



**N22 Farranfore to Killarney Improvement Scheme –
Lesser Horseshoe Bat trapping and radio-tracking Project Proposal**

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The N22 Farranfore to Killarney Improvement Scheme is a ~25 km route between Farranfore and Killarney currently progressing through design, with planning consent and approval targeted for early 2027.

In Ireland, lesser horseshoe bats are strictly protected under the EU Habitats Directive and associated Irish regulations. Given the scheme's scale and the sensitivity of the SAC population, the potential for significant effects is high. To satisfy Appropriate Assessment (AA) and Habitats Regulations Assessment (HRA) legal tests, specifically, the requirement to establish beyond reasonable scientific doubt that adverse effects on site integrity will not result, radio-tracking is necessary in addition to passive and modelling methods.

This report presents a project plan in support of an Education and Science licence application (section 23, 24 and 32) to NPWS for bat trapping and radio-tracking within Killarney National Park, the MacGillycuddy's Reeks and Caragh River Catchment SAC, Castlemaine Harbour SAC, and adjacent habitats. Objectives are to identify key flightlines, core foraging areas, and additional roosts (beyond NPWS-provided datasets) potentially affected by the scheme.

Both SACs comprise functionally connective habitats; results will support future conservation management to retain connectivity and the viability of the lesser horseshoe population, while also benefiting the wider bat assemblage.

Without suitably informed and species-specific mitigation measures, the Proposed Scheme has the potential to adversely affect the favourable conservation status of the lesser horseshoe bat population present, as well as other native bat species that rely on the surrounding habitats.

1. Introduction and Background

- 1.1 The N22 Farranfore to Killarney Improvement Scheme (shown in the orange boundary of Figure 1 (Appendix A) and hereon in referred to as the Proposed Scheme) is a scheme proposed for construction. This scheme is designed to strengthen and improve the existing route which currently connect Farranfore and Killarney.
- 1.2 The current option for the Proposed Scheme bisects two Special Areas of Conservations (SACs); namely Castlemaine Harbour SAC, Macgillycuddy's Reeks and Caragh River Catchment SAC, the latter is designated for lesser horseshoe (LHS) bats, (*Rhinolophus hipposideros*). The Proposed Scheme will cross both SACs or interface with an SAC at five locations, making the likely impacts upon the SAC and local bat assemblage significant.
- 1.3 All bats are protected by law in the Republic of Ireland under the Wildlife Act 1976 (and subsequent amendments). Specifically, LHS bats are protected in Ireland under the Wildlife (Amendment) Act, 2000 and are offered further protection under the European Communities (Birds and Natural Habitats) Regulations, 2011 which transpose the requirements of the European Habitats Directive (Council Directive 92/43/EEC) and Birds Directive (Council Directive 79/409/EEC) into Irish law. LHS are listed under Annex II and Annex IV of this Directive. The level of protection to LHS bats has resulted in the designation of SACs based on their regional presence.
- 1.4 European wide protection for LHS bats has arisen from the decline of this species across Europe. The LHS bat populations in Ireland represent the most northerly and westerly range of this species globally and are therefore considered to be of high importance due to their significant genetic value internationally. The Irish LHS bat populations are a European stronghold (Marnell *et al.*, 2009) however, the LHS bat is confined to just six western counties (Mayo, Galway, Clare, Limerick, Cork and Kerry) as a result of unique local environmental factors arising from the Gulf stream and the presence of suitable habitat for both LHS bats and its prey items; which include, crane flies, caddis flies, lacewings, midges and moths (McAney., 2014 & McAney *et al.*, 2013).
- 1.5 Lesser horseshoe bats form large maternity and hibernation roosts with specific ambient requirements, and they forage predominantly in deciduous woodland and riparian habitat, with core foraging areas (50% kernel density estimation (KDE)) within 2.5km of roosting locations (Bontandina., *et al* 2002). LHS bats forage close to the ground, gleaning prey items in cluttered habitats.
- 1.6 The favourable conservation status of Irish LHS bat populations are vulnerable to a number of factors (NPWS & VWT., 2022) including:
 - Urbanisation resulting in severance and loss of optimal habitat. Either through loss of roosting and foraging habitats, impact of artificial light at night, or direct mortality from factors such as road traffic collisions;
 - ineffective or unsympathetic land and habitat management and pollution; and
 - increasing regularity of extreme weather events arising from climate change impacting the Gulf stream. Such weather events can result in less favourable hibernation conditions to support existing population numbers or forcing individuals to change behaviour which can affect fitness and survival.

