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Survey and Mitigation Guidance for Barn Owls to inform the Planning, Construction and Operation of National Road Projects

PE-ENV-07005
March 2026

BirdWatchIreland
protecting birds and biodiversity

Prepared by BirdWatch Ireland

PE Planning & Evaluation

Technical

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TII Publication Title	*Survey and Mitigation Guidance for Barn Owls to inform the Planning, Construction and Operation of National Road Projects*
TII Publication Number	*PE-ENV-07005*

Activity	*Planning & Evaluation (PE)*		**Document Set**	*Technical*
Stream	*Environment (ENV)*		**Publication Date**	*March 2026*
Document Number	*07005*		**Historical Reference**	**N/A**

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TII Publications

Activity:	Planning & Evaluation (PE)
Stream:	Environment (ENV)
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TII Publication Number:	PE-ENV-07005
Publication Date:	March 2026
Set:	Standards

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Updates to TII Publications resulting in changes to

Survey and Mitigation Guidance for Barn Owls to inform the Planning, Construction and Operation of National Road Projects PE-ENV-07005

Date:	March 2026
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Section No:	

Amendment Details:

Document has been changed from Standard to Technical Guidance. Refer to Technical Bulletin GE-TBU-01046 for details.

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1. Introduction

1.1 Background and Legislative Context

The Roads Act, 1993, as amended, provides the principal legislation governing aspects of road development in Ireland and provides for the preparation of an Environmental Impact Assessment Report (EIAR) for National Road Projects to assess for, and provide mitigation of, the effects of roads on environmental considerations. The TII Publications (Technical) PE-PMG-02041 Project Management Guidelines outlines the required procedures which are followed by Transport Infrastructure (TII) and local authorities in the development of National Road Projects to ensure the efficient delivery of the national roads programme in a manner which minimises adverse human and environmental effects while maximising the benefits of the new road infrastructure and respecting all applicable legislation.

This document outlines recommendations for the treatment of Barn Owls (*Tyto alba*) during the planning, construction (including enabling works e.g. Ground Investigation) and operation of National Road Projects. The aim of this Technical Document is to ensure appropriate protection for Barn Owls and consistency of approach during the different stages of National Road Projects in accordance with PE-PMG-02041 and within the relevant legislative requirements. Specifically, this document outlines requirements to ensure appropriate surveying, reporting and assessment of impacts of National Road Projects on Barn Owls in Phase 2, Options Selection and Phase 3, Design and Environmental Evaluation of National Road Projects to include the preparation of the EIAR and standards for mitigation and post-construction monitoring.

This Technical Document is specific to Barn Owl and is informed by, and should be used in conjunction with, existing TII Environmental Standards, Technical Documents and Guidelines, which include:

- PE-PMG-02041 Project Management Guidelines
- PE-PMG- 02042 Project Manager's Manual for Major National Road Projects
- GE-ENV-01109 Guidelines for the Creation, Implementation and Maintenance of the Environmental Operating Plan
- PE-ENV-01112 Guidelines for Assessment of Ecological Impacts of National Road Schemes
- PE-ENV-01114 Environmental Impact Assessment for National Road Schemes – A Practical Guide
- PE-ENV-01113 Ecological Surveying Techniques for Protected Flora & Fauna during the Planning of National Road Schemes
- GE-ENV-01102 A Guide to Landscape Treatments for National Road Schemes in Ireland.

1.2 Legislation

Ireland is part of the European Union and is committed to protecting all wild bird species under the European Birds Directive (79/409/EEC). This directive is transposed into Irish legislation through the Wildlife Acts 1976-2018, the EC (Birds and Natural Habitats) (Restrictions on use of Poison Bait Regulations) 2010 and the EC (Birds and Natural Habitats) Regulations 2011-2015. This legislative framework provides for the protection of all wild birds and their nests, eggs and young (www.npws.ie/legislation) including Barn Owls, which are rare birds and have suffered serious population declines in recent decades.

In practical terms this legislation means that deliberate disturbance of Barn Owls on or near their breeding place requires a derogation licence from the National Parks and Wildlife Service (NPWS).

A derogation licence is also required for the destruction of Barn Owl nests, even outside the breeding season, as these bird's nest in the same site for many years.

Survey work which is likely to disturb the birds will also need a licence, as will the use of certain types of survey equipment listed in Section 38 of the Wildlife Act 1976-2018.

1.3 Impact of Road Schemes

Barn Owls may be impacted by the development of National Road Projects through the loss of nesting sites and displacement of nesting pairs during the construction phase and through direct mortality due to vehicle collisions during the operational phase of national roads (Shawyer 1987, Shawyer & Dixon 1999, Forman et al. 2003, Ramsden 2003, Lusby et al. 2021).

Detailed information on the effects of national roads on Barn Owls in Ireland is provided in TII Publications (Technical) RE-ENV-07004 The Interactions between Barn Owls and Major Roads: Informing Management and Mitigation (Lusby et al. 2021).

1.4 Requirements of a Barn Owl Specialist

A Barn Owl specialist is required to ensure appropriate surveying, reporting and assessment of impacts of National Road Projects to include the preparation of the EIAR and standards for mitigation and post-construction monitoring. The Barn Owl specialist should have a degree (Higher Education and Training Awards Council (HETAC)/National Framework of Qualifications (NFQ) Level 7 or equivalent or higher) in biological science or environmental science, or equivalent subject and three years' relevant post-qualification experience. The Barn Owl specialist should have a thorough understanding of the life cycle of the species, their breeding behaviour and their ecological requirements and should have relevant experience of surveying for Barn Owls prior to undertaking surveys to inform National Road Projects as outlined in this Guidance. Based on this expertise, the potential and likely consequences of alterations to the landscape brought about by development of a national road project can be confidently and comprehensively identified.

The Barn Owl specialist should have an understanding of the licence requirements for conducting specialised Barn Owl surveys and be in possession of the relevant licences (e.g. Section 22 9(d)) as appropriate for survey operations. They should be competent in determining the suitability of the range of sites that can be used by Barn Owls and possess an understanding of which survey techniques are most applicable based on the site-specific conditions to effectively assess occupancy and breeding status, locate nest sites and determine the stage of breeding where required. The Barn Owl specialist should have an understanding of potential negative effects of a proposed road development in both construction and operational stages, to inform design of effective suitable mitigation measures. Where mitigation measures are required, the Barn Owl specialist should be capable of assisting in designing such measures and should be able to ensure that any proposed mitigation measures are feasible and relevant to the scheme under investigation (for example, the provision and placement of nest boxes or the landscape treatment of the road). At the construction stage, it is essential that the Barn Owl specialist provides advice on the appropriate schedule for building demolition, alterations or other activities that can disturb breeding Barn Owls, as identified in the EIAR. The Barn Owl specialist should also advise on the requirements for post-construction monitoring specific to the road scheme and mitigation and biodiversity enhancement measures applied, which should be documented in the EIAR.

2. The Treatment of Barn Owls in the Planning and Design of National Road Projects

The PE-PMG-02041 Project Management Guidelines provides a framework for a phased approach to the management of the development and delivery of National Road Projects. These Guidelines divide the evolution and progression of a Project into an eight-phase process (Phase 0 to Phase 7 inclusive). Detail on each of these phases, their process and deliverables are provided in PE-PMG-02041.

Within this process, the surveying, reporting and assessment of impacts of National Road Projects on Barn Owls should be considered in Phase 2 Options Selection and Phase 3 Design and Environmental Evaluation, which are described below.

2.1 Phase 2 Options Selection

The purpose of Phase 2 is to examine alternative options to determine a Preferred Option through a structured appraisal process which can be referred to as a narrowing of options as outlined in TII Publications (Technical) PE-PAG-02013 Project Appraisal Guidelines Unit: 4.0 Consideration of Alternatives and Options. During this phase all reasonable / feasible options are examined (Option Selection Process) and their costs, benefits and effects on the environment are interrogated to identify a preferred option, if any, that will progress to Phase 3 Design and Environmental Evaluation.

The Option Selection Process is a three-stage process as outlined within PE-PAG-02013, each requiring a greater level of assessment and appraisal. The three stages are referred to as:

- Stage 1 – Preliminary Options Assessment
- Stage 2 – Project Appraisal Matrix
- Stage 3 – Preferred Option

A suitable study area will be defined to enable appropriate options to be developed and examined. Once a study area has been defined all constraints, at an appropriate level of detail, should be identified therein to facilitate a systematic assessment of the potential impacts associated with the options. These constraints will be documented and mapped such that options under consideration can be designed taking cognisance of such constraints. While the constraints study may be primarily a desk-based study, field surveys may be necessary to verify the nature and extent of certain constraints.

