

## **Appendix 5.7. Bat Surveys Report, 2024**

# Bat Surveys for the proposed Mortarstown Wastewater Treatment Plant Upgrade, Carlow. September 2024

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### Biodiversity Record Submission Policy:

It is the policy of Abbott Ecology to submit all bat records to Bat Conservation Ireland, via the National Biodiversity Data Centre (NBDC) recording website, one year post-surveying. This is to contribute to future desktop reviews that use the biodiversity/bat databases. Records will automatically be submitted, unless otherwise requested.

## Summary

Abbott Ecology was commissioned by AtkinsRéalis, on behalf of Uisce Éireann, to conduct bat surveys on the site of the proposed Mortarstown Wastewater Treatment Plant (WwTP) upgrade in Carlow town. The Mortarstown WwTP is located in Mortarstown townland on the southern side of Carlow town, and the Pumping Station is located between the R448 Kilkenny Road and the River Barrow, opposite the South East Technological University campus in Carlow. It is proposed to extend the WwTP and the Kilkenny Road Pumping Station, and to create a new pipeline between these two areas (which is mainly under-road), and to make changes to the outflow pipeline towards the River Barrow west of the Mortarstown WwTP.

Bat surveys were carried out between 14-20 September 2024 during suitable weather conditions. A variety of methods were used, including daytime visual searches for signs of bat roosting in buildings/structures and Potential Roost Features (PRFs) in trees, a daytime assessment of habitats for commuting/foraging bats, a night-time bat activity walkover, and passive bat detector monitoring for six consecutive nights 14-20 September 2024. The results of three previous bat survey reports completed by Dr. Caroline Shiel in 2020 and 2021 for the Mortarstown WwTP upgrade were also reviewed for context.

Bat activity levels were low during the current surveys (with the exception of higher activity levels adjacent to the River Barrow), but bat species diversity was high. Seven of the nine resident bat species were detected by passive detector monitoring at Mortarstown WwTP (in order of decreasing frequency); Soprano Pipistrelle (*Pipistrellus pygmaeus*), Common Pipistrelle (*Pipistrellus pipistrellus*), Leisler's Bat (*Nyctalus leisleri*) (these three more common and acoustically-detectable bat species accounted for c. 93% of the overall acoustic bat registrations), Daubenton's Bat (*Myotis daubentonii*), Brown Long-eared Bat (*Plecotus auritus*), Natterer's Bat (*Myotis nattereri*), and Whiskered Bat (*Myotis mystacinus*). Daubenton's Bat and Brown Long-eared Bat were detected on 5 out of 6 nights of automated acoustic monitoring. Four bat species were detected during the night-time bat activity walkover (in order of decreasing frequency); Soprano Pipistrelle, Common Pipistrelle, Daubenton's Bat, and Leisler's Bat. The suitability of habitats on site to foraging and commuting bat was assessed as low to moderate.

No signs of bat roosting were discovered during a daytime visual inspection of the exterior (and the interior where accessible) of buildings/structures within the site. There were access points for bats into hidden parts of some of the buildings, and so bat roosting cannot be entirely ruled out for all buildings. Three trees with Potential Roost Features were identified (previous surveys and this survey combined), but a re-inspection of trees in winter when the leaves have fallen would be necessary. The wooded area for the proposed outfall pipe between the Kilkenny Road and the River Barrow did not have survey access permission in September 2024, and would require a winter search for PRFs in trees there.

Potential impacts of the proposed upgrade/extension works on bats are assessed, and bat mitigation measures are outlined. These measures include recommendations for further targeted bats surveys, planting of new native hedgerows (that are allowed to grow tall and flower), and avoidance/minimisation of artificial lighting at night.

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# 1. Introduction

## 1.1 Background and Aims

Abbott Ecology was commissioned by AtkinsRéalis, on behalf of Uisce Éireann, to conduct bat surveys in September 2024 for a proposed upgrade to Mortarstown Wastewater Treatment Plant (WwTP) in Carlow Town.

The aims of this bat survey were to;

- Carry out a daytime walkover survey to assess suitability of habitats for foraging and commuting bats.
- Carry out a daytime search for bat roosting signs at buildings/structures within the study site, and assess roost suitability.
- Search for Potential Roost Features for bats in trees that may be impacted by upgrading/extending the WwTP.
- Complete a night-time bat activity walkover covering all safely accessible areas within the survey site.
- Assess potential impacts of the proposed works on bat populations.
- Recommend bat mitigation measures where appropriate.

## 1.2 Surveyor Information

**Dr. Isobel Abbott (Principal Ecologist, Abbott Ecology):** Isobel is an independent ecological consultant, specialising for >15 years in bat ecology, bat survey, assessment and mitigation. She graduated first in class in Zoology from University College Cork in 2007, and subsequently obtained her PhD on the effectiveness of bat mitigation measures employed on Irish national road schemes in 2012. She has published a number of research papers on bat ecology in scientific journals. She has extensive experience of conducting bat surveys and other multi-disciplinary ecology surveys for Ecological Impact Assessments, Preliminary Ecological Appraisal, and Ecological Constraints Reports. She has worked on a variety of projects including national bat monitoring programmes, wind farms, solar farms, road construction, bridge repairs, quarries, and residential and industrial developments. Isobel has designed bat mitigation measures and successfully applied for >50 bat derogation licenses from the National Parks and Wildlife Service associated with planning permission applications or research. She currently holds nationwide NPWS licenses to capture and handle bat species, and to disturb bat roosts for the purpose of ecological impact assessment.

## 1.3 Site Description and Proposed Works

The study location and site boundary, as provided by AtkinsRéalis, are shown in Figure 1 below. The existing Mortarstown WwTP is located in Mortarstown townland on the southern side of Carlow town (Lat. 52.819382, Long. -6.940005), and the Pumping Station is located between the R448 Kilkenny Road and the River Barrow, opposite the South East Technological University campus in Carlow (Lat. 52.827037, Long. -6.937938).

It is proposed to upgrade and extend the Mortarstown WwTP (extension area highlighted in Figure 2), and upgrade the Kilkenny Road Pumping. It is also proposed to create a new pipeline between the Pumping Station and the WwTP, which is mainly under-road along the R448 Kilkenny Road, then underground along the edge of the Southern Gardens housing estate. The connecting pipeline route is shown by the dashed blue line in Figure 1. A new outfall pipe and headwall are proposed adjacent to the existing to accommodate horizon flows and the existing outfall pipe is to be decommissioned but left in place (black line in Figure 1).

Aerial imagery of the landscape surrounding the existing Mortarstown WwTP, and the proposed extension area to the WwTP, is shown in Figure 2. The Mortarstown WwTP is in a suburban area in the outskirts of Carlow town that has become more built-up in recent years. There are however more rural pockets of mature trees, gardens, hedgerows, green fields, and a woodland strip along the western side of the River Barrow in the vicinity of Mortarstown WwTP (Figure 2). The woodland area along the River Barrow is part of the River Barrow and River Nore Special Area of Conservation (SAC). The tall hedgerow/treelines along the northern and south-eastern perimeters of the WwTP (visible in aerial imagery in Figure 2) are composed mainly of non-native coniferous trees. There is a tall perimeter fence lacking a hedgerow along the western perimeter of the WwTP. The proposed extension area to the WwTP is currently an agricultural field, grazed by sheep, with hedgerow around the west and south of its perimeter, and no hedgerow along the east and north of its perimeter.

The Pumping Station on the Kilkenny Road is on the edge of the urban centre of Carlow town in a narrow section of land between the R448 Kilkenny Road and the River Barrow. There is a line of mature Willow trees (mainly) between the Pumping Station and the River Barrow to its west, and a mix of rough grassland, bare recolonising ground, scrub, hedgerows, woodland, and built land surrounding the Pumping Station. The mature Willows along the River Barrow at the Pumping Station are outside the site boundary.

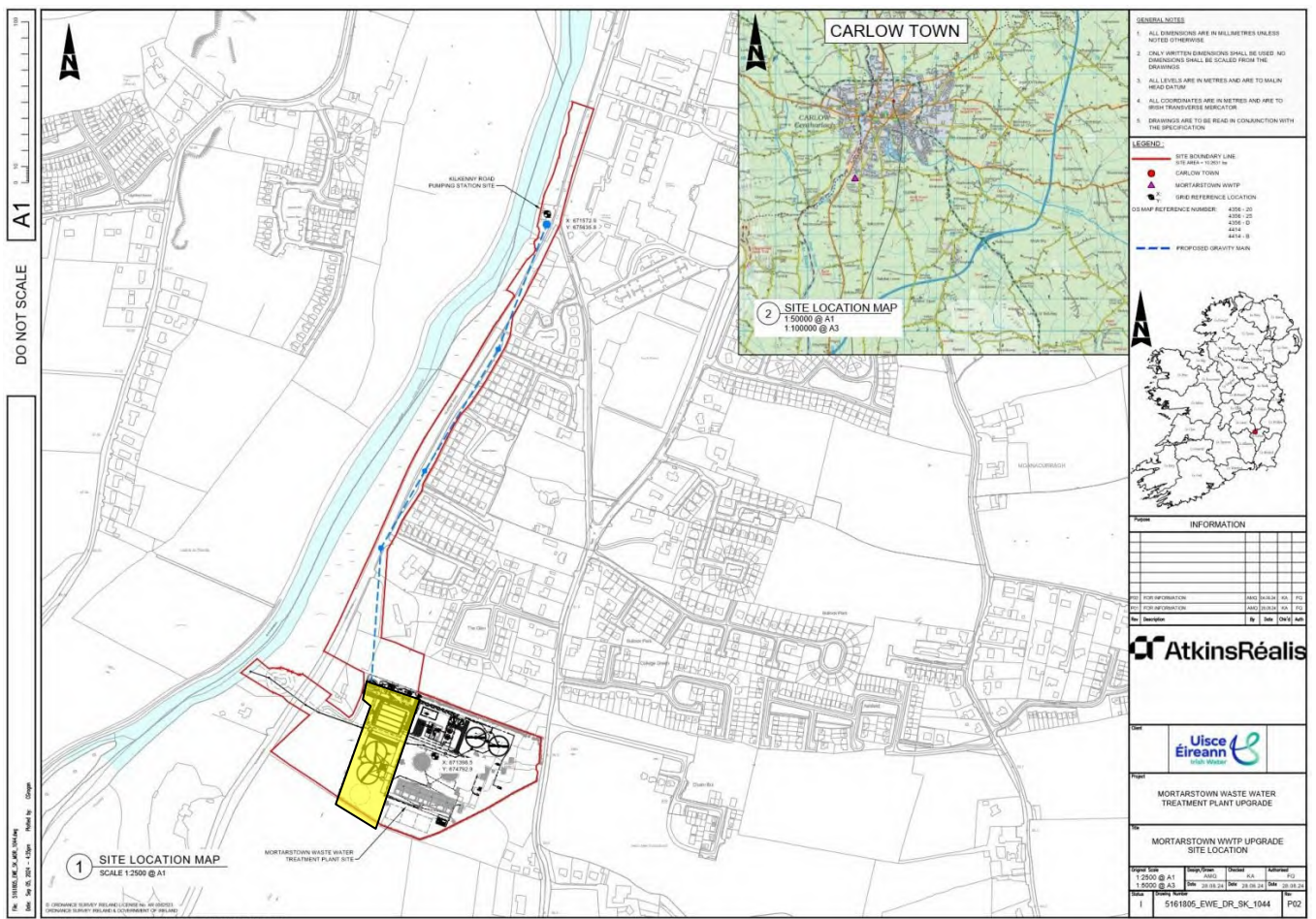


Figure 1. Mortarstown WwTP upgrade site location map and red line boundary. Source: AtkinsRéalis (Yellow area indicating extension area to Mortarstown WwTP added)



Figure 2. Aerial imagery surrounding the existing Mortarstown WwTP and the proposed extension area to the WwTP

## 1.4 Legal Protection of Bats

Bats comprise one of the most highly diverse mammalian groups. There are over 1,200 species of bat worldwide, with nine confirmed as resident in Ireland to date. Due to sharp declines in many bat populations in recent decades, all bat species in Europe are legally protected under the European Habitats Directive, 1992 (92/43/EEC). The Habitats Directive seeks to “maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community Interest”. It contains lists (in ‘Annexes’) of habitats, plant species, and animal species, which are rare or declining on a European scale. It is built around two pillars;

- A **System of Strict Protection** for species of European importance, **including all bat species** (listed under Annex IV, Article 12 of the EU Habitats Directive). This provides protection to the bats themselves, and also prohibits deterioration/destruction of breeding sites and resting places.
- **The Natura 2000 Network of Protected Areas** (Special Areas of Conservation, SACs, and Special Protection Areas, SPAs) (Article 6 of the EU Habitats Directive). The Lesser Horseshoe Bat (*Rhinolophus hipposideros*) is the only Irish bat species listed under Annex II, and for which the Irish government is required to designate SACs. This species occurs almost exclusively in the Atlantic seaboard counties of Cork, Kerry, Limerick, Clare, Galway and Mayo, with sparse records in counties Tipperary, Roscommon, and Sligo.

