bandstand.

3. The reconfiguration of the Ramparts Carpark with new access and egress points, cycle parking, public realm area and footpaths.

4. The demolition of 4 no. terraced derelict properties along the Athlumney Road and replacement with a stepped public plaza area at the entrance to Andy Brennan Park.

5. The redevelopment of the Andy Brennan Park for active recreational use including the refurbishment of the existing fishing platform.

6. Associated landscaping, associated pedestrian linkages including 2 no. pedestrian crossings; site drainage works; and all associated site development works.

2. Bat Survey Methodology

2.1 Daytime Inspections

One purpose of daytime inspections is to determine the potential of bat roosts within the survey area. Due to the transient nature of bats and their seasonal life cycle, there are a number of different type of bat roosts. Where possible, one of the objectives of the surveys is to be able to identify the types of roosts present, if any. However, the determination of the type of roost present depends on the timing of the survey and the number of bat surveys completed. Consequently, the definition of roost types, in this report, will be based on the following:

Table 4a: Bat Roost Types (adapted from Collins 2016).

Roost Type	Definition	Time of Survey
Day Roost	A place where individual bats or small groups of males, rest or shelter in the daytime but are rarely found by night in the summer.	Anytime of the year
Night Roost	A place where bats rest or shelter in the night but are rarely found in the day. May be used by a single bat on occasion or it could be used regularly by the whole colony.	Anytime of the year
Feeding Roost	A place where individual bats or a few bats rest or feed during the night but are rarely present by day.	Anytime of the year
Transitional Roost	A place used by a few individuals or occasionally small groups for generally short periods of time on waking from hibernation or in the period prior to hibernation.	Outside the main maternity and hibernation periods.
Swarming Site	Where large numbers of males and females gather. Appear to be important mating sites.	Late summer and autumn
Mating Site	Where mating takes place.	Late summer and autumn
Maternity Site	Where female bats give birth and raise their young to independence.	Summer months
Hibernation Site	Where bats are found, either individually or in groups in the winter months. They have a constant cool temperature and humidity.	Winter months in cold weather conditions
Satellite Roost	An alternative roost found in close proximity to the main nursery colony and is used by a few individuals throughout the breeding season.	Summer months

2.1.1 Building & Structure Inspection

Structures, buildings and other likely places that may provide a roosting space for bats are inspected during the daytime for evidence of bat usage. Evidence of bat usage is in the form of actual bats (visible or audible), bat droppings, urine staining, grease marks (oily secretions from glands present on stonework) and claw marks. In addition, the presence of bat fly pupae (bat parasite) also indicated that bat usage of a crevice, for example, has occurred in the past. Inspections are undertaken visually

with the aid of a strong torch beam (LED Lenser P14.2) and endoscope (General DC5660A Wet / Dry Scope).

Buildings were assessed to determine their suitability as a bat and described using the parameters Negligible, Low, Medium or High suitability in view of Table presented in the previous section.

Survey Dates: 16th August 2022

2.1.2 Tree Potential Bat Roost (PBRs) Inspection

Trees that may provide a roosting space for bats were classified using the Bat Tree Habitat Key (BTHK, 2018) and the classification system adapted from Collins (2016). The Potential Roost Features (PRFs) listed in this guide were used to determine the PBR value of trees.

Trees identified as PBRs were inspected during the daytime (9th December 2022), where possible, for evidence of bat usage. Evidence of bat usage is in the form of actual bats (visible or audible), bat droppings, urine staining, grease marks (oily secretions from glands present on stonework) and claw marks. In addition, the presence of bat fly pupae (bat parasite) also indicated that bat usage of a crevice, for example, has occurred in the past.

A general daytime inspections were undertaken of parkland trees within the Sports Campus adjacent to location of static units. These inspections followed the Phase 1 guidance (Collins, 2016) and were undertaken visually, from the ground, with the aid of a strong torch beam (LED Lenser P14.2) during the daytime searching for PRFs.

Table 4b: Tree Bat Roost Category Classification System (adapted from Collins, 2016).

Tree Category	Description
1 High	Trees with multiple, highly suitable features (Potential Roosting Features = PRFs) capable of supporting larger roosts
2 Moderate	Trees with definite bat potential but supporting features (PRFs) suitable for use by individual bats;
3 Low	Trees have no obvious potential although the tree is of a size and age that elevated surveys may result in cracks or crevices being found or the tree supports some features (PRFs) which may have limited potential to support bats;
4 Negligible	Trees have no potential.

A general walkabout survey was undertaken in relation to potential areas for locating alternative bat roost for Leisler's bats. This bat species is primarily a tree roosting species and therefore, the potential location of a bat house would be best positioned in an area of mature trees with good bat roosting features.

Survey Date: 9th December 2022

2.1.3 Bat Habitat & Commuting Routes Mapping

The survey site was assessed during daytime walkabout surveys (16th August and 9th December 2022), in relation to potential bat foraging habitat and potential bat commuting routes. Such habitats were classified according to Fossit, 2000 (Appendix 1, Table 1.B) while hedgerows were classified

according to BATLAS 2020 classification (Bat Conservation Ireland, 2015) (Appendix 1, Table 1.A). Bat habitats and commuting routes identified were considered in relation to the wider landscape to determine landscape connectivity for local bat populations through the examination of aerial photographs.

2.2 Night-time Bat Detector Surveys

2.2.1 Dusk, Dawn & Walking Transect Bat Surveys

Dusk Surveys were completed on the 16th and 17th August 2022 from 10 minutes before sunset to 110 minutes post sunset and the surveyors (x3) position themselves within the proposed development site to determine the general bat activity of the proposed development site. This was following by walking transects of the proposed development site and immediate vicinity of the proposed development site (i.e. River Boyne, Athlumney and the Ramparts). A dawn survey (x2 surveyors) was undertaken on the 17th August 2022 from 110 minutes before sunrise to 20 minutes after sunrise. The area between Spicer's Bakery and The Ramparts was the primary focus for this survey.

The following equipment was used:

Surveyor 1 (Principal surveyor): Anabat Walkabout Full Spectrum Bat Detector and Petersson D200 Heterodyne Bat Detector.

Surveyor 2: Bat Logger M2 Full Spectrum Bat Detector and Petersson D200 Heterodyne Bat Detector.

Surveyor 3: Anabat Scout Full Spectrum Bat Detector and Petersson D200 Heterodyne Bat Detector.

2.2.2 Passive Static Bat Detector Survey

A Passive Static Bat Surveys involves leaving a static bat detector unit (with ultrasonic microphone) in a specific location and set to record for a specified period of time (i.e. a bat detector is left in the field, there is no observer present and bats which pass near enough to the monitoring unit are recorded and their calls are stored for analysis post surveying). The bat detector is effectively used as a bat activity data logger. This results in a far greater sampling effort over a shorter period of time. Bat detectors with ultrasonic microphones are used as the ultrasonic calls produced by bats cannot be heard by human hearing.

The microphone of the unit was positioned horizontally to reduce potential damage from rain. Wildlife Acoustics Song Meter SM4 BAT and Mini Bat use Real Time recording as a technique to record bat echolocation calls and using specific software, the recorded calls are identified. It is these sonograms (2-d sound pictures) that are digitally stored on the SD card (or micro SD cards depending on the model) and downloaded for analysis. These results are depicted on a graph showing the number of bat passes per species per hour/night. Each bat pass does not correlate to an individual bat but is representative of bat activity levels. Some species such as the pipistrelles will continuously fly around a habitat and therefore it is likely that a series of bat passes within a similar time frame is one individual bat. On the other hand, Leisler's bats tend to travel through an area quickly and therefore an individual sequence or bat pass is more likely to be indicative of individual bats.

The recordings are analysed using Wildlife Acoustics Kaleidoscope Pro. Each sequence of bat pulses are noted as a bat pass to indicate level of bat activity for each species recorded. This is either expressed as the number of bat passes per hour or per survey night. The following static units were deployed during this static bat detector survey (16th to 23rd August 2022).

Table 4c: Static Bat Detectors deployed during Static Bat Detector Surveys.

Static Unit Code	Bat Detector Type	Recording Function	Microphone
SM4 Bat units	Wildlife Acoustics SongMeter 4 Bat FS	Passive Full Spectrum	SMM-U2, 4m cable

2.3 Desktop Review

2.3.1 Bat Conservation Ireland Database

Bat Conservation Ireland acts as the central depository for bat records for the Republic of Ireland. Its' bat database is comprised of >60,000 bat records. The database primarily contains bat records from the following datasets:

- Irish Bat Monitoring Programme

The Irish Bat Monitoring Programme is comprised of four surveys (Car-based Bat Monitoring Scheme (2003-), All Ireland Daubenton's Bat Waterways Survey (2006-), Brow Long-eared Bat Roost Monitoring Scheme (2007-) and Lesser Horseshoe Bat Monitoring Scheme (1980s-). Apart from the latter survey, all monitoring data is stored on the BCIreland database.

- BATLAS 2020 & 2010

BCIreland has undertaken two all-Ireland species distribution surveys (2008-2009 for BATLAS 2010 and 2016-2019 for BATLAS 2020) of four target bat species (Common and soprano pipistrelle, Leisler's bats and Daubenton's bat).

- Ad Hoc Bat Records

Ad hoc bat records from national bat groups, ecological consultants and BCIreland members are also stored on the BCIreland database.

- Roost Records

These records are only report at a 1km level to protect the location of private dwellings and to protect such important bat records.

A 1km radius search was requested for the Irish Grid Reference N8739467866.

2.3.2 Bat Conservation Ireland Bat Landscape Favourability Model

Bat Conservation Ireland produced a landscape conservation guide for Irish bat species using their database of species records collated during the 2000 - 2009 survey seasons. An analysis of the habitat and landscape associations of all bat species deemed resident in Ireland was undertaken and reported in Lundy *et al*., 2011. The geographical area suitable for individual species was used to identify the core favourable areas of each species. This was produced as a GIS layer for local authorities and planners in order to provide a guide to the consideration of bat conservation. The island is divided into 5km squares and the landscape favourability of each 5km square for each species of bat was modelled. A caveat is attached to the model and it is that the model is based on records held on the BCIreland database, while core areas have been identified, areas outside the core area should not be discounted as unimportant as bats are a landscape species and can travel many kilometres between roosts and foraging areas nightly and seasonally. This model was used as part of the desktop study for this report.

3. Bat Survey Results

3.1 Daytime Inspections

3.1.1 Building & Bridge Inspections

The following buildings / structures were inspected on the 16th August 2022. The names of the buildings/structures listed are labelled with reference to the Conservation Management Plan.

Figure 3a: Buildings surveyed within Spicer's Bakery, Navan, Co. Meath (Source: Conservation Management Plan).

Figure 3b: Buildings surveyed within Andy Brennan Park, Navan, Co. Meath.

Table 5a: Building & Bridge inspection results.

Building Code	Description	No.	Roost Type / Suitability
Spicer's Bakery – Protected structure mill building	Large natural stone structure with corrugated roof. This structure is open and connected to the industrial sheds.	No. 1	Medium to High Open stone crevices, lots of small tight spaces suitable for roosting bats. Large open window to rear of structure to allow bats to commute directly to Boyne Canal, River Boyne & The Ramparts.
Spicer's Bakery – 2 storey office building	2-storey modern building with attic space. Slate roof.	No. 2	Medium to High Slate roof and attic space. But no evidence of usage found during inspection.
Spicer's Bakery – industrial sheds	Corrugated roof structures with walls constructed from various materials e.g. stone.	No. 3	Low to Medium Not suitable of roosting but due to their proximity to the Ramparts and direct connection to mill, bats would avail of these dry open spaces during inclement weather conditions.
Spicer's Bakery - warehouses	Large modern warehouse structures.	No. 4	Low Not suitable of roosting but due to their proximity to the Ramparts and direct connection to other buildings and courtyards, bats would avail of these dry open spaces during inclement weather conditions.
Spicer's Bakery – derelict structures	Derelict cottage and townhouse (located adjacent to Navan Silver Band buildings) in poor condition and derelict walls/courtyards in between industrial sheds.	No. 5	Medium Exposed walls with crevices and small tight spaces suitable for roosting bats. Due to their proximity to the Ramparts and direct connection to mill, bats may avail of these dry spaces.
Andy Brennan Park – terrace houses	Row of derelict houses in poor condition. Roof collapsed in sections.	No. 6	Medium While the roof has partially collapsed, an attic space is present and therefore provides a roosting space for bats.
Andy Brennan Park – pump house	Single storey structure, stone cladding and slate roof.	No. 7	Medium Timber facia/soffit on natural stone provides suitable crevices for bats to access internal space.
Bridge No. 1	Single arch stone bridge within The Ramparts – Ruxton Lock.		Low – no deep crevices suitable for roosting bats.
Bridge No. 2	Single arch bridge under Athlumney Road		Low – no deep crevices suitable for roosting bats.

3.1.2 Tree Potential Bat Roost (PBRs) Inspection

There are a large number of mature parkland trees within the survey area and within the immediate area of the Ramparts (located outside the red line boundary of the proposed development area) that are considered to be Category 1 and 2 PBRs. As a consequence, these trees provide roosting features for bat species recorded during the survey and more importantly, are a buffer zone in relation to lighting present as a result of the urban setting of the survey area adjacent to the River Boyne. A Phase 1 tree inspection was completed on 9th December 2022 and all trees listed in the tree survey report were visually inspected during the daytime. A total of 3 trees were classed as Category 1 trees, 24 trees were classed as Category 2 trees and 2 trees as Category 3 trees in relation to their PBR value (as per Table 4b, Section 2.1.2). Category 1 trees are particularly important as these are large mature oak trees with extensive features for roosting bats.

