Comhairle Contae an Chláir
Clare County Council

Limerick City Council
Comhairle Cathrach Luimnigh

Limerick Northern Distributor Road

Route Corridor Selection Report




Volume 1 - Main Text

SEPTEMBER 2012

An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

Roughan & O'Donovan
MRG consulting engineers

Limerick Northern Distributor Road

Route Corridor Selection Report

Executive Summary

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Part I
Background Information

1.0 Introduction

This Route Corridor Selection Report for Phase 2 of the proposed Limerick Northern Distributor Road has been prepared by Roughan & O'Donovan Consulting Engineers on the instruction of Clare County Council.

The purpose of the Route Corridor Selection Report is to present the technical and environmental evaluation of the options presented in Public Consultation No. 2 (January 2012) and to outline the process by which the Preferred Route Corridor was selected.

Sketch RCSR-ES provided at the end of this Executive Summary shows the Study Area and the Route Options considered in the selection process.

2.0 Need for the Scheme

The Limerick Northern Distributor Road has been identified as an infrastructure objective of the Mid-West Regional Planning Guidelines 2010 – 2012. The Planning Guidelines were developed by the Mid-West Regional Authority which consists of Clare County Council, North Tipperary County Council, Limerick City Council and Limerick County Council. The need for the Limerick Northern Distributor Road is supported by and has been incorporated into County Development Plans published within the mid-west region.

The proposed scheme will provide a northern distributor road around Limerick, improving accessibility to Limerick City from County Clare and relieving pressure on the existing river crossings in the city centre. The road will provide significant improvement in connectivity between different areas along the northern fringe of the city, allowing people living in residential areas to the east of Limerick to access the employment areas in the west of Limerick and vice versa. This will reduce traffic flows in the city centre and facilitate public transport initiatives including bus corridors.

3.0 Constraints Study

In order to define the Constraints Study area, a significant data collection exercise was undertaken at the very earliest stages of the project. This focussed on determining the physical, environmental and engineering constraints that exist and which could affect the location, design and progress of the scheme.

This information was used to define a study area by developing an appropriate boundary and eliminating those areas where it is not considered feasible to locate a route. This information is available at Chapter 3 of this report.

At the commencement of the Constraints Study, the public were made aware of the proposal to develop a number of route options leading to the selection of a Preferred Route Corridor. Publicity Information Leaflets were made available to members of the public in November 2010 which explained the process involved in undertaking a

Constraints Study and incorporated a map of the Study Area for members of the public to review.

A draft Constraints Study (Work In Progress) was published in April 2012 documenting the constraints identified up to January 2011 and was supported by a draft Supplementary Constraints Information document (Work In Progress) which summarised additional constraints information which was gathered after January 2011.This information, together with that included in the earlier draft study, has been considered in the investigations which led to the identification of the emerging Preferred Route Corridor, and have included any issues raised by members of the public or other interested parties during the consultation processes for the project.

4.0 Engineering Parameters

The design standards for the scheme are the National Roads Authority's Design Manual for Roads & Bridges (the NRA DMRB).

For the purposes of undertaking the comparison of route corridors as part of the Route Selection Stage, it was agreed that the cross-section adopted for Phase 1 of the Limerick Northern Distributor Road (Coonagh – Knockalisheen Scheme) be maintained throughout the length of Phase 2 of the scheme. The proposed cross-section for the new mainline road is as follows:

- 1 x 2.6m wide central reserve;
- 2 x 7.0m carriageways, with 2 traffic lanes in each direction;
- 2 x 1.5m grass verge shoulders;
- 2 x 2.5m two-way cycle track;
- 2 x 2.0m footpath;
- 2 x 1.0m grass verge;
- Overall width to back of verges: 30.6m minimum.

Junction type will vary along the proposed new road and will reflect requirements to accommodate traffic movements in a safe manner and to minimise environmental impact where possible. In general, the following junction types will be considered:

- Roundabouts;
- Traffic Signals;
- Compact Grade Separated Junctions;
- Left in / Left out junctions.

Access to private lands and houses off the Limerick Northern Distributor Road will, wherever possible, be avoided by diverting the house access or access tracks onto the local road network. By limiting the number of accesses onto the Limerick Northern Distributor Road, the overall safety of the road will be improved. Where access cannot be gained to private land or houses via local roads or access tracks, consideration may be given to the use of a left in / left out junction.

Part II
Selection of the Preferred Route Corridor

5.0 Route Corridors

A number of initial Route Corridor Options were developed based on information documented in the constraints gathering exercise.

Following the identification of initial constraints within the Study Area, a number of feasible route options were developed in accordance with the requirements of the NRA Design Manual for Roads & Bridges while avoiding, where possible, significant constraints identified to date in the Study Area.

The development of route options within the Study Area was restricted by environmental, archaeological, social, geological and topographical constraints. Engineering parameters such as length of new construction, river crossings, and connectivity to Limerick City were also taken into account. The generation of route options was further limited by the amount of development within the Study Area.

All the feasible route corridor options developed for the Route Selection Process pass through a common location over the Tailrace Canal between Parteen and Ardnacrusha. For the purposes of comparing the feasible route options developed to the west and to the east of the Tailrace Canal near Parteen, the Study Area was split into two distinct sections at this common crossing point, Section 1 to the west of the tailrace and Section 2 to the east.

There are 6 Route Corridor Options in Section 1, two to the north of Meelick (Knockalisheen Marsh) and four to the south of the village; and, when taking all possible combinations of route segments into account, 16 route corridor options in Section 2 connecting to the R445 at four distinct locations from the Groody Roundabout eastwards to the Cappamore Road junction. These options were brought forward to the public for their consideration and comment.

Public Consultation No. 1

Public Consultation No. 1 was undertaken between June 2011 and July 2011 and included a public consultation exhibition held on Wednesday, 15th of June 2011 in the Green Hills Hotel, Ennis Road, Limerick.

A total of 39 people attended the consultation exhibition and a total of 108 submissions were received from the public in relation to the Route Corridor Options presented.