The domestic legislation, the European Communities (Birds and Natural Habitats) Regulations 2011-2021, (S.I. No. 477 of 2011) (“the Habitats Regulations”), which implements this EU Directive, combined with the Wildlife Acts 1976-2021, ensures that individual bats and their breeding sites and resting places are fully protected in Ireland. A summary of the law in relation to bats in Ireland and the Europe is highlighted in *Text Box 1* below.

### Text Box 1. Bats and the Law

As a result of the legislation outlined above, it is an offence to:

1. Deliberately capture, injure or kill a bat.
2. Deliberately disturb a bat, particularly during the period of breeding, hibernating or migrating.
3. Damage or destroy a breeding site or resting place of a bat.
4. Keep, transport, sell, exchange, offer for sale or offer for exchange any bat taken in the wild, other than those taken legally before the Habitats Directive was implemented.

### Bat Roost Derogation Licenses

Both pillars, (i) the System of Strict Protection and (ii) the Natura 2000 network of SACs and SPAs, allow for exceptions or “derogations” from the protection regimes under Article 6 and Article 16 of the EU Habitats Directive. A person may apply to the Minister under Regulation 54 of the Habitats Regulations for a derogation license to carry out one or more of these prohibited activities. Firstly, a license can only be granted by the Minister via the NPWS only for the reasons which are specifically listed in Regulation 54 (*Text Box 2*). Secondly, the applicant must demonstrate that there is no satisfactory alternative, and thirdly, that the action will not adversely affect the favourable conservation status of bat species in their natural range. Each case is considered on its particular circumstances, and an application may be refused. Mitigation to reduce or compensate for any impact of development is generally a condition of the licence and should be proportionate to the impact. Mitigation measures may require particular timing of operations, protection of existing roosts or the creation of new roosts to replace ones being lost. Monitoring of the effect of the mitigation is usually required (Marnell *et al.*, 2022).

### Text Box 2. Regulation 54 Derogation Reasons

- (a) In the interests of protecting wild fauna and flora and conserving natural habitats
- (b) To prevent serious damage, in particular to crops, livestock, forests, fisheries and water and other types of property
- (c) In the interests of public health and public safety, or for other imperative reasons of overriding public interest, including those of a social or economic nature and the beneficial consequences of primary importance for the environment
- (d) For the purpose of research and education, of repopulating and introducing these species and for the breeding operations necessary for these purposes, including artificial propagation of plants
- (e) To allow, under strictly supervised conditions, on a selective basis and to a limited extent, the taking or keeping of bats

## 1.5 Bats In Ireland

The nine confirmed resident bat species in Ireland are; Soprano Pipistrelle (*Pipistrellus pygmaeus*), Common Pipistrelle (*Pipistrellus pipistrellus*), Nathusius' Pipistrelle (*Pipistrellus nathusii*), Leisler's Bat (*Nyctalus leisleri*), Brown Long-eared Bat (*Plecotus auritus*), Lesser Horseshoe Bat (*Rhinolophus hipposideros*) and three myotis species; Daubenton's Bat (*Myotis*

*daubentonii*), Natterer's Bat (*Myotis nattereri*), and Whiskered Bat (*Myotis mystacinus*). Ireland hosts the world population stronghold for Leisler's Bat, and one of the world's population strongholds for Lesser Horseshoe Bat.

There have been confirmed records of a further two bat species, currently considered vagrant species; Brandt's Bat (*Myotis brandtii*) in Co. Wicklow in 2003 confirmed by DNA analysis (Mullen 2007), and Greater Horseshoe Bat (*Rhinolophus ferrumequinum*) has been confirmed by a single male in Co. Wexford in 2012/2013 (Roche *et al.* 2014), and more recently by acoustic recordings made during June and July 2020 in Glendalough, Co. Wicklow (email communication from Bat Conservation Ireland, 17.7.2020). There have been a few other Irish records of Brandt's Bat, unconfirmed by DNA analysis, and it is possible that Brandt's Bat may have been overlooked because of its close similarity to Whiskered Bat. However, a 2008-2009 re-survey of known Irish sites for Whiskered Bat did not confirm any additional Brandt's Bat through DNA analysis, so it cannot at present be considered a resident species (Boston *et al.* 2010).

Table 1 details the conservation status and legal protection of Irish bat species with respect to; Red List of Terrestrial Mammals (Marnell *et al.* 2019), the latest assessment of EU protected habitats and species in Ireland (NPWS 2019), the European Communities (Birds and Natural Habitats) Regulations 2011-2021, and the Irish Wildlife Acts (1976 - 2021).

**Table 1. Conservation status, population size estimate, and legal protection of Irish bat species**

| Bat species                                               | Estimated population size* | Red List Status** | EU Protected Species Assessment*** | Habitats Directive    | Irish Wildlife Acts |
|-----------------------------------------------------------|----------------------------|-------------------|------------------------------------|-----------------------|---------------------|
| Common Pipistrelle<br><i>Pipistrellus pipistrellus</i>    | 1.2 -2.8 million           | Least Concern     | Favourable                         | Annex IV              | Yes                 |
| Soprano Pipistrelle<br><i>Pipistrellus pygmaeus</i>       | 0.5-1.2 million            | Least Concern     | Favourable                         | Annex IV              | Yes                 |
| Nathusius' Pipistrelle<br><i>Pipistrellus nathusii</i>    | 10,000 - 18,000            | Least Concern     | Unknown                            | Annex IV              | Yes                 |
| Leisler's Bat<br><i>Nyctalus leisleri</i>                 | 73,000 - 130,000           | Least Concern     | Favourable                         | Annex IV              | Yes                 |
| Daubenton's Bat<br><i>Myotis daubentonii</i>              | 81,000 - 103,000           | Least Concern     | Favourable                         | Annex IV              | Yes                 |
| Natterer's Bat<br><i>Myotis nattereri</i>                 | Unknown                    | Least Concern     | Favourable                         | Annex IV              | Yes                 |
| Whiskered Bat<br><i>Myotis mystacinus</i>                 | Unknown                    | Least Concern     | Favourable                         | Annex IV              | Yes                 |
| Brandt's Bat<br><i>Myotis brandtii</i>                    | Unknown                    | Data Deficient    | Not included (vagrant)             | Annex IV              | Yes                 |
| Brown Long-eared Bat<br><i>Plecotus auritus</i>           | 64,000 - 115,000           | Least Concern     | Favourable                         | Annex IV              | Yes                 |
| Lesser Horseshoe Bat<br><i>Rhinolophus hipposideros</i>   | 14,000                     | Least Concern     | Inadequate                         | Annex II and Annex IV | Yes                 |
| Greater Horseshoe Bat<br><i>Rhinolophus ferrumequinum</i> | Unknown, low number        | Not included      | Not included (vagrant)             | Annex II and Annex IV | Yes                 |

\* After Roche *et al.* 2014. \*\* After Marnell *et al.* 2019. \*\*\* After NPWS 2019

Bats use different types of roosts during different times of the year and phases of their life cycle (Plate 1) (see summary of roost types in Appendix A). For example, in early summer, pregnant females gather together to form maternity roosts where they give birth to pups and suckle them until they are weaned by late summer. The pups are flightless for a few weeks and are completely reliant on their mothers' milk. Bats spend the summer months mostly hunting for insect prey at night and sheltering by day. In winter when insect food becomes scarce due to low temperatures, bats seek out winter hibernation roosts where they enter into a torpor, reducing their metabolic requirements, thus surviving through the period of low food availability. They are vulnerable to disturbance in winter roosts, as waking up causes them to burn fat reserves that must last until spring, and they are vulnerable to injury when in a torpid state.

Bats also make use of roosts other than their daytime roost. During night-time foraging bouts, they may take temporary shelter from inclement weather or process and digest insect prey in what are called 'night roosts'. These often tend to be close to key foraging areas e.g. for Lesser Horseshoe (Knight & Jones 2009). Wherever a bat lives or rests is a bat roost. However bats need different roosting conditions at different times of the year, and they will often move around to find a roost that meets their needs. Summer maternity roosts, where females gather to give birth and rear pups, are of greater conservation significance than a night roost or an occasional roost used by a single or small number of bats (Marnell, Kelleher & Mullen 2022).

Each bat species tends to have its own particular roost requirements and preferences. For example, Lesser Horseshoe Bats cannot use their limbs to crawl into crevices like other species, and they must instead fly directly into a roost through an opening of sufficient size and hang by their specially adapted feet from a suitable perch. For this reason, this species will not use bat roost boxes as other Irish bat species. Pipistrelle species on the other hand are crevice dwellers. They can land and crawl into very tight spaces through access holes as little as 1.2 x 2 cm. Their roosts can be concealed under ridge tiles, in wall cavities, or between slates and felt for example.

Bats, like other wildlife, tend to use habitat corridors with shelter of trees, hedgerows and woodland to move throughout the landscape. Such wildlife corridors provide connectivity between the various roosts, foraging, and mating sites that bats use during different seasons or phases of their life cycle (Plate 2, and see Appendix A for descriptions of roost types). Linear vegetated features such as tree lines, hedges, riverbanks, and woodland, are often important commuting and foraging habitats for bats. These landscape features provide concentrations of insect prey as well as shelter from wind, rain and predators. However, bats, like any other wildlife, will also move through less sheltered landscapes when exploring new roosting/foraging opportunities or migrating between areas e.g. moving between summer roosts and autumn mating sites or winter hibernation roosts. Loss of connective habitat patches/corridors can however impede bat movements and negatively impact bat populations (Voigt & Kingston 2016).

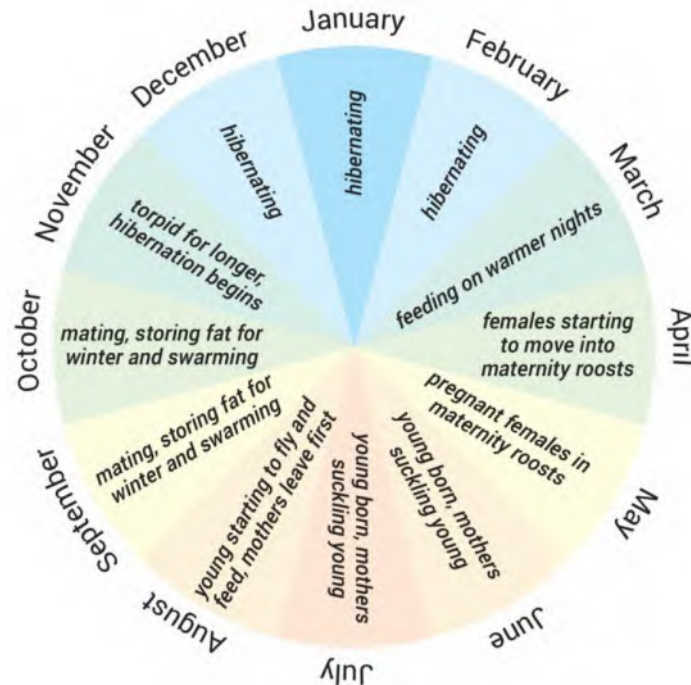


Plate 1. Generalised bat life cycle (from Bat Conservation Trust Guidelines 2023)

## 2. Methods

### 2.1 Overview

Bat surveys were undertaken in accordance with current bat survey guidelines *Bat Conservation Trust and NPWS Guidance - 'Bat Surveys for the Professional Ecologist Good Practice Guidelines (4th edition)'* and *'Bat Mitigation Guidelines for Ireland vol. 2'*; (Marnell *et al.* 2022; Collins 2023). The overall schedule of site surveys, and relevant weather conditions during surveys, are shown in Table 2.

