

APPENDIX B

EIAR Biodiversity Chapter

PLEASE NOTE

1. The 'Four Season Bat Survey Report' (referred to as Appendix 7.1 in the EIAR Biodiversity chapter) is presented in Volume 1, Appendix D to this NIS.
2. The 'Relevé Data for vegetation communities in the Lower River Shannon SAC at the River Maigue crossing point' (referred to as Appendix 7.2 in the EIAR Biodiversity chapter) are presented in Volume 1, Appendix G to this NIS.
3. The 'Barn Owl Report', 'Vertigo Report I' and 'Vertigo Report II' (referred to as Appendices 7.3, 7.4A and 7.4B in the EIAR Biodiversity chapter) are not presented in this NIS as they are not relevant to any of the European sites with which it is concerned.
4. The relevant drawings from Volume 3 of the EIAR are presented in Volume 2, Appendix I of this NIS.

Chapter 7

Biodiversity

7.1 Introduction

This chapter provides an assessment of the likely impacts of the proposed Foynes to Limerick Road (including Adare Bypass) on Biodiversity. It examines the biodiversity value of the lands impacted by the proposed road development and assesses the potential for significant effects on the natural environment. Mitigation is proposed, as appropriate, to avoid, reduce or remedy potentially significant impacts. A Natura Impact Statement has also been prepared for the proposed road development and is available separately to the EIAR.

7.2 Methodology

7.2.1 Relevant Guidance

This chapter has been compiled in accordance with the relevant national and EU guidelines as identified in section 1.4 of Chapter 1 and specific guidance in relation to the assessment of impacts on Biodiversity as identified below.

7.2.2 Establishing Key Ecological Receptors and the Zone of Influence

Ecological resources within the vicinity of the proposed road development were initially identified by a combination of desk studies, review of aerial imagery and consultations. These were then subject to walkover surveys to assess the habitats and ecological sensitivities which informed the selection of Key Ecological Receptors (KERs), for which detailed assessment and further surveys were required. A KER is defined as a site, habitat, ecological feature, assemblage, and species or individual that occurs within the vicinity of a proposed road development upon which impacts are likely and where further survey effort is required to assess the anticipated impacts. In accordance with the *Guidelines for Assessment of Ecological Impacts on National Road Schemes* (National Roads Authority, June 2009), receptors rated below Local Importance (Higher Value) are not included as KERs.

The initial walkover surveys were concentrated within a 300 m wide corridor centred on the centreline of the proposed road development; being the receiving environment for the activities associated with the proposed development and the biophysical changes that are likely to result. As there were amendments to the exact location of the centreline of the proposed road development during the iterative road design process, where required, further assessment was undertaken to ensure that the entire study corridor was the subject of a multidisciplinary walkover assessment.

Following desk studies and multidisciplinary walkover surveys, Zones of Influence (ZOIs) around the proposed road development were defined for different types of ecological receptors (e.g. terrestrial or aquatic). Where necessary, surveys were undertaken outside the study corridor to adequately assess the potential impacts on individual receptors, based on the ZOI for the relevant receptor type. The area surveyed to comprehensively assess the impacts on any receptor is hereafter referred to as the "study area".

The ZOI differs for different habitats and species. Within terrestrial habitats, the ZOI may be confined to the study area, whereas for aquatic habitats, the ZOI will be much more extensive and the surveys undertaken were scoped accordingly. Particular attention was given to identifying stepping-stone sites which could potentially provide

important links between European sites or support a qualifying interest habitat or species from an adjacent European site.

7.2.3 Ecological Evaluation and Impact Assessment Methodology

The evaluation of the key ecological receptors and the criteria used to assess the significance of impacts are derived from the *Guidelines for Assessment of Ecological Impacts on National Road Schemes* (TII, June 2009) (the "TII Guidelines"), *Guidelines on the Information to be contained in Environmental Impact Assessment Reports* (EPA, Draft August 2017) (the "EPA Guidelines") and the *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal* (CIEEM, 2016) (the "CIEEM Guidelines").

The criteria used for assessment of the value of the ecological resources follow those set out in Section 3.3 of the TII Guidelines, which sets out the context for the determination of value on a geographic basis with a hierarchy assigned in relation to the importance of any particular receptor. The guidelines provide a basis for determination of whether any particular site is of importance on the following scale:

- International Importance
- National Importance
- County Importance
- Local Importance (Higher Value)
- Local Importance (Lower Value)

The TII Guidelines clearly set out the criteria by which each geographic level of importance can be assigned. Receptors of Local Importance (Lower Value) contain habitats and species that are widespread and of low ecological significance and of importance only in the local area. Internationally Important sites are either designated for conservation as part of the Natura 2000 network, i.e. Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) or provide the best examples of habitats or internationally important populations of protected flora and fauna. All habitats and species within the study area were assigned a level of significance on the above basis and KERs were selected and classified on this basis.

The CIEEM Guidelines define a significant effect as, "*an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features'...or for biodiversity in general*". The criteria used for assessment of impacts are as follows:

Positive or Negative: Positive and negative impacts/effects should be determined according to whether the change is in accordance with nature conservation objectives and policy;

Extent: Extent should be predicted in a quantified manner and relates to the area over which the impact occurs;

Magnitude: Magnitude refers to size, amount, intensity and volume. It should be quantified if possible and expressed in absolute or relative terms e.g. the amount of habitat lost, percentage change to habitat area, percentage decline in a species population;

Duration: Duration is intended to refer to the time during which the impact is predicted to continue, until recovery or re-instatement (which may be longer than the impact-

causing activity). Duration should be defined in relation to ecological characteristics (such as a species' lifecycle);

Frequency and Timing: The timing of impacts in relation to important seasonal and/or life-cycle constraints should be evaluated. Similarly, the frequency with which activities (and concomitant impacts) would take place can be an important determinant of the impact on receptors and should also be assessed and described;

Reversibility: An irreversible effect is one from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it. A reversible effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation.

Likelihood:

- Certain/Near Certain: >95% chance of occurring as predicted;
- Probable: 50-95% chance as occurring as predicted;
- Unlikely: 5-50% chance as occurring as predicted and
- Extremely Unlikely: <5% chance as occurring as predicted.

Table 7.1 presents the criteria for assessing significance, while Table 7.2 presents the criteria for assessing impact quality based on the EPA Guidelines.

Table 7.1 Criteria for Assessing Impact Significance (EPA, 2017)

| Impact Magnitude | Definition |
|----------------------|--|
| No change | No discernible change in the ecology of the affected feature |
| Imperceptible Impact | An impact capable of measurement but without noticeable consequences |
| Slight Impact | An impact which causes noticeable changes in the character of the environment without affecting its sensitivities |
| Moderate Impact | An impact that alters the character of the environment that is consistent with existing and emerging trends |
| Significant Impact | An impact which, by its character, its magnitude, duration or intensity alters a sensitive aspect of the environment |
| Profound Impact | An impact which obliterates sensitive characteristics |

Table 7.2 Criteria for Assessing Impact Quality (EPA, 2017)

| Impact Type | Criteria |
|-------------|---|
| Positive | A change which improves the quality of the environment e.g. increasing species diversity, improving reproductive capacity of an ecosystem or removing nuisances |
| Neutral | A change which does not affect the quality of the environment |
| Negative | A change which reduces the quality of the environment e.g. lessening species diversity or reducing the reproductive capacity of an ecosystem |

7.2.4 Mitigation

Where potential detrimental impacts have been identified, detailed and specific mitigation has been developed in accordance with the hierarchy of options suggested in the research for the European Commission publication; '*Managing Natura 2000 Sites - The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, 2000*'. The adopted approach was - avoid at source, reduce at source, abate on site, and finally abate at receptor. These measures have been incorporated into the proposed road development as part of the avoidance and environmental protection strategy.

Mitigation measures prescribed are based on current best practice and existing guidance sources including:

- TII (2006a) *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes*. Transport Infrastructure Ireland.
- TII (2006b) *Guidelines for the Treatment of Bats during the Construction of National Road Schemes*. Transport Infrastructure Ireland.
- TII (2008a) *Guidelines for the treatment of Otters prior to the construction of National Road Schemes*'. Transport Infrastructure Ireland.
- TII (2008b) *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes*. Transport Infrastructure Ireland.
- TII (2008c) *Guidelines on the Management of Noxious Weeds and Non-native Plant Species on National Roads*. Transport Infrastructure Ireland.
- TII (2008d) *Environmental Impact Assessment of National Road Schemes – A Practical Guide*. Transport Infrastructure Ireland.
- TII (2009a) *Guidelines for Assessment of Ecological Impacts of National Road Schemes*. Transport Infrastructure Ireland.
- TII (2009b) *Ecological Surveying Techniques for Protected Flora and Fauna during the planning of National Road Schemes*. Transport Infrastructure Ireland.
- IFI (2016) *Guidelines on Protection of Fisheries during Construction Works in and adjacent to Waters*. Inland Fisheries Ireland.

7.2.5 Survey Methodology

7.2.5.1 Habitats and Flora

A first full walkover survey of the entire route corridor was carried out between June and September 2016, which is within the optimum period for botanical survey and habitat assessment. Further site visits were undertaken at various times and seasons over the following 3 years up to Autumn 2019.

The field surveys were preceded by a review of aerial photography for the entire route and adjoining areas of ecological interest. Habitats were surveyed and mapped to a minimum distance of 50 m either side of the proposed road development with larger areas surveyed and mapped as necessary (especially where wetlands exist).

Where potential Annex I listed habitats were encountered, species composition and relative abundance were recorded in sample relevés in order to determine conformity to the EU classification (provided in Appendix 7.2 in Volume 4A of this EIAR). Habitats were classified based on their species composition in accordance with the Heritage Council classification (Fossitt, 2000). Conformity to Annex I habitats was determined using the *Interpretation Manual of European Habitats* (EC, 2013) in conjunction with the following key references:

- *National Survey of Native Woodlands* (Perrin et al., 2008);

- *The Irish semi-natural grasslands survey 2007-2012. Irish Wildlife Manuals, No. 78* (O'Neill et al., 2013);
- *The Status of EU Protected Habitats and Species in Ireland* (NPWS, 2013);
- *Monitoring guidelines for the assessment of petrifying springs in Ireland. Irish Wildlife Manuals, No. 94* (Lyons & Kelly, 2016); and
- *Irish Wetland Types* (Irish Ramsar Wetlands Committee, 2018).

As much of the corridor is agricultural land (mainly semi-improved and improved grassland), emphasis has been placed on semi-natural habitats and where these occur more detailed botanical descriptions are provided. Following the field survey an assessment was carried out to define the ecological value of the various habitats in accordance with the TII *Guidelines for the Assessment of Ecological Impacts of National Road Schemes* (Revision 2, June 2009).

Specific surveys were undertaken to determine the presence/absence of rare plants, particularly species listed in the Flora (Protection) Order, 2015 ("the FPO"), where there were records of their occurrence within the vicinity of the proposed road development. Section 21 authorisation was received from the National Parks & Wildlife Service (NPWS) (Licence No. FL10/2016) to survey for Triangular Club-rush (*Schoenoplectus triquetus*) on the River Maigue in the vicinity of the proposed bridge crossing. The survey was undertaken on 29th September 2016 during a period of low water as the river is tidal in the vicinity of the proposed crossing point. Additional surveys were undertaken in potentially suitable habitat for Opposite-leaved Pondweed (*Groenlandia densa*) in the vicinity of the Maigue crossing point (where it has previously been recorded) and for Hairy Violet (*Viola hirta*) in the vicinity of Craggs, where there are scattered records in the vicinity of the proposed road development. These surveys were undertaken in May 2018 (Licence No. FL02/2018). Further surveys of the River Maigue crossing point were undertaken for Triangular Club-rush and Opposite-leaved pondweed in September 2019 (under Licence No: FL13/2019).

Throughout all surveys, evidence of invasive plant species listed on the Third Schedule to the European Communities (Birds and Natural Habitats) Regulations 2011 (as amended) ("the Habitats Regulations") and other non-native species with potential to cause significant effects to the environment, was checked for and recorded. Records of invasive plants were also checked for on the National Biodiversity Data Centre (NBDC) database.

7.2.5.2 Fauna

Surveys were undertaken for protected species of fauna in both terrestrial and aquatic environments using the methodologies outlined in the following Sections. The known distribution of the such species was also assessed by review of existing databases including those held by the NPWS, the NBDC, the EPA, IFI, Bat Conservation Ireland and BirdWatch Ireland. Other sources of information were also reviewed including the Environmental Impact Statement (EIS) prepared for the Adare Bypass Scheme (Jacobs Engineering, 2008) and the Adare Manor EIS (2015).

7.2.5.3 Ground mammals

A dedicated mammal survey was conducted in the period November 2016 to April 2017 within the entire survey corridor to identify and determine the status of all Badger setts and Otter holts along the proposed road development and within c. 500 m of it, in addition to signs of other large mammals including Deer, Red Squirrel, Pine Marten, Hedgehog and Irish Hare. Surveys were undertaken in accordance with the TII *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning*

of *National Road Schemes* (TII 2009), *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (TII, 2008) and *Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes* (TII, 2008). The surveys aimed to identify burrows, resting places, tracks, feeding signs and droppings which are generally distinctive for the species concerned.

7.2.5.4 Bats

Bat Eco Services carried out the Winter and Spring bat fauna assessment element of the Four-Season Bat Survey for the proposed road development. Summer and Autumn Surveys were completed by *Aardwolf Wildlife Surveys*. The results of the Four-season Bat Survey are summarised within this chapter while the full report is presented in Appendix 7.1 in Volume 4A of this EIAR, which details the full methodologies employed.

The surveys and assessment followed the approach detailed in the TII *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes (2006)*. Following a constraints review of known bat roosts and preferred habitats within the wider study area and on-site habitat assessments at Route Selection stage, the proposed road development was assessed as per TII guidelines which recommend that the potential negative impacts on bats of a proposed road development is assessed over four seasons in order to take into consideration the effect the road will have on both the animals' nightly and seasonal behaviour, including:

- winter hibernation
- spring re-emergence
- peak summer activity and
- autumnal mating behaviour

Following on from the initial overview of existing data on bats within the study area, bat activity along the proposed road development was assessed over the four seasons using the following approach:

Spring – April

- Detector survey: observe bat feeding, commuting and roosting behaviour.

Summer – June/July/August

- Detector and bat habitat survey: observe bat feeding, commuting and roosting behaviour along the route to establish priority bat habitats;
- Structure survey: inspect buildings, bridges, caves, culverts, souterrains etc. for use by bats;
- Re-assess previously identified roosts along the routes and identify any further maternity roosts through dawn swarming roost surveys;
- Detector survey: re-assess previously identified foraging areas and commuting routes and seek to identify any further current areas;
- Tree survey: identify potential tree roosts. The survey, along the entire route included visually assessing and mapping of all trees with potential to support bat roosts (large trees with crevices or with substantial ivy cover). Potential tree roosts were recorded using GPS co-ordinates; and
- Surveys of buildings (List provided by ROD).

Autumn – September/October

- Identify Leisler's bat sites; and

- Survey cave sites to identify level of bat use and autumnal swarming. Harp trap at such sites, if necessary.

Winter – December/January

- Access, if possible, known and potential hibernation sites to establish bat numbers present.

The first two elements (Summer and Autumn) were completed by Aardwolf Wildlife Surveys along the proposed road development on 28th and 29th of August, 26th and 27th September and 14th October 2016 (Kelleher, 2017). The Winter Survey was completed on 14th and 15th March 2018 while the Spring Survey was completed from 23rd April to 1st May 2018 by Bat Eco Services. Additional Summer Surveys (trees and buildings) completed by Bat Eco Services were undertaken on 20th, 21st and 22nd June and 24th August 2018 and 17th and 18th August 2019.

Daytime Inspections for Bats

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

Night-time Bat Surveys

Night-time bat surveying was completed using Pettersson D200 Heterodyne Bat Detector with Wildlife Acoustics Echo-Meter Touch. Dusk Surveys started 10 minutes prior to sunset and were completed during mild and dry weather conditions with air temperature 8°C or greater. Dusk Surveys involved walking transects along the proposed road development; traversing the field network (where accessible) and following the local road network and railway line. Each bat encounter was noted on maps, determining to species level, where possible.

Dawn Surveys started 60 minutes prior to sunrise and were completed during mild and dry weather conditions with air temperature 8°C or greater. Dawn Surveys involved walking transects along the proposed road development; traversing the field network (where accessible) and following the local road network and railway line. Each bat encounter was noted on maps, determining to species level, where possible.

Emergence Surveys started 10 minutes prior to sunset and last for 90 minutes. These were completed during mild and dry weather conditions with air temperature 8°C or greater. The focus of this survey is to determine whether a structure is a bat roost. Therefore, the survey was undertaken post-daytime inspections of structures deemed suitable to provide a roosting space for bats.

Passive Static Bat Surveys

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

7.2.5.5 Birds

Breeding Birds

Detailed breeding bird surveys were not considered necessary for the majority of the route, which is agricultural land and of low conservation importance for birds. Targeted breeding bird surveys were undertaken at specific locations, primarily those with potential for ground-nesting wader species of high conservation concern including Curlew, Lapwing and Snipe. These locations are principally wetland habitats supporting wet grassland or fen vegetation.

Dedicated surveys for Barn Owl were targeted on potential nest sites within approximately 2km of the proposed development based on a combination of existing records obtained from BirdWatch Ireland and a review of aerial imagery to identify potentially suitable structures (primarily old buildings, barns, ruins etc.) that are likely to support nesting habitat for the species. An initial survey was undertaken in May and June 2016 during the breeding season and entailed an examination of potentially suitable nest sites for evidence of owl activity determined principally by feathers and cast pellets. A further assessment of all these sites was undertaken in March 2017 by ornithologist Gerry Murphy. Consultation was undertaken with John Lusby of BirdWatch Ireland in relation to both records for breeding Barn Owl and in relation to mitigation for the species to reduce the risk of mortalities from traffic collision during operation of the proposed road development.

An investigation on the effects of road developments on Barn Owl behaviour and mortality patterns in Ireland was undertaken by BirdWatch Ireland and Transport Infrastructure Ireland to determine the impacts of road networks on Barn Owl populations and to identify mitigation requirements (Lusby *et al.* 2019), and is the primary resource used to inform the effects of the proposed road development on Barn Owl. An assessment of the potential scale and patterns of mortality of Barn Owl on the proposed road development was carried out by John Lusby, which is included as Appendix 7.3 in Volume 4A of this EIAR.

For all watercourse crossings, surveys were undertaken to determine potential nesting by riparian bird species (principally Kingfisher, Dipper and Grey wagtail) covering a stretch of river of up to 500 m upstream and downstream of the crossing point. These surveys were undertaken during the dedicated watercourse surveys carried out in May and June 2016 though most watercourses were revisited during the habitat mapping undertaken between June and September 2016.

Wintering birds

A background review of existing data on wintering birds was undertaken to identify known foraging areas for waterfowl including Whooper Swan, and to identify potential flight paths intersected by the proposed road development. Additional sites of potential value for wintering birds were also identified during earlier walkover surveys and review of aerial imagery in the vicinity of the proposed road development. These sites were then subject to a series of winter counts using vantage points (at a total of 33 separate locations) undertaken by ornithologist Gerry Murphy (Chairperson of the Irish Whooper Swan Study Group) over the period December 2016 to March 2017 inclusive.

7.2.5.6 Aquatic Surveys

The recommended survey techniques and periods for aquatic species vary according to the target species, but all surveys were in accordance with the relevant guidance, including *Ecological Surveying Techniques for Protected Flora and Fauna during Planning of National Road Schemes* (TII, 2009). Surveys of aquatic and riparian habitats were carried out during the period late March to mid-October 2016 to coincide

with the growing season of most plants. Surveys for aquatic fauna were carried out in August and September 2016.

For White-clawed Crayfish, the optimum survey period is identified as August to September. Although surveys are possible earlier and later in the year, absence of the species should not be inferred during this period. Surveys utilised sweep netting in marginal vegetation and active searching (turning stones, logs, etc.) to check for adults.

Surveys for Lamprey larvae are optimally carried out between August and October. Surveys for adult Lamprey are most efficiently undertaken either by capturing adults as they return to the upstream spawning sites, or by direct observation at the spawning sites which vary according to the species between March and June. The surveys for Lamprey included an assessment of the site as potential spawning habitat and the presence of potentially suitable nursery beds for larvae. Suitable nursery habitat was assessed by a combination of coring and sweep netting.

Survey for salmonids was based on visual assessments of the suitability of habitat to support spawning and as habitat for juvenile fish in conjunction with water quality assessment.

Otter surveys entailed a dedicated search to identify potential holts or couch sites in the study area, and to identify all signs of Otter activity including spraints, tracks, slides, twists and other field signs. While these surveys can be undertaken at any time of year, they are less likely to provide reliable results during mid- to late-summer, when the presence of dense vegetation may make it difficult to find field signs and holts. The survey area extended for approximately 500 m either side of all proposed watercourse crossings.

Invertebrate samples for the assessment of Q-value were derived from two minute kick-samples in the nearest area of suitable riffle habitat to the proposed crossing point using a 2 mm mesh net as per the EPA standard Methodology. This standardised approach for the biological assessment of water quality as used by the Environmental Protection Agency is based on the composition of the macroinvertebrate community which inhabit the substratum of rivers and streams. These comprise in the main, immature aquatic stages of insects, together with crustacean (shrimps), molluscs (snails and bivalves), oligochaetes (worms) and hirudinea (leeches). Shallow, fast-flowing stretches of riffle habitat are sampled in preference to non-riffle areas as they show most clearly the water quality status and effects of pollution. Samples were placed in individually labelled 1 litre plastic buckets and preserved in 70% ethyl alcohol. Samples were subsequently analysed to identify macro-invertebrates, enumerate and assigned a sensitivity rating based on the overall diversity and abundance of the various sensitivity groupings to determine the Q-value.

The survey of aquatic and riparian habitats aimed to identify habitats which conform to those listed on Annex I to the Habitats Directive, such as Watercourses of plain to montane levels with the *Ranunculion fluitans* and *Callitriche-Batrachion* vegetation [3260] and Hydrophilous tall herb fringe communities [6430].

Vertigo snails

Surveys were undertaken of three areas of fen habitat for Whorl Snails (*Vertigo* sp.) by John Brophy of *Botanical Environmental Consultants Ltd.* (BEC) within and adjacent to the proposed road development at Ballyellinan, Lismakeery and Blossomhill in Autumn 2019. The survey methodology for this Annex II listed species broadly

followed that used in the National *Vertigo* Monitoring Project (Long & Brophy, 2019). The most suitable vegetation found within the land-take or buffer area was sampled by shaking it over a white tray. At each sample location, three adjacent patches of vegetation were sampled and these were treated as a single sample. Whorl snails that were collected in the tray were transferred to labelled glass vials and returned to the laboratory for confirmation. The optimum time for carrying out *V. moulinsiana* surveys is September to November inclusive (Moorkens & Killeen, 2011).

A handheld computer and GPS (Nomad Trimble) running ArcPad 8.0 were used to navigate within the survey area and to record data in the field. An assessment of habitat suitability for supporting *V. moulinsiana* at a given sampling point was made based on the vegetation present and the water levels at the time of survey. The full survey report is presented in Appendix 7.4A in Volume 4A of this EIAR.

7.2.5.7 Sources of Data

Existing sources of information examined to provide data on ecological receptors within the zone of influence of the proposed road development included:

- Consultations with the NPWS, review of online Map Viewer and databases (accessed via data request);
- Consultations with Inland Fisheries Ireland (IFI);
- NBDC online mapping database;
- Environmental Protection Agency (EPA) online mapping tool;
- Botanical Society of Britain and Ireland (BSBI) online mapping database and consultation with Dr Sylvia Reynolds, Vice-county Recorder for Limerick (H8);
- Mollusc Ireland online mapping database;
- Ground Beetles of Ireland website;
- Consultations with Bat Conservation Ireland (BCI);
- Consultations with BirdWatch Ireland (BWI);
- Consultations with Irish Whooper Swan Study Group (IWSSG);
- Consultations with the Vincent Wildlife Trust (VWT);
- Review of previous studies carried out within the Constraints Study Area and Route Selection Study for the proposed road development;
- Review of other EIARs within the study area, including the Adare Bypass Scheme (Jacobs Engineering, 2008), the Adare Manor EIS (2015) and Capacity Extension at Shannon Foynes (RPS, 2018); and
- Examination of recent aerial photography to identify sites of ecological potential.

7.2.5.8 Consultations

Consultations were undertaken with the Development Application Unit (DAU) of the Department of Culture, Heritage and the Gaeltacht to seek their views and concerns in relation to the proposed road development. Following the DAU response dated 29th April 2015, an initial meeting was held with the Divisional Ecologist, District Conservation Officer (DCO) and local Wildlife Rangers on 14th July 2015 to discuss ecological issues along the proposed road development. Subsequent meetings were held with NPWS staff on 27th June 2017 and on 21st November 2017 to discuss the proposed road development and the crossing of the Lower River Shannon SAC at the River Maigue. Verbal communications regarding records of various species was undertaken with local wildlife staff (Stefan Jones, DCO and Liam Lenihan, Wildlife Ranger) on a number of occasions.

Consultations were also undertaken with IFI to determine the fisheries value of watercourses crossed by the proposed road development and to discuss the proposed crossing structures in relation to fish passage. Consultation was also undertaken with the Maigne Rivers Trust.

Correspondence was undertaken with the VWT in relation to studies and data for Lesser Horseshoe Bat within the study area and in relation to least-cost-pathway network identified by the VWT to maintain and facilitate connectivity between the west Limerick and Kerry bat populations.

Consultation was undertaken with John Lusby of BWI in relation to Barn Owl nesting records from the study area and also in relation to the conclusions and recommendations arising from the TII-funded study into Barn Owl mortality on the M8 and Tralee Bypass Roads carried out by BWI. A further meeting with the NPWS was held on the 7th September 2019 to discuss any changes or design developments with regard to the proposed road development since the last meeting in 2017.

7.3 Description of the Receiving Environment for Biodiversity

7.3.1 Context and Character

The proposed Foynes to Limerick Road (including Adare Bypass) extends from the Shannon-Foynes Port on the River Shannon estuary, for c. 2 km in a south-easterly direction to skirt to the south of the Churchtown estuary. It then swings to the east for a distance of c. 5 km to the Ballyclogh Junction (Section A) where a spur will extend north-east to link with the existing N69 on the western side of Askeaton (Section B). From the Ballyclogh Junction the mainline travels in a generally south-easterly direction for just over 9 km to the Rathkeale Junction located c. 1 km north of the town (Section C).

From the Rathkeale Junction the proposed road development will provide a new motorway replacement for the N21 (Section D) between Rathkeale and Attyflin (east of Adare). To the east of the Rathkeale junction the proposed motorway trends in a north-easterly direction to the north of the existing N21 to pass the village of Croagh where a further junction links south to the N21, and then on to pass north of Adare where the route will cross the River Maigne, which is within the Lower River Shannon SAC. The junction to Adare is located on the east of the Maigne crossing, while the mainline continues east to join with the existing N21 dual carriageway immediately west of the M20 Motorway junction at Attyflin.

The underlying geology within the study area is predominantly limestone with some localised areas of exposed karstified limestone such as at Barrigone to the north of the proposed road development. Watercourses within the vicinity of the proposed road development run primarily in a northerly direction to the River Shannon Estuary and include the River Deel which flows to the estuary at Askeaton, and the Maigne which is estuarine as far south as Adare. The landscape character throughout the entire route is gently undulating dominated by intensively-managed agricultural grassland.

The underlying limestone bedrock forms some elevated areas in Section A between Foynes and the Askeaton junction, with shallow soils supporting dry grassland and scrub. There are a number of quarries in this area also. This section and Section C south to the Rathkeale Junction is also characterised by low-lying areas which support wet grassland, and in places alkaline fen. This habitat type would historically have been more widespread but has been affected by drainage over the last century.

The soils in Section B and D tend to be deeper and richer with a corresponding more intensive land-use including some large areas of tillage. Section D is also characterised by a number of old demesne landscapes with extensive areas of mixed woodland and mature treelines and parkland, particularly to the west of Adare.

7.3.2 Designated Conservation Areas

The selection of the proposed road development has been heavily influenced by the dense concentration and distribution of designated conservation areas within the central part of the overall study area identified in the route selection stage. The location of these areas is shown in Figure 7.1 In Volume 3. There are five European sites afforded protection under the Habitats Directive (SACs) and Birds Directive (SPAs) within the original constraints study area, all of which are considered within the ZOI of the proposed road development due to their proximity or connectivity to it. Table 7.3 details these and outlines the qualifying interests or special conservation interests, and their nearest point to the proposed road development. There are no European sites outside of the original constraints study area that are considered at risk of significant effects due to the distance from source to receptor, and the lack of pathways.

The entire Shannon Estuary to the north of the proposed road development is within the Lower River Shannon SAC [site code: 002165] and the River Shannon and River Fergus Estuaries SPA [site code: 004077]. The SAC boundary extends to include the River Maigue upstream as far as Adare, while the SPA boundary extends upstream as far as Ferry Bridge on the N69. One of the principal ecological constraints and challenges in the proposed road development is the crossing of the River Maigue in a manner which will not adversely affect the integrity of the site concerned. A Natura Impact Statement (NIS) has been prepared for the proposed road development to assess the implications of the proposed road development for the integrity of these European sites, both alone and in combination with other plans or projects.

The Lower River Shannon SAC boundary also extends to include the estuary of the River Deel upstream as far as the N69 at Askeaton and the estuary of the River Ahacronane upstream as far as the N69 at Rincullia. The qualifying interests for the Lower River Shannon SAC comprise a large number of habitats and species including estuaries and mudflats, alluvial forests (a "priority" habitat in danger of disappearing from the EU), Atlantic Salmon, Lamprey species and European Otter. A full list of the qualifying interests of the site is presented in Table 7.3. Three plant species listed in the FPO (Triangular Club-rush, Opposite-leaved Pondweed and Meadow Barley) are also recorded from the River Maigue estuary.

A number of other European sites occur within the study area, including the large woodland complex at the Curraghchase Woods SAC [site code: 000174], which supports a hibernation roost of the Lesser Horseshoe Bat, a species listed on Annex II to the Habitats Directive. The Askeaton Fen Complex SAC [site code: 002279] includes a number of individual sites scattered to the north and south of the N69 between Askeaton and Kildimo. The fens occur in basins between undulating hills of limestone in an otherwise intensive agricultural landscape.

The Barrigone SAC [site code: 000432] is situated approximately 5 km west of Askeaton, and comprises an area of dry, species-rich, calcareous grassland with patches of scrub and occasional limestone outcrops. This site supports a large population of the Annex II-listed Marsh Fritillary butterfly, and Hairy Violet, a species listed in the FPO. The Stacks to Mullaghareirk Mountains SPA [site code: 004161] lies approximately 5 km to the west of the proposed road development at its closest, while

the Tory Hill SAC [site code: 000439] lies approximately 6km to the southeast at its closest to the proposed road development.

Outside of the Natura 2000 network of European sites, a number of sites are listed as proposed Natural Heritage Areas (pNHA). Prior to statutory designation, pNHAs are subject to limited protection, in the form of:

- Forest Service requirement for NPWS approval before they will pay afforestation grants on pNHA lands
- Recognition of the ecological value of pNHAs by Planning and Licencing Authorities.

Under the Wildlife Act, 1976 (as amended) (“the Wildlife Act”), NHAs are legally protected from damage from the date they are formally proposed for designation.

Proposed NHAs within the original constraints study area include the Adare Woods pNHA [site code: 000429], which occurs as six separate blocks of woodland to the east and west of Adare village, Inner Shannon Estuary - South pNHA [site code: 000435] (contained within the boundaries of the Lower River Shannon SAC), Dromore and Bleach Loughs pNHA [site code: 001030], Loughmore Common Turlough pNHA [site code: 000438], Ballinvirrick Marsh pNHA [site code: 001427], Cappagh Fen pNHA [site code: 001429], Ballymorrishen Marsh pNHA [site code: 001425] and Gortennamrock Fen pNHA [site code: 001433], of which the latter four sites are all part of the Askeaton Fen Complex SAC.

Table 7.3 Designated Conservation Sites within the Study Area

| Site Code | Site Name | Status | Distance | Qualifying or Ecological Interests (* indicates “priority” habitat) |
|-----------|---------------------|--------|---|---|
| 002165 | Lower River Shannon | SAC | The proposed road development crosses this site | [1110] Sandbanks which are slightly covered by sea water all the time [1130] Estuaries [1140] Mudflats and sandflats not covered by seawater at low tide [1150] *Coastal lagoons [1160] Large shallow inlets and bays [1170] Reefs [1220] Perennial vegetation of stony banks [1230] Vegetated sea cliffs of the Atlantic and Baltic coasts [1310] <i>Salicornia</i> and other annuals colonising mud and sand [1330] Atlantic salt meadows (<i>Glaucopuccinellietalia maritima</i>) [1410] Mediterranean salt meadows (<i>Juncetalia maritimi</i>) [3260] Water courses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitriche-Batrachion</i> vegetation [6410] <i>Molinia</i> meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinion caeruleae</i>) [91E0] *Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>) [1029] Freshwater Pearl Mussel (<i>Margaritifera margaritifera</i>) |

| Site Code | Site Name | Status | Distance | Qualifying or Ecological Interests (* indicates "priority" habitat) |
|-----------|--|--------|----------|--|
| | | | | [1095] Sea Lamprey (<i>Petromyzon marinus</i>) [1096] Brook Lamprey (<i>Lampetra planeri</i>) [1099] River Lamprey (<i>Lampetra fluviatilis</i>) [1106] Atlantic Salmon (<i>Salmo salar</i>) [1349] Bottle-nosed Dolphin (<i>Tursiops truncatus</i>) [1355] European Otter (<i>Lutra lutra</i>) |
| 004077 | River Shannon and River Fergus Estuaries | SPA | 400 m | [A017] Cormorant (<i>Phalacrocorax carbo</i>) [A038] Whooper Swan (<i>Cygnus cygnus</i>) [A046] Light-bellied Brent Goose (<i>Branta bernicla hrota</i>) [A048] Shelduck (<i>Tadorna tadorna</i>) [A050] Wigeon (<i>Anas penelope</i>) [A052] Teal (<i>Anas crecca</i>) [A054] Pintail (<i>Anas acuta</i>) [A056] Shoveler (<i>Anas clypeata</i>) [A062] Scaup (<i>Aythya marila</i>) [A137] Ringed Plover (<i>Charadrius hiaticula</i>) [A140] Golden Plover (<i>Pluvialis apricaria</i>) [A141] Grey Plover (<i>Pluvialis squatarola</i>) [A142] Lapwing (<i>Vanellus vanellus</i>) [A143] Knot (<i>Calidris canutus</i>) [A149] Dunlin (<i>Calidris alpina</i>) [A156] Black-tailed Godwit (<i>Limosa limosa</i>) [A157] Bar-tailed Godwit (<i>Limosa lapponica</i>) [A160] Curlew (<i>Numenius arquata</i>) [A162] Redshank (<i>Tringa totanus</i>) [A164] Greenshank (<i>Tringa nebularia</i>) [A179] Black-headed Gull (<i>Chroicocephalus ridibundus</i>) [A999] Wetlands and Waterbirds |
| 000174 | Curraghchase Woods | SAC | 3 km | [91E0] *Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (Alno-Padion, Alnion incanae, Salicion albae) [91J0] * <i>Taxus baccata</i> woods of the British Isles [1303] Lesser Horseshoe Bat (<i>Rhinolophus hipposideros</i>) |
| 002279 | Askeaton Fen Complex | SAC | 0.5 km | [7210] *Calcareous fens with <i>Cladium mariscus</i> and species of the Caricion davallianae [7230] Alkaline fens |
| 000432 | Barrigone | SAC | 0.5 km | [5130] Juniper Scrub [6210] Orchid-rich Calcareous Grassland* [8240] Limestone Pavement* [1065] Marsh Fritillary (<i>Euphydryas aurinia</i>) |
| 000439 | Tory Hill | SAC | 6 km | [6210] Orchid-rich Calcareous Grassland* [7210] *Calcareous fens with <i>Cladium mariscus</i> and species of the Caricion davallianae [7230] Alkaline Fens |
| 000429 | Adare Woods | pNHA | 0.9 km | Series of woodland blocks around Adare Village |

| Site Code | Site Name | Status | Distance | Qualifying or Ecological Interests (* indicates "priority" habitat) |
|-----------|--|--------|----------|--|
| 001030 | Dromore and Bleach Loughs | pNHA | 6.5 km | Two freshwater lakes and surrounding wetland habitats north of Kildimo |
| 000438 | Loughmore Common Turlough | pNHA | 5 k m | Turlough and adjacent wetland habitats south of Mungret |
| 000435 | Inner Shannon Estuary - South | pNHA | 200m | The pNHA boundaries are within the Lower River Shannon SAC boundaries |
| 001427 | Ballinvirrick Marsh | pNHA | 4 km | Calcareous / Alkaline fens with Swamp Sawgrass (<i>Cladium mariscus</i>) within Askeaton Fen Complex SAC |
| 001429 | Cappagh Fen | pNHA | 2 km | Calcareous / Alkaline fens with Swamp Sawgrass (<i>Cladium mariscus</i>) within Askeaton Fen Complex SAC |
| 001425 | Ballymorrishe en Marsh | pNHA | 0.5 km | Calcareous / Alkaline fens with Swamp Sawgrass (<i>Cladium mariscus</i>) within Askeaton Fen Complex SAC |
| 001433 | Gorteennamr ock Fen | pNHA | 3.5 km | Calcareous / Alkaline fens with Swamp Sawgrass (<i>Cladium mariscus</i>) within Askeaton Fen Complex SAC |
| 004161 | Stacks to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle | SPA | 5 km | A082 Hen Harrier (<i>Circus cyaneus</i>) |

7.3.3 Protected Plants

Nationally rare plants are listed in the FPO and protected under the Wildlife Act. Where potential impacts on any such species may occur as a result of the proposed road development, it will be necessary to obtain derogations under the Wildlife Act where a proposed road development is approved under Section 51 of the Roads Act, 1993, as amended. The known distribution of the various FPO species within the original Constraints Study Area was determined by a review of existing data sources. These included a data request submitted to the NPWS, a review of the BSBI database, records cited in the Flora of County Limerick (Reynolds, 2013) and an earlier survey for rare or protected flora species in the vicinity of the River Maigue proposed crossing point as part of the Adare Bypass EIS (Scott Cawley, 2008). Protected species for which records exist from within the constraints study area are detailed in Table 7.4 along with their preferred habitat.