In Section 1, Routes A2 and A4 were indicated as the most preferred individual routes by the public. Route A2.1 was the medium preferred individual route, with route options A1, A3 and A4.1 the least preferred individual route options. In Section 2, Docking Point E was indicated as the most preferred terminal point for the Limerick Northern Distributor road in Section 2. Docking Point D was indicated as the medium preferred terminal, while Docking Points B and C were considered the least preferred terminals.

Stage 1 – Preliminary Options Assessment

During the Public Consultation process additional constraints were identified which required the feasibility of a number of the route options displayed to the public to be re-considered.

The submission received from ESB International highlighted the hydrogeological sensitivity of the area immediately south of the Headrace Canal in the vicinity of the most northerly route options considered. The historical records submitted by the ESB in relation to hydrogeological incidents highlighted the risk of undertaking construction works in the proximity of the Headrace Canal.

The ESB submission highlighted the potential outcome should the Headrace Canal be undermined by works in the hydrogeologically sensitive area as follows;

- The Headrace Dam is a Category A Type Dam, meaning any breach could result in a significant loss of life.
- A breach of the Headrace Canal would result in a shutdown of the Ardnacrusha Power Station, an element of nationally strategic infrastructure.
- If the dam were breached the Parteen Weir would be automatically closed resulting in significant widespread flooding further downstream on the River Shannon.

Following the completion of the environmental assessments of the route corridor options, including the completion of specific detailed surveys of the Knockalisheen Marsh and the banks of the River Shannon (both areas included within the Lower River Shannon SAC), a meeting was held with the National Parks and Wildlife Service to review the route corridor options and the findings of the Ecological Assessment (Chapter 10 of this Report).

At this meeting, it was noted that a number of Routes Corridor Options have a significant impact on the integrity of the Lower River Shannon SAC due to routes traversing Alluvial Woodland habitat, Molinia Meadows habitat and Marsh habitat. NPWS confirmed that both the Alluvial Woodland habitat and the Molinia Meadows habitat conform to Annex I priority habitat and are qualifying interests of the SAC. In addition the Marsh habitat present conforms to the Annex 1 habitat '*Hydrophilous tall herb fringe communities'*, although this habitat is not a qualifying interest of the SAC.

The National Roads Authority '*Guidelines for Assessment of Ecological Impacts of National Roads Schemes'* (Figure 5, Page 41) includes the requirement to '*disregard those feasible alternative solutions that adversely affect priority habitats and continue with those which affect only non-priority habitats or species.*' Consequently and in accordance with the Guidelines, due to the existence of feasible alternatives to Routes A.2 & A.3 in Section 1 and to Routes C.1, D.1 (in the vicinity of the Shannon Crossing)and Link E.1 to D.1 in Section 2 these route corridors were disregarded from further consideration.

Refinement of Feasible Route Options

In accordance with the NRA 2010 Project Management Guidelines, a Stage 1 Preliminary Options Assessment was undertaken on all feasible route options developed for the scheme utilising the assessment criteria of Engineering, Environment and Economy. The objective of this exercise was to reduce the number of feasible route options to a more manageable number of routes (a number of 3 to 5

is recommended) that shall progress to the Project Appraisal Stage of Route Selection (Stage 2).

Following the completion of the Stage 1 Preliminary Options Assessment, Route Corridor A4.1 and Route Corridor B2 were excluded from further consideration. The three remaining route corridor options in Section 1 and two remaining route corridor options within Section 2 were progressed to be assessed under the Stage 2 - Project Appraisal of Route Options.

6.0 Stage 2 Project Appraisal

The route corridor options progressed to the Stage 2 - Project Appraisal were subsequently assessed in line with the NRA Project Appraisal Guidelines under the headings of:

- Environment;
- Economy;
- Safety;
- Accessibility and Social Inclusion; and
- Integration.

In order to select an emerging Preferred Route Corridor a decision tree was used to select the preferred Route Corridor. This was developed as a three step process as described below:

Step 1 Divide scheme into two distinct sections with common nodes:

Section 1 Node A to Node X

Section 2 Node X to Node E

Step 2 Section 1 – Select Preferred Route Corridor in Section 1 from Node A to Node X (Route Corridor A1, A2.1 (A2.2) or A4)

Step 3 Section 2 – Select Preferred Route Corridor from Node X to Node E, either via Route B1 docking the LNDR at the Groody Roundabout on the R445 or via Route B1/D1/E1 (E1.1) docking at Cappamore Junction on the R445.

Following the above three steps the emerging Preferred Route Corridor was selected as a combination of Route Corridor A2.2 in Section 1 and Route Corridor B1/D1/E1.1 in Section 2.

Public Consultation No. 2

The emerging Preferred Route Corridor was displayed to the public during the Public Consultation No. 2 (PC2) process which was undertaken between January 2012 and May 2012, with public consultation exhibitions being held on the 18th of January 2012 and the 27th March 2012.

The objectives of the consultation were to:

- Present the emerging Preferred Route Corridor to the public;
- Further inform the public of the process and the programme for the project;
- Invite submissions on the emerging Preferred Route Corridor;

- Gather local information, including that relating to land ownership, which may not be known to the design team;
- Answer questions from the public;
- Consider and review the information received.

A total of 250 attendees registered their attendance at the first public exhibition held on the 18th January 2012 however it is estimated that up to 450 people attended the consultation with 550 Public Consultation Information Leaflets taken by members of the public. A total of 125 attendees were registered at the second public exhibition held on the 27th March 2012.,

Over 470 individual responses were received through the process, either by means of submissions lodged with Clare County Council as requested in the Information Leaflet, or by means of comments received at the public exhibition events. A number of the submissions dealt with similar issues. The main issues raised included the following:

- Impacts on agriculture including:
  - Accommodation works;
  - Severance of lands.
- The perceived severance of Parteen Village;
- Concerns over affects of scheme on existing homes and structures;
- Impacts of road embankments and the scheme on the area when River Shannon floods;
- Safety issues regarding children crossing dual carriageway when cycling or walking to school;
- Impact on the local communities of increased use of local roads;
- Visual impact of the scheme on the landscape;
- Questions relating to the need for the scheme and the sustainability of road transport;
- The impact of the scheme on the Limerick Tunnel toll scheme;
- Questions relating to the traffic modelling and the impact of traffic docking at the R445;
- Need for scheme east of the University of Limerick Campus;
- Questions relating to the Ecological Surveys undertaken as part of the constraints gathering exercise.