The majority of the trees located in Andy Brennan Park are primarily young trees with little bat habitat and roosting value. These trees are not listed in the table below but the following do not have a bat roosting value: T1822 to T1846, T1848 – T1865.

Table 5b: Results of Phase 1 Tree Inspection.

Tree Tag Code	Tree Species	Features	PBR Value
T1775	Beech	Small tree holes due to previous tree surgery works	Category 2
T1776	Beech	No features suitable for roosting bats	None
T1777	Beech	No features suitable for roosting bats	None
T1778	Beech	Small tree holes due to previous tree surgery works	Category 2
T1779	Beech	No features suitable for roosting bats	None
T1780	Beech	No features suitable for roosting bats	None
T1781	Beech	Joins – two areas of tree	Category 2
T1782	Sycamore	Ivy, dead wood, spilt limbs	Category 2
T1783	White Willow	Heavy ivy growth, dead wood	Category 2
T1784	Sycamore	Ivy	Category 2
T1785	Beech	Dead wood	Category 2
T1786	Oak	No features suitable for roosting bats	None
T1787	Elm	No features suitable for roosting bats	None
T1788	White Willow	No features suitable for roosting bats	None
T1789	Larch	No features suitable for roosting bats	None
T1790	Larch	No features suitable for roosting bats	None
T1791	Larch	No features suitable for roosting bats	None
T1792	Sycamore	Tree holes, spilt limbs	Category 2
T1793	Sycamore	Tree holes (old surgery works)	Category 2
T1794	Sycamore	Ivy growth	Category 2
T1795	Sycamore	Ivy growth, tree holes	Category 2

T1796	Oak	Dead limbs, lots of crevices, peeling bark	Category 1
T1797	Oak	Dead wood	Category 1
T1798	Sycamore	Dead wood - minor	Category 3
T1799	Beech	Dead wood - minor	Category 3
T1800	Sycamore	Wounds, dead wood	Category 2
T1801	Oak	Dead wood, spilt limbs	Category 2
T1802	Oak	Ivy growth, dead wood	Category 2
T1803	Sycamore	Ivy growth	Category 2
T1804	Elm	Not applicable – tree not present	Not applicable
T1805	Sycamore	Ivy growth, wounds	Category 2
T1806	Oak	Large tree with numerous suitable features	Category 1
T1807	Sycamore	Wounds	Category 2
T1808	Sycamore	Ivy growth, wounds	Category 2
T1809	Sycamore	Ivy growth, wounds	Category 2
T1810	Oak	Dead wood, spilt limbs	Category 2
T1811	Oak	Dead wood, spilt limbs	Category 2
T1812	White Willow	Bark wounds	Category 2
T1813	White Willow	Bark wounds	Category 2
T1814	White Willow	Not applicable – tree not present	Not applicable
T1815	Popular	No features suitable for roosting bats	None
T1816	Alder	No features suitable for roosting bats	None
T1817	Alder	No features suitable for roosting bats	None
T1818	Willow	No features suitable for roosting bats	None
T1819	Willow	No features suitable for roosting bats	None
T1820	Willow	No features suitable for roosting bats	None
T1821	Elm	Not applicable – tree not present	Not applicable
T1847	Silver Birch	Ivy growth	Category 2

Due to the urban setting of both the Ramparts and Andy Brennan park, tall vegetation is an essential component to reduce the spilling of street lighting onto the water surface of the River Boyne. The River Boyne and River Blackwater are essential dark conduits through the town of Navan that aids the commuting and foraging of nocturnal wildlife and this is particularly important for local bat populations. It is essential that these watercourses are protected from lighting pollution. In Andy Brennan Park, this includes the area named G1880 on the Tree Survey & Constraints Plan. In vicinity of the Ramparts this includes G1866 which buffers the canal from lighting in the existing car park. G1867 and G1870 protects the River Boyne from street lighting. The existing buildings and walls of Spicer's Bakery reduced lighting spill from Athlumney Road into the area of the Ramparts.

3.1.3 Bat Habitat & Commuting Routes Mapping

The habitat types, with reference to Fossit (2000) were recorded both within the survey area and adjacent to the survey area. This proposed development site is comprised of building complexes of Spicer's Bakery and terrace houses / pump house on the boundary of Andy Brennan Park. The Ramparts is area located along the River Boyne and Boyne canal to the rear of Spicer's Bakery while Andy Brennan Park is largely an open urban grassland area with some immature trees and shrubs.

The Ramparts is an important area for local bat populations for roosting, commuting and foraging. Such zones are important in an urban setting especially in reducing the negative impacts of lighting pollution.

Table 6a: Habitat types present within survey area.

Habitat	Yes	Habitat	Yes	Habitat	Yes	Habitat	Yes
Cultivated land		Salt marshes		Exposed rock		Fens/flushes	
Built land	√	Brackish waters		Caves		Grasslands	√
Coastal structures		Springs		Freshwater marsh		Scrub	√
Shingle/gravel		Swamps		Lakes/ponds		Hedges/treelines	√
Sea cliffs/islets		Disturbed ground		Heath		Conifer plantation	
Sand dunes		Watercourse	√	Bog		Woodland	√

Table 6b: Habitat types present adjacent to survey area.

Habitat	Yes	Habitat	Yes	Habitat	Yes	Habitat	Yes
Cultivated land		Salt marshes		Exposed rock		Fens/flushes	
Built land	√	Brackish waters		Caves		Grasslands	√
Coastal structures		Springs		Freshwater marsh		Scrub	√
Shingle/gravel		Swamps		Lakes/ponds		Hedges/treelines	√
Sea cliffs/islets		Disturbed ground	√	Heath		Conifer plantation	√
Sand dunes		Watercourse	√	Bog		Woodland	√

3.2 Night-time Bat Detector Surveys

The primary purpose of the night-time surveys were to determine the bat activity usage of the survey area and to determine if bats are roosting in the buildings within Spicer's Bakery and Andy Brennan Park. Due to the large array of buildings and structures, the location of surveyors during dusk and dawn surveys are marked on a map and name of survey locations are with reference to the Conservation Management Plan.

3.2.1 Dusk, Dawn Bat Surveys & Walking Transects

Bat detector surveys were completed on 16/8/2022 (Dusk survey weather conditions: 15oC, patchy cloud cover, light breeze and dry), 17/8/2021 (Dawn survey weather conditions: 9.5oC, full cloud cover, calm and dry) and 17/8/2022 (Dusk survey weather conditions: 18oC, full cloud cover, calm and dry). Due to the crowded (i.e. numerous buildings) survey area within Spicer's Bakery, it was important to try to cover as many angles of the buildings over the course of the three surveys (i.e. two dusk surveys and one dawn survey). Therefore the thermal imagery scopes were also deployed to cover specific points while surveyors were located to cover other aspects of the bakery. Over the three nights, as many angles as possible within the bakery were surveyed either by a surveyor or by filming.

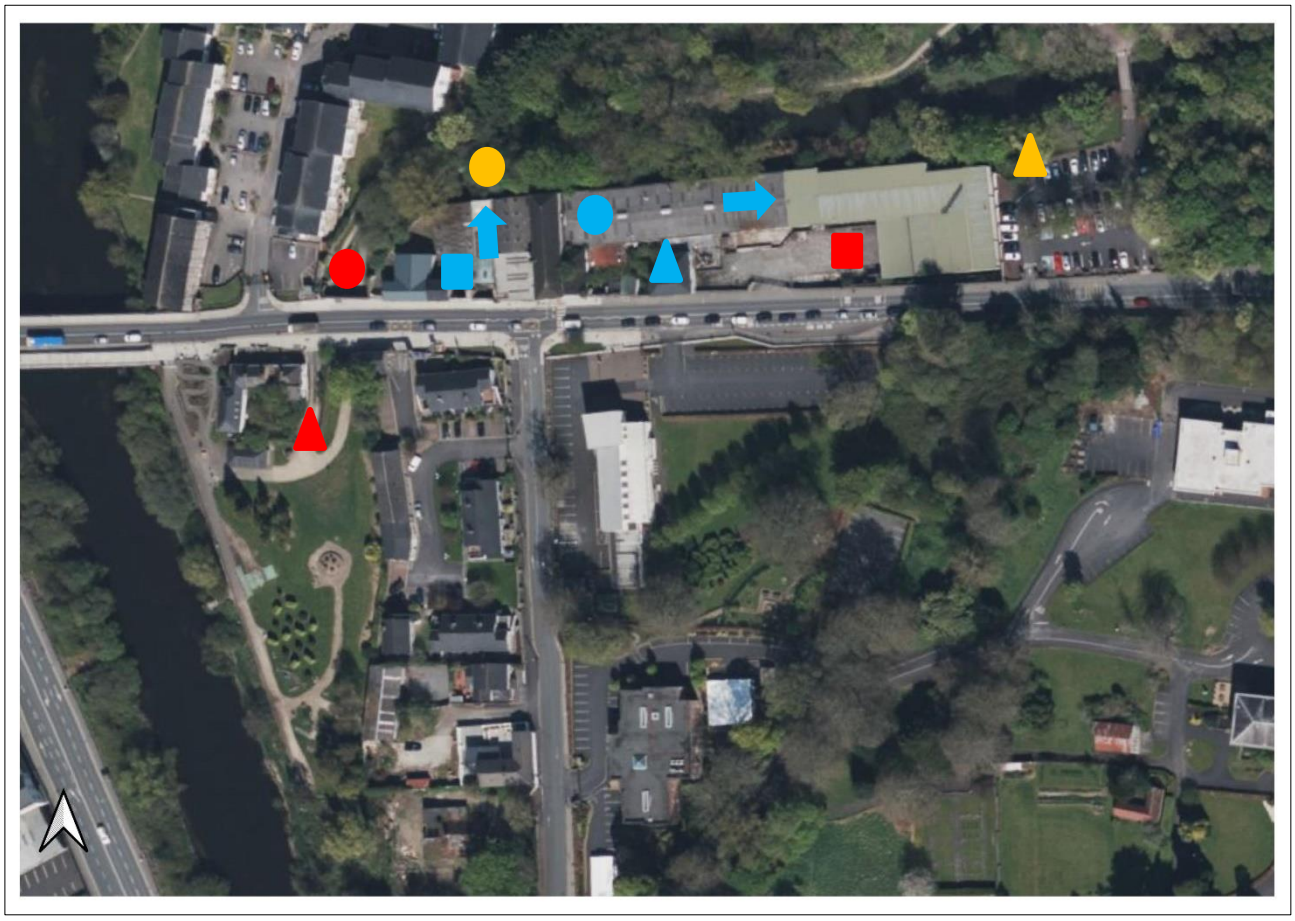

Figure 4a: Location of surveyors within Spicer's Bakery & Andy Brennan Park, Navan, Co. Meath.

KEY TO MAP

Surveyor 1 = Triangle; Surveyor 2 = Circle; Surveyor 3 = Square, Arrow = Thermal Imagery Scope (filming)
Colour of shapes = Survey Night: Blue = Dusk 16/8/2022; Orange = Dawn 17/8/2022, Red = Dusk 17/8/2022

3.2.1.1 Dusk Survey 16/8/2022 (Night 1)

During Night 1, three surveyors were located within the bakery to undertake the dusk survey (Figure 4a, Blue). Two thermal imagery cameras were set up to facilitate an accurate survey of the buildings.

Surveyor 1 recorded bat a Leisler's bat at 21:21 hrs but this was an individual commuting through survey area and not emerging from the buildings. The first soprano pipistrelle was recorded at 21:24 hrs and this was an emerging individual from the mill structure but the exact location of the emergence point was not recorded.

Surveyor 2 did not record any bats emerging from warehouses within the survey area.

Surveyor 3 recorded a soprano pipistrelle emerging from the walls of the derelict townhouse at 21:15 hrs. A common pipistrelle was recorded at 21:58 hrs but this was a commuting individual through the survey area.

On the thermal imagery scope located internally on the first floor of the mill, bats are recorded exiting through the open window at 21:43 hrs and 21:46 hrs. The second unit was located inside the large warehouse building and no bats were recorded on this unit.

Figure 4b: Screenshot of thermal imagery filming on 16/8/2022. Camera is located internally on the first floor of the mill building directed towards the rear window.

3.2.1.2 Dawn Survey 17/8/2022

During the dawn survey, two surveyors were located outside the perimeter of Spicer's bakery along the Boyne Canal to determine if bat were returning to roost in the buildings within the survey area. During the survey soprano pipistrelles were continuously recorded foraging within the tree canopy of the trees located to the rear of the bakery and between the Boyne Canal and the River Boyne. Daubenton's bats were recorded foraging over the water surface of the river. At sunrise, 3 individuals (soprano pipistrelles) returned to roost in the buildings of the bakery by entering holes in the walls of

the industrial sheds and windows of the older sections of the buildings (i.e. mill building). In addition, a single brown long-eared bat was recorded returning to roost in the mill at 04:53 hrs. Soprano pipistrelles were recorded commuting along the canal towards Andy Brennan Park (3 individuals), likely returning to roost recorded in the terrace houses.

3.2.1.3 Dusk Survey 17/8/2022 (Night 2)

During Night 2, three surveyors were located within the bakery to undertake the dusk survey (Figure 4a, Red).

Surveyor 1 recorded a soprano pipistrelles roost of (>20 individuals) emerging for the middle section of the terrace houses along the boundary of the Andy Brennan Park. The bats emerged from the collapsed section of the roof and therefore the bats a likely to roosting in the attic spaces of the houses. Individuals from this roost commuted to The Ramparts (see Figure 6c – Yellow Arrow) by travelling along the existing path under and over the road bridge towards the River Boyne.

Surveyor 2 also noted the emerging soprano pipistrelle bats and their commuting route direction to The Ramparts.

Surveyor 3 did not record any bats emerging from the buildings within the main car park of Spicer's Bakery. Three species of bat was recorded commuting through the survey area: common pipistrelle, soprano pipistrelle and Leisler's bat.