- 1.7 LHS bats are known to be faithful to maternity and hibernation roost sites, returning each year to the same sites, with evidence of these species moving between a number of roosts within the summer depending on the variation of conditions encountered in any one year. In addition to the faithfulness of roosts, LHS bats have been shown to be heavily reliant on linear commuting features and known routes for navigation. LHS bats echolocate at high frequencies. Such behaviour means these species are particularly vulnerable to severance of roosting and foraging bat habitats, such as with a road.

2. Project Purpose

- 2.1 Bat Trapping and Radio-tracking surveys are essential to establish a robust ecological baseline for the Proposed Scheme. They will provide spatially explicit information needed to assess potential impacts, design effective mitigation, and support the AA/HRA process. In line with NPWS guidance (IWM 134) and Irish Bat Mitigation Guidelines (Marnell et al. 2022), radio-tracking is appropriate and necessary for large-scale projects intersecting SAC bat habitat.
- 2.2 The radio-tracking surveys are designed to determine roost locations, flightline and core foraging areas associated with SAC LHS bat population in the first instance and to collect data on non-SAC LHS bats and other species within and around the SACs. This information will be required to inform the design of the Proposed Scheme to avoid (where possible) or minimise adverse impacts on the SAC population and other bat species present, through the use of appropriate mitigation. Without these surveys the mitigation is likely to be costly and ineffective to support the favourable conservation status of the SAC.
- 2.3 Bat trapping and radio-tracking surveys are proposed at appropriate locations within and adjacent to Castlemaine Harbour SAC and Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC during 2026 (Pre-maternity season May 2026 and post maternity season August 2026). The Proposed Scheme intersects SAC habitat at five locations, where severance of flightlines, disturbance to roost networks, and habitat fragmentation may occur. Tagged bats will have their flight lines and foraging ranges recorded for duration of the radio-tag life (approximately 5-10 days). In addition to the identification of main flight lines and foraging areas, existing roost locations will be checked, and any additional roosting sites determined. This information will also feed into any further surveys and proposed mitigation design that may be required.
- 2.4 The use of static telemetry loggers will ensure detailed telemetry data is gathered, far exceeding the volume of data gathered through traditional manual triangulations, and will incur no additional disturbance compared to typical radio-tracking methods. More details on this are provided in Section 5.
- 2.5 It is proposed that all data will be fully shared with the NPWS and that where possible work is undertaken collaboratively with NPWS, and any other organisations which operate within the area with similar objectives

Specific justification is as follows;

- Robust survey data required to establish beyond reasonable scientific doubt that the integrity of the SAC will not be adversely affected.
- Passive survey methods alone cannot provide sufficiently certain data on commuting routes, roost dependency, functional connectivity, or population vulnerability.
- Circuitscape modelling identifies theoretical corridors but requires validation using empirical radio-tracking fixes.

- High-resolution movement data enables targeted mitigation design and reduces the risk of costly, ineffective, or misplaced interventions and repeating ineffective surveys.
- Previous discussions with NPWS indicated that radio-tracking would be required due to the scale and sensitivity of the scheme.

3. Survey Aims and Objectives

3.1 The objectives of this project plan are set out below:

- 1) Identify all roosts, flightlines, and core foraging areas of the SAC lesser horseshoe bat population that may be impacted.
- 2) Characterise the wider bat assemblage through trapping and acoustic verification to support species-level assessment.
- 3) Gather biometric and reproductive data to inform population health and seasonal status.
- 4) Validate Circuitscape modelling and map functional connectivity across the landscape.
- 5) Provide data to inform route design, mitigation, and conservation management.
- 6) Identify connecting features within and outside of the Proposed Scheme to verify important functionally connective habitat, for LHS.