Following completion of Public Consultation No. 2 and a review of all submissions received, new constraints were identified which impacted the alignment identified for the emerging Preferred Route Corridor. A number of submissions raised issues regarding the corridor and these will have to be carefully considered during the Design Stage.

Recommendation of the Preferred Route Corridor

The recommended Preferred Route Corridor is a combination of Route Corridor Option A2.2 in Section 1 and Route Corridor Option B1/D1/E1.1 in Section 2 as shown in Sketch RCSR-PRC provided at the end of this Executive Summary.

Part III
Factors Considered in Assessment of Route Corridor Options

The potential impact of each route corridor option was assessed against a series of environmental, engineering, economic and social parameters. Chapter 7 through to Chapter 17 of this report outline the process of assessing each of the route corridor options under these criteria. The findings of these chapters were summarised and included in Chapter 5 and Chapter 6 of the report where considered appropriate.

7.0 Planning, Land-use and Socio-economic Impact

Chapter 7 outlines the findings of the planning, land-use and socio-economic assessment of the route corridor options. The planning aspects are presented in the context of the impact on strategic and regional planning policy. The impact on land-use examines the potential impact of each route corridor option on residential, community and commercial property and planning applications in close proximity to the route corridors options. The existing socio-economic conditions are briefly reviewed and then the socio-economic impacts of the route corridors are examined in terms of impacts on journey length, community severance, existing amenity and potential economic impacts.

The conclusion reached by the assessment is that the routes will have varying impact in terms of planning, land use and socio economic impacts. For Section 1, the primary finding is that Routes A.4 and A.4.1 clearly have a significantly higher impact. This is a direct consequence of their proximity to Meelick and the ribbon development north of the Knockalisheen Road. For Section 2 the main issue is the degree of severance which will occur as a result of the route corridor options which incorporate Nodes (X-J), in particular routes B1 and B2.

8.0 Noise and Vibration

The Route Corridor Selection Study has been completed in accordance with the NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes (Revision 1, 25th October 2004) The first stage of this process simply examines the number of properties within 300m of the centreline of each route corridor and an impact rating is generated based on the number of properties within 4 bands (0-50m, 50-100m, 100-200m and 200-300m). The second stage of the process combines this assessment with a review of the changes in traffic flow on the road network with the new road in place.

As would be expected the route corridors furthest from the main urban areas have the lowest Impact Rating and therefore are ranked best in terms of the reduced number of receptors in proximity to the route corridors.

The second stage of the assessment subsequently identifies that, due to the heavily urbanised nature of the R445, the impact of the increase in traffic along the R445 from the routes docking at the Groody Valley roundabout is such that these are deemed to be least preferable.

The preferred route option is Route A2.1 & Route D1/E1 as this route avoids the built up areas of Meelick and Athlunkard while also reducing traffic along the R445.

9.0 Air Quality

The Air Quality assessment was completed in compliance with the NRA document *"Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes.'(May 2011)*

Stage 1 of the assessment is based on property counts - the route options are ranked based simply on the number of properties within 50m of each route option The second stage of the process then examines the traffic figures for the scheme to ascertain if there are likely to be significant air quality impacts associated with any of the broadly defined routes.

Pollution from traffic sources increases at low traffic speeds and during congested traffic conditions. The assessment therefore ranks as favourite those options which avoid built up areas and reduce the congestion on the R445.

10.0 Ecology

The objective of Chapter 10 is to identify the principal ecological sites and constraints impacted by the various route options, and to provide a comparison between the options on the basis of potential impacts on the ecological environment.

Ecological sites and other habitats of potential ecological interest were identified from existing literature and data sets, consultations with statutory authorities, a review of the aerial photography, walkover surveys and protected species surveys (bats, otter, barn owl, whooper swan, kingfisher).

In addition as a result of the substantial presence of the Lower River Shannon Special Area of Conservation within the study area significant survey effort was expended mapping habitats and recording the presence of protected species. These surveys identified the presence of a number of qualifying habitats along the River Shannon and within the area known as Knockalisheen Marsh.

The potential impact of each route option within Section 1 and Section 2 was assessed and ranked with respect to the overall impact on the ecological resource along each route. The impact rating is based on the geographic frame of reference detailed in the NRA *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (Revision 2, 1st June 2009).

A key objective of the route selection process was the selection of a route which avoids impacting on any of the qualifying interests for the Lower River Shannon SAC and which results in no significant impact on the integrity of the SAC. The surveys and habitat mapping identified that a number of route options would have a significant impact on SAC habitats both at the Shannon Crossing and across Knockalisheen Marsh. Following the NRA Guidelines for Assessment of Ecological Impacts these routes were removed from the assessment process and two route variants were introduced.

The preferred route option under the ecological assessment within Section 1 is Route A.4 with Route A.4.1 second, as they avoid impacting on the SAC at Knockalisheen, although they do have significant impact on sites listed as being of County Importance. Route A.1 which crosses the SAC is ranked third. However, Route variant A.2.2 would have no significant impact on any of the qualifying interests or the integrity of the SAC (with appropriate design to avoid any alteration of

the existing hydrological conditions in the wet grassland habitat and to maintain ecological connectivity along the Knockalisheen Stream corridor). Subject to appropriate design, Route A.2.2 would have less of an ecological impact overall than either Route A.4 or A.4.1, though in accordance with the NRA guidelines, these latter route options are still ranked higher as they avoid the SAC entirely.

All of the route options in Section 2 must cross the SAC and will impact to some extent on the SAC habitat Alluvial Woodland which forms an extensive fringe along the southern river bank primarily. The preferred route option within Section 2 is the shortest option Route B.1. However when Route Corridor variant E.1.1 was compared to the other route options, it emerged as being comparable to B.1 impacting as it does on a very narrow fringe of Alluvial Woodlandand avoiding identified spawning areas for salmon and lamprey.