3.2.1.4 Summary of Results

- Soprano pipistrelle roost in terrace houses of Andy Brennan Park, likely to be a small maternity roost or a large satellite roost.

NOTE: this species of bat tends to form large maternity roost of 100+ individuals. However, the only way to confirm if it is a maternity roost is to catch individuals and sex and age them. This was not possible during this survey due to the derelict condition of the building and the height at which the bats were emerging from the roof space. Therefore, the exact type of roost present remains unknown.

- Individuals of soprano pipistrelle and brown long-eared bats were recorded roosting in the mill and these are likely to be a satellite roosts.
- Individuals of soprano pipistrelle were recorded roosting in the stone walls of the derelict town house (adjacent to Navan Silver Band building), likely to be a satellite roost.

3.2.2 Passive Static Bat Detector Survey

3.2.2.1 Static Surveillance

The following tables provides details with regards to the static units deployed in 2022 during the bat survey. Six static units were deployed for one to seven nights, two units were located on trees, one to the rear of the buildings along the boundary of Andy Brennan Park and one on a tree along the Boyne Canal to the rear of the bakery warehouses. The remaining units were located within buildings of the bakery Five bat species were recorded during the static surveillance: common pipistrelle, soprano pipistrelle, brown long-eared bat, Daubenton's bat and Leisler's bat.

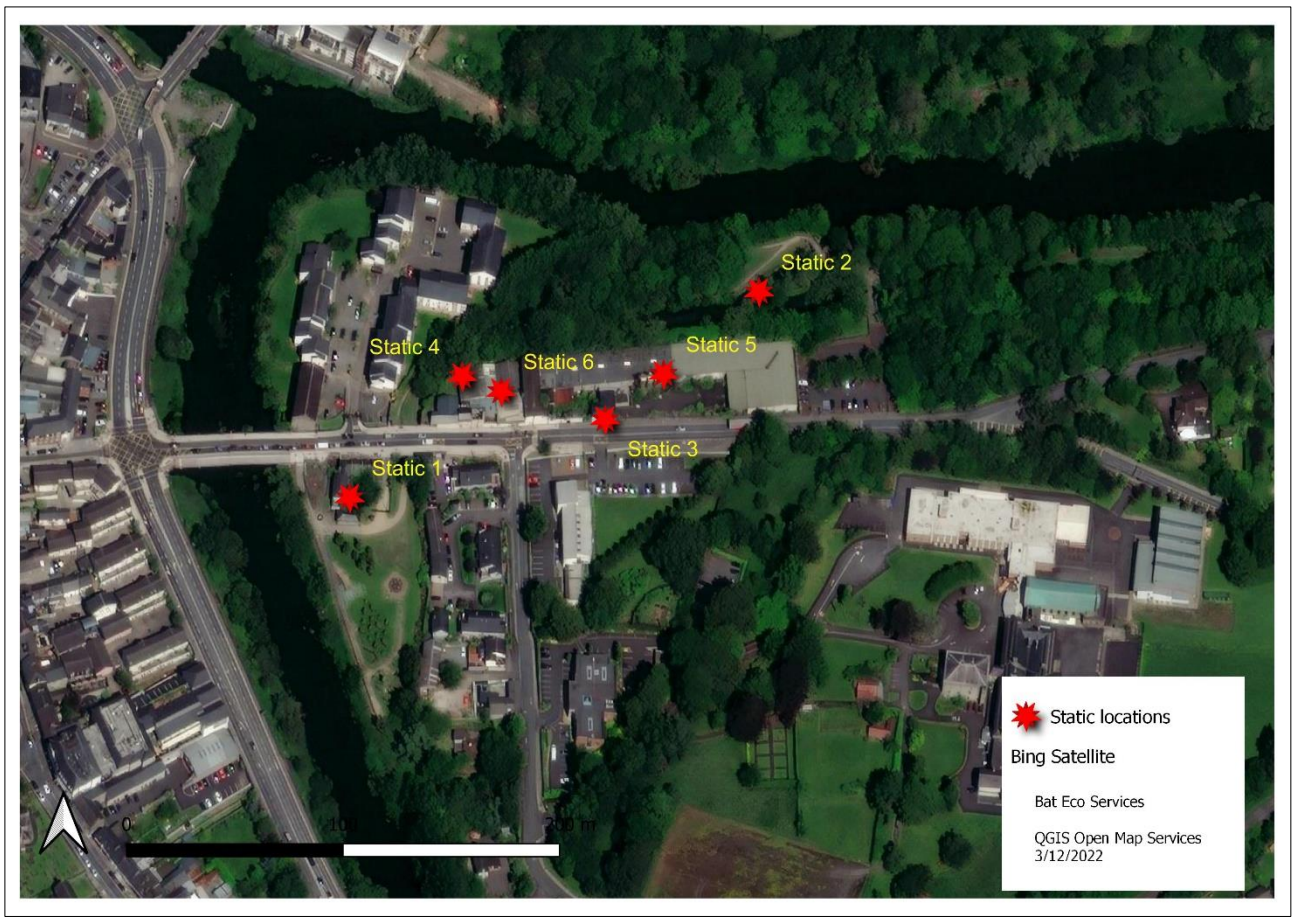

Figure 5: Location of static recording units.

The static unit (Static 3) located in the attic of the 2-storey office building recorded no bats species and therefore confirms that this is not a roosting site.

The static unit (Static 5) located in the modern warehouse buildings recorded brown long-eared bats. Five passes were recorded and these were during the middle of the night (01:21 to 01:57 hrs) indicating that bats entered the space briefly. No bat passes were recorded at dawn and therefore indicates that the space was not used as a day roost. It is likely that individuals of this species roosting in the mill flew into the warehouse. Bats explore spaces especially if there is inclement weather conditions.

The static unit (Static 6) located on Floor 1 of the mill recorded two species of bat (brown long-eared bat and soprano pipistrelle) and this confirms the results of the dusk survey. These two bat species are likely to be roosting within the mill structure. The level of brown long-eared bat activity was indicative of a single brown long-eared bat while the soprano pipistrelle was indicative of a small

number of soprano pipistrelles. This supports that the roosts present are likely to be satellite roosts or day roosts.

Table 7a: Results of Static Bat Detectors deployed during Static Bat Detector Surveys.

Static Code	Location Description	Survey Period	Results
Static 1	On tree to the rear of the terraces houses adjacent to Andy Brennan Park	16/8/2022 to 23/8/2022 (7 nights)	Leisler's bat, common pipistrelle, Daubenton's bat and soprano pipistrelle
Static 2	On tree adjacent to Boyne Canal	16/8/2022 to 23/8/2022 (7 nights)	Leisler's bat, common pipistrelle, Daubenton's bat and soprano pipistrelle
Static 3	Attic of 2-storey office building in Spicer's Bakery	16/8/2022 to 23/8/2022 (7 nights)	No bats recorded
Static 4	Open shed within the courtyard between the mill and 2-storey office building in Spicer's Bakery	16/8/2022 to 23/8/2022 (7 nights)	Leisler's bat, common pipistrelle, brown long-eared bat and soprano pipistrelle
Static 5	Located in modern warehouse building	17/8/2022 to 18/8/2022 (1 night)	Brown long-eared bat
Static 6	First floor of mill	16/8/2022 to 23/8/2022 (7 nights)	Brown long-eared bat & soprano pipistrelle

The static unit located in the open shed (Static 4) recorded a high level of soprano pipistrelle bat activity. This is likely to be commuting and foraging soprano pipistrelles that are roosting in the terraces houses adjacent to Andy Brennan Park. All other bat species recorded were at a lower level of bat activity.

The static unit (Static 1) location on the tree to the rear of the terrace houses adjacent to Andy Brennan Park also frequently recorded soprano pipistrelles and these passes are likely to be from roosting individuals in these houses. All other bat species recorded were at a lower level of bat activity.

The static unit (Static 2) erected on a tree adjacent to the canal recorded four species of bat foraging and commuting within this habitat.

Table 7b: Total number of bat passes recorded on Static Bat Detectors deployed (Please see total number of nights of deployment in Table 8a).

Static Code	Leisler's bat	Common pipistrelle	Soprano pipistrelle	Daubenton's bat	Brown long-eared bat
Static 1	188	145	549	2	0
Static 2	2	59	275	5	0
Static 3	0	0	0	0	0
Static 4	36	73	1101	0	3
Static 5	0	0	0	0	5
Static 6	0	0	54	0	5

3.2.3 Bat Survey Results

The following maps depict the bat distribution within the survey area for each of the five species of bat recorded. These maps are a collation of all of the surveys undertaken in 2022. Soprano pipistrelle was the most frequently recorded bat species and was recorded throughout the survey area and this is a reflection of the number of bat roosts recorded. Common pipistrelles was the second most frequently recorded bat species and had a similar distribution to soprano pipistrelles.

All other bat species were recorded in lower levels and tended to be more associated with tall vegetation habitats (i.e. treelines, hedgerows and wooded areas) while Daubenton's bats were associated with the River Boyne.

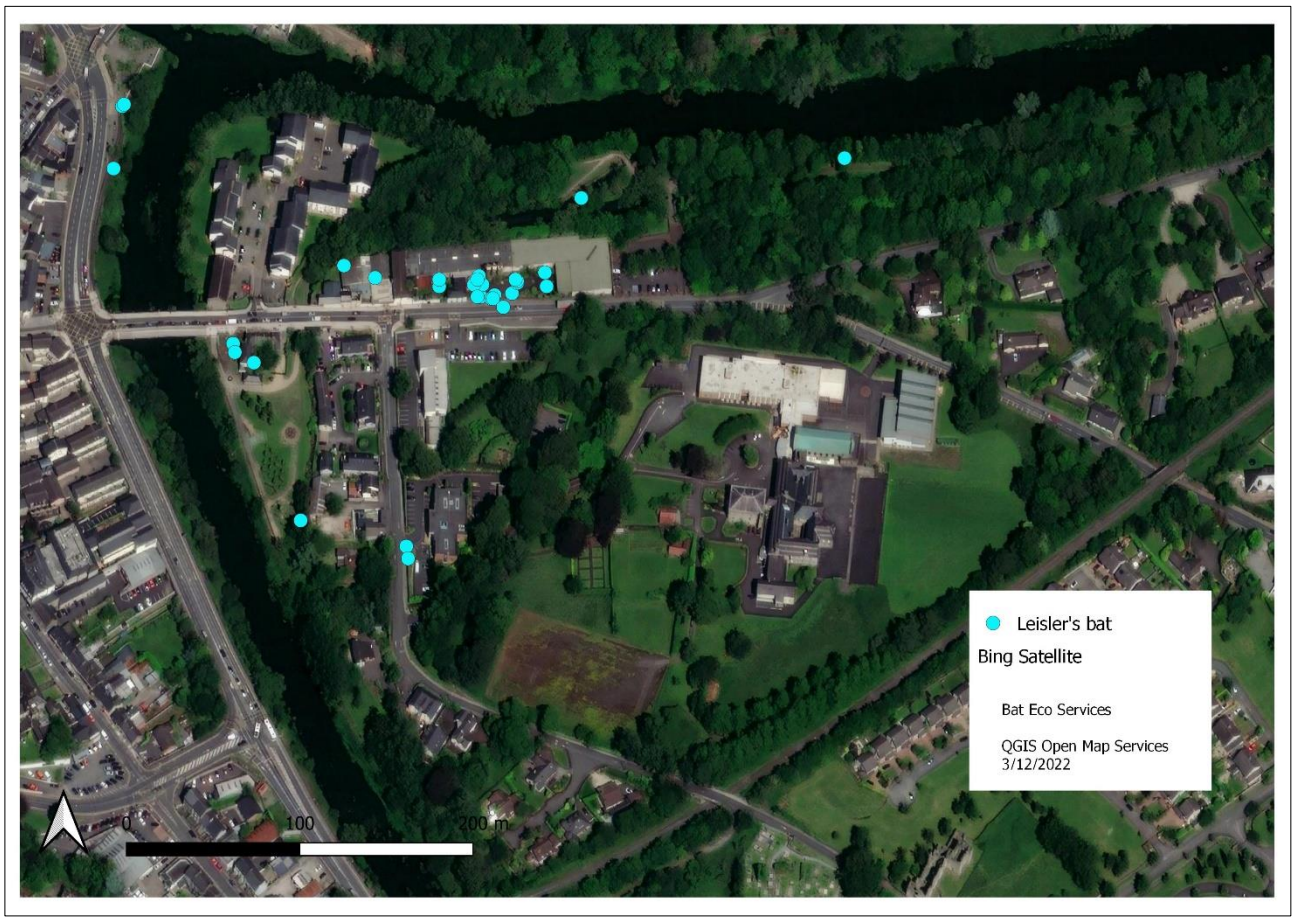

Figure 6a: Leisler's bat encounters within the survey area.