Table 2. Overall bat survey schedule

| Date      | Field Survey                                                                                                                                                                                                                                                                          | Times                                                | Weather Conditions                                                   | Surveyor* |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------|-----------|
| 14/9/2024 | <ul style="list-style-type: none"> <li>- Daytime visual survey, including bat habitat suitability assessment, external building inspections, and search for Potential Roost Features (PRFs) in trees.</li> <li>- Deploy automated bat detectors x 2 (A and B in Figure 3).</li> </ul> | N/A                                                  | Calm, dry, mild                                                      | IA        |
| 20/9/2024 | <ul style="list-style-type: none"> <li>- Further daytime visual surveys.</li> <li>- Collect passive detectors.</li> <li>- Night-time walked bat activity survey.</li> <li>- Observations on current levels of artificial lighting at night.</li> </ul>                                | Dusk walkover survey: 19:58 - 21:53<br>Sunset: 19:30 | Temperature 13-11°C; Wind F0,<br>Cloud 5/8 Otkas, Precipitation None | IA        |
| 21/9/2024 | <ul style="list-style-type: none"> <li>- Further daytime visual surveys.</li> </ul>                                                                                                                                                                                                   | N/A                                                  | Calm, dry, mild                                                      | IA        |

\* IA = Isobel Abbott

### 2.2 Desktop Review

A desktop review of publicly available ecology/bat data for the development site and locality was undertaken (i.e. searching the maps of the National Biodiversity Data Centre NBDC). The NBDC online ecology database holds bat records from Bat Conservation Ireland's national bat database, and also a Model of Bat Landscapes examining the relative importance of landscape and habitat associations for bats across Ireland (as per Lundy *et al.* 2011). Other available bat surveys for the area were reviewed, including three previous bat survey reports for the proposed upgrade to Mortarstown WwTP. These surveys were carried out by Dr. Caroline Shiel in September 2020 and November 2020 (report 1), May 2021 (report 2), and September 2021 (report 3). The proposed works/site boundary have changed from those in the 2020-21 bat survey reports. The results from the previous bat surveys are referenced throughout this report to provide a more complete overview.

### 2.3 Bat Habitat Suitability Assessment

Desktop review and daytime bat walkover surveys were used to assess habitats within the site boundary for their suitability to support roosting, foraging and commuting bats. Connectivity of the site with habitats in the wider landscape was also considered. Suitability was assessed according to Collins (2023) which provides a grading system for the suitability of roosting habitats and for commuting and foraging areas. Suitability categories are divided into **None**, **Negligible**, **Low**, **Moderate**, **High**, and are described fully in Appendix B.

### 2.4 Building/Structure Bat Roost Assessment

Some examples of bat roost and access points in buildings are illustrated in Plate 2. There were several built structures at the site, as described in the Results Section 3.3 and Figure 4. The exterior of the structures were visually searched during daylight hours, assessing potential roost spaces and access points. The interiors of buildings that were open and accessible on the day of the survey were also inspected. Visual surveys of structures were assisted with high powered directional torchlight, close-focusing binoculars, and an endoscope as needed. Potential signs of bat roosting include, for example;

- Bats, dead or alive
- Bat droppings: these can accumulate under established roosting and access locations.
- Feeding remains: discarded insects parts such as moth wings under feeding perches.
- Fur oil/grease staining: natural oils in bats' fur rubs onto regularly used surfaces.
- Urine staining, or splashes on windows.
- Scratch marks: from bats movements in and out of perching/roosting locations.
- Characteristic smells of bats may sometimes be detectable.
- Audible daytime roost bat chatter.

It is important to note that sometimes bats leave no visible sign of their presence even on the inside of a building, particularly where there are hidden cracks, crevices, and voids. The suitability of structures were categorised as **None**, **Negligible**, **Low**, **Moderate**, **High** according to the grading system in the Collins (2023) bat survey guidelines, as detailed in Appendix B.



**Plate 2. Possible roosting sites and access points for bats in buildings (source: Bat Conservation Trust UK)**

### 2.5 Search for Potential Roost Features in Trees

Potential tree roosts were surveyed from ground level with a torch, binoculars and endoscope, searching for the presence of bats or bat evidence, and any Potential Roost Features (i.e. PRFs) identified by the Bat Tree Habitat Key Project (Andrews & BTHK 2020). These include PRFs caused by disease and decay (knot holes, pruning cuts, tear outs, wounds, cankers, compression forks, butt rots), PRFs formed by damage (lightning strikes, hazard beams, subsidence cracks, shearing cracks, transverse snaps, welds, lifting bark, desiccation fissures, frost cracks) and other PRFs such as fluting, ivy-cover, and woodpecker and squirrel holes. When assessing the suitability of a PRF to hold bats, a division into those suitable to individuals/small numbers of bats, and those suitable to multiple bats/maternity colonies is recommended by the Collins (2023) guidelines (Plate 3). It's acknowledged that while PRFs are relatively straight-forward to find (but not always),

confirming actual bat tree roosts can be difficult, as bats sometimes roost in very inconspicuous tree roosts (Andrews & BTHK 2020) and can be there one day and not the next, and bat droppings do not typically persist for long in tree roosts.

| Bat Conservation Trust                                                                                                                                        |                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Table 6.2. Guidelines for categorising the potential suitability of PRFs on a proposed development site for bats, to be applied using professional judgement. |                                                                                                                                     |
| Suitability                                                                                                                                                   | Description                                                                                                                         |
| PRF-I                                                                                                                                                         | PRF is only suitable for individual bats or very small numbers of bats either due to size or lack of suitable surrounding habitats. |
| PRF-M                                                                                                                                                         | PRF is suitable for multiple bats and may therefore be used by a maternity colony.                                                  |

**Plate 3. Categorising PRFs in trees (from Bat Conservation Trust Survey Guidelines 2023)**

## 2.6 Night-time Bat Activity Walkover Survey

An active bat survey was completed on 20 September 2024 during suitable weather conditions (see survey schedule in Table 2) by walking the site from c. 30 minutes after sunset until c. 2 hr 25 min after sunset, while recording the bat species encountered and noting their behaviours where possible. A GPS track of the route taken is shown in Figure 3. The walkover started in the Mortarstown WwTP, then the slip road and field with the proposed WwTP extension area, and then along the R448 Kilkenny Road, the western edge of the Southern Gardens housing estate, and the Pumping Station area beside the River Barrow. The total length of the walked transect was 9.2 km. Bat species encountered were mapped in Figure 8.

## 2.7 Automated/Passive Detector Monitoring

Two automated bat detectors (Wildlife Acoustics Song Meter SM4BATFS with SMM U2 microphones) were used to record all-night bat activity during 6 full consecutive nights from 14 - 20 September 2024 (Table 3). These detectors were placed in the Mortarstown WwTP at locations A and B marked in Figure 3. Detectors were set to automatically record from half an hour before sunset until half an hour after sunrise. **Unfortunately one of these detectors (Location B, Figure 3) was damaged and all data was lost.**

There were also four 1-night deployments of passive detectors detailed in the previous three bat reports by Dr. Shiel. Their deployment schedule is shown in Table 4, and their locations marked 1 - 4 on Figure 3 to provide a more complete picture of bat surveys for this site to date.

Passive monitoring involves leaving a suitable bat detector in position with no observer present, and bats which pass sufficiently close to the detector microphone are recorded and their calls are stored for later analysis. Recordings were made in full spectrum, retaining all amplitude and harmonic information from the original signal for subsequent analysis, and were stored in WAV format.

Bat sonograms are then manually analysed and identified to species level using specialist software, Wildlife Acoustics Kaleidoscope Viewer Pro, noting the time and date of bat registration files. Activity analysis of recorded bat echolocation was defined as registrations/contacts per species within a 15 s (maximum) file. Multiple passes/calls/pulses of the same species within a (maximum) 15 s file count as a single registration - two species within the same 15 s file count as two registrations. Instances of files with multiple overlapping bat species are noted. Feeding buzzes (indicating a prey capture attempt by a bat), and social calling of bats (used for communication rather than foraging or orientation) were also noted. A feeding buzz is a shortening of pulse durations and inter-pulse intervals as the bat homes in on prey.

Pipistrelle calls with an 'in-between' frequency of maximum energy, FMAXE, of c. 50kHz, cannot always be reliably assigned to either Common Pipistrelle (typical FMAXE of c. 45kHz) or Soprano Pipistrelle (typical FMAXE c. 55kHz), and were classified as '50kHz Pipistrelle'. The echolocation pulses of *Myotis* sp. (Daubenton's Bat, Natterer's Bat, Whiskered Bat) can be difficult to separate to species due to similarities in calls types, particularly if the pulses recorded are faint, only partially detected, or atypical. Where uncertain, these were classified as *Myotis* sp.

As a general guide, bat activity levels recorded by passive bat detectors can be categorised as follows;  
Low: <10 bat registrations/hr, Medium: >10 - <50 bat registrations/hr, High: >50 bat registrations/hr.

**Table 3. Automated passive detector monitoring schedule 2024 (locations shown in Figure 3)**

| Detector Reference | Microphone Location Notes                                                                  | Dates Deployed        | Nights Running | Nights Analysed |
|--------------------|--------------------------------------------------------------------------------------------|-----------------------|----------------|-----------------|
| A                  | Attached to perimeter fence facing towards proposed WwTP extension area ('A' in Figure 3). | 14.9.2024 - 20.9.2024 | 6              | 6               |
| B*                 | Attached to metal scrap at area with scrub and trees in WwTP ('B' in Figure 3)             | 14.9.2024 - 20.9.2024 | 4              | 0*              |

\* detector damaged and all data lost

**Table 4. Automated passive detector monitoring schedule 2020-21 (locations shown in Figure 3)\***

| Detector Reference | Microphone Location Notes                                                                                                                                             | Dates Deployed        | Nights Running | Nights Analysed |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------|-----------------|
| 1                  | Inside Kilkenny Road Pumping Station ('1' in Figure 3)                                                                                                                | 29.9.2020 - 30.9.2020 | 1              | 1               |
| 2                  | Attached to perimeter fence facing towards proposed WwTP extension area ('2' in Figure 3)                                                                             | 29.9.2020 - 30.9.2020 | 1              | 1               |
| 3                  | Attached to western gate entrance to WwTP extension area ('3' in Figure 3)                                                                                            | 6.5.2021 - 7.5.2021   | 1              | 1               |
| 4                  | Attached to tree in intersection of hedgerows in a field/scrub/rough grassland area north of the WwTP ('4' in Figure 3). Not inside currently proposed site boundary. | 28.9.2021 - 29.9.2021 | 1              | 1               |

\* These detector deployments were already reported by Dr. Shiel, and included in this report for context/information

## 2.8 Note on Differences in Bat Species' Acoustic Detectability

Some Irish bat species have much higher intensity of echolocation than others, and can thus be detected from greater distances, e.g. Leisler's Bat (by far the loudest of all the Irish bat species), followed by relatively intense echolocation of Common Pipistrelle and Soprano Pipistrelle, and the rarer Nathusius' Pipistrelle. Bat species with quieter echolocation, such as Brown Long-eared Bat, and Natterer's Bat, must fly much closer to the microphone to be detected. Information taken from the UK Bat Conservation Trust's bat survey guidelines indicates that Brown Long-eared Bat and Natterer's Bat are among the most difficult to detect bat species (Plate 4, from Collins, 2023). These differences in acoustic detectability are important for interpreting the results of bat detector surveys.