For all crossing options, the proposed bridge design will clear span the riparian zones on both banks thus maintaining the ecological connectivity along the river corridor and avoiding the loss of the riparian vegetation. Acquisition of additional lands outside of the SAC will allow for the development of wetland habitats ensuring no net loss of woodland and wet grassland.

11.0 Architecture, Archaeology and Cultural Heritage

This study determines the nature of the cultural heritage resource surrounding the route options. The first phase of the assessment comprised a desk study of all available archaeological, architectural, historical and cartographic sources. The second phase involved a drive over of the Study Area containing the route options in an attempt to assess the current state of any recorded archaeological and built heritage sites that were accessible from the existing road network.

Section 1

The assessment carried out has identified proposed option A.1 as the preferred option for Section 1 as it has the least impact on the archaeology, architectural and cultural heritage resource of the area.

There are no recorded archaeological sites or protected structures located within the immediate vicinity of the proposed route. One potential significant impact was identified at BH 40 (boundary demesne) , but all route options will have this same potential impact. The route will also have a direct, but moderate adverse impact on four Areas of Archaeological Potential and BH 45 (a demesne wall). However, all route options will impact upon BH 45.

The route of least preference is A.4 due to a significant impact on BH 43 (vernacular house and Victorian post box) and a large number of direct and indirect moderate impacts. Very little separates A.4 and A.4.1. It should also be noted that these are the longest route options and therefore the chance of finding more previously unrecorded archaeological remains within greenfield areas is higher than the shorter routes.

Section 2

The assessment has identified proposed option B.1 as the preferred option for Section 2.

There are no recorded archaeological sites or protected structures located within the immediate vicinity of this route, with the exception of BH 36 (a house listed on the Record of Protected Structures). This house is located c. 110m east of the centre of the route corridor, within the built up area of the Limerick University Campus.

All routes within Section 2 will have to cross the River Shannon. This is a significant waterway and has been designated as an Area of Archaeological Potential (AAP 19). Rivers and lakes are a focus for human habitation due to the obvious transport and food resources. They also have the potential to preserve organic archaeological deposits or artefacts such as wood or leather, which do not usually survive within the alkaline conditions associated with terrestrial archaeology. They may have also played a role in prehistoric ritual, as significant artefacts from the prehistoric periods and into the early medieval period are often found within river bed deposits. This is certainly the case with regards to the River Shannon where an extensive range of archaeological artefacts have been recovered from the river further to the northeast at Killaloe.

The route options which include the link E.1 to D.1 bridging the Mulkear River will have a significant impact on AH 5 (an enclosure at Castletroy) and have emerged as the least preferred option due to their overall impact on archaeological resource.

The preferred route options represent the shortest of the proposed routes investigated. The risk of these options travelling through previously unrecorded archaeological deposits is lower than those routes that cover a greater area.

12.0 Agriculture

The proposed road scheme will have a significant effect on farming in the study area and in particular on individual holdings directly affected. The area in question comprises, for the most part, productive land and the majority of this land is intensively farmed at present. The area is currently used for a mixture of farming operations.

The level of dairy farming in the area is not overly intensive but where it is carried out the holdings are significant. There are seven dairy farms that may be affected and the level of impact varies greatly depending on the route options, for example the combination of options (A.4 / D.2 / Link D.2 to D.1 / E.1 – Nodes A - G - H - X-K - L - M - O - E) would have the greatest impact on the dairy farms. Route B1 (Nodes J – B) will also have a significant impact on one of the dairy operations.

The route option that would have least impact upon the farming community within the study area is the combination of Route A.2.1 from Section 1 and Route B.2 in Section 2. This combination is one of the shortest route options available and thus impacts upon the least number of holdings and will result in the smallest area of acquired land. This option will however significantly impact upon a horticultural business as well as a number of other significant holdings.

The next option would be the combination of Route A.3 from Section 1 and Route B.1 / D.1 / C.1 in Section 2. Again this combination is one of the shortest route options available thus reducing its impact upon on the number of affected holdings.

The combination of Route A.4 from Section 1 and Route D.2 / Link D.2 to D.1 / D.1 / E.1 in Section 2 is the route which will have the greatest impact on the farming community within the study area. This is the longest option available.

All of the available options investigated would have a considerable impact on individual farming operations. It will be important for the preferred route corridor selected that all possible mitigation measures are taken to minimise the impact to agricultural holdings in the area.

13.0 Landscape and Visual Impact

A Landscape and Visual Impact Assessment was carried out for the route options for the proposed road.

The analysis of the route options was undertaken based upon the following assessment criteria:

- *Conformity with Existing Landscape Pattern:* This refers to the extent to which the route aligns with, and would comfortably integrate with, the field pattern (in rural areas) or the urban grain (the spatial arrangement of roads, junctions, blocks and open space in urban areas) of the receiving environment.

- *Accordance with Topography:* This refers to the extent to which the route is potentially discordant with the topography, and the amount of cut, fill and/or bridging which would be required in the landscape to accommodate the road.

- *Exposure to Sensitive Visual Receptors – Residents:* This refers to the proximity of the route to the most sensitive visual receptors in the receiving environment. According to the *Guidelines for Landscape and Visual Impact Assessment* (2nd edition, 2002 published by the Landscape Institute and Institute of Environmental Management and Assessment), these include the occupiers of dwellings and users of outdoor recreation facilities. As well as the relative proximity and number of dwellings to the route the assessment considers the orientation of buildings and gardens, the elevation of the route relative to the building in the landscape, the existence of screening (such as vegetation) and the context of the dwelling (and associated quality/character of existing views). This criterion is considered the most important of those applied in the assessment exercise.

- *Exposure to Sensitive Visual Receptors – Recreation Facilities:* This refers to the relative proximity of the route to outdoor recreation facilities whose users would be focussed on and appreciative of the surrounding landscape.

- *Exposure to Sensitive Landscape Features:* This refers to the proximity of the route to valuable and sensitive features in the landscape, such as sites and monuments of archaeological, architectural or historical interest, which might be directly impacted (wholly or partially demolished) by the road or have their landscape setting (and views to and from the site) altered.

- *Loss of Hedgerows or Trees:* This refers to the quantity of woody vegetation which would be lost as a result of development of the route. The assessment takes account of the maturity, condition, function (e.g. field enclosure, visual amenity, screening, habitat connectivity, etc.) and context (including historic) of the vegetation.