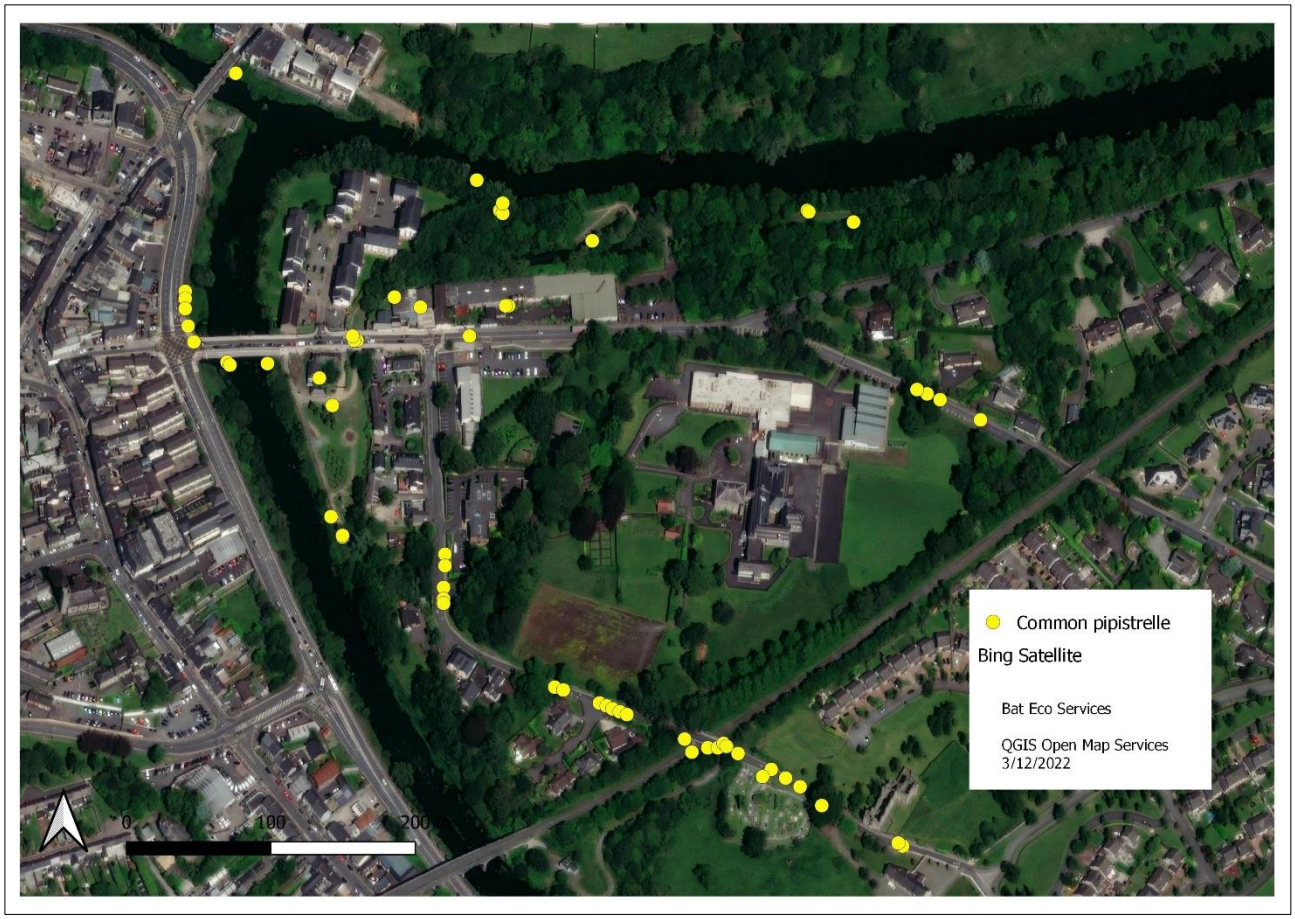

Figure 6b: Common pipistrelle bat encounters within the survey area.

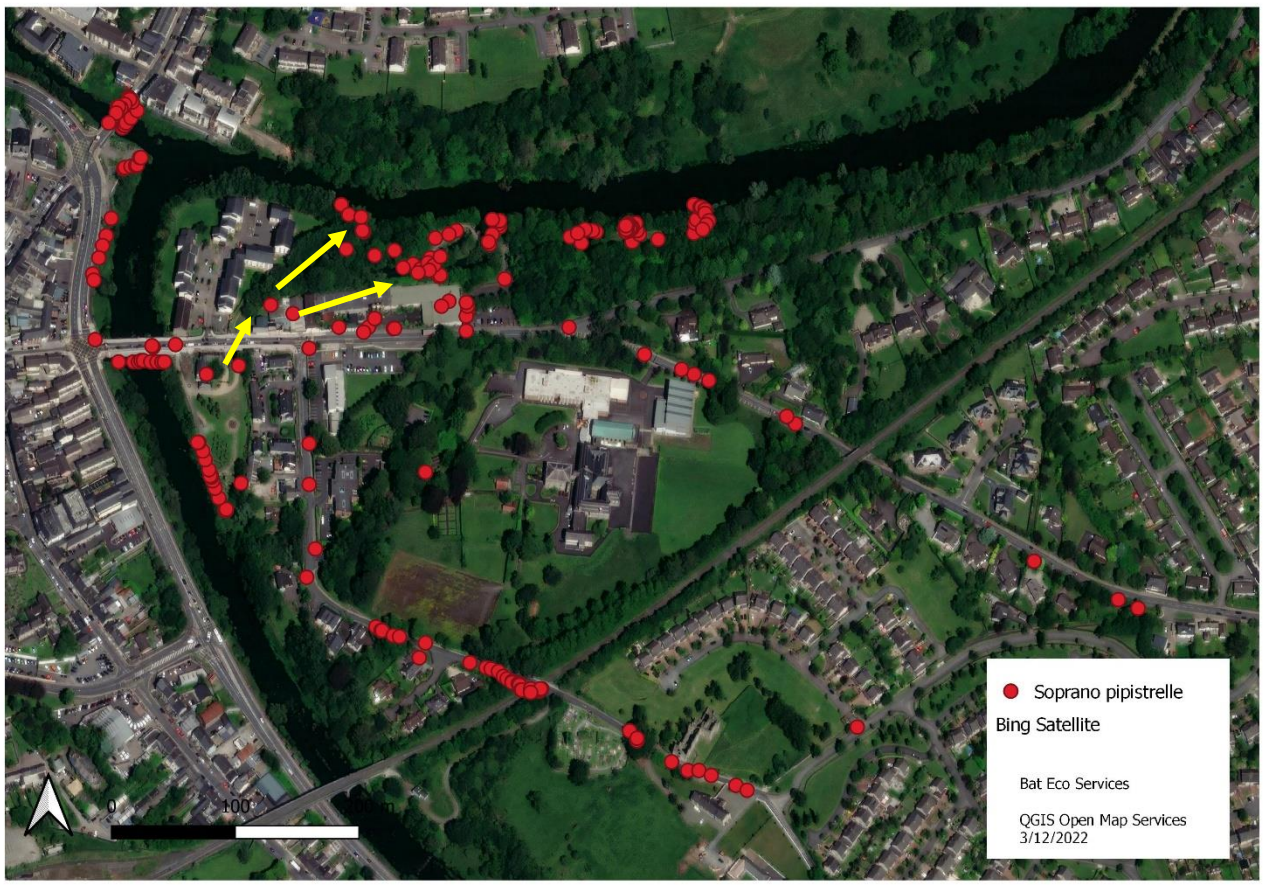

Figure 6c: Soprano pipistrelle bat encounters within the survey area (Arrows – commuting route).

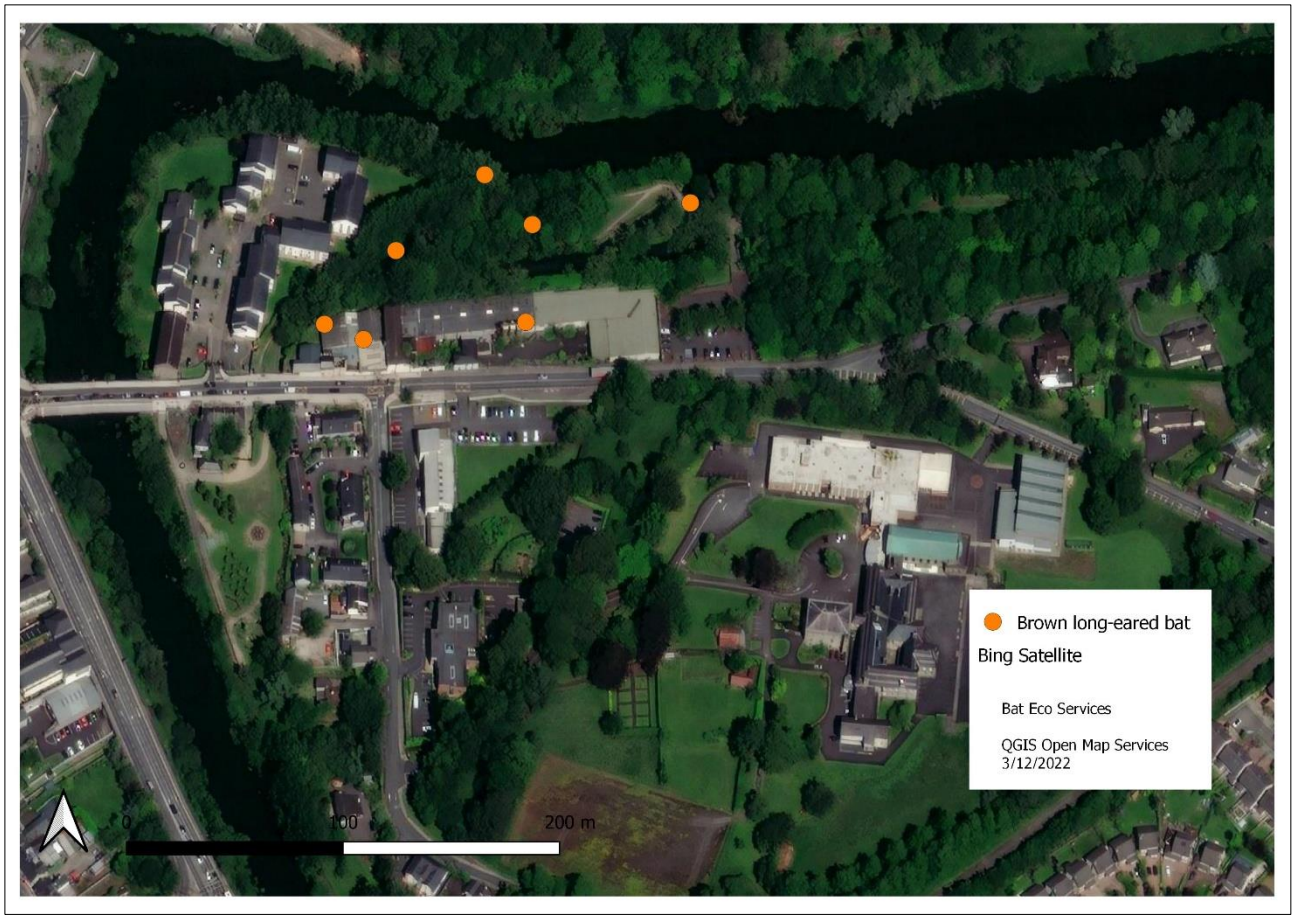

Figure 6d: Brown long-eared bat encounters within the survey area.

Figure 6e: Daubenton's bat encounters within the survey area.

3.3 Desktop Review

3.3.1 Bat Conservation Ireland Database

Within a 1km radius of the Irish Grid reference N8733267881, one roost (*Pipistrellus* spp.) was recorded. A total of 16 Transect Records pertaining primarily to three All Ireland Daubenton's Bat Waterway survey transects, two located on the River Boyne and one located on the Boyne Canal. The following bat species were recorded: soprano pipistrelle, Daubenton's bat, common pipistrelle, Nathusius' pipistrelle, Natterer's bat and whiskered bat. Twenty-three Ad Hoc records are also listed with bat detector records for Leisler's bat, soprano pipistrelle, common pipistrelle, Daubenton's bat, Natterer's bat and brown long-eared bat.

Five of these bat species were also recorded during this bat survey. Additional bat species known to the area are Natterer's bat, whiskered bat and Nathusius' pipistrelle. This reflects the importance of the River Boyne and associated habitats for local bat populations.

3.3.2 Bat Conservation Ireland Bat Landscape Favourability Model

Figure 7 depicts the BCIreland Bat Landscape Favourability Model (Lundy *et al.,* 2011) for all bat species (individual species values are presented in the table below). The county is divided into 5km squares and the darker the shading of the square, the higher favourability of the 5km square for bats. This GIS layer is hosted on the NBDC website www.biodiversityireland.ie. The proposed development site is approximately located in the Blue Box. The 5km square has a Medium favourability for bats. For the bat species recorded during this bat survey, the 5km square has a High favourability value for three recorded bat species: Daubenton's bat, common pipistrelle and Leisler's bat. A Medium to High value was recorded for soprano pipistrelle and brown long-eared bat.

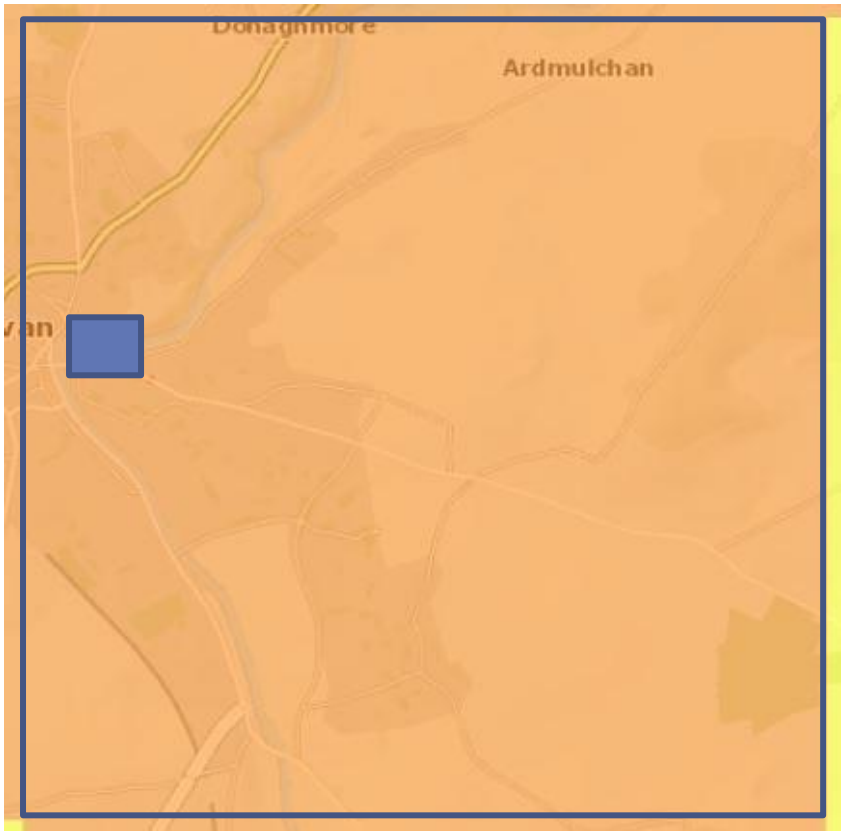

Figure 7: Bat Landscape Favourability Model (All Bats) (Source: NBDC) – Blue Box = approximate proposed development area.