4. Proposed Trapping Methodology

- 4.1 Trapping will occur at up to 18 strategic locations using harp traps, mist nets, and acoustic lures. All activities will follow best practice (Marnell et al. 2022; Collins 2023) and be undertaken by qualified, licensed ecologists. Disturbance will be minimised through reduced lighting, small team sizes, short handling times, and strict welfare protocols. Only fit and healthy bats meeting weight criteria will be tagged, with all tags below 5% of body mass.
- 4.2 The trapping surveys will be conducted using harp traps, mist nets and a mixture of AT100, Peersonic and Sussex Autobat acoustic lures. Surveys will commence from sunset and continue for at least 4 hours or until the target species have been caught and radio tagged.
- 4.3 Trapped bats will be identified in the hand and biometric data will be obtained, recorded and included in the licence return. All handling and disturbance of any animals taken will be kept to a minimum and bats will be kept for no more than 20 minutes. Only bats of a suitable weight and condition will be fitted with a radio-tag, following guidance of tags being <5% of the bat's body weight, to reduce impact on its health and survival. It will be ensured that heavily pregnant female bats are not radio-tagged or handled and will be released immediately. Radio-tags selected for the bat will be of a compatible weight for the bat to ensure the impact on radio-tagging the bat will not impact upon its health and survival.
- 4.4 Two trapping sessions are proposed: May 2026 (pre-maternity) and August–September 2026 (post-maternity). No trapping will occur during the core maternity season (1 June–mid/end of July).
- 4.5 Trapping surveys will be conducted over up to five nights for each trapping session at different locations along the route, including at the SAC population, followed by ten nights of radio-tracking. Radio-tracked bats will be tracked back to the roost the following day. Roost counts will be undertaken using infra-red filming cameras by a suitably qualified surveyor. Radio-tracking surveys will ensure sufficient data of each tagged bat is recorded during the night to inform upon the extent and range of the bats foraging behaviour. The data will then be analysed using Ranges Software, QGIS and ArcGIS Pro to provide flightlines and core foraging areas.
- 4.6 The proposed trapping dates are as follows; subject to variation dependant on weather, access or other constraints, which are outside of our control.
- 11-22 May 2026
 - 10 - 15 August 2026
- 4.7 In conjunction with the trapping and tracking surveys activity surveys will also be conducted, consisting of static monitoring at suitable crossing point locations.
- 4.8 Trapping surveys will be conducted by an extremely experienced team and will be overseen by one or more of the following fully qualified staff, all of whom have extensive experience of bat radio-tracking and trapping surveys in Ireland and the UK, including extensive experience of Annex II species such as LHS. Further details of relevant experience will be provided to NPWS within the licence application.
- Charlotte Wevill -Natural England Bat Survey Class Licence Level 3- 2022-10376-CL19-BAT (CL19 - 2019-37785-CLS-CLS)), Bat Survey Class Licence Level 4 2022-10377-CL20-BAT (CL20 - 2019-37786-CLS-CLS)

- James Shipman – Natural England Bat Survey Class Licence Level 3 - 2015-15761-CLS-CLS, Bat Survey Class Licence Level 4 2015-15762-CLS-CLS. Natural Resources Wales Bat Survey Class Licence S093347/1
- Sam Davis – Natural England Bat Survey Class Licence Level 3 2015-16022 -CLS-CLS; Natural England Bat Survey Class Licence Level 4 2015-16021 -CLS-CLS
- Hal Starkie – Natural England Bat Survey Class Licence Level 3 and 4 2018-38269-CLS-CLS and 2018-38270-CLS-CLS
- Tom Kitching – Natural England Bat Survey Class Licence Level 3 2023-11267-CL19-BAT, Natural England Bat Survey Class Licence Level 4 2023-11578-CL20-BAT
- Josh Mitchell – Natural England Bat Survey Class Licence Level 4 2022-10907-CL20-BAT
- Tim Rickard – Natural England Bat Survey Class Licence Level 4 2025-86231-CL20-BAT

- 4.9 A maximum of two trapping sessions will occur throughout 2026: pre-maternity (May), and post-maternity (August - September). No trapping will take place in the core maternity season from 1st June to end July.
- 4.10 Acoustic lures will be situated at least 200m apart from one another. The calls being emitted by the lures will be changed regularly to different species and periods of silence will also be used to reduce disturbance and prevent habituation to the lures. Harp traps will be checked every 15 minutes, and mist nets will be continuously monitored.
- 4.11 Where pregnant females, vulnerable bats (e.g. young, injured or underweight) or stressed bats are caught these will be released immediately, documenting the record without taking any biometric data. No trapping will be conducted in adverse weather conditions and if a significant proportion of pregnant females are trapped at a location, then trapping will cease.
- 4.12 Only suitable bats of the agreed species will be selected for tagging. Bats must also meet a suitable weight and condition to be fitted with a radio-tag, it will be ensured that bats which are in a poor condition or vulnerable, are not radio-tagged or handled and will be released immediately, if possible, to do so. If many pregnant bats are trapped unexpectedly, then trapping will cease for the night.
- 4.13 Radio-tags selected for each bat will be of a compatible weight to ensure the impact of radio-tagging will not impair health or survival. Tags will not exceed 5% of the bat's weight, and lighter individuals will not be tagged. See Table 1 for information of the bat species weight ranges and proposed tag weights for each species.