- *Potential for Beneficial Contribution to Landscape or Views:* This refers to the extent to which a route - particularly a bridge - could make a positive

contribution to the landscape, by adding a structure of aesthetic merit, in an appropriate location, to the receiving environment.

Based on the comparative assessment the route options for each section and sub-section of the road were ranked in order of preference.

Section 1

Route A.2.1 is preferred.

Routes A.4 and A.4.1 would have significant impact in all of the assessment themes/areas, in particular affecting the visual amenity and setting of a number of rural houses. Route A.3 has a similar effect on the Knockalisheen Accommodation Centre, while having generally low impact in other areas. Route A.1 avoids dwellings but in taking a long, winding route it has poor alignment with the established landscape pattern and cuts through a large number of field boundary hedgerows. Routes A.2 and A.2.1 are the most direct and best aligned with the field pattern. They are generally remote from dwellings and other intensive land use except where they cross the Quinspool Road. A.2.1 passes through lands in which a horticultural business is operated, while Route A.2 passes closer to a dwelling and a farm where an equine business operates.

Section 2

D.2 with the Link D.2 to D.1to D.1 is preferred.

Route B.1 (X – J) passes to the north an estate (Bishop Murphy Park) in Parteen, within view of houses and adjacent open space, and causes some severance to local settlement (albeit linear and dispersed) where it crosses the R464, with substantial local visual impacts as well as change to the structure and character of the area. The other routes avoid Parteen, traversing the rural landscape. Route D2 (X – K – M) takes the route most remote from dwellings, but crosses the Derryfadda bog and woodland and cuts diagonally across a hill. Route E1 (K – N) is also located relatively remotely from houses except for a stretch near the Rosmadda and Derryfadda Road junction, where it passes extremely close to several houses and would require a significant re-arrangement of the road network locally. Route D.2 with the Link to D.1 (X – K – L – M – N) crosses a landscape of particularly wooded character west of the bog, leading to the severance of numerous hedgerows and treelines, and crosses the Derryfadda Road closer to houses than the other routes. However there is existing vegetation screening at this road crossing.

14.0 Engineering Assessment

An assessment of each of the route corridors has been completed against a broad range of engineering parameters. This covers elements such as route length, complexity of the River Shannon crossing, the number of bridges, etc.

For the route corridor comparison, a number of assumptions were necessary to determine the types of junctions at the intersection between the proposed Limerick Northern Distributor Road and other roads. The types of junctions assumed for the comparison are based on the following:

- The recommended junction types in DMRB TD 41-42 for the proposed road cross sections comprise a combination of the following types:
    - Roundabouts;
    - Compact grade separation;
    - Left-in/left-out;
    - In urban areas, consideration will be given to signalising the whole junction to address safety concerns;
- Requirements for connection and allowable turning manoeuvres;
- Preliminary estimates of turning traffic at the junctions.

The length of the road and bridges through the floodplain and the impact of the route corridor on utilities was a significant factor in determining the cost of each route corridor.

The estimated cost of each element of the route corridors was calculated to create a predicted cost of each route corridor option. For Section 1 Route Corridor Option A2.1 has the lowest overall cost, although it is closely followed by Route Corridor A1. For Section 2, the shorter route option connecting to the R445 at the Groody Roundabout has the lowest overall cost.

15.0 Geology, Hydrology and Hydrogeology

Geology

The bedrock geology, soils and subsoils were identified to allow comparison of the routes. Preliminary ground investigations were also undertaken. The route corridors for each section were then ranked based on, a) the cut & fill earthworks balance of the alignment, b) the cumulative earthworks required, c) the length of the Route that passed through or impacted on soft alluvium, peat and/or fen deposits The extent of unfavourable soil and access conditions at the Tailrace Canal bridge approach were considered in Section 1. The extent of unfavourable soil and access conditions at the River Shannon bridge approach were also considered in Section 2.

Other factors relating to Karst, Land Use, Economic Geology and Geological Heritage are not likely to have significant impact for any of the alternative route corridors and therefore were not ranked. Pertinent observations regarding geotechnical risk issues such as karst features, land instability and landfilling are discussed in the main chapter but are not considered to have significant influence on route selection.

Section 1

The preferred Route that emerged from this analysis on the basis of soils and geology alone was Route Corridor Option A4, despite a higher total earthworks volume requirement. Option A2.1 may also be advantageous but covers significant lengths of soft ground. The worst Route was the southern Route Corridor Option A1.

Section 2

Route Corridor Option D1 was the least impacted by peat and fen areas and has the most advantageous location for the River Shannon crossing however Route B1 has better earthworks balance and total earthworks requirements. The worst Route Corridor Ooption is E1 with significantly higher earthworks requirements and worse soft ground/peat conditions. Overall Route Corridor Option D1 emerged as the preferred route.

Hydrology

The principal criteria used to assess and evaluate the route corridor options are:

- No. of significant watercourses crossed;
- Length of floodplain crossed;
- Surface water features.

A comparison of route corridors has been made based on the number and degree of likely impacts and along each corridor. This has established an order of preference from a hydrological perspective.

Where a similar number of likely impacts have been identified then the route corridor which affects the least number of high value attributes has been given preference.

In section 1, the route corridors identified as having the least impact are Route Corridor Option A2.1 and A4. In section 2, the route corridors identified as having the least impact are Route Corridor Option B1/D1/E1.

Hydrogeology

Bedrock geology and aquifer systems have been identified and characterised for consideration of the hydrogeological impacts of the scheme. The attributes and impacts that are assessed for each route corridor with respect to hydrogeology include:

- High yielding water supply springs and wells along each route corridor and increased risk presented by the road scheme;
- The classification (regionally important, locally important, poor) and extent of aquifers underlying each route corridor and increased risks presented to them by the road scheme (associated with aspects such as removal of subsoil cover, removal of aquifer (in whole or part), drawdown in water levels, alteration in established flow regimes, change in groundwater quality);
- Natural hydrogeological / karst features along each route corridor and the increased risk presented by the road scheme, and
- Groundwater fed ecosystems and the increased risk presented by the road scheme.