Table 8: Bat Conservation Ireland Bat Landscape Favourability Model – 5km Square value.

Bat species	5km Square
Common pipistrelle	46% (High)
Soprano pipistrelle	40% (Medium to High)
Nathusius' pipistrelle	16% (Medium)
Leisler's bat	45% (High)
Brown long-eared bat	38% (Medium to High)
Daubenton's bat	31% (High)
Natterer's bat	35% (Medium to High)
Whiskered bat	20% (Medium to High)
Lesser horseshoe bat	0% (Not suitable)

3.4 Survey Effort, Constraints & Survey Assessment

The following table details any Survey Constraints encountered and a summary of Scientific Assessment completed.

Table 9: Survey Effort, Constraints & Survey Assessment Results.

Category	Discussion
Timing of surveys Surveying meets Collins, 2016 guidelines.	2022 Summer bat survey: August 2022 – bat surveys, December 2022 – tree surveys Bat activity surveys were undertaken during the ideal survey period for bats and during suitable weather conditions. Surveys included daytime inspections of buildings, bridges and trees, dusk surveys (x2, 3 people per survey), dawn survey (2 people), static surveillance (1-8 nights) and walking transects (x2, 2-3 surveyors). This provided a comprehensive summary of bat usage of the proposed development site and adjacent area. Tree surveys was completed at an ideal time to see potential roosting features when no leaves are present.
Survey Type Full suite of surveys completed to ensure sufficient information was collated for bat assessment. Surveys completed according Collins, 2016 guidelines.	Bat Survey Duties Completed (Indicated by red shading) Tree PBR Survey ● Static Detector Survey ● Dusk Bat Survey ● Walking Transect ● Trapping/Mist Netting ○ Endoscope Inspection ○ Daytime Building Inspection ● Daytime Bridge Inspection ● Dawn Bat Survey ● Driving Transect ○ IR Camcorder filming ● Other (Thermal Imagery) ●
Weather conditions	Suitable weather conditions for bat surveys.
Survey Constraints	No internal access to terrace houses and pump house on boundary of Andy Brennan Park
Survey effort **TOTAL = 238 hrs**	2022 - Summer bat survey: Daytime inspection – 8 hrs Dusk Surveys & Walking Transects – 22 hrs Static Surveillance (x6 units, 1-8 nights) – 208 hrs
Extent of survey area	Summer bat survey: proposed development area, River Boyne and local road network of Athlumney
Equipment	All equipment in good working order.

The extent of the surveys undertaken has achieved to determine:

- Presence / absence of bat within the survey area;
- A bat species list for the survey area;
- Extent and pattern of usage by bats within the survey area.

It is therefore deemed that the Scientific Assessment completed is Appropriate in order to complete the aims of the bat survey.

4. Bat Ecological Evaluation

4.1 Bat Species Recorded & Sensitivity

Five species of bat was recorded within the survey area: Leisler's bat, brown long-eared bat, Daubenton's bat, soprano pipistrelle and common pipistrelle. Roosts were recorded for two species of bat: soprano pipistrelle and brown long-eared bat.

- Terrace Houses: soprano pipistrelle – Small Maternity Roost or Large Satellite Roost
- Mill in Spicer's Bakery: brown long-eared bat and soprano pipistrelle – Satellite or Day Roosts.
- Internal walls of Derelict Town House (adjacent to Navan Silver Band buildings) of Spicer's Bakery: soprano pipistrelle – Satellite or Day Roosts.

The bat activity recorded during bat detector surveys and static surveillance were indicative of roosting, commuting and foraging individuals. Three of the bat species recorded are considered to be common Irish bat species: Leisler's bat, common pipistrelle and soprano pipistrelle while the two remaining species are less common (brown long-eared bats and Daubenton's bats).

Soprano pipistrelle and common pipistrelle were the most frequently recorded bat species while Leisler's bat were the third most frequently recorded bats species. All other bat species were recorded at a low level of bat activity. Brown long-eared bats were recorded foraging and commuting in the wooded area of The Ramparts located between Spicer's Bakery and the River Boyne. Daubenton's bats were primarily recorded foraging over the River Boyne, it's preferred feeding habitat.

Overall, the survey results demonstrate that the survey area is an important location for bat populations as it likely provides roosting, foraging and commuting habitats for all of the bat species recorded. This is particularly important due to the fact that the location of the survey area in a largely expanding urban setting and therefore the Ramparts and associated habitats offers the opportunity for it to be managed as a Biodiversity Area using bats as a keystone species group.

Leisler's bat

- Leisler's bat is an Annex IV bat species under the EU Habitats Directive. The status of this bat species is listed as Least Concern. The national Leisler's bat population is considered to be significantly increasing trend (Aughney *et al.,* 2021).
- The modelled Core Area for Leisler's bats is a relatively large area that covers much of the island of Ireland (52,820km^2). The Bat Conservation Ireland Irish Landscape Model indicated that the Leisler's bat habitat preference has been difficult to define in Ireland. Habitat modelling for Ireland shows an association with riparian habitats and woodlands (Roche *et al.,* 2014). The landscape model emphasised that this is a species that cannot be defined by habitats preference at a local scale compared to other Irish bat species but that it is a landscape species and has a habitat preference at a scale of 20.5km.

Common pipistrelle

- Common pipistrelle is an Annex IV bat species under the EU Habitats Directive. The status of this bat species is listed as Least Concern. The national common pipistrelle population is considered to be significantly increasing trend (Aughney *et al.,* 2021).
- The modelled Core Area for common pipistrelle is a relatively large area that covers much of the island of Ireland (56,485km^2). The Bat Conservation Ireland Irish

Landscape Model indicated that the Common pipistrelle selects areas with broadleaf woodland, riparian habitats and low density urbanization (<30%) (Roche *et al.,* 2014).

Soprano pipistrelle

- Soprano pipistrelle is an Annex IV bat species under the EU Habitats Directive. The status of this bat species is listed as Least Concern. The national soprano pipistrelle population is considered to be significantly increasing trend (Aughney *et al.,* 2021).
- The modelled Core Area for soprano pipistrelle is a relatively large area that covers much of the island of Ireland (62,020km^2). The Bat Conservation Ireland Irish Landscape Model indicated that the soprano pipistrelle selects areas with broadleaf woodland, riparian habitats and low density urbanisation (Roche *et al.,* 2014).

Brown long-eared bat

- Brown long-eared bat is an Annex IV bat species under the EU Habitats Directive. The status of this bat species is listed as Least Concern. The national brown long-eared bat population is considered to be stable (Aughney *et al.,* 2021).
- The modelled Core Area for brown long-eared bat is a relatively large area that covers much of the island of Ireland (49,929 km^2). The Bat Conservation Ireland Irish Landscape Model indicated that the brown long-eared bat habitat preference is for areas with broadleaf woodland and riparian habitats on a small scale of 0.5km emphasising the importance of local landscape features for this species (Roche *et al.,* 2014).

Daubenton's Bat

- Daubenton's bat is an Annex IV bat species under the EU Habitats Directive. The status of this bat species is listed as Least Concern. The national Daubenton's bat population is considered to be stable (Aughney *et al.,* 2021).
- The modelled Core Area for Daubenton's bat is (41,285 km^2) reflecting the distribution of sizeable river catchments. The Irish Landscape Model indicated that the Daubenton's bat habitat preference is for areas with broadleaf woodland, riparian habitats and low density urbanisation (Roche *et al.,* 2014).

No resident Annex II bat species are known to occur in County Meath (i.e. lesser horseshoe bat) and were not recorded within the survey.

4.2 Bat Foraging Habitat & Commuting Routes

The results indicate that the survey area (includes the red line boundary of the proposed development area and the Ramparts) is a foraging and commuting area for five species of bat and supports roosting sites recorded in buildings within the survey area.

4.3 Zone of Influence – Bat Landscape Connectivity

The results indicate that the boundaries of the proposed development site are an active commuting and foraging habitat for local bat populations. The survey area is a large one and provides essential parkland habitat associated with both the locations within the red line boundary of the proposed development and The Ramparts, located adjacent to the red line boundary of the proposed development area. This is particularly important due to the urban development that is widely present as part of the town of Navan which reduces connectivity for local bat populations due to the loss of linear habitats and increased street lighting. As a consequence, the River Boyne and River Blackwater are essential dark corridors to facilitate commuting and foraging local bat populations.

5. Impact Assessment & Mitigation

The 2022 bat surveys provide information on the following:

a) Bat usage of the buildings within Spicer's Bakery;
b) Bat usage of Terrace Houses and pump house located adjacent to the Andy Brennan Park;
c) Bat usage of Andy Brennan Park;
d) Bat usage of area of the Ramparts adjacent to the proposed development area.

While the proposed development site is a large area, the majority of the site is brown field and it is proposed to retain the majority of the buildings within Spicer's Bakery and their existing uses. The proposed works to the former Spicer's Bakery are preservation and conservation works as per Conservation Management Plan. However, it is important to ensure that such conservation works do not impact on roosting sites within the buildings of Spicer's Bakery.

In terms of the car park, while the existing car park is currently lit, due to the presence of tall vegetation between the boundary of the existing car park and the River Boyne, the river is buffered from light spill. Therefore it is important that any further lighting of the extended car park does not spill beyond the red line boundary of the proposed development site into the tall vegetation buffer zone and therefore the River Boyne.

The overall objective of the plan is to increase openness and visibility into the proposed development site and also through passive surveillance to address issues of anti -social behaviour and therefore it is considered necessary to reduce the height of the stone wall at the rear of the proposed Spicer's Park. This will potentially allow light spillage from the proposed development site into The Ramparts. Therefore, as stated above, it is important that any further lighting of the extended car park does not spill beyond the red line boundary of the proposed development site into the tall vegetation buffer zone and therefore the River Boyne.

The proposed works for the proposed development area include the following:

- **Demolishment of the Terrace Houses**

This will result in the loss of a soprano pipistrelle maternity/satellite roost. An NPWS Derogation Licence will be required to allow this to be undertaken. In order to apply for a Derogation Licence, bat mitigation measures will be required. An alternative bat roosting site will be required to constructed and this is recommended to be located in the upper levels of the mill building. Consultation with the conservation architect team is required to be undertaken to draw up appropriate plans to meet soprano pipistrelle, as well as brown long-eared bat, roosting requirements. Once access to the 2nd floor of the mill is possible, further bat survey work will be required here to determine potential roosting and also to determine the location of the a bat loft as part of bat mitigation measures.

In addition, bat access to the attic space of the office building is also recommended as well as a bat box scheme for the proposed development site.

- **Conservation & Preservation of Mill Building, Spicer's Bakery (including adjacent derelict structures)**

Proposed conservation works for this buildings, that may impact on local bat populations, include the following (taken from Conservation Management Plan):

a) The removal of 20th century additions to the Mill will allow the original stone buildings to be read in a similar form as originally developed.

This will need to be further investigated in consultation with the conservation architectural team to determine potential impact on local bat populations.

b) Windows and doors above ground floor will have temporary protection in order to have the building wind and airtight.

As bats are roosting in the mill building, it is important that access remains from the rear of the structure (i.e. adjacent to the Boyne Canal / The Ramparts boundary) through an existing open window. While this window can be partially closed in order to help conserve the structure, bat access is required. Consultation with the conservation architectural team is required.

c) In relation to the gable walls of the derelict town house (connected to the Navan Silver Band building) –

"The walls could be stripped from all cementitious plaster to ensure no moisture is being trapped within the stone.

The random rubble stone walls could be re-pointed with a suitable lime mortar to ensure the breathability of the walls.

A suitable lime-wash or breathable external paint finish could be applied to the full gable elevation to allow breathability of wall.

The burnt timber ends that were previously the roof rafters could be removed from roof eaves level."

The works described above may result in entombing of roosting bats and/or the loss of roosting sites. Therefore, a conservation plan is required to ensure that works are undertaking with due care under an NPWS Derogation Licence. Alternative roosting sites will be required and a bat box will cater for this.

- **Restoration of Office Building, Spicer's Bakery**

This will not have an impact on location bat populations. However, there is an opportunity to provide bat access to the attic space of the office building during the proposed works as a bat conservation measure.

- **Removal of the majority of the historic stone walls**

This may result in the loss of potential roosting sites in the crevices of the stone wall and as well as the loss of a boundary wall that, currently, reduced lighting spillage on the Boyne Canal and other tall vegetation habitats associated with The Ramparts. Therefore further survey work is required to be undertaken along with consultation with the architectural team to ensure that no bats are harmed during proposed works.

- **Removal of Potential Bat Roost (PBR) trees in existing Ramparts Car Park**

This may impact on potential roosting sites for bats. Three trees within the car park were categorised as Category 2 PBRs and are proposed to be removed.

- **Demolishment of warehouses/industrial sheds of Spicer's Bakery**

While bats were recorded within these areas, it was not considered that individuals were roosting within the structures. However, careful demolishment is required to ensure that no bats are harmed in the process of any planned works. Consultation will be required to be undertaken with Meath Co. Co. in relation to a demolition plan.