Table 7.4 Rare plant species recorded from the Constraints Study Area

| Name | Species | Grid Square | Flora Protection Order | Preferred habitat |
|--------------------------|---------------------------------|-------------------|------------------------|---|
| Hairy violet | <i>Viola hirta</i> | R24 R34 R35 | Yes | A perennial of dry banks, rocky ground and limestone scrub. Recorded from a number of sites in the Askeaton/Foynes area. |
| Meadow barley | <i>Hordeum secalinum</i> | R35 R45 R55 | Yes | Upper parts of brackish marshes, chiefly near the sea and along the River Shannon. |
| Rough poppy | <i>Papaver hybridum</i> | R35 | Yes | Sandy fields. |
| Opposite-leaved pondweed | <i>Groenlandia densa</i> | R24 R45 R55 | Yes | Found in canals and drainage ditches. Recorded from the drains to the west of the River Maigue crossing. |
| Pennyroyal | <i>Mentha pulegium</i> | R55 | Yes | Damp sandy places. |
| Autumn crocus | <i>Colchicum autumnale</i> | R43 R55 | Yes | Found in Ballygarry Co. Limerick. Occurs in old damp meadows and on river banks. |
| Triangular club rush | <i>Schoenoplectus triqueter</i> | R44 R45 R55 | Yes | A creeping perennial found in mud bordering tidal rivers. Found in the Shannon estuary bordering creeks in the inner estuary including along the River Maigue upstream as far as Adare. |

Specific surveys were carried out for rare plants for which existing records occur within the vicinity of the proposed road development. There are no records of Meadow barley, Rough poppy, Pennyroyal or Autumn Crocus near the proposed road development. Presence / absence surveys were undertaken in the vicinity of the proposed River Maigue Crossing for Triangular Club Rush and Opposite-leaved pondweed in September 2016, May 2018 and September 2019. A survey was also undertaken for Hairy violet in suitable habitat in the Robertstown, Rincullia and Craggs area in May 2018. The combined results of these surveys and existing data for the various species are summarised below:

Triangular Club Rush (*Schoenoplectus triqueter*)

This species is listed under the FPO (2015) and is only found in Ireland in and around the upper Shannon Estuary in Counties Limerick and Clare where it is locally common by tidal creeks and stony-muddy shores and channels (Reynolds, 2013). The distribution of the plant in the estuary appears to be associated with sheltered sites where there is likely to be sediment accumulation and it is primarily found on creek banks, the outer zone of mud banks and within lagoons (B. Deegan, 2000). The plant was recorded in small quantities (less than 10 stems) on the intertidal muds on the west bank of the River Maigue in the immediate vicinity of the proposed crossing point in September 2016. However, a follow-up survey undertaken in September 2019 found no evidence of Triangular clubrush at this location.

A stand of several hundred stems was recorded in a small inlet also on the western river bank approximately 350 m upstream of the proposed crossing point during both surveys. This stand was listed on the NPWS database from both 2008 and 2009. At this location it occurs in association with Water pepper (*Polygonum hydropiper*), Fool's water-cress (*Apium nodiflorum*), Water cress (*Rorippa nasturtium-aquaticum*), Water forget-me-not (*Myosotis scorpioides*), Water plantain (*Alisma plantago-aquatica*), Pink water-speedwell (*Veronica catenata*) and occasional Curled dock hybrid (*Rumex crispus* sub. sp. *uliginosus*). It extends from the bare mud at the lower tidal limit into the edge of reed-swamp dominated by Reed canary grass (*Phalaris arundinacea*) and Branched bur-reed (*Sparganium erectum*) approximately 1.5m above the low water mark. The NPWS database lists this site from both 2008 and 2009.

There was no evidence of the plant from the eastern river bank in the vicinity of the proposed crossing point.

Opposite-leaved pondweed (*Groenlandia densa*)

This species is protected under the FPO (2015) and is locally abundant around Limerick City and near the lower River Maigue (Reynolds, 2013). It is recorded from a large drainage ditch to the west of the flood embankments along the River Maigue downstream of Adare in the vicinity of the proposed crossing point. During the surveys undertaken in May 2018 and September 2019, no evidence of Opposite-leaved Pondweed was recorded in the drainage ditch. On account of the maintenance of these drains it appears to undergo some movement in distribution locally, with the result that its absence on one occasion does not preclude it appearing there at a later stage. It has also been recorded from Doohyle Lough (north of Rathkeale) in 2007 where it occurs in a shallow ditch with a marl substrate. It has also been historically recorded from the Ahacronane River though was not found during a survey in 2005 (Reynolds, 2013).

Hairy violet (*Viola hirta*)

This species is protected under the FPO (2015) and is recorded as being common in the limestone area between Askeaton and Foynes (Reynolds, 2013). It is usually found in dry calcareous grassland, around the edges of blackthorn and hazel scrub and in areas of limestone outcrop, where it can be locally abundant. During the survey undertaken in May 2018 which focused on potentially suitable habitat in the areas of Robertstown, Rincullia and Craggs, no evidence of Hairy Violet was recorded.

Meadow Barley (*Hordeum secalinum*)

This species is protected under the FPO (2015) and is recorded from the upper parts of brackish marshes, chiefly near the sea and along the River Shannon. Meadow barley was not recorded during the surveys and there are no known records of this species within the immediate vicinity of the proposed crossing point on the River Maigue.

Wood Club Rush (*Scirpus sylvaticus*)

While this plant is not currently listed under the FPO (2015), it is considered a candidate species and would likely be included in any future revisions of the order (M. Wyse-Jackson, NPWS, pers. comm.). The plant is considered rare within the Limerick area, being only recorded from the western bank of the River Maigue a short distance downstream of the old railway crossing, and on the River Shannon near Plassey (Reynolds, 2013). The location on the Maigue is in close proximity to the stand of Triangular club-rush at a small inlet and c350m from the proposed crossing point.

7.3.4 Habitats

Figures 7.2 to 7.24 in Volume 3 show the habitats along the entire route corridor which have been mapped using the Habitat Council Classification (Fossitt, 2000) and for which codes are provided in the text below. From this process KERs were identified which include areas of semi-natural habitat outside of designated conservation sites that are important for wildlife. These areas are described and evaluated in Section 7.3.6 below and have been subject to detailed assessment of the likely significant impacts of the proposed road development in Section 7.4.

Hedgerows and Tree-Lines

Apart from these KERs the majority of the proposed road development crosses agricultural grasslands (GA1) subdivided primarily by networks of hedgerows (WL1) and treelines (WL2), often with accompanying drainage ditches (FW4). Where hedgerows are unmanaged they may form linear strips of scrub (WS1) or immature woodland (WS2). The network of hedgerows and treelines provide multiple benefits to biodiversity apart from their direct habitat value. Critically, they function as corridors for movement and connectivity within the landscape for all types of fauna and the fragmentation of this network by road developments without appropriate mitigation can have profound implications for many species.

Grasslands

The floristic diversity of grasslands across the proposed road development varies considerably with topography and management. Most areas of grassland that fall within the classification of Dry calcareous and neutral grassland (GS1) and Wet grassland (GS4) are included within KERs, though some small areas which are of low floristic diversity or isolated fragments are not included.

7.3.5 Invasive Plant Species

Throughout all surveys undertaken as part of the biodiversity assessment, evidence of invasive plant species (listed in the Third Schedule to the Habitats Regulations and other non-native species with the potential to cause significant effects to the environment) were checked for and recorded where present. The National Biodiversity Data Centre (NBDC) database was also checked for records of invasive species within the study area. As much of the proposed road development is crossing open countryside, invasive species are generally absent from much of the route corridor. Two Third Schedule species occur on the River Maigue embankments in the vicinity of the proposed crossing point, namely Giant Hogweed (*Heracleum mantegazzianum*) and Floating Fairy Fern (*Azolla filiculoides*). The former occurs in small quantities at the crossing point though is found in very large stands upstream at the N21 Bridge at Adare. Floating Fairy fern occurs in very small quantities primarily within the debris that marks the upper tidal limit on the river banks.

Himalayan Balsam (*Impatiens glandulifera*) was recorded in small quantities along the River Deel in the vicinity of the proposed crossing point and on the Cloghatrida Stream at Ballingarrane adjacent to KER 17, where it was present growing amongst woodland on the banks consisting of willow, ash, sycamore and briar.



Plate 7.1 Floating Fairy Fern at Maigne crossing point.



Plate 7.2 Himalayan Balsam at the River Deel crossing point.

There was no evidence or records of Japanese Knotweed (*Fallopia japonica*) within the vicinity of the proposed road development. While the plant is widespread throughout much of County Limerick and neighbouring counties, it appears to have a

very localised distribution within the study area based on the NBDC records. Records of Japanese Knotweed from the study area only exist for two sites: one at the N69 Ferry Bridge over the River Maigue (OSi Grid Ref. R482522) and one at Ballyshonick to the north of Curraghchase (OSi Grid Ref. R406536).

7.3.6 Key Ecological Receptors

A total of 27 separate sites were initially identified as potential KERs along the length of the proposed road development. These sites were then subject to detailed survey to assess their biota and determine their ecological value in accordance with criteria detailed in the TII Guidelines. Following detailed survey, seven of the sites (KERs 1, 4, 6, 8, 12, 13 and 22) were rated as being of Local Importance (Lower Value) and so were subsequently excluded from the final list of KERs, in accordance with the TII Guidelines. Descriptions of these sites are presented in Section 7.3.7 below. A description of the habitats and evaluation of KERs is presented in Table 7.5. A number of KERs also adjoin or encompass watercourses which are described in more detail in Section 7.3.8. Locations of all KERs are shown in Figures 7.25 to 7.47 in Volume 3 of the EIAR.

In addition to the sites within the footprint of the proposed road development, consideration was also given to sites outside of the footprint but which may be within the ZOI of the proposed road development, such as ground water dependant sites that may be affected by drawdown or alteration of the groundwater hydrological regime. A number of turloughs occur in the northern area of the proposed road development (Section A), including Lough Selleher, and two other small turloughs in the townlands of Morgans North. Both of these features show evidence of nutrient enrichment and consequently support a limited floristic diversity.

Table 7.5 Key Ecological Receptors within the Zone of Influence

| KER No. | Townland | Key habitats | Evaluation |
|---------|--|---|---------------------------------|
| 2 | Lower River Shannon SAC at Churchfield | Estuarine habitat mosaic designated as part of a European site | International Importance |
| 3 | Robertstown | Old quarry with mosaic wet grassland, ponds and scrub. | Local Importance (Higher Value) |
| 5 | Craggs | Mosaic of alluvial woodland (conforming to Annex I habitat Alluvial Forest) along Ahacronane River with oak-ash-hazel woodland, wet grassland and marsh. | County Importance |
| 7 | Ballyellinan | Area of Rich Fen (conforming to Annex I habitat Alkaline Fen) with a population of <i>V. moulinsiana</i> , bordering to L6062-L1220 continuous with site 6. | International Importance |
| 9 | Cloonreask | Band of scrub, dry calcareous grassland and recolonising bare ground along old railway line | Local Importance (Higher Value) |
| 10 | Ballycullen | Mixed broadleaved woodland with adjacent network of mature treelines and drainage ditches. | Local Importance (Higher Value) |
| 11 | Lismakeery | Area of Rich Fen (conforming to Annex I habitat Alkaline Fen), with a | International Importance |

| KER No. | Townland | Key habitats | Evaluation |
|---------|------------------------|---|---------------------------------|
| | | population of <i>V. moulinsiana</i> and wet grassland grading to dry calcareous grassland and scrub at northern end. | |
| 14 | Nantinan | Young plantation woodland with some blocks of mixed broadleaved – conifer woodland and scrub along lowland river. | Local Importance (Higher Value) |
| 15 | Feeagh | Wet grassland with network of drainage ditches and patches of marsh and scrub-woodland on shallow soils with some exposed calcareous rock in the south | Local Importance (Higher Value) |
| 16 | Graigeen | Dry calcareous grassland with patches of developing scrub. Semi-natural woodland – plantation mosaic in west, some of it immature. | Local Importance (Higher Value) |
| 17 | Graigeen/Ballingarrane | Belt of mixed broadleaved woodland with adjacent Cloghatrida Stream. | Local Importance (Higher Value) |
| 18 | Ballingarrane | Linear belt of developing oak-ash-hazel woodland and scrub along old railway line | Local Importance (Higher Value) |
| 19 | Kyletaun | Linear belt of developing oak-ash-hazel woodland and scrub along old railway line with adjacent Cloghatrida Stream | Local Importance (Higher Value) |
| 20 | Kyletaun | Cloghatrida Stream and tributary drains in an extensive area of wet grassland. Blocks of wet willow-alder-ash woodland and mixed broadleaved/conifer woodland in the south. | Local Importance (Higher Value) |
| 21 | Blossomhill | Limestone lake with adjacent mosaic of rich fen (conforming to Annex I habitat Alkaline Fen) with a population of <i>V. moulinsiana</i> and wet grassland. Some scrub and treelines to the east. Drainage ditch to south from lake. | National Importance |
| 23 | Clonshire More | Clonshire River with adjacent dry calcareous grassland with a scrubby treeline and a small area of scrub in the east. | Local Importance (Higher Value) |
| 24 | Gortnagrour | Linear belt of developing oak-ash-hazel woodland and scrub along old railway line continuous with riparian woodland along Greanagh River A. | Local Importance (Higher Value) |
| 25 | Rower More | Greanagh River B (tidal) with treelines and dry meadows and grassy verges along embankments with fields of wet grassland to east. | Local Importance (Higher Value) |

| KER No. | Townland | Key habitats | Evaluation |
|---------|----------------------------------|--|---------------------------------|
| 26 | L. River Shannon SAC at Islandea | Tidal stretch of river with fringing marsh and tall herb swamp along embankments. Some alluvial woodland downstream (conforming to Annex I habitat Alluvial Forest). Wet grassland along eastern bank. | International Importance |
| 27 | Gortaganniff | Linear belt of scrub along old railway line including strip of dry calcareous grassland and scrub between Ch. 61+900 to Ch. 64+870. | Local Importance (Higher Value) |

KER 2 Lower River Shannon SAC at Churchfield

This site is located in Churchfield (see Figure 7.26 of Volume 3) in the vicinity of chainages of approximately Ch. 2+050 to Ch. 3+250 in relation to the proposed road development and is rated of International Importance. The Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA extends to include the estuarine habitat of the Robertstown River at Churchfield as far as the N69 at the inflow of the Ahacronane River. The estuary includes areas of saltmarsh (CM1/2) and open intertidal muds (LS4) and is mainly surrounded by flood defence embankments (BL2). The saltmarsh conforms to Atlantic salt meadows *Glauco-Puccinellietalia maritima* (1330), while the exposed intertidal muds conforms to Mudflats and sandflats not covered by seawater at low tide (1140), both Annex I habitats and listed as qualifying interests of the SAC. A small area of wet grassland (GS4) and scrub (WS1) occurs to the west of the Ahacronane River bordering the N69. The estuary supports foraging by a variety of wintering waterfowl. This area was surveyed monthly over the period November 2015 to March 2017 (spanning two winter seasons) as part of the EIAR prepared for the development of Shannon-Foynes Port (Capacity Extension at Shannon Foynes EIAR: Chapter 7 – Biodiversity). Peak numbers of birds were recorded in December 2016 and January 2017 with a maximum of 2,150 birds of a variety of species recorded in December 2016. The most abundant species were Golden Plover, Dunlin, Lapwing, Wigeon, Teal and Black-headed Gull. The site also supports European Otter (listed as a qualifying interested of the SAC). This site will not be directly impacted by the proposed road development but does have direct connectivity through a number of streams and rivers which drain from the proposed road development to the estuary.

KER 3 Robertstown

This site is rated of Local Importance (Higher Value). It comprises a disused quarry (ER2) to the south of the existing N69 in the townland of Robertstown which is crossed by the proposed development between Ch. 3+150 and Ch. 3+425. There are two ponds (FL8) formed in the excavated hollows with a surrounding mosaic of wet grassland (GS4), dry calcareous and neutral grassland (GS1) and scrub (WS1). The ponds are quite eutrophic and have abundant algal cover with occasional Broad-leaved Pondweed (*Potamogeton natans*), Willow moss (*Fontinalis antipyretica*) and localised stands of Water Horsetail (*Equisetum fluviatile*) around the edge with patches of Water Speedwell (*Veronica anagallis-aquatica*). The ponds support breeding moorhen and a diversity of invertebrate species including a number of dragonfly species, and are likely to support both Common Frog and Common Newt spawning. They are surrounded by patches of dense Willow dominated scrub (WS1), with occasional Hawthorn (*Crataegus monogyna*) and Elder (*Sambucus nigra*). Larger areas of scrub occur in the adjacent land to the north and south of the ponds along

with some patches of Bracken (*Pteridium aquilinum*). The open areas of grassland support a dry community including Fescues, Crested Dog's-tail (*Cynosurus cristatus*), Cock's-foot (*Dactylis glomerata*), thistles, Red Bartsia (*Odontites vernus*), clovers and vetches (*Vicia* spp.). The site will be dissected by the proposed road development resulting in the loss of the main pond.



Plate 7.3 Pond at Robertstown.

KER 5 Craggs

This large site at Craggs (Ch. 4+350 to Ch. 5+350) consists of a mosaic of habitats extending from the Ahacronane River east-wards towards Mulderricksfield and is rated of County importance. The Ahacronane River (FW2) lies in a pronounced valley with shallow soils overlying the limestone bedrock. The river is quite alkaline with calcium deposits on the substrate and drops over a number of shallow cascades along its length. At one of these the channel bifurcates and floods an area along the eastern side of the river immediately upstream of the proposed crossing point resulting in a series of braided channels winding through riparian woodland (WN5). On the basis of the species composition and habitat characteristics, this habitat conforms to the Annex I priority habitat Alluvial Forests with *Alnus glutinosa* and *Fraxinus excelsior* [91E0]. The woodland canopy is dominated by Willow, Ash (*Fraxinus excelsior*), Hawthorn and Hazel, while the ground flora includes many aquatic or marginal aquatic species such as Watercress, Dropwort (*Oenanthe* sp.), Marsh Marigold (*Caltha palustris*), Yellow Flag and Reed Canary-grass (*Phalaris arundinacea*). Mosses, including Pointed Spear-moss (*Calliergonella cuspidata*), are widespread and in places dominant along with various ferns and leafy liverworts and Opposite-leaved Golden Saxifrage (*Chrysplenium oppositifolium*). The alluvial woodland is up to approximately 70 m at its widest after which the land rises and it changes to oak-ash-hazel woodland [WN2] with an associated dry herb community including Enchanters-nightshade (*Circaea lutetiana*), Bugle (*Ajuga reptans*), Primrose (*Primula vulgaris*), Lords-and-ladies (*Arum maculatum*) and Ivy. In the vicinity of the proposed crossing point, the woodland

narrows to a thin band of scrub along the river bank consisting of Blackthorn, Elder, Briar and occasional young Ash, which is backed to the east by an old quarry with mounds of broken rock, spoil and debris (recolonising bare ground ED3).



Plate 7.4 Riparian woodland at Craggs.

East of the river there are some low-lying areas of freshwater marsh (GM1) and wet grassland (GS4) with areas of Oak-Ash-Hazel woodland (WN2) and scrub (WS1) on elevated land which lie immediately north of the alignment. The lands to the south include some blocks of Oak-Ash-Hazel woodland (WN2) dominated by Hazel with Ash and Hawthorn on shallow soils with open fields of dry calcareous and neutral grassland (GS1) rising towards the east. The grasslands are lightly grazed and dominated by grasses but there are some areas of establishing Briar and Blackthorn scrub and pockets of dense Bracken (HD1). There are pockets of grassland on shallow soil which include Lady's Bedstraw (*Galium verum*), Glaucous Sedge, Hawkweed (*Hieracium pilosella*), Self-heal (*Prunella vulgaris*) and Slender Speedwell (*Veronica filiformis*) with occasional Common Spotted Orchid (*Dactylorhiza fuchsii*).



Plate 7.5 Dry grassland at Craggs.

The mosaic of habitats present including the well-developed and nationally rare alluvial woodland (listed as a “priority” habitat on Annex I to the Habitats Directive and a qualifying interest of the Lower River Shannon SAC, which is located c. 500 m downstream) render this KER as being of County Importance. In recognition of the importance of the alluvial woodland and in order to minimise the impacts on the overall habitat complex at this location, the proposed road development has been modified to avoid the sensitive habitats within this site.

KER 7 Ballyellinan

This site consists of an area of fen habitat within which the Annex II listed *V. moulinsiana* is present. and is rated as being of International Importance. It is not part of the Askeaton Fen Complex SAC, the nearest part of which is c. 5km to the southeast and to the east of the River Deel. It lies to the north of the L6062-L1220 from which it is separated from KER 6 (see Ch. 7+150 to 7+300). The site is dominated by Saw Sedge and Common Reed with abundant sedges, and is therefore classified as rich fen (PF1) intermediate with Reed and large sedge swamp (FS1). On the basis of the species composition and habitat characteristics, it is considered to conform to the Annex I habitat Alkaline fens [7230] with elements that may conform to the priority habitat Calcareous fens with Swamp Sawgrass (*Cladium mariscus*) and species of the *Caricion davallianae* [7210]. The section adjoining the L6062 road has a more diverse plant community, however, with Purple Loosestrife (*Lythrum salicaria*), Meadowsweet (*Filipendula ulmaria*) and Marsh Bedstraw (*Galium palustre*). The proposed road development passes to the south of this KER.

KER 9 Cloonreask

This site is rated of Local Importance (Higher Value) and is located in Cloonreask at Ch. 11+300. It consists of a linear strip of scrub (WS1) dry calcareous and neutral

grassland (GS1) and recolonizing bare ground (ED3) along the old railway line at Cloonreask. There are Hedgerows (WL1) and Treelines (WL2) on either side of the railway dominated by Hawthorn and Willow with occasional Ash, Alder (*Alnus glutinosa*), Gorse and Dog Rose (*Rosa canina*). The dry grassland community consists of Soft Brome (*Bromus hordeaceus*), fescues, Glaucous Sedge, Lady's Bedstraw, vetches (*Vicia* spp.) and Meadow Vetchling (*Lathyrus pratensis*). Creeping Cinquefoil (*Potentilla reptans*), Sow thistle (*Sonchus arvensis*) and Devil's-bit Scabious (*Succisa pratensis*) are occasional in the bare ground along the tracks. It will be dissected by the proposed road development through a bridge over the railway line

KER 10 Ballycullen

This site is rated of Local Importance (Higher Value). A network of mature treelines (WL2) divides some small fields to the south west of a stream (FW2) at Ballycullen. The treelines are comprised of sycamore (*Acer pseudoplatanus*), ash, Horse Chestnut (*Aesculus hippocastanum*) and Cherry (*Prunus avium*) separating fields of improved grassland (GA1). To the east of the stream is a broad belt of mixed broad leaved woodland (WD1) which extends from Ballyclogh Bridge in the west (Ch. 20+600) to Ch. 21+400, forming a boundary to the Ballycullen House demesne. The woodland consists of Oak (*Quercus robur*), Scots Pine (*Pinus sylvestris*), Ash, Sycamore, Beech (*Fagus sylvatica*) and occasional Aspen (*Populus tremula*). The stream is in a dredged channel which has steep banks almost 2 m in height exposing glacial till with abundant large boulders. It is calcareous with a silty substrate and occasional cobble and boulders. Instream vegetation is limited to small amounts of Watercress, Starwort (*Callitriche* sp.) and Duckweed (*Lemna minor*). The southern fringe of the site will be impacted by the proposed road development.



Plate 7.6 Dry grassland grading to fen south of Ballycullen

KER 11 Lismakeery

This site is rated of International Importance on account of the fen habitat and *V. moulinsiana* population, and Annex II listed species, which despite attempts at drainage have persisted. It is not part of the Askeaton Fen Complex SAC, the nearest part of which is c4km to the southeast and to the east of the River Deel. The site is continuous with KER10 and lies to the east of the stream which forms the western boundary of the site. The main element of the site is an area of drained rich fen (PF1) to the south of the proposed road development which grades to wet grassland (GS4) and then dry calcareous and neutral grassland (GS1) and scrub (WS1). The land rises to the north towards the belt of mixed broad leaved woodland (described in KER 10 above). The scrub (WS1) along the southern boundary of the woodland consists of Hawthorn, Hazel, Blackthorn with occasional young Ash, and a few scattered mature Ash trees extend to the south on a raised spur of land at Ch. 20+800.

The fen habitat (PF1) is dominated by Saw Sedge, rushes and Common Reed and is considered intermediate with Reed and large sedge swamp (FS1) but nonetheless conforms to the Annex I habitat Alkaline fens (7230). *V. moulinsiana* is found within the areas of Black Bog-rush and Saw Sedge. The grassland community includes fescues, Crested Dog's-tail, bents and occasional Quaking Grass (*Briza media*) with Red Bartsia, vetches, Oxeye Daisy, Self-heal, Knapweed, Ribwort Plantain (*Plantago lanceolata*) and Bird's-foot-trefoil (*Lotus corniculatus*). A belt of Willow and Gorse-dominated scrub occurs along the stream in the vicinity of Ch. 20+970. The proposed road development will impact the northern part of the site.

KER 14 Nantinan

This site is rated of Local Importance (Higher Value) and encompasses a large block of woodland which lies to the east of the River Deel commencing at Ch. 24+350 and extends east to the old Foynes to Limerick Railway line, while being bounded on the west by the Cloghatrida Stream which joins to the Deel. The site is a mixture of young plantation woodland (WD) with some blocks of mixed broadleaved – conifer woodland (WD2) which are developing towards Oak-Ash-Hazel woodland (WN2). There are patches of scrub (WS1) including an extensive area along the River Deel adjoining the confluence of the stream. The eastern bank of the stream immediately upstream of the proposed crossing point at Ch. 24+500 is lined with mature deciduous trees backed by conifer plantation (WD4) as far as Ch. 24+700 and thereafter by mixed broadleaved woodland (WD2) as far as Ch. 25+070. The proposed road development will cross a part of the site and impact on its western fringes.



Plate 7.7 Woodland at Nantinan.

KER 15 Feeagh

The site at Feeagh is rated of Local importance (higher) and adjoins KER14 from which it is separated by the stream. It encompasses a mosaic of habitats extending between Ch. 24+950 and 25+900. The main area consists of wet grassland (GS4) with a network of open drainage ditches (FW4). The grassland, which is grazed and heavily poached by livestock, is dominated by Rushes and Creeping Bent, with some Sedges. It supports a diverse range of herbaceous species including Meadowsweet, Mint, Marsh Thistle, Meadow Vetchling (*Lathyrus pratensis*), Angelica, Hemp Agrimony (*Eupatorium cannabinum*), Devils-bit Scabious and occasional Common Spotted Orchid (*Dactylorhiza fuchsii*).

An area of freshwater marsh (GM1) occurs at Ch. 25+600 which is fed from a small spring (FP2) at Ch. 25+690. This comprises many of the species found in the wet grassland but includes a higher herbaceous component including Bog Bean (*Menyanthes trifoliata*) and Marsh Pennywort (*Hydrocotyle vulgaris*) in wetter areas. The land rises to the south of the marsh and is enclosed in a network of small fields. These are bounded by some treelines of Ash and Hawthorn which extend into patches of scrub consisting of Willow, Hawthorn and Blackthorn. The grassland is neglected dry calcareous and neutral grassland (GS1) supporting Ragwort, Thistles, Nettle and occasional Bracken on shallow soils with occasional outcrops of rock (ER2) to the east of the alignment. It will be dissected by the proposed road development.

KER 16 Graigeen

This site is rated as Local importance (higher) and extends from Ch. 26+250 to 26+780 and consists primarily of dry calcareous and neutral grassland (GS1) on shallow soils with patches of developing scrub (WS1) dominated by Gorse with occasional Hawthorn, Willow and Blackthorn. To the west and outside of the alignment is an area of mature scrub (WS1) developing towards Oak-Ash-Hazel woodland (WN2) with a block of young Ash plantation (WS2). The open grassland element supports a variety of grasses including Fescues, Meadow Grasses and Glaucous Sedge, along with Hawkweed, Clovers, Knapweed, Buttercup, Birdsfoot Trefoil, Agrimony (*Agrimonia eupatoria*), Vetches, Oxeye Daisy, Ragwort and occasional Common Spotted Orchid. Also present locally are Self-heal, Silverweed, Eyebright (*Euphrasia officinalis*),

Quaking Grass and Meadowsweet. The site will be dissected by the proposed road development.

KER 17 Graigeen/Ballingarrane

This site is rated of Local importance (higher) which extends from Ch. 26+780 to 27+100 and consists of a linear block of mixed woodland (WD1) dominated by mature Chestnut (*Aesculus hippocastanum*), Sycamore and Ash with occasional Oak and Pine. There is a well-developed shrub layer consisting of Hawthorn, Blackthorn, Privet (*Ligustrum ovalifolium*) with occasional Spindle (*Euonymus europaeus*). The ground flora consists of False Wood Brome, Lesser Celandine, Ivy and Briar. The Cloghatrida Stream (FW2) flows along its eastern side where it is heavily over shadowed along much of its length by the woodland canopy. The Listed invasive species Himalayan Balsam (*Impatiens glandulifera*) is present in small quantities along the river bank. A pair of Ravens appear to nest in a tall Pine tree, while evidence of Badger activity was widespread in the woodland, though a sett location was not identified. The site will be dissected by the proposed road development.

KER 18 Ballingarrane

This site is rated of Local importance (higher) and consists of a linear belt of scrub (WS1) intermediate with Oak-Ash-Hazel woodland (WN2) along a spur of the old railway line which adjoins the CPO between Ch. 27+500 and 27+650. The scrub-woodland extends along much of the railway line to the north and to the south forming a valuable linear habitat. The canopy is comprised of Ash, Hazel, Hawthorn and Blackthorn which narrows to a treeline towards the minor road at Ch. 27+650. The ground flora included many woodland species along with dense areas of Briar. The southern part of this site will be impacted by the proposed road development.

KER 19 Kyletaun

This site is rated of Local importance (higher) and consists of a linear band of scrub (WS1) along the railway line spur which crosses the Cloghatrida Stream (FW2) on a stone arch bridge. There is also a low stone arch cattle underpass on the bridge immediately north of the stream at Ch. 28+200. The scrub along the railway line is dominated by Hawthorn, Blackthorn, Willow, and Briar with occasional young Ash and Dog Rose (*Rosa canina*). A small copse of woodland occurs on either side of the Cloghatrida Stream to the west of the railway bridge which consists of Ash, Willow, Hazel, Hawthorn and occasional Whitebeam (*Sorbus aria*). There are patches of open calcareous grassland (GS1) in places along the north side of the stream which supports Fescue, Crested Dogstail, False Oat Grass (*Arrhenatherum elatius*) and Quaking Grass, along with Birdsfoot Trefoil, Knapweed, Pignut, Selfheal, Vetches, and occasional Orchids.

The Cloghatrida Stream at this location is in a deep excavated cut and is heavily overshadowed. It has a very limited flow and is heavily choked with Branched Bur-reed (*Sparganium erectum*), Watercress and Duckweed (*Lemna minor*). The stream supports White-clawed Crayfish and Minnow. An area of wet grassland occurs to the west of the proposed road development along the north bank where the land dips. The site will be crossed by the proposed road development.



Plate 7.8 Scrub and dry grassland along the Cloghatrida Stream bank at Kyletaun.

KER 20 Kyletaun

This site is rated of Local Importance (Higher Value) extending from Ch.28+650 to Ch. 29+200 and encompasses a tributary of the Cloghatrida Stream which is in an excavated and heavily vegetated channel (FW4) where it swings to the east towards Ch. 29+030. There are open low-lying areas of wet grassland (GS4) on either side of the drain and a block of wet Willow–Alder-Ash woodland (WN6) to the south of the drain and immediately west of the alignment between Ch. 29+030 and 29+130. A belt of mixed broadleaved/conifer woodland (WD2) occurs on a low escarpment as the land rises to the south at Ch. 29+200.

The drain between Ch. 28+450 and 28+750 is in a deep cutting of c. 3 m depth with a treeline along its western side and a fringe of scrub-woodland along its eastern bank which consists of Ash, Hawthorn, Whitebeam and occasional mature Beech trees. As the ground lowers to the south the banks decrease in height and the surrounding lands merge to wet grassland dominated by Rushes, Creeping Bent and locally, Purple Moor-grass (*Mollinia caerulea*). Herbaceous plants include Purple Loosestrife, Meadowsweet, Devils-bit Scabious, Tormentil (*Potentilla erecta*) and Angelica. Pointed Spear Moss is widespread throughout the wet grassland while *Sphagnum* moss (*Sphagnum* sp.) is present in wetter areas. To the west of the alignment between Ch. 28+950 and 29+030 the grassland supports a large amount of Devils-bit scabious. On account of the abundance of this favoured food plant of the Red-listed butterfly Marsh Fritillary (*Euphydryas aurinia*), which is also listed on Annex II to the Habitats Directive, a survey was undertaken in this area to check for Marsh Fritillary larval (caterpillar) webs in September 2016 but none were recorded.

The drain is heavily choked with vegetation along most of its length dominated by Branched Bur-reed, Great Hairy Willowherb (*Epilobium hirsutum*) and Meadowsweet

with Duckweed wherever there is open water. Where it swings to the west at Ch. 29+030, it is fringed with a belt of wet Willow–Alder-Ash woodland (WN6) which extends for approximately 70m to the south before the land rises to fields of tillage. The woodland is dominated by Willow but includes some Downy Birch (*Betula pubescens*), along with Hawthorn towards the drier fringe on the south. The understorey includes many of the wet grassland herbaceous species along with abundant Common Reed (*Phragmites australis*).

The mixed conifer-broadleaved woodland in the vicinity of Ch. 29+200 consists of a fringe of conifers (mostly Spruce with occasional Pine) along the higher southern edge with Hawthorn, Elder, Blackthorn and Briar scrub on the steeper ground to the north with occasional outcropping rock (ER2). The site will be dissected by the proposed road development.

KER 21 Blossomhill

This site extends from Ch. 51+025 to Ch. 51+350. It is rated of National Importance on account of the lake and fen habitats and the presence of the Annex II listed *V. moulinsiana* within the site. The site encompasses a small limestone lake (FL3) with surrounding reedbed (FS1) (which may conform to the Annex I habitat hard-oligotrophic waters with benthic vegetation of *Chara* spp. (3140). Access to the lake is impeded by a dense fringe of reedbed. The lake has an adjoining strip of rich fen (PF1) to the west which conforms to the Annex I habitat Alkaline fen [7230], and wet grassland (GS4) to the south. On the eastern side there is some scrub (WS1) along a small escarpment with exposed bedrock (ER2) which merges to treelines (WL2) bounding fields to the east. A small drain (FW4) flows into the lake from the south west which is also flanked by a treeline.



Plate 7.9 Wet grassland grading to fringing reedbed around Blossomhill Lake.

The proposed road development runs to the south of the site, at a distance of 150 m from the lake, crossing the drainage ditch at Ch.51+050 after which it crosses the southern end of the wet grassland. The wet grassland is cut for silage and supports a

thin sward of Rushes, Creeping Bent, Cuckoo Flower (*Cardamine pratensis*), Creeping Buttercup and abundant Pointed Spear Moss. The grassland slopes gently towards the lake edge (which is separated by a fence) after which there is a dense band of reed swamp dominated by Common Reed with occasional stands of Reedmace (*Typha latifolia*) and scattered Willow. The lake appears mesotrophic given the extent of fringing reedbed and the occurrence of Yellow Water Lily (*Nuphar lutea*) in considerable amounts. The fen along the western flank of the lake supports Purple Moor-grass, Marsh Thistle, Devils-bit Scabious, Meadowsweet and small amounts of Grass of Parnassus (*Parnassia palustris*).

To the east of the wet grassland at Ch. 51+250 there is an area that has been subject to deposition of spoil consisting of a mixture of spoil and bare ground (ED2), recolonising bare ground (ED3) and pockets of developing scrub (WS1). East of this the land rises into a band of scrub dominated by Hawthorn, Blackthorn and Briar with occasional young and semi-mature Ash. Approximately 100m to the north of the alignment the scrub encompasses a low escarpment with exposed bedrock (ER2) and a number of mature Ivy-clad trees.

The proposed road development runs along the southern fringe of the site while an attenuation pond is proposed in the south-west of the KER.