The differences in typical behaviour of bat species' also strongly influence the level of bat activity recorded by static bat detectors, and the number of bat registrations does not equal the number of bats flying past the microphone. For example, Leisler's Bat typically fly high and fast in the sky and will often fly over a study site briefly en route through the landscape, occasionally foraging over the treetops. Pipistrelle species, on the other hand, will often repetitively forage back and forth at landscape features, thus generating more bat registrations. Bat species other than Leisler's Bat, Common Pipistrelle and Soprano Pipistrelle are more notable in the results, because of (1) having lower intensity echolocation, and (2) being less common in the landscape. Exceptions to this would include, for example, where the detector records lots of Daubenton's Bat at their typical foraging habitat over smooth waterways, or where detectors are positioned inside/near a bat roost.

**Table 3.8 Number of surveys required to achieve 95% certainty of detection on walked transect surveys in woodland (Scott and Altringham, 2014).**

| Species              | Number of surveys to achieve 95% certainty of detection for walked transect survey |
|----------------------|------------------------------------------------------------------------------------|
| Pipistrelle          | 1                                                                                  |
| Brandt's bat         | 2                                                                                  |
| Whiskered bat        | 2                                                                                  |
| Barbastelle          | 2                                                                                  |
| Horseshoe bat        | 4                                                                                  |
| Natterer's bat       | 5                                                                                  |
| Brown long-eared bat | Up to 9 <sup>a</sup>                                                               |
| Bechstein's bat      | 4–6 <sup>b</sup>                                                                   |
| Alcathoe             | 2–3 <sup>b</sup>                                                                   |

**Plate 3. Bat species' acoustic detectability from Bat Conservation Trust Survey Guidelines (Collins, 2023)**

## 2.9 Survey Constraints

Weather conditions were favourable during these surveys, with mild weather and very little rain during the automated detector monitoring, and ideal conditions during the night-time bat walkover survey. The search for Potential Roost Features in trees was conducted outside the optimal time of year (optimal in the winter months after leaves have fallen from the trees, making PRFs easier to see). There was no access permission during these surveys to the wooded area at the proposed outfall pipe between the Kilkenny Road and the River Barrow (most westerly section leading to river in Figure 3 below). AtkinsRéalis are arranging a winter bat survey, where this area can be searched, and further PRFs may be discovered. Another survey limitation is that one of the passive detectors that was deployed at location B, Figure 3, was irretrievably damaged, and all the data were lost. It is considered that the results of this detector, while they would have been

informative, were not essential to assessing the importance of habitats to bats or assessing potential impacts on bat populations. The data from the previous bat survey reports by Dr. Shiel in 2020 and 2021 also contribute to the acoustic monitoring and visual surveys of the site, and are referred to in this report to collate information together.

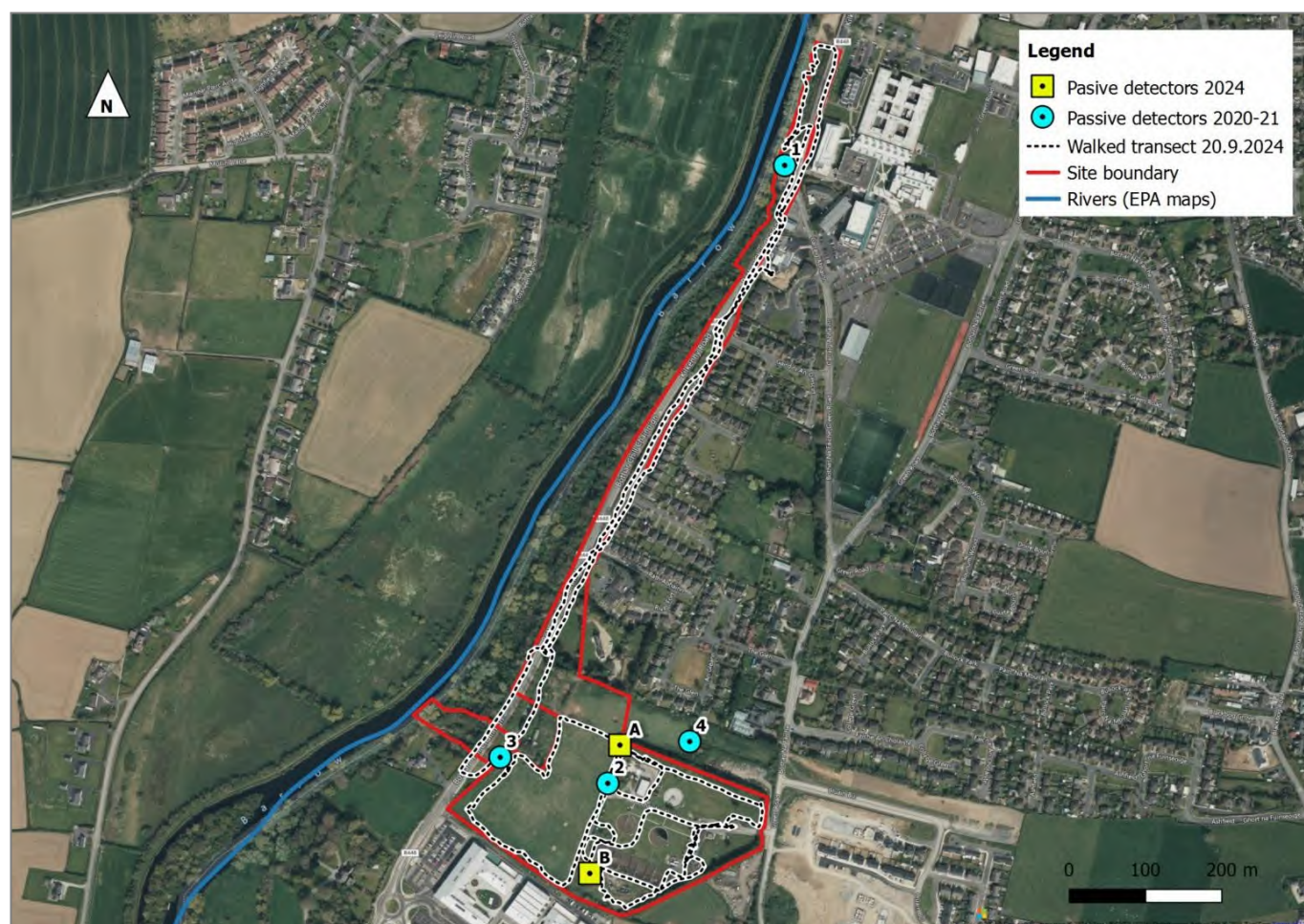


Figure 3. Night-time walked transect route 2024 and passive bat detector monitoring locations 2024 and 2020-21

## 3. Results

### 3.1 Desktop Review

NBDC Biodiversity Maps for the 1 km grid squares in which the site lies (S7174 and S7175) did not hold any records of bat species. This lack of records is likely to reflect a lack of bat surveys or submission of bat records for the locality, rather than an absence of bats. The wider 2km grid square (S77C) and 10km grid square (S77) in which the site lies, held the bat records shown in Table 5 below. The 'habitat suitability indices' from the Bat Landscapes GIS layer on the NBDC maps for the locality are shown in Table 6. The site lies outside of the known range of Lesser Horseshoe Bat (Ireland's only Annex II bat species). While the site is adjacent to, and partially within, The River Barrow and River Nore SAC, it is not located within or near a SAC or (proposed) Natural Heritage Area (pNHA) which has been designated for bats. There are no caves or underground sites which may be suitable for bats within, or close to, the study area.

Table 5. Bat records from the NBDC online database (accessed 14.9.24)

| Grid square | Scale | Species name                                                          | Record count | Date of last record | Title of NBDC dataset            |
|-------------|-------|-----------------------------------------------------------------------|--------------|---------------------|----------------------------------|
| S7174       | 1km   | No bat records                                                        | N/A          | N/A                 | N/A                              |
| S7175       | 1km   | No bat records                                                        | N/A          | N/A                 | N/A                              |
| S77C        | 2km   | Daubenton's Bat                                                       | 1            | 03/10/2015          | National Bat Database of Ireland |
| S77C        | 2km   | Soprano Pipistrelle                                                   | 1            | 03/10/2015          | National Bat Database of Ireland |
| S77         | 10km  | Brown Long-eared Bat                                                  | 7            | 09/10/2015          | National Bat Database of Ireland |
| S77         | 10km  | Common Pipistrelle ( <i>Pipistrellus pipistrellus sensu stricto</i> ) | 9            | 09/10/2015          | National Bat Database of Ireland |
| S77         | 10km  | Daubenton's Bat                                                       | 186          | 23/08/2021          | National Bat Database of Ireland |
| S77         | 10km  | Leisler's Bat                                                         | 2            | 02/10/2015          | National Bat Database of Ireland |
| S77         | 10km  | Natterer's Bat                                                        | 2            | 06/07/2009          | National Bat Database of Ireland |
| S77         | 10km  | Pipistrelle ( <i>Pipistrellus pipistrellus sensu lato</i> )           | 2            | 02/10/2015          | National Bat Database of Ireland |
| S77         | 10km  | Soprano Pipistrelle                                                   | 9            | 09/10/2015          | National Bat Database of Ireland |

Table 6. Habitat suitability indices from the Bat Landscapes GIS layer in NBDC mapping

| Bat species/grouping | Habitat Suitability | Habitat Suitability Index graded into quintiles: |
|----------------------|---------------------|--------------------------------------------------|
|----------------------|---------------------|--------------------------------------------------|

|                        | Index | 1. Low; 2.Low-moderate; 3.Moderate;<br>4.Moderate-high; 5. High |
|------------------------|-------|-----------------------------------------------------------------|
| All Bats               | 35.78 | Moderate-high                                                   |
| Soprano Pipistrelle    | 45    | Moderate-high                                                   |
| Brown Long-eared Bat   | 51    | High                                                            |
| Common Pipistrelle     | 54    | High                                                            |
| Lesser Horseshoe Bat   | 0     | Low                                                             |
| Leisler's Bat          | 48    | High                                                            |
| Whiskered Bat          | 32    | Moderate-high                                                   |
| Daubenton's Bat        | 43    | High                                                            |
| Nathusius' Pipistrelle | 4     | Low                                                             |
| Natterer's Bat         | 45    | Moderate-high                                                   |

### **Desktop review of previous bat reports for the Mortarstown WwTP upgrade:**

There were three bat survey reports for the Mortarstown WwTP upgrade, conducted by Dr. Caroline Shiel in 2020 and 2021. The following is a summary of the reports' findings, and the Figure numbers in the text refer to Figures in the current report;

### **Report 1: Sep and Nov 2020 Surveys**

- 29 - 30 September 2020: All-night passive detector monitoring with a Songmeter4 detector at the Pumping Station on the Kilkenny Road (Location 1, Figure 3) detected higher bat activity levels (135 total, Soprano Pipistrelle x 129, Common Pipistrelle x 4, Leisler's Bat x 2). Weather conditions were favourable, but with rain from c. 23:00 to 05:00 which lowered bat activity in that timeframe.
- 29 - 30 September 2020: All-night passive detector monitoring with a Songmeter4 detector at western perimeter fence of Mortarstown WwTP (Location 2, Figure 3) detected low bat activity levels (5 bat registrations in total, Soprano Pipistrelle x 3, Leisler's Bat x 2). Weather conditions were favourable, but with rain from c. 23:00 to 05:00 which lowered bat activity in that timeframe.
- 29 Sep 2020: All buildings on site were examined externally for evidence of bat usage during daylight. No signs of bats were recorded at either Mortarstown WwTP or the Pumping Station. There was no access for a night-time bat activity walkover.
- 5 November 2020: Daytime survey. Pumping Station red brick building was considered to have medium potential for roosting bats under the roof, and the cement building was assessed as having low potential for roosting bats. There were no trees with PRFs in the proposed extension area to the west of Mortarstown WwTP. Cottage at Location 3, Figures 4 and 5, had bat roost potential in the roof and sheds. Horse Chestnut trees to west of this cottage had ideal crevices for bats. See below - no bats observed emerging from this cottage or trees during 6 May 2021 surveys.