It is imperative to collate reliable information on Barn Owls within the defined study area, which is essential during each of the three stages of Phase 2, to identity the constraints and to evaluate and compare route options so that those with unacceptably high levels of impact on Barn Owl can be avoided to the extent feasible as part of the overall Options Selection process.

All information on Barn Owl occupancy, distribution and abundance within the defined study area should be collated from relevant and reliable sources including:

- Published sources (peer-review papers, reports, Bird Atlas, County Biodiversity Plans etc.)
- Previous studies (EIARs in the relevant area which may have taken account of Barn Owl)
- Consultation with BirdWatch Ireland (who manage a national dataset on Barn Owls)
- Consultation with National Parks and Wildlife Service

- Consultation with the National Biodiversity Data Centre
- Local experts with knowledge of Barn Owls

A desk study of locations with potential for breeding Barn Owl should be undertaken using up to date aerial photographs and Ordnance Survey maps to identify further potentially suitable habitats for Barn Owl. It may not be possible to conduct surveys for Barn Owl over the extent of study area, however field surveys (following the methods outlined in Section 3) may be undertaken to target known and potential sites for Barn Owls, as deemed necessary by the Barn Owl specialist and Project Manager to inform the Option Selection, including the following:

- Sites with recent or historic evidence of Barn Owl occupancy
- Sites where the presence of Barn Owls is suspected (based on records received)
- Sites which are potentially suitable for breeding Barn Owl (see Section 3)

All information on Barn Owls in the study area should be mapped in the Irish Transverse Mercator (ITM) coordinate system and reported accordingly to inform the processes and deliverables required to complete Phase 2 as outlined in PE-PMG-02041. Barn Owl site locations should be treated as sensitive information and the specific locations of breeding sites should not be disclosed in documents which will be publicly available.

Although all efforts will be made to obtain available information on Barn Owls to inform the Option Selection, the limitations in the existing knowledge of Barn Owl distribution should be recognised. It is typically not possible to achieve a comprehensive understanding of the presence and distribution of Barn Owl in an area solely from a desk-based approach. Additional sites may be identified in Phase 3, when a more thorough investigation is undertaken including comprehensive field surveys.

2.2 Phase 3 Design and Environmental Evaluation

The purpose of Phase 3 is to develop the project design, following selection of a preferred option, based on both technical and environmental inputs, to a stage where sufficient levels of detail exist to establish landtake requirements, to identify and mitigate project impacts, and to progress the project through the statutory processes. The processes and deliverables required to complete Phase 3 are outlined in PE-PMG-02041.

Where an Environmental Impact Assessment is required an EIAR will be prepared. An EIAR is a report or statement of the effects, if any, which the proposed project, if carried out, would have on the environment. Specialist Barn Owl surveys should be carried out in the preparation of the EIAR, to identify the impacts of the National Road Project on Barn Owls, and to inform the Environmental Mitigation Requirements, land acquisition requirements and constructions requirements as set out in PE-PMG-02041.

Guidelines for the planning, design and implementation of specialist Barn Owl surveys are outlined below.

2.2.1 Specialist Barn Owl Surveys

The aim of the specialist Barn Owl surveys to inform the EIAR is to identify all Barn Owl breeding locations within the defined search area. Specialist Barn Owl surveys to determine occupancy and breeding status should be carried out during the main nesting period (typically mid-March to mid-July) when the population is sedentary and when it is possible to detect and confirm nesting sites. It should be noted however that Barn Owls can have an extended breeding season and may have second broods, so the timing of breeding can vary, and surveys should cater for this.

The most important information is to determine the location of breeding sites, it is usually not necessary to determine breeding success, however if this is required, then additional visits (mid-July to August and later) may be necessary.

Appropriate Personal Protective Equipment should be used when conducting fieldwork, which should include a hard hat, high visibility clothing, boots, torch and mobile phone or two-way radio as required. A device for recording location (hand-held GPS unit or phone), camera for recording the site and site features, sample bags with labels for collecting signs, and binoculars and dark or camouflage clothing for conducting nocturnal surveys is also necessary.

Survey operations should be carried out to minimise disturbance to breeding bird and bat species which may be encountered or present in sites investigated as part of Barn Owl survey work. Barn Owls are particularly sensitive to disturbance during the early stages of the breeding season, before laying and during incubation. Confirmed or suspected nest locations should not be approached or directly inspected (unless operating under licence to do so) and should be watched from a discrete distance to confirm occupancy. If a bird/s are flushed, or alarm call due to disturbance caused by survey operations, the site should be vacated immediately to allow the bird/s to return to the nest. Data on Barn Owl nest site locations generated through the Barn Owl surveys should be provided to the NPWS and BirdWatch Ireland in an appropriate format (ITM coordinate system of the site location) subsequent to the publication of the EIAR, to aid the identification and protection of sites in relation to future developments.

2.2.1.1 Define the Zone of Influence

For National Road Projects the zone of influence for a Barn Owl survey should be a buffer of 5km around the proposed route alignment. The zone of influence will therefore extend for 5km either side of the route alignment, creating a survey area of 10km in width with the proposed route at the centre and extend for 5km from the start and end points of the route (see **Figure 1**). The extent of the zone of influence for Barn Owl surveys is based on the home range ecology of the species to incorporate all nest sites which may be potentially impacted by the road scheme (within 5km from the route) (Lusby et al. 2021).

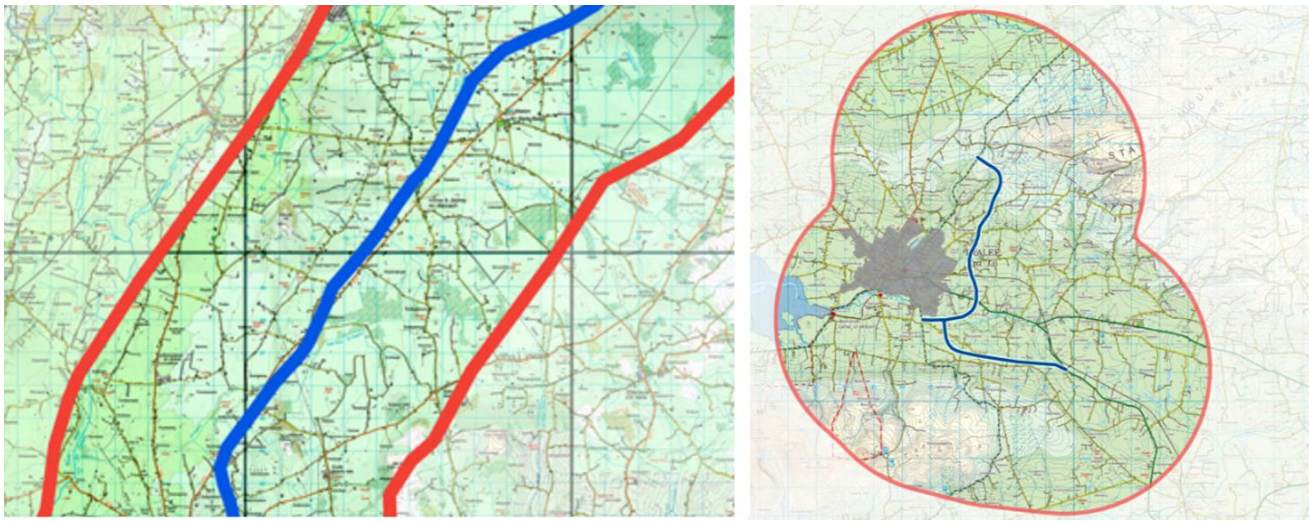

Figure 1 The zone of influence showing a buffer of 5km around the route.

2.2.1.2 Collate existing Information on Barn Owl Occupancy

Information on Barn Owl occupancy, distribution and abundance will have been collated from available sources during Phase 2 of the scheme.

Any additional information that can be obtained from relevant sources should be collated to supplement the existing data, and particularly in cases where the zone of influence for the Preferred Option is more extensive and takes in new areas not previously assessed during Phase 2.

2.2.1.3 Define the Search Area

Survey maps of the zone of influence of appropriate scale (to allow identification of features of interest such as buildings and quarries) should be prepared for use in the field. Maps should feature all roads and buildings within the zone of influence. Ordnance Survey and aerial imagery should be reviewed to identify potentially suitable buildings and quarries within the zone of influence to be marked on the survey maps, alongside all known active and historic Barn Owl sites.