KER 23 Clonshire More

This site is rated of Local Importance (Higher Value) and is situated downstream of Clonshire Bridge at Ch. 56+500 to 56+725, encompassing the Clonshire River (FW2) and an adjacent scrubby treeline (WL2) along the eastern river bank. The treeline along the river is comprised of mostly young to semi-mature Ash, Hawthorn and Alder, with occasional mature trees. The western river bank supports Briar dominated scrub adjoining improved agricultural grassland (GA1). The site will be dissected by the proposed road development.



Plate 7.10 Clonshire River upstream of Clonshire Bridge.

KER 24 Gortnagroun

This site is rated of Local Importance (Higher Value) and encompasses a section of the old Foynes to Limerick Railway line, which supports a narrow belt of oak-ash-hazel woodland (WN2) and scrub (WS1) with a belt of riparian woodland (WN5) along the Greanagh River A. The railway line is in a cutting at this location and has a well-developed canopy of trees along its length to the east of the Gortnagroun Railway Bridge consisting of Ash, Hawthorn, Crab Apple (*Malus sylvestris*), Willow, Sycamore and Blackthorn. To the south of the railway line at Ch. 58+050 the woodland extends outside of the embankment and includes some Oak and Beech. The woodland edge along the track is dominated by scrubby species including Rose, Gorse and Bracken with a patchy cover of herbaceous species along the tracks including Hypericum, Devil's-bit Scabious and Nipplewort (*Lapsana communis*) with abundant Ash seedlings.

The riparian woodland (WN5) along the eastern bank of the Greanagh River A forms a narrow band (c. 15 m in width), which is comprised primarily of a dense stand of Willow with occasional ash and a poorly developed ground flora. On the basis of the species composition and habitat characteristics, it does not conform to the Annex I priority habitat Alluvial Forests with *Alnus glutinosa* and *Fraxinus excelsior* [91E0]. It adjoins cultivated land to the east. The western river bank is open, adjoining improved agricultural grassland (GA1) separated by an electric fence. The river margins support a scattered fringe of tall herb swamp (FS2) consisting of Water Hemlock (*Oenanthe crocuta*), Horsetail (*Equisetum* sp.), Branched Bur-reed, Nettle, Bindweed (*Calystegia sepium*) and Reed Canary-grass. This site will be dissected by the proposed road development though there will be a bridge over both the railway line and river.

KER 25 Rower More

This site is rated of Local Importance (Higher Value) and extends from Ch. 59+100 to 59+600. It is centred on the Greanagh River B which at this location is tidal (CW2) and lined with flood embankments (BL2). The site also extends to include fields of wet grassland (GS4) and a network of drainage ditches (FW4) to the east. The banks of the Greanagh River B are tree-lined (WL2) along both banks predominately with young to semi-mature Ash and Willow, along with occasional Alder and Hawthorn. Two large solitary mature Crack Willow (*Salix fragilis*) occur on either side of the river at Ch. 59+280.

The level of the river, which is in an excavated cut with steep banks, rises and falls over approximately 1 m with the tide. It does not appear to have much saline intrusion however, as the aquatic vegetation includes Water Milfoil (*Myriophyllum* sp.), Water Crowfoot (*Ranunculus* sp.), Starwort (*Callitriche* sp.) and Willow Moss (*Fontinalis antipyretica*). A narrow fringe of tall herb swamp (FS2) occurs along the banks supporting Reed Canary Grass, Angelica, Bindweed, Creeping Bent, Figwort and Creeping Buttercup. The band of dry meadow and grassy verges (GS2) between the river and the embankment to the east is dominated by grasses with abundant Cow Parsley (*Anthriscus sylvestris*). The wet grassland to the east of the flood embankments is dominated by rushes with occasional patches of Yellow Iris.

The river supports Brown Trout and Kingfisher, though there was no evidence of suitable spawning or nesting habitat respectively in the vicinity of the proposed crossing. The river will be bridged while the grassland element will be dissected by the proposed road development.

KER 26 Lower River Shannon SAC at Islandea

This site encompasses the River Maigue which at this location is within the Lower River Shannon SAC and is rated of International Importance. The proposed road development will cross the River Maigue at Ch. 60+825 to 61+025. The river at this point is tidal (CW2) and undergoes a flood range of several meters. It has large flood embankments (BL2) on both banks which are set back approximately 20m from the river edge. The vegetation between the embankments and the river is a gradation of dry meadows and grassy verges (GS2) on the embankments, through a fringe of freshwater marsh (GM1) / reed swamp (FS2) at the upper tidal limit to a sparse tidal river community (CW2) in the intertidal zone with bare mud on the lowest levels exposed during low tide. Relevé data for the various vegetation communities is presented in Appendix 7.2 in Volume 4A of this EIAR.

The muds exposed during periods of low tide, which are comprised of very fine silt with a small fraction of gravel and occasional cobbles and boulders in the river channel, conform to the Annex I habitat and Qualifying interest for the Lower River Shannon SAC Mudflats and sandflats not covered by seawater at low tide [1140]. The muds exposed at low tide do not support vegetation except in some areas at the base of the river bank sides, where the habitat is considered to conform to the Annex I habitat and Qualifying interest for the Lower River Shannon SAC Watercourse of plain to montane levels with the *Ranunculus fluitans* and *Callitriche-Batrachion* vegetation [3260]. Vegetation present in these areas includes Water Forget-me-not (*Myosotis scorpioides*), Sea Beet (*Beta vulgaris* subsp. *maritima*), English Scurvy Grass (*Cochlearia anglica*), Curled Dock hybrid (*Rumex crispus* subsp. *uliginosus*) and Water Cress. The nationally rare and protected Triangular Club-rush occurs in small quantities on the western river bank (approx. 350m north of the proposed crossing) and is frequent along the entire Maigue estuary (see also Section 7.3.3 above).



Plate 7.11 River Maigue crossing point from western river bank (at high tide).

The freshwater marsh (GM1) / reed swamp (FS2) community consists of Reed Canary Grass, Greater Pond Sedge (*Carex riparia*), Branched Bur-reed, Cock's Foot, Curled Dock hybrid, Water Mint, Marsh Ragwort (*Senecio aquaticus*) with occasional plants of the listed invasive species Giant Hogweed (*Heracleum mantegazzianum*). Small amounts of Floating Fairy Fern (*Azolla filiculoides*), also a listed invasive species, occur amongst the drift material marking the high water tide line.

A drainage ditch occurs on the landward side of the western flood embankment (350m north of the proposed crossing point), which is heavily choked with vegetation (though regularly cleaned out). It supports various starworts (*Callitriche* spp.), Water Forget-me-not (*Myosotis scorpioides*), Fool's Watercress (*Apium nodiflorum*), Water Plantain (*Alisma plantago-aquatica*) and small amounts of Canadian pondweed (*Elodea canadensis*). Further south it becomes heavily choked with Branched Bur-reed, Reed Canary Grass, Reedmace and Water Horsetail (*Equisetum fluviatile*). The nationally rare and protected Opposite-leaved Pondweed (*Groenlandia densa*) has been recorded from this ditch (Reynolds, 2013) but no evidence of the plant was recorded during surveys undertaken for the purposes of the proposed road development.

A belt of Riparian Woodland (WN5) occurs a short distance (approximately 160 m) downstream of the proposed crossing point which is dominated by Willows including Osier (*Salix viminalis*), Sally (*S. cinerea*), Purple Willow (*S. purpurea*) along with occasional Alder and Ash. The understorey includes Honeysuckle (*Lonicera periclymenum*), Bramble, Meadowsweet, Wild Carrot (*Daucus carota*) and Fools' Watercress. On the basis of the species composition and habitat characteristics, the woodland is considered to conform to the Annex I priority habitat Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* [91E0]. The river and riparian habitats in the vicinity of the proposed bridge are regularly cleared of woody vegetation by the OPW as part of flood management works. The River Maigue will be bridged by a clear span structure at this location as part of the proposed road development.

KER 27 Gortaganniff

This site is rated of Local Importance (Higher Value) on account of its value as a habitat and its function in ecological connectivity. The site comprises a linear strip of scrub woodland (WS1) along the old railway line between Ch. 61+800 and 64+950. This includes small areas of dry calcareous and neutral grassland (GS1) in places. The scrub is dominated by Hawthorn and Blackthorn with occasional young and semi-mature Ash. This site lies on the fringe of the proposed road development.

7.3.7 Other Ecological Sites

Sites rated of Local Importance (Lower Value) identified along the proposed road development are listed in Table 7.6, while detailed descriptions of their ecological interests are presented below.

Table 7.6 Local Importance (Lower value) Ecological Receptors within the zone of influence

| Site No. | Townland | Key habitats | Evaluation |
|----------|----------|---|--------------------------------|
| 1 | Ardaneer | Mosaic of wet grassland, scrub and dry calcareous grassland. Recent clearance and scrub removal. Spring and drainage ditch in north corner. | Local Importance (Lower Value) |

| Site No. | Townland | Key habitats | Evaluation |
|----------|-----------------|---|--------------------------------|
| 4 | Rincullia | Dense block of hazel scrub. | Local Importance (Lower Value) |
| 6 | Ballyclogh | Area with wet grassland and drainage ditches. | Local Importance (Lower Value) |
| 8 | Clonreask | Area of wet grassland and drainage ditches. | Local Importance (Lower Value) |
| 12 | Baunreagh | Mosaic of wet grassland and scrub with network of drainage ditches. Some recent drainage and scrub clearance. | Local Importance (Lower Value) |
| 13 | Ballynacaheragh | Scrub and dry meadows and grassy verges mosaic on old quarry site. | Local Importance (Lower Value) |
| 22 | Clonshire | Clonshire River with associated fringing wet grassland / dry calcareous grassland. | Local Importance (Lower Value) |

ER1 Ardaneer

This site is rated of Local Importance (Lower Value). It extends from Ch. 1+100 to 1+750, encompassing an area of low-lying wet grassland (GS4) in the north with the land rising to the south in a series of undulating ribs of rock. A large open drain rises from a spring in the vicinity of Ch.1+150 and flows eastwards to join another large drain which flows into the Robertstown Estuary at Durnish. The wet grassland is dominated by Rushes (*Juncus* sp.), Silverweed (*Potentilla anserina*), Willow herb (*Epilobium* sp.), Meadowsweet (*Filipendula ulmaria*) and Knapweed (*Centaurea nigra*) with occasional Flag Iris (*Iris pseudacorus*) and Willow (*Salix* sp.). The drainage ditch has no apparent flow and is heavily choked with Watercress (*Rorippa nasturtium-aquaticum*), Brooklime (*Veronica beccabunga*) and occasional Curled Pondweed (*Potamogeton crispus*).

The elevated land has a thin soil covering with occasional exposed outcropping bedrock (ER2) and was covered with Gorse (*Ulex europaeus*) dominated scrub but was subject to recent clearance and scrub removal. The area now supports some small relic patches of scrub consisting of Gorse, Hawthorn (*Crataegus monogyna*), Blackthorn (*Prunus spinosa*) and Briar (*Rubus fruticosus* aggr.) with occasional young Ash (*Fraxinus excelsior*). Most of it has dry calcareous and neutral grassland (GS1) cover which is dominated by Bents (*Agrostis* sp.), Fescue (*Festuca* sp.), Yorkshire fog (*Holcus lanatus*) and a variety of herbs, including clovers (*Trifolium* spp.), Knapweed, Thistles (*Cirsium* sp.), Oxeye (*Leucanthemum vulgare*) and Ragwort (*Senecio jacobea*). There are small amounts of Glaucous Sedge (*Carex flacca*) and Hawkweed (*Hieracium pilosella*) present also. The site will be dissected by the proposed road development.

ER 4 Rincullia

This site is rated of Local Importance (Lower Value) and consists of a block of dense scrub (WS1) dominated by hawthorn and hazel (*Corylus avellana*) to the east of a minor road at Rincullia from Ch.3+600 to 3+975. The scrub occurs on an area of shallow soils and includes some Blackthorn, Willow and Elder in the canopy. The understorey is poorly developed with abundant Briar and Ivy (*Hedera helix*) along with occasional ferns (*Asplenium scolopendrium* and *Dryopteris* sp.) and Lesser Celandine (*Ranunculus ficaria*). This site will be dissected by the proposed road development.

ER 6 Ballyclogh

The site at Ballyclogh is rated of Local Importance (Lower Value) and consists of a series of low-lying fields which, prior to drainage, are likely to have supported fen habitat (PF1) but is now an area of seasonally grazed wet grassland (GS4) with an associated drainage ditch running in a west to east direction. See chainages Ch. 6+700 to 10+050. The site is bordered to the north by the L6062 road which separates it from KER 7 to the northeast. The vegetation is dominated by Rushes (*Juncus* sp.) with Creeping Bent (*Agrostis stolonifera*), Sedge (*Carex flacca*), Marsh Thistle (*Cirsium palustre*), Marsh Violet (*Viola palustris*), Mint (*Mentha aquatica*), Meadowsweet, Common Fleabane (*Pulicaria dysenterica*) and occasional clumps of Black Bog Rush (*Schoenus nigricans*). The associated drainage ditch (FW4) is choked with Common Reed (*Phragmites australis*), Hemp-agrimony (*Eupatorium cannabinum*), Meadowsweet and small amounts of Saw Sedge/Swamp Sawgrass (*Cladium mariscus*). It has a tree-line of low Willow along its eastern end. The site will be dissected by the proposed road development.

ER 8 Cloonreask

This site is rated of Local Importance (Lower Value) and consists of a low-lying block of wet grassland (GS4) with a drainage ditch (FW4) running in a northerly direction through the site, extending from Ch. 10+825 to 11+050. The site may have supported fen habitat in the past as the spoil arising from dredging of the ditch consist of marl suggesting shallow lake conditions. The species composition is similar to the wet grassland at Ballyclogh (ER6) though in addition supports some Yellow-wort (*Blackstonia perfoliata*), Tormentil (*Potentilla erecta*), with occasional young Gorse (*Ulex europaeus*) and Willow shrubs. The drainage ditch supports little vegetation as it had been recently cleared. This site will be dissected by the proposed road development.

ER 12 Baunreagh

This site is rated of Local Importance (Lower Value) and consists of an area of mostly low-lying ground with a mosaic wet grassland (GS4) and scrub with a network of drainage ditches (FW4) from Ch. 21+850 to 22+500. There has been some recent drainage and scrub clearance in parts, though a number of blocks of scrub still occur. The grassland is not species rich and is dominated by Rushes, Creeping Bent, Creeping Buttercup (*Ranunculus repens*) and Silverweed, with Yellow Flag, Mint, Horsetail (*Equisetum* sp.) and Brooklime occasionally in wetter areas. The proposed road development clips the north-eastern corner of the site.

ER 13 Ballynacaheragh

This small site is classified as being of Local importance (Lower Value) and consists primarily of scrub (WS1) with some patches of dry meadow and grassy verge (GS2) in what appears to be an old quarry site from Ch 22+925 to Ch. 23+050. There is some exposed gravel and glacial till forming recolonising bare ground (ED3). The scrub is dominated by Hazel, Hawthorn, Willow and Blackthorn with abundant Briar. The understorey consists of woodland herbs including Primrose, Lords and Ladies, Wood False-brome (*Brachypodium sylvaticum*) and Ground Ivy (*Glechoma hederacea*). The open grassland community includes various coarse grasses such as Cock's-foot and False Oat-grass (*Arrhenatherum elatius*) along with forbs such as Hogweed (*Heracleum sphondylium*), Knapweed and Wild Carrot (*Daucus carota*). There is a small wet hollow which supports Mint, Red Bartsia, Silverweed and Devil's-bit Scabious. This site will be crossed by the proposed road development.

ER 22 Clonshire

This site is rated of Local Importance (Lower Value) and consists of large open fields of wet grassland (GS4) and dry calcareous and neutral grassland (GS1) flanking either side of the Clonshire River (FW4) between Ch. 56+100 and 56+500. The grassland is primarily dry in the vicinity of the proposed road development, with a wet grassland extending to the east towards the river, where Flag Iris and Rushes are both abundant. The north of the site is bounded by a treeline (WL2) of Ash and occasional Sycamore. The eastern river bank is also flanked by a treeline of Ash, Alder and Willow, while the western bank is primarily Briar scrub (WS1). The proposed road development crosses the western corner of the site.

7.3.8 Aquatic Sites

A total of 20 watercourses are crossed by the proposed road development as listed in Table 7.7, which also gives the Chainage of the crossing point and rates their ecological value in accordance with Section 7.2.3. Watercourses have been identified from the OSi Discovery mapping, which typically does not include drainage ditches. However, many of the smaller watercourses have been heavily modified and appear as drainage ditches, having lost any natural channel variability and associated flow regime. Many of the watercourses are within sites identified as KERs, as detailed in Section 7.3.6 above. A summary description of each watercourse is given in Table 7.8 which includes their fisheries value, associated protected species and water quality based on the invertebrate biotic index (Q-value). Details on the protected aquatic species associated with the various watercourses is presented below.

Table 7.7 Watercourses crossed by the proposed road development.

| Ref. No. | Watercourse name | Chainage | Evaluation |
|----------|------------------------------|--------------------------|---------------------------------|
| W1 | Stream at Ardaneer | Ch. 1+100 | Local Importance (Lower Value) |
| W2 | Stream at Sroolane North | Ch. 2+150 | Local Importance (Lower Value) |
| W3 | Stream at Sroolane North | Ch. 2+500 | Local Importance (Lower Value) |
| W4 | Stream at Robertstown | Ch. 2+700 | Local Importance (Higher Value) |
| W5 | Ahacronane River | Ch. 4+450 | County Importance |
| W6 | Stream at Ballyclogh | Ch. 7+150 and Ch. 10+150 | Local Importance (Lower Value) |
| W7 | Ballycullen Stream | Ch. 10+300 | Local Importance (Higher Value) |
| W8 | Stream at Clonreask | Ch. 10+950 | Local Importance (Lower Value) |
| W9 | Ballycullen Stream | Ch. 20+950 | Local Importance (Higher Value) |
| W10 | Stream at Baunreagh | Ch. 21+950 & Ch. 22+450 | Local Importance (Lower Value) |
| W11 | River Deel at Milltown North | Ch. 24+000. | National Importance |

| Ref. No. | Watercourse name | Chainage | Evaluation |
|----------|-----------------------------------|--|------------------------------------|
| W12 | Doohyle Stream at Bullaun | Ch. 24+500 to Ch. 24+950 | Local Importance (Higher Value) |
| W13 | Doohyle Stream at Graigeen | Ch. 26+880 to Ch. 27+050 | Local Importance (Higher Value) |
| W14 | Doohyle Stream at Kyletaun | Ch. 28+200 to Ch. 28+300 and Ch. 28+550 to Ch. 28+750 | Local Importance (Higher Value) |
| W15 | Cloghatrida Stream at Blossomhill | Ch. 50+780 to Ch. 51+060 | Local Importance (Higher Value) |
| W16 | Clonshire River at Clonshire More | Ch. 56+550 | County Importance |
| W17 | Greanagh River A at Rower More | Ch. 58+180 | County Importance |
| W18 | Greanagh River B | Ch. 59+200 | County Importance |
| W19 | River Maigue | Ch. 60+850 to Ch. 61+000 | International Importance |
| W20 | Stream at Monearla | Ch. 64+500 to Ch. 64+550 | Local Importance (Higher Value) |

The River Maigue is crossed within its estuarine reaches and does not support spawning habitat for salmonids or lamprey species. The substrate in the vicinity of the crossing point is characterised by soft muds overlying coarse aggregates and large boulders. The river is subject to a c. 2.5 m tidal range in the vicinity of the bridge location and there is a corresponding zonation in the bankside vegetation communities (this is described in more detail under KER 26 in Section 7.3.6 above). The River Maigue is a renowned salmon fishery and also supports good populations of Brown Trout (*Salmo trutta*), both resident and anadromous ("sea/slob trout") and Sea Trout. It also supports spawning by lampreys, possibly both Sea Lamprey and River Lamprey, though upstream migration may be impeded by weirs.

The River Deel in the vicinity of the crossing point is approximately 15 m in width, with steep banks that have been modified during arterial drainage works in the past. The substrate comprises cobbles and boulders, with banks of softer sediments which support stands of bulrush. The substrate was heavily fouled with filamentous algae during all survey visits indicating nutrient enrichment. Nonetheless, the river supports moderate populations of trout and is an important recreational fishery.

The Greanagh River, Clonshire River, Cloghatrida Stream and Ahacronane River are all moderate sized watercourses ranging from 2 m to 6 m in width. They support populations of Brown Trout along with a range of other fish species (see Section 7.3.12 below). As with the Rivers Maigue and Deel, these watercourses have all been subject to some modification for drainage purposes in the past which has led to more uniform channel structure and gradient with a consequential simplification of the flow regime and value for fish and other biota.

The remaining watercourses are all heavily modified channels with the characteristics of drainage ditches. These are frequently deeply excavated channels up to 4 m below

adjacent ground level, with long uniform profiles. Substrates as a result are normally dominated by silts with associated dense beds of macrophyte and emergent vegetation. These support good invertebrate populations and provide suitable habitat for small fish (Minnow, Stickleback and possibly juvenile Brown Trout) and Eels.

Water quality in watercourses is generally moderate (Q3-4) with most showing evidence of nutrient enrichment or high sediment loads as a result of intensive land management within the catchment. Due to the underlying limestone geology, all the watercourses are trending towards high alkalinity which in some locations leads to a calcification of the substrate.

Table 7.8 Summary description of watercourses and associated attributes

| Ref. No. | River | Description | Fisheries value | Protected Species | Q Value (EPA) | Evaluation |
|----------|--------------------------|---|---|--|---|---------------------------------|
| W1 | Stream at Ardaneer | 2-3 m in width, depth c. 0.5 m. Substrate silty. Rising from spring at base of knoll to east of existing N69. No apparent flow and heavily choked vegetation (<i>Apium</i> , <i>Glyceria</i> , <i>Sparganium</i> and <i>Lemna</i>). Banks steep and adjacent wet grassland and briar scrub. | Likely to support Minnow and Three-spined Stickleback and possibly Eel. | No evidence of White-clawed Crayfish. Otter activity may occur sporadically. | Unsuited for kick-sampling. Nutrient levels appear high and possibly enriched. | Local Importance (Lower Value) |
| W2 | Stream at Sroolane North | Minor stream width c. 1 m depth and abundant growth of watercress. | May support populations of Minnow. | Not suited for White-clawed Crayfish and unlikely to support regular Otter movement. | Unsuited for kick-sampling. Nutrient levels appear high and possibly enriched. | Local Importance (Lower Value) |
| W3 | Stream at Sroolane North | Minor stream width c. 1 m depth and abundant growth of watercress. Tributary of the Robertstown Stream | May support populations of Minnow. | Not suited for White-clawed Crayfish and unlikely to support regular Otter movement. | Unsuited for kick-sampling. Nutrient levels appear high and possibly enriched. | Local Importance (Lower Value) |
| W4 | Robertstown Stream | Flows into western side of Churchfield Estuary c. 0.5 m downstream of crossing point. Width 3-4 m, depth c. 0.5 m. Glide flow on gravel and cobble substrate. Banks steep with abundant coarse grasses, nettle, Phalaris and Sparganium. Some riffle habitat in lower channel. | Trout present and may support brook lamprey though no evidence recorded. Probable Minnow, Three-spined stickleback and Eel. | Otter activity recorded in lower reaches near estuary and movement along river expected. No evidence of White-clawed Crayfish. Kingfisher likely though no suitable nesting habitat in vicinity of crossing point. | Evidence of enrichment with heavy algal growth on substrate. Q 3 recorded in lower reaches on riffle habitat. | Local Importance (Higher Value) |

| Ref. No. | River | Description | Fisheries value | Protected Species | Q Value (EPA) | Evaluation |
|----------|----------------------|---|--|--|--|---------------------------------|
| W5 | Ahacronane River | Flows into eastern side of Churchfield Estuary c. 0.5 km downstream of crossing point. Width 2-3 m, depth 0.2 – 0.4 m. Calcareous stream on gravel and cobble with good riffle, glide, pool sequence. River braids into channels within alluvial woodland upstream of crossing. | Trout present and may support Brook Lamprey, Minnow, Three-spined stickleback and Eel. | No evidence of White-clawed Crayfish despite apparent suitability of chemistry. Otter likely to be present though no evidence of holt sites. Kingfisher likely though no suitable nesting habitat in vicinity of crossing point. | Q4 in vicinity of crossing but Q3 (poor) at Br. west of Barrigone. | County Importance |
| W6 | Stream at Ballyclogh | Minor stream width c. 1 m depth and abundant growth of watercress. Tributary of the Ballycullen Stream | May support populations of Minnow. | Not suited for White-clawed Crayfish and unlikely to support regular Otter movement. | Unsuited for kick-sampling. Nutrient levels appear high and possibly enriched. | Local Importance (Lower Value) |
| W7 | Ballycullen Stream | Width 2-3 m, Depth 0.1 – 0.4 m. Glide and pool with occasional riffle on silty substrate with some sand, gravel and cobble. Tree-lined over much of length with some instream vegetation where open to light. Calcified substrate reduces spawning potential. Channel modified over much of length. | Trout present and may support Brook Lamprey, Minnow, Three-spined stickleback and Eel. | No evidence of White-clawed Crayfish despite apparent suitability of chemistry. Otter likely to be present though no evidence of holt sites. Kingfisher likely though no suitable nesting habitat in vicinity of crossing point. | Q3-4 due to high silt load. | Local Importance (Higher Value) |
| W8 | Stream at Cloonreask | Minor stream – width 1 m, depth 0.15 – 0.2 m. Silty substrate with gravel and cobble. Modified channel with some marginal aquatics along banks and adjoining hedgerow. | Unsuited for Trout but may support Minnow. | Unsuited for White-clawed Crayfish and unlikely to support regular Otter movement. | Unsuited for kick sampling. | Local Importance (Lower Value) |

| Ref. No. | River | Description | Fisheries value | Protected Species | Q Value (EPA) | Evaluation |
|----------|---------------------|---|--|---|--|---------------------------------|
| W9 | Ballycullen Stream | Width 2-3 m, Depth 0.1 – 0.4 m. Glide and pool with occasional riffle on silty substrate with some sand, gravel and cobble. Tree-lined over much of length with some instream vegetation where open to light. Calcified substrate reduces spawning potential. Channel modified over much of length. | Trout present and may support Brook Lamprey, Minnow, Three-spined stickleback and Eel. | No evidence of White-clawed Crayfish despite apparent suitability of chemistry. Otter likely to be present though no evidence of holt sites. Kingfisher likely though no suitable nesting habitat in vicinity of crossing point. | Q3-4 due to high silt load. | Local Importance (Higher Value) |
| W10 | Stream at Baunreagh | Minor stream – width 1 m, depth 0.15 – 0.2 m. Silty substrate in modified channel with some marginal aquatics along banks and adjoining hedgerow. | Unsuited for Trout but may support Minnow. | Unsuited for White-clawed Crayfish and unlikely to support regular Otter movement. | Unsuited for kick sampling. | Local Importance (Lower Value) |
| W11 | River Deel | Major river width c. 15 m and depth 0.3 – 1.0 m. Banks steep as previously dredged. Substrate cobble and boulder on glide flow. Some instream vegetation (Scirpus, Myriophyllum, Fontinalis) and abundant algae. Marginal fringe of reed swamp in places. | Resident population of Brown Trout and also some stocking taken place. Salmon apparently not able to migrate above Askeaton. Likely to support Eel, Brook Lamprey and Stone Loach. | White-clawed Crayfish present upstream of Askeaton, but recent outbreak of aphanomycosis (“crayfish plague”) appears to have decimated population at least upstream to Rathkeale. Otter present though no holts in vicinity of crossing. Kingfisher present and nest site located c400m upstream of crossing. | Q3 (poor) at Kilcool Bridge (EPA data 2014). Heavy loads of filamentous algae in vicinity of crossing point suggest high levels of enrichment. | National Importance |

| Ref. No. | River | Description | Fisheries value | Protected Species | Q Value (EPA) | Evaluation |
|----------|----------------------------|---|--|--|--|---------------------------------|
| W12 | Doohyle Stream at Bullaun | Width 2-3 m, depth 0.2 – 0.5 m. Substrate gravel and cobble in steep sided channel with predominantly gentle glide flow. Heavily vegetated banks with woodland to east and trees / scrub along west bank. Tributary of River Deel flowing out of Doohyle Lough. | Trout present and may support Brook Lamprey, Minnow, Three-spined stickleback and Eel. | White-clawed Crayfish further upstream though none evident at Bullaun. Recent outbreak of crayfish plague in Deel may have affected population. Otter likely to occur though no holts in vicinity of crossing. Kingfisher may occur in open stretches – no nest sites. | Q4. | Local Importance (Higher Value) |
| W13 | Doohyle Stream at Graigeen | Width 2 m, depth 0.3 – 0.5 m. Steep sided dredged channel with densely vegetated banks. Substrate silts with some gravel and cobble. Limited flow. | Unlikely to support Trout but may support Minnow, Three-spined stickleback and Eel. | White-clawed Crayfish present. Otter movement probable though no evidence of activity and no holts sites present. May support kingfisher but no nest sites. | Not suited to kick sampling but likely to be Q3-4 due to high silt load. | Local Importance (Higher Value) |
| W14 | Doohyle Stream at Kyletaun | Width 2 m, depth 0.1 – 0.3 m. Deep channel c. 3-4 m below adjacent ground level in places. No evident flow and pool like conditions with sandy gravel substrate. Densely vegetated in open areas with Sparganium, watercress, starwort and duckweed. Where canopied | Unlikely to support Trout but may support Minnow, Three-spined stickleback and Eel. | No evidence White-clawed Crayfish though may be present. Otter movement probable though no evidence of activity and no holts sites present. May support kingfisher but no nest sites. | Not suited to kick sampling but likely to be Q3-4 due to high silt load. | Local Importance (Higher Value) |

| Ref. No. | River | Description | Fisheries value | Protected Species | Q Value (EPA) | Evaluation |
|----------|-----------------------------------|---|---|--|---|---------------------------------|
| W15 | Cloghatrida Stream at Blossomhill | Width 1.5 m, depth 0.15 – 0.2 m. Minor stream flowing into Blossomhill Lake within steeply sided excavated channel heavily overgrown by scrub and hedgerows. Substrate silty with abundant watercress and duckweed. | Unlikely to support Trout but may support Minnow, Three-spined stickleback and Eel. | No evidence White-clawed Crayfish. Otter movement probable though no evidence of activity and no holt sites present. May support kingfisher but no nest sites. | Not suited to kick sampling but likely to be Q3-4 due to high silt load. | Local Importance (Higher Value) |
| W16 | Clonshire River at Clonshire More | Tributary of the Greanagh River. Width 4 m, depth 0.2 – 0.4 m. Gravel and cobble substrate with some sands. Calcareous. Mostly glide and pool with occasional riffle and small rapid. Instream vegetation limited to mosses and liverworts but fringe of Oenanthe and Phalaris along banks where open. Tree-lined along eastern bank, open to west. | Trout present and likely to support Brook Lamprey, Minnow, Three-spined stickleback, Stone loach and Eel. | No evidence of White-clawed Crayfish despite apparent suitability of chemistry. Otter likely to be present though no evidence holt sites. Kingfisher likely though no suitable nesting habitat in vicinity of crossing point. | Q4 with clean calcified substrate. | County Importance |
| W17 | Greanagh River A at Rower More | Width 4-5 m, depth 0.2 – 0.5 m. Gravel and cobble calcified substrate with silty deposits and algae. Mostly glide and pool with occasional riffle. Instream vegetation limited to mosses and liverworts but fringe of Oenanthe and Phalaris along banks where open. Fringe wet woodland along eastern bank, open to west. | Trout present and likely to support Brook Lamprey, minnow, Three-spined stickleback, Stone loach and Eel. | No evidence of White-clawed Crayfish despite apparent suitability of chemistry. Otter likely to be present though no evidence of holt sites. Kingfisher likely though no suitable nesting habitat in vicinity of crossing point. | Q3 with frequent algae and silt evident (Q3 recorded at Tuogh Bridge EPA 2014). | County Importance |

| Ref. No. | River | Description | Fisheries value | Protected Species | Q Value (EPA) | Evaluation |
|----------|--------------------|--|--|---|---|---------------------------------|
| W18 | Greanagh River B | Tributary of the River Maigue. Estuarine with tidal surge upstream to Coolah Bridge. Width 5-6 m, depth 0.2 – 0.8 m. Cobble, gravel with silts. Excavated channel with tidal embankments on both sides. Gentle glide flow. | May not receive saline intrusion and may support Trout though unsuited for spawning. Likely to support Brook Lamprey, Minnow, Three-spined stickleback, Stone loach and Eel. | Not suitable for White-clawed Crayfish. Otter present though no evidence of holt sites. Kingfisher likely though no suitable nesting habitat in vicinity of crossing point. | Q3 recorded at Coolah Bridge EPA 2014. | County Importance |
| W19 | River Maigue | Estuarine in vicinity of crossing point and upstream to Adare. Width c. 40m, depth from 0.3 m during low water to >2.0 m at high water. Flood embankments on both sides with strip freshwater marsh / reed swamp on lower banks. | Salmon, Brown Trout and Lamprey present but no spawning or nursery habitat in vicinity of or downstream of crossing point. | White-clawed Crayfish recorded upstream of Adare but conditions unsuited at crossing point. Kingfisher present but no suitable nesting habitat in vicinity of crossing point. Otter present though no evidence of holts in vicinity of crossing point. | Q3-4 recorded at Castleroberts Bridge EPA 2014. | International Importance |
| W20 | Stream at Monearla | Width 1 - 1.5 m, depth 0.1 – 0.3 m. Cobble and gravel substrate with abundant algae in modified channel with uniform glide flow. Heavily tunnelled with overhanging vegetation. | Trout present and may support Brook Lamprey, Minnow, Three-spined stickleback and Eel. | No evidence of White-clawed Crayfish. Potential for Otter though no holts recorded in vicinity of crossing. Kingfisher likely though no suitable nesting habitat in vicinity of crossing point. | Q3 (Poor) at bridge south-east of Clarina. | Local Importance (Higher Value) |

7.3.9 Mammals

A range of mammalian species afforded protection under the Wildlife Acts occur within the study area, including Otter (*Lutra lutra*), Badger (*Meles meles*), Pine Marten (*Martes martes*), Hedgehog (*Erinaceus europaeus*), Irish Stoat (*Mustela erminea hibernica*), Red Squirrel (*Sciurus vulgaris*), Red Fox (*Vulpes vulpes*) and Irish Hare (*Lepus timidus hibernicus*). The non-native American Mink (*Neovison vison*) has been recorded from the Greanagh and Maigue rivers on the NBDC website, though this listed invasive species is likely to be widespread throughout the study area. A range of small mammals are also likely to be widespread throughout the study area, including Rabbit (*Oryctolagus cuniculus*), Pygmy Shrew (*Sorex minutus*), Field Mouse (*Apodemus sylvaticus*), Brown Rat (*Rattus norvegicus*), Bank Vole (*Myodes glareolus*) and the Greater White-toothed Shrew (*Crocidura russula*), which has recently been recorded west of the Maigue.

Otter (*Lutra lutra*)

European Otter, which is also listed on Annex II and IV of the Habitats Directive, is recorded from more than 20 of the 1 km x 1km grid squares within the study area (NBDC, 2018) and is likely to occur on all watercourses crossed by the proposed road development. Given the distribution of lakes and fens within the study area, there is also a high potential for periodic movement of otter between these features which may be along drainage ditches but also potentially across open country. Signs of otter activity (primarily in the form of spraints) were recorded from the Ahacronane, Deel, Greanagh, Clonshire and Maigue rivers during the surveys. No evidence of any holt or couch sites was recorded in the vicinity of any of the proposed crossing points. Given the fish stocks present in these watercourses, unimpeded movement of otter will be required at all watercourse crossings with associated guide fencing.

Badger (*Meles meles*)

Signs of badger activity were recorded at a number of locations along the proposed road development evidenced by trails, dung latrines, foraging scrapes and setts. A total of five active setts were recorded from within the footprint of the proposed road, or on the boundary of the CPO line. These setts will require re-surveying to determine precise locations relative to the construction requirements prior to the commencement of construction. Where setts are outside of the footprint of works, they will be afforded protection in the form of an exclusion zone defined by robust fencing. Where within the footprint of proposed works, they will require exclusion in accordance with the procedures defined in the *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (TII, 2006). In addition, some areas of dense scrub may conceal setts. These areas should also be re-surveyed prior to construction to check for setts. Due to their sensitivity to disturbance, locations where activity and sett locations were recorded are not provided.

Pine Marten (*Martes martes*)

There is only one single Pine Marten record in the vicinity of the proposed road development on the NBDC website, which is from the Adare area (R462463). However, isolated records exist to the south of Rathkeale and to the west of Foynes, and it is probable that this secretive mammal is more widespread in the vicinity of the proposed road development but is under-recorded. Pine Marten is also listed on Annex IV to the Habitats Directive. This species is typically associated with woodland areas but utilises hedgerows and scrub areas also. Given that the Irish population is currently undergoing a dramatic increase and resultant range expansion, it is to be expected that Pine Marten will colonise suitable habitat in the study area in the near future, if not already present.

Irish Stoat (*Mustela erminea hibernica*)

There are a small number of Irish Stoat records within the study area on the NBDC website. Stoats occupy a range of habitat types though generally avoid open landscapes lacking in cover. They are particularly associated with open woodland and scrub areas and would be expected to occur at Rincullia (KER4), Craggs (KER5), Nantinan (KER14) and Kyletaun (KER20). However, they could be more widespread along the entire route corridor with the possible exception of the more intensively farmed lands between Rathkeale and Adare.