Estimation of the importance of hydrogeological attributes is based on criteria for rating site attributes as outlined in the NRA publication '*Guidelines on Procedures for*

Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes'.

Based on this assessment the preferred option in Section 1 is Route Corridor Option A4, with A1 and A2.1 being almost equal. In Section 2, the preferred Route Corridor Option is B1. Option E1 is least preferable due to higher aquifer vulnerability and the groundwater resources present.

16.0 Not Used

There is no Chapter 16 in this document.

17.0 Traffic Assessment, Economic Assessment & Road Safety

All route options considered will have a positive impact upon traffic within Limerick City centre by reducing the through traffic using all three city bridges. The Route Options that connect to the Cappamore Road junction are forecast to remove more traffic from the existing road network in Limerick than the other route options and perform best overall in terms of reducing delays, increasing average speeds, improving safety, and reducing carbon emissions. The following factors contribute to these findings:

- Route Options docking at the Cappamore Road junction generate the highest overall journey time benefits for the road network in Limerick during both the morning and afternoon peak periods. Along the R445 Annual Average Daily Traffic (AADT) is forecast to reduce by over 4000 AADT. A Management Option which has been investigated generates the least journey time benefits in both peak periods;
- Route options connecting to the R445 at the Groody roundabout are forecast to carry the highest traffic flows in the design year, which are estimated at approximately 34,000 AADT. The Management Option investigated carries the least amount of traffic with its highest AADT section forecast to be approximately 19,500 AADT. The highest safety benefits are generated by Route Options A2.1/B1/D1/E1(the preferred option) and A1/B1/E1, which are forecast to produce over 35% more safety benefits than the next best Route Option (A2.1/B1). The Management Option generates the least safety benefits;
- Both Route Options A2.1/B1/D1/E1 (preferred option) & A1/B1/D1/E1 have the biggest impact in reducing carbon emissions, with Route Option A4/B.1 performing least favourably;
- Route Option A2.1/B1/D1/E1 has the highest overall economic benefit, while the lowest economic benefit is attributed to the Management Option.

STUDY AREA BOUNDARY

DOCKING POINT A (LNDR PHASE 1)

DOCKING POINT B GROODY ROUNDABOUT

DOCKING POINT C KILMURRY ROUNDABOUT

DOCKING POINT D ANNACOTTY ROUNDABOUT

DOCKING POINT E JUNCTION OF R445 (DUBLIN ROAD) & R506 (CAPPAMORE ROAD)

LEGEND

- STUDY AREA
- PROPOSED COONAGH TO KNOCKALISHEEN DISTRIBUTOR ROAD SCHEME (LNDR PHASE 1)
- COUNTY AND CITY BOUNDARIES

Comhairle Contae an Chláir
Clare County Council

LIMERICK CITY COUNCIL
COMHAIRLE CATHRACH LUIMNIGH

An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

No.	Revision	Date	By	Chk'd	App'd
	Stage		Date		App'd
	PRELIMINARY				
	APPROVAL				
	TENDER				
	CONSTRUCTION				

Roughan & O'Donovan
Consulting Engineers
Civil - Structural - Transportation - Environmental

Arena House, Arena Road, Sandyford, Dublin 18.
Tel : +353 1 294 0800
Fax : +353 1 294 0820
e-mail : info@rod.ie
www.roughanodonovan.com

MRG consulting engineers
No.4 Day Place, Tralee, Co. Kerry
Telephone : (066) 7123130
Telefax : (066) 7123364
E-Mail : info@mrg.ie
Malone O'Regan McGillicuddy — CIVIL AND STRUCTURAL ENGINEERS

Project Title: LIMERICK NORTHERN DISTRIBUTOR ROAD

Drawing Title: ROUTE OPTIONS CONSIDERED

Designed:	Checked:	Approved:	Status:	Drawn:	Job No:	Drawing No:	Rev:
LF	MC	RTP	WORK IN PROGRESS	RE	10194	RCSR-ES	

Scale: 1:40,000 @ A3 — Date: SEPTEMBER 2012

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DOCKING POINT A
PROPOSED COONAGH TO
KNOCKALISHEEN SCHEME

DOCKING POINT E
JUNCTION OF R445
(DUBLIN ROAD) & R506
(CAPPAMORE ROAD)

LEGEND

- PREFERRED ROAD CORRIDOR
- PROPOSED COONAGH TO KNOCKALISHEEN DISTRIBUTOR ROAD SCHEME (LNDR PHASE 1)
- COUNTY AND CITY BOUNDARIES

Comhairle Contae an Chláir
Clare County Council

LIMERICK CITY COUNCIL
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Arena House, Arena Road,
Sandyford, Dublin 18.
Tel : +353 1 294 0800
Fax : +353 1 294 0820
e-mail : info@rod.ie
www.roughanodonovan.com

MRG consulting engineers
No.4 Day Place, Tralee, Co. Kerry
Telephone : (066) 7123130
Telefax : (066) 7123364
E-Mail : info@mrg.ie
Malone O'Regan McGillicuddy CIVIL AND STRUCTURAL ENGINEERS

Designed: LF | Checked: MC | Approved: RTP | Status: WORK IN PROGRESS

Project Title: LIMERICK NORTHERN DISTRIBUTOR ROAD

Drawing Title: PREFERRED ROUTE CORRIDOR

Drawn: SP | Job No: 10194 | Drawing No: RCSR-PRC | Rev:

Scale: 1:40,000 @ A3 | Date: SEPTEMBER 2012

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TABLE OF CONTENTS – VOLUME 1

Chapter 1 Introduction

1.1 Introduction

Clare County Council, in conjunction with Limerick City Council and Limerick County Council, has identified the need for the provision of a northern distributor route along the northern environs of Limerick City. The scheme is to be carried out in two phases;

- Phase 1 – Coonagh Knockalisheen Distributor Road (CKDR);
- Phase 2 – Limerick Northern Distributor Road (LNDR);

Phase 2 of the Limerick Northern Distributor Road connects to the Coonagh Knockalisheen Road Scheme at Knockalisheen Road and traverses the northern environs of Limerick City to the existing R445 (Old N7) to the east of Limerick City.

