Chapter 19

Mitigation and Monitoring Measures

Rialtas na hÉireann Government of Ireland
Tionscadal Éireann Project Ireland 2040
An Roinn Iompair Tráchtála agus Spóirt Department of Transport, Tourism and Sport
Comhairle Cathrach & Contae Luimnigh Limerick City & County Council
ROD AECOM

Chapter 19 Mitigation and Monitoring Measures

19.1 Introduction

Mitigation measures are the measures proposed in order to avoid, reduce or, where possible, remedy the significant adverse environmental effects of the proposed Foynes to Limerick Road (including Adare Bypass). These measures have been incorporated into the design of the proposed road development and will be applied during both the construction and operation phase where they have been assessed as necessary.

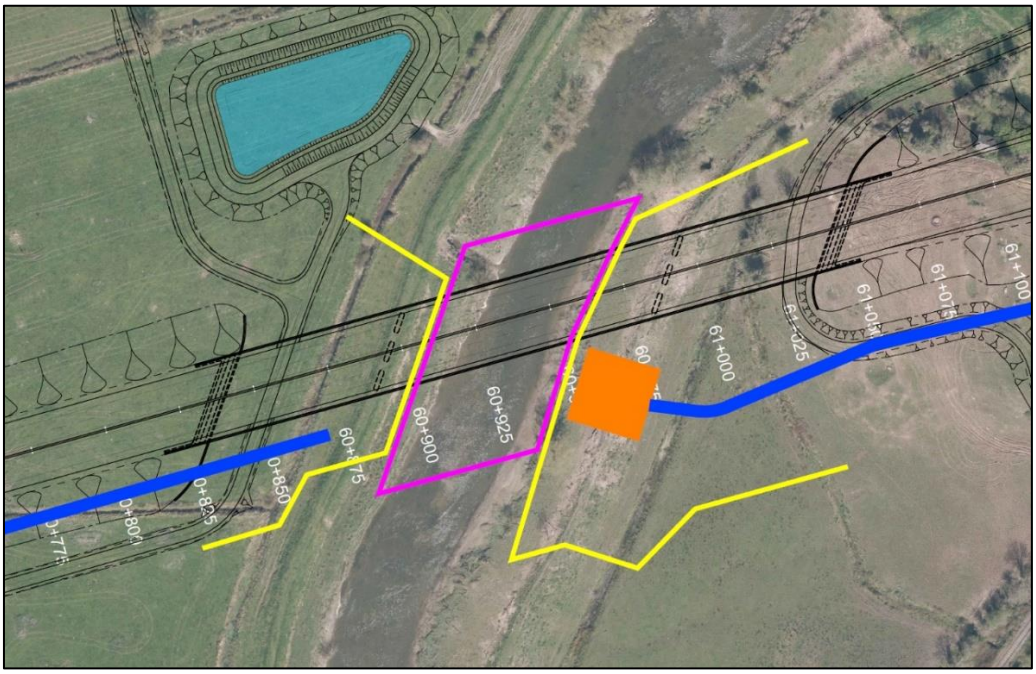
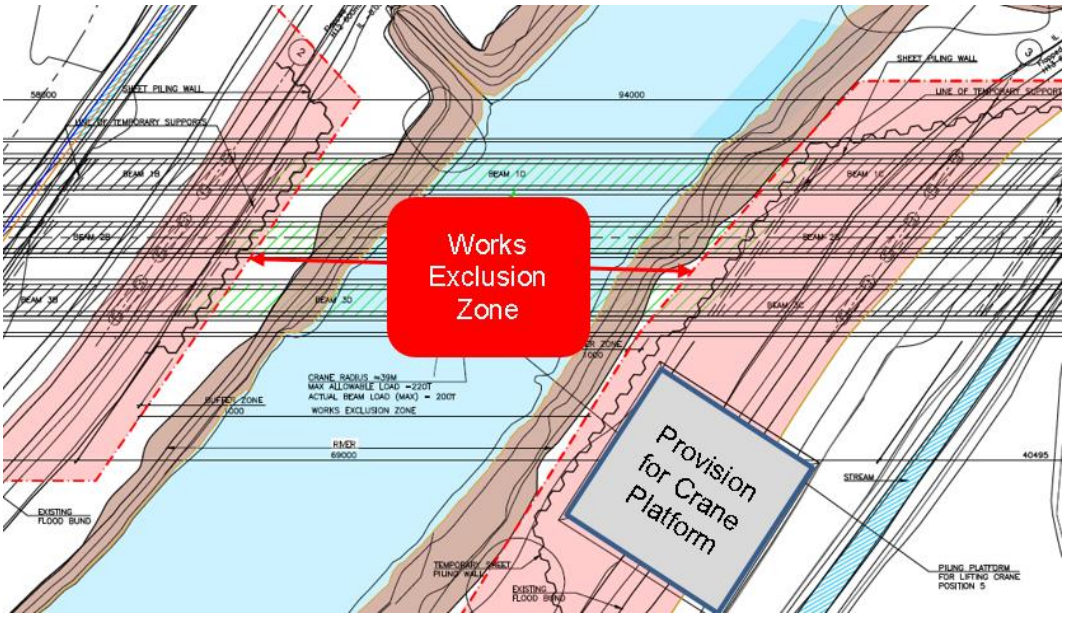
This Chapter provides a summary of the mitigation measures for the proposed road development, as contained within the Chapters of this Environmental Impact Assessment Report (EIAR). This is a summarised version stating only the mitigation measures to be provided and does not discuss the requirement for the measure to be applied or any anticipated residual impacts. This Chapter also deals only with mitigation measures to be applied to the proposed road development and does not address the avoidance or reduction mitigation which has been applied through the design development.

19.2 General Commitments

It should be noted that the planning and design of the proposed road development has been informed by key environmental constraints. Such design changes (referred to as 'mitigation by design') are extensive for the proposed road development and have not been listed in Table 19.1, below. Please refer to Chapter 4 Description of the Proposed Development, of Volume 2 of this EIAR for design details.

Table 19.1 General Mitigation and Monitoring Measures

No.	Description
4.1	Where mitigation measures have been identified in this EIAR, it will be a contractual requirement that the appointed Contractor implement those.
4.2	**Construction of the River Maigue Bridge** • For ecological reasons related to the SAC, the construction methodology for the proposed River Maigue Bridge will involve limited disturbance to outer areas of the river channel for some temporary piling for crane platforms outside the edges of the tidal zone, where works exclusion zones are defined. Provision is made for sheet-pile walls to be inserted into the riverbanks outside of the tidal mudflats, which will be protected from disturbance during the construction works. These sheet-piles will provide suitable supports for temporary works, support props and cranes, for the erection of the bridge. The proposed steel bridge deck can be erected in sections and connected over the river channel, with the central span section temporarily supported by props on the banks. • To protect the water quality in the river, a temporary drainage system will be provided at the works areas on the riverbanks, with all water directed away from the river and into a collection system that will be fitted with suitable pollution control measures prior to discharge to the existing drainage system that links to the river through flap-valve outlets. • Further measures will be adopted during the pouring of concrete for the bridge deck above the steel beams so as to prevent accidental spillages of pollutant materials directly into the river. Details of control measures for the construction stage are outlined in the Environmental Operating Plan (see Appendix 4.1 of Volume 4A). • On the western side of the river there is a 10m wide (13m skew) inter-tidal zone, consisting mainly of a mud bank, where Triangular Club-rush (*Schoenoplectus triqueter*; a rare, protected species of flowering plant) may grow, and this zone will be protected fully from any works disturbance. • To provide a small buffer zone for driving of sheet piles, a 70m clear zone is proposed for the works exclusion zone, outlined in pink on the aerial photograph in Plate 4.64, and on a plan drawing in Plate 4.65. • Works zones for the bridge piers and main span erection are outlined in yellow in Plate 4.64. These extend for about 10m north and south of the bridge along the riverbanks, apart from the south-eastern corner, where additional space is provided to accommodate a crane platform, as shown in orange. In these zones that are within the SAC, the topsoil will be stripped and stored in the nearby areas within the CPO, for later reinstatement. • Access routes for each side of the bridge are shown in blue in Plate 4.64. They will require short temporary culverts to span over the drainage ditches to the rear of the flood bunds. The ditches will be protected by 5m wide buffer zones, as they flow into the SAC. • Access footpaths for walkers and anglers will be retained for most of the time during the works in so far as is feasible for safety reasons. Temporary footpath diversions will be required around the bridge works areas and these may change as the bridge erection proceeds to keep members of the public away from lifting operations.

No.	Description
	 **Plate 4.64 River Maigue Bridge Construction Zones (shown in yellow) and Habitat Protection Zone (shown in pink)**  **Plate 4.65 River Maigue Bridge – Erection Plan showing the Works Exclusion Zone (Red Dashed Line) with Provision for Crane on the Eastern Riverbank**
4.3	As applies on all national roads in Ireland, appropriate maintenance arrangements will ensure that the drainage system is monitored and cleared out, as necessary, to ensure it continues to function properly (i.e. to protect water quality at the outfalls).
4.4	All unsuitable material from excavations, including soft ground beneath embankments, will be deposited on-site, for the outer slopes of embankments and in landscaping works. There will be no requirement to export waste soil materials from the site of the proposed road development.
4.5	Where boundaries at dwelling houses are removed as part of the works, they will generally be replaced on a like-for-like basis, subject to final agreement on accommodation works with individual property owners.

No.	Description
4.6	**Replacement of Electricity Towers and Poles** • Access to the towers for construction will be via local road access and through the lands being acquired as part of the proposed road development, while long-term maintenance access will be via the mainline of the proposed road development. • Access to the poles for construction will be via local road access and through the lands being acquired as part of the proposed road development, while long-term maintenance access will be via access from the local road network.
4.7	**Gas Mains** • The contractor for the main contract will be required to provide protection slabs or other forms of protection as required by GNI prior to undertaking any other road construction works on-line or adjacent to the GNI Transmission Lines. • Where a diversion of the mains within the road verge is required, the contractor for the main construction contract will be required to liaise with GNI with regard to the latter undertaking these diversions on behalf of the contractor.
4.8	**Design Modifications and Contractor's Environmental Commitments** • The contractor engaged will be responsible for finalising the design of the proposed road development in compliance with the Employer's Requirements, including compliance with the requirements of the EIAR and Nature Impact Statement (NIS) (including all mitigation measures) and any development consent conditions. Minor modifications may be made to the current design at the detailed design stage to avail of opportunities to improve the design in the light of experience on the ground or other innovations. Any such minor modifications, however, will not give rise to any impacts which are more significant than those already identified and assessed in this EIAR.
4.9	**Pre-construction Works** Archaeological investigation works, including testing and any follow-on resolution works, will be undertaken prior to the main works contract commencing on site.
4.10	**Traffic Management** • The section of the N21 east of Adare up to Attyflin Junction, that is to be constructed on-line as a motorway, will require extensive traffic management. This will require the switching of traffic lanes and use of hard shoulders in order that two-way traffic flow can be maintained alongside the works. The duration of these on-line works, together with the work required to the existing services, is estimated to be between 6 and 8 months. Construction of this on-line section may require a combination of alternating temporary traffic transitions from one side to the other. To undertake and install these transitions, short term temporary diversions and one-way traffic working may be required. Otherwise, two-way traffic will be maintained on this section, whenever possible, with reductions to one-way traffic working permitted only at off-peak times, as agreed with the Roads Authority and An Garda Síochána. • In cases where the proposed new road will cross above a side road on an under-bridge, traffic management restrictions such as stop-go arrangements will be required during construction of the foundations and sub-structures at each side of the road crossing. • During the erection of bridge beams over the public road, it will be necessary, for safety reasons, to close these roads for several days, and traffic will be diverted on the shortest available suitable detour route, as described in this EIAR and included in Table 4.21, below. • Where temporary road closures are required on National and Regional Roads, the traffic detour routes will follow Regional and National Roads, and not Local Roads (insofar as possible), which are generally too narrow to be suitable to cater for more than small volumes of local traffic. • These traffic management measures are to be adhered to by the successful Contractor, as part of the Works Requirements.

No.	Description

- All temporary diversions, lane closures, one-way systems, signage and temporary safety measures will be carried out in accordance with Chapter 8 of the Traffic Signs Manual.
- The traffic management plans, the diversions to be implemented and the interface between the works and traffic will be the Contractor's responsibility. The Contractor will also be responsible for acquiring the necessary licensing and permissions for the use of these roads with regard to temporary closures and traffic management.
- Public information about traffic diversions will be made available on the website for the proposed road development, where all proposed diversions will be posted. There will be a public access telephone number, where specific traffic diversion details may be clarified by the Project Public Liaison Officer to be appointed for the duration of the construction works by LCCC.

Table 4.21 Temporary Traffic Management and Road Diversions

Ref.	Road Number & Name	Mainline Chainage	Construction Issues and Traffic Management
		Section A	
A1	Existing N69 North at Foynes	1+000	Traffic management at tie-in, short term single lane working
A2	Existing N69 South at Foynes	1+000	Traffic management at tie-in, short term single lane working
A3	L-6188 Shannon-Foynes Port Access Road	1+000	Traffic management at tie-in, short term single lane working
A4	Road Bridge over N69 at Robertstown	2+600	Temporary road closures for bridge beam erection for up to 1 week. Traffic detour to south via R521, R523, N21 & R518 through Shanagolden, Ardagh and Rathkeale to Askeaton over 30km distance. Co-ordinate not to coincide with R518 closures: Ref C4.
A5	N69 Widening at Robertstown	2+600	Traffic management for online widening of the N69 at the existing river bridge with stop/go for up to twelve months. Timed to be undertaken once mainline is completed between Foynes and Askeaton to allow for closures.
A6	L-6068 at Robertstown	3+610	Road closed permanently early in the Works. Detour via L-1222 at 1km to west.
A7	Cooper's Lane (cul-de-sac access to lands)	5+440	Traffic management until new diversion and bridge is completed.
		Section B	
B1	L-1220 North at Ballyclogh	10+080	Temporary road diversion with traffic management at tie-in. Stop/go haul road crossing for up to twelve months.
B2	L-6062 at Ballyclogh	10+080	Temporary road diversion with traffic management at tie-in
B3	Existing N69 West at Askeaton	11+965	Traffic management at tie-in, short term single lane working
B4	Existing N69 East at Askeaton	11+965	Traffic management at tie-in, short term single lane working
B5	R518 at Askeaton	11+965	Traffic management at tie-in, short term single lane working

No.	Description			
	Section C			
	C1	L-1220 South at Ballyclogh	20+660	Stop/go haul road crossing for up to one year and occasional night-time closures to facilitate bridge construction works. Diversion from Askeaton direction via L-1236 to Newbridge and L-1222 to Creeves over 10km.
	C2	L-1236 at Ballynacaheragh	22+563	Phased temporary road diversion beside existing road with stop/go haul road crossing for up to one year.
	C3	L-1222 at Graigeen	26+535	Temporary road diversion beside existing road with stop/go haul road crossing for up to one year.
	C4	R518 at Graigeen	26+685	Stop/go haul road crossing for up to one year and occasional night-time closures to facilitate bridge construction works. Regional Traffic detour to south and west via R518, N21, R523, R521, and N69 through Rathkeale, Ardagh and Shanagolden to Askeaton over 30km distance. Local traffic detours via Cappagh on L-6021 and L-1203. Co-ordinate not to coincide with N69 closures (Ref A4) and L-6132 (Ref C5).
	C5	L-6132 at Ballingarrane	27+650	Stop/go haul road crossing for up to one year and temporary closures to facilitate bridge construction works. Detour 2.5km via Graigeen Cross to the north, L-6021 and L-1203. Co-ordinate not to coincide with R518 closures: Ref C4 or L-1203 closures: Ref. D2.
	Section D			
	D1	N21 West at Rathkeale	50+000	Traffic management at tie-ins, short term single lane working, temporary diversions and night-time closures to facilitate construction works
	D2	L-1203 at Rathkeale	50+185	Single Lane working and occasional closures with temporary diversions to facilitate bridge construction works. To be coordinated not to coincide with closures of L-6132 nearby to northwest.
	D3	L-1248 at Rathkeale	50+200	Traffic management at tie-in, short term single lane working
	D4	L-6023 at Blossomhill (North of N21)	51+530	Temporary road diversion alongside existing road with traffic management at tie-ins.
	D5	L-8027 at Blossomhill & Amogan Beg	51+530	Permanent road diversions to L-6023 with traffic management at tie-ins. Farm access track to be maintained at crossing till underpass is available.
	D6	L-52309 at Amogan Beg	51+950	Temporary road closure for link to L-8027 to north for up to 12 months with 0.3km diversion to N21 to south.
	D7	L-1421 at Croagh	54+450	Temporary road diversion beside existing road with traffic management at tie-in.
	D8	Existing N21 West of Croagh Junction	55+590	Traffic management at tie-in. No single lane restriction permitted.
	D9	Existing N21 East of Croagh Junction	55+590	Traffic management at tie-in. No single lane restriction permitted.
	D10	L-8026 at Clonshire More	56+170	Permanent road diversion over 1km via L-8025 with traffic management and stop/go haul road crossing until new link to L-8025 is available.

No.	Description

D11	L-8025 at Clonshire More	56+505	Traffic management and stop/go haul road crossing until bridge is completed. Temporary road closure to facilitate bridge construction works. Traffic detour to south and west via N21 & L-1421 at Croagh over 8km distance.
D12	L-8024 at Gortnagrour	57+665	Stop/go haul road crossing for up to one year. Temporary duration road closure to facilitate bridge construction works. Traffic detour to east via N21 & L-1422 at Adare or to west via N21 and L-1421 at Croagh over 9.5km distance.
D13	L-1422 Blackabbey Road	59+915	Stop/go haul road crossing for up to one year. Temporary road closure to facilitate bridge construction works. Local traffic detour via Clonshire over 7km distance. HGV traffic detour to west via N21 and L-1421 at Croagh over 17km distance.
D14	L-1423 Station Road	60+320	Temporary road diversion with traffic management at tie-in. No road closure likely to be required.
D15	Existing N21 West of Adare Junction	61+950	Temporary road diversion with traffic management at tie-in.
D16	Existing N21 East of Adare Junction	61+950	Temporary road diversion with traffic management at tie-in.
D17	L-1424 Kilgobbin Road	62+615	Stop/go haul road crossing for up to one year. Temporary road closure to facilitate bridge construction works. Traffic detour 7.5km long to east via L-1427 near Patrickswell.
D18	L -1427 at Rineroe	63+000	Traffic management at tie-in with stop/go working for short periods.
D19	Existing N21 at Attyflin tie-in	Ch. 63+500	Traffic management, hard shoulder running with occasional night- time contraflow for up to 12 months.