Areas which are unsuitable for breeding Barn Owls should be highlighted on the survey maps and excluded from further survey effort (see **Figure 2**). Unsuitable areas are defined as all lands over 350m asl, densely populated and built-up areas, open bodies of water, and the interior of forests (**Figure 2**). The search area should therefore include all other areas within the zone of influence which are below 350m asl and which may contain suitable breeding sites for Barn Owls, including buildings, mature trees, quarries and rock faces and artificial nest boxes.

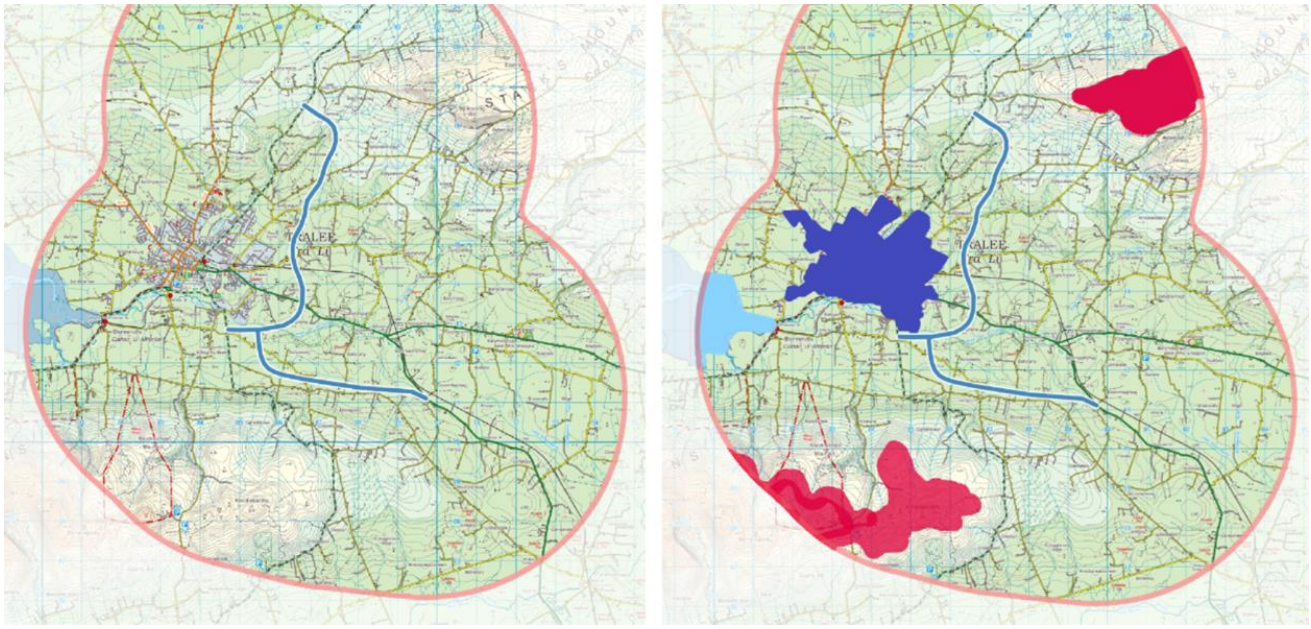

Figure 2 **A defined zone of influence for a Barn Owl survey (left), and the defined search area (right) showing upland areas above 350m asl (in red) and a built-up area (blue) which are excluded from the search area.**

2.2.1.4 Survey Techniques

2.2.2 Sign Searching

Sign searching is an effective method for establishing the presence of Barn Owls (Barn Owl Trust 2012). At many sites, the presence or absence of Barn Owls can be determined by a visual inspection during the day to search for signs of occupancy which include pellets, white-wash and moulted feathers. Confirmation of signs indicates that a site has been used by Barn Owls, however it is necessary to conduct a nocturnal survey to establish current occupancy and breeding status to inform road planning. Signs should be collected in a sealable bag and labelled with the site location and date, so that species identification can be validated if required, and this will also serve to ascertain recent activity at the site based on presence or absence of fresh signs on future visits.

At certain sites, sign searching may not be an effective means of determining occupancy, as signs may not be obvious or accessible, for example sites which are inaccessible (a building which is unsafe or not possible to enter) or where the nest site is concealed (within a blocked chimney, roof space, or tree cavity which is not possible to access and where signs remain in the nest space). At sites where sign searching is deemed to be ineffective in determining Barn Owl presence a nocturnal survey should be carried out to confirm occupancy.

2.2.3 Pellets

Barn Owls usually swallow their prey whole and regurgitate the undigested remains in the form of a pellet. Barn Owl pellets are large (approx. 4cm x 2.5cm), dark in colour and contain large bones and skulls of small mammals and other prey items. Two pellets are generally cast over a 24-hour period (Shawyer 1998). At sites which have been in use for some time, large build-up of pellets may be obvious. However, depending on the characteristics of the site, pellets may not be evident, for example in active sites where pellets do not fall from the nest to the ground (e.g. if birds use a chimney which is blocked, a tree cavity or a roof space to which there is no access etc.).

Barn Owl pellets are similar to those of Long-eared Owl *Asio otus*. However, the two can generally be differentiated on the location where they are found. Long-eared Owls typically nest in old corvid nests in trees and rarely use buildings. Barn Owls typically only nest in trees which have hollow cavities of sufficient size and depth, and therefore close investigation of the tree itself will usually provide a reliable indication of the species present. Kestrels routinely use buildings for nesting and roosting, and it is common to find both Kestrel *Falco tinnunculus* and Barn Owl pellets (**Figure 3**) in the same building.

Figure 3 Barn Owl pellets (left) and Kestrel pellets (right).

With practice, Kestrel pellets are easily distinguished from those of Barn Owl by their smaller size (2.5cm x 1.5cm), colouration and contents, as Kestrel pellets regularly contain invertebrate remains which are unusual in Barn Owl pellets.

White-Wash

At most sites where Barn Owl are breeding, white-wash will be evident, either directly associated with the nest or roost site, or under regular perches within or close to the site. Barn Owls are habitual in their behaviour and regularly use the same perches, under which there is often a build-up of white-wash.

Barn Owl white-wash can be distinguished from most other species as it is large, often almost pure white and regularly occurs in long vertical streaks (similar to lines of “white paint”) (**Figure 4**).

The white-wash of Kestrel, Peregrine *Falco peregrinus* and Raven *Corvus corax* which can frequently use the same sites, can be confused with Barn Owl, and further searching for additional signs (pellets or moulted feathers) and/or a nocturnal survey should be carried to confirm the species present as appropriate.

In situations where Barn Owls nest within chimneys, build-up of white-wash can often be observed in the fireplace or at the top of the chimney. Evidence of white-wash can be particularly useful at sites where pellets or moulted feathers are not obvious, such as derelict cottages where birds nest in the chimney but do not access the interior of the building. In such situations, birds will typically use perches close to the building, often inside adjacent open buildings. In these circumstances white-wash may be the only obvious signs to indicate Barn Owl occupancy.

Figure 4 **Examples of Barn Owl 'whitewash' on a fireplace used to access a chimney nest (top left), on vegetation under a nest entrance (top centre), at the entrance to a cavity nest in a quarry (top right), and under regular perches in buildings (bottom).**

Moulted Feathers

Moulted feathers can provide a reliable indication of Barn Owl presence (**Figure 5**). White 'fluffy down' can gather around the nest entrance, and the presence of flies around the nest entrance may also provide a useful indication of nest location, as can prey remains or dropped prey items.

Figure 5 **Barn Owl moulted feathers, including flight feathers (top left and bottom right), and a body feather (bottom left) which are distinctive, and fluffy down at the entrance to a chimney nest (top right), also the remains of a prey item dropped directly beneath the nest within a building (bottom centre).**

2.2.4 Nocturnal Surveys

Nocturnal surveys involve observing a potentially suitable or active Barn Owl site from a selected vantage point during the period when the birds are active in order to establish occupancy and breeding status based on observations, vocalisations and/or behaviour of birds associated with the site. Nocturnal surveys should be conducted during the breeding period mid-March to mid-July and should be carried out from a discrete vantage point to avoid disturbance to breeding birds.

The position of the vantage point should be informed by the specific characteristics of the site to ensure a good view of the site, and/or area of suspected activity, including flight paths to and from the site, and preferably so that the site/area of interest is against a light background or clear sky to aid observations. Typically, 20m – 50m from the site is an appropriate distance to conduct a nocturnal survey, however, this may vary depending on site specific conditions including the scale of the site and access, (see **Figure 6**). Thermal imaging equipment can be used to aid detection of Barn Owls. A licence is required from NPWS to use thermal imaging for survey purposes, which can be included as a survey method within the survey licence or should be requested separately.