Hedgehog (*Erinaceus europaeus*)

There are scattered records of Hedgehog within the study area on the NBDC website, many of which are road traffic casualties. The paucity of records may reflect the absence of recorders from the area however, as the habitats throughout the majority of the study area are suitable for the species. Hedgehogs are preyed upon by Badger, and the generally low evidence of Badger activity from the vicinity of the proposed road development alignment may be to the advantage of the Hedgehog. A single road kill Hedgehog was observed during surveys on the N69 Robertstown.

Red Squirrel (*Sciurus vulgaris*)

There are records of Red Squirrel from Foynes (R250508), Craggs (R300485), Curraghchase (R397487/R44) and Adare Manor (R44) on the NBDC website. Red Squirrels are also likely to occur in other woodland areas along the proposed road development including at Nantinan (KER14), Ballycullen (KER10) and Graigeen/Ballingarrane (KER17).

Irish Hare (*Lepus timidus hibernicus*)

Irish Hare is typically associated with open habitats, though these range from saltmarsh to upland moors. Within the study area, hares are likely to be found in areas of permanent pasture though these may be in mosaic areas such as Craggs or more open intensively farmed areas such as at Clogh East. Scattered records from the study area occur on the NBDC website. Population densities of Irish Hare are highly variable from year to year, which may relate to food supply in autumn, weather conditions over winter and predation (Hayden and Harrington, 2000).

Red Fox (*Vulpes vulpes*)

Red Fox is probably the most widespread mammal in Ireland as it is highly versatile and adaptable with no specific habitat requirements. While poorly recorded from the study area on the NBDC website, foxes are likely to occur in the vicinity of the entirety of the proposed road development.

Deer

There are no records of Red Deer (*Cervus elaphus*) or Sika Deer (*Cervus nippon*) from within the study area. However, both species (which hybridise readily) are widespread in the southwest of the county and have been undergoing a considerable range expansion over the past few decades. The nearest record for Red Deer is from Ahane (R2032), c. 20 km west of Rathkeale, while the nearest record for Sika Deer is to the west of the study area at Tarbert (R04) (NBDC website). While Fallow Deer (*Dama dama*) are recorded from the study area on the NBDC website, consultation with the local NPWS staff suggests that they have not yet colonised west of the Maigue. However, as with Red and Sika deer, they are also undergoing a steady range expansion and can be expected to occur in the study area in the near future. All three deer species require dense cover to lie up during the day while moving out into pasture and open areas to forage at night.

7.3.10 Bats

Winter Daytime Inspections

There are no known major hibernation sites with large numbers of bats along or within several kilometers of the proposed road development and none were identified during the present assessment. However, structures such as bridges, medieval tower houses, farm buildings, disused buildings and mature trees in the study area offer unlimited crevices into which bats may secrete themselves individually or in small numbers. Finding single animals in such places is extremely difficult and individual bats may be overlooked. Hibernation sites can also be transient and used only occasionally by bats and their presence may be missed due to timing. The structures listed in Table 7.9 were inspected.

Table 7.9 Summary results of Winter Bat Survey

| Site Name Location | Location | Results of Winter Survey |
|--|-----------------------|---|
| Clonshire Castle | Off-line Ch 56+450 | LHB droppings were recorded within the structure. |
| Clonshire Bridge | Ch 56+500 | Suitable crevices for roosting bats. |
| Railway Bridge at Ballycullen | Ch 11+300 | Suitable crevices for roosting bats. |
| Railway Bridge at Clonshire | Ch 58+000 | Suitable crevices for roosting bats. |
| Railway Bridge at Feeagh | Off-line Ch 25+550 | Suitable crevices for roosting bats. |
| Derelict cottage & church at Feeagh | Off-line Ch 25+800 | Both suitable for roosting bats. (Soprano pipistrelles were recorded 25/04/2018). |
| Ballycullen House outbuildings | Off-line Ch 20+550 | A small number of LHB and brown long-eared bat droppings recorded in open sheds. |
| Derelict buildings adjacent to Ahacronane River / Bridge | Off-line Ch 4+450 | LHB droppings recorded. |
| Agriculture buildings at Islandea | Ch 50+800 | No evidence of bat usage. |
| Agricultural buildings at Rineroe | Ch 62+400 | No evidence of bat usage. |

Spring Night-time Bat Surveys

Full details of the walking transects undertaken for the Spring Surveys in 2018 along with survey locations and weather conditions are presented in the Four-Season Bat Report (Appendix 7.1 in Volume 4A of this EIAR). A total of 197 bat encounters were recorded during surveys along the proposed road development. These were marked on maps and are presented in the appendices to the Four-Season Bat Report along with the corresponding results for each bat encounter location. Frequently, more than one bat species was recorded per bat encounter location.

In summary, common pipistrelles was the most frequently encountered bat species and was recorded at 124 locations. Soprano pipistrelles were recorded at 119 locations followed by Leisler's bats at 42 locations. *Myotis* species was encountered at 24 points and this consisted of 15 positive detections of Daubenton's bat and one positive

identification of Natterer's bat. Brown long-eared bats were detected at six points during the walking transects.

During the Dawn Survey of Askeaton town environs undertaken on 24/04/2018, soprano pipistrelles, common pipistrelles and Daubenton's bats were detected foraging along the River Deel from Askeaton Castle to the Franciscan friary. Three species of bat were detected foraging within the grounds of the friary: common pipistrelle, soprano pipistrelle and Natterer's bat. Three species of bat were also recorded foraging along the roadways leading to the N69: common pipistrelle, soprano pipistrelle and Leisler's bat.

During the Dawn Survey of Foynes town environs undertaken on 24/04/2018 only common pipistrelles and soprano pipistrelles were detected along the local roads leading from the entrance to Shannon-Foynes Port to the outskirts of the town.

During the Dusk Survey of the river walkway in Adare undertaken on 29/04/2018, extensive foraging of five species of bat were recorded: common pipistrelles, soprano pipistrelles, Leisler's bats, Daubenton's bats and brown long-eared bats.

High levels of bat activity were noted at the following locations on the route of the proposed road development:

- Chainage 6+250 Townland of Ballyclogh
- Chainage 20+400 Townland of Ballyclogh
- Chainage 11+900 Townland of Clonreask
- Chainage 23+600 Townland of Milltown North
- Chainage 25+400 Townland of Feeagh
- Chainage 25+550 Townland of Feeagh
- Chainage 62+700 to 63+300 along the River Maigne
- Chainage 63+450 Townland of Ardshanbally

Spring Passive Static Bat Surveys

Static recording units were placed to record nightly in locations at nineteen locations along the proposed road development accumulating a total of 400 hours of recordings. Recordings were analysed to species level, where possible, except for *Myotis* species, which are often too difficult to distinguish from one another. The locations of the static recorders are shown in Plate 7.12 below

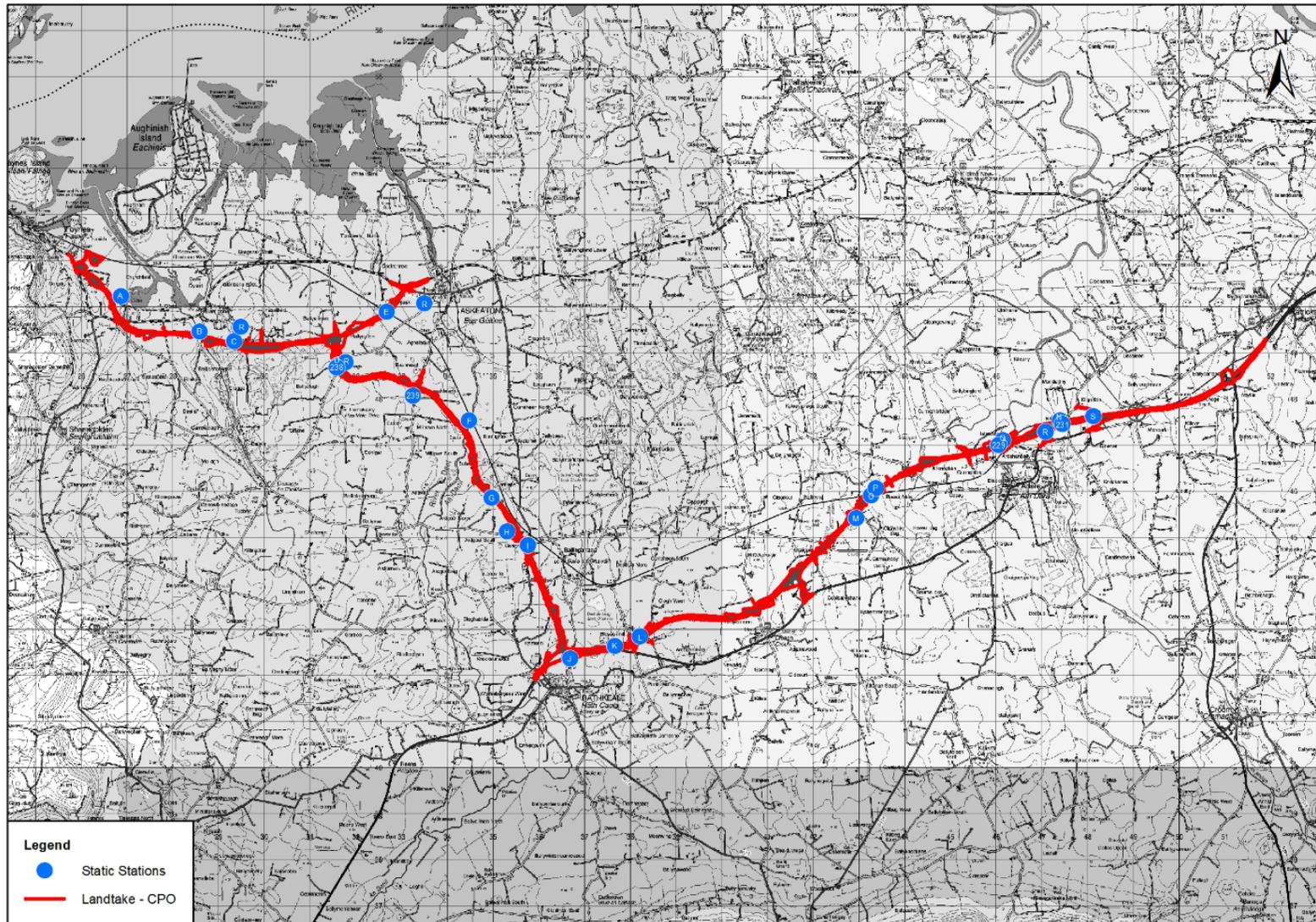


Plate 7.12: Static Stationary Unit Locations during Spring Bat Survey, 2018. (Please note that the static locations are in alphabetical order and that Statics M-P are in close proximity to each other. Therefore, Statics N and O are obscured by Statics M and P labels).

The results from the static stations survey provides essential information in relation to the presence of Lesser Horseshoe Bats, as this species was not detected during the walking transects. Lesser Horseshoe Bats were detected at 12 of the 19 static stations. The static stations where this species was recorded emphasise the importance of the disused railway line, rivers and woodland in the immediate landscape of the proposed road for this bat species.

Common pipistrelle and soprano pipistrelle were detected at all 19 stations, thereby confirming that these two species are most common bat species in the survey area. Common pipistrelle was detected at a high level of bat activity at 6 static stations while soprano pipistrelle was detected in high levels of bat activity at 7 static stations. Leisler's bats were detected at 17 of the stations, generally in low to medium levels of bat activity, indicating commuting individuals. *Myotis* species were recorded at 11 of the stations and generally the bat activity level was deemed low. Brown long-eared bats were present in vicinity of 4 static stations while Nathusius' pipistrelle was only recorded at 1 static station (Chainage 62+450).

Summer & Autumn Bat Surveys

Kelleher (2017) completed Summer and Autumn surveys along the proposed road development on the 28th and 29th August, 26th and 27th September and 14th October 2016. Several buildings including dwellings and farm outbuildings, in three separate locations, that are immediately adjacent to the proposed road development corridor were surveyed for the presence of bats in August and September 2016. The following are the results extracted from Kelleher (2017).

Kelleher noted that key locations of importance for bats along the route include watercourses (Rivers Ahacronane, Deel, Clonshire, Greanagh and Maigue) and treelines and hedgerows. Additional habitats of importance adjoining the route include small areas of woodland and scattered trees in areas such as at Ballycullen House.

Kelleher reports Common and Soprano Pipistrelles were ubiquitous throughout the study area and were found using a variety of habitats including watercourses, hedgerows, treelines, parkland, and areas of woodland. Daubenton's bat was typically found along watercourses and was present over each of the local rivers. Leisler's bats were most frequently detected feeding over street lights in and around the villages of Foynes, Askeaton, Rathkeale, and Adare and also over open countryside across the area. Brown Long-eared bats are likely to be more frequent within the study area than the current survey indicates as these bats are seldom heard on a bat detector. The species was detected at Ballycullen, Askeaton and in the woodlands at Adare. *Myotis* sp. (Whiskered, Natterer's and Daubenton's) are also likely to be more abundant in areas of woodland than detected as these habitats are used by a variety of bat species for foraging and roosting purposes. Whiskered bats were encountered at Ballycullen and in the Adare woodlands and Natterer's bat was also present at the latter site.

Kelleher (2017) stated that Lesser Horseshoe Bats formerly roosted in Adare Manor prior to its development as a hotel and other known major roost sites for this species include several roosts around Curraghchase (Roche 2001) which is within 4 km of the proposed road development and at Ballywilliam House estate near Rathkeale. The only observation of a Lesser Horseshoe Bat during the Summer and Autumn Surveys was of a commuting/hunting specimen at Clonshire Beg, west of Adare, in August 2016. This species produces a very narrow echolocation call which is extremely difficult to detect and especially so in areas where the population is low, so this species may be more widespread in the local landscape than these surveys would suggest but, as

is known from prior local studies, this species' numbers are greater north of the proposed road development at Curraghchase than they are in the Adare area.

A summary of the Summer and Autumn surveys at structures along the proposed road development is presented below:

Ballycullen House and outbuildings

This large farmhouse and its adjoining outbuildings were surveyed on 28th August 2016 when five species of bat were recorded flying near these structures, these included Common and Soprano Pipistrelle, Brown Long-Eared, Leisler's and Whiskered Bats. Of these, the Brown Long-Eared Bats were observed exiting the outbuildings and the Pipistrelles and Whiskered Bats may also have emerged from these structures, but this was not confirmed. The Leisler's bats did not originate from the farmhouse or the outbuildings.

Stone cottage and associated structures at Ardshanbally

No evidence of bats was noted at the cottage and sheds at Ardshanbally in September 2016 and no associated bat activity was recorded during the detector survey at this time. Also, at this time, no bat activity was observed at the nearby cottage to the immediate east of the railway line here where pipistrelles were noted roosting during a previous survey of this structure in August 2005.

In September 2016, male Leisler's bats and Pipistrelle bats were noted by Kelleher (2017) emitting social calls as enticements to attract females for mating along the lane at Ardshanbally where mature tree specimens act as advertisement locations.

Bungalow and farm buildings at Blossomhill

The disused bungalow at Blossomhill had been badly damaged by fire prior to survey and the building was effectively roofless and as such was not fit for habitation by bats. The nearby farm buildings are certainly suitable for bat-use and, although no bat activity was noted at these structures during the present survey, it is highly likely that the older buildings in the complex are in occasional use by these animals. Male Pipistrelle bats were also advertising their presence to females while on the wing in the grounds of Ballycullen House.

Additional buildings were surveyed in August 2018 and 2019. Ten buildings / structures were surveyed and this resulted in the identification of three confirmed roosts and two potential roost sites.

Surveys of trees along the proposed route in June 2018 identified 103 Potential Bat Roosts (PBRs).

Overview of Survey Results for Bat Species

The Four-Season Bat Survey recorded all nine resident bat species in vicinity or online of the proposed road route.

Lesser Horseshoe Bat

While all bat species in Ireland are afforded protection under Annex IV of the EU Habitats Directive, the Lesser Horseshoe Bat is the only resident bat species afforded protection under Annex II and is listed as a qualifying Interest for the Curraghchase Woods SAC. Lesser Horseshoe Bats were recorded along much of the length of the proposed road route on static recording units. Compared to other regions on the west coast of Ireland where this species is found, the number of individuals and roosts is

considered to be low in County Limerick, and therefore vulnerable. The Irish Landscape Model indicated that the Lesser Horseshoe Bat habitat preference is for areas with broadleaf and mixed woodland and that a mosaic of habitats is important (Roche *et al.*, 2014).

In general, this species has a preference for buildings constructed prior to the 1900s, built of stone with slate roofs (Schofield, 2008). Roche *et al.*, 2014, reports that the knowledge of roosting sites for this species is extensive due to intensive survey completed for the 6 key range counties by the Vincent Wildlife Trust (VWT) in the 1990s. Hibernation sites in Ireland are typically found underground although a number of sites are located in the basements or ground storey rooms of buildings.

One of the principal issues for Lesser Horseshoe Bats commuting in the landscape is the need for continuous linear habitats to fly along. The VWT prepared a map documenting the potentially important flight paths for this species through the Limerick landscape linking the Curraghchase SAC to the south of the county. This was overlain with the proposed road development in Plate 7.13, below, and emphasises a number of locations where commuting bats are likely to occur.

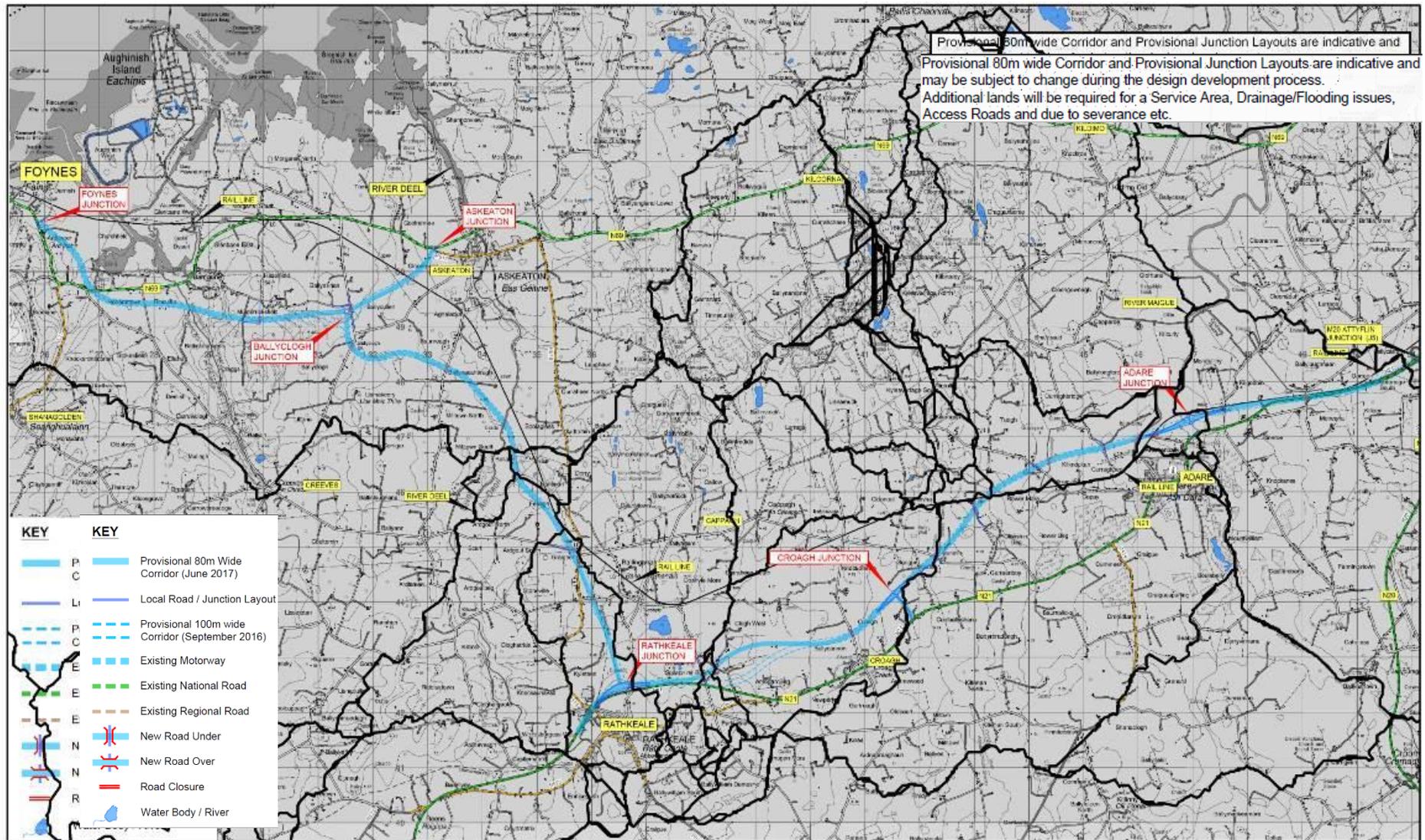


Plate 7.13: Lesser Horseshoe Bat flight paths reported by the VWT (black lines) overlain on the June 2017 Design update

Leisler's bat

Ireland's population is deemed of international importance and the paucity of knowledge of roosting sites makes this species vulnerable. However, it is considered to be widespread across the island. This species was recorded along much of the length of the proposed road development on static recording units and during the walking transects.

Brown long-eared bat

This species is generally considered to be widespread across the island, but only a few records are known for County Limerick. This species was only occasionally encountered along the length of the proposed road development. However, this may be due to its quiet echolocation calls which make detection difficult.

Natterer's bat

This species was rarely encountered along the length of the proposed road route. However, *Myotis* species echolocation calls were regularly recorded on the static units, many of which are likely to be this species, especially in relation to the static units located away from waterbodies.

Nathusius' pipistrelle

This species was only encountered once during the Four-Season Bat Survey. There is also only one record on the Bat Conservation Ireland database for the searched area.

Daubenton's bat

This species was recorded along waterbodies within the survey area, which is the typical habitat for foraging Daubenton's bats. Daubenton's bat is widespread throughout the country.

Common pipistrelle

The species is widespread and is found in all provinces. It is generally considered to be the most common bat species in Ireland. This species was the most recorded species along the proposed road development.

Soprano pipistrelle

The species is widespread and is found in all provinces, with particular concentration along the western seaboard. It is generally considered to be the second most common bat species in Ireland. This species was the second most recorded species along the proposed road route.

7.3.11 Invertebrates

White-clawed Crayfish (*Austropotamobius pallipes*)

White-clawed Crayfish, which is listed on Annex II to the Habitats Directive, is confined to alkaline or calcareous waterbodies. The underlying geology of the lands within the vicinity of the proposed road development provides suitable conditions and White-Clawed Crayfish are recorded in many of the watercourses crossed by the proposed road development. Existing records occur for the River Maigue upstream of Adare and from the River Deel just south of Askeaton (NBDC, 2018). However, in June 2017, an outbreak of aphanomycosis (commonly known as "crayfish plague" and caused by the oomycete *Aphanomyces astaci*) was recorded on the River Deel in the vicinity of Rathkeale (Crayfish Plague Outbreak Information Note, the NPWS and the Marine Institute, October 2017). Latest monitoring (August 2019) shows a significant spread

in records of infected crayfish upstream to Newcastle West and downstream as far as Ardgoul.

(<http://www.biodiversityireland.ie/projects/invasive-species/Crayfish-plague/>).

Crayfish plague is recognised as a very significant threat to the survival of the globally threatened White-Clawed Crayfish in Ireland. The disease causes near 100% mortality in infected White-clawed Crayfish populations. The disease can survive for extended periods on damp surfaces and thus may be moved to other river and lake systems on equipment, boats and machinery.

Records of crayfish from the NBDC (2018) also exist for the stream in Adare village (R464461) and Castleroberts Bridge on the River Maigue upstream of Adare (R479437). However, an outbreak of crayfish plague has also been recorded from the River Maigue in Spring 2019 (NBDC, pers. comm.) which may have eliminated these populations. The crossing point of the proposed road development over the River Maigue downstream of Adare is in the estuarine reaches of the river and unsuitable for crayfish. During the current surveys undertaken for the proposed road development, White-clawed Crayfish were recorded in the Doohyle Stream which flows out of Doohyle Lough at Graigeen/Ballingarrane (KER 17) and at Kyletaun (KER 19). Crayfish are likely to occur throughout this watercourse between Doohyle Lough and the River Deel. No evidence of crayfish was recorded from the other watercourses crossed by the proposed road development.

Marsh Fritillary Butterfly (*Euphydryas aurinia*)

Records exist on the NBDC website for Marsh Fritillary butterfly from the 10 km × 10 km grid squares ("hectads") R33, R35 and R54, which cover part of the study area for the proposed road development. A resident population is known from Barrigone SAC in the northwest of the study area, which is not affected by the proposed road development. An area of wet grassland on the proposed road development at Kyletaun (KER20) which supports considerable amounts of Devils-bit Scabious (*Succisa pratensis*), the dominant food plant for the Marsh Fritillary caterpillar was surveyed in September 2016 to check for larval webs, which if present, are very conspicuous. No evidence of larval webs was recorded. The vegetation structure required to sustain breeding populations of this butterfly, is however quite specific and has been described by Woodman and Fowles (2002) as "*grassland with Molinia abundant, vegetation height in the range of 10-20 cm, Succisa present and scrub (>0.5 m) covering no more than 10% of area*". The vegetation at Kyletaun was 60-70 cm in height which is considerably higher than the optimal. So, while the species composition is potentially suitable, the structure of the habitat under current management is not suitable.

Whorl Snails (*Vertigo* spp.)

There are records of the Common Whorl Snail (*Vertigo pygmaea*) from the hectads to the north of the study area including R25, R35 and R45. Square R25 covers Foynes where the record dates from 1977 and do not specify the precise location of the record. This species is found throughout Ireland primarily in damp pastures and the margins of wetlands at low altitude, though in the north and west is mostly associated with coastal habitats like dune grassland (Anderson, 2016).

The NPWS database contains records of both Narrow-mouthed Whorl Snail (*Vertigo angustior*) and Desmoulin's Whorl Snail (*Vertigo moulinsiana*) from Curraghchase in 2005.

The Narrow-mouthed Whorl Snail's distribution in Ireland is restricted to dune slacks and marshes in the west and north, and to a few rich marshes across the central plain. It is found at low altitude, on moderately to heavily grazed sites with a sparse, low vegetation, which are calcareous and permanently moist (Anderson, 2016). At Curraghchase it was recorded on sedges at the edge of the lake.

Desmoulin's Whorl Snail, and Annex II listed species, is found mainly in south central Ireland, particularly along the central canal system and the Shannon Callows, with outlying sites in Wexford and North Kerry, where it is restricted to lowland, floodplain wetlands in areas of calcareous bedrock. While there are no other records of whorl snail species from the study area, a survey was undertaken of potentially suitable fen habitat at Ballyellinan (KER 7), Lismakeery (KER 11) and Blossomhill (KER 21) by John Brophy of BEC Consultants in Autumn 2019 to check for presence (Brophy, 2019).

Vertigo moulinsiana was recorded at all three fen sites. At Ballyellinan, the species was recorded outside the land-take boundary, but within the 50 m buffer. There is an overlap of approximately 90 m² between the estimated suitable habitat area and the land-take area. This may be an artefact of the suitable habitat estimation, which was based on aerial photograph interpretation, as well as in-field observations.

At Lismakeery, *V. moulinsiana* was recorded both within the land-take boundary and the 50 m buffer. The land-take area overlaps with an estimated 5,130 m² (0.51 ha) of suitable habitat. At Blossomhill, *V. moulinsiana* was recorded outside the land-take boundary, but within the 50 m buffer.

The full *Vertigo* survey report is presented in Appendix 7.4A in Volume 4A of this EIAR.

Other Invertebrate Species

Crucifix Beetle (*Panagaeus cruxmajor*) is a black ground beetle with a conspicuous red cross on the elytra. It is hygrophilous, occurring at the margins of standing or slow-flowing water amongst rich vegetation. While it is widely distributed in temperate regions of Eurasia, it is considered local and rare in Ireland, where it has only been recorded in Counties Clare, Galway and Mayo. There are anecdotal records of it occurring within the study area but there are no records on the Ground Beetles of Ireland Website.

7.3.12 Fish

Salmon (*Salmo salar*) and Brown Trout (*Salmo trutta*)

The River Maigue supports good stocks of Atlantic Salmon with relative abundance of salmon being greatest in the main channel. Low numbers or absence of Salmon is recorded from the tributaries and headwaters of the River Maigue attributable to poor water quality (Harrington, 2017). The River Maigue was regarded as one of Ireland's premier Brown Trout fisheries prior to the arterial drainage works undertaken in the 1970's which canalised the channels and destroyed their natural character (O'Reilly, 2004). Some rehabilitation works have subsequently been undertaken by IFI which have resulted in an improvement in trout stocks. Fully anadromous trout have not been reported from the Maigue Catchment, though "slob trout", i.e. Brown Trout which migrate to brackish waters during their adult phase, can be found downstream of Adare (Harrington, 2017). There is no salmonid spawning habitat in the vicinity or downstream of the proposed crossing point where the river is tidally influenced.

The River Deel has been subject to intensive drainage works and a weir at Askeaton apparently prevents the successful upstream migration of salmon (O'Reilly, 2004).

The river supports a moderate resident population of Brown Trout and has also been artificially stocked by local angling clubs in the past (O'Reilly, 2004.).

Populations of Brown Trout also occur on the Greanagh River, Clonshire River, Cloghatrida Stream and Ahacronane Rivers.

Lamprey Species

While there are no records of Sea Lamprey (*Petromyzon marinus*) within the study area, the species may occur on both the Maigue and the Deel Rivers. Sea lamprey are anadromous, spending their adult lives at sea and returning to spawn in fresh water. They are, however, severely impeded in upstream migration by weirs, of which there are numerous on the lower reaches of both the Maigue and Deel. There is no lamprey spawning habitat in the vicinity or downstream of the proposed crossing point where the river is tidally influenced.

Brook Lamprey (*Lampetra planeri*) are recorded from the Maigue where they were present in 16 of the 56 sites sampled in the 2013 Fish Population Index (FPI) survey (Harrington, 2017). They were mainly found in the upper parts of the catchment. While no records exist, they are likely to occur in many of the watercourses throughout the study area as this species is heavily under-recorded. During the current surveys, no evidence of lamprey ammocoetes were recorded in soft sediments sampled on the various watercourses. All lamprey species are listed on Annex II to the Habitats Directive.

Other Fish species

The River Maigue also supports a range of other fish species including European Eel (*Anguilla anguilla*), Gudgeon (*Gobio gobio*), Stone-loach (*Barbatula barbatula*), Three-spined Stickleback (*Gasterosteus aculeatus*), Minnow (*Phoxinus phoxinus*) along with the introduced coarse fish Perch (*Perca fluviatilis*) and Dace (*Leuciscus leuciscus*). European Smelt (*Osmerus eperlanus*), a small anadromous fish species listed in the Irish Red Data Book as vulnerable, is also recorded from the River Maigue. Smelt are only known from a limited number of large estuaries in Ireland where the majority of their life is spent living and feeding in the estuary, returning only for a brief period to spawn in freshwater (Quigley et al. 2004). The estuarine reaches of the River Maigue downstream of Adare will also support a number of estuarine specialists such as Flounder (*Platichthys flesus*) and Mullet (*Chelon labrosus*).

The larger of the remaining watercourses crossed by the proposed road development including the Clonshire, Greanagh, Cloghatrida and Ahacronane are all likely to support populations of Brown Trout and Brook Lamprey, along with European Eel and some of the smaller species such as Gudgeon, Stone Loach and Minnow. The smaller streams and ditches will typically only support Minnow and Stickleback with possibly European Eel in small numbers.

7.3.13 Amphibians and Reptiles

Both Common Frog (*Rana temporaria*) and Common Newt (*Lissotriton vulgaris*) are expected to be widespread in the study area. Both species primarily use standing water to spawn in during the early spring period. While these are typically shallow ponds, they may use ditches with very slack flows. Along the proposed road development, potential spawning sites occur in a series of ponds in a disused quarry site at Robertstown (KER 3 Ch. 3+320) and in drainage ditches to the west of the flood embankments of the River Maigue (KER 26 Ch. 61+020).

The Common Lizard (*Lacerta vivipara*), Ireland's only native reptile, is likely to occur in a range of suitable habitats which occur along or in the vicinity of the proposed road development including heath, woodland and marshes. Areas with high potential along the route include east of the Ahacronane River at Craggs (KER5 Ch.4+450 to 4+900), the wetland complex at Nantinan (KER14 Ch.24+950 to 25+800), the grasslands at Graigeen (KER 16 Ch.26+300 to 26+650) and the habitat mosaic at Blossomhill (KER 21 Ch.51+050 to 51+350).

7.3.14 Birds

Kingfisher (*Alcedo atthis*)

Kingfisher, a piscivorous species typically feeding on slow moving waters, are afforded protection on Annex I to the Birds Directive and are Amber listed under the Birds of Conservation Concern in Ireland (BoCCI) by BirdWatch Ireland. Their nesting requirements are quite specific, preferring a steep to over-hanging bank of exposed clay or sand adjacent to water. No nest sites were recorded on or in the immediate vicinity of the proposed road development on any watercourses. An active Kingfisher nest site was recorded on the River Deel c. 400 m from the proposed crossing point. Kingfishers were observed in flight on the Greanagh River at Rower More and are expected to occur on the Clonshire and Ahacronane Rivers also. However, there was no evidence of nests or suitable nesting habitat recorded on any of these rivers in the vicinity of the proposed crossing points. The estuarine reaches of the River Maigue downstream of Adare is unsuitable for breeding, but estuaries provide good wintering habitat for birds.

Barn Owl (*Tyto alba*)

The Barn Owl is a BoCCI Red-listed species and has suffered high mortality on a number of recent road scheme developments in the southwest of the country. The Bird Atlas (Balmer et al., 2013) revealed a breeding range decline of 39% over the past 40 years, which is attributed to the intensification of agriculture, particularly the reduction of prey-rich foraging habitat, the increased use of anticoagulant rodenticides and increased mortality associated with major road developments where mitigation for Barn Owl was not incorporated into the design (Lusby and O'Clery, 2014).

Barn Owls hunt for rodents over rough grassland, grassy margins, woodland edge and wetland. They nest predominantly in ruined or derelict buildings, and occasionally in hollow cavities of mature trees. The NBDC database records the presence of Barn Owls from all the hectads within the study area. Records of known breeding sites from the study area were obtained from BirdWatch Ireland. Additional potential breeding sites were identified from a review of aerial imagery and OSI mapping and all known and potential sites within a c. 2 km zone of the proposed road development were surveyed in the period May to June 2016. During the winter bird surveys, undertaken during December 2016 to March 2017, known and potential sites were re-surveyed for evidence of Owl activity. Evidence of breeding was not confirmed at any of the sites, but pellets (regurgitated fur and bones), feathers and droppings were recorded at two locations near Clonshire Beg within <1 km from the proposed road development. Due to their sensitivity to disturbance, details are not provided of known or potential breeding or roosting locations for this species. The full Barn Owl report is presented in Appendix 7.3 in Volume 4A of this EIAR.

Whooper Swan (*Cygnus cygnus*)

Whooper Swan is listed on Annex I to the Birds Directive and the BoCCI Amber List, and is one of the Qualifying Interests of the River Shannon and River Fergus Estuaries SPA. Whooper swans are a wintering species in Ireland for birds that breed in Iceland.

The status of the wintering population in counties Limerick, Kerry and south Clare have been monitored since the early 1990's by the Irish Whooper Swan Study Group (IWSSG). The nearest known swan foraging sites to the proposed road development are at Cooperhill, Newtown, Carrig West and Cloonanna, the latter site (R485507) being the closest at c.3km from the proposed road development. Birds utilising these sites tend to move north to the confluence of the Maigne and Shannon Rivers and there are no foraging areas to the south.

A series of winter counts from known foraging sites in the vicinity of the proposed road development was undertaken by Gerry Murphy (Chairperson of the IWSSG) over the period December 2016 to March 2017. The maximum number of swans recorded was 106 birds on 13th January 2017 at Mungret. A maximum of 19 birds were recorded at Cloonanna during the survey in February 2017. A flock of 17 Whooper Swan were also recorded to the west of the proposed development along the River Deel callows at Ardnanean (R338384), approximately 5 km from the western limit of the proposed road development. This site was utilised in both January and February 2017 by a flock of 17 birds, while a flock of 15 Swans were recorded at Ardbohill (R342392) in March 2017, approximately 3 km from the western limit of the proposed road development. This flock is also a sub-unit of the Mungret flock and will probably use the Deel River as a corridor to connect to the River Shannon and other foraging areas. They occasionally use Doohyle Lough as a night-time roost, which is approximately 800 m north of the proposed road development at Blossomhill. There was no evidence of foraging elsewhere along the River Deel during the surveys undertaken and there are no records of Whooper Swans from the vicinity of the proposed River Deel crossing at Bullaun.

Wintering Water-birds

The only site which supports significant populations of wintering water-birds is the Churchfield (Robertstown) Estuary (KER2) which is part of the Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA. This area was surveyed monthly over the period November 2015 to March 2017 (spanning two winter seasons) as part of the EIAR prepared for the development of Shannon-Foynes Port (Capacity Extension at Shannon Foynes EIAR: Chapter 7 – Biodiversity). Peak numbers of birds were recorded in December 2016 and January 2017 with a maximum of 2,150 birds of a variety of species recorded in December 2016. The most abundant species were Golden Plover, Dunlin, Lapwing, Wigeon, Teal and Black-headed Gull. A minor peak in activity was recorded in October 2016 during the migration period when migrant birds pass through the area, while summer numbers ranged from just over 100 birds to none.