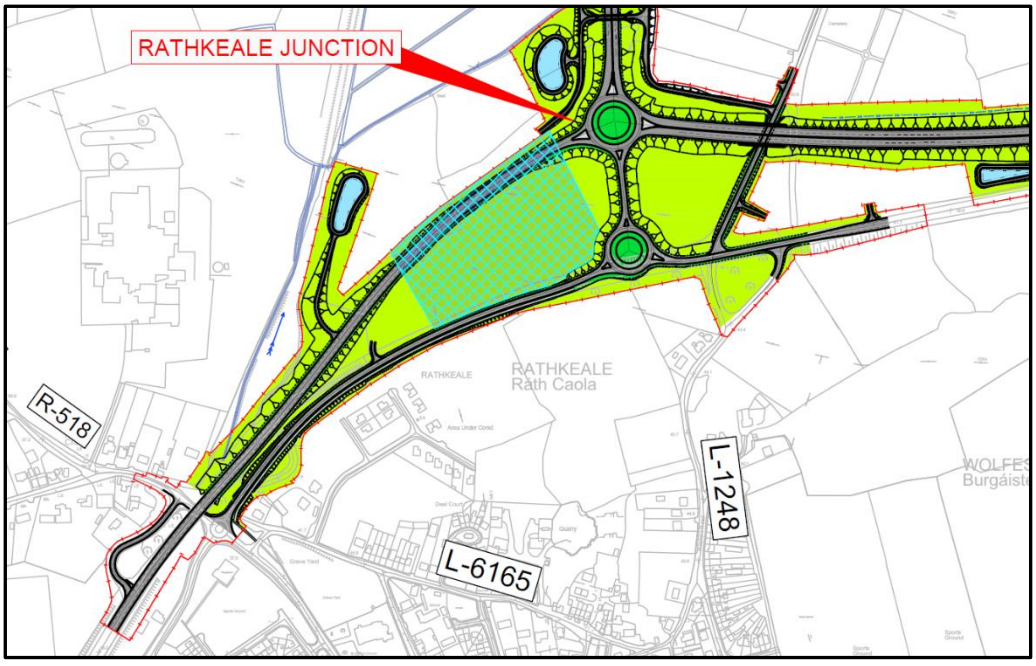
4.11 **Quarries**

- Only those quarries that conform to all necessary statutory consents may be used in the construction phase by the appointed Contractor.

For whatever quarry source, or sources, utilised for the fill material to be imported to the proposed road development, all will require suitable access routes for HGV traffic from their sites to the suitable main road network, in accordance with their planning approvals.

4.12 **Construction Traffic**

- Access to the site for the mainline works will be primarily off and along the following national and regional roads, at 7 locations, as shown in Figure 4.69 in Volume 3:
  (i) N21 at three locations: (i) east of Adare, (ii) at Croagh and (iii) at Rathkeale;
  (ii) N69 at three locations at (i) Foynes, (ii) Robertstown and (iii) Askeaton; and
  (iii) R518 at Graigeen, north of Rathkeale.
- For the River Maigue Bridge, a western access route will be required from the L-1423 (Station Road), just north of the village. Construction materials for the western part of the bridge, including sections of bridge beams, will be delivered to the site along this western access route through Adare village. This arrangement is necessary, as a temporary bridge will not be provided across the River Maigue during construction, because the span would be too long, and temporary supports will not be permitted within the tidal zone of the river channel to accommodate a shorter span.
- For the River Deel Bridge, the main construction approach will be from the south, off the R518 at Graigeen, north of Rathkeale. A secondary access route will be required from the north, through Askeaton and along the L-1423 (Station Road) for delivery of

No.	Description
	materials for the western abutment and pier. The main bridge beams can be delivered from the eastern side, via the main access route from the R518 at Graigeen, and each of the three spans can be progressively erected from east to west across the river. • Other than where described in this EIAR, general construction access will not be permitted from Local Roads, other than for light vehicles for personnel to gain access to bridge construction sites. • HGVs will be required to use a temporary haul road along the route of the proposed road development, from the nearest access point on a National or Regional Road. • The typical max. haul road distances will be up to 4km from the nearest of the 7 site access points. • Where the haul roads cross public roads, the Contractor will be required to provide a suitable temporary road pavement to withstand the loading of the construction traffic, and to maintain the surface in a good condition during the works. • In general, materials excavated within the site will be hauled along the route of the proposed road development between sections, without the need to use the public road network. • The Contractor will be prohibited from moving earthworks materials sourced from within the site via the public road network. • Crushed rock for road foundations, pavement materials, concrete, bridge beams and other items will also be transported to the site via the National and Regional road network. • The operating hours for construction traffic delivering bulk materials to site through Adare on the N21 will be restricted to cease at 16:00 on all days, and through weekends, to 07:00 on Mondays (or Tuesday, in the case of a public holiday on a Monday), so as to minimise adding to general traffic delays at peak periods. • Temporary crossing points will be required for each of the national, regional and local roads crossed by the proposed road development. The crossings will require local traffic management, in accordance with the issued Traffic Management Plan, Traffic Signs Manual and the Safety, Health & Welfare at Work (Construction) Regulations, when required.
4.13	**Construction Compounds**  **Plate 4.82 Main Construction Compound Location**

No.	Description
	• A general restriction will apply for all construction compounds not to be located within 100m of any inhabited dwelling, so as to limit risk of noise nuisance impacts. • The main construction compound will be accommodated within the lands immediately west of the proposed Rathkeale Junction, as shown in Plate 4.82. • Compounds will be subject to the control measures proposed in this EIAR in terms of dust control and noise, night-time illumination and sediment run-off, including at night-time, *etc*. • The storage of fuels, other hydrocarbons and other chemicals within the construction compounds will comply with the protection / mitigation measures described in this EIAR, the NIS and the Environmental Operating Plan (Appendix 4.1 of Volume 4A).
4.14	**Environmental Operating Plan** An Environmental Operating Plan (EOP) has been developed for the proposed road development in accordance with the TII *Guidelines for the Creation and Maintenance of an Environmental Operating Plan*. It will be finalised by the successful Contractor in agreement with LCCC and implemented by the Contractor throughout the duration of the construction phase. The EOP for the proposed road development is to be regarded as a comprehensive set of minimum environmental requirements for the Contractor to adhere to during the construction phase, which address all pathways for potential environmental and human health impacts as a result of the proposed works. It also sets out the mitigation measures prescribed in the EIAR and / or NIS and the mandatory measures (if any) stipulated in the conditions of the planning permission. The best practice measures set out in the EOP will be informed by the relevant TII guidelines, including but not limited to the following: • *Guidelines for the Treatment of Badgers prior to the Construction of a National Road Schemes;* • *Guidelines for the Treatment of Bats during the Construction of National Road Schemes;* • *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes;* • *Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage for National Road Schemes;* • *Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, During and Post-Construction of National Road Schemes;* • *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes;* • *Guidelines on the Management of Noxious Weeds on National Roads;* • *Guidelines for the Treatment of Noise and Vibration in National Road Schemes;* • *Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes;* • *Guidelines for the Management of Waste from National Road Construction Projects;* and • *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan.* This is a non-exhaustive list and relevant guidance current at the time of construction will be followed. At a minimum, the EOP will include the following, as they relate to the proposed works: • All environmental commitments / mitigation measures, as prescribed in the EIAR and / or NIS and conditioned by the Competent Authority (An Bord Pleanála) or any other statutory body (e.g. NPWS).

No.	Description
	• Methodologies for the implementation of the above-stated environmental commitments / measures, where required. • A list of all applicable environmental statutory requirements, the corresponding legislation, and a methodology for documenting compliance with same. • Methodologies by which construction work will be managed to avoid, reduce or remedy potential adverse impacts on the environment. The EOP has been appended to this EIAR at Appendix 4.1 of Volume 4A. The EOP will include a number of sub sections which identify the approach in respect of the following for the construction stage of the proposed road development, as follows: • Construction, Erosion and Sediment Control; • Construction and Demolition Waste Management; • Incident Response; and • Invasive Species Management. It will be a condition of the Contract for the construction of the proposed road development that the successful Contractor fully implement the EOP throughout the works. To oversee the implementation of the EOP, the Contractor will be required to appoint a responsible Site Environmental Manager (SEM) to ensure that the environmental commitments (as described above) and the EOP are fully executed for the duration of works, and to monitor whether the mitigation measures employed are functioning properly (i.e. are effectively addressing the environmental impact(s) which they were prescribed for).

19.3 Mitigation and Monitoring Measures for Traffic and Transport

Table 19.2 Mitigation and Monitoring Measures for Traffic and Transport

No.	Description
	There are no mitigation measures proposed for Chapter 5 Traffic and Transport as part of the Foynes to Limerick Road (including Adare Bypass).

19.4 Mitigation and Monitoring Measures for Population and Human Health

Table 19.3 Mitigation and Monitoring Measures for Population and Human Health

No.	Description
6.1	**Community Severance** In most locations, the local road network will remain connected through the provision of bridges under or over the new roads so as to maintain local community connectivity. One local road, the L-6068 at Rincullia (Km3.6) will be closed by the proposed road development. However, mitigation is not necessary, due to the absence of community severance impacts at this location. One private road 'Cooper's Lane' at Mulderricksfield (Km5.5) will also be closed, but an alternative will be provided c300m to the east.
6.2	**Economy** Appropriate signage will be provided at the junctions along the route at Adare, Croagh, Rathkeale, Ballyclogh, Askeaton and Foynes to direct drivers towards the available local services.
6.3	**Human Health** Mitigation measures for Noise and Vibration and Air Quality and Climate are detailed in Chapters 12 and 13, respectively. Any residual potential negative impacts will not be significant, and therefore no further mitigation measures are proposed for human health as a result of the proposed road development.

19.5 Mitigation and Monitoring Measures for Biodiversity

Table 19.4 Mitigation and Monitoring Measures for Biodiversity

No.	Description
Mitigation Measures for Designated Areas	
7.1	**Lower River Shannon SAC** The potential for direct impacts on the Lower River Shannon SAC during the construction of the Maigue River Crossing will be avoided, reduced and remedied by a suite of measures as detailed below: (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 the 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 the EIAR. (viii) Construction Erosion & Sediment Control Measures have been included in the Environmental Operating Plan (EOP, see Appendix 4.1 in Volume 4A of the 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 riverbanks and to avoid disturbance to fish, mammals and bats in the area.

No.	Description
	The construction method for the proposed River Maigue Bridge as described in Chapter 4 and in Section 7.4.1 of the Biodiversity 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.
7.2	**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 (see section on Mitigation for Aquatic Sites).
Mitigation for Terrestrial Sites	
7.3	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.

No.	Description
Mitigation for Aquatic Sites	
7.4	**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 (see7.3.8 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.

No.	Description
	(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. Realignments 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 of Chapter 7). (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.
7.5	**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.
Construction Stage Mitigation for Fauna	
7.6	**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 riverbanks or channel outside of construction activities. Continued movement of Otter will also need be accommodated along the riverbanks during the construction phase requiring permeable fencing along site boundaries. Maintenance of water quality as detailed in Section 7.5.3 above (Mitigation for Aquatic sites) will address requirements for Otter also.

No.	Description
	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.
7.7	**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. <u>*Pre-construction Badger Survey*</u> 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. <u>*Monitoring During Site Clearance*</u> 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. <u>*Protection of Setts Close to the CPO*</u> 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.

No.	Description
	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. Sett 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.
7.8	**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. *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, of Chapter 7. 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

No.	Description
	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 the 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);

No.	Description
	• 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: o Prior to demolishment, undertake dusk / dawn surveys to determine if the buildings are being used by bats. o 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). o The building / structure is left open overnight. o Undertake dusk / dawn surveys to determine if the buildings are being used by bats. o Examination of internal spaces to ensure that no bats are present during demolition the following day. o Removal of remaining sections, in the presence of a bat specialist. • Stone structures / ruins: o Undertake dusk / dawn surveys to determine if the buildings are being used by bats. o 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. o 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. o Once the ruin is deemed bat free, remove in the presence of a bat specialist. • Farm buildings (i.e. corrugated iron barns): o Undertake dusk / dawn surveys to determine if the buildings are being used by bats. o Remove the timber and insulation partitions by hand in the presence of a bat specialist.

No.	Description
	○ 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. *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.
7.9	**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.

No.	Description
	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.
7.10	**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 some dumping 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 habitat management 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 proposed measures should see improvement of the 4.6 ha of Suboptimal-Unsuitable habitat to Suboptimal and see the improvement of most of the remaining 14 ha to Suboptimal-Unsuitable or better. The prospects of success would be 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.

No.	Description
7.11	**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.
Operation Stage Mitigation for Fauna	
7.12	**Otter** *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.
7.13	**Badger** *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.

No.	Description
	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.
7.14	**Bats** Tables 7.12a to d 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

No.	Description
	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): o All luminaires used will lack UV/IR elements to reduce impact. o LED luminaires will be used as they are highly directional, of lower intensity, and provide good colour rendition and dimming capability. o A warm white spectrum (<2700 Kelvins is achieved to reduce the blue light component of the LED spectrum). o Luminaires will feature peak wavelengths higher than 550nm to avoid the component of light most disturbing to bats. o The use of specialist bollard or low-level downward directional luminaires shall be considered in bat sensitive areas to retain darkness above. o Column heights will be carefully considered to minimise light spill. The shortest column height allowed shall be used, where possible.

No.	Description
	○ 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.
7.15	**Amphibians and 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.
7.16	**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

No.	Description
	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 below).

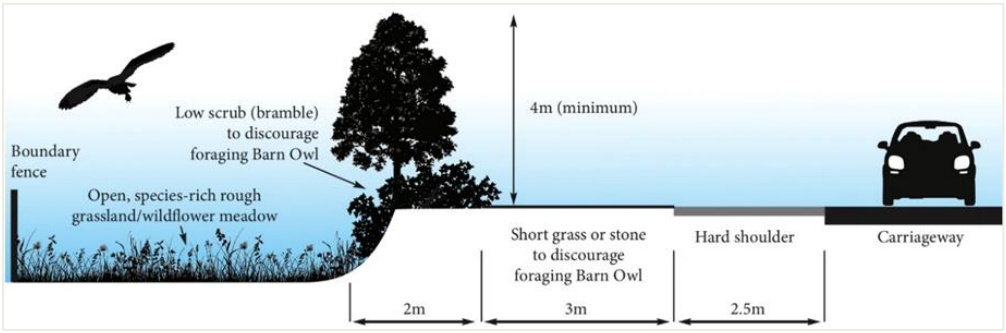


Plate 7.15 Schematic landscape design to reduce risk of Barn Owl traffic mortality.

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

7.17 Tables 7.12 a – d, below, 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

BMYY: Bat Mitigation at Kilometre YY

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.

No.	Description		
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 *Myotis* 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	MU4.15	Mammal passage. 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.

No.	Description		
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.	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. 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. 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 *Myotis* 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. 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).
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.	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. 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. Known and potential bat roosts shall be protected in the area. Two bat tubes shall be installed in the culvert (FRC6).

Table 7.12b Biodiversity Mitigation Measures – Section B

No.	Description

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	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). FRC7: Two separate 600mm diameter mammal culverts shall be put in place, with one on either side of proposed culvert (FRC7, 2m wide × 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. 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. 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.
10+800 to 11+000	BM10.9 FRC9	Habitat protection. Mammal and bat passage. Landscape planting. Bat box installation. Bat tube installation.	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. 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 *Myotis* 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. One no. rocket bat box shall be installed in the vicinity of the proposed attenuation pond at 10+900.

No.	Description		
11+000 to 12+000	RB01 FRC10	Mammal and bat passage. Mammal passages. Landscape planting. Bat tube installation.	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 *Myotis* species. Underpass at Ch.11+225 (UP4, 4.5m x 4.5m) will also facilitate bat passage. 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. 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).

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.

No.	Description		
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.
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 free standing 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.

No.	Description		
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.
24+200 to 24+500	FRC14 BM24.4	Mammal and LHB passage. Habitat protection. Bat tube installation. Landscape planting.	FRC14: A 1.8m wide × 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.

No.	Description		
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	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. 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. BM25b: Retained interests (wet grassland at Ch. 24+950 to 25+140) shall be protected during construction. 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. 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. 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.
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.	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. BM25d: Retained interests (wet grassland and marsh at Ch. 25+550 to 25+690) shall be protected during construction. 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. 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. 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.

No.	Description		
25+700 to 26+675	UP08 FRC24	Mammal and LHB passage. Mammal and bat passage. Landscape planting. Bat tube installation.	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. 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. 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.
26+675 to 27+225	BM27 UB04	Habitat protection. Bat box installation. Bat tube installation. Mammal and bat passage. Landscape planting.	One rocket bat box shall be installed in the vicinity of the proposed attenuation pond at Ch. 26+750. 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. 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. 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.
27+225 to 28+200	MU27.2 MU27.5 BM27.6 UP9	Mammal and LHB passages. Habitat protection. Landscape planting.	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. 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. BM27.6: Retained interests (scrub along railway at Ch. 27+500 to 27+650) shall be protected during construction. 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.

No.	Description		
28+200 to 28+525	FRC26 BM28a	Mammal and bat passage. Habitat protection. Bat box installation. Bat tube installation. Landscape planting.	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. BM28a: Linear riverine/riparian habitat along the river (at Ch. 28+200 to 28+300) shall be protected during construction. Two rocket bat boxes shall be installed in the vicinity of the proposed attenuation ponds at Ch. 28+250 to 28 +525. 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.
28+525 to 29+250	BM28b FRC27 BM28c FRC28 UP10	Habitat protection. Stream channel realignment. Mammal passage. LHB passage. Bat tube installation. Landscape planting.	BM28b: Natural channel of stream shall be recreated; bed widths, gradients, and riparian habitat landscaping shall be matched (Ch. 28+550 to 28+750). 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. 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. 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. 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. 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.

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).

No.	Description		
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.
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 × 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).

No.	Description		
55+990 to 57+150	UP14a/ UP14b/ UP15 M21-C3	Mammal and LHB passage. Bat tube installation. Habitat protection. Landscape planting.	UP14a (3m × 2.6m), UP14b (3m × 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.
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).

No.	Description		
59+200 to 59+650	RVB03 UP16 UP17	LHB passage. Habitat protection. Landscape planting. Bat tube installation.	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. 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. Appropriate landscaping shall be completed on both sides of the alignment (Ch. 59+200 to 59+650). 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.
60+000 to 61+850	RVB04 RB03	LHB passage. Mammal and LHB passage. Landscape planting. Habitat protection. Bat box installation. Bat tube installation.	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. 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. 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. 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. 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.
61+850 to 63+450	M21-C11	Mammal passage. Landscape planting. Habitat protection. Bat box installation.	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. 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. Appropriate landscaping shall be carried out along the alignment (Ch. 61+850 to 63+450). One rocket bat box will be installed on suitable mature trees in the vicinity of the proposed attenuation pond at 61+250.