### **Report 2: May 2021 Surveys**

- 6 - 7 May 2020: All-night passive detector monitoring with a Songmeter4 detector at Kilkenny Road slip-road gate to the proposed extension area of Mortarstown WwTP (Location 3, Figure 3). The total number of calls was 51 (8 Soprano pipistrelle, 30 Common pipistrelle, 6 Leisler's, 7 Brown long-eared). The majority of the bat activity was recorded before midnight. Activity dropped off as temperatures fell overnight.
- 6 May 2020: Daytime search in the area in the vicinity of the outflow pipe from Mortarstown WwTP between the R448 Kilkenny Road and the River Barrow revealed a large dead Beech tree with a PRF (Figures 4 and 5). There were no trees with PRFs in a small area south of the existing Pumping Station on the Kilkenny Road where an extension of the Pumping Station was proposed.
- 6 May 2020: Dusk emergence survey at the cottage at Location 3, Figures 4 and 5. No bats were recorded emerging from the cottage or the Horse Chestnut tree with PRFs. Several Soprano and Common pipistrelles were recorded foraging along the lane/slip-road in front of the cottage during the dusk survey.
- 6 May 2020: During a bat detector survey of the proposed extension area to the south of Kilkenny Road Pumping Station no bat activity was recorded in the extension area. Both Common and Soprano pipistrelles were recorded foraging in the open area of the Pumping Station itself and along the R448 road.
- 7 May 2020: Dawn return survey at the large dead Beech tree with PRF in the outflow pipe area to the River Barrow (marked Beech on Figures 4 and 5) - no bats observed returning to this tree.

### **Report 3: Sep 2021 Surveys**

There were two new route options being explored for the pipe connection between the Kilkenny Road Pumping Station and the Mortarstown WwTP, which resulted in additional areas being surveyed. (Note that these routes were different to the currently proposed route shown in Figure 1).

- 28 - 29 Sep 2021: All-night passive detector monitoring with a Songmeter4 detector in a field area to the north of Mortarstown WwTP (Location 4, Figure 3) (this area lies outside of the current proposed red line boundary in Figure 1). The total number of calls was 36 (9 Soprano pipistrelle, 23 Common pipistrelle, 1 Leisler's, 3 Brown long-eared). The majority of the bat activity was recorded in the first 2.5 hours after sunset.
- 28 Sep 2021: Daytime survey reported various invasive plant species and badger trails and latrines in the field area north of Mortarstown WwTP (area not within current proposed red line boundary in Figure 1).

- 28 Sep 2021: Night-time bat activity walkover survey - small numbers of Soprano and Common Pipistrelle noted foraging in various locations. Brown Long-eared Bat recorded foraging in field area north of Mortarstown WwTP near the entrance from the Green Road.
- 29 Sep 2021: Dawn bat detector survey in a field area to the north of Mortarstown WwTP (approx. location 4, Figure 3) to try to detect Brown Long-eared Bat that had been there during night-time survey, and no Brown Long-eared were detected in the period approaching dawn.

#### **Desktop review of other available bat reports for the locality:**

A Preliminary Daytime Bat Roost Assessment was done in January 2024 for a proposed pedestrian rail link through Carlow College by Panther Ecology Ltd. There was no evidence of bat roost usage reported, and there are no acoustic bat records generated from these type of surveys as it was a winter daytime survey.

A bat survey for a proposed regeneration of a derelict terrace of houses in Barrick St., Carlow was done in December 2022 by Gerard Tobin. There was no evidence of bat roost usage reported, and there are no acoustic bat records generated from these type of surveys as it was a winter daytime survey.

### **3.2 Assessment of Suitability of Habitats for Foraging and Commuting Bats**

As can be seen in Figure 1, the site is spread out in different areas on the edge of Carlow town, and as such is divided in terms of habitat suitability. The tree-lined River Barrow corridor beside the western perimeter of the site has high habitat suitability for foraging and commuting bats. However, the R448 Kilkenny Road at the edge of Carlow town runs parallel with the wooded river corridor, and these areas have low habitat suitability, and form a partial barrier to bats in the landscape due to high levels of artificial light at night. The existing Mortarstown WwTP and the proposed extension area for the WwTP have low to moderate habitat suitability. There are some mature treelines, scrub, scattered mature trees, and hedgerow which are suitable to bat foraging and commuting, but bats need to cross the lit-up R448 road to reach the higher quality habitats along the River Barrow. There are low suitability urbanised areas around the Mortarstown WwTP, including the new Carlow Institute to the south, and a new housing estate to the east, which are lacking in cover of trees. Habitat suitability for bats is further discussed in context with the bat survey results (e.g. map of collated Brown Long-eared Bat records in Figure 9).

### **3.3 Buildings/Structure Roost Assessment**

The buildings/structures referred to in this Section 3.3, and the trees with PRFs referred to in Section 3.4, are labelled and mapped in Figures 4 & 5 (numbered from North to South). There were no bridges or underground sites within the study area.

#### **3.3.1 Kilkenny Road Pumping Station**

The small cement and red-brick buildings at the Pumping Station on Kilkenny Road, Carlow (Lat. 52.827119, Long. -6.937741, '1' and '2' in Figure 4, Plate 4) were inspected externally with close focusing binoculars from various vantage points outside of the perimeter fence, as there wasn't access inside. These buildings had no external visual signs of bat roosting. In terms of surrounding habitat, the buildings could be attractive to bats because they are situated beside a tree-lined section of the River Barrow, which would provide an ideal foraging habitat for bats. However, these buildings are illuminated by relatively high levels of light spill from street lights on the R448 Kilkenny Road, which would not favour bat roosting of any bat species.

During the survey by Dr. Caroline Shiel from inside the perimeter in November 2020, the cement building was considered to have low roosting potential, while the red brick building was considered to have moderate roosting potential for bats under the roof. A dusk emergence survey is recommended at the Pumping Station buildings prior to proposed works.



**Plate 4. Kilkenny Road Pumping Station showing small red-brick building and cement building**



Figure 4. Labelling of structures on site, and trees with PRFs, referred to in the results



Figure 5. Close up of structures and trees with PRFs in Mortarstown area of study site

### 3.3.2 Cottage and sheds to west of Mortarstown WwTP

At the time of these surveys, there was a vacant cottage and sheds at Lat. 52.820316, Long. -6.942825, which was up for sale (location labelled '3' in Figures 4 and 5, Plates 5 & 6). These buildings are outside of the site boundary, west of the Mortarstown WwTP. There were no external visual signs of bat roosting, but the cottage and shed were assessed as having moderate bat roost potential. There were potential access points for bats into the cottage roof via small gaps underneath the wooden barge boards in places (e.g. Plate 5). There were potential access points into a shed via gaps at the tops of doors e.g. Plate 6. There was evidence of Swallows nesting in the shed. The shed was open to daylight, and so it may not be suitable to roosting bats unless there are dark and sheltered/hidden spaces inside. In terms of surrounding habitat, the buildings here would be attractive to bats because there is cover of mature trees (Horse Chestnut, Ash, others) beside them, and they are mainly shielded by tree cover from the street lighting on the nearby R448 Kilkenny Road.

No bats were observed emerging from the cottage, sheds, or from the nearby Horse Chestnut PRFs during a dusk emergence survey carried out on the 6 May 2020 by Dr. Shiel. Several Soprano and Common pipistrelles were recorded foraging along the lane in front of the house during the dusk survey.



Plate 5. No external visual signs of bat roosting, but roost potential, at the cottage and sheds west of Mortarstown WwTP



Plate 6. Potential access points for bats into sheds at cottage through gaps at the tops of doors (indicated by red arrows).

### 3.3.3 Mortarstown WwTP

The buildings/structures in the Mortarstown WwTP are labelled in Figures 4 & 5. No visual signs of bat roosting were found for any of the structures, but a number had some bat roost potential due to having bat access points into their roofs. Dr. Shiel also found no visual evidence of bat roosting in buildings/structures inside Mortarstown WwTP during the 2020 survey.

The Sludge Dewatering Building at Lat. 52.819732, Long. -6.940693 ('4' in Figure 5, Plate 7) had no signs of bat roosting externally or internally, and was assessed as having low bat roost suitability.



**Plate 7. Sludge Dewatering Building had no signs of bat roosting and low bat roost suitability**

The Storm Screen Building at Lat. 52.819303, Long. -6.938954 ('5' in Figure 5, Plate 8) had no signs of bat roosting externally, and was not accessible for internal survey. It was assessed as having low bat roost suitability. There was however a single Common Pipistrelle repetitively flying around this building during the night-time bat activity survey on 20 September 2024 (Results Section 3.6) even though there was little cover of trees nearby. This behaviour was observed outside of the typical dusk emergence timeframe for this species.



**Plate 8. No bat roost signs at Storm Screen Building**

The Administration Building and associated outbuildings at Lat. 52.819122, Long -6.939601 ('6' in Figure 5, Plate 9) had no external visual signs of bat roosting. There was access for bats underneath the roof tiles, particularly where guttering had collapsed along the rear of the building (Plate 9). It was assessed as having low roost suitability. Single Soprano and Common Pipistrelle were recorded flying near this building during the night-time bat activity survey on 20 September 2024 outside of the typical dusk emergence timeframes for these species.



**Plate 9. Administration building - no bat signs but bat access points present underneath roof tiles**

The Air Blower Building at Lat. 52.818643, Long. -6.940143 ('7' in Figure 5, Plate 10) had no external signs of bat roosting, and was assessed as having low roost suitability. It did however have bat access potential underneath the roof via gaps under a loose roof tile and beneath the edge of the roof tiles (Plate 10).



**Plate 10. No bat signs but access points underneath roof tiles at Air Blower Building**

There were numerous discarded garden sheds at Lat. 52.818494, -6.941059 ('8' in Figure 5, Plate 11). These had open doors and were accessible for searching and no external or internal visual evidence of bat roosting was found. The sheds had low roost suitability. They were not suitable for day-roosting bats because they had ingress of daylight, but they were open to bat access via open doors for night-roosting or as sheltered feeding perches (see bat roost types in Appendix A). Bats could potentially hang from the timber roofs. No signs of this sort of bat usage was in evidence.



**Plate 11. Old timber garden sheds open to bat access for night-roosting/feeding perches but no signs of bat usage**

There were no suitable potential roosting features in the other structures in the treatment plant, such as settlement tanks, sheds, silos, containers, and various plant/machinery.

### 3.4 Potential Roost Features (PRFs) in Trees

Three trees identified with PRFs for bats are marked on Figure 5 above (Ash, Horse Chestnut, and dead Beech). The Horse Chestnut and dead Beech were previously identified in Dr. Shiel's surveys. There were no visual signs of bat roosting in the Horse Chestnut, and no repeat access to the dead Beech location in 2024. These trees are not likely to be subject to felling/pruning due to the proposed upgrade works to Mortarstown WwTP.

An additional knot-hole PRF in a semi-mature Ash was identified in 2024 (marked 'Ash' in Figure 5). The Ash appeared to be suffering from ash die-back disease. This tree is located near the pipeline route between the Pumping Station and the proposed extension area to Mortarstown WwTP (blue dashed line in Figure 1), so may require felling or pruning due to the proposed works. It was assessed as a PRF-M, and warrants further surveying for bat roosting via dusk emergence survey, endoscope inspection or via motion-activated night-vision trail camera (although the knot-hole is too high to mount a camera easily, requiring a mounting fixture and MEWP/climbing to deploy or check with endoscope).