- **Lighting Plan**

Due to the fact that bats are nocturnal mammals outdoor lighting will impact on local bat populations. Therefore, the lighting plan is an important element of the proposed development that needs to consider its potential impact on commuting and foraging bats. Consultation was undertaken and measures have been agreed to reduce this potential impact of outdoor lighting on commuting and foraging bats, especially lighting located adjacent to boundary habitats with particular reference to the lesser horseshoe bat requirements. Due to the location of the River Boyne (part of the Rivers Boyne and Blackwater SAC), a buffer zone is required to ensure that potential impacts on local bat populations using the SAC are protected from lighting and noise pollution. This can be achieved by ensuring that no lighting is install outside the Red Line boundary of the proposed development, that any lighting installed meet the BCT (2018) guidelines and that landscaping is planted to buffer potential lighting spillage from the lighting plan along the boundary of proposed development site adjacent to the River Boyne.

There will be an increase in human activity (noise and light levels) (Operational Operations) as a result of the proposed development and due to the high level of bat biodiversity, it is considered that this will impact on local bat populations.

5.1 Potential Bat Impact Assessment

The principal areas of bat impact in relation to construction operations, will be:

- Loss of soprano pipistrelle roost in Terraced Houses

Permanent and Slight to Moderate Negative Impact

- Loss of three PBR trees (Category 2) in existing car park

Permanent and Not Significant Negative impact

- Loss of roosting sites in crevices of stone walls and gable wall of derelict town house

Permanent and Not Significant Negative impact

The principal areas of bat impact in relation to the operation of the proposed development area, will be:

- Increased lighting

Permanent and Slight to Moderate Negative Impact

5.2 Bat Mitigation Measures

5.2.1 Terrace Houses

For the design of bat mitigation measures, the soprano pipistrelle roost located in the terraces houses is deemed as a small maternity roost. The NPWS Bat Mitigation Guidelines (Marnell *et al.,* 2022) states that the potential loss of a maternity roosts for common bat species such as soprano pipistrelle bats will result in the following:

- Time constraints.
- More or less like for like replacement as a minimum.
- Bats not to be left without a roost and must be given time to find replacement.
- Monitoring for at least two years.

Therefore, in relation to the demolishment of the terraces houses along the boundary of Andy Brennan Park the following is required:

- A NPWS Derogation Licence will be required for the demolition of the terrace houses.
- Prior to applying for this licence, alternative bat roosting will be required. This will be provided by the provision of a bat box scheme designed for soprano pipistrelles species (i.e. bat box designs known to successfully provide roosting for this species group).
- Additional bat roosting will be designed as a bat loft in the upper floor of the mill and in the attic space of the former office building. It is recommended that the bat lofts are located in this area as it is closer to the prime foraging area for bats in The Ramparts. Individuals of the bat roost were recorded commuting to the Rampart and therefore the location of alternative roosts closer to this habitat will ensure greater success of new roosting spaces.
- A detailed demolition plan is required to de formulated in conjunction with the contractors and the bat specialist to ensure that the roofs of the buildings (i.e. terrace houses) are stripped by hand and under supervision by a bat specialist. These works will also be required to be undertaken outside the summer months of May to August. Further bat survey work may be required to assist the Derogation Licence application. Consultation will be undertaken with NPWS.

5.2.2 Mill Building, Spicer's Bakery

The NPWS Bat Mitigation Guidelines (Marnell *et al.,* 2022) states that the potential loss of a non-maternity roosts for common bat species such as soprano pipistrelle bats will result in the following:

- Flexibility over provision of bat boxes, access to new buildings etc.
- No conditions about timing or monitoring

However, as the proposed works for the mill building is primarily conservation and restoration works, consultation will be undertaken with the conservation architect team to ensure that roosting sites are retained and protected as well as access points for roosting bats. Further survey work will be required once access to the 2nd floor is achieved. This will also allow for the design of the proposed bat loft in the mill building to mitigate for loss of the soprano pipistrelle roost in the terrace houses.

5.2.3 Alternative Bat Roosts

It is recommended that a Bat Loft is constructed in the Mill Building as an alternative roosting site for soprano pipistrelles and brown long-eared bats. This will be designed once further survey work of the upper floor of the mill is undertaken and in consultation with the conservation architect team.

It is also recommended that access to the attic space of the Office Building for local bats is also provided as part of the bat mitigation measures. This will required the following:

- Install bat access ridge tiles (x4) in the roof of the office building.
- Flooring of attic space with marine ply wood to protect insulation.
- A cover on any water tanks within the attic space.
- Use of non-breathable felt within the attic space or at a minimum within the bat loft section of the attic space.

In addition, a bat box scheme consisting of 25 bat boxes (an array of designs is recommended) should be erected on trees and buildings within the proposed development area (Please See Section 1.2.3.3.1 for effectiveness of bat boxes) are as follows:

- 5x 2F woodcrete bat boxes (to be erected on trees along the southern boundary of Andy Brennan Park);
- 10x Universal Bat Summer Roost 1FTH (to be erected 4m or greater on walls within the proposed development site and on rear walls of the former office building)
- boxes;
- 5x IFF woodcrete bat boxes (to be erected at a height of 4m or greater on walls within the proposed development site).

One potential source of bat boxes is www.veldshop.nl.

Bat boxes are to be sited carefully and this will be undertaken by a bat specialist. A selection of bat boxes will be erected prior to works. The bat specialist will erect the bat boxes with assistance from the contractor. Some general points that will be follow include:

- Straight limb trees (or telegraph pole) with no crowding branches or other obstructions for at least 1 metre above and below position of bat box (this is for bat boxes in Andy Brennan Park).
- For bat boxes on buildings – bat boxes should be erected as high as possible (minimum of 4m off the ground) in dark zones within the proposed development site and as close as possible to the boundary adjacent to The Ramparts.
- Diameter of tree should be wide and strong enough to hold the required number of boxes.
- Locate bat boxes in areas where bats are known to forage or adjacent to suitable foraging areas. Locations should be sheltered from prevailing winds.
- Bat boxes should be erected at a height of 4-5 metres to reduce the potential of vandalism and predation of roosting bats.
- Locations for bat boxes should be selected to ensure that the lighting plan for the proposed site does not impact on the bat boxes. Therefore the bat boxes are to be erected mature trees to the rear of the proposed development site and away from public street lighting.

5.2.4 Historic Stone Walls

It is recommended that the existing historic walls of the proposed development are retained to a greater height and length along the boundary of the proposed development, where possible, in order to achieve the following:

- Retention of potential roosting sites;
- Buffer of lighting and noise pollution into The Ramparts.

In relation to planned removal of sections of walls and re-pointing of remaining walls, such areas should be re-surveyed to ensure that no bats are present in crevices. A selection of crevices, suitable for roosting bats, should be retained to provide bat roosting sites post development works. Any re-pointing works should be undertaken under supervision by a bat specialist.

5.2.5 PBR Trees

Any PBR trees proposed to be felled must be felled in a manner that does not impact on local bat populations. Tree felling is only permitted in the months of September, October, November and February during mild weather conditions. A Phase 2 survey is also required and this should entail a daytime inspection as per Phase 1 and dusk and/or dawn surveys to ensure that there are no bats roosting prior to tree felling. Bat boxes are required to be erected to mitigation for tree felling. For every three Category 2 tree felled, one bat woodcrete bat box is required.

5.2.6 Demolition Plan – Warehouses/Industrial Sheds, Spicer's Bakery

While bats were recorded within these areas, it was not considered that individuals were roosting within the structures. However, careful demolishment is required to ensure that no bats are harmed in the process of any planned works. Consultation will be required to be undertaken with Meath Co. Co. in relation to a demolition plan.

5.2.7 Lighting Plan

This element of the proposed planning application is important aspect in relation to local bat populations. All European bat species, including Irish bat species, are nocturnal. They usually hide in roosts during the daytime, while fly to feeding areas or drinking sites using commuting routes during the night. Annually bats will hibernate in the winter, swarm in the autumn and give birth in the summer months. In all aspects of the bat lifestyle, Artificial Light at Night (ALAN) may significantly change their natural behaviour in relation to roosting, commuting and feeding. While bats are naturally exposed only to very low lighting levels produced by moonlight, starlight and low intensity twilight, light levels greater than natural light levels can impact on the lifestyle of bats.

Bats are light sensitive species, hence their nocturnal activities. The three bat species recorded commuting and foraging within the survey area are Light Tolerant or Semi-tolerant bat species. However, it is still important that strict lighting guidelines are required to reduce the potential impact of the proposed development on local bat populations as standard best practice.

Luminaire design is extremely important to achieve an appropriate lighting regime. Luminaires come in a myriad of different styles, applications and specifications which a lighting professional can help to select. The following should be considered when choosing luminaires. This is taken from the most recent BCT Lighting Guidelines (BCT, 2018).

- All luminaires used will lack UV/IR elements to reduce impact.
- LED luminaires will be used due to the fact that they are highly directional, lower intensity, good colour rendition and dimming capability.
- A warm white spectrum (<2700 Kelvins will be used to reduce the blue light component of the LED spectrum).
- Luminaires will feature peak wavelengths higher than 550nm to avoid the component of light most disturbing to bats.
- Column heights should be carefully considered to minimise light spill. The shortest column height allowed should be used where possible.
- Only luminaires with an upward light ratio of 0% and with good optical control will be used.

- Luminaires will be mounted on the horizontal, i.e. no upward tilt.
- Any external security lighting will be set on motion-sensors and short (1min) timers.
- As a last resort, accessories such as baffles, hoods or louvres will be used to reduce light spill and direct it only to where it is needed.

Any external lighting for the proposed development should strictly follow the above guidelines and these should be strictly implemented during construction and operation phase of the proposed development.

A 50m dark zone (i.e. from the river bank and along the length of the river in vicinity of the proposed development zone) is required in vicinity of the River Boyne and any lighting plan should ensure that there is no lighting spill into this dark zone. The boundary of the proposed development on the River Boyne side should be at 0 LUX level. Any luminaires installed should also meet all of the criteria above.

Any security lighting installed should be on a timer and designed to ensure that no lighting is spilling into the adjacent Ramparts. Location of lighting should not be in vicinity of bat roosting exit points or bat box schemes.

5.2.8 Landscaping

It is recommended that the landscape plan for the proposed development is undertaken to improve its conservation value of The Ramparts for local bat populations. Where the lighting may impact on adjacent bat foraging and commuting routes, planting should be used to as a buffer zone to protect dark zones for nocturnal wildlife. Planting should consist of native tree and shrub plant species.

5.2.9 Bat Conservation Measures

Due to the close proximity of The Ramparts and the River Boyne to the proposed development site, it is important that a Bat Management Plan is considered to ensure the long-term conservation of bat biodiversity in this area. This is particularly important in relation to the parkland trees located in The Ramparts, many of high have a high potential to provide bat roosting for bat species.

5.2.10 Monitoring

Monitoring is recommended post-construction works. This monitoring should involve the following aspects:

- Monitoring of bat lofts will be required for a minimum of 3 years. This will include internal inspections, temperature data logger surveillance and static surveillance.
- Inspection of bat boxes within one year of erection of bat box scheme/rocket box. Register bat box scheme with Bat Conservation Ireland. This should be undertaken for a minimum of 3 years.
- Monitoring of any other bat mitigation measures. All mitigation measures should be checked to determine that they were successful. A full summer bat survey is recommended post-works.
- Specific monitoring is recommended in relation to the proposed lighting scheme to determine that a level of 0 Lux is achieved along the boundaries of the proposed dark zones of bat commuting routes and foraging habitats.

6. Survey Conclusions

Five species of bat was recorded within the survey area: Leisler's bat, brown long-eared bat, Daubenton's bat, soprano pipistrelle and common pipistrelle. Roosts were recorded for two species of bat: soprano pipistrelle and brown long-eared bat.

- Terrace Houses: soprano pipistrelle – Small Maternity Roost or Large Satellite Roost
- Mill in Spicer's Bakery: brown long-eared bat and soprano pipistrelle – Satellite or Day Roosts.
- Internal walls of Derelict Town House (adjacent to Navan Silver Band) of Spicer's Bakery: soprano pipistrelle – Satellite or Day Roosts.

The bat activity recorded during bat detector surveys and static surveillance were indicative of roosting, commuting and foraging individuals. Three of the bat species recorded are considered to be common Irish bat species: Leisler's bat, common pipistrelle and soprano pipistrelle while the two remaining species are less common (brown long-eared bats and Daubenton's bats).

Soprano pipistrelle and common pipistrelle were the most frequently recorded bat species while Leisler's bat were the third most frequently recorded bats species. All other bat species were recorded at a low level of bat activity. Brown long-eared bats were recorded foraging and commuting in the wooded area of The Ramparts located between Spicer's Bakery and the River Boyne. Daubenton's bats were primarily recorded foraging over the River Boyne, it's preferred feeding habitat.

Overall, the survey results demonstrate that the survey area is an important location for bat populations as it likely provides roosting, foraging and commuting habitats for all of the bat species recorded. This is particularly important due to the fact that the location of the survey area in a largely expanding urban setting and therefore the Ramparts and associated habitats offers the opportunity for it to be managed as a Biodiversity Area using bats as a keystone species group.

The proposed works will impact on local bat populations in relation to the demolishment of the terrace houses along the boundary of Andy Brennan Park, stabilisation of gable walls of derelict town house (adjacent to Navan Silver Band), repointing of historical walls and removal of trees in existing car park. There is also potential negative impacts in relation to conservation and restoration works for the mill building. However, bat mitigation measures have been prescribed, an NPWS Derogation Licence will be applied for and more detailed surveying and consultation is required to ensure successful application of mitigation measures.