No.	Description		
63+450 to 64+975	MU63.5 M21-C14		MU63.5: A 600mm diameter mammal passage shall be put in place, and associated approach fencing shall be erected. M21-C14: Mammal passage shall be accommodated beside existing stream culvert as separate 600mm pipe. Associated approach fencing shall be completed. 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.
65+400	MU 65.4	Mammal passage	Existing culvert under existing N21 dual carriageway and associated approach fencing

19.6 Mitigation and Monitoring Measures for Soils and Geology

Table 19.5 Mitigation and Monitoring Measures for Soils and Geology

No.	Description
8.1	No mitigation measures are required for impacts on soils and geology during the construction and operational phases of the proposed road development. Efforts have been made, insofar as possible, to source infill material from within the proposed cuttings, in order to minimise the volume of material imported from quarries in the region.

19.7 Mitigation and Monitoring Measures for Hydrogeology

Table 19.6 Mitigation and Monitoring Measures for Hydrogeology

No.	Description
General Mitigation Measures for Hydrogeology	
9.1	**Operational Mitigation** The impact of road construction on aquifers and groundwater resources can be minimised by applying sound design principles and by following good work practices as outlined by the TII in its 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2008)'. For groundwater the following were the main responses and guidelines considered during the development of the hydrogeological mitigation measures for the proposed road development: • Where possible, re-align the road down-gradient or an appropriate distance up-gradient of the source protection area for high yielding water supply springs and wells and natural hydrogeological features; • Where possible, minimise the depth of road cutting within a source protection area or zone of contribution to minimise the impact on groundwater flows to down gradient springs, wells, wetlands and other hydrogeological features; • Where possible, minimise the depth of road cutting below the permanent groundwater table in order to ensure that its zone of contribution does not extend up gradient to a hydrogeological feature or wetland; • Provide sealed drains along sections of road overlying the vulnerable parts of locally important or regionally important aquifers; • Provide site-specific measures to protect relatively small natural hydrogeological features such as springs, seeps or wetlands; • Assess the potential impact of re-grading small streams on nearby wells or springs; • Ensure all surface water run-off discharged to groundwater via soakaways or unlined attenuation ponds is passed through systems for settlement or filtration of suspended solids with the parallel effect of removing contaminants (certain heavy metals and hydrocarbons) associated with the suspended solids; • Groundwater monitoring may be appropriate in certain instances, instead of automatically providing specific mitigation measures. In these circumstances however, thresholds should be set that will trigger the introduction of pre-defined mitigation measures; • Specifying regular monitoring of groundwater during the construction period and for a defined period thereafter, following opening of the proposed road development; • All wells abandoned as part of the road development should be sealed and abandoned in accordance with "*Well Drilling Guidelines (2007)"* produced by the Institute of Geologists of Ireland (IGI). Ground investigation boreholes should be backfilled using bentonite or cement bentonite grout in accordance with the *Specification and Related Documentation for Ground Investigation (2006)* published by the Institution of Engineers of Ireland; and • Abandon obsolete ground investigation boreholes / water supply wells and springs in accordance with the appropriate well drilling guidelines. The above guidelines have been considered during the development of the design such that impacts have been minimised. Site specific mitigation measures for the unavoidable impacts are detailed in Section 9.5.1.2.

No.	Description
	In formulating hydrogeological mitigation measures, regard was made to the requirements of the Water Framework Directive (Directive 2000/60/EC of the European Parliament, 2000) and Groundwater Directive (Directive 2006/118/EC of the European Parliament, 2006) and the enabling national legislation. In developing mitigation measures, there was co-ordinated and ongoing consultation with the River Basin Management Projects, the National Parks and Wildlife Service (NPWS), Office of Public Works (OPW), Local Authorities, Group Water Schemes and Environmental Protection Agency (EPA) as required. The following mitigation will be incorporated in respect of groundwater supplies: • All groundwater supplies currently in use that are within the footprint of the proposed road development will be replaced either through the provision of a private supply or by providing a connection to an existing public or group water scheme; • All groundwater supplies identified in Table 9.18 and existing private wells within 300m of areas of road cuttings greater than 5m will be monitored (for water level and quality). The proposed monitoring will consist of: o Quarterly monitoring for 12 months pre-construction o Bi-monthly monitoring during construction o Quarterly monitoring for 12 months post-construction o Monitoring of any private supplies is subject to agreement by the relevant land/ property owner. Should it be concluded that any of these monitored private supplies will be lost or contaminated as a result of the development, these shall be replaced either through the provision of a replacement private supply or by providing a connection to an existing public or group water scheme. • The incorporation of the above listed mitigation measures will ensure that there will be no likely significant residual effects on any private or group groundwater supply.
9.2	**Construction Mitigation for Hydrogeology** During the construction phase any compound areas / service yards are to be located away from key hydrogeologically sensitive areas and features (Watercourse, wetlands habitats, etc.) – further details are set out in Section 9.5.1.2 below. In terms of avoiding regionally important aquifers, this was not possible as it is the dominant aquifer type along the route and therefore best environmental practices are required to protect against potential pollution. To minimise the risk of pollution to the groundwater, any fuel storage, refuelling and maintenance of construction vehicles will be carried out in protected areas to manage any spillages. Procedures are set out in Chapter 10 Hydrology which will require that any hydrocarbon leakages or spillages during construction will be dealt with immediately. These measures will absorb the bulk of the contaminant immediately with absorbent material, storing it and the contaminated soil in a stockpile underlain and covered by plastic to prevent leachate generation, until such time as it can be removed off-site by an appropriately licensed waste management company. Where significant groundwater flows are encountered in deep bedrock cut sections, mitigation will be provided to ensure the continued flow of same where possible. The mitigation may involve either piping, construction of gravel filled pathways or short diversions. The Contractor shall be made aware of any areas of potential karst features located at shallow depths, and site traffic in these areas should be kept to a minimum to reduce the potential compression and collapse of subsurface flow features. Imported fill shall be in accordance with the requirements of the TII Specification for Road Works. Where water supply wells and springs are located underneath the proposed road development footprint, these will be sealed to prevent contaminants entering the aquifer (*Well Drilling Guidelines (IGI, 2007)*). The incorporation of such mitigation measures will

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>ensure there will be no likely significant residual effects to any private or group groundwater supplies.</td></tr>
<tr><td colspan="2">Site Specific Mitigation Required for Hydrogeology</td></tr>
<tr><td>9.3</td><td>Extreme Vulnerability Areas

<u>Construction</u>
Prior to the commencement of construction works, clean runoff water from lands adjacent to and up gradient of the works area will be diverted to local watercourses through the installation of cut-off ditches. Soiled construction runoff water will undergo treatment before discharge by being passed through a settlement pond (either temporary or permanent pond system). The treated water may be discharged to a surface water body and/or depending on the subsoil conditions may also discharge to ground so as to maintain the existing recharge conditions.

<u>Operation</u>
Throughout the proposed road development in areas of extreme and high vulnerability and near sensitive ecological receptors, a sealed drainage system will be used – see Table 9.9 above for details. This avoids the potential for infiltration to groundwater as a linear source and this approach is in accordance with best practice. Wetland systems will be provided at all outfalls to protect both surface and groundwater from any adverse quality and/or quantity impacts of the road drainage discharge.</td></tr>
<tr><td>9.4</td><td>Hydrogeological Features
Each of the hydrogeological features identified that are potentially at risk due to the proposed road development were assessed based on the potential magnitude of the impact. Where an impact rating was deemed to be slight or imperceptible it is considered that the adherence to good construction practices applies, as fully outlined in the Environmental Operating Plan (Appendix 4.1) and as further detailed in Chapter 10. Adoption of these measures can adequately mitigate the level of risk involved and no additional specific mitigation is required. Each of the features which were found to have an impact rating greater than slight have been considered to require some form of mitigation to reduce the magnitude of the risk posed.</td></tr>
<tr><td>9.5</td><td>Specific Mitigation Measures for Hydrogeological Features
The table below gives details of the specific mitigation measures proposed at each hydrogeological feature.

<table>
<tr><th>Feature / Location</th><th>Description of Impact</th><th>Mitigation Measure</th><th>Residual Impact</th></tr>
<tr><td rowspan="2">KER4 Rincullia Km 4</td><td>Increased frequency or extent of localised groundwater / pluvial flooding of agricultural lands.</td><td>Fill with clean broken rock and wrap in geotextile prior to completing the road formation / embankment. Maintain north-south drainage beneath the road construction.</td><td rowspan="2">Imperceptible</td></tr>
<tr><td>Localised pollution of the bedrock aquifer by routine surface runoff and spillages</td><td>Provide sealed road drainage at this location and treat prior to outfall.</td></tr>
</table>
</td></tr>
</table>

No.	Description			
	KER7 Fen Wetland at Ballyellinan Km 7	Changes to the groundwater flow regime causing a deterioration in the status of the fen as a wetland habitat.	No improvement to existing drainage systems in this area – provide a drainage neutral design. All existing surface water flow paths to be piped and culverted to match existing conditions. Provide a drainage blanket between Ch.6+600 and Ch.7+150 with a transverse barrier at either end to ensure north-south shallow drainage paths are not blocked and to ensure road formation does not act as a longitudinal drain. Base of the embankment for Side Road 5B and the L1220 shall be constructed of cohesive non-permeable material to ensure the road formation does not drain the wetland fen area located to the north of the alignment.	Imperceptible
		Localised pollution of the bedrock aquifer or the fen wetland by routine surface runoff and spillages	Road drainage to be treated prior to outfall as per good design practice. Appropriate drainage system to be used as per the assessment in Section 9.4.1.2	
	KER11 Fen Wetland at Lismakeery Km 21	Changes to the groundwater flow regime causing a deterioration in the status of the fen as a wetland habitat.	No improvement to existing drainage systems in this area – provide a drainage neutral design. All existing surface water flow paths to be piped and culverted to match existing conditions. Provide a drainage blanket between Ch.21+000 and Ch.21+150 with a transverse barrier at either end to ensure north-south shallow drainage paths are not blocked and to ensure road formation does not act as a longitudinal drain. Any springs / groundwater seepages which may be encountered shall be filled with clean broken rock, wrapped in geotextile and piped/directed to its natural flow path which is likely towards this wetland. Hydrological management measures including a drainage link from the existing spring under the proposed road development at Ch.21+080 southward to the main fen area and sluice controls on the drainage outlet.	Imperceptible
		Localised pollution of the bedrock aquifer or the fen wetland by routine surface runoff and spillages	Road drainage to be treated prior to outfall as per good design practice. Appropriate drainage system to be used as per the assessment in Section 9.4.1.2	

No.	Description			
	KER21 Fen Wetland Blossomhill Km 51	Changes to the groundwater flow regime causing a deterioration in the status of the fen as a wetland habitat.	No improvement to existing drainage systems in this area – provide a drainage neutral design. All existing surface water flow paths to be piped and culverted to match existing conditions. Base of embankment on north side of alignment between Ch.51+050 and Ch.51+300 shall be constructed from cohesive material to ensure the road formation toes not act as a longitudinal drain away from this area.	Imperceptible
		Localised pollution of the bedrock aquifer or the fen wetland by routine surface runoff and spillages	Road drainage to be treated prior to outfall as per good design practice. Appropriate drainage system to be used as per the assessment in Section 9.4.1.2	
	Craggs / Barrigone GWS Km 6	Reduction in yield be observed of water supply at the Group Water Scheme borehole	The principal mitigation measure proposed at this supply is to monitor the pre, during and post construction water level and water chemistry at the supply for any impacts. Whilst a moderate / significant impact to the yield of the existing supply at Craggs / Barrigone GWS cannot be discounted, the likelihood of a significant impact is low, and the more likely scenario is that the impact will be minor or imperceptible. However, in the absence of absolute certainty two alternative mitigation measures are proposed which will form a backstop should a reduction in yield be observed: (i) Connection of the public water supply to the Group Water Scheme reservoir in advance of the main scheme construction (ii) Should a significant impact in quality or yield be observed as a result of the proposed road development, installation of a new suitably located replacement/additional borehole and pump system connected to the existing group water scheme network. Mitigation measures are only provided for should a reduction in yield below the maximum abstraction rate occur and to ensure no interruption in supply.	Slight

No.	Description			
	Croagh-Farrandonnelly GWS Km 54	Reduction in yield of water supply at the Group Water Scheme borehole	Monitor pre, during and post construction water level and water chemistry at this supply. Should a significant impact in quality or yield be observed as a result of the proposed road development, take necessary steps which may include provision of a replacement borehole or connection to an adjacent supply.	Slight
		Contamination of water supply from road drainage entering aquifer via weathered bedrock.	Provide sealed drainage system between Ch.53+150 and Ch. 55+800 to ensure no pollution of the underlying aquifer in this area where bedrock will be exposed by the proposed cutting.	
	Spring feeding local stream Km 1	Loss of water supply for agricultural use	Fill with clean broken rock, wrap in geotextile and pipe/redirect to adjacent stream/watercourse located to the north.	Slight
	Spring / Well Agricultural Use Km 11	Loss of water supply for agricultural usage	Provide replacement borehole or connection to adjacent supply.	Slight
		Contamination of water supply from road drainage entering aquifer via exposed bedrock	Prior to completing road construction, fill with clean broken rock, wrap in geotextile and pipe/redirect to cut-off drain or adjacent stream / watercourse. If a well or bore is present follow the IGI guidance for the abandonment of wells.	Imperceptible
	Spring/Well Agricultural Use Km 51	Loss of water supply for agricultural usage	Provide replacement borehole or connection to adjacent supply.	Slight
		Contamination of water supply from road drainage entering aquifer via exposed bedrock	Prior to completing road construction, fill with clean broken rock, wrap in geotextile and pipe / redirect to cut-off drain or adjacent stream / watercourse. If a well or bore is present, follow the IGI guidance for the abandonment of wells.	Imperceptible
	Domestic well located c.150m south of the proposed alignment at Ch.55+200. Alignment is in cutting to a max depth of c.7.5m at this location.	Reduction in yield or loss of water supply for domestic usage	Monitor pre, during and post construction water level and water chemistry at this supply. Should an impact in quality or yield be observed provide a replacement borehole or connection to an adjacent supply.	Slight
		Contamination of water supply from road drainage entering aquifer via exposed bedrock	Road drainage to be treated prior to outfall as per good design practice. Appropriate drainage system to be used as per the assessment in Section 9.4.1.2	Imperceptible
	Domestic well located c.200m south of the proposed alignment at Ch.55+400. Alignment is in cutting to a max	Reduction in yield or loss of water supply for domestic usage	Monitor pre, during and post construction water level and water chemistry at this supply. Should an impact in quality or yield be observed provide a replacement borehole or connection to an adjacent supply.	Slight

No.	Description			
	depth of c.7.5m at this location	Contamination of water supply from road drainage entering aquifer via exposed bedrock	Road drainage to be treated prior to outfall as per good design practice. Appropriate drainage system to be used as per the assessment in Section 9.4.1.2	Imperceptible
	A cluster of domestic well supplies located down-gradient of a proposed cutting at Ch.55+600. Cutting max depth of c.7.5m located between 100 – 450m up-gradient.	Reduction in yield or loss of water supply for domestic usage	Establish locations of all domestic and agricultural supplies in the likely potential zone of impact. Monitor pre, during and post construction water level and water chemistry at these supplies. Should an impact in quality or yield be observed provide a replacement borehole or connection to an adjacent supply.	Slight
		Contamination of water supply from road drainage entering aquifer via exposed bedrock	Road drainage to be treated prior to outfall as per good design practice. Appropriate drainage system to be used as per the assessment in Section 9.4.1.2	Imperceptible

19.8 Mitigation and Monitoring Measures for Hydrology

Table 19.7 Mitigation and Monitoring Measures for Hydrology

No.	Description
Construction Stage Mitigation for Hydrology	
10.1	An Environmental Operating Plan (EOP) has been prepared for the proposed road development and is attached to the EIAR as Appendix 4.1. Reference should be made in the first instance to this Plan for specific construction mitigation proposals – a summary of the key mitigation is also given below. The EOP includes the following: • An Emergency Response Plan detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, any incidence of non-compliance with any permit or license or other such risks that could lead to a pollution incident, including flood risks. • A Water Quality Management Plan to ensure compliance with environmental quality standards specified in the relevant legislation (i.e. European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations 1989 and European Communities (Quality of Salmonid Waters) Regulations 1988). This plan will include details and method statements for the control, treatment and disposal of potentially contaminated surface water. • All necessary permits and licenses for in-stream construction works for the provision of culverts and bridges including new and widening of existing structures will be obtained prior to commencement of construction of same. OPW Section 50 approval has been applied for in the case all culverts and bridges proposed for this road development.
10.2	Construction operations will be required to take cognisance of the following guidance documents for construction work on, over or near water. • Shannon Regional Fisheries Board – Protection and Conservation of Fisheries Habitat with Particular Reference to Road Construction. • Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites (Eastern Regional Fisheries Board) • Central Fisheries Board Channels and Challenges – The Enhancement of Salmonid Rivers. • CIRIA C532 Control of Water Pollution from Construction Sites Guidance for Consultants and Contractors. • CIRIA C648 Control of Water Pollution from Constructional Sites. • Guidelines for the Crossing of Watercourses during the Construction of National Road schemes (TII, 2006). • Guidelines on Protection of Fisheries During Construction Works in and adjacent to Waters (IFI, 2016)
10.3	Based on the above guidance documents concerning control of constructional impacts on the water environment, the following outlines the principal mitigation measures that will be prescribed for the construction phase in order to protect all catchment, watercourse and ecologically protected areas from direct and indirect impacts: • All construction compound areas will be required to be set back a minimum of 10m from river and stream channels and out of potential floodplain areas. • Surface water flowing onto the construction area will be minimised through the provision of berms, diversion channels and cut-off ditches. • Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and the diversion of runoff water off these stockpiles to the construction settlement ponds.