If the nest site location is known or suspected based on existing evidence (presence of signs, information from previous nocturnal surveys etc.), the watch may focus specifically on this area. It may be necessary to conduct the watch from inside buildings in certain situations.

Regardless of the position, the surveyor should remain discrete at all times, including when accessing and departing the vantage point, and position themselves against a dark background or cover where possible, wearing dark or camouflage clothing. If one or both adults alarm call due to the presence of a surveyor then they should finish the watch and make an obvious departure from the site, as alarm calling can be taken as evidence of breeding. For large sites, or those with many potential nesting areas, two or more surveyors or repeated visits may be required to effectively establish occupancy and breeding status.

Nocturnal surveys should be conducted in calm and dry conditions, commencing 30 minutes prior to sunset. In good conditions, where visibility is adequate to detect Barn Owls entering or exiting a site it is possible to conduct surveys throughout the night, until sunrise.

When conducting a nocturnal survey, it is important to listen for and note all vocalisations which often can be the best means of establishing occupancy and information on breeding status. If it is not possible to hear vocalisations from the vantage point, then the site should be quietly approached on completion of the vantage point watch to listen for calls which may indicate occupancy and breeding. The surveyor should remain stationary for a minimum of 15 minutes or until calls are confirmed.

Watches should be undertaken until the status of the specific site is effectively determined. Multiple watches may be necessary to effectively establish occupancy and breeding status. The vantage point position may be adjusted on subsequent watches based on information gathered and areas of activity identified for the site. If evidence of breeding is confirmed, the site should be recorded as a ‘breeding site’ and there is no requirement for further visits unless necessary to obtain information on breeding success. If nocturnal surveys during the breeding season produce no evidence of Barn Owls, then the site can be considered as ‘unoccupied’.

Figure 6 **Images of sites which are the focus of nocturnal surveys taken from the vantage point, for the stone shed (left) the watch is focusing on birds approaching and entering or exiting via the roof space. In the case of the derelict farmhouse (right) the watch is focusing on the chimney. The vantage points are positioned to afford good views of the potential area of activity, against a clear sky and at sufficient distance to not cause disturbance.**

2.2.4.1 Determine Breeding Site Suitability and Occupancy of Barn Owls

All buildings (to include bridges), quarries, rock faces and artificial nest boxes within the defined search area should be assessed to determine their suitability for breeding Barn Owls. Barn Owls may also use mature trees with hollow cavities, however assessment of the suitability for Barn Owls of all mature trees within the search area may not be possible, and where this is the case survey efforts should focus on areas where there is suspected or confirmed evidence of Barn Owls (based on records received) to locate potential breeding sites and within the landtake of the National Road Project.

Assessment of site suitability can be undertaken prior to the breeding season during January to mid-March, or alternatively during mid-March to mid-July, when Barn Owl occupancy of potentially suitable sites can also be assessed on the same visit.

Sites confirmed to be 'unsuitable', which do not provide nesting opportunities for Barn Owls should be recorded as such as can be excluded from further survey effort. All sites which are classed as 'potentially suitable' for Barn Owls should be recorded, including an accurate location (using ITM coordinate system) and marked on the survey map. A thorough inspection should be conducted during the day to assess occupancy based on the presence of signs and to inform the requirement for follow up visits and nocturnal surveys. The methods for determining suitability and occupancy for each site type are outlined below.

Buildings

All buildings (to include bridges) within the defined search area should be assessed to determine suitability for breeding Barn Owls. The exterior of modern and occupied buildings and the interior and exterior of ruined, derelict, farm buildings, and any other built site considered to be potentially suitable should be inspected thoroughly, checking for potential nesting opportunities.

Buildings should be classed as 'unsuitable' if there are no nesting opportunities for Barn Owls. Most modern and occupied dwellings will be unsuitable for Barn Owls and can be quickly ruled out on inspection to ensure that there are no artificial nesting sites associated with the building, blocked chimneys or access to the roof space or other suitable cavities.

Buildings should be considered 'potentially suitable' if they provide nesting opportunities for Barn Owls which include any cavities or other dry, dark and secluded spaces with a floor space greater than 30cm x 30cm (Taylor 1994) and access point of approximately 7cm x 7cm or greater (Barn Owl Trust 2012), which can include blocked chimneys, roof spaces, wall cavities, chutes and any other cavities which meet these specifications. Where the suitability of a site is not possible to accurately determine but where it is suspected there may be nesting opportunities available, the site should be recorded as 'potentially suitable'. The location of all potentially suitable sites should be recorded and mapped.

For all buildings considered to be 'potentially suitable' for breeding Barn Owls, a thorough day-time inspection should be carried out during mid-March to mid-July (on the same day as assessing the suitability of the site if possible) to record the presence of signs indicating Barn Owl occupancy, including pellets, white-wash and moulted feathers. All areas of the interior and exterior of the building which are safe to access should be checked, with particular attention to the ground under suitable cavities, chimneys and perches both inside and outside the building, and the entrance to potential nesting or roosting sites. Areas where there is a build-up of white-wash should be inspected for additional signs to confirm the relevant species.

If it is possible to access all areas of the site and a thorough inspection yields no signs to indicate the presence of Barn Owls, then the site should be classed as 'unoccupied' and can be excluded from further survey effort, and no further action is required.

Other species using the site should be recorded, to include the species, signs observed and breeding status where possible.

At sites where sign searching may not be effective as a stand-alone method for determining Barn Owl occupancy (e.g. where part or all of the building is inaccessible, unsafe to search, or where the nest site may be concealed), a nocturnal survey is necessary to confirm activity.

All signs which may be attributed to Barn Owl should be collected in a sealable bag and labelled with the site location and date. Collection of signs will facilitate assessment of future use by conducting a follow up visit to record the presence or otherwise of fresh signs. Collecting signs will also allow confirmation of the species identification should this be necessary.

A nocturnal survey should be conducted at all sites where Barn Owl activity is confirmed, suspected or possible by a day-time inspection. Nocturnal surveys shouldshould be carried out according to best practice methods as defined (Section 2.1.1.4).

2.2.5 Trees

All mature trees with a trunk diameter greater than 50cm which are isolated, or within tree lines, hedgerows or at the woodland edge within the defined search area should be inspected to determine suitability for breeding Barn Owls. All trees which do not meet these criteria can be considered 'unsuitable' and excluded from further survey effort. Trees which provide large and deep cavities should be considered 'potentially suitable'. It should be noted that some tree cavities may have small entrances which open into large cavities or cavities which are hidden from view. If it is suspected that a tree may have concealed cavities (e.g., Ivy *Hedera helix* covered mature trees) then this site should be considered 'potentially suitable' and the location recorded and mapped accordingly.

A thorough inspection of all trees classed as potentially suitable should be conducted in the daytime during mid-March to mid-July. The perimeter around the base of the tree extending out to the furthest branches should be scanned for signs of Barn Owl occupancy including pellets, white-wash and moulted feathers. All parts of the tree should be scanned to check for white-wash and the presence of down, particularly around cavity entrances.

If signs of Barn Owl are recorded, they should be collected and placed in a sealable bag and labelled with the site location and date. Nocturnal surveys should be conducted according to best practice methods (Section 2.1.1.4) at all sites where Barn Owl activity is confirmed or suspected by the day-time inspection.

2.2.6 Quarries and Rock Faces

The entire quarry or rock face should be scanned with binoculars from a suitable vantage point/s and assessed from beneath and above to determine the availability of suitable cavities for Barn Owls. If there are no suitable cavities, then the site can be classed as 'unsuitable' and excluded from further survey effort. If suitable cavities are confirmed, suspected or possible then the site should be classed as 'potentially suitable' and location recorded and mapped accordingly.

For all potentially suitable quarries, all areas of the base of the quarry or rock face should be inspected to within 5m for the presence of signs indicating use by Barn Owls, with particular attention to the ground under suitable cavities, or perches where there is a build-up of white-wash.

If a complete search can be effectively carried out which yields no signs to indicate the presence of Barn Owls, then this site can be classed as 'unoccupied' and can be excluded from further survey effort. If it is not possible to conduct a complete search of the site, or if there are potentially suitable cavities which may not yield signs then a nocturnal survey should be conducted to determine occupancy.

Nocturnal surveys should be conducted according to best practice methods (Section 2.1.1.4) at all sites where Barn Owl activity is confirmed, suspected or possible based on the day-time inspection.

2.2.7 Nest Boxes

Nest boxes which are installed within buildings or on mature trees should be recorded when assessing the suitability of these sites. Nest boxes can also be mounted on poles and placed in open areas away from buildings and mature trees. All open areas within the defined search area should be scanned with binoculars to detect pole mounted nest boxes.