The strict implementation of the bat mitigation measures will reduce the potential negative impact of the proposed development on local bat populations.

7. Bibliography

Abbott, I. M., Butler, F. And Harrison, S. (2012) When flyways meet highways – the relative permeability of different motorway corssing sites to functionality diverse bat species. Landscape and Urban Planning 106 (4): 293-302.

Abbott, I. M., Berthinessen, A., Stone, E., Booman, M., Melber, M. and Altringham, J. (2015) Bats and Roads, Chapter 5, pp/ 290-299. In: Handbook of Road Ecology. Editors: R. Van der Ree., D. J. Smidt and C. Grilo. Wiley Blackwell.

Altringham, J. D. (2013) Biritah Bats. Collins New Naturalist Library, Volume 93. Haper Collins, London.

Altringham, J. And Kerth, G. (2016) Bats and Roads, Chapter 3. In: Bats in the Anthropocence: Conservation of Bats in a Changing World. Editors: C. C. Voigt and T. Kingston. Springer Open.

Aughney, T., Roche, N., & Langton, S (2018) The Irish Bat Monitoring Programme 2015-2017. *Irish Wildlife Manuals*, No. 103. National Parks and Wildlife Service, Department of Cultural heritage and the Gaeltacht, Ireland.

Aughney, T., Roche, N. and Langton, S. (2022) Irish Bat Monitoring Programme 2018-2021. *Irish Wildlife Manuals*, No. 137. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

Barratt, E. M., Deauville, R., Burland, T. M., Bruford, M. W., Jones, G., Racey, P. A., & Wayne, R. K. (1997). DNA answers the call of pipistrelle bat species. *Nature* 387: 138 - 139.

Bat Conservation Ireland (2015) BATLAS 2020 Pilot Project 2015: Volunteer Survey Manual. Version 01. www.batconservationireland.org.

Bat Conservation Trust (2018) Bats and artificial lighting in the UK: bats and the built environment series. Guidance Note 08/2019. BCT, London.

Bharddwaj, M., Soaner, K., Straka, T., Lahoz-Monfort, J., Lumsden, L. F. and van der Ree, R. (2017) Differential use of highway underpasses by bats. Biological Conservation 212: 22-28.

Billington, G. E. & Norman, G. M. (1997). A report on the survey and conservation of bat roosts in bridges in Cumbria, Kendal. English Nature.

BTHK (2018) Bat Roosts in Trees – A Guide to Identification and Assessment for Tree-Care and Ecology Professionals. Exeter: Pelagic Publishing.

CIEEM (2016) Guidelines for Ecological impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (2nd Edition). CIEEM, Winchester.

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

Collins, J.H., Ross, A.J., Ferguson, J.A., Williams, C.D. & Langton, S.D. (2022) The implementation and effectiveness of bat roost mitigation andcompensation measures for *Pipistrellus* and *Myotis* spp. and brown long-eared bat (*Plecotus auritus*) included in building development projects completed between 2006 and 2014 in England and Wales. Conservation Evidence: 17, 19-26.

Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) 1982.

Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979.

Dietz, C., Helversen, O. and Dietmar, N. (2011) Bats of Britain, Europe & Northweat Africa. A&C Black, London.

Downs, N.C., Beaton, V., Guest, J., Polanski, J., Robinson, S.L. and Racey, P.A. (2003) The effects of illuminating the roost entrance on the emergence behaviour of *Pipistrellus pygmaeus*. Biological Conservation 111, p. 247-252.

EC Directive on The Conservation of Natural habitats and of Wild Fauna and Flora (Habitats Directive) 1992.

Eisenbeis G and Hassel F. (2000). Zur Anziehung nachtaktiver Insekten durch Straßenlaternen – eine Studie kommunaler Beleuchtungseinrichtungen in der Agrarlandschaft Reinhessens Attraction of nocturnal insects to street lights – a study of municipal lighting systems in a rural area of Rheinhessen (Germany)]. *Natur und Landschaft* **75**: 145–56.

EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports. EPA, Ireland.

Frank K.D. (1988). Impact of outdoor lighting on moths: an assessment. *J Lepidop Soc* 42: 63–93.

Gunnell, K., Grant, G. and Williams, C (2012) Landscape and urban design for bats and biodiversity. The Bat Conservation Trust, London.

Hanski, I. (1998) Metapopulation Dynamics. Nature, 396, 41-49.

Holker, F., Wolter, C., Perkin, E.K. & Tockner, K. (2010). Light pollution as a biodiversity threat. Trends Ecol. Evol. 25, 681–682. https://doi.org/10.1016/j.tree.2010.09.007.

Hundt, L. (2012) Bat Surveys: Good Practice Guidelines (2nd Edition). The Bat Conservation Trust, London.

Kelleher, C. & Marnell, F. (2006) Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Kolligs D. 2000. Ökologische Auswirkungen künstlicher Lichtquellen auf nachtaktive Insekten, insbesondere Schmetterlinge (Lepidoptera) [Ecological effects of artificial light sources on nocturnally active insects, in particular on moths (Lepidoptera)]. *Faunistisch-Ökologische Mitteilungen Suppl* **28**: 1–136.

Lintott P. & Mathews F. (2018) *Reviewing the evidence on mitigation strategies for bats in buildings: informing best-practice for policy makers and practitioners*. CIEEM Commissioned Report

Longcore T. and Rich C. (2004). Ecological light pollution. *Frontiers in Ecology and Environment.* **2**: 191-198.

Lundy, M.G., Montgomery, I.W., Roche, N. & Aughney, T. (2011). *Landscape Conservation for Irish Bats & Species Specific Roosting Characteristics* (Unpublished). Bat Conservation Ireland, Cavan, Ireland.

Lysaght, L. and Marnell, F. (eds) (2016) Atlas of Mammals in Ireland 2010-2015, National Biodiversity Data Centre, Waterford.

Marnell, F., Kingston, N. & Looney, D. (2009) *Ireland Red List No. 3: Terrestrial Mammals*, National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

Marnell, F., Looney, D. & Lawton, C. (2019) Ireland Red List No. 12: Terrestrial Mammals. National Parks and Wildlife Service, Department of the Culture, Heritage and the Gaeltacht, Dublin, Ireland.

Marnell, F., Kelleher, C. & Mullen, E. (2022) Bat mitigation guidelines for Ireland v2. Irish Wildlife Manuals, No. 134. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

Martín, B.; Pérez, H.; Ferrer, M. Light-Emitting Diodes (LED): A Promising Street Light System to Reduce the Attraction to Light of Insects. *Diversity* **2021**, *13*, 89. https://doi.org/10.3390/d13020089.

Mathews, F., Roche, N., Aughney, T., Jones, N,M. Day, J., Baker, J. and Langton, S. (2015) Barriers and benefits: implications of artificial night-lighting for the distribution of common bats in Britain and Ireland. *Philosphical Transactions of the Royal Society of London B* 370 (1667), doi: 10.1098/rstb.2014.0124.

McAney, K. (2006) A conservation plan for Irish vesper bats, Irish Wildlife Manual No. 20 National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. McAney, K. (2014). An overview of Rhinolophus hipposideros in Ireland (1994-2014). *Vespertilio* **17**, 115–125.

McAney, K., O'Mahony, C., Kelleher, C., Taylor, A. & Biggane, S. (2013). *The Lesser Horseshoe Bat in Ireland: Surveys by The Vincent Wildlife Trust*. Belfast, Northern Ireland: Irish Naturalists' Journal.

Mullen, E. (2007). Brandt's Bat *Myotis brandtii* in Co. Wicklow. Irish Naturalists' Journal 28: 343.

Norberg U.M. and Rayner J.M.V. (1987). Ecological morphology and flight in bats (Mammalia; Chiroptera): wing adaptations, flight performance, foraging strategy and echolocation. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences.* **316**: 335-427.

NPWS (2018) Conservation objectives supporting document – lesser horseshoe bat (Rhinolophus hipposideros) Version 1. Conservation Objectives Supporting Document Series. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Dublin, Ireland

O'Sullivan, P. (1994). *Bats in Ireland.* Special supplement to the Irish Naturalists' Journal.

Rich, C. & Longcore, T. (eds). 2006 Ecological consequences of artificial night lighting. Washington, DC: Island Press

Richardson, P. (2000). *Distribution atlas of bats in Britain and Ireland 1980 - 1999*. The Bat Conservation Trust, London, UK.

Roche, N., Aughney, T. & Langton, S. (2015). *Lesser Horseshoe Bat: population trends and status of its roosting resource* (No. 85). , Irish Wildlife Manuals. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Roche, N., Langton, S. & Aughney, T. (2012). *Lesser Horseshoe Bat: Population, Trends and Threats 1986 to 2012* (Unpublished). Bat Conservation Ireland, Cavan, Ireland.

Roche, N., Aughney, T., Marnell, F. & Lundy, M. (2014). *Irish Bats in the 21st Century.* Bat Conservation Ireland, Cavan, Ireland.

Rowse EG, Harris S, Jones G. 2018Effects of dimming light-emitting diode street lights on light-opportunistic and light-averse bats in suburban habitats. *R.Soc. open sci.* **5**: 180205.http://dx.doi.org/10.1098/rsos.180205

Russ, J. (2012) British Bat Calls: A guide to species identification. Pelagic Publishing, Exeter.

Russo, D., Cistrone, L., Libralato, N., Korine, C., Jones, G. & Ancillotto, L. (2017). Adverse effects of artificial illumination on bat drinking activity. Anim. Conserv. 20, 492–501. https://doi.org/10.1111/acv.12340.

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

Rydell J. (2006). Bats and their insect prey at streetlights. In C. Rich and T. Longcore (eds.) Ecological Consequences of Artificial Night Lighting. 43-60.

Rydell J. and Racey P.A. (1995). Street lamps and the feeding ecology of insectivorous bats. In P.A. Racey and S.M. Swift (eds.) Ecology, evolution and behaviour of bats. *Symposia of the Zoological Society of London*. **67** pp 291-307. Clarendon Press, Oxford.

Schofield, H. (2008). *The Lesser Horseshoe Bat Conservation Handbook*. Herefordshire, England: The Vincent Wildlife Trust.

Speakman, J.R. (1991) Why do insectivorous bats in Britain not fly in daylight more frequently? Funct. Ecol. 5, 518–524.

Stebbings, R. E. & Walsh, S. T. (1991) *Bat Boxes: A guide to the history, function, construction and use in the conservation of bats.* The Bat Conservation Trust, 1991.

Stone, E., Jones, G. and Harris, S. (2009). Street lighting disturbs commuting bats. *Current Biology*, **19**: 1123-1127.

Stone, E. L., Jones, G., and Harris, S. (2012). Conserving energy at a cost to biodiversity? Impacts of LED lighting on bats. *Global Change Biology* **18**, 2458–2465. doi:10.1111/j.1365-2486.2012.02705.x

Stone EL, Harris S, Jones G. 2015 Impacts of artificial lighting on bats: a review of challenges and solutions. *Mammal. Biol.* **80**, 213–219. (doi:10.1016/j.mambio.2015.02.004)

Svensson A.M. and Rydell J. (1998). Mercury vapour lamps interfere with bat defence of tympanate moths (*Operophtera* spp.; Geometridae). *Animal Behaviour* **55**: 223-226.

Voigt C.C., Azam, C., Dekker, J., Feguson, J., Fritze, M., Gazaryan, S., Holker, F., Jones, G., Leader, N., Limpens, H.J.G.A., Mathews, F., Rydell, J., Schofield, H., Spoelstra, K., Zagmajster, M. (2018) Guidelines for consideration of bats in lighting projects. EUORBATS Publication Series No. 8. UNEP/EUROBATS Secretatiat, Bonn.

Wakefield, A., Broyles, M., Stone, E.L., Jones, G. & Harris, S. (2016). Experimentally comparing the attractiveness of domestic lights to insects: Do LEDs attract fewer insects than conventional light types? Ecol. Evol. 6, 8028–8036. https://doi.org/10.1002/ece3.2527.

Whilde, A. (1993). *Threatened mammals, birds, amphibians and fish in Ireland. Irish Red Data Book 2: Vertebrates.* Belfast: HMSO.

Wildlife Act 1976 and Wildlife [Amendment] Act 2000. Government of Ireland.

Wilson, R., Wakefield, A., Roberts, N. and Jones, G. (2021) Artificial light and biting flies: the parallel development of attractive light traps and unattractive domestic lights. Parasite & Vectors. https://doi.org/10.1186/s13071-020-04530-3.

Zeale, M.R.K., Stone, E.L., Zeale, E., Browne, W.J., Harris, S. & Jones, G. (2018). Experimentally manipulating light spectra reveals the importance of dark corridors for commuting bats. Glob. Chang. Biol. 24, 5909–5918. https://doi.org/10.1111/gcb.14462.

8. Appendices

8.1 Appendix 1 Bat Habitat & Commuting Route Classifications

Table 1.A: Hedgerow Category (Bat Conservation Ireland, 2015)

Type of Hedgerow / Treeline	Code	Description / Bat Potential
Small Hedgerow	**SH**	Hedgerow is less than approximately 1.5 m high, there are no, or very few, protruding bushes or trees. This type of hedgerow would provide little shelter to bats. 
Medium Hedgerow	**MH**	Hedgerow is approximately 1.5 to 3 m high. This type of hedgerow will provide foraging and commuting potential for bats. 
Sparse Treeline Hedgerow	**ST**	Hedgerow, low or medium in height, with individuals trees (where tree canopies, for the most part, do not touch).

		
Dense Treeline Hedgerow	**DT**	Large uncut hedgerows or treelines, dominated by mainly large tree or very tall scrub species (e.g. tall hawthorn, blackthorn or hazel), where the canopies are mostly touching. 