No.	Description
	• Where construction works are carried out adjacent to turloughs, fens, stream and river channels and lakes, protection of such waterbodies from silt load will be carried out through use of grassed buffer areas, timber fencing with silt fences or earthen berms to provide adequate treatments of runoff and construction site runoff waters to the watercourses. Locations for silt fences are outlined in the EOP. • Use of settlement ponds, silt traps and bunds and minimising construction within watercourses. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap. • All watercourses will be fenced off at a minimum distance of 5 m from site compounds/storage facilities. In addition, measures will be implemented to ensure that silt laden or contaminated surface water runoff from the compound does not discharge directly to the watercourse. Compounds will not be constructed on lands designated as Flood Zone A or B in accordance with the OPW Flood Risk Management Guidelines (November 2009). • The storage of oils, fuel, chemicals and hydraulic fluids will be in secure areas within the site compounds and will not occur within a minimum of 10m from watercourses. Storage tanks will have secondary containment provided by means of an above ground bund to capture any oil leakage. Storage tanks and associated provision, including bunds, will conform to the current best practice for oil storage and will be undertaken in accordance with *Best Practice Guide BPGCS005 – Oil Storage Guidelines* (Enterprise Ireland). • Foul drainage from all site offices and construction facilities will be taken off-site and disposed of by a licensed contractor in accordance with legislation to prevent pollution of rivers and local water supply. • The construction discharge will be treated such that it will not reduce the environmental quality standard of the receiving watercourses. • Riparian vegetation along the identified sensitive watercourse will be fenced off to provide a buffer zone for its protection to a minimum distance of 5m with the exception of proposed crossing points. • Any surface water abstracted from a river for use during construction will be through a pump fitted with a filter to prevent intake of fish. • The use and management of concrete in or close to watercourses will be carefully controlled to avoid spillage which as stated earlier has a deleterious effect on water chemistry and aquatic habitats and species. Alternate construction methods are encouraged, for example, where reasonably possible, use of pre-cast or permanent formwork will reduce the amount of in-situ concreting required. Where on-site batching is proposed, this activity will be carried out well away from watercourses. Washout from such mixing plants will be carried out only in designated contained impermeable areas.
General Operational Stage Mitigation for Hydrology	
10.4	**Water Quality Impact Mitigation** All road pavement runoff water will be collected in a road drainage system and discharged to receiving surface waters. Spillage containment in excess of $50m^3$ and pre-treatment in terms of silt traps will be provided upstream of all road drainage outfalls. These treatment and spillage containment facilities are proposed to be provided within the storm attenuation ponds. The proposed drainage system incorporates a range of pollution control features to limit the water quality impact to receiving waters. These include the use of filter drains, closed drainage systems and the use of a vegetated lined wetland system upstream of all road drainage outfalls. Each of the attenuation ponds include a wetland system/treatment forebay which has been sized to cater for the first flush volume from the road runoff (this is 10% of the pond area as per the Sustainable Drainage Systems (SUDs) Manual). Further detention storage (for the 100-year storm event) is available within the overall attenuation

No.	Description
	storage which includes the pond for settlement of suspended pollutants. The vegetated system will allow for the take up of nutrients in the drainage water. A sealed road drainage system will be used to prevent pollutants infiltrating to groundwater in areas of Regionally Important karst Bedrock Aquifer which have a High or Extreme Vulnerability. Refer to Chapter 9 Hydrogeology for further details. To facilitate emergency response to serious spillages all pond and storage systems will be fitted with a manual penstock so as to close off the outfall and contain the spillage water within the pond/storage system for pumping out and appropriate treatment and disposal.
10.5	**Storm Runoff Mitigation** In order to minimise local flooding and associated channel morphological impacts all outfall storm discharges to watercourses will undergo storm attenuation reducing outflow so that there is a negligible increased risk of flooding in the receiving watercourse due to construction of the road up to the 100 year return period and attenuating the 100 year critical storm event within the pond storage area which will then be released at greenfield runoff rates or lower. The attenuation pond for each of the outfalls will be sited outside of flood plain areas in order to avoid any residual flood storage loss to the receiving river / stream. These attenuation ponds provide a dual function of attenuation and primary water quality treatment through physical settlement of suspended sediments.
10.6	**Culverts and Bridges** All culverts and bridges are designed to prevent permanent impact to the river morphology. A short-term temporary impact may occur whilst on-line bridges and culverts are being put in place. These impacts will be minimised through the incorporation of strict control procedures – refer to the Environmental Operating Plan in Appendix 4.1. Permanent impacts on river morphology will be prevented by ensuring the river width is not exceeded or contracted by the proposed culvert or bridge and that reasonable transition to and from the bridge or culvert is provided where approach and exit channels are skewed to the culvert alignment. In all watercourses the proposed culvert will be embedded into the channel to a depth of 500mm for box sections and a minimum of 300mm for pipe culverts (depending on hydraulic size requirements). All crossings identified as potential Salmonid rivers/streams and important for mammalian (otter) migration have been designed to maintain the existing migratory routes as far as possible, in accordance with Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes, TII 2008.
10.7	**Watercourse Diversions** For the proposed stream and drain diversions, localised mitigation measures have been identified to prevent bank erosion at sites of bends which were found often to coincide with the proposed culvert. This protection may be in the form of large boulders or rip-rap along the outer bank with a suitable filter material or geotextile placed inside the armouring to protect the native soil bank. All diversion channels will include fishery friendly requirements where they are identified as having fishery potential. The flood capacity will be enhanced while importantly preserving the low flow channel characteristics. The inclusion of shoals and pools in the channel will assist the rehabilitation of the low flow channel at crossing and diversion sites.

19.9 Mitigation and Monitoring Measures for the Landscape

Table 19.8 Mitigation and Monitoring Measures for the Landscape

No.	Description
11.1	Mitigation measures from other specialist areas of assessment that take the form of landscape planting, notably Biodiversity and Agriculture, have been coordinated with the landscape mitigation measures and included in the provisions in Figures 11.1 to 11.23 of Volume 3.
General Mitigation and Monitoring Measures	
11.2	A suitably qualified landscape architect will devise the specification for the proposed road development based on the mitigation measures outlined in this EIAR, in consultation with a suitably qualified ecologist. The drawings, specifications and management documents will include for the treatment of the existing vegetation, soil preparation, seeding, planting, maintenance and establishment works. In addition, requirements put forward in Chapter 7 Biodiversity will be coordinated with the landscaping works.
11.3	Consultation with a suitably qualified arborist is required for the successful and safe retention of existing mature trees where possible. A Tree and Vegetation Management Plan will be prepared by the arborist which will identify the specific trees for retention and measures required for protection of trees prior to commencement of construction works, with reference, where appropriate, to BS 5837:2012 *Trees in relation to design, demolition and construction. Recommendations*.
11.4	Existing semi-mature and mature tree groupings within the land-take area or adjacent, that are to be retained will be protected through the erection of fencing prior to the commencement of construction works on site. The fence must remain intact for the duration of the works and will exclude any construction related activities. The fence type, installation method and location to be advised by a suitably qualified landscape architect. A suitably qualified arborist will assess the condition of the retained trees during and post construction works (and in particular will advise on the risk of windthrow, particularly where the route divides woodland areas).
11.5	In considering landscape mitigation measures, it should be noted that Ash (*Fraxinus excelsior*) is currently restricted due to Ash Dieback Disease and cannot therefore be planted at present. Ash is one of the most common native trees in Irish hedgerows, woodlands and scrub. For the purposes of this assessment, it is assumed that these restrictions will be lifted prior to the construction of the road and implementation of the landscape scheme. If they are not, Ash should be omitted and replaced with appropriate native alternatives suited to the site.
11.6	The plants selected for the landscape treatments are found in the existing landscape and are appropriate to the local soil types and climatic conditions. The breakdown of the proposed landscape treatments, which have been devised to achieve the objectives for landscape mitigation, are as follows: • **Hedgerow / Treelines:** In order to re-establish hedgerow / treeline corridors that have been severed by the proposed road development, the fence-lines are to be established with native hedgerow material. The native hedgerow material will include species which widely occur in the existing landscape area; such as – Hawthorn (*Crataegus monogyna*), Blackthorn (*Prunus spinosa*), Hazel (*Corylus avellana*) and Willow (*Salix* spp.) with emergent trees including Elder (*Sambucus nigra*), Ash, Sycamore, Rowan (*Sorbus* spp.), Birch (*Betula pendula*), Aspen (*Populus tremula*) and Oak (*Quercus robur*). Many of the hedgerows in the study area have a proportion of both native and non-native parkland trees and form linear treelines in the landscape. Thus a proportion of non-native parkland tree species should be included in the hedgerows to reflect the history of the landscape. Appropriate species currently found in this landscape are Beech (*Fagus sylvatica*), Horse Chestnut (*Aesculus hippocastanum*), Lime (*Tilia* spp.), Sweet Chestnut (*Castanea sativa*), Larch (*Larix decidua*), and

No.	Description
	Lombardy Poplar (*Populus nigra italica*). The number of non-native species in the proposed mix should be approximately 30% of the native tree numbers. • **Compensatory Parkland Trees:** This landscape has a high proportion of parkland trees, some of which will be unavoidably removed. Replacement trees will be planted where appropriate clearance distance from the carriageway permits. Species will be determined at detailed design stage but may include Oak (*Quercus robur*), Scots Pine (*Pinus sylvestris*), Beech (*Fagus sylvatica*), Horse Chestnut (*Aesculus hippocastanum*), Sycamore (*Acer pseudoplatanus* & varieties), Maple (*Acer platanoides, A. campestre*), Lime (*Tilia* spp.), Sweet Chestnut (*Castanea sativa*), Hornbeam (*Carpinus betulus*) and Lombardy Poplar (*Populus nigra italica*). This measure is to be implemented as part of Specific Landscape Measures (SLMs); see following section 11.5.2. • **Screen Planting Measures:** At specific areas, there will be a requirement for particular screening of the proposed road development in views from properties, to address potential visual impact. These will be established using woodland planting with a specific emphasis on quick establishment of a woodland screen, with larger material to create woodland screening and effective woodland in the long-term, as well as an understorey of planting to screen at lower levels. Species to be included are: Scots Pine *(Pinus sylvestris*), Holly (*Ilex aquifolium*), Ash (*Fraxinus excelsior*), Oak (*Quercus petraea*), Birch (*Betula pendula*), Alder (*Alnus glutinosa*), Hawthorn (*Crataegus monogyna*), Willow (*Salix spp.*). In some cases, where woodland planting could adversely affect the level of light in the property to be screened, or where woodland would be inappropriate in the landscape context, it would be more appropriate to plant only shrub understorey species which will reach 4-5m, sufficient to provide adequate screening of traffic or integrate structures into the landscape, such as Holly (*Ilex aquifolium*), Hazel (*Corylus avellana*), Willow (*Salix* spp.), Guelder Rose (*Viburnum opulus*), Spindle (*Euonymus europaeus*) and Elder (*Sambucus nigra*). Screen planting measures will have a minimum of 10 rows of planting parallel to the carriageway / element to be screened, spaced at 1-1.5m, unless space is limited. Screen planting will be located as far as practicable from the property to be screened to avoid excessive dominance / presence of large trees adjacent to the house, particularly where screen planting is located to the south of the house and could limit light into the property. • **Riparian / Wetland Planting:** Throughout the study area there are copses beside streams and riverbanks of wet woodland. These are generally scrubby in make-up and distributed at random in the low-lying areas in particular. In order to integrate the proposed road development into the landscape it is proposed to plant copses or groups of appropriate tree species along the route in these areas. Species to be included are: Alder (*Alnus glutinosa*), Birch (*Betula pendula*) and Willow (*Salix aurita, Salix purpurea, Salix caprea, Salix cinerea*). These areas are to be planted in naturalistic groups and integrated with either wildflower seeding, hay-strewing or bare-earth recolonization techniques. • **Attenuation Ponds:** Drainage attenuation ponds or basins will be designed as passively-safe so that visually intrusive secure fencing is not necessary. Tree and shrub planting to create naturalistic barriers and for visual amenity or screening where needed around the ponds will include the following species: Alder (*Alnus glutinosa*), Birch (*Betula pendula*) and Willow (*Salix aurita, Salix purpurea, Salix caprea, Salix cinerea*), Hawthorn (*Crataegus monogyna*) and Blackthorn (*Prunus spinosa*). Where space is available, areas of grass should be allowed to develop adjacent to ponds as suitable foraging habitat for Barn Owl (see Biodiversity Chapter 7) with clumps of trees of the above species. Within the ponds, establishment of native aquatic or marginal

No.	Description
	plant species will be encouraged through management. See Figures 11.24 to 11.26 for examples of the layout required at all attenuation ponds. • **Scrub Planting:** Selected areas are to be established with scrub in order to integrate the proposed road development into the landscape, provide variety, stabilise embankments, and for ecological reasons. Areas planted with native scrub species will include species such as: Bramble (*Rubus* spp.), Hawthorn (Crataegus monogyna), Blackthorn (*Prunus spinosa*), Hazel (*Corylus avellana*), Holly (*Ilex aquifolium*), Spindle (*Euonymus europaeus*), Willow (*Salix caprea*), Buckthorn (*Rhamnus frangula*) and Dogwood (*Cornus sanguinea*). See further details of Barn Owl mitigation measures below. • **Grass:** Grass verges immediately alongside the carriageway (max 3m width), slip roads, roundabouts and side roads are to be established with a low maintenance grass seed mix, consisting predominantly of indigenous fescue grasses. • **Wild Grass / Flower Meadow:** Where screening and scrub planting is not a requirement, semi-natural grasslands are to be allowed to establish using bare-earth regeneration techniques or hay-strewing (gathering seed from appropriate areas adjacent to the scheme). Such areas will be monitored by the project ecologist. • **Stabilising Grass Seeding:** Drains, ponds, basins and swales are to be established using a specific grass seed mix of predominately fescue grasses to stabilise the slopes, but that will not impede the flow of water once established. • **Rock Faces:** In cut slopes where natural bedrock is present and can be left exposed, this will be retained as a landscape feature on the route. No landscape works will be carried out, unless there is a need to stabilise or modify certain areas for safety. Hydroseeding with native seed could be considered in such a scenario. An important aspect of the proposed landscape planting measures is to enhance the effectiveness of the Biodiversity mitigation measures, such as mammal underpasses or culverts for use by bats as described in Chapter 7 Biodiversity. Native hedge and shrub planting will be included at the entrances to underpasses or culverts to ensure that they can be detected by target species and used by them.
11.7	Mitigation measures for Barn Owl are required across the proposed road development (see Chapter 7 Biodiversity, and Appendix 7.3 Recommendations for mitigation to minimise the impacts of the proposed Foynes to Limerick Road on Barn Owls (Tyto alba)), and will be integrated into the general landscape treatment as follows to optimise conditions favourable to Barn Owl conservation: • Within 3m of the edge of the hard shoulder, the grass should be maintained to a height not exceeding 100mm, or replaced with gravel if appropriate (noting that gravel would generally be considered inappropriate unless there are issues for access for maintenance, or aesthetic considerations at feature areas, such as roundabouts or entrances to towns); • Between 3-5m from the hard shoulder a 2m-wide belt of shrubs and trees that will reach a minimum of 4m in height should be planted to divert the flight of the owls over the height of the Heavy Goods Vehicles. This should be varied in composition appropriate to the landscape adjacent and may consist of a mix of fast-growing species such as Alder (*Alnus glutinosa* - 5% of mix), Birch (*Betula pendula* - 5%), Whitebeam (*Sorbus aria* - 5%), Mountain Ash (*Sorbus aucuparia* - 5%), Hazel (*Corylus avellana* - 40%) and Willow (*Salix aurita, Salix caprea, Salix cinerea* - 40%) and understorey species such as Bramble (*Rubus spp.* - 60% of understorey mix),

No.	Description
	Hawthorn (*Crataegus monogyna* - 10%), Holly (*Ilex aquifolium* - 10%) and Blackthorn (*Prunus spinosa* - 20%). *It should be noted that this belt of scrub and trees proposed is within the 'Clear Zone' defined by TII technical guidance. For new plantings or existing trees within the Clear Zone, the maximum allowable diameter shall not exceed 100mm or a girth of 314mm (when measured at 0.3m above the ground). For new plantings, the design shall consider the mature size of the tree. The grouping of trees with trunk diameters ≤ 100mm and/or girths ≤ 314mm together may constitute a hazard due to the cumulative impact of the trees on an errant vehicle for a spacing of less than 1500mm. (Reference: The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridges Transport Infrastructure Ireland [TII Ref: DN-REQ-03034 - May 2019]). Thus, to achieve the desired mitigation for Barn Owls, the trees should be planted as multi-stem or bush forms in these locations, as they will reach the required height, but will not breach the 314mm girth limit (when measured at 0.3m above the ground). Such trees should be planted at 3.5-4m height from the outset, in order to ensure that the required protection is in place.;* • In areas of cut, the belt of shrubs and trees should be extended up the sides of the cut slopes so that the owls flight path is diverted to the required extent. • Behind the shrub and tree belt, topsoil should be a minimum of 200mm deep to allow for tall grass ("rank grassland") to develop which is the preferred habitat of the Barn Owl's rodent prey, providing suitable and safe habitat areas. At attenuation ponds, areas are to be left free of planting with rank grassland as suitable foraging habitat, set back from the road and in combination with the measures outlined above.
11.8	At 32 no. locations along the proposed road development, specific landscape planting measures are proposed for the mitigation of impacts to Bats (see Chapter 7 Biodiversity for further details). The planting is proposed where hedgerows / scrub / treelines will be removed or bisected as a result of the construction of the proposed road development. The purpose of the planting is to provide alternative flight paths or reinstate such features for commuting bats. This planting will comprise of a mix of native species, of the same species removed wherever possible. Such planting should be of a size directed by the project ecologist in order to ensure continuity of cover. Nominal size expected for such planting is 3.5-4m in height for trees and 1.5-2m for hedgerow / shrub plants.
11.9	Where planting for landscape and visual mitigation and biodiversity mitigation are proposed within the same areas, this will be resolved by selection of species that are suited to both purposes. It is anticipated that this will not compromise either mitigation in any substantive way. With regard to biodiversity, native plants with value for pollinators and other insects will be included in planting design specifications. In addition to structural and functional planting (all native species which are flowering and fruiting) listed above, the plant mixes will include small quantities of Honeysuckle (*Lonicera periclymenum*), native Rose species (*Rosa canina, Rosa pimpinellifolia,* etc.) and herb layer flowering plants. Chapter 7 (Biodiversity) noted very little presence of invasive species along the proposed road development, with some plants recorded at the River Deel, and at the Blossomhill Stream in Ballingarrane. Where invasive plants are discovered within the development boundary, measures to eradicate or prevent their further spread will be specified in the landscape works. Measures to control the spread of Invasive Species are outlined in the Environmental Operating Plan, see Appendix 4.1 of this EIAR.
11.10	In the construction process, the excavation and grading of all areas will be carried out in a sensitive manner to marry in the new formations with the existing landscape. Sharp ridges or overly steep embankments will be avoided where possible. In general, embankments

No.	Description
	are designed with 1:3 slopes which are flatter than typical road embankments, resulting in a more sympathetic fit with the existing landscape.
11.11	Care will be taken when clearing existing drains or streams to avoid damage to existing vegetation and the general character of these landscape features.
11.12	With regard to the setting out and arrangement of planting this will be carried out using naturalistic planting arrangements associated with those already found in the landscape and in order to create a mosaic of habitats. For example, in wet woodland areas this may involve planting clusters of plants at wider randomised spacings. Where screening is required and a general covering of plants to integrate the proposed road development, close planting densities will be followed at 1.5m spacings. Woodland mixes will be planted at varying widths to ensure the linearity of the road is not emphasised and variety is maximised. Planting guidelines laid down by TII (*A* Guide *to Landscape Treatments for National Road Schemes in Ireland* – Transport Infrastructure Ireland [TII Ref: GE-ENV-01102; February 2006]) are to be referred to in this regard.
11.13	Unless otherwise stated, road verge or bank planting will consist of "bare root transplants", "whips" and "feathered trees" which are more natural in form and, due to their smaller stock size at time of planting, will adapt more easily to the disturbed ground and exposed site conditions. Larger sized stock may be required to achieve specific objectives for ecological mitigation, as already noted, and some Specific Landscape Measures (see section 11.5.2) may also require larger stock.
11.14	All trees, shrubs, transplants, hedging material and ground cover planting shall be guaranteed for a minimum three year period (post planting) against death, deformation, die-back, or disease other than that caused by malicious damage. Maintenance to establishment is to be included in all planting and planting works and maintenance to be carried out by a fully qualified and experienced Landscape Contractor. *Note that all mitigation requirements proposed in the EIAR must be established, monitored and maintained into perpetuity.*
11.15	The contractor will prepare a landscape maintenance plan after the implementation of the proposed road development. All landscape works will be in an establishment phase for the initial three years. This will include (a) Weed and litter control including monitoring particularly during the early growing seasons of the landscape maintenance contract, (b) Grass cutting and replacement of failed plants and (c) compliance with all health and safety standards in particular with regard to maintenance works during the operation phase of the road.
11.16	Redundant sections of the disused road network can be reinstated as grassland, scrub or woodland where appropriate.
11.17	In certain areas, where there are views to monuments or other landscape features in the adjacent landscape and where screening is not required, the embankments will be maintained free of planting to allow views into the landscape and enhance the tourism and scenic potential of the new road. This is included at Milltown Cashel (Ch24+000 west), in particular, which is a particularly fine upstanding monument and there are no visual receptors in the vicinity.
Specific Mitigation Measures	
11.18	**SLM 0 HGV Service Area (Chainage 0+000)** Building and parking area to be screened with native woodland. Existing trees to be retained where possible. Arborist to be engaged to develop a plan for the safe retention of the tree group adjacent to the site entrance and trees along the rail line during construction. Plan for service area to include native shrub and tree planting to the islands and fringes, with non-native evergreen groundcover planting where necessary for maintenance purposes. The large areas surrounding and on the boundaries should be planted with selected native trees and hedgerows, allowing for open grassland where possible. Barn Owl mitigation measures (see Section 11.5.1) incorporated along edges of vehicular routes. Proposed boundary ditches / streams and attenuation pond are to be integrated into design.