The majority of nest boxes should be considered suitable for Barn Owls unless their specifications (Lusby et al. 2021) do not meet the requirements for breeding Barn Owls, or their placement is deemed to be inappropriate. The location of all suitable nest boxes should be recorded and mapped.

The area under the nest box and all suitable perches in proximity to the nest box (approximately 20m) should be inspected for signs to indicate the presence of Barn Owls. The area immediately around the nest box, including the top of the box, landing ledge and entrance should be scanned with binoculars to check for the presence of white-wash, pellets and down.

Nocturnal surveys should be conducted according to best practice methods (Section 2.1.1.4) at all nest box sites where Barn Owl activity is confirmed, suspected or possible based on the day-time inspection.

2.2.7.1 Confirm Occupancy and Breeding Status

Sites should be recorded as **'unsuitable'** for breeding Barn Owls if the day-time inspection confirms that there are no nesting opportunities available.

Sites should be classed as **'potentially suitable'** if the day-time inspection records confirmed, suspected or possible nesting opportunities for breeding Barn Owls.

Potentially suitable sites should be confirmed as **'unoccupied'** if best practice survey methods can effectively record no evidence of Barn Owl activity at the site. The site should be recorded as **'previously occupied'** if signs to indicate the presence of Barn Owls are confirmed, however no indication of recent use is established via follow up day-time inspections and nocturnal surveys. The site may have been used as a seasonal or temporary roost or may have been previously used as a nest site which has since been abandoned.

The site should be recorded as **'active'** if Barn Owl activity is confirmed via evidence of fresh signs or confirmation of one or both adults via observation or vocalisation, but there is no indication of breeding, this could be a non-breeding site, used for roosting, or a 'breeding site' which may have failed prior to the survey visits.

Sites should be confirmed as a **'breeding site'** based on confirmation of; a pair present at the site by observation or vocalisation; a female attending a nest, or confirmation of pre-laying, incubation or brooding behaviour; defensive behaviour by one or both adults; confirmation of a prey delivery or if young are observed or heard.

A step-by-step outline of all stages of the Barn Owl survey are shown below (**Figure 7**).

If it is required to determine breeding success, nocturnal surveys focused on the nest site should be conducted as necessary during June to August as appropriate based on the timing of breeding and according to best practice methods (Section 2.1.1.4) to confirm fledging and to determine the number of fledged young.

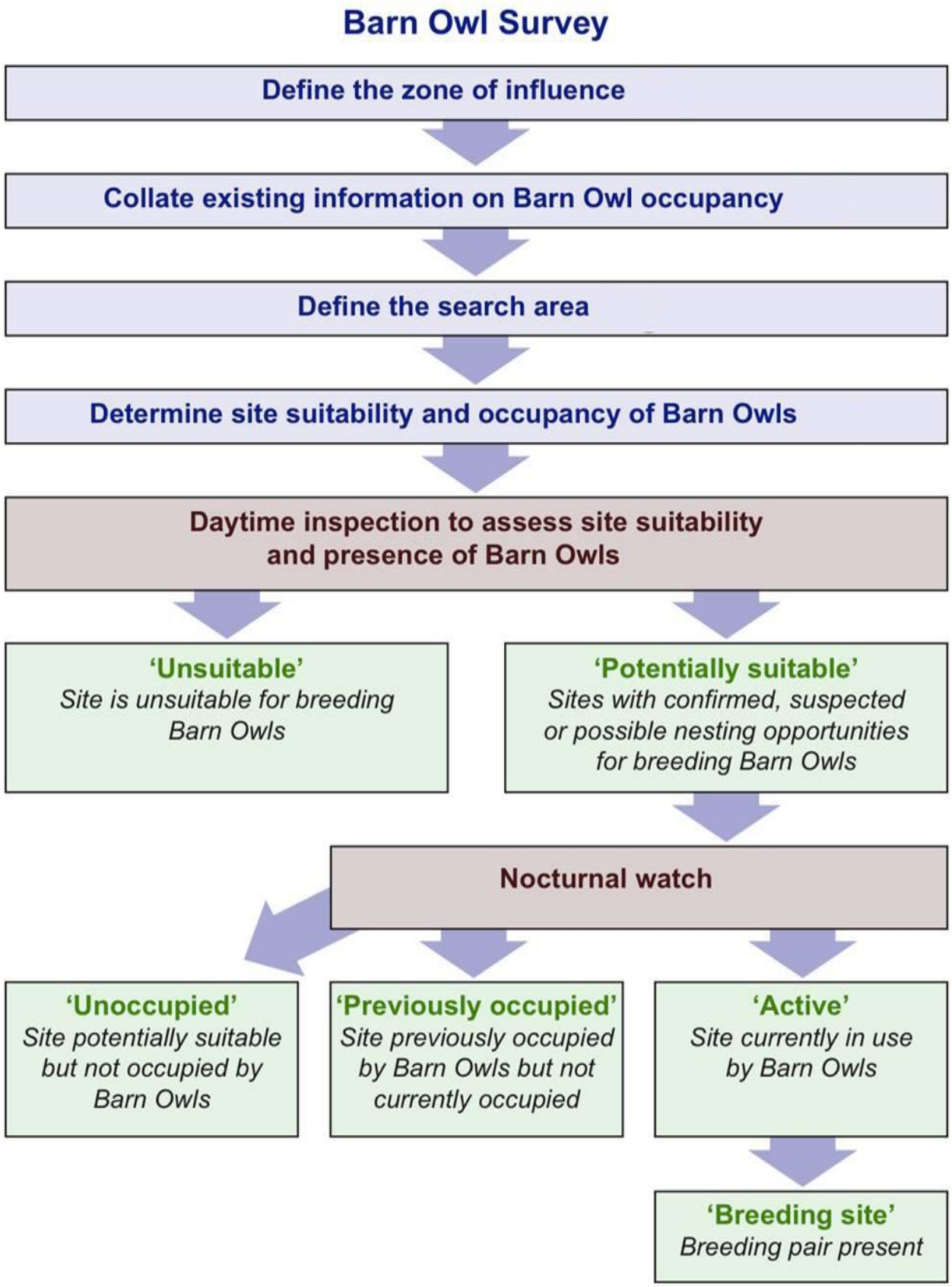

Figure 7 An overview of all the steps and outcomes of a Barn Owl survey

2.2.7.2 Survey Schedule

The survey schedule below provides a recommended schedule for survey visits. The first visit is to determine suitability and to undertake a day-time inspection for the presence of Barn Owls and a second visit to conduct a nocturnal survey to determine occupancy and breeding status (these can be carried out on the same day if within the relevant time period). Further visits should be carried out as necessary to determine occupancy and breeding status of a site. To determine breeding success and performance one or more additional visits are required.

Table 1 Barn Owl survey schedule

Visit 1	January to March	To identify suitable sites and nesting opportunities
Visit 2	Mid-March to mid-July	To identify suitable sites, occupancy and breeding status
Visit 3	June to July	To confirm breeding status and success
Visit 4	July to August (September)	To determine breeding success and late nests / second broods

3. Mitigation Measures for Barn Owls

The mitigation measures to reduce the negative impacts of roads on Barn Owls are summarised in Table 2, based on the phases of National Road Projects as set out in PE-PMG-02041. The mitigation measures are designed to:

- Reduce the direct effects, disturbance and displacement of breeding Barn Owls during the construction phase of National Road Projects
- Reduce incidents of mortality of Barn Owls during the operational phase of National Road Projects

The requirement for mitigation should be clearly set out in the EIAR, which will inform the Schedule of Environmental Commitments to avoid, reduce or, where possible, remedy effects on the environment. The mitigation measures should comply with regulatory requirements and statutory requirements and take cognisance of guidelines prepared by regulatory and statutory bodies, and guidelines prepared by TII when determining the extent of environmental mitigation works necessary.