Table 1.B: Habitat Classification (Bat Conservation Ireland, 2015, based on Fossit, 2000)

Cultivated land		Salt marshes		Exposed rock		Fens/flushes	
Built land		Brackish waters		Caves		Grasslands	
Coastal structures		Springs		Freshwater marsh		Scrub	
Shingle/gravel		Swamps		Lakes/ponds		Hedges/treelines	
Sea cliffs/islets		Disturbed ground		Heath		Conifer plantation	
Sand dunes		Watercourse		Bog		Woodland	

8.2 Appendix 2 Summer Bat Boxes

Woodcrete Bat Boxes (IFF Design) – to be erected on trees

Bat Boxes for Bat Box Scheme on trees: 1FF, 2F & 2FN designs

Bat boxes for buildings / walls - Universal Bat Summer Roost 1FTH

8.3 Appendix 3 Bat Assessment Tables

Table 4.1 Guidelines for assessing the potential suitability of proposed development sites for bats, based on the presence of habitat features within the landscape, to be applied using professional judgement.

Suitability	Description Roosting habitats	Commuting and foraging habitats
Negligible	Negligible habitat features on site likely to be used by roosting bats.	Negligible habitat features on site likely to be used by commuting or foraging bats.
Low	A structure with one or more potential roost sites that could be used by individual bats opportunistically. However, these potential roost sites do not provide enough space, shelter, protection, appropriate conditions[a] and/or suitable surrounding habitat to be used on a regular basis or by larger numbers of bats (i.e. unlikely to be suitable for maternity or hibernation[b]). A tree of sufficient size and age to contain PRFs but with none seen from the ground or features seen with only very limited roosting potential.[c]	Habitat that could be used by small numbers of commuting bats such as a gappy hedgerow or unvegetated stream, but isolated, i.e. not very well connected to the surrounding landscape by other habitat. Suitable, but isolated habitat that could be used by small numbers of foraging bats such as a lone tree (not in a parkland situation) or a patch of scrub.
Moderate	A structure or tree with one or more potential roost sites that could be used by bats due to their size, shelter, protection, conditions[a] and surrounding habitat but unlikely to support a roost of high conservation status (with respect to roost type only – the assessments in this table are made irrespective of species conservation status, which is established after presence is confirmed).	Continuous habitat connected to the wider landscape that could be used by bats for commuting such as lines of trees and scrub or linked back gardens. Habitat that is connected to the wider landscape that could be used by bats for foraging such as trees, scrub, grassland or water.
High	A structure or tree with one or more potential roost sites that are obviously suitable for use by larger numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, conditions[a] and surrounding habitat.	Continuous, high-quality habitat that is well connected to the wider landscape that is likely to be used regularly by commuting bats such as river valleys, streams, hedgerows, lines of trees and woodland edge. High-quality habitat that is well connected to the wider landscape that is likely to be used regularly by foraging bats such as broadleaved woodland, tree-lined watercourses and grazed parkland. Site is close to and connected to known roosts.

[a] For example, in terms of temperature, humidity, height above ground level, light levels or levels of disturbance.
[b] Evidence from the Netherlands shows mass swarming events of common pipistrelle bats in the autumn followed by mass hibernation in a diverse range of building types in urban environments (Korsten *et al.*, 2015). This phenomenon requires some research in the UK but ecologists should be aware of the potential for larger numbers of this species to be present during the autumn and winter in large buildings in highly urbanised environments.
[c] This system of categorisation aligns with BS 8596:2015 Surveying for bats in trees and woodland (BSI, 2015).

Figure A: Table 4.1 (p 35) Reproduced from Collins (2016).

(1) Conversion, modification, demolition or removal of buildings (including hotels, schools, hospitals, churches, commercial premises and derelict buildings) which are:

- agricultural buildings (e.g. farmhouses, barns and outbuildings) of traditional brick or stone construction and/or with exposed wooden beams;
- buildings with weather boarding and/or hanging tiles that are within 200m of woodland and/or water;
- pre-1960 detached buildings and structures within 200m of woodland and/or water;
- pre-1914 buildings within 400m of woodland and/or water;
- pre-1914 buildings with gable ends or slate roofs, regardless of location;
- located within, or immediately adjacent to woodland and/or immediately adjacent to water;
- Dutch barns or livestock buildings with a single skin roof and board-and-gap or Yorkshire boarding if, following a preliminary roost assessment, the site appears to be particularly suited to bats.

(2) Development affecting built structures:

- tunnels, mines, kilns, ice-houses, adits, military fortifications, air-raid shelters, cellars and similar underground ducts and structures; unused industrial chimneys that are unlined and brick/stone construction;
- bridge structures, aqueducts and viaducts (especially over water and wet ground).

(3) Floodlighting of:

- churches and listed buildings, green space (e.g. sports pitches) within 50m of woodland, water, field hedgerows or lines of trees with connectivity to woodland or water;
- any building meeting the criteria listed in (1) above.

(4) Felling, removal or lopping of:

- woodland;
- field hedgerows and/or lines of trees with connectivity to woodland or water bodies;
- old and veteran trees that are more than 100 years old;
- mature trees with obvious holes, cracks or cavities, or that are covered with mature ivy (including large dead trees).

(5) Proposals affecting water bodies:

- in or within 200m of rivers, streams, canals, lakes, reed beds or other aquatic habitats.

(6) Proposals located in or immediately adjacent to:

- quarries or gravel pits;
- natural cliff faces and rock outcrops with crevices or caves and swallets.

(7) Proposals for wind farm developments of multiple wind turbines and single wind turbines (depending on the size and location) (NE TIN 051 – undergoing updates at the time of writing).

(8) All proposals in sites where bats are known to be present[1]

This may include proposed development affecting any type of buildings, structures, feature or location.

Notes:

1. Where sites are of international importance to bats, they may be designated as SACs. Developers of large sites 5–10km away from such SACs may be required to undertake a HRA.

Figure B: Reproduced from Collins (2016) – page 13.

Table 2 Factors affecting the probability of bats being present.

Factors affecting the probability of a building being used by bats in summer	
Increased probability	Disused or little used; largely undisturbed
	Large roof void with unobstructed flying spaces
	Large dimension roof timbers with cracks, joints and holes
	Uneven roof covering with gaps, though not too draughty
	Entrances that bats can fly in through
	Hanging tiles or wood cladding, especially on south-facing walls
	Rural setting
	Close to woodland and/or water
	Pre-20th century or early 20th century construction
	Roof warmed by the sun
	Within the distribution area of horseshoe bats
Decreased probability	Highly urbanised area with few feeding places
	Small or cluttered roof void (esp. for brown long-eared bat)
	Heavily disturbed
	Modern construction with few gaps around soffits or eaves (but be aware these may be used by pipistrelles in particular)
	Prefabricated with steel and sheet materials
	Active industrial premises
	Roof shaded from the sun
Factors affecting the probability of trees being used by roosting bats	
Increased probability	In ancient woodland or parkland
	Large trees with complex growth form
	Species that typically form cavities, such as beech, willow, oak or ash
	Visible damage caused by rot, wind, lightning strike *etc.*
	Loose bark providing cavities
Decreased probability	Coniferous plantation with no specimen trees
	Young trees with simple growth form and little damage
Factors affecting the probability of underground sites being used by roosting bats	
Increased probability	Large enough to develop stable temperature in winter
	High humidity
	Undisturbed
	Close to woodland or water (but note that bats will also use upland sites)
	Many cracks and crevices suitable for bats
Decreased probability	Small and draughty
	Heavily disturbed
	In urbanised areas
	Smooth surfaces with few roosting opportunities

Figure C: Table 2 Reproduced from Marnell *et al.* (2022).

9. Bat Species Profile

9.1 Leisler's bat

Ireland's population is deemed of international importance and the paucity of knowledge of roosting sites, makes this species vulnerable. However, it is considered to be widespread across the island. The modelled Core Area for Leisler's bats is a relatively large area that covers much of the island of Ireland (52,820km^2). The Bat Conservation Ireland Irish Landscape Model indicated that the Leisler's bat habitat preference has been difficult to define in Ireland. Habitat modelling for Ireland shows an association with riparian habitats and woodlands (Roche *et al.,* 2014). The landscape model emphasised that this is a species that cannot be defined by habitats preference at a local scale compared to other Irish bat species but that it is a landscape species and has a habitat preference at a scale of 20.5km. In addition, of all Irish bat species, Leisler's bats have the most specific roosting requirements. It tends to select roosting habitat with areas of woodland and freshwater.

Irish Status	Near Threatened
European Status	Least Concern
Global Status	Least Concern
Irish Population Trend	2003-2013 ↑
Estimated Irish Population Size	73,000 to 130,000 (2007-2013) Ireland is considered the world stronghold for this species
Estimate Core Area (Lundy *et al. 2011)*	52,820 km^2

Taken from Roche *et al.,* 2014, Lysaght & Marnell, 2016 & Marnell *et al.*, 2019

The principal concerns for Leisler's bats are poorly known in Ireland but those that are relevant for this survey area are as follows:

- Selection of maternity sites is limited to specific habitats;
- Relative to the population estimates, the number of roost sites is poorly recorded;
- Tree felling, especially during autumn and winter months; and
- Increasing urbanisation.

9.2 Common pipistrelle

This species is generally considered to be the most common bat species in Ireland. The species is widespread and is found in all provinces. The modelled Core Area for common pipistrelles is a large area that covers much of the island of Ireland (56,485km^2) which covers primarily the east and south east of the area (Roche *et al.,* 2014). The Bat Conservation Ireland Irish Landscape Model indicated that the Common pipistrelle selects areas with broadleaf woodland, riparian habitats and low density urbanization (<30%) (Roche *et al.,* 2014).

Irish Status	Least Concern
European Status	Least Concern
Global Status	Least Concern
Irish Population Trend	2003-2013 ↑
Estimated Irish Population Size	1.2 to 2.8 million (2007-2012)
Estimate Core Area (km^2) (Lundy *et al. 2011)*	56,485

Taken from Roche *et al.,* 2014, Lysaght & Marnell, 2016 & Marnell *et al.*, 2019

Principal concerns for Common pipistrelles in Ireland that are relevant for this survey area are as follows:

- Lack of knowledge of roosting requirements

- This species has complex habitat requirements in the immediate vicinity of roosts. Therefore, careful site specific planning for this species is required in order to ensure all elements are maintained.
- Renovation or demolition of derelict buildings.
- Tree felling
- Increasing urbanisation (e.g. increase in lighting)

9.3 Soprano pipistrelle

This species was the second most recorded species along the proposed development site and it generally considered to be the second most common bat species in Ireland. The species is widespread and is found in all provinces, with particular concentration along the western seaboard. The modelled Core Area for soprano pipistrelle is a large area that covers much of the island of Ireland (62,020km^2). The Bat Conservation Ireland Irish Landscape Model indicated that the soprano pipistrelle selects areas with broadleaf woodland, riparian habitats and low density urbanisation (Roche *et al.,* 2014).

Irish Status	Least Concern
European Status	Least Concern
Global Status	Least Concern
Irish Population Trend	2003-2013 ↑
Estimated Irish Population Size	0.54 to 1.2 million (2007-2012)
Estimate Core Area (km^2) (Lundy *et al. 2011)*	62,020

Taken from Roche *et al.,* 2014, Lysaght & Marnell, 2016 & Marnell *et al.*, 2019

Principal concerns for Soprano pipistrelles in Ireland that are relevant for this survey area are as follows:

- Lack of knowledge of roosts;
- Renovation or demolition of structures;
- Tree felling; and
- Increasing urbanisation (e.g. increase in lighting).

9.4 Brown long-eared Bat

This species is generally considered to be widespread across the island. The modelled Core Area for Brown long-eared bats is a relatively large area that covers much of the island of Ireland (52,820km^2) with preference suitable areas in the southern half of the island. The Bat Conservation Ireland Irish Landscape Model indicated that the Brown long-eared bat habitat preference is for areas with broadleaf woodland and riparian habitats on a small scale of 0.5km emphasising the importance of local landscape features for this species (Roche *et al.,* 2014).

Irish Status	Least Concern
European Status	Least Concern
Global Status	Least Concern
Irish Population Trend	2008-2013 Stable
Biographical Range	km^2
Estimate Core Area (Lundy *et al. 2011)*	49,929 km^2

Taken from Roche *et al.,* 2014, Lysaght & Marnell, 2016 & Marnell *et al.*, 2019

Principal concerns for brown long-eared bats are poorly known in Ireland, but those that are relevant for this survey area are as follows:

- Selection of maternity sites is limited to specific habitats;
- Lack of knowledge of winter roosts;
- Loss of woodland, scrub and hedgerows;
- Tree surgery and felling;
- Increasing urbanisation; and
- Light pollution.

9.5 Daubenton's bat

The modelled Core Area for Daubenton's bats is a relatively large area that covers much of the island of Ireland (41,285km^2) reflecting the distribution of sizeable river catchments. The Irish Landscape Model indicated that the Daubenton's bat habitat preference is for areas with broadleaf woodland, riparian habitats and low density urbanisation (Roche *et al.,* 2014).

Irish Status	Least Concern
European Status	Least Concern
Global Status	Least Concern
Irish Population Trend	2008-2013 Stable
Estimated Irish Population Size	81,000 to 103,000 (2007-2012)
Estimate Core Area (km^2) (Lundy *et al. 2011)*	41,285

Taken from Roche *et al.,* 2014, Lysaght & Marnell, 2016 & Marnell *et al.*, 2019

Principal concerns for Daubenton's bats are poorly known in Ireland but those that are relevant for this survey area are as follows:

- Potential roost loss due to bridge maintenance;
- Loss of woodland and forest clearance;
- Loss of woodland, scrub and hedgerows;
- Tree surgery and felling;
- Increasing urbanisation; and
- Light pollution.