1.2 Extent of the Road Scheme

Phase 2 of the Limerick Northern Distributor Road falls within two counties, Limerick and Clare, with the River Shannon generally acting as the boundary. The area to the north and west of the River Shannon falls within County Clare and the area east of the River Shannon is within County Limerick. The location of the scheme is shown on Drawing RCSR – 101 in Volume 2 - Drawings of this report.

The existing road network in the proximity of the road scheme consists of a Motorway and a number of Regional and Local Roads. With the exception of the M7 – Limerick to Dublin Motorway to the south of the R445, there are no National Primary or Secondary Roads within the vicinity of the scheme. This may be a contributing factor to the relative low levels of development which have occurred within the lands enclosed by the River Shannon and the Ardnacrusha Headrace and Tailrace Canals.

The M7 Motorway which runs adjacent to the R445 at Castleconnell intersects the R445 (Old N7) at the Newport Roundabout. The R445 is a regional road that connects Limerick City to Nenagh. This road was downgraded to a regional road following the opening of the M7. The R463, R464 and R465 are three heavily trafficked regional roads within the Study Area that provide important strategic connections between south Clare and Limerick City.

1.3 Scheme Objectives

The proposed scheme will provide a northern distributor road around Limerick City, improving accessibility to the city from County Clare and relieving pressure on the existing river crossings in the centre of Limerick City. The road will provide significant improvement in connectivity between different areas along the northern fringe of the city, allowing people living in residential areas to the east of Limerick to access third level and educational facilities as well as employment areas in the west of Limerick and vice versa.

The Limerick Northern Distributor Road will promote balanced regional development in Limerick County and South Clare. After delivery of the proposed road, it is hoped that economic development will be encouraged as improved access attracts investment to the area. The fundamental objective of the scheme is, therefore, to provide a transport link between the eastern and western fringes of Limerick City and a link to South County Clare to facilitate economic development in this region.

1.4 Purpose of this Report

The purpose of this report is to outline the process undertaken to identify a Suitable Study Area for the examination of alternative routes, to identify key constraints within that Study Area, to develop feasible route options and to carry out systematic assessment of these options leading to the selection of a Preferred Route Corridor which will form the basis for the detailed design to follow. The report also describes the public consultations that occurred during the Constraints Study, at Route Options Stage and following the identification of an emerging Preferred Route Corridor.

The general requirements which inform the preparat6ion of a Route Corridor Selection Report are outlined in the 2010 NRA Project Management Guidelines.

1.5 Structure of this Report

This Route Corridor Selection Report has been prepared in two volumes, namely:

- Volume 1 – Main Text
- Volume 2 – Drawings

Volume 1 – Main Text describes the process of selecting the Preferred Route Corridor for Phase 2 of the Limerick Northern Distributor Road. This Volume should be read in conjunction with Volume 2 – Drawings, which is a book of A3 drawings presenting the findings described in this document.

Chapter 2 Need for the Scheme

2.1 Need for the Scheme

The Limerick Northern Distributor Road has been identified as an infrastructure objective of the Mid-West Regional Planning Guidelines 2010 – 2012. The Planning Guidelines were developed by the Mid-West Regional Authority which consists of Clare County Council, North Tipperary County Council, Limerick City Council and Limerick County Council. The need for the Limerick Northern Distributor Road is also supported by and has been incorporated into County Development Plans published within the mid-west region.

Historically, the need for the scheme was identified initially in 'The Limerick Planning, Land Use and Transportation Study' (PLUTS) for Greater Limerick. This study has been superseded by the Mid-West Regional Planning Guidelines 2010 – 2012 that were developed by Clare County Council, Tipperary North County Council and Limerick City and County Councils to guide and co-ordinate the planning and control of land use developments and the investment in and operation of transport systems within a significant part of the Mid-West Region focussed on the Limerick/Shannon gateway.

The Planning, Land Use and Transportation Study identified strategic issues that required consideration in the future planning of the region. The issues identified for County Clare focus upon the growth of Shannon Airport, the development of a West Coast Rail Corridor including the Shannon Rail Link, the development of a road network improving links between Limerick and Galway, the provision of a northern distributor road around Limerick and a new bridge crossing over the Shannon to the north of Limerick City.

The proposed scheme will provide a northern distributor road around Limerick, improving accessibility to Limerick City from County Clare and relieving pressure on the existing river crossings in the city centre. The road will provide significant improvement in connectivity between different areas along the northern fringe of the city, allowing people living in residential areas to the east of Limerick to access the employment areas in the west of Limerick and vice versa. This will reduce traffic flows in city centre and facilitate public transport initiatives including bus corridors.

The need for the scheme was further highlighted in the report compiled by John Fitzgerald *"Addressing issues of Social Exclusion in Moyross and other disadvantaged areas of Limerick City"*, which states that one of three strands to dealing with social exclusion involves "Economic and infrastructural regeneration, to create employment, unlock value, improve access, and create a better commercial and housing mix". The report states that the infrastructure around Moyross estate is "extremely weak with poor transport links to the rest of the city". Poor access to facilities, such as education and areas of employment, inhibits any progressive growth in disadvantaged areas.

The report states that previous experience has shown that *"a key element in developing economic activity, and ending the isolation of deprived areas, is through putting in place a sound roads and transport infrastructure".* The Limerick Northern Distributor Road will meet this objective, which the report claims will "open up potential for mixed-use development and attract investment, allow for improved transport links, and facilitate greater linkage between the local community and other parts of the city".

The scheme will provide this connectivity from the Moyross area to both the peripheral routes of Limerick City and to the national route network. The need for the scheme has also been identified as an important aspect of the regeneration of Moyross and is supported by the Limerick Northside Regeneration Agency.

2.2 Strategic and Local Policy Context

The development of the regional, county and local development plans are governed by a number of key documents at national and regional level. A synopsis of the key National and Regional policies and the compatibility of the Limerick Northern Distributor Road with existing transportation policies and plans is set out in the following sections:

- *The National Spatial Strategy;*
- *Regional, County and Local Development Plans*

2.2.1 The National Spatial Strategy (NSS) 2002-2020

The National Spatial Strategy (NSS) for Ireland is a twenty-year planning framework designed to achieve a better balance of social, economic, physical development and population growth between regions. Amongst other things, the NSS sets out a future spatial strategy in the form of a proposed National Transport Framework.