Table 2 Mitigation measures to reduce negative effects of National Road Projects on Barn Owls

Mitigation purpose	Mitigation requirement	Mitigation measure	Mitigation requirement identified	Mitigation implemented
Protection of Barn Owl sites	Barn Owl nest site/s are directly affected	- Avoidance of an area or structure	Phase 3 – 4 (Design and Environmental Evaluation, Statutory Processes)	Phase 6 (Construction)
Avoiding disturbance to breeding Barn Owl	Barn Owl nest site/s are directly affected	- Timing of works - Pre-construction survey	Phase 3 – 4 (Design and Environmental Evaluation, Statutory Processes)	Phase 6 (Construction)
Avoiding displacement of Barn Owls due to loss, alteration or reduced suitability of a breeding site	Construction of the road renders a Barn Owl site unsuitable	- Provision of alternative nesting sites	Phase 3 – 4 (Design and Environmental Evaluation, Statutory Processes)	Phase 6 (Construction)
Reduce Barn Owl mortality on roads	All National Road Projects	- Discourage Barn Owls from flying and/or foraging in close proximity to road - Divert the flight height of birds above the height of traffic	Phase 3 – 4 (Design and Environmental Evaluation, Statutory Processes)	Phase 6 (Landscape treatment)

3.1 Barn Owl Mitigation Measures in the Construction of National Road Projects

Barn Owls may be affected during the construction phase of National Road Projects, for example where a site used by Barn Owl is directly affected (demolished, altered etc.) or where construction works in close proximity to a breeding site can cause disturbance to the breeding pair.

It is the responsibility of the Barn Owl specialist to determine whether construction will constitute a disturbance to Barn Owls or a Barn Owl breeding site. The potential for disturbance may vary depending on the scale of works, proximity of the works to the breeding site, the characteristics of the site (nest site type, nest location, level of existing disturbance activities) and the topography. The potential impacts of construction on individual sites and the requirement for mitigation should be clearly set out in the EIAR and the Schedule of Environmental Commitments as appropriate.

It is necessary to determine if the site in question will be rendered permanently unsuitable or whether the site may only be unsuitable during the construction period but may be suitable and used by Barn Owls post-construction, as this will dictate the measures applied as outlined below.

A step-by-step outline to determine the requirement for mitigation for Barn Owls during the construction phase of National Road Projects is shown below (**Figure 8**).

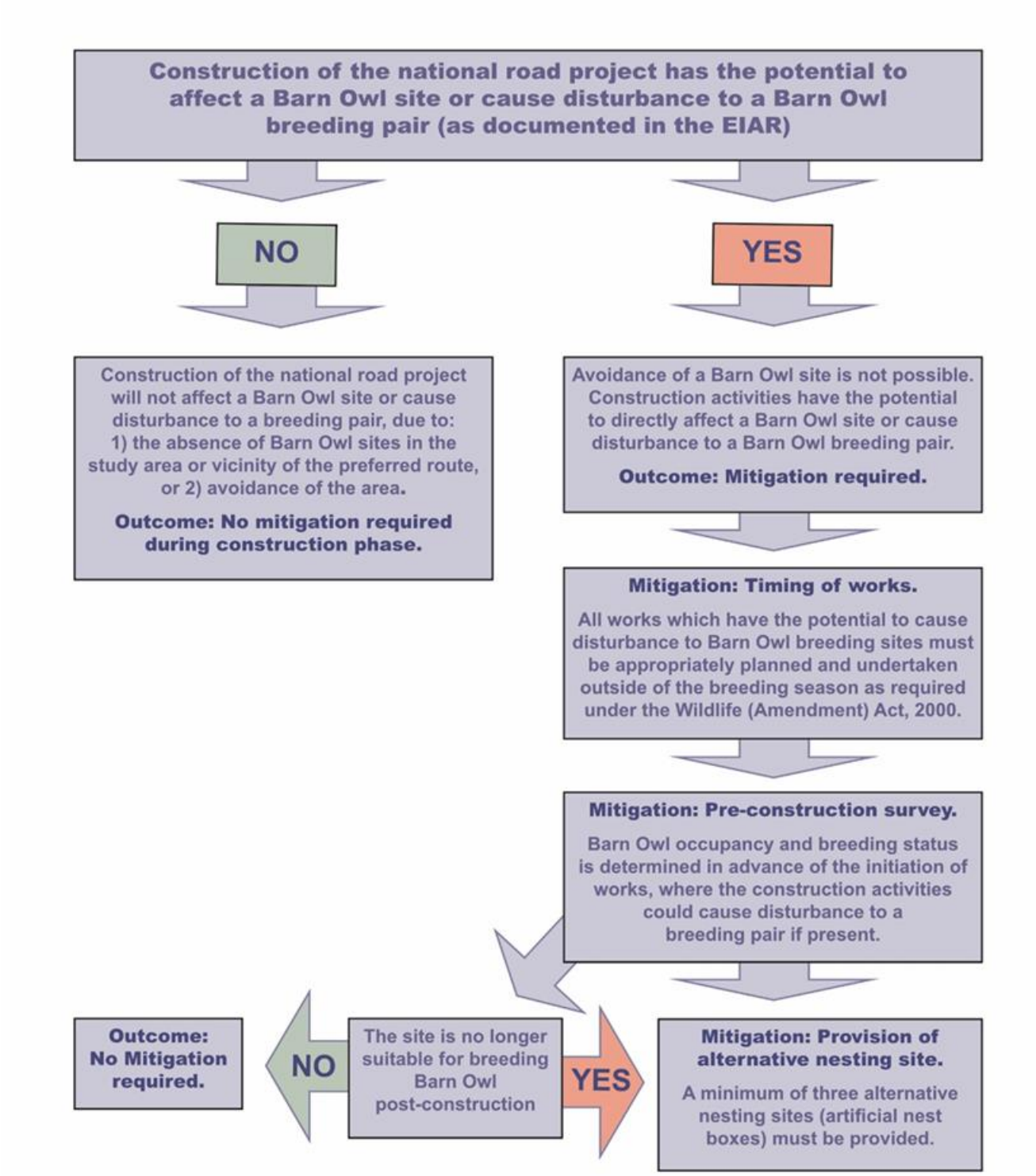

Figure 8 **An overview of the steps required to identify the requirement for mitigation for Barn Owls during the construction phase of National Road Projects**

3.1.1 Avoidance of an Area

Avoidance of an area, or specific site (e.g., building, tree, nest box) which is used by Barn Owl is the most effective mitigation measure for the protection of Barn Owl breeding sites. If there is no potential for disturbance to a Barn Owl site or breeding pair during the construction phase of the National Road Project, then no mitigation is required at this phase.

In some circumstances, avoidance of a Barn Owl site may not be possible because of the range of other environmental, social and economic factors that should also be considered when planning and developing a National Road Project. In situations where a site used by breeding Barn Owls is within the landtake of a road, where construction works will directly affect a site used by breeding Barn Owls, or where there is potential for disturbance to a breeding pair, then mitigation is required. Appropriate mitigation may include the appropriate scheduling of the timing of works to minimise disturbance, a pre-construction survey and the provision of alternative nesting sites to reduce the risk of displacement of birds in the area, as outlined below.

3.1.2 Timing of Works

All works which have the potential to cause disturbance to Barn Owl breeding sites should be appropriately planned and undertaken outside of the breeding season and under a derogation licence as required under the Wildlife Acts 1976 - 2018. The timing of breeding of Barn Owls can vary and therefore the timing of works which could affect individual breeding sites or breeding pairs should be informed by a pre-construction survey to determine breeding status and stage of breeding on a site-specific basis. This will allow the works to be initiated when Barn Owls are not breeding and allow the maximum time for works to be undertaken (typically a seven-month period would be available for works to be undertaken which would avoid disturbance to Barn Owls during the breeding cycle), while minimising the potential for negative impacts to the breeding pair. Typically, the best time to undertake works on a site which is used by breeding Barn Owls is September, however the timing should be informed by the Barn Owl specialist, based on a pre-construction survey and in consultation with the National Parks and Wildlife Service (NPWS).

Once works commence, the nest site should be rendered unsuitable (during the period of construction for sites which are not demolished) to reduce the risk of birds returning to the site during construction. This may be possible by planning works to start in the vicinity of the nest, or alternatively the nest entrance can be blocked to prevent the birds from accessing the nest. Care should be taken to ensure that any exclusion measures do not affect other species which may also be using the site (e.g., hibernating bats) and this should be done in consultation with the bat specialists and other ecologists on the road team. At sites where disturbance is temporary (during the construction phase), the exclusion measures should be removed once construction works are complete. If Barn Owls return or continue to be present at the site, and if works are to be carried out which could result in disturbance to breeding Barn Owls (which may constitute an offence), a derogation licence is required from the NPWS.

3.1.3 Pre-Construction Survey

The purpose of the pre-construction (to include enabling works e.g. Ground Investigation) survey is to determine Barn Owl occupancy and breeding status at a site in advance of the initiation of works, where the construction activities could cause disturbance to a breeding pair if present. If the timing of works is planned appropriately to avoid the main nesting period of Barn Owls then the potential of breeding activity in the site is low. A single visit, according to best practice methods as defined in Section 2.1.1.4., is usually sufficient to determine breeding status.