Small numbers of wintering water-birds also occur along the Maigne Estuary (in the vicinity of KER 26) though the limited extent of intertidal mud limits the value of this area to birds. Elsewhere along the proposed road development, areas of wet grassland provide suitable habitat for the dispersed population of wintering Snipe, while flocks of Golden Plover and Lapwing may utilise a range of pasture types in an unpredictable way.

Other Bird Species

Overall, the majority of the landscape through which the proposed road development crosses supports a typical assemblage of birds associated with lowland agricultural grasslands with associated hedgerows / tree-lines (collectively referred to as "countryside birds"). The habitats in the study area support a range of passerines, including various tits, finches, thrushes and corvids. Areas of permanent grassland provide feeding opportunities for seed-eating species such as Goldfinch (*Carduelis*

carduelis), Siskin (*C. spinus*) and Linnet (*C. cannabina*). Ground-nesting species, including the BoCCI Amber-listed Skylark (*Alauda arvensis*) and Meadow Pipit (*Anthus pratensis*) may also nest in some of the larger permanent lea grasslands. Jay (*Garrulus glandarius*) is present in woodland habitats at a number of locations along the proposed road development including at Craggs (KER 5) and Graigeen/Ballingarrane (KER 17) and are also likely to occur along the linear woodland habitat on the old Foynes to Limerick Railway line and along river corridors. The watercourses crossed by the proposed road development support a range of Water-birds including breeding Moorhen (*Gallinula chloropus*), Little Grebe (*Tachybaptus ruficolus*), Mute Swan (*Cygnus olor*) and Mallard (*Anas platyrhynchos*). Grey Wagtail (*Motacilla cinerea*), a BoCCI Red List species, were observed on the River Deel in the vicinity of the proposed crossing point and also on the Clonshire River at the Clonshire Bridge and on the Greanagh at the disused railway bridge at Rower More. Breeding is likely at all these locations.

Heron (*Ardea cinerea*) were observed feeding along the Deel and Maigue rivers, though no breeding sites were noted in the vicinity of the proposed road development. A single Little Egret (*Egretta garzetta*) was observed feeding upstream of the proposed crossing point on the River Maigue. This species is afforded protection under Annex I of the EU Birds Directive. Little Egrets frequently nest with their larger relatives the Grey Heron.

No evidence of breeding waders was recorded in the wet grassland and fen habitats in the vicinity of the proposed road development during the breeding bird surveys. However, the Amber listed (BoCCI) Snipe (*Gallinago gallinago*) may utilise wet grassland for breeding at Craggs (KER 5), Ballyellinan (KER 7), Lismakeery (KER 11), Feeagh (KER 15), Kyletaun (KER 20) and Blossomhill (KER 21). These sites are also suitable for other wetland species including Reed Bunting (*Emberiza schoeniclus*) and Sedge Warbler (*Acrocephalus schoenobaenus*).

Raptors observed during field surveys include Sparrowhawk (*Accipiter nisus*), Kestrel (*Falco tinnunculus*) and Buzzard (*Buteo buteo*), all of which nest in mature trees or woodland habitat. Long-eared Owl (*Asio otus*) is also likely to occur in woodland habitats and a pair was recorded breeding close to Blossomhill Lake at KER 21. Peregrine Falcons (*Falco peregrinus*) were not recorded during the winter bird survey, though they may utilise inactive quarry faces as nesting sites in the area to the south of Creeves. There are no records of nesting Hen Harrier (*Circus cyaneus*) or Merlin (*Falco columbarius*) within the study area and habitats are unsuited for breeding by these Annex I listed species. The lands along the proposed road development do not provide typical wintering habitat for either species but occasional occurrences cannot be ruled out.

7.4 Description of Predicted Impacts for Biodiversity

7.4.1 Impacts on Designated Sites

Lower River Shannon SAC

The proposed road development has the potential to result in negative impacts on the Lower River Shannon SAC at two separate locations, namely at Churchfield (KER 2) and at Islandea (KER 26) where the proposed road development crosses the River Maigue. The SAC is rated of International Importance. It should be noted that all watercourses crossed by the proposed road development drain to the Lower River Shannon SAC, with potential risk of effects on water quality during both construction and operation. For the other watercourses (apart from W1 to W5 inclusive and the

crossing of the River Maigue addressed below), the risks are considerably less due to the greater distance between the crossing points and the SAC, and appropriate mitigation has also been prescribed to address these risks during both construction and operation. A Natura Impact Statement has also been prepared for the proposed road development, to assess the impacts on sites designated as European Sites (SACs and SPAs).

Construction Impacts at the Lower River Shannon SAC

The Lower River Shannon SAC at Churchfield (KER 2) is located just over 100m from the nearest point of the proposed road development (in the vicinity of Ch. 2+200), though it also crosses watercourses W1, W2, W3, W4 and W5 which all drain in to the Churchfield Estuary. While there will be no direct impact on the estuary and SAC at this location, there is a potential for indirect impacts at this location as a result of effects on water quality during the construction phase without appropriate mitigation. The extent and magnitude of impacts on water quality within the SAC would relate directly to the scale and duration of a pollution event. While a catastrophic event could result in a significant local impact (e.g. an oil spillage) the more likely risk would be associated with a lower magnitude events such as siltation, insipid ingress of hydrocarbons, etc. Such impacts could, in the absence of appropriate design and mitigation, result in potential short term, moderate-significant negative impacts on the SAC.

The Lower River Shannon SAC will be crossed directly at the River Maigue at Islandea (KER 26). The river at this point is tidal (CW2) and undergoes a flood range of several meters. It has large flood embankments (BL2) on both banks which are set back approximately 20m from the river edge. The lower section of the banks exposed at low tide are primarily bare mud with small amounts of Starwort (*Callitriche* sp.) and occasional Curled Dock hybrid (*Rumex crispus* subsp. *uliginosus*). Above this in the mid-section of the banks, the vegetation cover is almost complete and is dominated by Water Forget-me-not (*Myosotis scorpioides*), Water pepper (*Polygonum hydropiper*), Fool's water-cress (*Apium nodiflorum*), and Water Cress (*Nasturtium officinale*). Other components include sea beat (*Beta vulgaris* sup. sp. *maritima*), English scurvy grass (*Cochlaeria anglica*) and occasional stands of Reed canary-grass. A small amount of Triangular Club-rush was recorded in this zone on the western riverbank during surveys in 2016 but was not evident in 2019. In view of this, the community is considered to conform to the Triangular Club-rush sub-type of the Annex I habitat Watercourse of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation.

The proposed bridge design will entail a structure with piers set into the flood embankments providing a clear-span between the eastern and western flood embankments, thereby retaining the riverbanks intact. The construction will, however, require temporary supports inside the flood embankment along with platforms to support the cranes required to lift the pre-cast beams into place. These elements will be contained within a temporary sheet piling wall erected above the riverbanks which is set back to avoid disturbance to the riverbanks within the middle and lower tidal zones. The sheet piling, which will be installed at the outset of the works and removed post-construction, will define the works zone on the river side, while the minimum amount of land required for construction will be used on the landward site. The proposed bridge design and construction sequence are shown in Figures 4.74 to 4.76 of Volume 3 of this EIAR, River Maigue Crossing General Arrangement and Construction Sequence Drawings. The piles will not impact on the tidal river community (CW2) in the intertidal zone which is the habitat for the Triangular Club-rush. The proposed bridge will not affect the plant's distribution or abundance.

Within the works zone between the sheet pile wall and the flood embankments, all topsoil will be stripped and stored separately for subsequent reinstatement post works. This plant community which is comprised of mainly rhizomatous species, will regenerate rapidly post-construction though the reduced light levels as a result of the bridge deck may affect plant growth under the central part of the bridge. While reduced light may also effect the vegetation growing on the river banks immediately under the bridge, the plants will not be subject to any change in hydrology and more shade tolerant species are likely to dominate over time.

There was no evidence of Opposite-leaved Pondweed from the drainage ditch to the west of the flood embankments (and outside of the SAC) during the surveys undertaken in 2016 or 2019. It was recorded from the drain approximately 100m to the south of the proposed bridge location in 2008 (Reynolds, 2013). This drain is subject to periodic maintenance dredging, which the plant appears to tolerate and may also contribute to the disturbance necessary for the species' persistence, and so is likely to reappear in the future. The drain will be retained intact, though the reduced light levels associated with the bridge deck will render the conditions under the section covered by the bridge deck unsuitable for the species. As with Triangular Club-rush, the bridge construction will not lead to any changes in the habitat distribution or area for the species. Further information on the construction sequence for the proposed River Mague bridge crossing is provided in Chapter 4 of this EIAR in section 4.9.

NOTES:
 1. ALL DIMENSIONS ARE IN MILLIMETRES
 2. ALL LEVELS ARE REFERRED TO ORDNANCE DATUM
 (A46M RED)

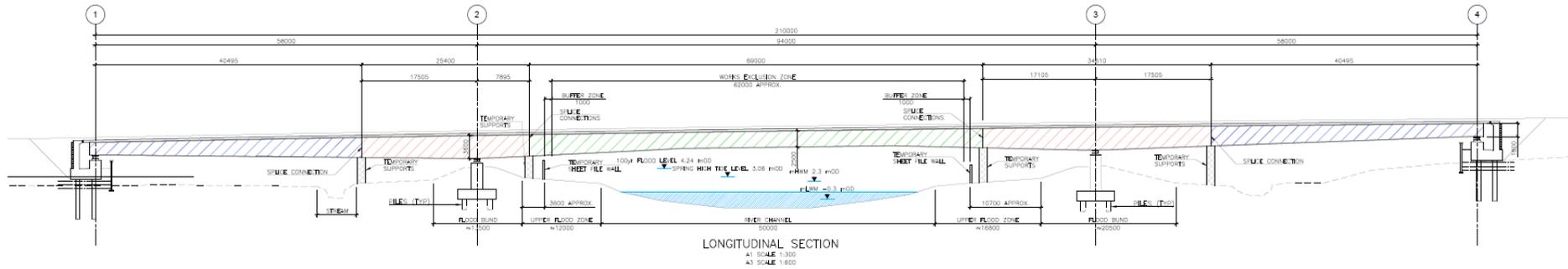


Plate 7.14 Cross section of River Mague Bridge showing permanent and temporary piers

In view of the estuarine nature of the river at this location, the river is considered not as sensitive to siltation in the same way as a freshwater stretch would be, where spawning and juvenile fish stocks would occur. Nonetheless, siltation would represent a deterioration in water quality. The river would be vulnerable to pollution from hydrocarbons, cement laitance, water-proofing substances and other pollutants associated with the construction phase. Construction activities in the vicinity of the River Mague crossing will require strict adherence to mitigation as prescribed in Section 7.5 to address these risks.

Two invasive alien plants listed under the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 occur in the vicinity of the proposed bridge within the SAC, namely Floating Fairy Fern (*Azolla filiculoides*) which occurs amongst the drift material marking the high water mark, and Giant Hogweed which occurs sparsely on the higher margins. Without an appropriate biosecurity protocol in place during construction, there is a risk that these species may further spread in the vicinity or wider along the proposed road development as a result of transfer of propagules on machines or materials.

A belt of riparian woodland (WN5), which conforms to the Annex I priority habitat type and Qualifying Interest of the Lower River Shannon SAC Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0], occurs approximately 150 m downstream of the proposed crossing point. While this is not mapped within the NPWS Conservation Objectives as a known location for this habitat it is noted that further areas are likely to be present within the SAC (NPWS, 2012). "Alluvial forests" is a generic term for a number of different woodland types. The alluvial forest at this location is of the "gallery" type (*Salicion albae*), which is dominated by tall willows forming small, narrow stands on the river banks and islands where the trees are subject to frequent flooding and/or have their roots permanently in water. It will neither be directly nor indirectly impacted by the proposed bridge construction as it is sufficiently remote from the proposed works and CPO line.

Otter, a listed qualifying interest for the SAC, also occur in the River Mague at the proposed crossing location in KER 26, though there is no evidence of holt or couch sites in the vicinity of the crossing point. The construction period presents a risk of disturbance to the species, although, as works will be confined to daylight, this should not affect the primarily nocturnal activities of the Otter. As the construction works will be confined to the vicinity of the flood embankments with protection afforded to the riparian zone, the works will not pose an impediment to the ongoing access of Otter along the river during the construction phase. There will be an uninterrupted zone of >10m between the pier base and the high water mark which fulfils the requirement for a 10m terrestrial buffer along river banks identified as critical for otters (NPWS, 2012). There will be a localised reduction in available habitat during the construction works but the river banks will not be affected allowing for the continued unimpeded movement of otter during the construction phase. There will be no permanent loss of habitat for otter within the Lower River Shannon SAC as a result of the proposed road development.

Operational Impacts at the Lower River Shannon SAC

All surface water from the proposed road development will ultimately drain to the Lower River Shannon SAC, with potential risks of effects on water quality during operation as a result of road run-off and accidental spillages. Whereas the former could lead to chronic pollution with periodic pulses following rainfall events, the latter would present an episodic risk with severity of impact dependant on the magnitude and location of such an occurrence. The level of risk will be proportionally higher where the distance

to the SAC is small, such as at watercourses W1 to W5 inclusive which drain to Churchfield Estuary and on the River Maigue Crossing. However, a suite of measures are inherent in the design of the proposed road development which is aimed at trapping and treating all road runoff as well as acting as spill-containment facilities. These measures, which have been developed to ensure that the operational phase of the project will not adversely affect the integrity of the SAC, are outlined in Section 7.5 and in the Environmental Operating Plan (EOP) for the proposed road development (Appendix 4.1 in Volume 4A of this EIAR).

While Otter activity has been recorded on many of the larger watercourses, all watercourses may support periodic Otter movement, a species listed as qualifying interest for the Lower River Shannon SAC. Impediments to Otter movement along watercourses may result in traffic mortality where animals attempt to cross the carriageway. Over time, regular mortalities could reduce the viability of local populations and lead to localised extinctions. As part of the road development design, all watercourse crossings along the proposed road development will accommodate unimpeded Otter movement via retention of existing banks alongside larger rivers, dedicated mammal ledges or culverts on smaller streams and appropriate guide fencing as detailed in Section 7.5. Otter are also vulnerable to a reduction in prey associated with deterioration of water quality or pollution events. An increase in mortality of Otter directly as a result of traffic collision or indirectly as a result in a reduction of prey availability would constitute a decline in favourable conservation status (FCS) of this Annex II listed species and equate to a significant negative impact. There were no holts or couches identified along any watercourse in the vicinity of the proposed crossing points and no change is expected on the conservation status of otter as a result of the proposed development.

The proposed crossing of the River Maigue will not interfere with fish movement within the river including the qualifying interest Salmon and the three Lamprey species. As the river is tidal at the Islandea location downstream of Adare, it does not support spawning by any of these species. Unimpeded movement of Annex II fish species has been accommodated on all watercourse crossings as part of the design by using appropriately sized structures set with inverts 500 mm below bed level.

7.4.2 River Shannon and River Fergus Estuaries SPA

Construction Impacts at the River Shannon and River Fergus Estuaries SPA

The River Shannon and River Fergus Estuaries SPA includes the Churchfield Estuary (KER 2) at the western end of the proposed road development where it occurs c. 100m from the nearest point of the road development. However, the SPA boundary at this point encompasses a small lobe of the estuary and the main estuary is located approximately 300m from the road. The estuary supports foraging by a variety of wintering waterfowl listed as conservation interests for the SPA during periods of low water. The risk of disturbance to foraging waterfowl associated with the road construction is, however, considered negligible given the distance and intervening hedgerows between the road development and the main body of the estuary. Habituation by wintering waterfowl to confined forms of disturbance is evident at a number of locations within the River Shannon and River Fergus Estuaries SPA such as at Shannon-Foynes Port and Aughinish Island nearby.

The SPA also extends into the Maigue Estuary as far as Ferry Bridge, a distance of approximately 6km downstream from the proposed road development at the River Maigue crossing location. Very small numbers of wintering waterfowl utilise the exposed muds along the river bank in the vicinity of the proposed crossing location.

While these may be more susceptible to disturbance, the small numbers involved and the distance from the SPA render this an imperceptible impact.

Issues relating to the risk of deterioration in water quality within the SPA as a result of construction are dealt with under Section 7.4.7.

Operational Impacts at the River Shannon and River Fergus Estuaries SPA

The only Qualifying Interest of the SPA for which operational-phase impacts are considered likely is Whooper Swan. Dedicated surveys to determine whether there are any foraging areas within the vicinity of the proposed road development, in combination with a review of all known foraging sites (database held by the IWSSG) found no evidence of activity within 3km of the proposed road development. The nearest foraging sites are at Ardbohill to the west of the proposed road development and Cloonanna to the north of the Mague crossing. There is therefore considered no risk of interfering with foraging areas for Whooper Swan.

Issues relating to the risk of deterioration in water quality within the SPA as a result of operation of the proposed road development are dealt with under Section 7.4.7.

7.4.3 Other Designated Areas

The only other designated area which is considered within a potential zone of influence for the proposed road development is the Askeaton Fen Complex SAC. This SAC is comprised of a series of isolated areas of fen habitat, which is primarily a groundwater fed system and there is therefore a potential for hydrological connectivity with other wetland habitats along or in the vicinity of the proposed road development. The alignment of the proposed road development was selected to avoid potential impacts on this disparate suite of sites by staying to the west and south of the complex of sites. The nearest part of the SAC to the proposed road development is at Ballymorrishen where the development is approximately 0.5km to the west of the fen. An assessment of the potential for an impact on this habitat has been undertaken within the Hydrogeology Chapter of this EIAR (Chapter 9) which concluded that there is no risk of drawdown or alteration of the existing hydrological regime during construction or operation.

The Barrigone SAC lies approximately 500m to the north of the proposed road development in the townland of Mulderricksfield. This SAC is designated for *Juniperus communis* formations on heaths or calcareous grasslands, semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites), Limestone pavements and the Marsh Fritillary butterfly (*Euphydryas aurinia*). There is no direct pathway connecting the proposed road development and the SAC, and the QI Habitats for the site are not ground water dependant. There have been no recent verified records of marsh fritillary located within Barrigone SAC and a survey undertaken on behalf of the NPWS in 2012 did not find the species in the SAC (NPWS, 2019).

Curraghchase Woods SAC lies approximately 3.6km north of the proposed road development at Croagh. The SAC is designated for Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*), *Taxus baccata* woods of the British Isles and Lesser Horseshoe Bat (*Rhinolophus hipposideros*). There is no hydrological connectivity between the proposed road development and the SAC and therefore no potential for any effects on the alluvial woodland habitat at the site. The SAC supports internationally important winter and summer roosts for Lesser horseshoe bat. Lesser horseshoe bats are capable of undertaking considerable movements though normally forage in woodlands/scrub

within 2.5km of their roosts (Schofield, 2008). While the proposed road development is beyond this range, the requirement to maintain the connectivity of suitable habitat for Lesser horseshoe bat within the wider environment has been addressed in detail in the proposed road development design (see Section 7.5.4.1).

7.4.4 Impacts on Protected Plants

Triangular Club-rush (*Schoenoplectus triqueter*)

This FPO species was recorded in small quantities (less than 10 stems) on the intertidal muds on the west bank of the River Maigue in the immediate vicinity of the proposed crossing point in September 2016 though there was no evidence of the Triangular Club-rush at the bridge location in 2019. The river banks will not be directly impacted during the construction of the proposed bridge which will have piers set into the flood embankments which are approximately 15m from the high-water level. The construction will however require temporary supports inside the flood embankment along with platforms to support the cranes required to lift the pre-cast beams into place. These elements will be contained within a temporary sheet piling wall erected above the river banks which is set back to avoid any de-stabilising effects on the banks. The sheet piling, which will be installed at the outset of the works and cut to below ground level post-construction, will define the works zone on the river side. The bridge soffit will be set approximately 6.5m over high water level and the bridge width will be 25.6m, which will to some extent reduce the light penetration to vegetation under the bridge. This may render the conditions immediately under the bridge less suitable for Triangular clubrush but would not affect the overall distribution and abundance of the plant.

Opposite-leaved Pondweed (*Groenlandia densa*)

This FPO species was recorded in a drainage ditch to the west of the flood embankments along the River Maigue downstream of Adare in the vicinity of the proposed crossing point, however surveys undertaken in May 2016 and September 2019 as part of the proposed development, no evidence was recorded in the drainage ditch. On account of the regular maintenance of these drains it appears to undergo some temporal shifts in distribution. The drain will be retained intact, though the reduced light levels associated with the bridge deck will render the conditions under the section covered by the bridge deck less suitable for the species. As with Triangular Club-rush, the bridge construction will not lead to any changes in the habitat distribution or area for the species.

Hairy Violet (*Viola hirta*)

This FPO species was recorded as being common in the limestone area between Askeaton and Foynes (Reynolds, 2013). During the survey undertaken in May 2018 no evidence of Hairy Violet was recorded from the areas identified as supporting potentially suitable habitat along the proposed road development at Robertstown, Rincullia and Craggs. There is therefore no impact expected on this species.

7.4.5 Impacts on Key Ecological Receptors

A summary assessment of the predicted impacts on the KERs is presented in Table 7.10 below. The table presents an overview of the impacts during construction as well as operation, including loss of habitat, effects on habitat continuity, risks to the continued functioning of the habitat, etc. The most significant KER is the Lower River Shannon SAC at KER 26 (the River Maigue, which will be crossed by the proposed road development). This is addressed in Section 7.4.1 above along with potential impacts on KER 2, the internationally important Lower River Shannon SAC and River

Shannon and River Fergus Estuaries SPA at Churchfield Estuary at Robertstown, at the western end of the proposed road development.

Habitat exclusion zones are defined for a number of KERs which are aimed at affording protection to specific ecological interests either within the CPO for the proposed development (in a few instances where there is such potential) or more typically along the periphery of the CPO during the construction phase. This will require defining the works zone at the outset of the construction phase, and the installation of appropriate protective fencing and in some cases silt fencing (as per measures set out in the EOP, Appendix 4.1 in Volume 4A of this EIAR), prior to any other works being undertaken. These are illustrated as areas for 'Habitat Protection' within the Biodiversity Mitigation Figures (7.25 to 7.47) in Volume 3 of the EIAR.

Construction Impacts on KERs

For all KERs, the construction impacts will entail a loss of habitat associated with the clearance and loss of vegetation due to the construction of the proposed road development, including associated features such as accommodation works and drainage. While the extent of impact will vary between KERs dependant on the scale of loss and the nature and sensitivities of the habitats being impacted, the route selection process and design of the proposed road was aimed at avoiding critical sensitivities where possible and to minimise land-take in all KERs. Nonetheless, the proposed road development will result in fragmentation of a number of KERs with potential consequences for associated fauna which, without mitigation, could be isolated by the barrier effect of the road.

Construction activities will also result in disturbance at all KERs, which will have a localised effect on fauna but no effect on habitats. Risks to habitats arise primarily from potential pollutants used during the construction phase including fuels, oils and lubricants, cementitious laitance, water-proofing agents, etc. Spillage or leaks can result in pollution of watercourses and / or soils with significant consequences for associated biota proportional to the toxicity of the material and the magnitude of the event. Dust can also result in a negative effect on vegetation by coating leaves and thereby reducing photosynthetic activity. In the Irish climate, however, the impact of dust is typically localised and temporary. All sites are equally susceptible to the introduction and spread of invasive alien species as a result of infected imported material or other failures in biosecurity protocol. These risks are applicable across all construction projects and can be mitigated for by the adoption of and adherence to mitigation as detailed in Section 7.5.

In KER's with groundwater- or surface water-dependant habitats, construction could also lead to an alteration in the hydrological regime which may result in an alteration of the vegetation and faunal communities of the remaining habitat over time. These considerations have been factored into the design of the proposed road development and, where such risks have been identified, appropriate measures have been developed to avoid altering the existing hydrology.

Three KERs support fen habitat, namely KER 7 at Ballyellinan, KER 11 at Lismakeery and KER 21 at Blossomhill. These three sites are rated of International / National Importance due to the presence of *V. moulinsiana* and the area of suitable habitat to support this species. The sites also comprise Alkaline fens, an Annex I habitat and Qualifying Interest of the Askeaton Fen Complex SAC, which extends to include a number of disparate locations. The proposed road development has been selected to avoid crossing between any parts of the Askeaton Fen Complex SAC. The three KERs are not within the SAC complex, though as groundwater dependant habitats, are at

risk from modifications to their hydrology. Coarse material used as a capping layer for the road could lead to new preferential flow paths which could lower the water table of these sites without appropriate design mitigation. This risk is assessed in more detail in Chapter 9 Hydrogeology and Chapter 10 Hydrology.

The fen habitat at KER 7 at Ballyellinan, lies to the north of the L6062 road which is off the proposed road development but will require modification to tie-in with the L1220 which will be elevated to cross the mainline on an overbridge. The proposed embankment for the L6062 has been designed so as not to encroach on the fen habitat, and subject to there being no alteration in the hydrology, the impact at this site is considered slight negative and temporary as it will be confined to temporary impacts only.

The fen habitat at KER 11 at Lismakeery lies primarily to the south of the road and has been modified in the past by attempted drainage works. The Cloghatrida Stream which runs along the western side of the fen has also been drained in the past with probable consequences for the original hydrology of the fen. The proposed road will encroach upon the northern fringe of the site leading to a direct loss of approximately 0.5 Ha (20%) of the fen habitat between Ch. 21+000 and 21+120. The land rises to the north at this location supporting a fringe of wet grassland grading to dry calcareous grassland with developing scrub along the boundary to Ballycullen Demesne. The loss of habitat at this site constitutes a permanent moderate negative impact. The road design has been developed at this location to avoid any impact on the hydrology of the fen habitat. There is an existing spring that feeds groundwater to the fen at the north-eastern edge that is located within the footprint of an embankment for the proposed road. A drainage layer will be provided under the road embankment to enable the spring-water to continue to flow south-westwards into the fen.

KER 21 at Blossomhill includes some fen habitat to the west of the small reed-fringed lake with wet grassland to the south. The fen and lake will not be directly impacted by the proposed road, but the wet grassland will be marginally encroached upon by the accommodation access leading to the attenuation pond which has been designed to run as close as possible to the mainline. The impact on this KER will be slight negative if confined to temporary impacts. The design of the route at this location has considered the requirement to avoid any impacts on the hydrology of the site. Risks of pollution during construction are also significant due to the inflowing minor stream to the lake which will require realignment.

KER 5 at Craggs encompasses an area of alluvial woodland along the eastern side of the Ahacronane River which conforms to the Annex I priority habitat Alluvial Forests with *Alnus glutinosa* and *Fraxinus excelsior* [91E0]. The Alluvial woodland habitat has, however, been avoided during the Route Selection process by moving the alignment to the north. This large site includes a mosaic of habitats including some areas of oak-ash-hazel woodland, hawthorn dominated scrub, dry calcareous grassland, wet grassland and freshwater marsh. The route has been refined to avoid areas of sensitive habitat and it crosses through an area of spoil and bare ground at the southern end of the adjoining coal yard, and then fields of dry calcareous and neutral grassland and some patches of scrub. The impact overall is rated as permanent moderate negative due to the loss of habitat and the dissection of the site. In the absence of appropriate mitigation, habitat fragmentation will also affect the movement of fauna. Habitat exclusion zones are required to minimise the impacts on retained interests during the construction phase. The presence of the Ahacronane River which flows into the Churchfield Estuary, part of the Lower River Shannon SAC, has required appropriate mitigation to avoid impacts on water quality during construction as well as appropriate design of the watercourse crossing to avoid

interference with the movement of Otter and fish species using the river as detailed in Section 7.5.4 and in Table 7.12a.

The remainder of the KERs impacted by the proposed road development are evaluated as being of Local Importance (Higher Value). These sites encompass a range of habitats including an old quarry site at Robertstown (KER 3) which contains two ponds with associated mosaic of wet grassland and scrub, and linear areas of scrub and dry grassland along the disused railway track at Clonreask (KER 9), Ballingarrane (KER 18), Kyletaun (KER 19), Gortnagrour (KER 24) and Gortnaganniff (KER 27). The impact on these sites will be localised as the road will be bridged over the railway track but nonetheless there may be a permanent moderate negative impact due to loss of habitat. However, with the implementation of exclusion zones to protected retained habitats, and as the continuity of the habitat will be retained, the effects are likely to be slight negative following construction.

An area of mixed broadleaved woodland occurs at Ballycullen (KER 10) in conjunction with the Cloghatrida Stream and some mature treelines to the west of the stream. The woodland at Ballycullen will be unaffected by the proposed road and will be retained intact, though there will be some potential impact on mature treelines in the west of the site in the vicinity of the proposed attenuation pond without mitigation. The impact is assessed as moderate negative due to potential loss of habitat and the fragmentation of the site. However, habitat exclusion zones to protect retained interests including the woodland and treelines will be established for the construction zone which will minimise potential impacts and reduce the impact severity to slight negative.

A belt of mixed broadleaved woodland also occurs at Graigeen / Ballingarrane (KER 17) which also fringes the Cloghatrida Stream. This woodland will be dissected by the proposed road development which crosses the site obliquely and will result in the removal of over half of the woodland. The stream will also require realignment to reduce the length of culvert required though the span of the structure has been modified to accommodate the diversion of the stream under the western side span. The loss of habitat and dissection of the site will give rise to a permanent moderate negative impact. The construction phase will require the establishment of habitat exclusion zones to protect retained areas of woodland.

The proposed road development will impact on two adjoining KER sites to the immediate east of the proposed River Deel crossing, namely KER 14 at Nantinan and KER 15 at Feeagh. The former site encompasses a range of woodland habitats which included mixed broad-leaved / conifer woodland, and conifer plantation along with some areas of scrub. A narrow fringe of mature trees runs along the Doohyle Stream which flows into the River Deel upstream of the main Deel crossing. The stream will require realignment over almost 200m to minimise the length of culvert required. The overall impact on this site is rated as permanent Moderate negative due to the loss of habitat and the dissection of the site. Construction will require habitat exclusion zones to protect woodland, treelines and sections of the stream to be retained. The site at Feeagh (KER 15) encompasses a large area of wet grassland with a network of drainage ditches, and some patches of freshwater marsh and scrub – woodland in the eastern part. The site will be dissected by the proposed road development and without appropriate design could interfere with the hydrology of the wetland habitats. The impact on this KER is assessed as Moderate negative due to loss of habitat and dissection of the site. The construction phase will require habitat exclusion zones to protect wet grassland to be retained within the CPO line between Ch. 25+550 to 25+690.

KER 20 at Kyletaun encompasses a mosaic of wet grassland with drainage ditches with some areas of dry calcareous / neutral grassland and blocks of wet Willow–Alder–Ash woodland with a fringe of mixed broadleaved woodland at the southern end. The proposed road development at this location immediately north of the Rathkeale interchange, will result in dissection of the site and a loss of wet grassland habitat. The wet woodland will not be impacted by the construction, though the mixed woodland will be removed in its entirety. The loss of habitat and dissection of the site will result in a permanent Moderate negative impact. The construction phase will require habitat exclusion zones to protect wet grassland and drainage ditch habitats to be retained within the CPO line.

KER16 at Graigeen consists primarily of dry calcareous and neutral grassland (GS1) on shallow soils with patches of developing scrub. The site will be dissected by the proposed road development which cuts through the centre of the site. Areas of well-developed scrub and some young forestry in the west of the site will not be impacted by the proposed road development. There will be a loss of grassland habitat associated with the road construction, but the remaining habitat will be unaffected. The impact on the site is rated as being permanent Moderate negative due to the loss of habitat and the dissection of the site.

KER 25, at Rower More, encompasses the Greanagh River B and fringing treelines along with a strip of dry meadow and grassy verges within the flood embankments, and fields of wet grassland to the east. The river habitat will be retained intact and bridged, though the fields of wet grassland will be dissected by the road. While the grassland is not very species rich, the overall impact on this site is rated as being permanent Moderate negative due to loss of habitat and dissection of the site. The construction phase will require habitat exclusion zones to protect wet grassland and riparian habitats which are to be retained within the CPO line.

Table 7.10 Summary of impacts and magnitude for Key Ecological Receptors.

| KER No. | Townland | Key habitats | Evaluation | Summary of Pre-mitigation Impacts |
|---------|--|--|---------------------------|--|
| 2 | Lower River Shannon SAC at Churchfield | Estuarine habitat mosaic designated as part of a European site | International Importance | Not directly impacted. Susceptible to water quality deterioration primarily during construction and to a lesser extent during operation. Temporary moderate to significant negative impact during construction without mitigation, with long term moderate negative impact during operation without mitigation. Both reduced to imperceptible with mitigation. Risk of disturbance to wintering waterfowl during construction considered short-term slight impact due to distance from receptor. |
| 3 | Robertstown | Old quarry with mosaic wet grassland, ponds and scrub. | Local Importance (higher) | Permanent moderate negative impact due to loss of part of pond complex and associated habitats. Dissection of site. Requires habitat exclusion zone to protect retained habitat. |
| 5 | Craggs | Mosaic of alluvial woodland (conforming to Annex I habitat Alluvial Forest) along Ahacronane River with oak-ash-hazel woodland, wet grassland and marsh. | County Importance | Permanent moderate negative impact due to loss of habitat & dissection of site. Extensive cutting to east. Requires habitat exclusion zone to protect riparian habitat. |
| 7 | Ballyellinan | Area of Rich Fen (conforming to Annex I habitat Alkaline Fen) bordering to L6062-L1220 continuous with site 6. | International Importance | Permanent slight negative impact as a result of construction impacts. Sensitive to alteration of hydrology. |
| 9 | Cloonreask | Band of scrub, dry calcareous grassland and recolonising bare ground along old railway line | Local Importance (higher) | Permanent moderate negative impact due to loss of habitat associated with bridge but will not interfere with continuity of site. |
| 10 | Ballycullen | Mixed broadleaved woodland with adjacent network of mature treelines and drainage ditches. | Local Importance (higher) | Permanent slight negative impact due to loss of habitat & dissection of site. Realigned section of stream channel. Requires habitat exclusion zone to protect riparian habitat. |

| KER No. | Townland | Key habitats | Evaluation | Summary of Pre-mitigation Impacts |
|---------|------------------------|---|---------------------------|--|
| 11 | Lismakeery | Area of Rich Fen (conforming to Annex I habitat Alkaline Fen) and wet grassland grading to dry calcareous grassland and scrub at northern end. <i>V.moulinsiana</i> also present. | International Importance | Permanent moderate negative impact due to loss of fen habitat and habitat for <i>V. moulinsiana</i> . Sensitive to alteration of hydrology. |
| 14 | Nantinan | Young plantation woodland with some blocks of mixed broadleaved – conifer woodland and scrub along lowland river. | Local Importance (higher) | Permanent moderate negative impact due to loss of habitat & dissection of site. Realigned section of stream channel. Requires habitat exclusion zone to protect riparian habitat and retained habitat. |
| 15 | Feeagh | Wet grassland with network of drainage ditches and patches of marsh and scrub-woodland on shallow soils with some exposed calcareous rock in the south. | Local Importance (higher) | Permanent moderate negative impact due to loss of habitat & dissection of site. Requires habitat exclusion zone to minimise impacts. |
| 16 | Graigeen | Dry calcareous grassland with patches of developing scrub. Semi-natural woodland – plantation mosaic in west, some of it immature. | Local Importance (higher) | Permanent moderate negative impact due to loss of habitat & dissection of site. |
| 17 | Graigeen/Ballingarrane | Belt of mixed broadleaved woodland with adjacent Cloghatrida Stream. | Local Importance (higher) | Permanent moderate negative impact due to loss of habitat & dissection of site. Realigned section of stream channel. Requires habitat exclusion zone to protect riparian habitat. |
| 18 | Ballingarrane | Linear belt of developing oak-ash-hazel woodland and scrub along old railway line | Local Importance (higher) | Permanent moderate to slight negative impact due to loss of habitat along railway may be reduced by sensitive alignment of access track. |
| 19 | Kyletaun | Linear belt of developing oak-ash-hazel woodland and scrub along old railway line with adjacent Cloghatrida Stream | Local Importance (higher) | Permanent moderate negative impact due to loss of habitat & dissection of site. Realigned section of stream channel. Requires habitat exclusion zone to protect riparian habitat. |

| KER No. | Townland | Key habitats | Evaluation | Summary of Pre-mitigation Impacts |
|---------|----------------|--|---------------------------|---|
| 20 | Kyletaun | Cloghatrida Stream and tributary drains in an extensive area of wet grassland. Blocks of wet willow-alder-ash woodland and mixed broadleaved/conifer woodland in the south. | Local Importance (higher) | Permanent moderate negative impact due to loss of habitat & dissection of site. Realigned section of stream channel. Requires habitat exclusion zone to protect riparian habitat. |
| 21 | Blossomhill | Limestone lake with adjacent mosaic of rich fen (conforming to Annex I habitat Alkaline Fen) and wet grassland. Some scrub and treelines to the east. Drainage ditch to south from lake. | National Importance | Permanent moderate negative impact without mitigation reduced to slight negative if confined to temporary impacts and with measures to ensure no alteration of hydrology. Realigned section of stream channel. Requires habitat exclusion zone to protect riparian and retained habitats. |
| 23 | Clonshire More | Clonshire River with adjacent scrubby treeline. | Local Importance (higher) | Permanent slight negative impact due to dissection of site. Requires habitat exclusion zone to protect Clonshire River. |
| 24 | Gortnagrour | Linear belt of developing oak-ash-hazel woodland and scrub along old railway line continuous with riparian woodland along Greanagh River A. | Local Importance (higher) | Permanent moderate negative impact due to loss of habitat though site continuity not affected due to overbridge. Requires habitat exclusion zone to protect riparian habitat. |
| 25 | Rower More | Greanagh River B (tidal) with treelines and dry meadows and grassy verges along embankments with fields of wet grassland to east. | Local Importance (higher) | Permanent moderate negative impact due to dissection of site. Requires habitat exclusion zone to protect Greanagh River B. |

| KER No. | Townland | Key habitats | Evaluation | Summary of Pre-mitigation Impacts |
|---------|-------------------------------------|--|---------------------------|---|
| 26 | Lower River Shannon SAC at Islandea | Tidal stretch of river with fringing marsh and tall herb swamp along embankments. Some alluvial woodland downstream (conforming to Annex I habitat Alluvial Forest). Wet grassland along eastern bank. | International | There is potential for temporary to short term moderate to significant negative impacts on this site as a result of construction activities without appropriate mitigation. However, there is expected to be no direct impact on any Qualifying Interests of the SAC and no change in conservation condition for any habitats or species as a result of the proposed road development. The abutments for the proposed bridge will tie into existing flood embankments and there will be no effect on habitat continuity within the SAC during construction or operation. Construction activities will require strict adherence to mitigation and habitat exclusion zones to protect riparian habitat. |
| 27 | Gortaganniff | Linear belt of scrub along old railway line including strip of dry calcareous grassland and scrub between Ch. 61+900 to Ch. 64+870. | Local Importance (higher) | Permanent slight negative impact due to disturbance during construction. No loss of habitat subject to use of habitat exclusion zone along railway line. |

Operational Impacts on KERs

The operational impacts of the proposed road development on KERs relates primarily to disturbance and the potential for pollution to sites via road run-off. Habitats are not at risk from disturbance though species utilising them are, and these impacts are assessed under Section 7.4.8, below.