No.	Description
11.19	**SLM 1 Foynes Roundabout (Chainage 1+000)** This landscape area created by the realigned roadways offers an opportunity for a landscape or artistic feature at the entrance to Foynes to create a sense of place and aid in wayfinding. Such a feature could reference the port, and/or heritage of the town. The stone walls removed as a result of the proposed development will be replaced with stone walls to match the existing at the edges of the proposed road development in this area. Noise barriers to be screened with hedgerow or shrub species. Barn Owl mitigation planting (see Section 11.5.1) is to be incorporated into the landscape design within this SLM. Screen Planting will be provided within the SLM to further screen views from adjacent properties.
11.20	**SLM 2 Over-bridge, Sroolane North / Robertstown (Chainage 2+250 to 3+000)** The provision of appropriate screen planting along the embankments of the proposed road development to provide a balance between screening, aesthetics and allowing light into the properties. Special design consideration given to integrating the bridge structure with the landscape in terms of finishes and landscape planting. Noise barriers to be screened with hedgerow or shrub species. Barn Owl mitigation planting (see Section 11.5.1) to be incorporated into landscape proposals along the embankments.
11.21	**SLM 3 Ballyclogh Roundabout & Local Roads (Chainage 10+000 & environs)** Ballyclogh Roundabout is set in a rural location and will be treated sensitively to integrate the proposed road and structures into the landscape. Existing trees and vegetation are to be protected where possible by minimising working space and erecting protective fencing. Riparian vegetation along existing rivers in particular are marked for habitat protection in the Biodiversity Mitigation Drawings and will be fenced off prior to construction. Appropriate native planting will be provided to integrate the roundabout and embankments into the landscape. Parkland trees as compensation for trees removed from surrounding areas will also be included. Design consideration has been given to the context and surrounding habitats, which include fen and streams, taking into account the Project Ecologist's recommendations. Extensive planting is proposed for Biodiversity mitigation (see Chapter 7) and Barn Owl mitigation is proposed around these areas to provide suitable foraging areas which are segregated from the traffic by shrub and tree lines.
11.22	**SLM 4 Askeaton Roundabout & Adjacent Roads (Chainage 11+900 & environs)** This landscape area created by the realigned roadways, offers an opportunity for a landscape or artistic feature at the entrance to Askeaton to create a sense of place and aid in wayfinding. Such a feature could reference the heritage of the town. Planting, including parkland trees, will be provided in landscape spaces and the decommissioned area of N69 road to compensate for removal of trees and shrubs along existing N69 and hedgerows / treelines in fields to north. This planting will also provide screening for the junction from adjacent properties and lands. Biodiversity mitigation measures will be incorporated in this SLM including Barn Owl mitigation planting as included along the majority of the proposed road development (see Section 11.5.1).
11.23	**SLM 5 Ballycullen / Ballyclogh Bridge (Chainage 20+425 to 20+800)** Compensate for hedgerow/trees removed by planting similar species mix along embankments. Planting to screen road from receptor C20-002. Biodiversity mitigation measures to be incorporated including Barn Owl mitigation planting (see Section 11.5.1). Existing Pill Box to be protected in accordance with recommendations in Chapter 14 Architectural, Archaeological and Cultural Heritage and surrounding area to be kept clear of planting.
11.24	**SLM 6 Ballycullen (Chainage 20+870 to 21+160)** Appropriate wetland planting of Willow and Birch, and sensitive treatment of the fen habitat at this location. Biodiversity mitigation measures to be incorporated including Barn Owl mitigation planting (see Section 11.5.1).
11.25	**SLM 7 L-1236 Station Road over Mainline (Chainage 22+450 to 22+575)**

No.	Description
	The provision of screen planting to screen the bridge structure from visual receptors to north and south and to integrate the proposed road development into landscape. Redundant road sections also to be planted with hedgerow and landscape planting. Replacement planting will be provided at entrances to properties where they are impacted / realigned, similar to the existing landscaping.
11.26	**SLM 8 Mainline over River Deel (Chainage 23+800 to 24+325)** Appropriate riparian planting will be provided taking into account the Project Ecologist's recommendations for barn owl mitigation and bat connectivity measures. The landscape scheme in this area allows for open views to Milltown Cashel from the bridge.
11.27	**SLM 9 Bullaun (Chainage 24+325 to 25+680)** Existing trees and vegetation are to be protected where possible by minimising working space and erecting protective fencing, in accordance with a Tree Management Plan to be prepared by the Arborist. Appropriate riparian and wetland planting along stream / drain channels will be provided, taking into account the Project Ecologist's recommendations for bat and barn owl mitigation in Chapter 7 and responding to the varied character of this landscape area. Screening is required to property C24-001 at Ch24+780. Measures to include compensatory tree planting for any parkland or woodland trees removed. Noise barriers to be screened with planting and integrated to improve impermeable visual screening.
11.28	**SLM 10 Mainline over L-1222 and R-518 roads at Graigeen (Ch26+540 to 27+350)** The provision of appropriate planting to screen the bridge structure from visual receptors and integrate into landscape in terms of finishes and landscape planting. Planting scheme will be cognisant of avoiding light restriction into nearby properties. Planting will also be appropriate to potential wetland condition in part of area adjacent to attenuation pond. Noise barriers to be screened with hedgerow or shrub species. Biodiversity mitigation measures to be incorporated including Barn Owl mitigation planting (see Section 11.5.1). Climbing plants will be provided on the bridge to mitigate the visual impacts associated with the structure.
11.29	**SLM 11 Great Southern Trail Greenway (Chainage 27+500 to 28+300)** The proposed road development includes for the accommodation of a future greenway along the abandoned railway line which is currently undeveloped between Rathkeale and Ballingarrane. The underpass at Ch28+250 is designed to be a wide and comfortable space. Consideration has been given to retention of the historic railway context in the design, through the preservation of the old railway bridge over the Doohyle Stream within a wide-span underpass below the proposed road development. Replacement boundary hedges will be planted along the diverted greenway to mimic the existing arrangement of a green corridor and Biodiversity mitigation measures are also integrated (See Chapter 7 & Appendix 7.1 for details) including those for Barn Owl. Noise barriers to be screened with hedgerow or shrub species.
11.30	**SLM 12 Rathkeale Junction (Chainage 50+000 & environs)** The landscape areas created by the realigned roadways offer an opportunity for a landscape or artistic feature at the entrance to Rathkeale to create a sense of place and aid in wayfinding. Such a feature could reference the heritage of the town. Screen planting for the cemetery and other visual receptors is proposed. The majority of the current mature planting along the existing Rathkeale Bypass will be maintained and protected. Compensatory planting for all trees removed is to be instated in the SLM area, which should be of a similar low canopy native woodland type plantation. Noise barriers to be screened with hedgerow or shrub species. Barn Owl protection strategy is also to be implemented around the junction.
11.31	**SLM 13 Smithfield Demesne (Chainage 55+100 to 55+400)** The proposed road development passes close to the northwest corner of the demesne. There are 3 mature trees on the corner of this estate, which are closest to the proposed works. Specific measures will be developed by an Arborist to safeguard these trees and

No.	Description
	all trees on the boundary with Smithfield House demesne south of the proposed attenuation pond. Drainage routes should be located to avoid the existing trees and root protection areas defined by the arborist.
11.32	**SLM 14 Croagh Junction (Chainage 55+170 to 56+010, link road and environs)** The landscape areas created by the grade separated junction and link road offer an opportunity for a landscape or artistic feature at the entrance to Croagh to create a sense of place and aid in wayfinding. The link road will be planted according to a specific landscape scheme taking into account the local landscape character and historic designed demesne landscapes nearby. Parkland trees (see section 11.5.1) and hedgerows / treelines (Hedgerow Type 2 – see 11.5.1) are proposed to reflect the character of the nearby demesne landscapes (note that no demesne is directly affected here) and to compensate for those removed in the construction of the proposed junction. Barn Owl mitigation planting (see Section 11.5.1) is to be incorporated into landscape scheme also.
11.33	**SLM 15 Motorway over L-1422 Blackabbey Road and Greanagh River (Chainage 58+750 to 59+800)** The provision of appropriate planting to screen the bridge structure from visual receptors on both sides of proposed road development and integrate into landscape. Riparian planting (see section 11.5.1) to river area will be provided taking into account the Project Ecologist's recommendations, and all other Biodiversity requirements, including mitigation measures for Barn Owl (see chapter 7 and section 11.5.1). Noise barriers to be screened with hedgerow or shrub species.
11.34	**SLM 16 L-1423 Station Road over Mainline (Chainage 60+325)** The realigned local road will be planted with boundary hedges and treated to acknowledge Curraghbridge House demesne to the north. Redundant sections of road to be removed and planted with screen woodland and scrub planting for biodiversity mitigation. Noise barriers to be screened with hedgerow or shrub species.
11.35	**SLM 17 Mainline over River Maigue (Chainage 60+525 to 61+200)** This is an extensive area around the River Maigue, allowing for appropriate riparian planting, taking into account the Project Ecologist's recommendations. Evergreen planting will be specified around the existing railway embankments at Ardshanbally in accordance with Irish Rail requirements. Screen planting to mitigate the visual impacts of the road will, where possible, be in keeping with the riparian character of this location and parkland trees should be included in hedgerows. Noise barriers to be screened with hedgerow or shrub species.
11.36	**SLM 18 Adare Junction (Chainage 61+225 to 62+600) Link Road and Environs** The roundabouts and surrounding areas created by the grade-separated junction and link road offer an opportunity for a landscape or artistic feature at the entrance to Adare to create a sense of place and aid in wayfinding. The entrance road will be planted according to a site-specific landscape scheme taking into account the local landscape character of the heritage town. In particular, the view of Adare Manor demesne and boundary wall from the link road is important. For the purposes of assessment, the SLM will consist of – at a minimum – shrub and tree planting to the landscape areas along the entrance and the stone wall which will be removed will be replaced with walling of the same design and materials in the vicinity of the roundabout. Wetland or riparian plant species to be incorporated around attenuation ponds as necessary. Barn Owl mitigation planting (see Section 11.5.1) incorporated into landscape scheme. Noise barriers to be screened with hedgerow or shrub species.
11.37	**SLM 19 Tie-In to Existing N21 (Chainage 65+250 to 65+550)** Landscape measures to tie into the current landscape treatment of trees and grassing along the existing N21. Along the remainder of the proposed road development, the existing planting and treatments will be maintained as per the current situation, with the addition of Barn Owl mitigation measures (see section 11.5.1).

No.	Description
	Where boundaries or entrance routes to existing dwellings or private properties are altered as a result of the proposed road development, a specific scheme of mitigation will be agreed with the landowners at the appropriate time. For the purposes of this assessment, the minimum level of mitigation will be taken to be the planting / building of similar boundaries to those existing. For example, where the proposed road development results in the realignment of a wall and removal of hedgerows and trees, these are assumed to be reinstated along the new boundary and entrance route to the same standard as the existing landscape.

Summary of Mitigation Measures

11.38 **Summary of Proposed Remedial or Reductive Measures on Landscape Impacts**

Road Section	Proposed Remedial or Reductive Measures
A Foynes to Ballyclogh Ch. 1+000 to Ch. 7+320 6.3km	SLM 0 / 1 / 2 / 3; Screening of HGV Service area with native woodland; Hedgerow reinstatement along road development boundary (c.12km); Biodiversity mitigation planting; Parkland tree planting where possible within development boundary; Reinstatement of stone wall at Foynes roundabout.
B Ballyclogh to Askeaton Ch. 10+000 to Ch. 11+940 1.9km	SLM 3 / 4; Hedgerow reinstatement along development boundary (c.4km); Biodiversity mitigation planting; Parkland tree planting where possible within development boundary.
C Ballyclogh to Rathkeale Ch. 20+000 to Ch. 29+250 9.3km	SLM 3 / 5 / 6 / 7 / 8 / 9 / 10 / 11 / 12; Hedgerow reinstatement along development boundary (c.18km); Biodiversity mitigation planting; Parkland tree planting where possible within development boundary.
D Rathkeale to Attyflin Ch. 50+000 to Ch. 67+500 17.5km	SLM 12 / 13 / 14 / 15 / 16 / 17 / 18 / 19; Hedgerow reinstatement along Scheme boundary (c.35km); Biodiversity mitigation planting; Parkland tree planting where possible within development boundary; Reinstatement of stone wall.

11.39 **Summary of Proposed Mitigation on Visual Impacts**

Ref. Montage No.	Building Type & Location	Proposed Mitigation (see Section 11.5)
A00-001 to 007	7 dwellings, Dernish Avenue	SLM 0 and SLM1
A00-008 to 013	6 dwellings, Dernish Avenue	SLM 0 and SLM1
A00-014 to 017	4 dwellings, local road	NA
A00-018	Dwelling, N69	SLM1
A00- 019/ 021	2 dwellings, N69	SLM1
A00-020	Dwelling, N69	NA
A01-001	Dwelling, N69	SLM1; Screen Planting
A01-002/ 003	2 dwellings, N69	SLM1; Screen Planting
A01-004	Dwelling	NA
A01-006/ 007/ 008	3 dwellings, N69	NA
A01-PV1 *VP1*	Public View	SLM2, Screen Planting and other general measures as outlined across the development

No.	Description	
A02-001	Dwelling	Screen Planting (Shrub 5m height)
A02-004	Dwelling, private road	Hedge on CPO line
A02-005-006	2 dwellings, local road	Screen Planting (Shrub 5m height)
A02-007 *VP3*	Dwelling, N69	SLM2
A02-007A & 007B	2 dwellings, N69	SLM2
A02-008	Dwelling	SLM2
A02-017 & 018	2 dwellings	SLM2
A02-PV1	Roberts-town Church ruin and Graveyard	SLM2
A02-009 *VP4*	Dwelling, N69	SLM2
A02-010	St. Roberts Church	SLM2
A02-011 / 012	2 Dwellings, L-1222	SLM2
A02-013	Dwelling, L-1222	SLM2
A02-014	Dwelling, L-1222	SLM2, Screen Planting
A02-015 / 016	2 dwellings, L-1222	SLM2, Screen Planting
A03-001	Dwelling, L-1222	SLM2, Screen Planting
A03-003	Dwelling, L-1222	SLM2, Screen Planting
A03-004/ 005	2 dwellings, N69	SLM2, Screen Planting
A03-006	Dwelling, L-6068	Hedge on CPO line, Screen Planting
A03-007	Dwelling, L-6068	Hedge on CPO line, Screen Planting
A04-001	Dwelling, N69	Hedge on CPO line
A04-002	Dwelling, accessed from N69	Hedge on CPO line
A05-001 & Adj. Properties	9 dwellings, L-6062	Hedge on CPO line
A05-005	Dwelling, off L-6062	Hedge on CPO line
A05-008 A06-004/ 006	3 dwellings; L-6062	Hedge on CPO line, Screen planting for A06-006
A05-007, A06-001/ 002/ 003/ 005	5 dwellings, L-6062	Hedge on CPO line
A06-007	Dwelling, L-6062	Hedge on CPO line, Screen Planting
A06-008	Dwelling, L-6062	Screen Planting
A07-001	Dwelling, L-6062	SLM 3
B10-001/ 002/ 003	3 dwellings, L-1220	SLM 3, Screen Planting
B10-004	Dwelling, L-1221	Hedge on CPO line, Screen Planting
B10-005 & Adj. Properties	12 Dwellings, L-1221	Hedge on CPO line
B11-001	Dwelling on local road off N69	Hedge on CPO line
B11-001A & 001B	2 Dwellings on local road off N69	Hedge on CPO line
B11-002 to 005	4 x Dwellings on local road off N69	SLM 4
B11-006	Dwelling, N69	SLM 4

No.	Description	
B11-007	Dwelling, N69	SLM 4
B11-008 & 009	2 Dwellings, N69	SLM 4, Screen Planting
B11-010 and 011, B12-003 and 004 and B12-007 to 016	14 Dwellings, R-518	SLM 4
B12-001	Dwelling, N69	SLM 4
B12-005 and B12-006	2 Dwellings, R-518	SLM 4
B12-017 to 020	4 Dwellings	SLM 4
B12-021	Dwelling	
B12-022	Dwelling	SLM 4
B12-023 to 025	3 Dwellings, N69	SLM 4
C20-001 *VP5*	Dwelling, L-1221	SLM 3, Screen Planting
C20-002 *VP5*	Dwelling, Ballycullen House, L-1221	SLM 3, Screen Planting
C20-002A	Dwelling	
C20-003	Dwelling, L-1220	Screen Planting
C20-004/ 005/ 006	3 Dwellings, L-1220	Screen Planting
C22-001	Dwelling, L-1236	SLM 7
C22-003 to 014	12 Dwellings, L-1236	SLM 7
C22-014A	Site with Planning Permission for Dwelling, L-1236	SLM 7, Screen Planting
C22-015 to 018	4 Dwellings, L-1236	SLM 7
C22-019	Dwelling, L-1236	Screen Planting
C22-020	Dwelling, L-1236	Screen Planting
C22-021/ 022	2 Dwellings, L-1236	Screen Planting
C23-001	Dwelling off L-1236	Screen Planting
C24-001	Dwelling, private road off L-1222	SLM 9
C25-002/ 003	2 Dwellings, private road off L-1222	Screen Planting
C26-001/ 002	2 Dwellings, off R518	Hedge on CPO line
C26-003	Dwelling, R518	Screen Planting
C26-004	Dwelling, R518	Screen Planting
C26-005 *VP8*	Dwelling, L-1222	SLM 10
C26-006/ 007	2 Dwellings, L-6021	SLM 10
C26-008/ 009	2 Dwellings, R-518	SLM 10
C26-008A	Dwelling, R-518	SLM 10
C27-001/002	2 Dwellings, R-518	
C27-003 *VP9*	Dwelling, R-518	SLM 10
C27-004/ 005/ 006	3 Dwellings, R-518	SLM 10