The pre-construction survey should be carried out within two weeks of the initiation of works which have the potential to cause disturbance at the site in question. If breeding activity is recorded, then works should not be carried out. If no breeding activity is recorded, then works can proceed. Barn Owls can use sites (particularly buildings) throughout the year and may be present outside of the breeding season, however if it is confirmed that there is no breeding activity then works can continue.

3.1.4 Provision of Alternative Nest Sites

Where a site used by breeding Barn Owl is lost or rendered unsuitable, alternative sites in suitable locations should be provided.

A minimum of three alternative nesting sites (artificial nest boxes) should be provided in suitable locations at a distance of 500m - 1km from the original breeding site (which would ensure that nest boxes are at least 500m from the new road).

This distance is selected to increase the likelihood of birds taking up the nest box (i.e., close to the original nest site to increase chances of birds encountering the nest box), while also attempting to relocate the breeding pair away from the major road.

It is important to note that artificial nesting sites may not be taken up by Barn Owl, for several reasons, which may include the pair relocating to other available and suitable nesting sites in the area, if there are such available or other species may occupy the nest box before Barn Owls have the opportunity to establish. In this context, this mitigation should not be deemed to have failed if the artificial nesting sites are not occupied by Barn Owl. The objective is that the pair, if displaced from the original nest site, relocates to another nest site and continues to breed, whether this is in an artificial nesting site provided or another site.

Potential and suitable locations for nest boxes should be recorded as part of the Barn Owl specialist survey. This will negate the requirement to conduct a separate feasibility study to identify locations for artificial nesting sites. Nest boxes should be in place in advance of any works which render the original site unsuitable and should be installed by January if it is intended that birds are to relocate to the nest box in the breeding season of that same year. Nest boxes can be designed for installation in both indoor and outdoor situations. The selection of sites, placement and installation, and maintenance of nest boxes should be informed by the Barn Owl specialist and should consider the following:

- Select a suitable site based on Barn Owl nesting requirements, examples include buildings or mature and isolated trees
- Ensure the nest box is in view (e.g., not concealed by vegetation if on a tree etc.)
- Select a site where there is minimal human disturbance
- The position of the nest box depends on the site, typically nest boxes should be placed 3m or more from the ground
- Select a site or ensure access for potential predators (e.g. Cat *Felis spp*., Pine Marten *Martes martes*) is restricted
- If the nest box is not in use by Barn Owls, the nest box should be inspected and maintained each winter for a period of three years from its installation to ensure the nest box remains suitable for Barn Owls (e.g. remove nesting materials blocking the entrance, ensure the nest box is dry etc.).

3.2 Barn Owl Mitigation Measures in the Landscape Treatment

Barn Owl mitigation measures are designed to discourage Barn Owls from flying and/or foraging in close proximity to major roads and to divert the flight height of birds above the height of traffic, as shown in (**Figure 9**). The immediate roadside verge should be created or maintained as unsuitable foraging conditions (low maintenance, infrequently mown grass or stone) to discourage Barn Owls from hunting in this area to reduce risk of direct vehicle collision and/or birds becoming caught in the wake of a Heavy Goods Vehicle (HGV). A natural barrier of dense shrub and tree line should be provided in the wider verge adjacent to the immediate roadside verge to serve as buffer to: (i) focus the foraging activities of birds further from the road, (ii) reduce the wake effect of HGVs, and (iii) deflect the flight path of Barn Owls which are crossing the road above the height of vehicles. Where the width of the verge and other landscape treatment requirements allow, suitable foraging habitat for Barn Owl in the form of semi-natural grassland can be provided which is segregated from the traffic by shrub and tree lines.

Mitigation should be integrated into the general landscape treatment as follows to optimise conditions favourable to Barn Owl conservation (by reducing foraging potential):

- Within 3m of the edge of the hard shoulder in the immediate roadside verge, the grass should be maintained to a height not exceeding 10cm, or replaced with gravel if appropriate (noting that gravel would generally be considered inappropriate unless there are issues for access for maintenance, or aesthetic considerations at feature areas, such as roundabouts or entrances to towns).
- Between 3-5m from the hard shoulder in the wider verge area, a 2m wide belt of shrubs and trees that will reach a minimum of 4m in height should be planted to divert the flight of the owls over the height of the HGVs. This should be varied in composition appropriate to the landscape adjacent and may consist of a mix of fast-growing species such as Alder (*Alnus glutinosa*), Siler Birch (*Betula pendula*), Whitebeam (*Sorbus aria*), Mountain Ash (*Sorbus aucuparia*), Hazel (*Corylus avellana*) and Willow species (*Salix aurita, Salix caprea, Salix cinerea*) and understorey species such as Bramble (*Rubus spp*. - 60% of understorey mix), Hawthorn (*Crataegus monogyna*), Holly (*Ilex aquifolium*) and Blackthorn (*Prunus spinosa*). It should be noted that this belt of shrub and trees proposed is within the 'Clear Zone' defined by TII technical guidance (GE-ENV-01102 A Guide to Landscape Treatments for National Road Schemes in Ireland). For new plantings or existing trees within the Clear Zone, the maximum allowable diameter should not exceed 100mm or a girth of 314mm (when measured at 0.3m above the ground). For new plantings, the design should consider the mature size of the tree. The grouping of trees with trunk diameters ≤ 100mm and/or girths ≤ 314mm together may constitute a hazard due to the cumulative impact of the trees on an errant vehicle for a spacing of less than 1500mm. Thus, to achieve the desired mitigation for Barn Owls, the trees should be planted as multi-stem or bush forms in these locations, as they will reach the required height, but will not breach the 314mm girth limit (when measured at 0.3m above the ground). Such trees should be planted at 3.5-4m height from the outset, in order to ensure that the required protection is in place at the earliest possible stage.
- In areas of cut, the belt of shrubs and trees should be extended up the sides of the cut slopes so that the Barn Owl's flight path is diverted to the required extent.
- Where the width of the verge allows, behind the shrub and tree belt, topsoil should be a minimum of 200mm deep to allow for tall grass ("rank grassland") to develop which is the preferred habitat of the Barn Owl's small mammal prey, providing suitable and safe habitat areas. Preference should be given to the establishment of semi-natural grassland through direct seeding or, where appropriate, natural recolonisation.
- At attenuation ponds and other areas of wide verge, areas are to be left free of planting with rank grassland as suitable foraging habitat, set back from the road and in combination with the measures outlined above.