Impact of Water Pollution

As many of the KERs incorporate watercourses and drainage ditches, these receptors are particularly sensitive to pollution from run-off, accidental spillage, etc. The assessment of this risk is examined in more detail in Section 7.4.7 below.

Impact of Air Pollution

The impact of NO_x (i.e. NO and NO₂) emissions resulting from the proposed road development at the Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA have been assessed in Chapter 13 Air Quality and Climate.

In the case of the Lower River Shannon SAC, the road contribution from the existing N21 crossing in Adare was also included in the assessment. The predicted annual average NO_x level near Islandea/Ardshanbally, Adare has been found to be above the limit value of 30 µg/m³ for the “Do-Something” scenario in 2024 and 2039 with NO_x concentrations reaching 116% of this limit in 2024 and 132% in 2039 including background levels.

The impact of the proposed road development can be assessed relative to “Do-Minimum” levels in 2024 and 2039 (see Table 13.12 in Chapter 13). The impact of the proposed road development leads to an increase in NO_x concentrations of greater than 2 µg/m³ NO_x within the SAC up to 200m from the proposed road centreline bringing it marginally above the limit value for the protection of vegetation of 30 µg/m³. However, in view of the nature of the habitats within the SAC at this location (not considered sensitive to a marginal increased loading in Nitrates), the exceedance is unlikely to cause any noticeable effect. In addition, after 200m from the centre line, concentrations decrease to below the limit value of 30 µg/m³. Concentrations have been modelled at the maximum speed limit on the proposed road of 120 km/hr, a speed at which engines are not working as efficiently and therefore have higher pollutant emissions. In reality, not all vehicles will travel at this maximum speed and with moderately reduced speeds, NO_x concentrations will be reduced. It must also be noted that the DMRB screening model does not accurately account for predicted concentrations to 2039 as it does not take into account recent trends in hybrid and electric vehicle usage and revised fleet emissions past the Euro V standards (see Section 13.8 for further details). Therefore, the concentrations stated within this report are conservative in nature, take a worst-case approach and are very unlikely to actually be reached.

The proposed road development contribution to the NO₂ dry deposition rate along the 200m transect within the SAC at Islandea/Ardshanbally, Adare is also detailed in Table 13.12 in Chapter 13. The maximum increase in the NO₂ dry deposition rate is 0.74 Kg(N)/ha/yr in 2024 and 0.89 Kg(N)/ha/yr in 2039. This reaches a maximum of 18% of the critical load for inland and surface water habitats of 5 - 10 Kg(N)/ha/yr (TII, 2011).

Therefore, the overall impact of the proposed road on the SAC is considered to be negative, long-term and not significant.

In addition, an assessment was undertaken for NO_x concentrations within the River Shannon & River Fergus Estuaries SPA at Robertstown, east of Foynes. The predicted annual average NO_x level in the River Shannon & River Fergus Estuaries SPA at

Robertstown is below the limit value of 30 $\mu\text{g}/\text{m}^3$ for the “Do-Something” scenario in 2024 and 2039 with NO_x concentrations reaching 34% of this limit in 2024 and 36% in 2039 including background levels. The proposed road development will cause a 11.52 $\mu\text{g}/\text{m}^3$ decrease in concentrations in 2024 and a 15.68 $\mu\text{g}/\text{m}^3$ decrease in concentrations in 2039 within the SPA when assessed against the Do Minimum scenario.

The road contribution to the NO_2 dry deposition rate along the 200m transect within the SPA at Robertstown is also detailed in Table 13.13. The proposed road development will result in a decrease in deposition rates at this location. The maximum decrease in the NO_2 dry deposition rate is 0.61 $\text{Kg}(\text{N})/\text{ha}/\text{yr}$ in 2024 and 0.80 $\text{Kg}(\text{N})/\text{ha}/\text{yr}$ in 2039. This reaches a maximum of 16% of the critical load for inland and surface water habitats of 5 - 10 $\text{Kg}(\text{N})/\text{ha}/\text{yr}$ (TII, 2011).

Overall, the impact of the proposed road development on the River Shannon & River Fergus Estuaries SPA is long-term, positive and not significant.

Impacts on Hedgerows and Tree-lines

The total lengths of hedgerows and treelines to be impacted by the proposed road development include 23,300m of hedgerows and 15,800m of treelines. The impacts of loss of hedgerows is described in later sections for fauna, especially bats and birds.

7.4.6 Other Ecological Sites

The impact on the seven sites rated of Local Importance (Lower Value) (ER 1, 4, 6, 8, 12, 13 and 22) will include loss of habitat during construction and potential fragmentation due to the barrier effect of the road giving rise to permanent slight negative impacts on all sites. However, the loss of habitat has been minimised during the development of the road design and measures are detailed in Section 7.5 to minimise disturbance through the establishment of habitat exclusion zones during construction, to maintain habitat connectivity and offset habitat loss by appropriate landscaping measures. The impact on these sites is rated as permanent slight negative.

7.4.7 Impacts on Aquatic Sites

Construction Impacts for Aquatic Sites

The principal impacts from the construction phase of the proposed road development on the aquatic environment include:

- Permanent loss of habitat through culverting or channel realignments;
- Temporary degradation to water quality from construction related activities such as sediment run-off and accidental spillage, with potential downstream impacts on spawning habitats or instream aquatic fauna including Salmon, White-clawed Crayfish and Lamprey; and
- Temporary impacts on faunal species listed as Qualifying Interests of a site (Otter and Atlantic Salmon) during construction primarily through noise, lighting and vibration.

Aquatic Habitats and Fisheries

The primary direct impact on the aquatic habitat and fisheries value of watercourses to be crossed relates to loss of habitat as a result of bridge or culvert construction. The construction phase also brings high risks of siltation and pollution which are dealt with under Water Quality below.

All the major watercourses (the Mague, Deel, Greanagh, Clonshire and Ahacronane) will be crossed by bridge structures which will retain the existing channel and banks of the watercourse intact. The Cloghatrida Stream and 11 other watercourses will have pre-cast concrete bottomless culverts, which will also retain the existing river channel and banks intact and allow for unimpeded mammal movement. These structures require a simple strip footing under each side wall that extends forward towards the watercourse with a 0.5 m toe and backwards with a 1.5 m or longer heel. Watercourse channels with a width of 2m or more will have a further 2m clearance on either side giving a total 6m+ minimum width. Vertical clearances above bank level will vary between 2.5m and 4.5m typically, which will maximise light penetration and also allow people to walk through as well as accommodate mammal passage. These structures will not alter the existing stream beds so will not affect fish movement in any way.

Other culverts for drainage ditches with low ecological value will be concrete boxes or pipes up to 2m wide, designed to match existing channel widths, whilst accommodating flood flows in line with the OPW requirements. These culverts will have inverts set 500mm below bed level to ensure they are always backwatered and therefore accommodate unimpeded fish movement under all flow conditions. The culverts will also accommodate mammal passage either as a dedicated ledge or as a separate but immediately adjacent 600mm pipe culvert.

The loss of aquatic habitat within the section of culvert will be kept to a minimum by localised channel realignments to give right-angled crossings, minimising the length of culvert. All channels to be realigned will be designed to replicate a natural meandering watercourse with appropriate instream and riparian habitat enhancement measures. As many of the existing channels have been heavily modified and effectively canalised during drainage operations, this will therefore present an increase in biodiversity value once vegetation is established.

Both the Mague and Deel Rivers are of significant angling value and continued unimpeded access for anglers to walk along the banks of both rivers is accommodated in the bridge design for the proposed crossings of these rivers.

Water Quality

During construction, all watercourses are at risk of impacts on the aquatic environment arising from a potential deterioration in water quality due to silt or pollution loads entering the system. A reduction in water quality could affect a range of invertebrate, fish, mammal and bird species within the specific watercourse, but also downstream for a considerable distance dependant on the scale of pollution. As all watercourses drain to the River Shannon estuary this could have effects within the Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA. Silt generated during construction works will travel downstream over time and could affect spawning habitat for salmonids and lamprey species which are dependent on well-oxygenated and clean gravels. Pollution events could result directly in fish kills dependant on the scale of the discharge and the nature of the pollutant. While this would directly affect fish and / or aquatic invertebrates, it would also indirectly affect their predators including Otter and kingfisher. Without appropriate mitigation during the construction phase, impacts could be moderate to significant negative. However, adherence to best practice methodologies during construction (as detailed in Section 7.5.3 below and within the Construction Erosion & Sediment Control Section of the Environmental Operating Plan in Appendix 4.1 in Volume 4A of this EIAR) will avoid such risks.

Operational Impacts for Aquatic Sites

The principal impacts from the operational phase of the proposed road development include:

- Impacts on water quality arising from surface water run-off or aerial N deposition during the operation of the road.
- Impeding fish passage at watercourse crossings.
- The risk of mortality of Otter through traffic collisions where movement not accommodated in culvert design.

The principal risk to the aquatic environment during operation relates to the potential for pollutants from road run-off entering watercourses leading to deterioration in water quality. However, the drainage design for the proposed road development includes the direction of all surface water run-off through a controlled drainage system which includes attenuation ponds to allow for the settlement of run-off and capture of suspended solids and pollutants. These facilities will also operate as spill containment facilities. Where drainage presents a higher risk (at the Rivers Mague and Deel) hydrocarbon interceptors will be incorporated. The assessment of the operational impacts of the proposed road development on the hydrology is dealt with in detail in Chapter 10 Hydrology.

7.4.8 Impacts on Fauna

7.4.8.1 Construction Impacts for Fauna

Mammals

During the construction phase, there will be construction noise, traffic movements and human activity along the proposed road development, which will provide a dramatic change from the current scenario, given that much of the route is in green field locations. Construction activities will be confined primarily to daytime, though in a few locations there may be a requirement at certain stages of construction to work during the night for short periods (1-2 nights at a time) in order to limit traffic impacts on public roads. The construction phase will lead to localised disturbance but as most ground mammals are nocturnal, the level of disturbance is considered to be localised, slight and temporary.

Otter

There are no potential holt sites or couches (above ground lie-up) on or in the vicinity of any of the watercourse crossing locations. Construction works on the watercourse crossings may lead to localised disturbance and displacement of otters, but this is a short term effect which will not alter territorial occupancy. Continued movement of otters will be accommodated along all watercourses during the construction phase. The potential impact on Otter is considered to be imperceptible.

Badger

A total of five active badger setts were recorded within the footprint of the proposed road development, or on the boundary of the CPO line which may require exclusion. None of the setts recorded were main setts, though they will require re-surveying prior to the commencement of construction to determine their current activity status (as this may change over the intervening period). While these setts will be removed and the proposed road will dissect existing territories, their loss will not affect the continued survival of badgers. There will however, be a temporary disruption associated with the construction phase which may lead to temporary displacement from part of a clan's territory. Following construction, the animals are expected to adjust to the re-ordered landscape and there will be no long term impact on the Badger population within the

vicinity of the road. The impact on Badger populations along the proposed road development is rated as slight negative and temporary to short-term.

Other Mammals

The proposed development has the potential to result in fragmentation of habitats on either side of the road and the restriction of mammal movement by associated fencing and median barriers. This will give rise to a significant risk of mortality through traffic collision where mammals gain access to and attempt to cross the road. In a worst-case scenario, this could lead to a reduction in populations of larger mammals such as Hares and Hedgehogs over time. Mitigation measures including mammal passages and fencing are outlined in section 7.5 and tables 7.12a to d.

There will be a minor reduction in the foraging area for various small mammals likely to occur along the proposed road development, though overall such loss is considered slight negative and will be partially offset by the proposed landscaping along the road.

Bats

The presence of bats was given full consideration at the design/Route Selection phases of the proposed road development and as a result much of the most important habitats and breeding sites of bats in this area of West Limerick were avoided (Kelleher, 2017).

A variety of habitats occur along the proposed road development, which vary in their importance for bats. The loss of areas of improved agricultural grassland within the proposed road development will have a negligible or minor adverse impact on bats. Watercourses should not be significantly impacted by the proposed development and thus bats are likely to continue using them. The main impact on bats arises through the loss of hedgerows and treelines along the route which are widely used by Pipistrelles but also by *Myotis* species and Lesser Horseshoe Bat. Loss of bat habitats such as treelines, hedgerows or other linear features as a result of construction will impact on commuting bats. This may temporarily affect bats during construction though reconnection of linear features following landscaping and provision of underpasses will lessen potential impacts.

Bats are often faithful to a particular roost site from year to year. Buildings occupied by bats are typically maternity roosts where females congregate to give birth. The loss of such sites can have serious implications for a colony as there may be no other suitable sites in the area. The loss of roosts is believed to be one of the major factors contributing to declines in bat populations throughout Europe. Ten buildings / structures will be impacted by the proposed road development, three have been identified as bat roosts (satellite or night roosts) for a small number of Soprano pipistrelles and Common pipistrelles. In order to remove structures and provide alternative roosting sites, a derogation licence has been applied for to the NPWS.

Bats often use trees as roosting sites. Potential Bat Roosts (PBRs) in trees are also an important area to address. A total of 103 trees deemed to be potential bat roosts, the majority of which are categorised as Category 2 value PBRs will be impacted by the proposed road development. Alternative roosting sites will be provided to reduce the potential impact of the loss of roosting features in felled trees. The loss of trees in the landscape as a result of road construction is likely to constitute a slight to moderate negative impact. However, a large number of trees are to be planted to fulfil the mitigation measures as part of the proposed road development.

Invertebrates

White-clawed Crayfish

The construction of the proposed road development could impact on the crayfish population (if persisting at the time of construction) through direct mortality in the section of channel to be realigned at Bullaun, and through deterioration of water quality, and through facilitating further transfer of the disease at Bullaun and Graigeen. Specific measures to avoid or minimise these risks are presented in Section 7.5 and in the EOP. Salvage and translocation of Crayfish (along with fish) within sections of channel where works are required will take place under appropriate licence from the NPWS and IFI. Overall, the potential impact on this species is considered to be imperceptible.

Marsh Fritillary Butterfly

There are no records or evidence of Marsh Fritillary butterfly from any location along the proposed road development and therefore no potential for an impact on this species.

Vertigo moulinsiana

Vertigo moulinsiana was recorded at three fen sites along the proposed road development, namely Ballyellinan (KER 7), Lismakeery (KER 11) and Blossomhill (KER 21). At Ballyellinan and Blossomhill, *V. moulinsiana* was recorded outside the land-take boundary indicating at worst, a potential minor loss of habitat for the species. At Lismakeery, *V. moulinsiana* was recorded within the land-take boundary with an estimated 5,130 m² (0.51 ha) of suitable habitat will be lost for the species. Further information is available in Appendices 7.4A and 7.4B Vertigo Reports provided by John Brophy of BEC Environmental. Impacts outside of the footprint of the proposed road development will be avoided by ensuring there is no alteration of the hydrology of the fen habitat as a result of construction. The loss of *V. moulinsiana* due to the proposed road development is considered a moderate, negative permanent effect.

Fish

All fish species are at risk from deterioration in water quality during the construction phase, although this issue is addressed under 7.4.7 above.

The larger of the watercourses crossed by the proposed road development including the Rivers Mague, Deel, Clonshire, Greanagh and Ahacronane support populations of Salmon, Brown Trout and potentially Brook Lamprey, along with European Eel and some of the smaller species such as Gudgeon, Stone Loach and Minnow. All these watercourses will be crossed with bridges or bottomless culverts that will retain the existing channels and riverbanks intact. There will therefore be no impediment to the continued movement of fish species, although the aquatic and riparian habitat may change over time due to the reduced light penetration affecting plant growth.

The smaller streams and ditches typically only support Minnow and Stickleback with possibly European Eel in small numbers. Again, the culvert design for these minor watercourses will accommodate unimpeded fish movement. The loss of habitat within culverts will constitute a slight negative impact, though where channel realignments are being developed this will partially off-set the loss of habitat.

Amphibians and Reptiles

Common Frog, Smooth Newt and Common Lizard are all protected species under the Wildlife Acts. Common Frog is a Red Data Book species but is common throughout much of Ireland.

There will be a loss of one of the two ponds at Robertstown (KER 3) which provides potentially suitable spawning habitat for both frogs and newts, in addition to impacts on numerous drains along the proposed road development which are frequently used by frogs. Salvage and translocation of spawn or tadpoles may be required depending on the seasonality of the works at this receptor. One pond at Robertstown will be retained intact and the extent of the drainage network and numerous wetland habitats ensures both species will still persist in the vicinity of the proposed road development. The impact on amphibians is considered to be slight negative at most.

There may be loss of habitat utilised by Common Lizard along the proposed road development but the overall impact on this species is imperceptible.

Birds

Countryside Birds

A range of species of countryside birds will be affected by loss of nesting and foraging habitats, including some species with localised distributions such as Skylark and Grasshopper Warbler. However, all species would be expected to maintain local populations, and none would be deterred from utilising habitats alongside the proposed road development. Landscaping along the margins of the road will provide future habitats for a range of countryside birds. Overall, the significance of the impact on birds of the countryside is rated as slight negative.

Kingfisher

No nest sites of Kingfisher have been recorded in the vicinity of any of the watercourse crossings. Following the completion of construction phase, the use of watercourses by Kingfisher will not be impeded and no impact is expected on their continued use of watercourses or foraging success subject to the maintenance of good water quality.

Barn Owl

While evidence of breeding Barn Owl was not confirmed at any of the known nesting sites in the vicinity of the proposed road development, evidence of activity was recorded at two locations near Clonshire Beg within <1 km from the proposed road development. However, there are no known or potential Barn Owl nest sites on or in the immediate vicinity of the road development which would be impacted by the construction of the proposed development. The loss of habitat associated with the proposed road development is not expected to have any significant effect on foraging behaviour or success by birds. The impact on Barn Owl as a result of construction is therefore considered negligible.

Whooper Swan

The nearest foraging sites for wintering Whooper Swan to the proposed road development is at Cloonanna c. 3km to the north of the Maigue crossing and at Ardnanean on the River Deel callows, approximately 3km southwest of Rathkeale. These sites are considered to be well beyond any potential for disturbance during either construction or operation. While the flock utilising the Ardnanean callows may use the River Deel as a flyway connecting to the River Shannon and other foraging areas, the proposed road would not impact on the use of this flyway. There are no impacts predicted on this Annex I listed species.

Wintering Waterbirds

The construction works in the vicinity of Churchfield Estuary (KER 2) within the Lower River Shannon SAC and River Shannon and Fergus Estuaries SPA presents a risk of giving rise to impacts on wintering Water-birds due to the proximity of the site to the

road. The estuary and SAC/SPA boundary is c. 150m at its nearest point to the proposed road development though the estuary extends in two separate lobes for a distance of c. 1.7km from west to east at this location. Any disturbance would only be expected to occur within a limited extent (<100m) of the proposed road development. The Institute of Estuarine & Coastal Studies (IECS) (Cutts, et. al., 2009) showed that birds were found in general, to accept a wide range of steady state noise level from 55dB(A), up to 85dB(A), therefore complete exclusion within up to 250m was considered very unlikely. Evidence presented by Cutts et al. (2009) from repair work to a pipeline in the Humber Estuary has shown that disturbed birds (within 100m) are likely to return within a short time frame once disturbance ceases, potentially within 30 minutes, and with no evidence of effects on numbers during surveys the following week, emphasising the short-term nature of any impacts.

In view of the extent of estuarine habitat available to wintering waterbirds in the area, disturbance of birds from the part of the Churchfield Estuary in closest proximity to construction works (which will be limited at most to two winter seasons), will only result in a localised displacement. This is considered to be a temporary and localised impact which will not adversely affect the Qualifying Interests of the SPA utilising the Churchfield Estuary.

7.4.8.2 Operational Impacts for Fauna

The impacts of the operational phase of the proposed road development on faunal species are considered below. The assessment only addresses species or groups which are likely to be impacted.

Mammals

During the operational phase, the most significant potential impact to mammals from the road relate to animals attempting to cross the carriageway being exposed to traffic collision. In the absence of measures to accommodate unimpeded movement and prevent access to the carriageway, mortality of small mammals is likely to be a regular occurrence, with peaks occurring during mating times and when juvenile animals start foraging independently.

The new road will generate ongoing disturbance through traffic movements and human activity both during daytime and to a lesser extent at night. Significant noise disturbance could result in reduced foraging success, displacement from refugia, and interference with commuting habitat for mammals. As mammal species are primarily active at night the disturbance effects from operational activities is not predicted to result in any significant effects on mammal activity, and any effect is likely to be confined to a very marginal zone along the road corridor. Habituation by mammal species occupying territories adjacent to the proposed road is expected to occur over a relatively short time frame.

Otter

An interruption to the movement of Otter along all watercourses presents a risk of mortality though traffic collision where animals attempt to cross the carriageway. Periodic mortality could result in significant impacts over time. However, this risk will be minimised as mammal passages will be accommodated on all watercourse crossings. All larger watercourses will have clear span structures retaining open river banks to allow for unimpeded otter movement (locations as detailed in Table 7.11). Smaller watercourses that will be culverted will have either mammal ledges or adjoining mammal culverts (as detailed in Tables 7.12a to d) which will allow for the continued movement of otter (and other mammals) across the landscape thereby reducing the fragmentation effect of the proposed road development.

Table 7.11 Mammal Underpasses at Watercourse Crossings

| Chainage | Reference | Location | Type and Size |
|----------|------------------|-----------------|---|
| 2+150 | FRC2 | Sroolane North | 6m span over stream |
| 2+625 | UB01 | Robertstown | N69 & Robertstown River: 140m / 4-span |
| 4+440 | FRC5 | Rincullia | Ahacronane River: 8m span |
| 10+300 | FRC8 | Ballycullen | 7m span over stream |
| 10+955 | FRC9 | Ballycullen | 7m span over stream |
| 20+970 | FRC11 | Ballyclogh | 8m span over stream |
| 24+000 | RVB01 | Booaglass | River Deel: 86m / 3-span |
| 24+500 | FRC15 | Booaglass | 8m span over stream |
| 24+950 | FRC16 | Bullaun | 6m span over stream |
| 27+000 | UB04 | Graigeen | R518 Under-bridge & stream: 47m span |
| 28+250 | FRC26 | Kyletaun | Stream bridge & Access: 15m single span |
| 50+750 | M21-C1 | Rathkeale | 10m span over stream and access track |
| 56+600 | M21-C3 | Clonshire More | Clonshire River Bridge: 15m single span |
| 58+175 | RVB02 | Rower More | Greanagh River Bridge A: 32m span |
| 59+250 | RVB03 | Kilnockan | Greanagh River Bridge B: 81m / 3-span |
| 60+695 | M21-C7 | Islandea | 6m span over stream |
| 60+925 | RVB04 | Islandea, Adare | River Maigne Bridge: 204m / 3-span |
| 63+570 | MU63.5 / M21-C12 | Monearla | 6m span over stream |

The localised loss of habitat associated with culverting stretches of minor watercourses will not result in any substantial reduction in foraging area for Otter. There is also a potential indirect impact on Otter as a result of a reduction in prey availability due to a decline in water quality from pollution during the operational phase of the proposed development. These risks are assessed in Section 7.4.7 above.

In view of the accommodation of Otter movement on all watercourse crossings in combination with the design of road drainage to maintain water quality, the overall impact on Otter during operation is considered to be imperceptible.

Bats

The Lesser Horseshoe Bat population in the Adare area is low and preserving continuity of potential commuting routes at the River Maigne crossing will allow these animals to cross beneath the new carriageway. The proposed road development to the north of Rathkeale and Adare will be approximately 3.6 km distant from the main Limerick Lesser Horseshoe Bat breeding population located at Curraghchase Forest Park. As noted, the Limerick Lesser Horseshoe population is suffering from isolation, so it is extremely important to ensure that the landscaping of the proposed road development facilitates positive movement of this bat species through the landscape. The impact is considered as a Moderate-Significant negative but may be reduced to Slight-Moderate negative impact if linear features are retained or reconnected in the landscape and other mitigation measures are employed as detailed in Section 7.5.4 and Tables 7.12a-7.12d below.

Loss or fragmentation of foraging habitats may also diminish the available insect prey species and reduce feeding area for bats in some locations. This is considered as a moderate impact and will be reduced to slight negative following landscaping.

Loss of roosting sites, due to the removal of three buildings, will reduce roosting sites. This is considered as a slight impact but the provision of alternative roosting sites will mitigate this.

Invertebrates

White-clawed Crayfish

There will be no effect on continued White-clawed Crayfish movement along any of the watercourse crossings where this species has been recorded. All realigned sections of channel will provide suitable habitat and refugia for the species. Overall, the potential impact on this species is considered to be imperceptible during the operational phase.

Vertigo moulinsiana

There will be no impacts on *V. moulinsiana* in the 3 fen areas adjoining the proposed road development in the operational stage as there will be no alteration of the hydrology or water quality within the fen habitats utilised by this species.

Fish

All watercourse crossings will accommodate fish movement, with the larger watercourses retaining their natural stream beds unaltered. There will be no effect on fish movement along any of the realigned sections of channel which will be designed to provide natural channel features and flow regimes. The maintenance of water quality is of extreme importance to fish populations and this is assessed in Section 7.4.7 above.

Overall, the potential impact on fish species during the operation of the proposed road development is considered to be imperceptible.

Amphibians and Reptiles

The operational phase of the proposed road development will have no negative impact on amphibians and the provision of attenuation ponds may provide an increase in breeding habitat which could benefit the population. As amphibians are a prey item for a range of mammals and birds, an increased population would also have a potential positive impact for other species.

Birds

Kingfisher

Kingfisher movement along the watercourses where they have been recorded or are likely to occur will be accommodated in the structures proposed thereby avoiding the risk of birds flying over the carriageway and being exposed to traffic collision.

Barn Owl

The Bird Atlas (Balmer et al., 2013) revealed a decline in breeding range of Barn Owl in Ireland by 39% over the past 40 years, which is attributed to increased mortality associated with major road developments along with agricultural intensification and the increased use of anticoagulant rodenticides (Lusby and O'Clery, 2014).

Mortality on roads however, is the primary cause of mortality recorded for Barn Owls in Ireland between 2008 and 2017, representing just under three quarters (73.7%) of all recorded mortalities (Lusby et al. 2019). The majority of road mortality incidents were recorded in the south west, with 84% of all road casualties recovered on roads in Munster. The bias in recorded road mortality incidents towards the south west can be partly explained by the distribution and densities of Barn Owls in Ireland, with the majority of the breeding population located in the south west (Balmer et al. 2013; Lusby et al. 2019). Barn Owl road mortality occurs disproportionately on motorways, with 60% of all recorded road deaths on motorways. The number of Barn Owls killed on motorways is 15 times higher than on national roads and over 500 times higher than on secondary routes relative to route length (ibid).

An investigation into the effects of road developments on Barn Owl behaviour and mortality patterns in Ireland was undertaken by BirdWatch Ireland (Lusby et al. 2019) and Transport Infrastructure Ireland (TII) to determine the impacts of road networks on Barn Owl populations and to identify mitigation requirements. The response of individual Barn Owls to major roads as assessed using GPS dataloggers confirmed that major road infrastructures are not barriers to the movement of birds and that individuals can regularly encounter and cross major roads in Ireland. Investigation of the movements and behaviour of adult Barn Owls in the south west of Ireland identified an attraction effect to major roads. Barn Owls spent more time in proximity to major roads than expected and spent more time hunting along or in close proximity to major roads than elsewhere in their home range. This confirms that major roads can provide some benefits to Barn Owls in the form of the provision of suitable habitat. The fact that roadside verges are more important as a foraging habitat for Barn Owls in Ireland compared to other European countries however, is likely a reflection of the habitat conditions in the wider landscape, and the larger home range size of Irish birds further indicate poorer habitat quality (Lusby et al. 2019).

The programme Maxent (Phillips et al. 2019) was used to determine the probability of Barn Owls using the area surrounding and in the immediate vicinity of the proposed Foynes to Limerick Road (including Adare Bypass). There was found to be a high probability of occurrence of Barn Owls across the entire route due to the relatively uniform topography and lack of elevated areas in the vicinity of the proposed road development. This indicates a similar level of risk across the entire development and places a greater emphasis on the influence of verge characteristics in determining the occurrence of Barn Owl vehicle collisions along the proposed road development.

An estimate of a maximum rate of mortality for Barn Owls on the proposed road development was made via a comparison of known mortality rates on a similar road scheme, the N22 Tralee Bypass in County Kerry, which is of a similar road type and design. The Tralee Bypass and the proposed road development are located less than 50km apart in the south-west, which is the stronghold for the Barn Owl population (Balmer et al. 2013; Lusby et al. 2019). At the county level, the number of recorded Barn Owl breeding pairs were 90 and 50 in County Kerry and Limerick (2006 to 2016), representing the highest and fourth highest number of pairs per county respectively (TII 2017). Similar, and relatively high road mortality levels were also recorded in both counties, with 37 road casualties recorded in Kerry and 23 in Limerick (2008 to 2017) (Lusby et al. 2019). It is expected that Barn Owl mortality rates on the proposed road development without mitigation should not exceed the mortality rates recorded on the Tralee Bypass which recorded a maximum mortality rate of 60 Barn Owls per 100km per year, equating to 21 Barn Owls per year over the length of the proposed road development.

The risk of collision is highest in juvenile birds which have not developed the behavioural awareness required to avoid collisions. Due to the low population numbers of the species in combination with the other threats to its survival, mortality of Barn Owl as a result of traffic collision on the proposed road development could lead to a localised extinction in the population, which would constitute a permanent significant negative impact.

7.5 Mitigation and Monitoring Measures for Biodiversity

Mitigation consists of three principal elements, namely (in order of decreasing preference) avoidance, reduction and remediation. The process of avoidance of sites of potentially significant biodiversity value and the consideration of alternatives is an integral part of the entire EIA process which commences at the initial Constraints Study stage and continues through the Route Selection (Phases 2 and 3 of the *National Roads Project Management Guidelines* (TII, 2010)).

During these phases, the proposed road development which is being assessed in this EIAR was selected on the basis of it being the option with the least overall potential impact on designated conservation areas in particular and on biodiversity in general. Throughout the process of finalising the proposed road development within the preferred route corridor, there has been further modifications to the alignment (including horizontal and vertical design) with a view to minimising the loss of habitats of significant ecological value. The process has continued through the development of the design in order to avoid or reduce the scale of impact through measures such as ensuring continuity in existing hydrology of wetland sites in the vicinity of the proposed road development, minimising lengths of watercourses to be culverted by sensitive channel realignment, and the establishment of exclusion zones around Key Ecological Receptor (KER) sites and watercourses.

7.5.1 Mitigation for Designated Areas

Lower River Shannon SAC

The potential for direct impacts on the Lower River Shannon SAC during the construction of the Mague River Crossing will be avoided, reduced and remedied by a suite of measures as detailed below:

Mitigation within the SAC:

- (i) There will be no works permitted outside the identified land take area within the SAC as shown in Figures 4.74 to 4.76 of Volume 3;
- (ii) The location of piers on the flood embankments has been selected to minimise damage or disturbance to habitats within the SAC;
- (iii) The detailed design for the bridge has been developed to avoid any requirement for piers or other elements within the SAC by providing a clear span structure. A construction method statement has been developed along with Erosion and Sediment Control Measures as included in the Environmental Operating Plan (see Appendix 4.1 in Volume 4A of this EIAR) to ensure that all risks of impacts during the construction phase are adequately mitigated. Detailed method statements for the construction phase will be developed by the selected contractor in accordance with the mitigation measures of the EIAR and NIS and any conditions attached to the approval. Where site investigation (including archaeological works) is required in the vicinity of or adjacent to the SAC, these works will be supervised by an appropriately qualified ecologist to ensure the application of all mitigation measures as outlined in this section;

- (iv) In the vicinity of the SAC, the site boundary will be defined at the outset of construction using rigid timber or equivalent robust fencing. Within the site boundary fence, earth bunds will be constructed to contain surface water run-off and channel it to a silt trap before discharge. This will entail measures to ensure that suspended solids in any runoff (either direct or via field drains) into the River Maigue from the construction area, machinery access routes or any other source does not exceed 25mg/l. Among other measures, this will require isolating the area where works are carried out from the river and pumping all runoff to sediment removal facilities;
- (v) All top-soil in the construction zone for the bridge works within the SAC will be stripped and stored (in windrows no greater than 2m in height) for subsequent reinstatement post works.
- (vi) Bridge and approach road design incorporate best environmental practice and design in the control of road run-off and accidental spillage. Run-off will be channelled through a spill-containment facility and hydrocarbon interceptor prior to discharge to the drainage network;
- (vii) A sustainable drainage system will be installed on the new road which will prevent pollution to surface receiving waters. Full details of the drainage system are provided in Chapter 10 of this EIAR.
- (viii) Construction Erosion & Sediment Control Measures have been included in the Environmental Operating Plan (EOP, see Appendix 4.1 in Volume 4A of this EIAR) and have been developed to ensure protection of watercourses during the construction phase from siltation and site run-off.
- (ix) An Incident Response plan has been established to deal with incidents or accidents during construction that may give rise to pollution within the Lower River Shannon SAC. This will include means of containment in the event of accidental spillage of hydrocarbons or other pollutants (including oil booms and soakage pads);
- (x) There is no lighting proposed over the River Maigue Bridge so as to avoid light spill into the river and the adjacent river banks and to avoid disturbance to fish, mammals and bats in the area.

The construction method for the proposed River Maigue Bridge as described in Chapter 4 and in Section 7.4.1 of this chapter, will involve no disturbance to the river channel other than some temporary piling for crane platforms at the edges of the channel within the upper tidal zone. The construction methodology has been designed to avoid any direct impacts on the qualifying interests of the SAC (which occur within the tidally inundated zone) and to ensure that all risks associated with the construction phase on species or habitats within the SAC are adequately mitigated to reduce potential impacts to a negligible level.

River Shannon and River Fergus Estuaries SPA

The River Shannon and River Fergus Estuaries SPA includes the Churchfield Estuary (KER 2) at the western end of the proposed road development where it occurs c.100m from the nearest point of the development. The risk of disturbance to foraging waterfowl associated with the road construction is considered negligible given the distance and intervening hedgerows between the proposed road development and the main body of the estuary (300m from the proposed development). No mitigation is considered necessary at this location to avoid disturbance, though measures to avoid impacting on water quality at this location (and at all watercourses which drain to the River Shannon) will be required during the construction and operational phases. These measures are detailed in Section 7.5.3 below.

7.5.2 Mitigation for Terrestrial Sites

As habitats will be lost and disturbed in all of the KER sites with the exception of Churchfield Estuary (KER 2), habitat mitigation will be required to minimise impacts and provide compensatory habitat where feasible. The habitat loss of linear features (hedgerows and treelines) will be compensated for in the landscape design which will reconnect severed features and create a variety of scrub-woodlands to off-set the loss. These mitigation measures are shown in Figures 11.1 to 11.24 of Volume 3 in the figures associated with the Landscape chapter, which have been developed with input from the project ecologist.

The Compulsory Purchase Order / Motorway Order (CPO/MO) extends to include lands (areas of severance) in a number of sites which are not required for construction purposes and these will be fenced off prior to construction. Trees and hedgerows which are being retained at the edge of the CPO will also be fenced to prevent accidental damage during construction. A number of areas of severance along the proposed road development (outside of KER sites) will be landscaped and managed to increase their biodiversity value by establishing native vegetation communities appropriate to the prevailing soil conditions. These sites will help to mitigate to some extent for the habitat losses along the length of the proposed road development as well as providing habitat connectivity between existing features.