No.	Description	
C27-007 to 017	11 Dwellings, R-518	Screen Planting
C27-PV1	Public greenway	SLM 11
C27-019 *VP10*	Dwelling, L-6132	Screen Planting; Protect existing trees
C27-020	Dwelling, L-6132	
C27-021/ 028 *VP11*	2 Dwellings, L-6132	SLM 11
C27-027	Dwelling, L-6132	
C27-026	Dwelling, R-518	Screen planting
C27-022 to 025	4 Dwellings, L-6050/R-518	Screen planting
C27-031	Dwelling, L-6132	SLM 11
C27-029	Dwelling, L-6132	SLM 11
C27-030/ 032	2 Dwellings, L-6132	SLM 11
C27-033 to 035	3 Dwellings, R-518	Screen planting
C27-036 & 037	2 Dwellings, R-518	Screen planting
C28- 002/ 003 and Adj. Properties	4 Dwellings, L-1203	SLM 11
C28-004	Dwelling, off R518	SLM 11 Screen Planting
C28-005	Dwelling, L-1203	Screen Planting
C29-001/ 002/ 003	3 Dwellings, L-1203	SLM 12
D50-PV1 *VP13*	Rathkeale Cemetery	SLM 12
D49-018 to 025 *VP12*	8 Dwellings, Rathkeale	SLM 12
D49-042 to 044 *VP12*	3 Dwellings, Rathkeale	SLM 12
D49-050/ 051/ 059 *VP12*	3 Dwellings, Rathkeale	SLM 12
D49- 049/ 052 / 060 to 063 *VP12*	6 Dwellings, Rathkeale	SLM 12
D50-001 to 003 *VP12*	3 Dwellings, Rathkeale	SLM 12
D50-004 to 012 *VP12*	9 Dwellings, Rathkeale	SLM 12
D50-013	Dwelling, N21	SLM 12, Screen planting
D51-001	Dwelling, N21	Screen planting [to restore similar level of visual enclosure]
D51-002	Dwelling, N21	Screen planting
D51-003	Dwelling, L8027	Screen planting
D51-004/ 005	2 Dwellings, L6023	Screen planting
D51-006/ 007	2 Dwellings, L-8027	Screen planting
D51-008 to 010	3 Dwellings, L-8027 / L-52309	Screen planting
D52-001	Dwelling, L-8027	Screen planting
D52-002/ 004	2 Dwellings, L-8027	Screen planting
D52-003	Dwelling, L-8027/ L-52309	Screen planting
D54-001	Dwelling, off L-1421	Screen planting
D54-011	Dwelling, L-1421	Screen planting

No.	Description	
D54-007 to 010	4 Dwellings, L-1421	Screen planting
D54-002 to 006	5 Dwellings, L-1421	Screen planting
D54-012 & 012A	2no. Dwellings, L-1421	Screen planting
D54-013 to 015	3 Dwellings, off and on L-1421	Screen planting
D55-014	Dwelling, Smithfield House	SLM 13, SLM 14, Screen planting
D55-002	Dwelling, N21	SLM 14,
D55-003 and 007	2 Dwellings, N21, Croagh	SLM 14
D55-004, 005, 006	3 Dwellings, N21, Croagh	SLM 14
D55-008	1 Dwelling, N21, Croagh	SLM 14
D55-013	Dwelling, L-8026	Screen planting, SLM 14
D55-015	Dwelling off L-8026	SLM 14
D56-001 to 003	3 Dwellings, L-8026	Screen planting
D56-005 *VP19*	Dwelling, L-8026	Screen planting
D56-006 to 008	3 Dwellings, L-8026	Screen planting
D56-009	Dwelling, L-8026	Screen planting
D56-010 / 014/ 015	3 Dwellings, L-8026	Screen planting
D56-011	Dwelling, L-8025	Screen planting
D56-012/ 012A	2 Dwellings L-8025	Screen planting
D56-013	Dwelling L-8025	Screen planting
D56-016	Dwelling L-8025	Screen Planting
D57-001	Dwelling off L-8025	Screen planting
D57-002-to 006	5 Dwellings L-8024	Screen planting
D57-007 *VP22*	Dwelling, L-8024	Screen planting
D57-008 *VP21*	Dwelling, L-8024	Screen planting
D57-009/ 009A/ 012	3 Dwellings, L-8024	Screen and wetland planting
D57-013	Dwelling, L-8024	Screen planting
D57-014 to 016	3 Dwellings, L-8024	Screen planting
D58-001/ 004/ 005	3 Dwellings, L-1422	SLM 15, Screen planting
D58-002/ 003	2 Dwellings, L-1422	SLM 15, Screen planting
D59-PV1	Public view, N21	NA
D59-001	Dwelling, L-1422	SLM 15
D59-002 *VP24*	Dwelling, L-1422	SLM 15
D59-004/ 006	2 Dwellings, L-1422	SLM 15
D59-005/ 007/ 008	3 Dwellings, L-1422	SLM 15
D59-009/ 010/ 011	3 Dwellings, L-14221	SLM 15
D59-012/ D60-001	2 Dwellings, L-1423	SLM 15 & SLM 16
D60-005	Dwellings, L-1423	SLM 16
D60-003	Dwelling, L-1423	SLM 16, Screen planting
D60-004	Dwelling, L-1423	SLM 16, Screen planting

No.	Description	
D60-007 to 010 and 012-013 *VP29*	6 Dwellings, L-1423	SLM 17
D60-011 *VP25*	Dwelling, off L-1423	SLM 16 & 17.
D61-PV1 *VP27, 28, 29*	Public view, N21	SLM 18
D61-002/002A	Dwelling, L-21016	
D61-003 *VP26*	Dwelling, L-21016	SLM 18, Screen Planting
D61-004 to 009 *VP26*	6 Dwellings, L-21016	SLM 18, Screen planting
D61-010, 011, 013, and 014	4 Dwellings, L-21016, N21	SLM 18, Screen planting
D61-015	Dwelling, N21	SLM 18, Screen planting
D62-003	Dwelling L-1424	
D62-004/ 006/006A *VP30*	3 Dwellings, L-1424	SLM18/ Screen planting
D62-005	Dwelling, L-1424	SLM18/ Screen planting
D62-007 to 011; 016 to 017	7 Dwellings, L-1424	Screen planting
D62-012 / 015	2 Dwellings, N21	Screen planting
D62-018 to 024 / D63-001	8 Dwellings, L-1424	Screen planting
D63-002/ 003 / 005/ 007	4 Dwellings, L-1427	Screen planting
D63-004	Dwelling, N21	Screen planting
D63-006 / D64-001 to 012	13 Dwellings	Screen planting

19.10 Mitigation and Monitoring Measures for Noise and Vibration

Table 19.9 Mitigation and Monitoring Measures for Noise and Vibration

No.	Description
Construction Phase Mitigation for Noise Impact	
12.1	The construction contract documents will clearly specify the construction noise criteria included in this chapter which the construction works must operate within. The contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of *BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise* and *BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites - Part 2: Vibration* and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001. These measures will ensure that: • The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations; • All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract; • Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools will be fitted with suitable silencers; • Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use; and • Any plant, such as generators or pumps that is required to operate before 07:00hrs or after 19:00hrs will be surrounded by an acoustic enclosure or portable screen. Specific control measures relating to construction activities undertaken by the contractor will be set out within the construction noise and vibration management plan to be prepared in advance of the works and updated as the construction phase progresses. Noise control measures that will be considered include the selection of quiet plant, enclosures and screens around noise sources, limiting the hours of work and noise monitoring. The contractor will be required to conduct construction noise predictions prior to works taking place and put in place the most appropriate noise control measures depending on the level of noise reduction required at any one location.
12.2	**Selection of Quiet Construction Plant** The potential for any item of plant to generate noise will be assessed prior to the item being brought onto the site. The least noisy item of plant will be selected wherever possible. Should a particular item of plant already on the site be found to generate high noise levels, the first action will be to identify whether or not said item can be replaced with a quieter alternative. Where this is not possible, noise control at source or pathway screening is then required. For static plant such as compressors and generators used at work areas such as construction compounds etc., the units will be supplied with manufacturers' proprietary acoustic enclosures where possible. The contractor will evaluate the choice of piling, excavation, breaking or other working method taking into account various ground conditions and site constraints. Where possible, where alternative lower noise generating equipment that would economically achieve, in the given ground conditions, equivalent structural/ excavation/ breaking results, these will be selected to minimise potential disturbance. The decision regarding the type of pile, excavation technique, rock breaking, crushing etc. to be used on a site will normally be governed by other engineering, and environmental constraints. In these instances, it may not be possible for technical reasons to replace a

No.	Description
	noisy process by a quieter alternative (e.g. rotary bored piling over driven piles). Even if it is possible, the adoption of a quieter method may prolong the overall process (e.g. rock breaking versus blasting); the net result being that the overall disturbance to the community will not necessarily be reduced.
12.3	**Construction Noise Control at Source** If replacing a noisy item of plant is not a viable or practical option, consideration will be given to noise control "at source". This refers to the modification of an item of plant, or the application of improved sound reduction methods in consultation with the supplier or the best practice use of equipment and materials handling to reduce noise. In practice, a balance may need to be struck between the use of all available techniques and the resulting costs of doing so. It is therefore proposed to adopt the concept of "*Best Available Techniques"* as defined in EC Directive 210/75/EU. In this context *"best"* means *"the most effective in achieving a high general level of protection of the environment as a whole"*. The expression *"Best available techniques"* means *"means the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and, where that is not practicable, to reduce emissions and the impact on the environment as a whole".* The term *"techniques"* includes *"both the technology used and the way in which the installation is designed, built, managed, maintained, operated and decommissioned"*. Thus, the concept of Best Available Techniques requires a degree of balance between the attainment of environmental benefits and the likely cost implications. Proposed techniques will also be evaluated in light of their potential effect on occupational health and safety. The following outline guidance relates to practical noise control at source techniques which relate to specific site considerations: • For mobile plant items such as cranes, dump trucks, excavators and loaders, the installation of an acoustic exhaust and/or maintaining enclosure panels closed during operation can reduce noise levels by up to 10dB. Mobile plant will be switched off when not in use and not left idling; • For piling plant, noise reduction can be achieved by enclosing the driving system in an acoustic shroud. For steady continuous noise, such as that generated by diesel engines, it is possible to reduce the noise emitted by fitting a more effective exhaust silencer system or utilising an acoustic canopy to replace the normal engine cover; • For percussive tools such as pneumatic concrete breakers, rock drills and tools a number of noise control measures include fitting muffler or sound reducing equipment to the breaker 'tool' and ensuring any leaks in the air lines are sealed. Installation of localised screens around the breakers or drill bits when in operation in close proximity to noise sensitive boundaries are other suitable forms of noise reduction; • For concrete mixers, control measures will be employed during cleaning to ensure no impulsive hammering is undertaken at the mixer drum; and • For all materials handling, the contractor will ensure that best practice site noise control measures are implemented including ensuring that materials are not dropped from excessive heights and drop chutes/dump trucks are lined with resilient materials. This is an important consideration for site compounds where materials are loaded and unloaded. Site compounds in close proximity to noise sensitive areas will incorporate a strict noise control policy relating to materials handling;

No.	Description
	• Where compressors, generators and pumps are located in areas in close proximity to noise sensitive properties/ areas and have potential to exceed noise criterion, these will be surrounded by acoustic lagging or enclosed within acoustic enclosures providing air ventilation; • Resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can be controlled by fixing resilient materials in between the surfaces in contact; • Demountable enclosures can also be used to screen operatives using hand tools and may be moved around site as necessary; and, All items of plant will be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures.
12.4	**Noise Screening for Construction** The length of the screen should in practice be at least five times the height, however, if shorter sections are necessary then the ends of the screen will be wrapped around the source. BS 5228 *-1:2009+A1 2014* states that on level sites the screen should be placed as close as possible to either the source or the receiver. The construction of the barrier will be such that there are no gaps or openings at joints in the screen material. In most practical situations the effectiveness of the screen is limited by the sound transmission over the top of the barrier rather than the transmission through the barrier itself. In practice screens constructed of materials with a mass per unit of surface area greater than 10kg/m^2 will give adequate sound insulation performance. As an example, the use of a standard 2.4m high construction site hoarding will provide a sufficient level of noise screening once it is installed at a suitable position between the source and receiver. Annex B of *BS 5228-1:2009+A1:2014* (Figures B1, B2 and B3) provide typical details for temporary and mobile acoustic screens, sheds and enclosures that can be constructed on site from standard materials. In addition, careful planning of the site layout will also be considered. Within site compounds, the placement of site buildings such as offices and stores between the site and sensitive locations can provide a good level of noise screening. Similarly, in some instances materials such as topsoil or aggregate along the proposed road development can provide a degree of noise screening if placed between the source and the receiver.
12.5	**Hours of Work** Construction activity will mostly take place during daytime hours Monday to Friday and Saturdays. It will be necessary to work overtime (including weekends) at certain critical stages during the project to minimise public disturbance such as temporary road closures at night during installation of bridge beams above. Consideration will be given to the scheduling of activities in a manner that reflects the location and sensitivity of the site and the nature of neighbouring properties. Each potentially noisy event/activity will be considered on its individual merits and scheduled according to its noise level, proximity to sensitive locations and possible options for noise control within the contractors' construction management plan. In situations where a particularly noisy activity is scheduled e.g. activities identified in **Error! Reference source not found.**(rock breaking/ crushing / impact piling etc.) or other activities of similar noise level, the use of other on-site activities will be scheduled to ensure control of cumulative noise levels.
12.6	**Liaison with the Public during Construction** A designated noise liaison officer will be appointed to site during construction works. All noise complaints will be logged and followed up in a prompt fashion by the liaison officer.

No.	Description
12.7	**Noise Monitoring** During the construction phase noise monitoring will be undertaken at the nearest sensitive locations to ensure construction noise limits outlined in **Error! Reference source not found.** are not exceeded. Contractual obligations will ensure that the operations causing noise exceedance must be suspended until suitable protections are adopted to prevent any further exceedance. Noise monitoring will be conducted in accordance with the International Standard ISO 1996-2: 2017 *Acoustics – Description, measurement and assessment of environmental noise* Part 1 (2016) and Part 2 (2017). The selection of monitoring locations will be based on the nearest sensitive buildings to the working area which will progress along the length of the road construction.
Construction Phase Mitigation for Blasting and Air Overpressure	
12.8	In terms of blast design control, specific guidance will be obtained from the recommendations contained within *BS 5228-2:2009+A1:2014 Code of Practice for* Noise *and Vibration Control on Construction and Open Sites – Vibration* in relation to blasting operations in addition to experienced blast control techniques used by the contractor. These will include some or all of the following: • All blasting will be undertaken by professionally trained blast contractors; • Restriction of hours within which blasting can be conducted (09:00 –18:00hrs); • Trial blasts will be tested in less sensitive areas to assist in blast designs and identify potential zones of influence; • Explosive charges will be properly confined by a sufficient amount of stemming • Blasting contractors will ensure that the minimum amount of primer cord is used, and that no primer cord is located above ground; • Profiling will be carried out after each blast in order to ensure the geometry of the rock face can be established, enabling the optimum burden and spacing to be applied for subsequent blasts; • The design, execution and completion of any blasting within 150 metres of any existing structure will require special considerations. This will include the use of pre and post condition structural surveys by a competent structural engineer; • Ground vibration and air overpressure (AOP) will be recorded simultaneously for each blast at the most sensitive locations, depending on the works area being blasted; • When blasting moves into a new area, an initial low-level blast will be carried out (i.e. a low Maximum Instantaneous Charge (MIC)) and monitoring will be carried out simultaneously at a number of sensitive properties in different directions in order to generate specific scaled distance graphs; The scaled distance graphs will be used to determine the optimum MIC for subsequent blast areas in order to control vibration and AOP limits below the relevant limit values at the nearest sensitive buildings.
12.9	In line with best practice mitigation measures from vibration sources, good communication and public relations are a key factor in reducing any startle effects to residents. In this instance, a Public Communications Strategy will be implemented by the contractor prior to the commencement of any blast works. In such cases, the following mitigation measures are proposed: • Relevant nearby residents will be notified before any work and blasting starts (e.g. a minimum of 24-hour written notification); • The firing of blasts will be undertaken, where possible, at similar times to reduce the 'startle' effect; • Ongoing circulars will be issued informing people of the progress of the blasting works; • The implementation of an onsite documented complaints procedure will be maintained by the contractor; and

No.	Description
	• The use of independent monitoring will be undertaken by external bodies for verification of results. The Public Communications Strategy will be implemented by the contractor prior to the commencement of intrusive works in close proximity (i.e. <50m) to occupied buildings with potential for high vibration levels.
Construction Phase Mitigation for Vibration	
12.10	The TII Guidelines recommend that in order to ensure that there is no potential for vibration damage during construction, vibration from construction activities should be limited to the values set out in **Error! Reference source not found.**. On review of the likely vibration levels associated with construction activities, the construction of the proposed road development is not likely to give rise to vibration that is either significantly intrusive or capable of giving rise to cosmetic or structural damage to buildings. In the case of vibration levels giving rise to human discomfort, in order to minimise such impacts, the following measures will be implemented during the construction period: • A clear communication programme will be established to inform adjacent building occupants in advance of any potential intrusive works which may give rise to vibration levels likely to exceed perceptible levels. The nature and duration of the works will be clearly set out in all communication circulars; • Alternative less intensive working methods and/or plant items will be employed, where feasible; • Appropriate vibration isolation will be applied to plant, where feasible; and • Cut off trenches to isolate the vibration transmission path will be installed where required. In the case of impact piling or demolition works for instance, a reduction in the input energy per blow will be considered where required. Monitoring will be undertaken at identified sensitive buildings, where proposed works have the potential to be at or exceed the vibration limit values.
12.11	**Property Condition Surveys** Property condition surveys will be offered for all buildings within 150m of proposed blasting works along the proposed road development. Property condition surveys will also be carried out at buildings and structures considered appropriate relative to their proximity to the works. Such property condition surveys will be carried out by a Chartered Surveyor or Chartered Structural Engineer. Such property condition surveys, subject to the written agreement of relevant property owners, will be carried out in two stages as follows: • the first stage will consist of pre-construction condition surveys including photographic records which will be carried out prior to the commencement of construction; and • the second stage will consist of post-construction condition surveys which will include photographic records. Vibration impacts to building occupants can be significantly reduced through the use of clear communication and information circulars relating to planned works, and their duration.
Operational Phase Mitigation for Noise	
12.12	The following section details the mitigation measures deemed practicable to achieve the design goals previously defined in Section 12.2.2.