Plate 12. Knot-hole Potential Roost Feature (PRF) in Ash tree indicated in red

### 3.5 Automated Bat Detector Acoustic Monitoring

The weather conditions were favourable to bat activity during the 6-night passive acoustic monitoring period from 14.9.24 to 20.9.24, with few, if any, night-time hours with rain. There was a relatively even spread of bat activity throughout the six nights of monitoring, as shown in Figure 6, with Night 1 having the least activity. The hourly spread of overall bat activity is shown in Figure 7, with the most activity being recorded between 8-9 pm and tailing off approaching sunset. As mentioned in the survey constraints, the passive detector at Location B Figure 3 was damaged and all the data was lost.

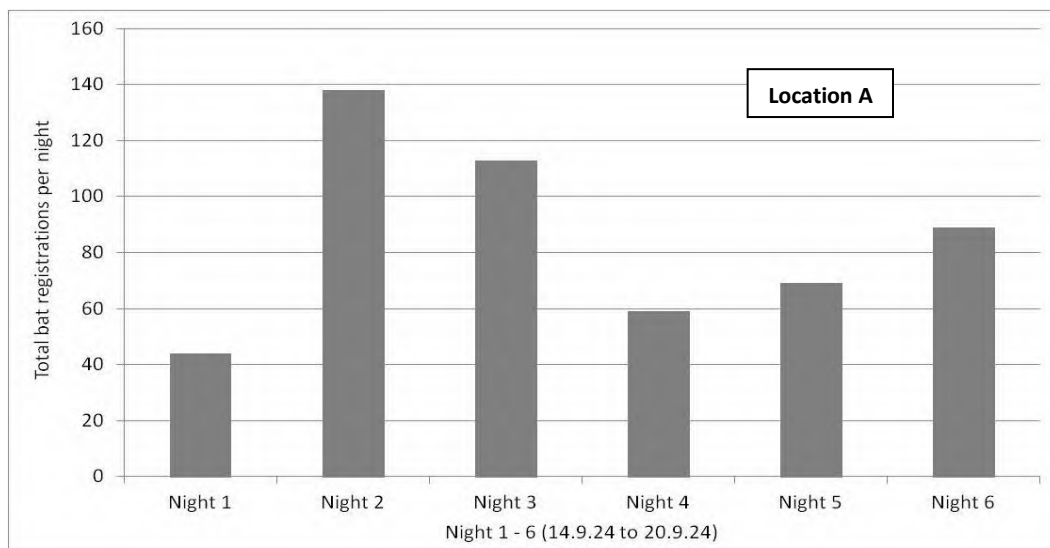


Figure 6. Passive detector total bat registrations per night (all species combined)

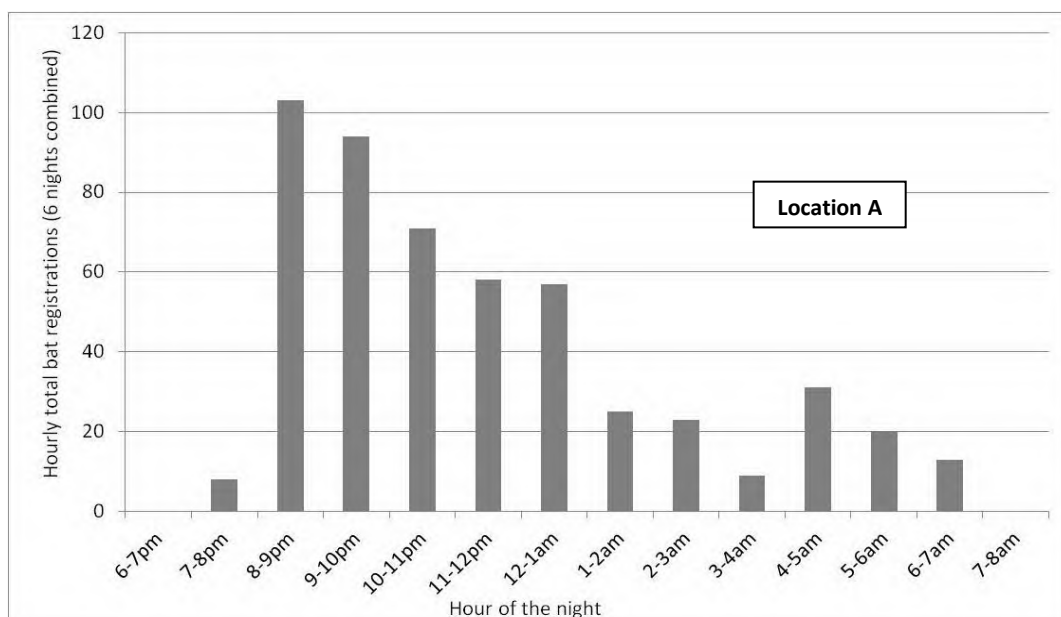


Figure 7. Passive detector hourly total bat registrations (across six night, all bat species combined)

Table 7 shows the total number of bat registrations of each bat species (and percentages) detected at the NW corner of Mortarstown WwTP (Location A, Figure 3) during six consecutive nights from 14.9.24 to 20.9.24. In total, seven bat species were detected (in order of decreasing frequency); Soprano Pipistrelle, Common Pipistrelle, Leisler's Bat (these more common and acoustically-detectable bat species accounted for c. 93% of the overall bat registrations), Daubenton's Bat, Brown Long-eared Bat, and with one recording each of Natterer's Bat and Whiskered Bat (Table 7). Feeding buzzes (indicating foraging) were recorded for Soprano Pipistrelle, Common Pipistrelle, Leisler's Bat, and Daubenton's Bat, while social calling was recorded for Soprano Pipistrelle, Common Pipistrelle, and Brown Long-eared Bat.

There was 512 bat registrations in total over 6 consecutive nights. At an average rate of just 7.5 bat registrations per hour for all bat species combined, there was an overall low level of bat activity for all bat species detected at the corner of the Mortarstown WwTP. However, there was high bat species diversity recorded, with seven of the nine bat species resident in Ireland detected (Table 7).

**Table 7. Total bat registrations per species recorded by passive detector A during 6 nights 14.9.24 - 20.9.24**

| Species/group                                                      | Location A:                    |                                                  |
|--------------------------------------------------------------------|--------------------------------|--------------------------------------------------|
|                                                                    | Total                          | Percentage                                       |
| Soprano Pipistrelle                                                | 240                            | 46.9%                                            |
| Common Pipistrelle                                                 | 173                            | 33.8%                                            |
| '50kHz Pipistrelle'                                                | 14                             | 2.7%                                             |
| Leisler's Bat                                                      | 49                             | 9.6%                                             |
| Daubenton's Bat                                                    | 18                             | 3.5%                                             |
| Brown Long-eared Bat                                               | 14                             | 2.7%                                             |
| <i>Myotis</i> sp.                                                  | 2                              | 0.4%                                             |
| Natterer's Bat                                                     | 1                              | 0.2%                                             |
| Whiskered Bat                                                      | 1                              | 0.2%                                             |
| <b>Totals</b>                                                      | <b>512</b>                     | <b>100.0%</b>                                    |
| <b>Average registrations per night/hour (all species combined)</b> | <b>85.3/night<br/>7.5/hour</b> | <b>LOW bat activity<br/>levels (all species)</b> |

**Notes on patterns of activity and timing of onset of dusk acoustic bat activity:**

It is interesting to note that Daubenton's Bat was detected during 5 out of 6 nights of passive detector monitoring. There is some indication that there is a regular commuting route for a small number of Daubenton's Bat due to a fairly consistent detection pattern at 52, 57, 51, and 53 minutes past sunset on nights 3 - 6 (Table 8). Daubenton's Bat tends to emerge from its roosts later than Leisler's Bat and the pipistrelles. It was somewhat unexpected to find fairly regular Daubenton's Bat on these recordings, because it would normally roost and forage close to water bodies, such as the River Barrow, and it would need to cross the street lights along the R448 to reach it from Location A. Perhaps it forages over settling tanks in the treatment plant sometimes, although this was not observed during the night-time bat walkover survey.

Brown Long-eared Bat, despite being a relatively difficult-to-detect bat species acoustically (Section 2.8), was also recorded at the WwTP during 5 out of 6 nights of recording, at more random times (Table 9). All of the locations where Brown Long-eared Bat was recorded during the various bat surveys combined are presented in Figure 9.

**Table 8. Dates and timestamps of Daubenton's Bat detected by passive detector A**

| Date       | Time     | Species         | Notes                                    | Overlap | Night |
|------------|----------|-----------------|------------------------------------------|---------|-------|
| 15/09/2024 | 21:00:22 | Daubenton's Bat | Sunset at 19:42                          | y       | 2     |
| 15/09/2024 | 21:14:04 | Daubenton's Bat |                                          |         | 2     |
| 15/09/2024 | 22:00:54 | Daubenton's Bat |                                          |         | 2     |
| 16/09/2024 | 00:16:03 | Daubenton's Bat |                                          |         | 2     |
| 16/09/2024 | 00:33:54 | Daubenton's Bat |                                          |         | 2     |
| 16/09/2024 | 05:47:24 | Daubenton's Bat | Feeding buzz. 7:04 sunrise               |         | 2     |
| 16/09/2024 | 20:32:07 | Daubenton's Bat | 52 minutes after 19:40 sunset            | y       | 3     |
| 16/09/2024 | 20:46:43 | Daubenton's Bat |                                          |         | 3     |
| 16/09/2024 | 23:22:35 | Daubenton's Bat |                                          |         | 3     |
| 17/09/2024 | 00:09:49 | Daubenton's Bat |                                          |         | 3     |
| 17/09/2024 | 00:45:20 | Daubenton's Bat | Pulses contrast with Whiskered Bat above |         | 3     |
| 17/09/2024 | 20:34:35 | Daubenton's Bat | 57 minutes after 19:37 sunset            |         | 4     |
| 18/09/2024 | 04:33:38 | Daubenton's Bat |                                          |         | 4     |
| 18/09/2024 | 20:26:03 | Daubenton's Bat | 51 minutes after 19:35 sunset            |         | 5     |
| 18/09/2024 | 20:28:42 | Daubenton's Bat |                                          |         | 5     |
| 19/09/2024 | 00:53:35 | Daubenton's Bat |                                          |         | 5     |
| 19/09/2024 | 20:25:05 | Daubenton's Bat | 53 minutes after 19:32 sunset            |         | 6     |
| 19/09/2024 | 20:31:19 | Daubenton's Bat |                                          |         | 6     |

**Table 9. Dates and timestamps of Brown Long-eared Bat detected by passive detector A**

| Date       | Time     | Species              | Notes                                          | Overlap | Night |
|------------|----------|----------------------|------------------------------------------------|---------|-------|
| 15/09/2024 | 20:45:32 | Brown Long-eared Bat | 63 minutes after 19:42 sunset                  |         | 2     |
| 15/09/2024 | 20:45:41 | Brown Long-eared Bat |                                                |         | 2     |
| 15/09/2024 | 21:14:58 | Brown Long-eared Bat |                                                |         | 2     |
| 15/09/2024 | 21:33:49 | Brown Long-eared Bat |                                                |         | 2     |
| 16/09/2024 | 00:48:54 | Brown Long-eared Bat |                                                |         | 2     |
| 16/09/2024 | 05:40:21 | Brown Long-eared Bat |                                                |         | 2     |
| 16/09/2024 | 21:16:09 | Brown Long-eared Bat |                                                |         | 3     |
| 17/09/2024 | 21:07:53 | Brown Long-eared Bat |                                                |         | 4     |
| 18/09/2024 | 21:45:29 | Brown Long-eared Bat | High intensity social calling. Clear           |         | 5     |
| 18/09/2024 | 21:45:34 | Brown Long-eared Bat |                                                |         | 5     |
| 19/09/2024 | 04:44:20 | Brown Long-eared Bat |                                                |         | 5     |
| 20/09/2024 | 00:41:26 | Brown Long-eared Bat | Flight and social calls<br>Low frequency calls |         | 6     |
| 20/09/2024 | 00:54:45 | Brown Long-eared Bat |                                                |         | 6     |
| 20/09/2024 | 01:14:10 | Brown Long-eared Bat |                                                |         | 6     |

Soprano Pipistrelle was first recorded each evening at Location A (Figure 3) at 30, 25, 24, 23, 28, and 9 (average 23.2) minutes after sunset respectively on the six nights of monitoring between 14.9.24 and 20.9.24. The 9-minute instance would be considered an early arrival on site after sunset (Collins 2023), and is suggestive of Soprano Pipistrelle having emerged from a bat roost located fairly close to the site. The closest activity to sunrise for this species was 38 minutes, which is not particularly suggestive of roosting. There is probably only a small/minor roost nearby, given that bat activity was generally low. There are no known/publicly recorded roosts of Soprano Pipistrelle in the area, but this would generally be more reflective of a lack of bat surveys/recording, rather than a lack of roosts.