Landscaping along the road verges and embankments will comprise planting of trees and shrubs as well as grass verges. Where trees are being planted, these will link in with existing hedgerows (which will have been truncated by road construction) so as to maintain corridors for animals. Where space exists, the planting of trees and shrubs in copses (as opposed to lines) will be carried out. To maximise the value for wildlife, trees and shrubs used for landscaping will be limited to native species suitable for the prevailing conditions. These include Hawthorn, Blackthorn, Hazel, Alder, Birch, Willow, native Holly, Oak, Rowan, Crab-apple, Spindle and Elder. Some sections of verges and embankments will be planted with native meadow grass seed mixtures. In areas of cuttings, bare rock and shallow soils will be left to revegetate naturally, consistent with engineering stability.

To reduce the impact of dust on adjacent habitats during the construction phase, best practice will be employed including watering exposed soil surfaces, covering trucks transporting dust-producing material leaving or entering a construction site, reducing construction vehicle travel speeds on unpaved surfaces, and maintaining equipment to manufacturers' specifications.

7.5.3 Mitigation for Aquatic Sites

Measures as detailed below are required to ensure that any potential impacts on aquatic environment from siltation or pollution during either the construction and operation phases are avoided or remedied. Given that all watercourses crossed by the proposed road development drain to the River Shannon, there is potential for downstream impacts on the Lower River Shannon SAC and River Shannon and River Fergus SPA across the entire road development.

Construction Stage Mitigation for Aquatic Sites

The mitigation measures detailed below will be incorporated in their entirety into the construction contract documentation.

- (i) A suitably qualified project ecologist will be employed by the contractor to ensure successful implementation of the mitigation measures.

- (ii) Throughout all stages of the construction phase of the project the contractor will ensure that good housekeeping is maintained at all times and that all site personnel are made aware of the importance of the freshwater environments and the requirement to avoid pollution of all types.
- (iii) All design, construction and operation will be carried out in accordance with *Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes* (TII, 2006) and *Control of water pollution from construction sites; Guidance for Consultants and Contractors* (SP156) (CIRIA, 2001) and *Guidelines on the Protection of Fisheries During Construction Works* (IFI, 2016).
- (iv) Incident Response Measures are outlined in the EOP in Appendix 4.1 in Volume 4A of this EIAR to ensure measures will be established to deal with incidents or accidents during construction that may give rise to pollution within any watercourse. This will include means of containment in the event of accidental spillage of hydrocarbons or other pollutants (including oil booms, soakage pads, etc.).
- (v) Where further pre-construction site investigation (including archaeological works) is required in the vicinity of or adjacent to any watercourses, these works will be carried out with due sensitivity and appropriate measures employed to minimise siltation. Where excavations will be undertaken in proximity to watercourses, silt fences will be erected at the locations outlined in EOP to prevent any runoff entering watercourses during excavations.
- (vi) Site compounds will be located at a minimum distance of 50m from any watercourse. Soil storage areas will be located at a minimum distance of 20m from any watercourse. All drainage from these facilities will be directed through a settlement pond with appropriate capacity and measures to provide spill containment.
- (vii) Sediment traps or settlement ponds will be provided at all outfalls to watercourses during construction. Total suspended solid levels in all waters discharging to any watercourse shall not exceed 25mg/l (IFI, 2016). All construction site run-off will be channelled through a stilling process to allow suspended solids to settle out and through a spill-containment facility prior to discharge to the drainage network.
- (viii) Daily monitoring of all sediment traps and settlement ponds will be undertaken to ensure satisfactory operation and/or maintenance requirements.
- (ix) The storage of oils, hydraulic fluids, etc., will be undertaken in accordance with current best practice for oil storage (Enterprise Ireland, BPGCS005).
- (x) The pouring of concrete, sealing of joints, application of water-proofing paint or protective systems, curing agents, etc., will be completed in the dry to avoid pollution of the freshwater environment.
- (xi) All machinery operating in-stream will be steam-cleaned in advance of works and routinely checked to ensure no leakage of oils or lubricants occurs. All fuelling of machinery will be undertaken on dry land.
- (xii) Instream works on all watercourses supporting salmonids (see 7.3.8 above) shall be undertaken during the period July to September unless otherwise agreed with IFI, to avoid accidental damage or siltation of spawning beds. This will include preparatory work such as piling or rock blasting in the vicinity of watercourses. Bank works will not interfere with migrating fish from March to June and spawning fish migration from October to February.
- (xiii) Clear span structures and box culverts will be used on watercourses as specified in Tables 7.12a to 7.12d below. Where culverts are proposed, these shall match the existing width of the watercourse.

- (xiv) Culvert design will avoid impacting on flow regimes and river bed profiles upstream and downstream of the structure and allow for unimpeded movement of fish by ensuring a minimum depth of water within the structure. Flow regimes for all crossings identified as supporting salmonids will allow for the unimpeded passage of fish upstream and downstream by having the invert buried 500mm below bed level, be open bottomed or be clear spanning.
- (xv) Where watercourses require re-alignment to provide a right-angle crossing to the road or to minimise culvert length, the designs incorporate sinuosity and varied flow regimes with substrate composition to reconstruct a natural river system in both plan and profile. Realignment will tie in with the upstream and downstream sections of the existing channel. Landscaping along realigned sections of watercourse will aim to recreate riparian habitats using exclusively appropriate native species.
- (xvi) New stretches of watercourse on realignments will be completed and have vegetation established prior to connecting to the original watercourse. Abandoned stretches will be electro-fished by suitably qualified personnel (under licence from IFI or the NPWS, as appropriate) to salvage fish and White-clawed Crayfish where identified as occurring, or having the potential to occur (see 7.3.8 above).
- (xvii) Where bank strengthening or scour protection is required, this will utilise sensitively placed rock armour with appropriate landscaping to tie the feature into the existing river bank profile. Gabion baskets and Reno mattresses shall not be used.
- (xviii) The risk of accidental transfer of non-native invasive species and diseases will be minimised by the implementation of Invasive Species and Biosecurity Management measures which have been developed to avoid the spread or transfer of all invasive plants, animals and diseases in accordance with current best practice protocol, the *TII Guidelines on the Management of Noxious Weeds and Non-native plant species on National Road Schemes* (2010) along with any modified or updated approaches to invasive alien species control (www.invasivespeciesireland.com). Measures for the management of IAS are included in the EOP in Appendix 4.1 in Volume 4A of this EIAR. These measures will be enforced during construction to ensure accidental spread does not occur on machinery or materials to and from the site.

Operation Stage Mitigation for Aquatic Sites

The drainage design for the proposed road development adequately addresses all concerns in relation to water quality as a result of the operation of the road. Full details on the drainage design are presented in Chapter 10 Hydrology. The drainage design entails the collection of all road surface water run-off which will be directed through attenuation ponds. These ponds will function as spill-containment facilities and will also settle out particulate matter and allow for entrapment of pollutants. Hydrocarbon interceptors are proposed where the drainage from the ponds will discharge directly to large watercourses considered as sensitive receptors.

7.5.4 Mitigation for Fauna

All recommended mitigation measures are based on the *TII Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (2006a), *TII Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes* (2006b), *TII Guidelines for Crossing of Watercourses During the Construction of National Road Schemes* (2005) and the *Highways Agency Design Manual for Roads and Bridges* (Highways Agency, 2001a and b). An approach of multiuse mitigation has been employed which involves the effective use of all

structures: culverts, agricultural underpasses and bridges, for wildlife passage and protection. All mitigation measures as detailed below will be put in place and completed before the road is opened to traffic.

7.5.4.1 Construction Stage Mitigation for Fauna

Otter

Continued access along all watercourses will be maintained during the construction phase to accommodate unimpeded movement of Otter. As there are no holts or couches identified on any watercourses in the vicinity of any watercourse crossings along the proposed road development, there is no risk of disturbance to these features. Mitigation is required to ensure that noise/vibration and lighting during the construction of the various watercourse crossings will not lead to significant effects in terms of barriers to connectivity for Otter. This will entail confining the timing of pile driving activities during construction to daylight hours during winter months. It will also require avoiding light spill from flood lighting onto the river banks or channel outside of construction activities. Continued movement of Otter will also need to be accommodated along the river banks during the construction phase requiring permeable fencing along site boundaries. Maintenance of water quality as detailed in Section 7.5.3 above will address requirements for Otter also.

Given the implementation of the above mitigation, the impacts of the construction stage activities on Otter is considered to represent a short term and localised effect which will not alter territorial occupancy or conservation condition.

Badgers

A total of 5 Badger setts were identified within, or within 50 m of, the CPO boundary of the proposed road development and each of these setts will require site specific mitigation measures. A further 6 setts are located within 50 to 150m of the CPO boundary and would only be subject to mitigation measures if pile driving or blasting is proposed within 150m of the sett location.

The mitigation measures for each sett are separated into two stages: (1) mitigation measures during fence-line construction or vegetation clearance; and, (2) mitigation measures prior to or during construction. This takes account of the potential for the vegetation clearance/fence-line construction to be carried out in advance of the commencement of the construction works. If the vegetation clearance/fence-line construction is carried out in conjunction with the construction phase, then the mitigation measures prior to or during construction details all the required mitigation measures.

Pre-construction badger survey

In addition to those already found, badgers may also create new setts in advance of road construction. In accordance with the TII *Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (2006a)*, where 36 months or more has elapsed between obtaining statutory approval for a road development and initiation of the construction phase, an appropriate level of resurvey will be carried out as the baseline date may be altered during this time.

Known setts will require re-surveying to determine precise locations relative to the construction requirements prior to the commencement of construction. Where setts are outside of the footprint of works, they will be afforded protection in the form of an exclusion zone defined by robust fencing. Where within the footprint of proposed works, they will require exclusion in accordance with the procedures defined in the *Guidelines for the Treatment of Badgers Prior to the Construction of National Road*

Schemes (TII, 2006). In addition, some areas of dense scrub may conceal setts. These areas should also be re-surveyed prior to construction to check for setts.

Monitoring during site clearance

Where dense vegetation prevents adequate determination of the presence or absence of setts, these areas will require monitoring during vegetation clearance to ensure that any setts present will be found and treated appropriately.

Protection of setts close to the CPO

No construction machinery will be used within 30m of Badger setts (extended to 50m for active setts during the breeding season from December to June inclusive). During the pre-construction survey setts located adjacent/close to the CPO boundary (within 50m) will be clearly marked and the extent of bounds prohibited for vehicles clearly marked by fencing and signage, if deemed necessary. Such marker fencing will be sufficiently durable and robust to cover the period of construction. Neither blasting nor pile-driving will be undertaken within 150m of active setts during the breeding season.

Landscaping activities after the road construction phase can also affect badger setts, and care will be taken to ensure that setts safeguarded on or near the site are not interfered with at this stage and that access to foraging areas is not restricted.

Evacuation of setts adjacent to the CPO

Where required, exclusion/closing of active badger setts will be carried out under the supervision of an appropriately qualified ecologist. Evacuation and closure of setts will be undertaken during the period 1st July to 30th November. All active setts will be protected from interference or disturbance by an exclusion zone of 30 m (50 m during the breeding season - December to June inclusive) within which no machinery or vegetation removal will take place. Settt tunnels can extend for over 20 m from sett entrances and use of any vehicles, digging, or heavy machinery can cause collapse of tunnels and cause mortality of badgers. Light work, such as hand-digging or scrub clearance will not take place within 10 m of sett entrances.

The setts will be clearly marked and the area from which vehicles are prohibited will be clearly marked by timber post and rail fencing (and appropriate signage) which will allow Badgers to move in and out freely. To ensure that accidental damage to setts does not occur, it is important that there is a transfer of information between construction personnel at all levels. Exclusion of badgers from disused or currently inactive setts is not seasonally restricted and can be conducted at any time. The mitigation measures and procedures required in relation to badgers will be included in the Environmental Operating Plan for the proposed road development.

Bats

Mitigation Measures for Bats are outlined in full in the Four Season Bat Report as Appended to this EIAR (see Appendix 7.1 in Volume 4A of this EIAR). The mitigation measures in this Four Season Bat Report must be carried out in full.

The principal impacts on bats during construction relate primarily to the loss of roost sites in either trees or buildings. However, in addition, protection will be required of retained interests (riparian habitat and peripheral habitats to the construction zone) during construction.

Avoidance / Prevention of Impacts

- Treelines, hedgerows or other linear habitats that have been earmarked for protection (as illustrated in Figs. 7.25 – 7.47) shall remain in-situ and remain protected from the construction of access link roads and other supporting infrastructure construction where possible.
- Habitats identified as important foraging areas for bats (refer to Section 5.4 in Appendix 7.1 in Volume 4A of this EIAR) shall be protected from damage e.g. scrub areas (known as bat habitats).

Replanting of Linear Habitats / Landscape Planting

A large number of hedgerows / scrub / treelines will be removed or bisected as a result of the construction of the proposed development. At these points, it is important to provide alternative flight paths or reinstate such features for commuting bats, especially in relation to chainage numbers listed in Table 22, above. The landscape planting proposed to create alternative flight paths are illustrated in Figs. 7.25 – 7.47 of Volume 3 of the EIAR.

Landscape planting shall be undertaken using native shrub and tree species of Irish provenance to re-establish linear vegetation. To ensure that bats adopt the newly instated commuting routes as early as possible, this landscaping shall be in place as early as possible and ideally prior to road construction and prior to interruption / removal of traditional bat commuting routes (preferably 2-3 seasons prior to works) where possible.

All areas for habitat protection shall be required to be fenced off to a distance equal to the outer canopy.

Mature Trees

A survey of all trees along the proposed road development was undertaken. A total of 103 trees were deemed as PBRs, the majority of which have a Category 2 value.

Phase 2 inspections will be undertaken within the CPO line prior to construction, once a mark for felling is confirmed. The Phase 2 inspection will generally involve a closer examination of individual trees using a strong torch beam (LED Lenser P14.2) and endoscope (General DC5660A Wet / Dry Scope) and where required and / or possible, height surveys, to be completed using a ladder. If a tree is deemed to be a roost site then further surveying, involving dusk and dawn surveys of the actual trees, may be recommended to determine what bat species are present, *etc.*

Tree Felling

In accordance with Section 40 of the Wildlife Act (1976; as updated 2019), tree felling shall not be carried out during the bird nesting season (1st of March – 31st of August, inclusive). Additionally, in order to avoid periods when bats are hibernating or most active, tree felling shall be restricted to the months of September, October and November only. When tree felling is to be carried out, trees in question shall be subject to a detailed inspection by a suitably qualified ecologist / bat specialist prior to felling, and shall be felled according to PBR value. Any trees (Category 1 value and potentially some Category 2 trees, depending on the results of Phase 2 surveys) showing crevices, hollows, *etc.*, shall be removed only while a bat specialist is present to deal with any bats found / disturbed. Such animals shall be kept in a box until dusk and released on-site.

A bat expert will survey all PBR trees due for removal prior to construction works commencing. Large mature trees shall be felled carefully; gradual dismantling shall be carried out by a competent and experienced tree surgeon(s), under the supervision of a bat specialist. Care shall be taken when removing branches, as removal of loads may cause cracks or crevices to close, crushing any animals contained within. These cracks shall be wedged open prior to load removal. Dead branches shall be lowered to the ground using ropes to avoid impacts which may injure or kill bats contained within.

Any ivy-covered trees (generally applies to Category 2 trees with heavy ivy growth) which require felling will be left to lie for 24 hours after cutting to allow any bats beneath the ivy cover to escape.

Bat boxes will be erected to compensate for trees marked as PBRs which are felled. The number of bat boxes to be erected shall depend on the number of PBRs to be felled and their respective values, as assigned herein. For every individual Category 1 tree felled, one no. bat box shall be erected (1:1); for every 6 Category 2 trees felled, one no. bat box shall be erected (6:1). Accordingly, the erection of 19 no. bat boxes (woodcrete or woodstone summer bat boxes) is being recommended. As these type of bat boxes are best erected on mature trees, an alternative is to erect Habitat Double Chamber Rocket Box ('rocket box' hereafter; see Appendix A of Appendix 7.1 in Volume 4A of this EIAR), a free standing maternity bat box. Rocket boxes shall be located in suitable areas within the CPO (i.e. as set out in Table 7.12a). In order to create roosting opportunities, equivalent to the recommended 19 no. summer bat boxes, 6 no. double-chamber rocket boxes would suffice.

Buildings to be Removed

A small number of buildings are proposed to be demolished to facilitate the construction of the proposed development. The buildings surveyed in 2018 identified two satellite roosts and two night roosts and another building that has potential for roosting bats. An NPWS Derogation Licence has been obtained to remove these buildings. A set of mitigation measures and roost compensation have been submitted with the Derogation Licence application. The following is required:

For each of the buildings / structures identified above as known / potential bat roosts, the Contractor shall prepare a demolition plan to ensure the safe removal of bats, with following considered:

- Undertake demolition works outside the main summer season (avoid May to August) and avoid cold winter months (December and January);
- Provide alternative roosting sites prior to demolition within areas of the proposed development which will not be impacted by construction. The type of alternative roosts depends on the roost types recorded. The roosts types recorded were satellite or nights roosts. Alternative roosts include the erection of double-chamber rocket bat boxes (free standing structures) at numerous locations along the length of the proposed road development. Bat tubes will also be installed as part of culvert and bridges proposed as part of the development. One rocket bat box per structure to be removed is recommended.
- Re-survey structures / buildings in question prior to demolition to determine if bats are present. Undertake a dusk and dawn survey and internal inspection of the structure as deemed appropriate by the bat specialist.
- The demolition plan will involve a series of steps in order to reduce the suitability of the structure as a roost site (i.e. partial removal of roof, clearance of vegetation, dismantling of sections (by hand) and supervision by a bat specialist).

In consultation with the demolition contractor, a slow dismantling of structures will be undertaken. The dismantling will change the internal environment of the areas where bats have been found roosting by changing the internal temperature and increasing light level. General scope of a demolition plan would include the following:

- Buildings with rooves:
 - Prior to demolition, undertake dusk / dawn surveys to determine if the buildings are being used by bats.
 - During the daytime, remove sections of the roof structures to increase lighting and reduce temperatures within and adjacent to buildings used by roosting bats. The ridge tiles and a selection of main roof tiles / slates will be removed in the presence of a bat specialist and removal will be undertaken by hand (with each tile / slate checked for clinging bats).
 - The building / structure is left open overnight.
 - Undertake dusk / dawn surveys to determine if the buildings are being used by bats.
 - Examination of internal spaces to ensure that no bats are present during demolition the following day.
 - Removal of remaining sections, in the presence of a bat specialist.
- Stone structures / ruins:
 - Undertake dusk / dawn surveys to determine if the buildings are being used by bats.
 - Examine the stonework crevices with an endoscope to determine if bats are present. Crevices found to have bats present will be marked as shown in Plate 7.15a and b.
 - Each crevice that is deemed empty will be blocked up with bubble wrap to prevent bat entering until the structure is to be demolished. Alternatively, once sections of the structure are deemed bat free, wrap in hessian material (see Plate 7.16a and b) to prevent bats from roosting in the walls post-inspection.
 - Once the ruin is deemed bat free, remove in the presence of a bat specialist.
- Farm buildings (i.e. corrugated iron barns):
 - Undertake dusk / dawn surveys to determine if the buildings are being used by bats.
 - Remove the timber and insulation partitions by hand in the presence of a bat specialist.
 - Check any potential crevices with an endoscope.
 - Remove sections of the corrugated sheets to change the internal temperature of the building and leave overnight.
 - Undertake a Dawn survey and if deemed bat free, remove the remaining structure.



Plate 7.15a, b Crevices containing bats circled in water-based red paint



Plate 7.16a, b Example of hessian material curtains for sealing bridge arches

Protection of Habitats

Any semi natural habitats adjacent to proposed road development (and situated in the lands to be acquired) shall be protected, where possible. Working areas shall be clearly defined prior to the commencement of construction or fenced to ensure they are kept to a minimum.

Maintain Roosts = No Disturbance to Roosts

With the exception of those buildings currently proposed to be demolished to facilitate the construction of the proposed development, buildings located close to the proposed road development will not be disturbed during construction works.

Limit Work Spaces and Lighting During Construction

Open areas required to facilitate road works along the proposed road development shall be limited to areas where tree felling and hedgerow removal is not required. Lighting of such work spaces can also disrupt traditional foraging grounds for bats and, therefore, shall be limited and shall not occur during the foraging period (from 30 minutes prior to sunset until 30 minutes after sunrise). Works at night-time will be avoided in areas where foraging bats are concentrated. All other areas shall be

screened to prevent lighting spilling out onto adjacent habitats and lighting used shall be directional onto works.

Existing Bridges

A bat survey of any existing bridges or underpasses, where impacted by the proposed road development, shall be undertaken prior to the construction phase to determine if bats are roosting within such structures prior to construction works commencing.

Culverts / Underpasses / New Bridges

It is essential that the height of any proposed bridges and culverts in areas identified as commuting corridors are high enough to encourage bats species to fly under the road. The underpass height requirements are dictated by the preferred flight height of the different bat species, as follows:

- Natterer's bat, whiskered bat, brown long-eared bat, LHB and Daubenton's bat will be catered for by a min. height of 2 – 3m in relation to underpasses.
- Common and soprano pipistrelle require a min. height of 4 – 6m in relation to underpasses.

The above requirements have been accommodated where possible across the proposed road development, as detailed in Table 7.12a. In addition, bat tubes will be installed in a number of structures, as outlined in Table 7.12a, to provide alternative roosting sites for bats. Two bat tubes per structure, where possible, will be accommodated.

Birds

Countryside Birds

An automatic derogation in respect of clearance of vegetation within the bird nesting season (1st March to 31st August) associated with road construction exists under the Wildlife Act. If clearance is required within the restricted period, this will require appropriate measures to minimise destruction of nests and will be supervised by a suitably qualified ecologist.

Barn Owl

Although there were no Barn Owl breeding sites identified on or within the immediate vicinity of the proposed road development, it is possible for Barn Owls to occupy sites in the intervening period prior to the commencement of construction works, and potentially suitable sites (e.g. buildings, mature trees, quarries and nest boxes) considered vulnerable to direct disturbance from the development of the proposed road should be subject to a pre-construction survey using best practice methods (TII, 2017). In the event that a Barn Owl breeding site is confirmed, then all works which have the potential to cause disturbance to this site should be appropriately planned and undertaken outside of the breeding season as required under the Wildlife (Amendment) Act, 2000.

Wintering Water-birds

No specific mitigation is considered necessary for wintering waterbirds due to negligible impacts.

Invertebrates

White-clawed Crayfish

The principal mitigation requirement for White-clawed Crayfish during the construction phase relates to prevention of the spread of crayfish plague between watercourses as

a result of the movement of machinery, materials and personnel. The Biosecurity protocol detailed for watercourses in Section 7.5.4.1 above will avoid the risk of transfer. Where watercourses identified as supporting or having the potential for White-clawed Crayfish to occur are to be realigned, the abandoned stretches will be monitored during de-watering by suitably qualified personnel. Any crayfish will be salvaged and translocated downstream (under licence from NPWS).

Vertigo moulinsiana

The construction works at Lismakeery (KER 11) will result in the direct loss of *V. moulinsiana* habitat. There is no potential to alter the route to avoid impacting on the fen site due to the other constraints in this location.

An additional area of the Lismakeery Fen is included in the lands to be acquired for the proposed road development, with a view to potentially providing habitat protection and enhancement measures within the remaining 80% of the fen area that will not be impacted by the proposed road development. The existing drains that have historically diminished the quality of the fen habitat could be modified to improve the hydrological conditions. The southern area of the fen grades into wet grassland beyond the extent of the Black Bog-rush. Habitat conservation would require minimal or no intervention, with the main benefit being that the site could be protected from future reclamation or more intensive grazing, both of which impact negatively on *V. moulinsiana*. The site currently shows evidence of some cattle grazing, as well as the deposition of spoil and rock at the eastern end.

In the northern area of the fen the intervention would be to reduce the drainage outflow with a sluice to allow the regulation of water flows as required.

If the proposed measures were to be put in place, it should encourage the expansion of the suitable fen vegetation and allow the expansion of *V. moulinsiana* into the currently unsuitable area of fen area to the south. On the historical 6-inch maps, this entire area is marked as rough pasture and 'liable to floods', which suggests a more wetland situation than is currently apparent after agricultural improvement.

The removal of grazing pressure and the threat of infilling related to agriculture in Polygons B, C and D could secure the 0.18 ha of Suboptimal habitat in Polygon B, see improvement of the 0.45 ha of Suboptimal-Unsuitable habitat in Polygon C to Suboptimal, and see the improvement of most of the 1.41 ha of Polygon D to Suboptimal-Unsuitable or better. The prospects of success are high due to the current habitat and water levels present.

The protection of main fen area to the south of the proposed road development would ensure *V. moulinsiana* continued to be present within the two 1 km grid squares into the future.

Fish

The maintenance of water quality during construction is of extreme importance to fish populations and will require adherence to measures as addressed in Section 7.5.3 above. Where watercourses are to be realigned during construction, the abandoned stretches will be electro-fished (under licence from IFI) by suitably qualified personnel with all fish salvaged and translocated downstream.

All realigned sections of watercourses will be designed to provide natural channel features and flow regimes to allow for the unimpeded movement of fish and to recreate the habitats required for their various life stages.

7.5.4.2 Operation Stage Mitigation for Fauna

Otter

Otters are likely to use most of the watercourses in the study area and will traverse along smaller as well as larger streams and rivers and also along drainage channels, where they access foraging areas. No holts or couches were recorded on any of the watercourses crossed by the proposed road development.

Pre-construction Otter Survey

In the event that construction does not commence within 36 months of the most recent survey, a detailed pre-construction survey will be required to check for any Otter holts within or close to the alignment (at least 200m upstream and downstream of all river crossing points). Any holts found to be present will be subject to monitoring and mitigation as set out in the *TII Guidelines for the Treatment of Otter prior to the Construction of National Road Schemes (2006)* under appropriate licence from the NPWS.

Otter passage

Facilities for Otter passage will be provided at all watercourses, as listed in Table 7.12a to 7.12d. Each of the culverts or bridges will incorporate provision for mammal passage either through the retention of natural bank paths along the watercourse, or as a raised ledge within box culverts, or as a separate dedicated mammal culvert.

Mammal resistant fencing

Mammal-proof fencing will be put in place in accordance with the *TII Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes (2006b)* and Standard Construction Design (TII SCD 300 Series, 2017) extending 500m either side of the crossing point. Locations of mammal passages along the proposed road development are detailed in Tables 7.12a to 7.12d. Mammal resistant fencing will be required at each of these locations.

Protection of riparian corridor

Natural riparian vegetation cover will be retained where practical, or other landscaping measures undertaken, to ensure that all watercourses may continue to function as contiguous natural habitat for this species.

Badger

Badger will require dedicated mammal underpasses at suitable locations along the entire road development to accommodate unimpeded movement across their territories and avoid traffic collision on the proposed road.

Badger underpasses

The locations of underpasses have been selected based on existing mammal trails, locations close to Badger setts or where foraging activity has been recorded and which tie-in with existing features on either side of the carriageway (hedgerows, treelines, etc.). In addition, a series of dedicated underpass culverts are being provided for Lesser Horseshoe Bat which will also accommodate movement of Badgers along with other small mammals. There are also a number of agricultural underpasses and railway overbridges which will allow for the unimpeded movement of mammals. The locations recommended for Badger/mammal underpasses are listed in Tables 7.12a to d and presented on Figures 7.25 to 7.47 in Volume 3.

Underpasses will be constructed in accordance with the *TII Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (2006a)* and Standard Construction Design (TII SCD 300 Series, 2017).

The following general guidelines will be adhered to:

- The exit and entrance to tunnels will be flush with mammal-resistant fencing and the invert set at ground level. A concrete surround will provide a solid connection to the uprights of the fence and inhibit any efforts by Badgers to dig under the pipe. Drainage will be adequate to prevent water-logging at the entrances during wet weather.
- Specific design of underpasses will be tailored to individual locations and will be carried out at the detailed design stage.

Mammal-resistant Fencing

Mammal resistant fencing will be required to guide Badgers and other mammals to passage facilities and to prevent animals crossing the new roadway. The specification for mammal resistant fencing is given in the *TII Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (2006a)* and TII SCD 300 Series (TII, 2017). Fencing will be recessed and tied into culvert and mammal underpass locations to guide Badgers and other mammals safely under the road and prevent them accessing the road carriageway. Dedicated mammal crossings will have appropriate landscape planting to provide shelter and cover to animals. Mammal resistant fencing will be incorporated at the earliest possible stage during road construction, preferably during erection of the permanent fence line with gaps left at locations recommended for underpasses. Gaps shall be subsequently closed after underpasses have been constructed. Mammal resistant fencing will be required at all mammal passages as detailed in Tables 7.12a to d.

Where there is an overlap of stock-proof fencing and mammal resistant fencing at culvert/underpass locations, stock-proof fencing must be adjusted to allow for unimpeded access to the underpass. This involves modification of the lower section of the stock-proof fence. The fence will be adjusted so that the bottom rail and wire mesh are removed and chain-link is not fixed to the ground at the location of the underpass. This allows the animals to see a break in the fence line and thus clear access to the underpass nearby.

Post-construction monitoring of mitigation

The success of the mitigation measures for Badgers will be monitored for a period after construction, and measures taken to enhance use of underpasses where required. Monitoring will be carried out to determine the success of the measures employed within one year after construction ceases, in accordance with the *TII Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (2005)*.

In order to ensure that the long-term effectiveness of Badger resistant fencing and underpasses, these will require periodic maintenance in accordance with the *TII Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (2006a)*.

Other Measures

The location of any depots, spoil heaps or other additional site usage during clearance and construction will avoid any disturbance to the location of the setts and also avoid areas identified for the installation of mammal underpasses.

Bats

Tables 7.12a provides a list of specific bat mitigation measures aimed at enabling unimpeded movement of bats across the road alignment, re-connecting habitat features through landscaping and avoiding bat foraging or commuting activity by limiting light spill in areas of potential activity. A number of these measures also tie-in with other biodiversity mitigation requirements as detailed in Tables 7.12a to 7.12d which summarises all of the combined biodiversity protection and mitigation measures. The mitigation measures outlined in the Four Season Bat Report will also be implemented in full (refer to Appendix 7.1 in Volume 4A of this EIAR).

Lighting

Nocturnal mammals are affected by lighting. Therefore, it is important that lighting installed along the proposed road development is completed with sensitivity for local wildlife while still providing the necessary lighting for human usage. Lighting will be avoided where possible as it deters some bat species from foraging. It is important to maintain dark zones for foraging bats in areas where lighting is not necessary. This is particularly important at river crossings and in vicinity of proposed mammal and bat passages. Lighting will be avoided in the areas listed in Table 22 where bat mitigation measures are being installed. This is particularly important for the following bat species: LHB, brown long-eared bat, Natterer's bat, Daubenton's bat and whiskered bat. Lighting along the proposed road development will be limited to junctions and the associated slip roads.

General principles for the installation of lighting as part of the proposed development are as follows:

- Lighting will be limited to junctions and roundabouts to avoid impacts on ecological features;
- Any lighting shall be minimal and of a type that will not cause a spillage of light on to the water surface of rivers or in vicinity of bat habitats, commuting routes and / or roosting areas.
- Artificial lights shining on bat roosts, their access points and / or the flight paths away from roosts **must always be avoided**. This includes alternative roosting sites such as bat boxes.
- Lighting design will be flexible and shall fully take into account the presence of protected species. Therefore, appropriate lighting will be used along the proposed road development and adjacent areas with more sensitive lighting regimes deployed in wildlife sensitive areas.
- Dark buffer zones will be used as a good way to separate habitats or features from lighting by forming a dark perimeter around them. This will be used for habitat features noted as foraging areas for bats.
- Buffer zones will be used to protect dark buffer zones and shall rely on ensuring light levels (levels of illuminance measured in lux) within a certain distance of a feature do not exceed certain defined limits (BCT, 2018 – see details below). The buffer zone can be further subdivided into zones of increasing illuminance limit radiating away from the feature or habitat that requires to be protected.
- Luminaire design is extremely important to achieve an appropriate lighting regime. Luminaires come in a myriad of different styles, applications and specifications, which a lighting professional can help to select. The following will be considered when choosing luminaires. The following is taken from the most recent BCT Lighting Guidelines (Institution of Lighting Professionals, 2018):
 - All luminaires used will lack UV/IR elements to reduce impact.

- LED luminaires will be used as they are highly directional, of lower intensity, and provide good colour rendition and dimming capability.
- A warm white spectrum (<2700 Kelvins is achieved to reduce the blue light component of the LED spectrum).
- Luminaires will feature peak wavelengths higher than 550nm to avoid the component of light most disturbing to bats.
- The use of specialist bollard or low-level downward directional luminaires shall be considered in bat sensitive areas to retain darkness above.
- Column heights will be carefully considered to minimise light spill. The shortest column height allowed shall be used, where possible.
- Only luminaires with an upward light ratio of 0% and with good optical control will be used.
- Luminaires will always be mounted on the horizontal, i.e. no upward tilt.
- Any external security lighting will be set on motion-sensors and short (1 minute) timers.
- As a last resort, accessories such as baffles, hoods or louvres will be used to reduce light spill and direct it only to where it is needed.

In particular, lighting shall not shine onto important commuting and foraging areas identified for local bat populations. No spotlight will be permitted on the underside of bridges, culverts, *etc.*, or on the side panels of named structures. No lighting will be permitted adjacent to locations of bat tubes, bat boxes and rocket bat boxes or at other bat roosting mitigation measures recommended to be incorporated into the proposed road development.

Amphibians & Reptiles

The construction will lead to the loss of one pond at Robertstown (KER 3) where two ponds occur in old quarry pits and works in this location will be carried out in late summer to early winter to avoid impacting on tadpoles or immature amphibians present. Should works be required during the spring to early summer period, salvage and translocation of spawn of tadpoles will be undertaken, under appropriate licence from the NPWS. The creation of numerous attenuation ponds along the proposed road development will provide additional breeding habitat for both species.

No specific mitigation is required for Common Lizard.

Birds

Countryside Birds

Landscaping along the proposed road development will provide nesting and feeding habitat for a range of small bird species of the countryside and will help to off-set the loss of habitat and the effects of habitat fragmentation as a result of the proposed road development.

Kingfisher

Kingfishers occur on a number of the larger watercourses along the proposed road development, though no breeding sites are recorded within the vicinity of any of the watercourse crossing points. They will retain unimpeded movement along these watercourses given the size of structures to be used. Risks to prey from deterioration in water quality are adequately addressed in Section 7.5.3 and no further specific mitigation measures are required.

Barn Owl

Although there were no Barn Owl breeding sites identified on or within the immediate vicinity of the proposed road development, there are numerous known or potential nest sites for the species within 5km of the proposed road development and thus Barn Owl activity is possible and expected along the entire length of the proposed road development.

The mitigation measures outlined are designed to discourage Barn Owls from flying and/or foraging in close proximity to the road while maintaining the suitability and integrity of verge habitats as per Lusby *et al.* (2019). A buffer (3m) of unsuitable foraging conditions (short grass or stone) in the immediate vicinity to the road surface is required to discourage Barn Owls from hunting in this area and to reduce the risk of direct vehicle collision and/or birds becoming caught in the wake of a HGV. A natural barrier of dense vegetation (scrub and tree line) will form an additional buffer which will serve 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. The scrub band will provide food and shelter for small mammals which will help to increase their numbers in the adjacent verge behind this natural barrier (on the far side to the road) which is considered relatively safe for Barn Owls to forage in (see sample design in Plate 7.15).

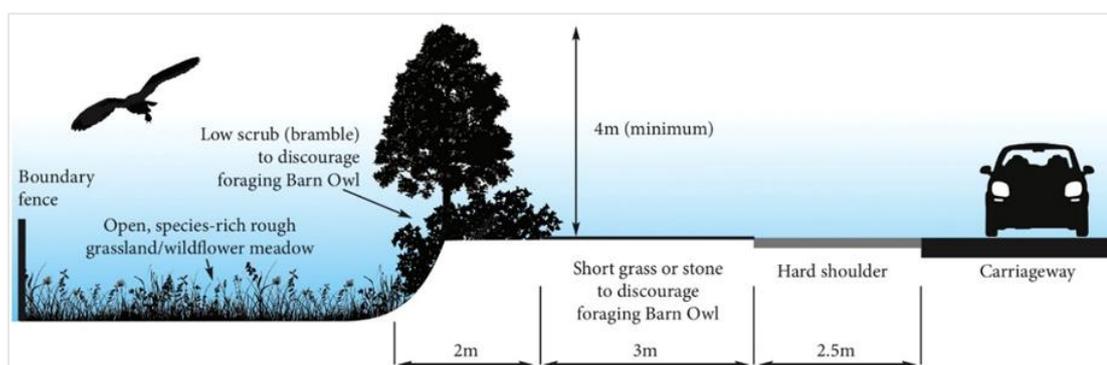


Plate 7.15 Schematic landscape design to reduce risk of Barn Owl traffic mortality.

Mitigation for Barn Owl has therefore been developed in conjunction with the Landscape design for the proposed road development (Chapter 11) and this approach has been reflected in the landscape design along the proposed road development where there is sufficient land-take within the CPO to implement it. Natural regeneration will be allowed in areas of rock cutting or very poor soils which would not develop into suitable rodent habitat.

Summary of Mitigation Measures for Fauna

The following Tables 7.12a to 7.12d summarise the combined biodiversity mitigation measures for fauna in each section of the proposed road development. These tables should be read in conjunction with Figures 7.25 – 7.47 of Volume 3 of this EIAR, which illustrate the proposed measures. The landscaping measures are illustrated in conjunction with the Landscape mitigation in Figures 11.1 to 11.24 of Volume 3 also.