No.	Description
	The mitigation measures required to reduce traffic noise levels are specified based on the predicted noise levels for the Design Year of 2039. The results of the modelling exercise show that noise mitigation is required for 121 properties along the proposed road development for this Design Year. The first mitigation option is the inclusion of a low noise road surface (LNRS) along the following roads: • Section A: Full extent of the proposed road between Foynes and Ballyclogh; • Section C: Full extent of the proposed road between Ballyclogh and Rathkeale; • Section D: Full extent of the proposed road between Rathkeale and Adare to the end of realigned N21 including junction slip roads; • Existing N21 at tie in between the eastern end of Section D and the N20 Attyflin Junction, and; • Adare Link Road. In line with TII guidance, the correction applied to LNRS for noise mitigation purposes is -2.5dB compared to Hot Rolled Asphalt (HRA). Further options to reduce operational noise levels along the proposed road development will include the use of noise barriers to reduce noise levels along the propagation path between the source (proposed road development) and the specific receivers. Barriers can take the form of proprietary acoustic screens, solid block walls, earth berms or other solid structures. The barriers chosen should be solid, with no gaps at the base or between vertical joints and should have a minimum surface mass of 10kg/m^2. The barriers will have a minimum sound insulation performance of B3 as classified in I.S. EN 1793 Part 2. All absorptive barriers will have a minimum absorptive index of A3 as classified in I.S. EN 1793 Part 1.
12.13	Table below summarises the barrier requirements. The location of the noise barriers are illustrated in Figures 12.1 of the EIAR and Figure 12.22 in Volume 3.

Barrier Ref.	Incident to	Road Link	Chainage Start (m)	Chainage End (m)	Height (m)	Length (m)	Alignment / Notes
NB-001	A01-001/A01-002	N69	1+050	1+250	2	200	South
NB-002	A02-007A/A02-007B	N69	2+325	2+600	2.5	275	South
NB-003	A02-008/ A02-017	N69	2+325	2+600	2.5	275	North
NB-004	D51-001A	M21	51+150	51+325	3	175	South
NB-005	D51-001A	M21	51+325	51+450	3.5	125	South
NB-006	C26-005 - C26- 009 / C26-011 / C27-001	Ballyclogh to Rathkeale	26+555	27+175	2	620	East

No.	Description							
	NB-008	C27-002 - C27-007	Ballyclogh to Rathkeale	26+900	27+350	2	450	West
	NB-009	C27-008/C27-009 - C27-014 /C27-019	Ballyclogh to Rathkeale	27+350	27+750	2.5	400	West
	NB-010	C27-021, C27-027, C27-031	Ballyclogh to Rathkeale	27500	27+900	2.5	400	East
	NB-012	D50-013	M21	50+750	51+025	3	275	North
	NB-013	D51-003	M21	51+550	51+775	3.5	225	South
	NB-014	D51-006/ D51-007/D51-011	M21	51+775	51+925	3	150	South
	NB-015		M21	51+925	52+150	2.5	225	South
	NB-016	D51-012/ D52-001	M21	51+775	52+225	2	450	North
	NB-017A/B	D54-012	M21	54+350	54+450	2.5	125	North
	NB-018		M21	54+475	54+560	2	100	North
	NB-019	D56-003, D56-004, D56-005, D56-008	M21	55+975	56+300	3.5	325	South
	NB-020	D56-012 / D56-013	M21	56+300	56+500	2	200	South
	NB-021			56+500	56+730	2.5	230	South
	NB-022	D56-009/ D56-010/ D56-014/ D56-015	M21	56+000	56+400	3.5	400	North
	NB-023	D56-011	M21	56+400	56+875	2.5	325	North
	NB-024	D57-001	M21	56+875	57+225	3	350	North
	NB-025	D57-006 / D57-008/ D57-017	M21	57+475	58+025	3.5	550	South
	NB-026	D57-007/ D57-009/ D57-009A/ D57-012/ D57-013 - D57-015	M21	57+475	58+075	3.5	50	North

No.	Description							
	NB-027	D58-002 - D58-005 / D59-001	M21	58+675	59+250	3	575	North
	NB-028	D59-002/D59-004/ D59-006/ D59-007	M21	58+725	59+325	3	600	South
	NB-029	D59-009/ D59-011	M21	59+675	60+100	3.5	425	South
	NB-030	D60-004/ D60-005	M21	60+100	60+300	3.5	200	South (Absorptive)
	NB-031	D60-003	M21	60+025	60+300	3.5	275	North
	NB-032	D60-003 / D60-011	M21	60+325	60+510	2.5	185	North
	NB-033	D60-011	M21	60+510	60+860	3	350	North
	NB-034	D61-003	M21	60+975	61+325	3.5	350	South
	NB-035	D61-004 / D61-005 / D61-006 / D61-008 - D61-010	M21	61+325	61+475	3	150	South
	NB-036		M21	61+475	61+725	2.5	250	South
	NB-037	D61-015	M21	61+650	62+125	2.5	475	South
	NB-038	D62-004 - D62-011 / D62-016 / D62-017	M21	62+375	62+875	3.5	500	North
	NB-039			62+875	63+025	3	150	North
	NB-040	D62-011 /D63-004	M21	63+025	63+560	3.25	535	North
	NB-041	D62-012 /D63-003 /D63-005	M21	62+625	63+630	3	1005	South
	NB-042	D63-006	M21	63+775	64+025	3	250	North
	NB-043	D63-002 / D64-004 /D63-006 - D64-009 - D64-012	M21	64+025	65+050	3.5	1025	North
	NB-044	D64-001 /D64-003 / D64-005	M21	63+750	64+300	3.5	550	South
	NB-045	D66-001	Existing N21	65+775	66+175	2	400	South

No.	Description
	The proposed noise mitigation set out above have been designed to sufficiently reduce traffic noise levels to at, or below, the traffic noise design goal of 60dB $L_{den,}$ where relevant. A total length of approximately 15.5km of barrier is required, ranging in height from 2.0m to 3.5m, and on average just under 3.0m. Three-quarters of the proposed barriers will be located along Section D for the M21 motorway which carries the highest volumes of traffic and passes near to more houses than the rest of the route between Rathkeale and Foynes. The combined mitigation measures associated with the use of a Low Noise Road Surface (LNRS) in addition to physical noise screening has been assessed to provide the most suitable available noise mitigation at the nearest sensitive locations. Discussion on the residual impacts taking account of the proposed mitigation measures are outlined in Section 12.6. A number of additional barriers have been specified along the proposed road development in order to reduce potential visual and noise impacts at equine holdings. These are illustrated also in Figures 12.1 to 12.23 in Volume 3. Specific discussion on potential impacts to equine holdings and recommended mitigation measures is included in Chapter 15 Material Assets and Land – Agriculture.

19.11 Mitigation and Monitoring Measures for Air Quality and Climate

Table 19.10 Mitigation and Monitoring Measures for Air Quality and Climate

No.	Description
13.1	**Air Quality** The pro-active control of fugitive dust will ensure the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released. The main contractor will be responsible for the coordination, implementation and ongoing monitoring of the dust management plan. The key aspects of controlling dust include the following: • The specification and circulation of a Dust Management Plan for the site and the identification of persons responsible for managing dust control and any potential issues; • The development of a documented system for managing site practices with regard to dust control; • The development of a means by which the performance of the dust management plan can be monitored and assessed; and, • The specification of effective measures to deal with any complaints received. Full details of the Dust Management Plan can be found in Appendix 13.3 of Volume 4. At all times, the procedures within the plan will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust could be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.
13.2	**Climate** Construction traffic and embodied energy of construction materials are expected to be the dominant source of greenhouse gas emissions as a result of the construction phase of the proposed road development. Construction vehicles, generators etc., may give rise to some CO_2 and N_2O emissions. However, due to short-term and temporary nature of these works, the impact on climate will not be significant. Nevertheless, some site-specific mitigation measures can be implemented during the construction phase of the proposed road development to ensure emissions are reduced further. In particular, the prevention of on-site or delivery vehicles from leaving engines idling, even over short periods, will reduce emissions. Minimising waste of materials due to poor timing or over ordering on site will help to minimise the embodied carbon footprint of the site. Materials will be reused as much as possible within the extent of the sites, in addition, materials will be sourced locally where possible to reduce the embodied emissions associated with transport. A Construction Stage Traffic Management Plan will be implemented throughout the construction stage to avoid congestion and thus reduce emissions (see Chapter 4 for more details). All plant and machinery will be maintained and serviced regularly.
13.3	**Monitoring** Monitoring of construction dust deposition at nearby sensitive receptors (residential dwellings) during the construction phase of the proposed road development is recommended to ensure mitigation measures are working satisfactorily. This can be carried out using the Bergerhoff method in accordance with the requirements of the German Standard VDI 2119. The Bergerhoff Gauge consists of a collecting vessel and a stand with a protecting gauge. The collecting vessel is secured to the stand with the opening of the collecting vessel located approximately 2m above ground level. The TA Luft limit value is 350 mg/(m^2.day) during the monitoring period between 28 - 32 days. There is no monitoring recommended for the operational phase of the development as impacts to air quality and climate are predicted to be insignificant.

19.12 Mitigation and Monitoring Measures for Archaeology, Architecture and Cultural Heritage

Table 19.11 Mitigation and Monitoring Measures for Archaeology, Architecture and Cultural Heritage

No.	Description
Mitigation and Monitoring for Archaeology	
14.1	Exclusion zones have been defined around a number of recorded monuments and archaeological sites identified during the LiDAR survey which are located within the lands required for construction, in order to allow preservation in situ of all or part of the monuments. These consist of the following assets: AH 4, 24, 64 and LI 13 and 25. As the full extent of AH 64 is currently unknown, there is a potential significant impact to part of the monument during construction
14.2	Measured survey of upstanding archaeological monuments directly impacted by the proposed road development following removal of vegetation if necessary – including all upstanding ringforts, raths, enclosures. These consist of the following assets: AH 7 and 39.
14.3	A full written and photographic record will be made of the setting of following assets in order to mitigate operational impacts: AH 2, 4, 9, 16, 19, 21, 24, 29, 32, 33, 34, 41, 42, 57, 59, 61, 64, 69 and LI 10, 14, 28, 37, 38, 53, 54, 59, 69, 70.
14.4	A programme of archaeological test excavations will be carried out within the lands made available (LMA) for construction of the proposed road development prior to any construction going ahead. This will target the sites and areas of archaeological and cultural heritage potential (including all AAPs), as well as all known archaeological sites (AH), LiDAR sites (LI), and newly identified archaeological sites resulting from geophysical survey (M/E), as well as previously undisturbed areas within the boundary of the proposed road development.
14.5	Test excavations will be carried out in accordance with Ministerial Directions issued to Limerick City and County Council under Sect. 14A(2) of the National Monuments Acts (1930 – 2014) by the Minister for Culture, Heritage and the Gaeltacht and a TII Project Archaeologist. Full provision will be made available for the excavation leading to preservation by record of any archaeological features and / or deposits that may be identified, if that is deemed the most appropriate manner in which to proceed.
Mitigation and Monitoring for Architecture	
14.6	Pillboxes BH 25 and CH 104 will be preserved in situ during construction, however both will be subject to a full measured, written and photographic survey to record their form and setting. Pillbox CH 103 will be removed during construction, options for the relocation of the asset to the south, outside of the cutting, will be explored and the asset will be assessed by a conservation engineer, in consultation with a structural engineer, in order to confirm the viability of this option. Whether relocation is possible or not, a full measured, written and photographic survey will be undertaken to record its form and setting. Surveys will be carried out by a suitably qualified person or team in accordance with Ministerial Directions issued to Limerick City and County Council under Sect. 14A(2) of the National Monuments Acts (1930 – 2014) by the Minister for Culture, Heritage and the Gaeltacht and a TII Project Archaeologist.
14.7	BH 1 is located only very slightly within the lands made available for construction. During construction, care will be taken not to impact the structure. Should the structure need to be fenced off, this will be undertaken prior to and maintained throughout construction.
14.8	A full written and photographic record will be made of the setting of the following assets in order to mitigate operational impacts: BH 2, 3, 4, 6, 8, 9, 14, 17, 20, 25, 26, 27, 29, 32, and 34.

No.	Description
14.9	DL 1, 2, 3, 5, 6, 8, and 9 will be subject to a detailed photographic and written record prior to the construction of the proposed road development in order to mitigate construction and operational impacts. This will be carried out by a suitably qualified person or team in accordance with Ministerial Directions issued to Limerick City and County Council under Sect. 14A (2) of the National Monuments Acts (1930 – 2014) by the Minister for Culture, Heritage and the Gaeltacht and a TII Project Archaeologist.
Mitigation and Monitoring for Cultural Heritage	
14.10	Exclusion zones have been defined around a number of cultural heritage assets located within the lands required for construction in order to allow preservation in situ. These consist of the following assets: CH 16, 92 and 104.
14.11	Railway culvert CH 131 will be preserved in situ; however, the railway structure will be subject to a full measured, written and photographic survey to record its form and setting prior to construction. All CH sites directly impacted by the proposed road development that include built heritage remains will be subject to a detailed written and photographic survey (to include measured survey and test trenching where appropriate). This includes CH 67, 100, 102,115, and 132. Culvert CH 132 will also be subject to a measured survey and stone from this asset will be retained for future use. This shall be carried out in accordance with Ministerial Directions issued to Limerick City and County Council under Sect. 14A(2) of the National Monuments Acts (1930 – 2014) by the Minister for Culture, Heritage and the Gaeltacht and a TII Project Archaeologist. Full provision will be made available for the excavation leading to preservation by record of any archaeological features and / or deposits that may be identified, if that is deemed the most appropriate manner in which to proceed.
14.12	A full written and photographic record will be made of the setting of the following assets in order to mitigate operational impacts: CH 1, 3, 9, 14,18, 19, 20, 22, 29, 31, 35, 37 40, 42, 43, 44, 45, 47, 49, 56, 60, 65, 68, 69, 85, 106, 107, 109, 112, 113, 119, 120, 123, 124 and 127.
14.13	Archaeological wade or underwater assessments will be carried out at any natural water courses to be impacted upon by the proposed road development by disturbance to their banks or beds. This includes those at: • Ardaneer stream (AAP 1/ TB 1 and 54); • Shanagolden stream (AAP 2/TB 2; AAP 3/ TB 3); • Ahacronane stream (AAP 5/ TB 7, 9 and 10); • Unnamed stream where it crosses AAP6/ TB 11; • Unnamed stream at AAP 7; • Lismakeery stream (AAP 9 / TB 13); • Unnamed steam at AAP 10 (TGB 17); • Unnamed stream at AAP 12 (TB 20); • Cloghatrida stream at AAP 13 (TB 21); • Knockaunavad stream at AAP 15; • Carrignamedina stream at AAP 16 (TB 24-25); and • Kilglobbin stream at AAP 21. This shall be carried out in accordance with Ministerial Directions issued to Limerick City and County Council under Sect. 14A(2) of the National Monuments Acts (1930 – 2014) by the Minister for Culture, Heritage and the Gaeltacht and a TII Project Archaeologist. Full provision will be made available for the excavation leading to preservation by record of any archaeological features and / or deposits that may be identified, if that is deemed the most appropriate manner in which to proceed.

No.	Description
14.14	Any currently surviving section of Townland Boundary to be impacted upon will be subject to a detailed written and photographic survey (to include test trenching where appropriate). This includes all townland boundaries listed in Table 14.9 save for TB 48–52 which has been previously impacted by the construction of the N21. This shall be carried out in accordance with Ministerial Directions in issued to Limerick City and County Council under Sect. 14A(2) of the National Monuments Acts (1930 – 2014) by the Minister for Culture, Heritage and the Gaeltacht and a TII Project Archaeologist. Full provision will be made available for the excavation leading to preservation by record of any archaeological features and / or deposits that may be identified, if that is deemed the most appropriate manner in which to proceed.

19.13 Mitigation and Monitoring Measures for Material Assets and Land – Agriculture

Table 19.12 Mitigation and Monitoring Measures for Material Assets and Land (Agronomy)

No.	Description
15.1	**General Mitigation Measures for Agriculture** Access will be restored to lands where it is removed or restricted. Details of proposed access structures to lands are presented in Table below. Access will also be provided to lands via accommodation access tracks and the replacement of field access gates. The location of such field access gates will be at a suitable location and, where possible, with the agreement of the landowner.