Common Pipistrelle was first recorded at Location A (Figure 3) at 33, 5, 45, 16, 20, and 41 (average 26.7) minutes after sunset respectively on the six nights of monitoring. The 5-minute and 16-minute instances would be considered early arrivals on site after sunset, and is suggestive of Common Pipistrelle having emerged from a (probably minor) bat roost located close to the site. There are also no known/publicly recorded roosts of this species in the area.

Leisler's Bat was recorded infrequently (despite its high intensity echolocation) and at random times. It was recorded at 9 minutes before sunset (while still bright) on 17 September 2024. This species is a powerful flyer, and thus tends to emerge earlier and travel further and faster from its roosts compared to the other Irish bat species, and so this daytime flying would not be particularly unusual or indicative of a nearby roost. It is possible that it roosted in an unknown nearby minor roost on that evening, but it may also have flown over the site from far away. Daytime flying would be unusual for the other Irish bat species.

### 3.6 Night-time Bat Activity Walkover Survey

Four bat species, Soprano Pipistrelle, Common Pipistrelle, Daubenton's Bat, and Leisler's Bat were detected during the night-time bat activity walkover survey on 20 September 2024. Soprano Pipistrelle and Common Pipistrelle activity dominated (bat species encounters during the walkover survey are shown on the map in Figure 8). Daubenton's Bat was recorded foraging low over the River Barrow beside the area north of the Kilkenny Road Pumping Station (Figure 8). Large, smooth-surfaced water bodies like this river are the typical favoured foraging habitat of Daubenton's Bat, which is strongly associated with water habitats.

The levels of bat activity were relatively low during this night-time bat activity walkover, but there were Soprano Pipistrelle and Common Pipistrelle to be found in low numbers throughout the site, often while foraging (Figure 8). The highest levels of foraging activity of pipistrelles were recorded while walking close to the mature willow trees lining the River Barrow north of the Pumping Station. Soprano Pipistrelle was observed using the tall green western perimeter fence of the WwTP as a commuting route, apparently moving south to north.

During a night-time bat walkover survey by Dr. Shiel on 28 September 2021, low numbers of Common Pipistrelle and Soprano Pipistrelle were also recorded in various locations along the previously proposed pipeline routes along roads. Brown Long-eared Bat was also recorded further away from the roads (all Brown Long-eared Bat records from the various surveys in 2020-21 and 2024 are collated in the next Section 3.7, Figure 9).

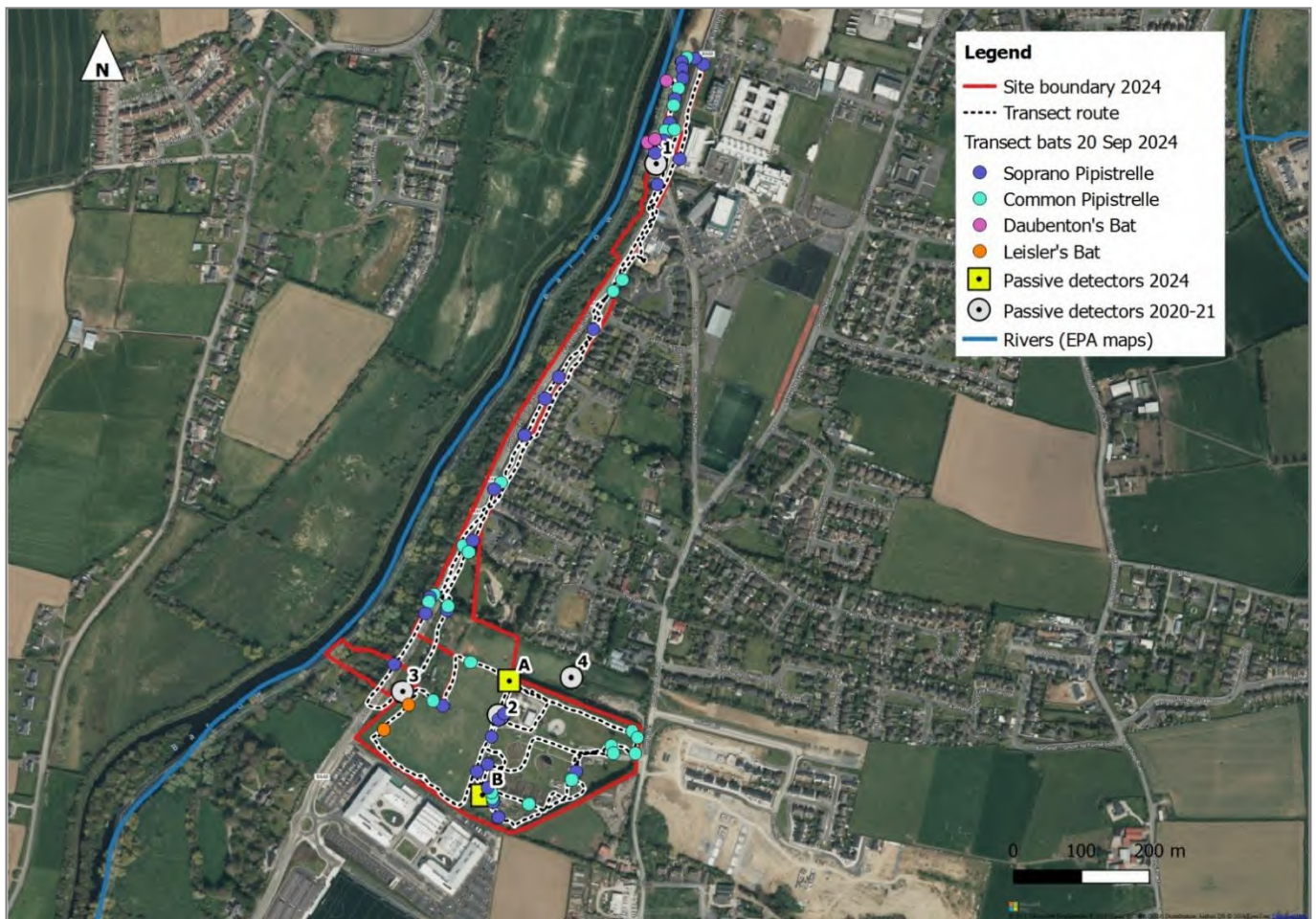


Figure 8. Locations of bat species encountered during night-time bat activity walkover (GPS track in dashed line)

### 3.7 Brown Long-eared Bat Collated Records from 2020-21 and 2024 Surveys

As discussed in Section 2.8, Common Pipistrelle, Soprano Pipistrelle, and Leisler's Bat are more acoustically detectable than the other bats detected during this survey; Daubenton's Bat, Brown Long-eared Bat, Whiskered Bat, and Natterer's Bat. The former three species are also more tolerant to urbanised environments than the latter four bat species. As Brown Long-eared Bat is a difficult to detect species, requires good cover of vegetation around its roosts, and is one of the most sensitive bat species to artificial light at night, it is useful to collate and map all the records of this species from the various surveys in 2020-21 and 2024 (Figure 9).

Brown Long-eared Bat was detected during 1-night passive detector monitoring in 2020-21 in two locations, and a further two locations during night-time bat walkovers in 2020-21. It was also recorded by the passive detector at Location A, Figure 3, during 5 out of 6 nights of monitoring in September 2024. There was evidence of both foraging and social calling recorded. Brown Long-eared Bat does not typically travel very far from its day roosts during night-time foraging, and therefore this pattern of recordings is strongly indicative of the presence of an undiscovered roost of Brown Long-eared Bat in vicinity. It clearly has fairly regular foraging and commuting habitats in the area indicated by the blue stars in Figure 9. The habitats here should not be fragmented and artificial lighting should be avoided. Enhanced landscape connectivity and foraging resources would benefit Brown Long-eared Bat, as well as the three *Myotis* sp. also detected in this area, albeit in low numbers. The bat impact assessment and recommended mitigation/enhancement measures reflect the presence of these four sensitive bat species in the area; Daubenton's Bat, Brown Long-eared Bat, Whiskered Bat, and Natterer's Bat.



Figure 9. Brown Long-eared Bat collated records from 2020-21 and 2024 surveys

### 3.8 Observations on Existing Levels of Artificial Light at Night

There was no artificial lighting switched on at night in the Mortarstown WwTP at the time of survey, and this area was relatively dark. There were street lights installed all along the R448 Kilkenny Road, reducing habitat permeability for bats and other wildlife between the study site and the wooded river corridor along the Barrow (left, Plate 13). There were also street lights installed on the roads in the Southern Gardens housing estate where the connecting pipeline route is proposed (right, Plate 13).



Plate 13. Artificial Lighting at Night along the R448 Kilkenny Road and in the Southern Gardens housing estate

## 4. Bat Ecological Evaluation and Assessment of Potential Impacts on Bats

Note that there will be a winter bat surveys to search for PRFs in trees throughout the site, and also accessing the small area of woodland where the outfall pipe is proposed to enter the River Barrow that was not accessible during the present survey. Therefore, this is a preliminary impact assessment pending results from that survey.

There were low bat activity levels, but high bat species diversity recorded at this site. Seven of the nine resident bat species known to Ireland were detected during these surveys, albeit in low numbers/low levels of activity. All bat species recorded

during this bat survey are Annex IV species under the EU Habitat Directive and all have a Favourable Conservation status in Ireland (Table 1).

The three bat species comprising c. 93% of the overall passively detected acoustic bat activity (Soprano Pipistrelle, Common Pipistrelle, and Leisler's Bat) are the three most common bat species in Ireland (see Table 1). They are also more tolerant of the impacts of artificial lighting and urbanisation than the other Irish bat species.

Daubenton's Bat was recorded at its typical foraging habitat along the River Barrow at the Kilkenny Road Pumping Station, but also in low numbers at a non-typical habitat at the NW corner of the Mortarstown WwTP on 5 out of 6 nights of monitoring. The rarer *Myotis* sp., Natterer's Bat and Whiskered Bat were also confirmed once each in the recordings at this location. Brown Long-eared Bat was also recorded at the NW corner of the Mortarstown WwTP on 5 out of 6 nights of monitoring, and at four other locations near the WwTP during various bat surveys (Figure 9).