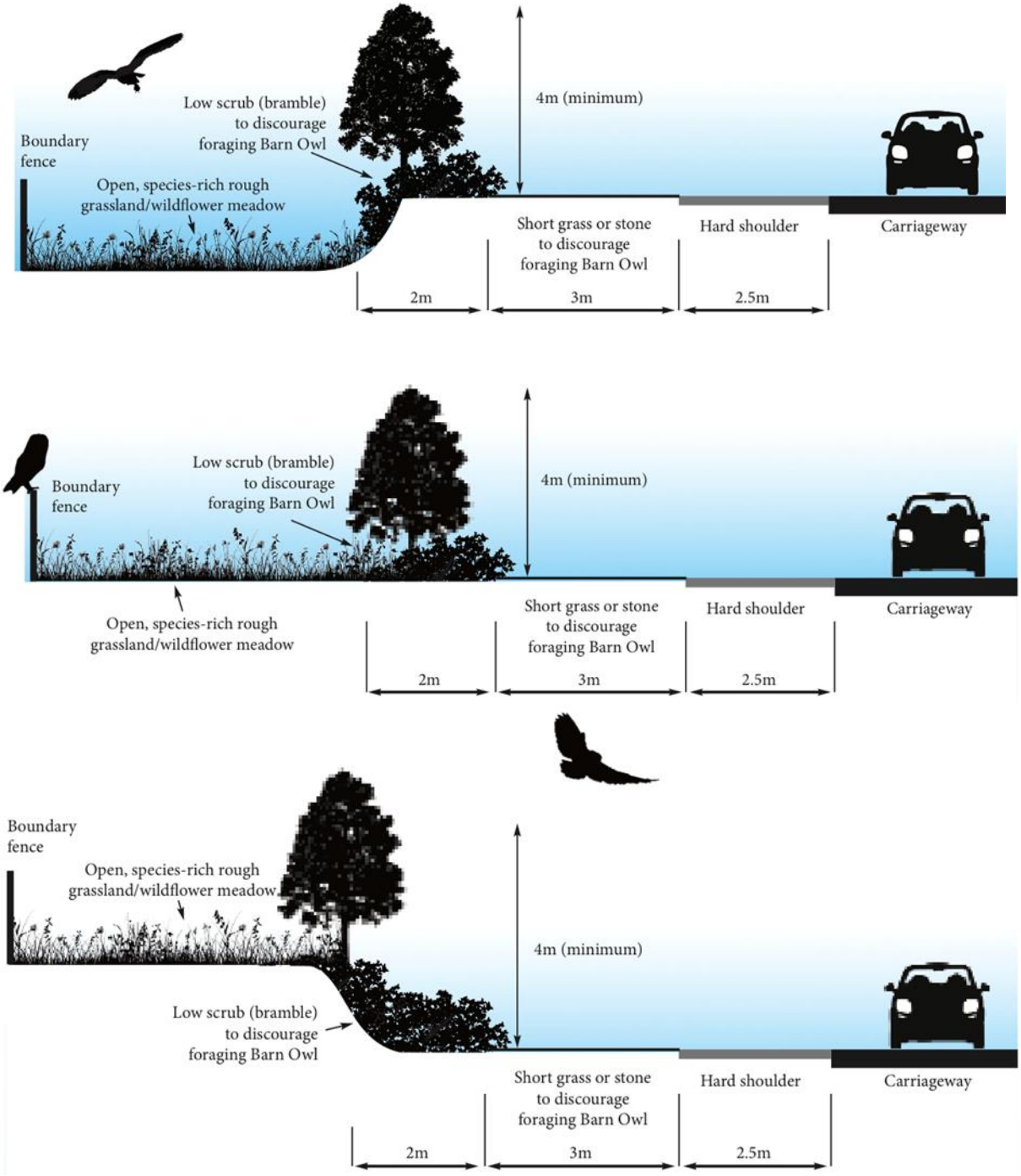

Figure 9 Barn Owl mitigation measures on cut (top), level (middle) and embanked (bottom) sections of road

3.2.1 Identifying Areas for Barn Owl Mitigation

The Barn Owl mitigation measures should be integrated into the landscape treatment across the scheme, where these measures do not conflict with other landscape and safety requirements and other environmental considerations of the road design.

Where other landscape and safety requirements and/or other environmental mitigation requirements dictate that the Barn Owl mitigation measures cannot be applied across the scheme, then the Barn Owl mitigation should be applied as priority in the following areas, where they are compatible with safety requirements.

The priority areas for Barn Owl mitigation, are:

i. Where the route intersects with a 5km buffer surrounding Barn Owl nest locations (as documented in the EIAR),

ii. Sections of road with wide verge (≥ 20m) of suitable open grass/herbaceous cover (including attenuation ponds, junctions etc.)

iii. Sections of road which traverse areas of a high probability of use by Barn Owls (including river crossings and suitable foraging habitats in the form of semi-natural grasslands)

3.2.2 Barn Owl Mitigation in the Context of Landscape Treatment Requirements

The Barn Owl mitigation measures should comply with regulatory and statutory requirements in relation to road design and road user safety. The mitigation measures should be considered in the context of other road design and landscape treatment requirements to ensure the measures are compatible with road safety and the other environmental considerations. The selection and layout of treatments should address aspects relating to clear zones as well as any other access, drainage, safety and design functions as a priority, which will dictate where it is possible to incorporate the Barn Owl mitigation measures as outlined above.

There are two distinct zones within the verge, which are the immediate roadside verge and the wider verge area. Each zone has particular issues of relevance in the determination of appropriate landscape treatments which include the Barn Owl mitigation measures.

The immediate roadside verge which is directly adjacent to the hard shoulder or carriageway is generally within the clear zone. The immediate roadside verge also has specific design requirements, which may include the maintenance of sightlines, the provision of signage and lighting, the incorporation of drainage systems and the provision of a margin of safety or demarcation between the carriageway and the wider landscape resource or road boundary. The Barn Owl mitigation measures as outlined above require that the immediate roadside verge is maintained as unsuitable foraging habitat for Barn Owls, to reduce the risk of birds being attracted to hunt in close proximity to the carriageway. The mitigation measures for Barn Owl are therefore compatible with the range of other road design requirements in the immediate roadside verge and in line with the TII guidelines on landscape treatments for National Road Projects in Ireland (GE-ENV-01102), which state that ‘treatments selected for the immediate roadside verge should not prove attractive to fauna that could otherwise be at increased risk due to the proximity of traffic’.

The wider verge may also have design requirements, which include the maintenance of sightlines, the provision of signage and lighting, the incorporation of drainage systems; and the provision of a margin of safety or demarcation between the carriageway and the wider landscape resource or road boundary, in such cases implementation of the Barn Owl mitigation measures may not be possible. The wider verge may also fall within clear zones or act as access areas for a particular road scheme, thereby restricting potential for planting of shrubs and a tree line, which is a requirement of the Barn Owl mitigation. Where a significant area within the wider verge falls outside clear zones and, where aspects of road safety are not an issue, consideration should be given to the Barn Owl mitigation measures.

The Barn Owl mitigation measures should also be compatible with other environmental mitigation requirements as set out in the EIAR, which will inform the Schedule of Environmental Commitments to avoid, reduce or, where possible, remedy environmental effects on the environment, to ensure that the mitigation for Barn Owls does not negatively impact other species.

3.2.3 Post-Construction Monitoring and Mitigation

Post-construction monitoring is a requirement on all National Road Projects where Barn Owl mitigation measures are applied in the landscape treatment. The specific requirements for post-construction monitoring should be set out in the EIAR. Post-construction monitoring should include a road casualty survey to assess Barn Owl mortality rates and locations on the scheme and in relation to the mitigation measures. The methods for designing and undertaking the road casualty survey are specified in RE-ENV-07004 'The interactions between Barn Owls and major roads: informing management and mitigation' (Lusby et al. 2021).

Where post-construction monitoring of sections of road without mitigation measures identifies Barn Owl hotspots, or in areas where there is a high risk of vehicle collisions occurring, options for the installation of mitigation measures should be considered where beneficial. Any post-construction measures should be limited to minor works.

The requirements for implementation of post-construction should be set out in the EIAR.

References

PE-PAG-02013 Project Appraisal Guidelines for National Roads Unit 4.0 - Consideration of Alternatives and Options

PE-PMG-02041 Project Management Guidelines

PE-PMG-02042 Project Manager's Manual for Major National Road Projects

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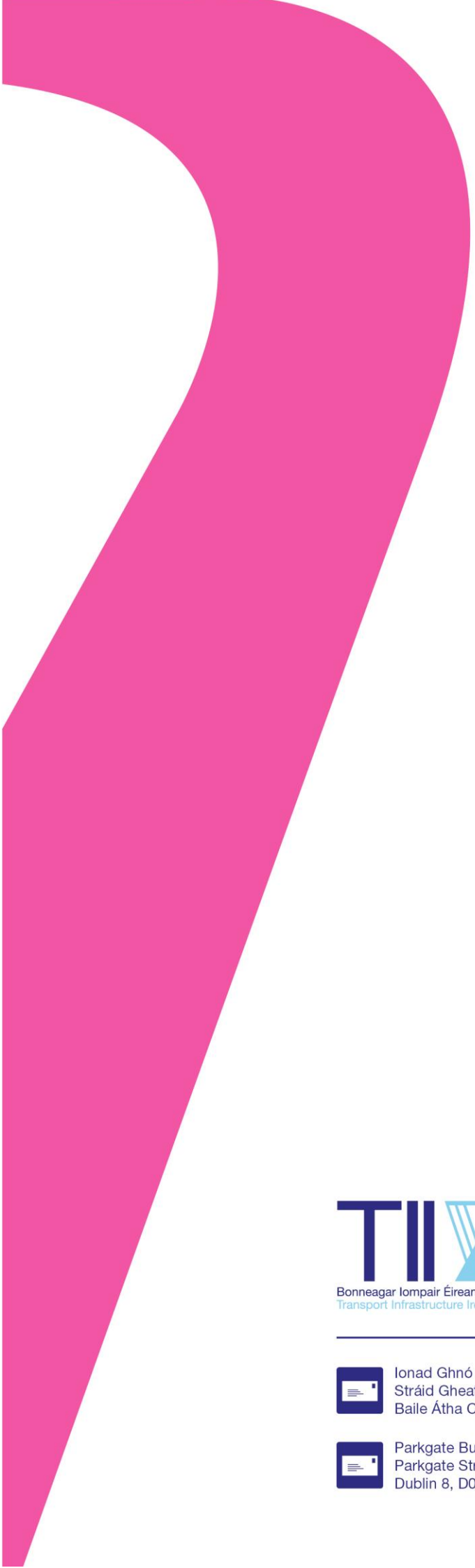

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