Details of Access Accommodation Structures

Chainage	Reference	Location	Type and Size
2+000	UP01	Ardaneer	Farm Underpass: 4.5m wide x 3.0m high
4+990	UP02	Craggs	Farm Underpass: 4.5m wide x 4.5m high
6+825	UP03	Ballyclogh	Farm Underpass: 4.5m wide x 4.5m high
11+225	UP04	Cloonreask	Farm Underpass: 4.5m wide x 4.5m high
20+550	UP05	Ballyclogh	Farm Underpass: 4.5m wide x 3.0m high
21+760	UP06	Lismakeery	Farm Underpass: 4.5m wide x 4.5m high
24+000	RVB01	Ballynacaheragh	Farm Underpass: 4.5m wide x >4.5m high
24+050	RVB01	Boolaglass	Farm Underpass: 4.5m wide x >4.5m high
24+500	FR-C15	Boolaglass	Farm Underpass: 4.5m wide x 3.0m high
25+675	UP07	Feeagh	Farm Underpass: 4.5m wide x 4.5m high
26+175	UP08	Ardgoul South	Farm Underpass: 4.5m wide x 4.5m high
28+075	UP09	Ballingarrane	Farm Underpass: 4.5m wide x 4.5m high
29+150	UP10	Rathkeale	Farm Underpass: 4.5m wide x 4.5m high
50+750	M21-C1	Wolfeburgess East	10m span across stream and access track (4.5m wide x 4.5m high)
51+800	UP11A	Blossomhill	Farm Underpass: 4.5m wide x 3.0m high
51+840	UP11B	Blossomhill	Farm Underpass: 4.5m wide x 3.0m high
52+150	UP12A	Clogh West	Farm Underpass: 4.5m wide x 4.5m high
52+150	UP12B	Clogh West	Farm Underpass: 4.5m wide x 4.5m high
54+450	OB05	Croagh	L-1421 Overbridge: 4.0m wide x >4.5m high
55+550	UP13	Croagh Junction Link Road	Farm Underpass: 4.5m wide x 4.5m high
56+320	UP14B	Graigue	Farm Underpass: 3.0m wide x 3.0m high
56+740	UP15	Clonshire More	Farm Underpass: 4.5m wide x 4.5m high
58+500	OB07	Rower More	Farm Access Overbridge: 4.0m wide
58+950	UP16	Tuogh	Farm Underpass: 4.5m wide x 3.0m high
59+425	UP17	Kilknockan	Farm Underpass: 4.5m wide x 4.5m high

No.	Description

60+325	OB08	Curraghbeg	L-1423 Station Road Overbridge: backspan access 4.5m wide X 4.5m high
60+850	RVB04	Islandea	Farm Underpass: 4.5m wide x 4.5m high
61+360	UP18	Ardshanbally	Farm Underpass: 4.5m wide x 4.5m high

- In general, permanent fencing will be a stock-proof timber post fence in accordance with TII CC-SCD-00301 and TII CC-SCD-00320. Where permanent fencing occurs within the clear-zone area it will be timber post and tension mesh construction in accordance with CC-SCD-00320. At locations beyond the clear-zone the fence may be timber post and rail construction with PVC coated chain link complying with TII CC-SCD-00301. Where permanent fencing is erected on the boundary of the proposed mainline or the associated attenuation ponds, it will be maintained by the Local Authority. Further fencing details are presented in Section 4.12 of Chapter 4 (Description of the Proposed Road Development) of this EIAR.
- For farm holdings with equestrian livestock, permanent fencing will be a stock-proof timber post fence in accordance with TII CC-SCD-00302 and TII CC-SCD-00321. Where permanent fencing occurs within the clear-zone area it will be timber post and tension mesh construction in accordance with CC-SCD-00321. At locations beyond the clear-zone the fence may be timber post and rail construction with PVC coated chain link complying with TII CC-SCD-00302. Where permanent fencing is erected on the boundary of the proposed mainline or the associated attenuation ponds, it will be maintained by the Local Authority.
- Where boundaries at dwelling houses are removed as part of the works boundary, treatment is proposed on a like for like basis.
- In general, on non-national side-road tie-ins with the proposed road, the permanent fencing will be timber post and rail fence with chain-link wire mesh in accordance with TII CC-SCD-00301 unless otherwise agreed with the landowner and will be maintained by the landowner.
- All existing land drains and watercourses severed by the proposed road development will either be directed to a culvert under the proposed road and / or associated side road realignments or will be incorporated into the new road drainage system. The new drainage system will be designed to ensure that there will be no increased risk of flooding as a consequence of the proposed road development.
- Any services that are interfered with as a result of the proposed road will be repaired / replaced without unreasonable delay.
- Ducting for the restoration of water and power supply services will be provided, as necessary.
- Screening will be provided, where required, to mitigate the noise and visual effects of construction works and operational traffic on a number of farms. The screening measures to reduce noise and visual impacts will comprise of an acoustic barrier on the works boundary, or where the section is elevated, an acoustic barrier on earth bunding. The noise barriers proposed for the operational stage of the proposed road development are illustrated in Figures 12.1 to 12.23 of Volume 3. In addition, Supplementary Equine barriers have been provided where required, as illustrated. These are illustrated in the above referenced figures and are detailed in Table 15.6 above.

Details of mitigation measures for individual farms affected by the proposed road development are presented in Table 15.6.

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td colspan="2">Construction</td></tr>
<tr><td>15.2</td><td>Noise
Measures to mitigate noise impacts on sensitive receptors are detailed in Chapter 12 (Noise and Vibration). In addition, construction stage mitigation has been included for a number of agricultural properties which is detailed in Table 15.6. Good communication between the contractor and adjacent landowners during the construction phase, especially when excessively loud activities are programmed, will prevent undue disturbance to farm animals due to noise. It will also facilitate farm enterprises so that livestock can be moved away from the construction work during critical times.</td></tr>
<tr><td>15.3</td><td>Dust
Measures to control the production of dust will be put in place by the contractor (refer Chapter 13 Air Quality and Climate which presents a series of measures to control dust). Good communication between the contractor and the farmers in the proximity of construction activities will facilitate on-going farm enterprises so that livestock may be kept as far as possible from the construction work during critical times.</td></tr>
<tr><td>15.4</td><td>Restricted Access to Land
Access will be restored, as soon as possible, to lands where it is removed or restricted by the proposed road development. The location of such access will be at a suitable location and, where possible, with the agreement of the landowner. Good communication between individual farmers and the contractor will minimise difficulties caused by the restriction of access to land. Temporary fencing will be erected as required to delineate the site boundary and to minimise disturbance to adjacent lands. Temporary access gates may be required until such time as the permanent access arrangements are in place.</td></tr>
<tr><td>15.5</td><td>Disturbance of Field Drainage
In cases where drainage is impeded during construction and causes obvious difficulty to a particular landowner, temporary measures will be considered on a site-specific basis. This may include allowing waters to drain to less critical areas, so as to minimise the impact.</td></tr>
<tr><td>15.6</td><td>Disturbance of Services
Where required, an alternative source of water / electricity will be provided to ensure that disruption to farming is minimised during the construction phase.</td></tr>
<tr><td>15.7</td><td>Property-specific Measures
The following table (adapted from Table 15.6- see figures 15.1 to 15.23 of Volume 3 for farm Reference numbers) details the specific mitigation measures required for individual farms.

<table>
<tr><th>Farm Ref.</th><th>Mitigation Measures</th></tr>
<tr><td>001</td><td>Relocate access to the remaining area. Replace boundary with permanent stockproof boundary.</td></tr>
<tr><td>002</td><td>Provide access to the severed area. Replace boundary with permanent stockproof boundary.</td></tr>
<tr><td>003</td><td>Provide access to the severed area via Access Accommodation track and Access Accommodation Structure at Ch. 2+000m (3.0m in height). Restore right of way access to second plot of land. Replace boundary with permanent stockproof boundary.</td></tr>
<tr><td>004</td><td>Replace boundary with permanent stockproof boundary.</td></tr>
<tr><td>005</td><td>Replace boundary with permanent stockproof boundary.</td></tr>
<tr><td>006</td><td>Replace boundary with permanent stockproof boundary.</td></tr>
<tr><td>007</td><td>Replace boundary with permanent stockproof boundary.</td></tr>
<tr><td>008</td><td>Replace boundary with permanent stockproof boundary.</td></tr>
</table>
</td></tr>
</table>

No.	Description	
	009	Provide access gate to the severed area. Replace boundary with permanent stockproof boundary.
	010	Replace boundary with permanent stockproof boundary.
	011	Replace boundary with permanent stockproof boundary.
	012	Replace boundary with permanent stockproof boundary.
	013	Provide private access to the severed area via field access gate on access accommodation tracks and Accommodation Structure at Ch. 5+000m (4.5m in height). Provide access to eastern area via field access gate. Replace boundary with permanent stockproof boundary.
	014	Replace boundary with permanent stockproof boundary.
	015	Replace boundary with permanent stockproof boundary.
	016	Replace boundary with permanent stockproof boundary.
	017	Provide access via Overbridge (OB01) to the severed area. Replace boundary with permanent stockproof boundary.
	018	Replace boundary with permanent stockproof boundary.
	019	Provide private access to the severed areas via Access Accommodation track off Sideroad 7 (L-1220) and Accommodation Structures at Ch. 6+825m (4.5m in height) and Ch. 20+560m (3.0m in height). Replace boundary with permanent stockproof boundary.
	020	Replace boundary with permanent stockproof boundary.
	021	Replace boundary with permanent stockproof boundary.
	023	Replace boundary with permanent stockproof boundary.
	024	Replace boundary with permanent stockproof boundary.
	025	Replace boundary with permanent stockproof boundary.
	026	Provide private access to the severed area via Access Accommodation Structure at Ch. 11+220m (4.5m in height). Replace boundary with permanent stockproof boundary.
	027	Replace boundary with permanent stockproof boundary.
	028	Replace boundary with permanent stockproof boundary.
	029	Replace boundary with permanent stockproof boundary.
	030	Replace boundary with permanent stockproof boundary.
	031	Provide field accesses to remaining areas. Replace boundary with permanent stockproof boundary.
	032	Replace boundary with permanent stockproof boundary.
	036	Replace boundary with permanent stockproof boundary.
	037	Provide private access to the severed area via Access Accommodation Structure at Ch. 21+775m (4.5m in height). Replace boundary with permanent stockproof boundary.
	038	Relocate field access to remaining area. Replace boundary with permanent stockproof boundary.
	039	Restore field access to remaining area. Replace boundary with permanent stockproof boundary.
	040	Restore field access to remaining area. Replace boundary with permanent stockproof boundary.
	041	Replace boundary with permanent stockproof boundary.
	042	Provide private access to the severed areas via Accommodation Track from Sideroad 8 (L1236), access track to south and track under River Deel Bridge at Ch. 23+980m (>4.5m in height). Provision of a 1 metre high noise barrier at the top of the southern side of the

No.	Description	
		embankment extending from chainage 23+100 to 24+000. Replace boundary with permanent stockproof boundary.
	043	Replace boundary with permanent stockproof boundary.
	044	Replace boundary with permanent stockproof boundary.
	045	Provide access to the severed area via access track under River Deel Bridge at Ch. 24+050m (>4.5m in height). Replace boundary with permanent stockproof boundary.
	046	Provide private access to the severed area and River Deel via Access Accommodation Structure at Ch. 24+500m (3.0m in height). Replace boundary with permanent stockproof boundary.
	047	Replace boundary with permanent stockproof boundary.
	048	Provide private access to the severed area via Access Accommodation Structure at Ch. 25+685m (4.5 in height). Replace boundary with permanent stockproof boundary.
	049	Provide private access to the severed areas via Access Accommodation Structure at Ch. 26+160m (4.5 in height). Replace boundary with permanent stockproof boundary.
	050	Replace boundary with permanent stockproof boundary.
	051	Provide access to remaining area. Replace boundary with permanent stockproof boundary.
	052	Provide access to the severed areas via Access Accommodation tracks. Replace boundary with permanent stockproof boundary.
	053	Replace boundary with permanent stockproof boundary.
	054	Provide access to severed area via access tracks and private Access Accommodation Structure at Ch. 28+050m (4.5m in height). Replace boundary with permanent stockproof boundary.
	055	Relocate access to the remaining area. Replace boundary with permanent stockproof boundary.
	056	Replace boundary with permanent stockproof boundary.
	057	Replace boundary with permanent stockproof boundary.
	058	Replace boundary with permanent stockproof boundary.
	059	Replace boundary with permanent stockproof boundary.
	060	Provide access tracks to the severed area and Access Accommodation Structure at Ch. 29+150m (4.5m in height). Replace boundary with permanent stockproof boundary.
	061	Replace boundary with permanent stockproof boundary.
	062	Provide access to remaining areas. Replace boundary with permanent stockproof boundary.
	063	Provide access to the dwelling house, farmyard and severed area at Rathkeale via Access Accommodation Structure (4.5m in height) at Ch. 50+750m. Restore field accesses to remaining Graigeen areas. Replace boundary with permanent stockproof boundary.
	064	Provide private access to the severed areas via the Access Accommodation Structure (3.0m in height) at Ch. 51+840m. Provide field access to the remaining areas. Replace boundary with permanent stockproof boundary.
	065	Provide access to remaining area. Replace boundary with permanent stockproof boundary.
	066	Provide access to remaining area. Replace boundary with permanent stockproof boundary.
	067	Replace boundary with permanent stockproof boundary.
	068	Provide accesses to remaining areas. Replace boundary with permanent stockproof boundary.

No.	Description	
	069	Provide private access to the severed areas via the Access Accommodation Structure (3.0m in height) at Ch. 51+800m. Provide field accesses to the remaining areas. Replace boundary with permanent stockproof boundary.
	070	Provide private access to the severed area via the Access Accommodation Structure (4.5m in height) at Ch. 52+150m. Restore field access gate. Replace boundary with permanent stockproof boundary.
	071	Provide private access to the severed area via the Access Accommodation Structure (4.5m in height) at Ch. 52+150m. Replace boundary with permanent stockproof boundary.
	072	Replace boundary with permanent stockproof boundary.
	073	Replace boundary with permanent stockproof boundary.
	074	Replace boundary with permanent stockproof boundary.
	075	Replace boundary with permanent stockproof boundary.
	076	Replace boundary with permanent stockproof boundary.
	077	Replace boundary with permanent stockproof boundary.
	078	Replace boundary with permanent stockproof boundary.
	080	Provide private access to the severed area via access tracks and the Access Accommodation Structure at Ch. 54+450m. Replace boundary with permanent stockproof boundary.
	081	Restore farm entrance to the property. Replace boundary with permanent stockproof boundary.
	082	Provide private access to the severed area via the Access Accommodation Structure (4.5m in height) on Croagh Link Road. Replace boundary with permanent stockproof boundary.
	083	Restore farm access onto N21. Replace boundary with permanent stockproof boundary.
	084	Provide a temporary barrier, of a minimum 2.4m in height, erected to screen the noise and visual impacts during construction stage. Provide recommended screening as illustrated in Figures 11.1 to 11.24 and 12.1 to 12.23, including a supplementary equine barrier of 3.5m from Ch. 55+900 to Ch. 55+975m to mitigate the noise and visual effects of operational activities. Replace boundary with permanent stockproof boundary.
	085	Provide access via the Accommodation Access Structure (3.0m in height) at Ch. 56+325m. Replace boundary with permanent stockproof boundary.
	086	Provide recommended screening as illustrated in Figures 11.1 to 11.24 and 12.1 to 12.23 including a 2.5m high supplementary equine barrier from Ch. 56+725 to 56+875m, to mitigate the noise and visual effects of construction and operational activities. Replace boundary with permanent stockproof boundary.
	087	Provide private access via the Accommodation Access Structure (4.5m in height) at Ch. 56+745m. Replace boundary with permanent stockproof boundary.
	088	Replace boundary with permanent stockproof boundary.
	089	Provide screening of a minimum of 2.4 metres high for the construction stage along the working ground level. Provide recommended screening as illustrated in Figures 11.1 to 11.24 and 12.1 to 12.23, including 1.5m high supplementary equine barriers from Ch. 57+350 to 57+475 (North) and Ch. 57+250 to 57+475 (South) mitigate the noise and visual effects of operational activities. Replace boundary with permanent stockproof boundary.
	090	Provide screening of a minimum of 2.4 metres high for the construction stage above the working ground level.
	091	Provide recommended screening as illustrated in Figures 11.1 to 11.24 and 12.1 to 12.23, including a supplementary equine barrier of 1.5m from Ch. 58+025 to 58+150m to mitigate the noise and visual effects of operational activities.

No.	Description	
	092	Provide access to the severed area via a private Access Accommodation Structure at Ch. 58+490m and a shared Access Accommodation Structure (3.0m height) with Accommodation Tracks (one shared). Replace boundary with permanent stockproof boundary.
	093	Provide private access to the severed area via the access track (shared) and Access Accommodation Structure (3.0m height) at Ch. 58+940m. Replace boundary with permanent stockproof boundary.
	094	Provide field access to the severed area. Replace boundary with permanent stockproof boundary.
	095	Replace boundary with permanent stockproof boundary.
	096	Provide private access via the Accommodation Access Structure (4.5m in height) at Ch. 59+425m. Replace boundary with permanent stockproof boundary.
	097	Provide field access to the severed area. Replace boundary with permanent stockproof boundary.
	098	Restore field access to the remaining area. Replace boundary with permanent stockproof boundary.
	099	Provide field access to the severed area. Replace boundary with permanent stockproof boundary.
	100	Provide shared access to the severed area via the access track (>4.5m in height) at Ch. 60+850m under River Maigue Bridge. Replace boundary with permanent stockproof boundary.
	101	Replace field access to the remaining area. Replace boundary with permanent stockproof boundary.
	102	Provide access via the access accommodation tracks to severed lands. Replace boundary with permanent stockproof boundary.
	103	Provide access to the severed area via the Access Accommodation Structure (4.5m in height) at Ch. 61+375m. Restore field accesses to remaining areas. Replace boundary with permanent stockproof boundary.
	104	Phased construction of proposed road to be implemented to ensure maximum access to lands south of N21 during period of construction. Section of redundant N21 to be returned to agricultural use. Replace boundary with permanent stockproof boundary.
	105	Provide new access accommodation track from Kilgobbin local road (L-1424). Provide field access gates to severed lands.

19.14 Mitigation and Monitoring Measures for Material Assets and Land – Non-Agriculture

Table 19.13 Mitigation and Monitoring Measures for Material Assets and Land (Non-agronomy)

No.	Description
16.1	**Access** Access will be maintained to all affected property as much as possible and if interrupted will be restored without unreasonable delay. Traffic management measures will be put in place during construction where temporary or minor diversions are required. See section 4.16.5 of Chapter 4 for further details proposed for temporary traffic management measures.
16.2	**Noise and Vibration** Timing of works and noise and vibration limit values are amongst the main measures to mitigate noise impacts on sensitive receptors. These measures are detailed within Chapter 12 Noise and Vibration. Prior to construction and subject to written agreement with the relevant property owners, property condition surveys will be undertaken in relation to all buildings / structures in use located within 50m of the extents of the landtake boundary and within 150m of any proposed blasting works along the proposed road development. Good communication between the contractor and property owners during the construction phase will prevent undue disturbance due to noise.
16.3	**Dust** Dust suppression measures to mitigate the production of dust are detailed within Chapter 13 Air Quality and Climate. Good communication between the contractor and property owners during the construction phase will prevent undue disturbance due to dust
16.4	**Disturbance of Drainage Systems** In cases where drainage is impeded during construction and causes obvious difficulty to a particular property owner, temporary measures will be considered on a site-specific basis. This may include allowing waters to drain to less critical areas, so as to minimise the impact.
16.5	**Disturbance of Services** Where required, an alternative source of water / electricity will be provided to ensure that disruption is minimised during the construction phase.
16.6	**Property-specific Measures** The following table (adapted from Table 16.5 – see Figures 15.1 to 15.23 of Volume 3 for property reference numbers) details the specific mitigation measures required for individual properties (non-agricultural).

Ref.	Mitigation Measures
01	Replace affected property boundary.
02	Replace affected property boundary.
09	Replace affected property boundary.
11	Replace affected property boundary.
14	Restore entrance. Reinstate affected property boundary.
22	Provide alternative access to the site off side road.
28	Replace affected property boundary.
34	Replace affected property boundary.
42	Replace affected property boundary.

No.	Description	
	44	Restore entrance and access. Re-instate affected property boundary.
	49	Restore entrance and access. Re-instate affected property boundary.
	53	Restore entrance. Reinstate affected property boundary.
	54	Restore entrance. Reinstate affected property boundary.
	56	Restore entrance. Reinstate affected property boundary.
	57	Restore entrance. Reinstate affected property boundary.
	67	Reinstate affected property boundary.

19.15 Mitigation and Monitoring Measures for Major Accidents and Natural Disasters

Table 19.14 Mitigation and Monitoring Measures for Major Accidents and Natural Disasters

No.	Description
17.1	Following the above assessment of potential cumulative impacts as a result of planned or reasonably foreseeable developments within the study area, there are no additional mitigation measures proposed as part of the Foynes to Limerick Road (including Adare Bypass).