Reference Key:

MUXX: Mammal Underpass at Kilometre XX

BMYX: Bat Mitigation at Kilometre XX

UPX: Underpass No. X

FRCX / M21CY: Culvert No. X or Y.

UBX / OBX / RVBX: Reference numbers for bridge structures.

FHX: Fen Habitat protection at Kilometre X

Table 7.12a Biodiversity Mitigation Measures – Section A

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|------------------|---|--|
| 1+100 | MU1.1 / FRC1 | Mammal passage | A 600mm diameter mammal passage shall be put in place to tie in in parallel with culvert FRC1. Associated approach fencing shall be erected. |
| 2+0100 to 2+250 | FRC2 UP1 | Mammal and bat passage. Landscape planting. Bat box installation. Bat tube installation. | Proposed culvert FRC2 (at Ch. 2+150) coincides with an important bat commuting route. It allows a vertical clearance of 2.7m above water level. This clearance is sufficient to facilitate passage of bats, including brown long-eared bat and <i>Myotis</i> species, and other mammals. It shall also have a min. 1m setback from the watercourse to facilitate mammal passage. Landscape planting shall also be carried out (Ch. 2+100 to 2+250) to guide bats and other mammals towards the passage. Additionally, two bat tubes shall be installed in the culvert. No disturbance to stream bed shall occur. Underpass UP1 at 2+000, (4.5m x 3m) will also facilitate bat and other mammal passage. One rocket bat box shall be installed in the vicinity of the proposed attenuation pond at 2+200. |
| 3+150 to 3+425 | BM3.3; MU 3.4 | Habitat protection. Landscape planting. Mammal and bat passage. Bat tube installation | BM3.3: Planting shall be carried out around the existing pond (at Ch. 3+325) to connect to landscaping and, thereby, provide commuting and foraging habitat for bats. MU3.4: A 2m high x 1.8m wide underpass (MU3.4 at Ch. 3+400) shall be put in place to facilitate passage of mammals and bats. Landscaping shall be carried out (Ch. 3+150 to 3+425) to connect existing linear habitats to the underpass and to guide mammals and bats towards the underpass. Bat tubes (2 units) shall be installed in the underpass. |
| 3+800 to 3+950 | MU3.9 | Mammal and bat passage. Landscape planting. Bat tube installation. | A 2m high x 1.8m wide underpass (MU3.9 at Ch. 3+900) shall be put in place to facilitate passage of mammals and bats. Landscaping (Ch. 3+800 to 3+950) shall be carried out to connect existing linear habitats to the underpass. Two bat tubes shall be installed in the passage. |
| 4+100 to 4+440 | | Landscape planting. Habitat protection. | Landscape planting shall be carried out to direct bats and other mammals along the development. Existing linear habitats shall be protected during construction, as illustrated in Figure 7.27 of Volume 3 of this EIAR. |
| 4+440 to 4+450 | FRC5 | Bat and mammal passage Landscape planting Bat tube installation | FRC5 (at Ch. 4+440) allows a vertical clearance of 2.3m above water level. This is sufficient to allow passage of bats. It also features a min. 1m setback from the watercourse to facilitate passage of mammals. Landscaping shall be completed (Ch. 4+440 to 4+450) to direct bats and other mammals towards the passage. Two bat tubes shall be installed in the bridge. |

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|--------------------------|---|---|
| 4+450 to 5+050 | BM4.5 MU4.8 MU 5.0 | Habitat protection. Mammal passage. Mammal and bat passage. Landscape planting. Bat box installation. Bat tube installation. | <p>BM4.5: The area of habitat protection illustrated in Figure 7.27 of Volume 3 of this EIAR (Ch. 4+450 to 4+900) shall be designated as a works exclusion zone, with protection of retained interests (river and riparian zone and woodlands to south of proposed attenuation pond at 4+620) during construction. One rocket bat box shall be installed in the vicinity of the proposed attenuation pond at 4+600.</p> <p>MU4.8: A 600mm diameter mammal passage (MU4.8 at Ch. 4+840) shall be put in place, and associated approach fencing shall be erected.</p> <p>MU5.0: A 1.8m wide x 3.0m high culvert (MU5.0 at 5+000) shall be put in place to facilitate passage of brown long-eared bat and <i>Myotis</i> species. Two bat tubes shall be installed in the culvert. Underpass 2 at 4+990 (UP2, 4.5m x 4.5m) will also facilitate bat passage.</p> <p>Appropriate landscape planting shall be carried out (Ch. 4+450 to 5+050) to connect with the area of protected habitat (Ch. 4+450 to 4+900).</p> |
| 6+560 | MU6.5 | Mammal passage | A 600mm diameter mammal passage (MU6.5 at Ch. 6+560) shall be put in place, and associated approach fencing shall be erected. |
| 7+150 to 7+400 | BM7.3a/b FRC6 | Habitat protection. Mammal and bat passage. Landscape planting. Bat tube installation. Bat box installation. | <p>BM7.3a/b: Retained interests (linear habitats, woodland, treelines, riverine and riparian habitats) along stream (Ch. 7+150 to 7+400, as illustrated in Fig.7.29 of Volume 3 of this EIAR) shall be protected during construction. Appropriate landscaping shall be carried out in the area to link in with the retained interests. Impacts on fen north of L6062 to west of L1220 junction shall be minimised by confining works to the south. One rocket bat box shall be installed in the vicinity of the proposed attenuation pond at 7+250.</p> <p>FRC6: A 2m wide x 2.5m high above-bank drainage culvert, embedded 0.5m such that actual clear height is 2m shall be put in place at Ch. 7+160. This structure shall allow sufficient clearance for the passage of LHBs. Two separate 600mm diameter mammal culverts shall also be put in place, one each on either side, parallel to the ditch. Approach fencing shall be erected. Two bat tubes shall be installed in the proposed culvert.</p> <p>Known and potential bat roosts shall be protected in the area. Two bat tubes shall be installed in the culvert (FRC6).</p> |

Table 7.12b Biodiversity Mitigation Measures – Section B

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|----------------------|--|--|
| 7+400 to 10+500 | FRC7 FRC8 BM10 | Habitat protection. Landscape planting. Bat tube installation. Mammal passages. Stream channel realignment | <p>BM10: Woodland, treelines and riverine habitats at edge of land-take at Ballyclogh Junction, and adjoining area shall be protected (Ch. 10+000 – 10+500; as illustrated in Fig. 7.29 of Volume 3 of this EIAR).</p> <p>FRC7: Two separate 600mm diameter mammal culverts shall be put in place, with one on either side of proposed culvert (FRC7, 2m wide x 1.9m high culvert (embedded by 0.5m such that actual clear height is 1.4m) at Ch. 10+150), parallel to the ditch. Approach fencing shall be erected. Bed widths, gradients and riparian habitat landscaping shall be matched (i.e. restored) during stream channel realignment. Two bat tubes shall be installed in the proposed culvert.</p> <p>FRC8 (at Ch. 10+300) allows a vertical clearance above water level of 1.7m. It shall have a min. 1m setback from the watercourse to facilitate use by mammals. Associated approach fencing shall be erected. Proposed bridge shall be on skew alignment. No disturbance to stream channel shall occur. Four bat tubes shall be installed in the proposed bridge.</p> <p>Landscape planting shall be carried out (Ch. 7+400 to 10+500) to tie in with retained interests. Known and potential bat roosts in the area shall be protected.</p> |
| 10+800 to 11+000 | BM10.9 FRC9 | Habitat protection. Mammal and bat passage. Landscape planting. Bat box installation. Bat tube installation. | <p>BM10.9: Retained interests (stream and riparian zone; Ch. 10+800 to 11+000) shall be protected during construction. Appropriate landscaping shall be carried out at the same Ch. to tie in with retained interests. One rocket bat box shall be installed in the vicinity of the proposed attenuation pond at 10+900.</p> <p>FRC9 (at Ch. 10+950) allows a vertical clearance above water level of 2.1m. This clearance is sufficient to allow the passage of brown long-eared bats and <i>Myotis</i> species. The proposed bridge shall also have a min. 1m setback from the watercourse to facilitate use by mammals. Approach fencing shall be erected. Proposed bridge shall be on skew alignment. No disturbance shall occur to the stream channel. Two bat tubes shall be installed in the proposed bridge.</p> <p>One no. rocket bat box shall be installed in the vicinity of the proposed attenuation pond at 10+900.</p> |

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|---------------|--|---|
| 11+000 to 12+000 | RB01 FRC10 | Mammal and bat passage. Mammal passages. Landscape planting. Bat tube installation. | <p>RB01: Passage under railway bridge (at Ch. 11+300), with min. 5.3m vertical clearance, will facilitate mammal passage along with brown long-eared bat and <i>Myotis</i> species. Underpass at Ch.11+225 (UP4, 4.5m x 4.5m) will also facilitate bat passage.</p> <p>FRC10: Two 600mm diameter mammal passages shall be put in place, with one each on either side of the culvert (FRC10). Approach fencing shall be erected at stream culvert on both banks.</p> <p>Landscape planting (linking in with existing linear habitats in the vicinity) shall be carried out along the alignment (Ch. 11+000 to 12+000) to direct bats and other mammals towards the respective passages (RB01 and FRC10).</p> |

Table 7.12c Biodiversity Mitigation Measures – Section C

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|---|--|---|
| 20+000 to 20+700 | BM20 BM20.2 MU20.4 UB02 | Habitat protection Stream channel realignment. Bat passage Bat tube installation Landscape planting. | BM20: At Ballyellinan Road (L-1220), Ballyclogh Bridge and adjoining habitats, woodland, treelines and riverine habitats shall be protected. BM20.2: At Ballyclogh Stream (at Ch. 20+200), a natural channel shall be recreated to new culvert. Bed widths, gradients, and riparian habitat landscaping shall be matched. MU20.4: A 3.0m high x 1.8m wide mammal and bat passage (MU20.4 at Ch. 20+400) shall be put in place. Associated fencing shall be erected. Two bat tubes shall be installed in the passage. Underpass at 20+550 (UP5, 4.5m x 3m) will also facilitate bat passage. Landscape planting shall be carried out along the alignment (Ch. 20+000 to 20+700), to link in with existing linear habitats. |
| 20+700 to 21+400 | BM20.8 FRC11 BM21 MU21.4 FH21 | Habitat protection Mammal and bat passage. Mammal passage. Bat box installation. Bat tube installation. Landscape planting. Fen Habitat protections. | BM20.8: Retained interest (stream, riparian habitat and treelines at Ch. 20+750 to 21+400) shall be protected during construction. One rocket bat box shall be installed in the vicinity of the proposed attenuation pond at 20+850. FRC11 (at Ch. 20+950) is an 8m span stream bridge with proposed internal depth of 6.3m and clearance above mean water level of 4.7m. This is sufficient to allow passage of bats. Additionally, min. 1m setback shall allow passage of mammals. Approach fencing shall be erected. Proposed bridge shall be on skew alignment. No disturbance to stream channel shall occur. Two bat tubes shall be installed in the proposed bridge. BM21: Retained interest (woodland edge at Ch. 20+950 to 21+430) shall be protected during construction. MU21.4: A 600mm diameter mammal passage (MU21.4 at Ch. 21+400) shall be put in place, and associated approach fencing shall be erected. Appropriate landscape planting shall be carried out along the alignment (Ch. 20+700 to 21+400) shall be carried out, to tie in with retained interests. Hydrological management measures at Lismakeery fen including a drainage link from the existing spring under the proposed road at Ch.21+080 southward to the main fen area and sluice controls on the drainage outlet. |

| Location Chainage | Reference | Key Action | Mitigation Measures |
|--|------------------------|--|--|
| 21+750 to 21+950 | UP 6 / MU21.95 / FRC12 | Mammal passage. Channel realignment. | Underpass 6 (4.5 wide x 4.5m high) will facilitate the passage of bats. A 600mm diameter mammal passage (MU21.95 at Ch. 21+950) shall be put in place, and associated approach fencing shall be erected. Natural channel shall be recreated; bed widths, gradients, riparian habitat landscaping shall be matched. |
| 22+250 to 22+450 & L-1236 Station Road | BM 22.4 | Channel realignment | Natural channel shall be recreated; bed widths, gradients, riparian habitat landscaping shall be matched. |
| 22+350 | MU 22.35 | Mammal passage | A 600mm diameter mammal passage shall be put in place, and associated approach fencing shall be erected. |
| 22+850 to 23+025 | BM23 MU22.95 | Habitat protection. Mammal passage. Landscape planting. Bat box installation. | BM23: Retained interest on northern side of road (scrub at Ch. 22+950) shall be protected during construction. One rocket bat box shall be installed on a freestanding pole or three summer woodcrete bat boxes will be erected on mature trees in the scrubland at Ch. 22+950. MU22.95: A 600mm diameter mammal passage (MU22.95 at Ch. 22+950) shall be put in place, and associated approach fencing shall be erected. Landscape planting shall be completed (Ch. 22+850 to 23+025) to tie in with retained interest and mammal passage. |
| 23+800 to 24+200 | RVB01 | Habitat protection. Lesser horseshoe bat (LHB) passage. Mammal passage. Bat tube installation. Landscape planting. | River Deel Bridge (RVB01) coincides with an important LHB commuting route. Proposed bridge shall have a min. vertical clearance from 100-year flood water level of 19.9mOD. This is sufficient clearance to allow use of space above water and under bridge by bat species including LHBs. Bat tubes (2 units) shall be installed in the bridge to provide roosting sites for bats, and passage of other mammals. Retained interest (riverine and riparian habitats at Ch. 24+000 to 24+050) shall be protected during construction. Landscape planting shall be carried out on either side of the bridge (Ch. 23+800 to 24+200) to direct bats towards the passage. This landscaping shall link in with existing linear habitats in the vicinity, especially that which related to the railway line. Known and potential bat roosts in the area shall be protected. |

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|-----------------|--|---|
| 24+200 to 24+500 | FRC14 BM24.4 | Mammal and LHB passage. Habitat protection. Bat tube installation. Landscape planting. | FRC14: A 1.8m wide x 3.2m high drainage culvert, embedded by 0.5m such that actual clear height is 2.7m, shall be put in place at Ch. 24+350. Structure will allow sufficient clearance to facilitate passage of LHBs. Two separate 600mm diameter mammal culverts shall be put in place, with one each on either side of the culvert. Two bat tubes shall be installed in the culvert. Associated fencing shall be erected. BM24.4: Adjoining interests (woodland and hedgerows at Ch. 24+200 to 24+500) shall be protected during construction. Appropriate landscape planting shall be carried out along the alignment (at the stated Ch.), to link to the culvert and retained existing habitats. |
| 24+500 to 24+690 | FRC15 BM24.5 | Mammal and LHB passage. Habitat protection. Stream channel realignment. Bat tube installation. Landscape planting. | FRC15 (at Ch. 24+500) is a minor river bridge over the Doohyle Stream with a vertical clearance of 3m. This is sufficient clearance for passage of bats (including LHBs) and other mammals. Two bat tubes shall be installed in the bridge. Adjoining interests (woodland at Ch. 24+500) shall be protected during construction. BM24.5: Natural channel (of Doohyle Stream) shall be recreated; bed widths, gradients, and riparian habitat landscaping shall be matched. Appropriate landscape planting shall be carried out to tie in with the bridge (FRC15), the realigned Doohyle Stream, and retained existing habitats. |
| 24+690 to 24+920 | BM24.8 | Habitat protection. Bat box installation. Landscape planting. | BM24.8: Retained interests (woodland and stream on eastern side of alignment at Ch. 24+690 to 24+920) shall be protected during construction. One bat box shall be erected on a free standing pole or three summer woodcrete bat boxes will be erected on suitable mature trees in the area of protected habitat. Appropriate landscape planting shall be carried out on the western side of the alignment at the stated chainage. |

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|----------------------------------|--|---|
| 24+920 to 25+400 | FRC16 BM25a BM25b BM25c | Mammal and LHB passage. Habitat protection. Bat box installation. Bat tube installation. Landscape planting. Stream channel realignment | <p>FRC16 is a 6m span bridge with a proposed clearance above water level in excess of 2.4m. This is sufficient clearance to facilitate use of the space above the water and beneath the bridge by LHBs. Additionally, a min. 1m setback from the watercourse shall facilitate mammal passage. Two bat tubes shall be installed in the proposed bridge.</p> <p>BM25a: Insofar as possible, no disturbance of the Doohyle Stream channel shall occur at the stated chainage. Natural channel shall be recreated; bed widths, gradients, and riparian habitat landscaping shall be matched.</p> <p>BM25b: Retained interests (wet grassland at Ch. 24+950 to 25+140) shall be protected during construction.</p> <p>BM25c: Treelines to north and east of field (at Ch. 25+210 to 25+400) shall be protected. Attenuation pond at the stated chainage shall be designed so as to retain some water at all times in order to facilitate development of marsh-type vegetation.</p> <p>Landscape planting shall be carried out on either side of the alignment at the stated chainage, to link in with existing linear habitats in the vicinity, and direct bats and other mammals towards the passage.</p> <p>One rocket bat box shall be erected on a free standing pole or three summer woodcrete bat boxes will be erected on suitable mature trees in the area of habitat at approx. Ch. 25+050.</p> |

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|---------------------------------|---|---|
| 25+400 to 25+700 | FRC22 BM25d BM25e UP07 | Mammal passage. Habitat protection. Stream channel realignment. Landscape planting. Mammal and bat passage. Bat tube installation. | <p>FRC22: Two separate 600mm diameter mammal passages shall be put in place, with one each on either side of drainage culvert (FRC22 at Ch. 25+550). Associated mammal fencing shall be erected.</p> <p>BM25d: Retained interests (wet grassland and marsh at Ch. 25+550 to 25+690) shall be protected during construction.</p> <p>BM25e: Natural channel of Doohyle Stream (at Ch. 25+400 to 25+575) shall be recreated; bed widths, gradients, and riparian habitat landscaping shall be matched.</p> <p>UP07: UP07 at Ch.25+675 is a 4.5m high x 4.5m wide farm underpass with sufficient space to accommodate passage of mammals and bats. Mammal fencing shall be erected on approaches. Two bat tubes shall be installed in the proposed underpass.</p> <p>Appropriate landscape planting shall be carried out (Ch. 25+400 to 25+700) to tie in with the mammal passages associated with FRC22 and the underpass, UP06, and retained existing habitats.</p> |
| 25+700 to 26+675 | UP08 FRC24 | Mammal and LHB passage. Mammal and bat passage. Landscape planting. Bat tube installation. | <p>UP08: UP08 at 26+175 is a 4.5m high x 4.5m wide farm underpass with sufficient space to accommodate passage of mammals and bats (including LHBs). Guide fencing shall be erected to direct bats and mammals towards the underpass on either side. Two bat tubes shall be installed in the underpass.</p> <p>FRC24: A 1.6m wide x 3.0m high drainage culvert, embedded by 0.5m such that actual clear height is 2.5m, shall be put in place at Ch. 26+300. Structure shall allow sufficient clearance to facilitate passage of LHBs. An existing hedge will link in with linear habitats at the railway line to the north. Two separate 600mm diameter mammal culverts shall be placed, with one each on either side of the drainage culvert, with associated mammal fencing to be erected. Two bat tubes shall be installed in the proposed culvert.</p> <p>Known and potential roosts shall be protected. Landscape planting shall be carried out on either side of the alignment (Ch. 25+700 to 26+675) to direct bats and other mammals towards the passages.</p> |

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|-----------------------------------|--|--|
| 26+675 to 27+225 | BM27 UB04 | Habitat protection. Bat box installation. Bat tube installation. Mammal and bat passage. Landscape planting. | <p>One rocket bat box shall be installed in the vicinity of the proposed attenuation pond at Ch. 26+750.</p> <p>BM27: Retained interests (woodland and stream at Ch. 26+830 to 27+010) shall be protected during construction. Natural channel of Doohyle Stream shall be recreated; bed widths, gradients, riparian habitat landscaping shall be matched.</p> <p>UB04: UB04 (at Ch. 27+000) is a 52.5m single span bridge over a regional road and the Doohyle Stream. It shall allow 5.3m vertical clearance above the regional road, which will be sufficient to allow the passage of bats and other mammals. Two bat tubes shall be installed in the proposed bridge.</p> <p>Appropriate landscape planting shall be carried out (Ch. 26+675 to 27+225) to tie in with retained existing habitats and to direct bats and other mammals to the passage.</p> |
| 27+225 to 28+200 | MU27.2 MU27.5 BM27.6 UP9 | Mammal and LHB passages. Habitat protection. Landscape planting. | <p>MU27.2: A minimum 2m high mammal passage shall be put in place, and associated approach fencing shall be erected. This will also accommodate the passage of bats.</p> <p>MU27.5: A minimum 2m high mammal passage shall be put in place, and associated approach fencing shall be erected. If there is room under the alignment, this passage could be enlarged (min. height 1.6m) to also accommodate the passage of bats.</p> <p>BM27.6: Retained interests (scrub along railway at Ch. 27+500 to 27+650) shall be protected during construction.</p> <p>Landscape planting shall be carried out along the alignment at the stated chainage (27+225 to 28+200). This shall connect retained habitats along the former railway with the stream further along the alignment, to create a flight corridor for LHB, and shall direct mammals (and potentially bats, as discussed above) to the proposed passages. This planting will link up with Underpass 9 at Ch.28+075 (UP9, 4.5m x 4.5m) which will also facilitate bat passage.</p> |

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|--|--|---|
| 28+200 to 28+525 | FRC26 BM28a | Mammal and bat passage. Habitat protection. Bat box installation. Bat tube installation. Landscape planting. | <p>FRC26: FRC26 is a single span (26m) minor river bridge which traverses the Doohyle Stream and a section of the proposed route for the Great Southern Trial greenway. It will have a minimum vertical clearance of 2.7m over the cycle path below, which is sufficient for the passage of bats and other mammals. Associated mammal fencing shall be erected. Two bat tubes shall be installed in the bridge.</p> <p>BM28a: Linear riverine/riparian habitat along the river (at Ch. 28+200 to 28+300) shall be protected during construction.</p> <p>Two rocket bat boxes shall be installed in the vicinity of the proposed attenuation ponds at Ch. 28+250 to 28 +525.</p> <p>Scrub-woodland landscape planting shall be carried out (Ch. 28+200 to 28+525) to tie in with retained existing habitats and direct bats and other mammals towards the passage.</p> |
| 28+525 to 29+250 | BM28b FRC27 BM28c FRC28 UP10 | Habitat protection. Stream channel realignment. Mammal passage. LHB passage. Bat tube installation. Landscape planting. | <p>BM28b: Natural channel of stream shall be recreated; bed widths, gradients, and riparian habitat landscaping shall be matched (Ch. 28+550 to 28+750).</p> <p>FRC27: Two separate 600mm diameter mammal passages shall be placed, with one each on either side of the structure (FRC27 at Ch. 28+670), with associated mammal fencing to be erected.</p> <p>BM28c: Habitats on either side of the alignment (stream and wet grassland at Ch. 28+675 to 29+190) shall be retained and protected during construction.</p> <p>FRC28 (at Ch. 29+00) is a 7.9m clear span river bridge with a vertical clearance of 10.2m from flood water level. Two separate 600mm diameter mammal culverts shall be placed, with one each on either side of the bridge, with associated mammal fencing to be erected.</p> <p>UP10 is a 4.5m high x 4.5m wide farm underpass with sufficient space to accommodate passage of mammals and bats (including LHBs). Mammal fencing shall be erected. Two bat tubes shall be installed in the proposed underpass.</p> <p>Scrub-woodland landscape planting shall be carried out along the alignment (Ch. 28+525 to 29+250), to tie in with retained existing habitats and proposed passages and create a flight corridor for LHB.</p> |

Table 7.12d Biodiversity Mitigation Measures – Section D

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|---|--|--|
| 50+000 to 50+950 | M21-C1 | Mammal and bat passage. Landscape planting. Bat tube installation. | M21-C1 (at Ch. 50+745) is a 13.5m clear span bridge with a vertical clearance of 8m above flood water level and 7.1m above a cycle track. This shall provide sufficient clearance for the passage of bats and other mammals. Mammal fencing shall be erected in association with the structure. Two bat tubes shall be installed in the proposed bridge. Appropriate landscape planting shall be carried out on either side of the alignment (Ch. 50+000 to 50+950), |
| 50+950 to 51+700 | MU51.3 | Habitat protection. Bat box installation. Bat tube installation. Mammal and LHB passage. Landscape planting. | Retained interests (riparian habitat, fen and wet grassland at Ch. 51+000 to 51+360, as illustrated in Fig. 7.38 of Volume 3 of this EIAR) shall be protected on both sides of the alignment during construction. One rocket bat box shall be installed in the vicinity of the proposed attenuation pond at 51+050. MU51.3: This site coincides with an important LHB commuting route. A 3m wide x 1.8m high drainage culvert (MU51.3) shall be put in place to facilitate passage of bats (including LHBs) and other mammals. Two bat tubes shall be installed in the proposed culvert. Landscape planting shall be carried out on either side of the alignment (Ch. 50+950 to 51+700) to direct bats and mammals towards the passage. This landscaping shall link in with existing linear habitats in the vicinity. |
| 51+700 to 52+300 | UP11a, UP11b, UP12a and UP 12b | Mammal and LHB passages. Bat tube installation. Landscape planting. | UP11a (at 51+800) and UP 11b (at 51+840) re a 3m high x 4.5m wide farm underpass with sufficient space to accommodate passage of mammals and bats (including LHBs). There shall be no lighting in the immediate vicinity of underpass, to allow for passage of LHBs. Approach mammal fencing shall be erected. Two bat tubes shall be installed in the proposed underpasses. UP12a and UP12b (at Ch. 52+150) are a 4.5m high x 4.5m wide farm underpass with sufficient space to accommodate passage of mammals and bats (including LHBs). Approach mammal fencing shall be erected. Two bat tubes shall be installed in the proposed underpasses. Landscape planting shall be carried out (Ch. 51+700 to 52+300) to direct bats and other mammals towards the underpasses and to link in with existing linear habitats in the vicinity. |

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|---------------------------------|---|--|
| 52+400 | MU 52.4 | Mammal passage | A 600mm diameter mammal passage shall be put in place, and associated approach fencing shall be erected. |
| 53+450 to 54+450 | | Bat box installation, Bat tube installation. Habitat protection. Landscape planting. | Existing linear habitat (at Ch. 53+750 to 53+825, as illustrated in Fig. 7.39 of Volume 3 of this EIAR) shall be protected during construction and retained. Two rocket bat boxes shall be installed in the vicinity of the proposed attenuation ponds at Ch. 53+800 and 54+300, respectively. Existing linear habitat (at Ch. 54+150 to 54+450, as illustrated in Fig. 7.39 of Volume 3 of this EIAR) shall be protected during construction and retained. Appropriate landscaping shall be completed along the alignment and around attenuation ponds (Ch. 52+300 to 54+450). |
| 54+450 to 55+990 | MU55.5 | Habitat protection. | UP13 (at 55+550 on the Croagh link road) is a proposed 4.5m x 4.5m underpass with sufficient space to accommodate the passage of bats, including LHBs. In addition, appropriate landscape planting is required on either side of the underpass to direct bats towards it, and this planting shall be linked in with existing linear habitats. Retained interests (treelines to south of Smithfield House demesne at Ch. 55+150 to 55+550) shall be protected on both sides of the alignment during construction. Appropriate landscaping shall be completed around attenuation pond. Landscape planting shall be carried out along the north-western side of the alignment (Ch. 54+450 to 55+990). |
| 55+990 to 57+150 | UP14a/ UP14b/ UP15 M21-C3 | Mammal and LHB passage. Bat tube installation. Habitat protection. Landscape planting. | UP14a (3m x 2.6m), UP14b (3m x 3m) (at 56+320) and UP15 (at 56+740, 2.5m x 5m) are proposed underpasses with sufficient space to accommodate the passage of bats, including LHBs. M21-C3: The proposed M21-C3 bridge over the Clonshire River (at Ch. 56+575) shall have a minimum vertical clearance of 6.8m from the top of the riverbank, and a setback of >6.5m on both sides of the channel. This design shall allow for the passage of bats and other mammals. Two bat tubes shall be installed in the proposed bridge. Retained interests in vicinity of Clonshire River (riverine and riparian habitats) shall be protected on both sides of the alignment during construction. Appropriate landscaping shall be completed on both sides of the alignment (Ch. 55+990 to 57+150), to tie in with the proposed bridge and retained habitats. |

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|-----------------|---|---|
| 57+150 to 57+950 | MU57.4 | Mammal passage. Landscape planting. Habitat protection. Bat box installation. | Retained interests (hedgerows and treelines at Ch. 57+150 to 57+450) shall be protected on both sides of the alignment during construction. Known and potential bat roost sites in the area shall be protected. One rocket bat box shall be installed in the vicinity of the proposed attenuation pond at Ch. 57+200 to 57+450 MU57.4: A 600mm diameter mammal passage (MU57.4 at Ch. 57+420) shall be put in place, and associated approach fencing shall be erected. Scrub-woodland landscape planting shall be carried out (Ch. 57+150 to 57+950) to tie in with retained habitats and the mammal passage. |
| 57+950 to 58+150 | RB02 | Mammal and LHB passage. Landscape planting. Bat tube installation. | Proposed railway bridge (RB02 at 58+000) shall have 10.6m clear span and min. 5.3m vertical clearance, facilitating passage of bats (including LHBs) and mammals along railway corridor. Scrub-woodland planting shall be carried out on either side of the proposed bridge (Ch. 57+950 to 58+150) to create flight corridor for LHB. |
| 58+150 to 59+200 | RVB02 MU58.8 | Mammal and bat passage. Mammal passage. Habitat protection. Bat box installation. Bat tube installation. Landscape planting. | RVB02 (at Ch. 58+175) is a 36m single span river bridge with a min. vertical clearance from 100-year flood water level of 4.10mOD. This shall allow sufficient clearance for passage of bats and other mammals. Two bat tubes shall be installed in the proposed bridge. Retained interests (riverine and riparian habitats on both sides of the stream and linear habitats; Ch. 58+160 to 58+325) shall be protected during construction. One rocket bat box shall be installed in the vicinity of the proposed attenuation pond at 58+200. MU58.8: A 600mm diameter mammal passage shall be put in place, and associated approach fencing shall be erected. Appropriate landscaping shall be completed along the alignment (Ch. 58+150 to 59+200). |

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|-----------------------|--|--|
| 59+200 to 59+650 | RVB03 UP16 UP17 | LHB passage. Habitat protection. Landscape planting. Bat tube installation. | <p>RVB03: Greanagh River Bridge (RVB03; Ch. 59+250) is a three-span river bridge (23m; 35m; 23m) with a min. clearance over 100-year flood water level of 4.10m. This bridge coincides with an important bat commuting route, and provides sufficient clearance for passage of LHBs. Two bat tubes shall be installed in the proposed bridge.</p> <p>Retained interests (riverine and riparian habitats on either side of the Greanagh River) shall be protected during construction. Known and potential bat roosts in the area shall be protected.</p> <p>Appropriate landscaping shall be completed on both sides of the alignment (Ch. 59+200 to 59+650).</p> <p>UP16 (at 56+740, 4.5m x 3m) and UP 17 (at 59+425, 4.5m x 4.5m) are proposed underpasses with sufficient space to accommodate the passage of bats, including LHBs.</p> |
| 60+000 to 61+850 | RVB04 RB03 | LHB passage. Mammal and LHB passage. Landscape planting. Habitat protection. Bat box installation. Bat tube installation. | <p>RVB04 is a three-span river bridge (58m; 94m; 58m) with a min. clearance over 100-year flood water level of 4.24mOD – sufficient clearance for passage of bats. Retained interests in the vicinity of the River Maigue (riverine and riparian habitats) shall be protected on both sides of the alignment during construction. Two bat tubes shall be installed in the proposed bridge.</p> <p>RB03 is a 10.6m clear span railway bridge with a min. vertical clearance of 5.3m – sufficient clearance for passage of bats and other mammals. Scrub-woodland planting shall be carried out to develop a flight corridor for LHBs. Two bat tubes shall be installed in the proposed bridge.</p> <p>Retained interests (hedgerows, treelines, riverine and riparian habitats) shall be protected (Ch. 60+850 to 61+475, as illustrated in Fig. 7.43 of Volume 3 of this EIAR) during construction.</p> <p>Three rocket bat boxes shall be installed on suitable mature trees in the vicinity of the proposed attenuation pond / protected habitat area at Ch. 61+100 to 61+475.</p> <p>Scrub-woodland landscape planting (Ch. 60+000 to 61+850) shall be carried out on either side of the alignment, to tie in with retained habitats and bridges.</p> |

| Location Chainage | Reference | Key Action | Mitigation Measures |
|-------------------|-------------------|--|--|
| 61+850 to 63+450 | M21-C11 | Mammal passage. Landscape planting. Habitat protection. Bat box installation. | <p>M21-C11: A 600mm diameter mammal passage (M21-C11 at Ch. 62+310) shall be put in place, and associated approach fencing shall be erected.</p> <p>Habitats along the railway corridor at the stated chainage (which fall within the development boundary) shall be protected during construction. Additionally, linear habitats at Ch. 61+900 to 62+200 and at Ch. 63+050 to 63+225 (as illustrated in Figs. 7.44 and 7.45) shall be protected.</p> <p>Appropriate landscaping shall be carried out along the alignment (Ch. 61+850 to 63+450).</p> <p>One rocket bat box will be installed on suitable mature trees in the vicinity of the proposed attenuation pond at 61+250.</p> |
| 63+450 to 64+975 | MU63.5 M21-C14 | | <p>MU63.5: A 600mm diameter mammal passage shall be put in place, and associated approach fencing shall be erected.</p> <p>M21-C14: Mammal passage shall be accommodated beside existing stream culvert as separate 600mm pipe. Associated approach fencing shall be completed.</p> <p>Habitats along the railway corridor at the stated chainage (which fall within the development boundary) shall be protected during construction. Landscape planting (scrub-woodland) shall be carried out along the alignment at the stated chainage to link treelines on both sides and along the railway.</p> |
| 65+400 | MU 65.4 | Mammal passage | Existing culvert under existing N21 dual carriageway and associated approach fencing |

7.6 Residual Impacts for Biodiversity

The proposed road development will impact directly or indirectly upon 20 sites identified as KERs. Of these, four are considered of International Importance, one is of National Importance, one is of County Importance and 14 are of Local Importance (Higher Value). A further seven sites were identified as being of Local Importance (Lower Value). Before the implementation of mitigation, the impact is considered permanent moderate negative on 17 of the receptors (mainly due to habitat loss and fragmentation) and minor negative on three sites. Measures to minimise impacts during construction and the provision of sensitive landscaping along with facilitating faunal movement will serve to offset the severity of these impacts.

The provision of mammal passage for Otters on watercourses will avoid the risks of mortality for this Annex II listed species. The provision of mammal underpasses for Badger and for Lesser Horseshoe Bat will provide for habitat continuity for these species along with a range of other small mammals that will avail of these structures. With the implementation of the prescribed mitigation measures, the impact of the road construction is likely to be reduced to minor negative for all mammals.

Mitigation measures adopted for Barn Owl will discourage owls from flying and foraging adjacent to the road and serve to deflect the flight of birds which cross the road above the height of vehicles. A certain level of Barn Owl mortality can however, be expected as a result of the proposed road development, but this should be minimised by the implementation of the appropriate landscape design along the proposed road development, which should reduce the mortality rates significantly below those recorded on other road schemes in the south west of the country. There are no negative residual impacts anticipated for any other bird species as a result of the proposed road development.

The five major watercourse crossings (Deel, Clonshire, Greanagh twice and Maigne) and 11 of the minor watercourses crossed by the route will retain the existing river channels intact, and with the implementation of the mitigation measures specified above to avoid pollution during construction and operation, there will be no impact on the aquatic environment. A number of minor watercourses will require some realignment to minimise the lengths of culverts. While culverting will result in the loss of habitat this will constitute at most a moderate negative impact as most of these watercourses are artificially modified channels. The sensitively designed realignments for these watercourses and associated landscaping will provide new aquatic habitat in a short period of time to compensate for the loss of existing channels. Uninterrupted passage of fish will be accommodated on all watercourse crossings and there will be no loss of salmonid spawning habitat. There is expected to be no negative residual impact for White-clawed Crayfish or any other aquatic species as a result of the proposed road development.

There will be a loss of 20% of the *Vertigo moulinsiana* habitat at Lismakeery (KER 11) and there is no potential to mitigate this impact by avoidance. Mitigation has been implemented through minimising the footprint of the works and ensuring there is no alteration of the hydrology of the remaining fen habitat. The proposed road development will not affect the remainder 80% of the fen habitat at Lismakeery or the continued survival of the *Vertigo* population at this site. The residual impact is therefore considered to be moderate negative and permanent. Further enhancement is proposed through the inclusion of additional lands within the fen area in the lands to be acquired for the proposed road development so that habitat protection and enhancement measures can be undertaken. In that context the impact of the proposed road would reduce to slight negative.

With the full and proper implementation of the mitigation detailed in this chapter, the residual impacts of the proposed road development will be localised and mostly temporary in nature. The NIS in relation to the proposed road development concludes that, in view of best scientific knowledge and on the basis of objective information, the proposed road development either individually or in combination with other plans or projects, is not likely to have significant effects on any European sites. Overall, the proposed road development will have no negative effect on water quality within any watercourses, all of which drain to the River Shannon and thus to the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA.

7.7 Difficulties Encountered

No significant constraints or difficulties were encountered in compiling the Biodiversity chapter of the EIAR for the Foynes to Limerick Road. Thus, there are no deficiencies or gaps in the survey data compiled which for the basis for the Biodiversity assessment.

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