Table 1: Proposed tag weight for each species and the weight ranges of each bat

Species	weight	Tag weight at 5% of lowest threshold weight	Tag type	Tag type
lesser horseshoe bat	5-9g	0.25	0.2g Perdix	AG317
common pipistrelle	4-8g (~5g)	0.2	0.2g Perdix	

soprano pipistrelle	4-8g	0.2	0.2g Perdix	
Nathusius' pipistrelle	6-15g	0.4	0.2g Perdix	
Leisler's bat	12-20g	0.6	0.4g Perdix	
brown long-eared bat	6-12g	0.4	0.4g Perdix	0.2g Perdix
Daubenton's bat	6-10g	0.4	0.4g Perdix	0.2g Perdix
whiskered bat	4-8g	0.2	0.2g Perdix	
Natterer's bat	7-12g	0.4	0.4g Perdix	

- 4.14 It is proposed that all species caught will be tagged, if meeting the ethical requirements and needs of the project. A maximum total of 20 tags would be used across both sessions using a combination of the below maximum numbers of bats species.
- 4.15 The SAC LHS bat population is estimated to be 3-500 bats from recent counts, we are proposing to tag a maximum of 12 bats, where possible this number will be reduced to 6 or 8 bats if suitable data is obtained from initial tags which answers the objectives robustly. In total this would be a maximum impact of 2-4% of the population that might be tagged. All possible precautions will be taken to make sure any bats taken face the minimal disturbance.

Table 2: Proposed maximum number of tags per species ratios may vary depending on what's caught

Species	Maximum number of tags per session	Total max number of tags	Likelihood of capture in the area
lesser horseshoe bat SAC	6	12	High
Lesser horseshoe caught outside of SAC	4	8	High
common pipistrelle	3	6	High
soprano pipistrelle	3	6	High
Nathusius' pipistrelle	3	6	Moderate to Low
Leisler's bat	3	6	High
brown long-eared bat	4	8	High
Daubenton's bat	4	8	High
whiskered bat	3	6	Moderate
Natterer's bat	3	6	Moderate to Low

5. Proposed Tracking Methodology

- 5.1 A hybrid approach will be deployed, combining manual tracking teams with automated TrackIt telemetry stations. Automated stations provide continuous, high-resolution data and enable simultaneous monitoring of multiple individuals. This greatly exceeds the resolution achievable through manual triangulation and provides fine-scale insight into roost networks, foraging areas, and movement patterns. This technology is now becoming well established and used. We have successfully used these masts on a number of large radio-tracking projects and shown the data obtained is comparable to traditional radio-tracking approaches. Subsequently we have released peer reviewed information. The data resolution achieved through automated radio-tracking is substantially greater than that obtained via manual techniques, producing a high-fidelity representation of individual flightlines, roost networks, foraging areas, and interactions between sub-populations. Such data provides a robust empirical basis for developing targeted and effective mitigation and avoidance strategies. Evidence from comparable projects demonstrates that higher-resolution datasets enable more precise impact prediction and better-designed interventions, thereby reducing overall scheme effects and justifying the temporary impacts associated with tagging. Furthermore, this provides adequate scientific data to determine if the three HRA tests can be met, which is not possible to obtain from other survey methodologies.
- 5.2 Each automated station includes directional antennas, receivers, and remote data access. Stations will be deployed with landowner permission at 16–20 locations along the route, focusing on SAC interfaces. Data will be uploaded daily, quality-checked, and analysed using specialist spatial software to generate flightlines, utilisation distributions, and connectivity assessments.
- 5.3 Using automated radiotracking stations we can target specific areas at a higher resolution where the Proposed Scheme is coming into contact with the Macgillycuddy's Reeks and Caragh River Catchment SSAC or other key habitats and continuously record any bats which fly within range of the stations for the lifetime of the tags. In addition to this, the locations of the automated radio-tracking stations have excellent coverage along the Proposed Scheme to provide a real time view of how bats use the landscape.
- 5.4 For the automated radio-tracking system it is proposed that 16 to 20 of these masts will be situated in distinct locations with landowner permission, along the Proposed Scheme focusing on where the two SACs cross the Proposed Scheme and other areas of suitable habitat.
- 5.5 The stations detect tag frequency continuously (as long as the tag is within range) and will be able to collect data on the lifetime of the tag (~10-20 days for 0.2g Perdix tags or similar tags). The stations triangulate live flight line data when a bat is detected by more than one mast simultaneously and can record multiple tags at once within a 300hz range. This means a greater number of bats can be monitored at the same time compared to traditional radiotracking which is more labour intensive allowing for a robust assessment of how the bats are using the landscape to be made.
- 5.6 Day-time tracking will confirm roost locations and support emergence counts. All data will be shared fully with NPWS.

6. References

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Figure 1: N22 Farranfore to Killarney Improvement Scheme and existing SAC boundaries and lesser horseshoe bat roost locations. The route option for the Proposed Scheme will fall within the orange boundary but surveys will extend out to roost locations or functionally connected habitats.