Brown Long-eared Bat and *Myotis* sp. (Daubenton's Bat, Natterer's Bat, and Whiskered Bat) are particularly intolerant of artificial light at night. These four species are among the guild of so-called 'clutter-adapted' bat species, which are adapted by their wing morphology and characteristic low-intensity echolocation to slow manoeuvrable flight at low heights, and foraging close to tree canopies or lower ground vegetation. Natterer's Bat and Brown Long-eared Bat are capable of close-up detection of prey and slow, hovering flight. This allows them to glean prey which is resting on foliage (Swift 1998; Siemers & Schnitzler 2000; Swift & Racey 2002). The adaptations of the clutter-adapted species render them much more light-averse than either edge-adapted (e.g. pipistrelle species) or open-adapted bat species (e.g. Leisler's Bat) (Rowse *et al.* 2016; Voigt *et al.* 2021). This is one of the reasons that clutter-adapted species typically emerge later from, and return earlier to, their roosts when it is darker compared to other bat species (Jones & Rydell 1994; Duvergé *et al.* 2000). Natterer's Bat and Brown Long-eared Bat are among the most light-averse of all bat species (Roche *et al.* 2014; Zeale *et al.* 2016; Rydell, Eklöf & Sánchez-Navarro 2017; Rydell *et al.* 2021). Artificial lighting for the Mortarstown WwTP upgrade should be avoided and minimised in the interest of protecting bat species in the area (see Mitigation measures below).

The proposed extension to the Mortarstown WwTP is on an area of an agricultural grassland field, and there is no requirement for hedgerow or tree removal in the extension area. The reduction of a small area of agricultural grassland here will have a negligible impact on bats. The existing field is unlikely to support substantial insect populations on which bats prey, and the settling tanks may possibly support more insect prey. Park & Cristinacce (2006) found that the biomass of insects and pipistrelle bat activity was higher at filter beds than at activated sludge treatment works, although these insects from treatment works may cause accumulation of toxicants in bat bodies (Hill, Schoeman & Vosloo 2018). There was little foraging activity of bats observed at Mortarstown WwTP during the current surveys. Lighting should be avoided in the extension area.

There will be a loss of some scattered trees, grassland and scrub within the existing Mortarstown WwTP to facilitate the proposed upgrades. This would have a minor negative impact at a local scale on a small number of bats by potentially reducing their foraging opportunities. Compensation planting is recommended in the mitigation measures below.

The proposed works to the Pumping Station are unlikely to have a negative impact on foraging and commuting bats, as long as the spill of artificial night light onto the tree-lined river is avoided. The river corridor here supports foraging of Common Pipistrelle, Soprano Pipistrelle, and Daubenton's Bat, and potentially other bat species. There was no evidence of roosting found at the Pumping Station, but an up-to-date pre-works bat survey is recommended.

The pipeline connection between the Kilkenny Road Pumping Station and the extension area to the Mortarstown WwTP will be mainly installed underneath the R448 Kilkenny Road and the grassland area beside this road in the Southern Gardens housing estate. This part of the works will have a negligible impact on bats. There may be some loss of trees involved in bringing the pipeline from the roadway towards the proposed treatment plant extension area. The Ash tree with a PRF (Figure 5) may be impacted by this, potentially resulting in destruction of a bat roost. There may be more trees in this area that have PRFs and these will be surveyed during the optimal timeframe for PRF this coming winter. A pre-works survey of the Ash tree PRF is needed to check its bat roost status. There would also be a minor loss of foraging and commuting habitat on a small scale if trees or hedgerow needs removal here. Compensatory planting is recommended in the mitigation measures below.

The proposed works are on a small geographical scale, in habitats assessed as having low to moderate suitability to foraging and commuting bats. No bat roosts have been confirmed in the area and structures assessed had low suitability. Nonetheless, pre-works surveys at structures are recommended to make sure there are no bats impacted by the works. The overall potential impact of the proposed works on bat populations is considered to be minor negative at a local scale. With implementation of the mitigation measures below, there is negligible potential for population-level impacts on bats.

## 5. Recommended Bat Mitigation Measures

As there was no evidence of bat roosting found, there is currently no requirement for an application for a bat roost derogation license from the NPWS.

### **Further targeted bat survey recommendations:**

PRF search at the optimal time of year (winter) (including area at Barrow which had no access permission in September 2024)

Pre-works bat survey at knot-hole PRF in Ash (Figure 5).

Pre-works bat surveys at buildings that may be altered/demolished due to the proposed works.

If bat roosts are found, then a bat derogation license from the NPWS would be needed.

If the residents at the house at Lat. 52.821431, Long. -6.941546 are amenable, conduct bat surveys of the house and sheds, as this may be where Brown Long-eared Bat have an undiscovered roost.

### **Avoidance, minimisation and design of new Artificial Lighting at Night:**

New lighting should be avoided where possible. Any new lighting (if necessary) at the Pumping Station or the upgraded Mortarstown WwTP should be minimised. This could be achieved by;

- Keeping lights switched off at all times, except for cases of emergency.
- Use of the minimum lux levels that are necessary.
- Prevention of upward and sideward trespass of light into the surrounding landscape. No upward tilt to luminaires.
- Motion-detection lighting systems which only switches selected lights on when needed.
- Keeping/replacing as much cover of trees as possible.
- Luminaires should lack UV elements to reduce impacts on bats.
- Luminaires with warm white spectrum (<2700 Kelvins) to reduce the blue light component of the LED spectrum.

### **Replacement planting and enhancement planting of native tree species, hedgerows, and allowing wildflower areas;**

- As much of the tree cover as possible to be retained during proposed works.
- If space allows, plant some native Oak trees in the Mortarstown WwTP and extension area, and allow them reach maturity. Native Oak trees in particular are supportive of the highest number of insect species populations, and therefore support biodiversity in general and generate food and shelter resources for bats.
- Plant new native hedgerows to enhance insect populations and improved landscape connectivity. New hedgerows in areas marked in green on Figure 10, and supplemental planting to existing hedgerows in areas marked in orange in Figure 10. Suggested species mix, planted in groups: Guelder Rose (*Viburnum opulus*), Blackthorn (*Prunus spinosa*), Spindle (*Euonymus europaeus*), Bird Cherry (*Prunus padus*), Hawthorn, Hazel, and Holly (*Ilex aquifolium*). Include some larger trees such as Oak where possible.
- Grass areas in the WwTP should be managed as native wildflower areas, and herbicides and pesticides should not be used.



Figure 10. Suggested new (green) and supplemental (orange) planting of native hedgerows

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## Appendices

### Appendix A: Roost Types Used by Bats

Text adapted from (Hundt 2012)

- **Transitional Roost (generally April-September/October)**  
On waking from hibernation or in the period prior to hibernation, bats search for roosts in which they stay for only a few days or on some occasions several weeks. These transitional roosts can be occupied by a few individuals or occasionally small groups. The transitional roosts used prior to hibernation are generally cool and thus may allow bats to reduce their energy requirements before going into hibernation.
- **Maternity Roost (generally May-August)**  
Breeding females gather together around the beginning of May to form nursery colonies. During this period gestation begins with births typically occurring between June and July. The females and their young remain within the maternity roost until the young are weaned and independent (late July-August). These roosts tend to break up between August and September. Adult males are rarely found within these colonies. However, the adult males of long-eared bats, Daubenton's, Natterer's and lesser horseshoe bats can be found roosting within maternity colonies with their numbers increasing throughout the active season.
- **Satellite Roost (generally May-August)**  
Breeding females may have alternative roost sites in close proximity to the main nursery colony. These are referred to as 'satellite roosts'. The number of bats using these roosts can vary greatly, from a few individuals, to small groups.
- **Mating Roost (generally September-November)**  
All Irish bats are polygynous i.e. males mate with several females. Mating generally takes place from late summer and can continue through the winter. A number of different mating strategies are used by bats, though males of some species establish mating roosts, whereby they defend territory and display/call to females to mate.
- **Hibernation Roost (generally October-March)**  
Depending on the weather and food availability, bats tend to move to hibernation sites from October. Hibernation roosts can vary greatly in terms of the number of individuals and the diversity of species that occupy them. However, they tend to have a constant cool temperature and high humidity, which allows the bats to use less energy regulating their temperature. Bats will wake occasionally during hibernation to drink and feed.
- **Night Roost (generally March-November)**  
Bats may use roosts other than traditional day roosting sites to rest in during the night. These roosts vary in their conservation significance. Night roosts may be used by a single individual on occasion or they could be used regularly by the whole colony. Studies have shown that night roosts may be of particular importance to some species such as the lesser horseshoe bat, providing key resting places within core foraging areas.
- **Day Roost (generally March-November)**  
These roosts are used during the day to rest in. Males of most Irish species spend the summer roosting alone or in small groups with other males in such roosts. Bats may regularly use a number of day roosts, switching between them on a daily basis, though conversely they may occupy the same roosting site for several weeks.
- **Feeding Roost (generally May-November)**  
These roosts can be occupied by a single animal or a few individuals throughout the active season. They vary in their significance as they may be used by the whole colony or just a few individuals to feed, to shelter from the weather or to rest temporarily. Feeding roosts are often used by *Plecotus* and *Rhinolophus* species.
- **Swarming Sites**  
Swarming takes place between August and November, whereby large numbers of bats from several species gather, generally around caves and mines. They are often dominated by the *Myotis* species and appear to be important mating sites with some bats travelling tens of kilometres to reach these areas. A proportion of the bats that travel to these sites will remain to hibernate.

## Appendix B: Bat Habitat Suitability Assessment Grading System from Collins (2023) Guidelines

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.

| Potential suitability   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | Roosting habitats in structures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Potential flight-paths and foraging habitats                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| None                    | No habitat features on site likely to be used by any roosting bats at any time of the year (i.e. a complete absence of crevices/suitable shelter at all ground/underground levels).                                                                                                                                                                                                                                                                                                                                        | No habitat features on site likely to be used by any commuting or foraging bats at any time of the year (i.e. no habitats that provide continuous lines of shade/protection for flight-lines, or generate/shelter insect populations available to foraging bats).                                                                                                                                                                                                                         |
| Negligible <sup>a</sup> | No obvious habitat features on site likely to be used by roosting bats; however, a small element of uncertainty remains as bats can use small and apparently unsuitable features on occasion.                                                                                                                                                                                                                                                                                                                              | No obvious habitat features on site likely to be used as flight-paths or by foraging bats; however, a small element of uncertainty remains in order to account for non-standard bat behaviour.                                                                                                                                                                                                                                                                                            |
| Low                     | A structure with one or more potential roost sites that could be used by individual bats opportunistically at any time of the year. However, these potential roost sites do not provide enough space, shelter, protection, appropriate conditions <sup>b</sup> 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 and not a classic cool/stable hibernation site, but could be used by individual hibernating bats <sup>c</sup> ). | Habitat that could be used by small numbers of bats as flight-paths such as a gappy hedgerow or unvegetated stream, but isolated, i.e. not very well connected to the surrounding landscape by other habitat.<br><br>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 with one or more potential roost sites that could be used by bats due to their size, shelter, protection, conditions <sup>b</sup> and surrounding habitat but unlikely to support a roost of high conservation status (with respect to roost type only, such as maternity and hibernation – the categorisation described in this table is 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 flight-paths such as lines of trees and scrub or linked back gardens.<br><br>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 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 <sup>b</sup> and surrounding habitat. These structures have the potential to support high conservation status roosts, e.g. maternity or classic cool/stable hibernation site.                                                                                                       | Continuous, high-quality habitat that is well connected to the wider landscape that is likely to be used regularly by bats for flight-paths such as river valleys, streams, hedgerows, lines of trees and woodland edge.<br><br>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.<br><br>Site is close to and connected to known roosts. |

**a** Negligible is defined as 'so small or unimportant as to be not worth considering, insignificant'. This category may be used where there are places that a bat could roost or forage (due to one attribute) but it is unlikely that they actually would (due to another attribute).

**b** For example, in terms of temperature, humidity, height above ground level, light levels or levels of disturbance.

**c** 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.*, 2016 and Jansen *et al.*, 2022). Common pipistrelle swarming has been observed in the UK (Bell, 2022 and Tomlinson, 2020) and winter hibernation of numbers of this species has been detected at Seaton Delaval Hall in Northumberland (National Trust, 2018). 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 prominent buildings in the landscape, urban or otherwise.