As an international and national transport hub, Limerick City in combination with Shannon, is seen as an important 'Gateway' in the Mid-West with the Limerick Northern Distributor Road supporting each of the following NSS objectives:

- *Support the economic growth of National Gateways;*
- *Promote balanced regional development;*
- *Achieve a better spread of investment and work opportunities across the country;*
- *Ensure that growth of towns and cities meets the economic and social needs of an increasing population, while also protecting the environment; and*
- *Improve quality of life for Irish communities.*

The NSS provides the basis for the roads programme contained in the National Development Plan which is a key element in meeting the above objectives.

2.2.2 Regional Planning Guidelines 2010 - 2022

The Mid-West Regional Authority developed the Regional Planning Guidelines 2010-2022 to set clear objectives and targets in relation to the development plans of the planning authorities that are specific in relation to future population, settlement strategy and development distribution and infrastructure investment priorities.

When considering these Guidelines, a number of key national policies and strategies were taken into account. The NDP 2000-2006 had set out the framework for this regional strategy. The NDP adopted four national objectives to underpin the strategy:

- *Continuing sustainable national economic and employment growth;*
- *Consolidating and improving Ireland's international competitiveness;*
- *Fostering balanced regional development;*
- *Promoting social inclusion.*

Key elements included stability-oriented macroeconomic policies, investment in infrastructure, commitment to a better regional distribution of public and private

investment, training policies attuned to the labour markets and a multi-faceted approach to social inclusion.

The NDP 2007 - 2013 (Transforming Ireland — A Better Quality of Life for All) set out a roadmap to Ireland's future. Since its publication, and particularly from 2008 onwards, Ireland has faced unprecedented international economic and financial factors which have given rise to a contracting construction sector and public finances that are under severe pressure.

Responding to this environment, government strategy was clear that future economic growth would depend on re-orientating the economy towards exporting goods and services. This will require the stimulation of enterprise, making use of the potential of the green economy, reducing the relative cost of doing business in Ireland, continuing to invest in both labour and productive infrastructure, increasing competition across the economy, attracting high value added employment, guiding the construction sector to a more sustainable growth path and addressing issues such as the cost and security of energy supply. All of these issues must be addressed within the context of the need to respond to issues of environmental sustainability including climate change while retaining services and supports for the weaker sections of society.

Taking all of the above into consideration, the Regional Planning Guidelines 2010-2022 identified the provision of the Limerick Northern Distributor Road as a key investment priority required to support the development of the region. The guidelines envisage the Limerick Northern Distributor Road as a crucial element of the strategic development of the Region, to enhance access to Shannon International Airport and its related industrial zone, and to enhance access to the University of Limerick and its associated knowledge based industrial zone.

Taking consideration of the Regional Planning Guidelines 2010-2022, the recently adopted Mid-West Area Strategic Plan (MWASP) have examined land-use and transportation issues in the region and include the following aims:

a) Strengthen and enhance the functionality of the Limerick-Shannon Gateway as identified in the National Spatial Strategy 2002-2020.
b) Provide guidelines for the promotion of a more balanced regional settlement pattern through a more structured dispersal of population.
c) Identify Limerick and the Mid-West strategic requirements for the next 30 years.
d) Inform future social, physical, educational and economic infrastructural spending programs.
e) Inform the current and future National Development Plans, Regional Planning Guidelines and National Spatial Strategy areas.
f) Aid in securing national funding.

The key attributes of a more sustainable form of spatial development for the Limerick Area are summarised as follows:

a) Development that is concentrated rather than dispersed allowing for the area to be served more efficiently by public transport.
b) Improved access to locations of employment, education, health, leisure and residence through the provision of a high quality sustainable public transport system.
c) Development of new residential neighbourhoods and employment zones that can be adequately served by public transport.

2.2.3 Mid West Area Strategic Plan

The Mid West Area Strategic Plan (MWASP) sets out the planning, land-use and transportation strategy for the local authority areas of Limerick City, Limerick County, Clare County and North Tipperary County Council's and their respective statutory councils.

The MWASP notes that Irish enterprises are operating in difficult times and facing severe challenges in terms of securing their business and retaining jobs. However, despite the current challenge facing the economy, Ireland's export sector, specifically in respect of multinational companies located here, continues to perform well. There is an expectation that the Irish economy will return to growth soon and increase that growth in the coming years. MWASP identifies the need to plan for that growth and establish a strategy that can identify the road to recovery for the Mid-West Region. The first step in that recovery has led to the establishment of a future vision for the Region. That vision is;

"The Mid-West Region and Limerick City as its capital, will realise its potential as a gateway region both nationally and internationally. The future of the region will be based on sustainable, economic, social equity and environmental drivers, which together will deliver an enhanced quality of life"

The vision has inspired the strategy and by implementing the recommendations outlined in MWASP, the region will develop with a strong City at its core which will drive the region's economy and improve its image. The resultant shall deliver a better quality of life for its citizens. Investment into the national secondary and regional road network and promote a number of new routes including the Limerick Northern Distributor Road has been identified as a key objective to achieving this vision.

MWASP notes that the regional and local road networks form a significant part of a regional transport strategy to aid in competitiveness, connectivity, accessibility and enhance the public transport offering and identifies the Limerick Northern Distributor Road to the north of Limerick City as one of the most important of these schemes. This scheme crossing up to three local authority jurisdictions would enable the region to connect and access the northern periphery of the city limits and protect the City Centre. It also brings the ability to make the regeneration area more accessible, enhance access to Limerick University and related industrial zones.

2.2.4 Smarter Travel – A Sustainable Transport Future

Smarter Travel – A Sustainable Transport Future, presents a transport policy framework for Ireland covering the period up to 2020. The policy, launched by the Department of Transport in 2009, sets out a vision, goals and targets to be achieved, and outlines 49 actions that form the basis of achieving a more sustainable transport future.

Whilst the document does not present a definitive list of requirements with respect to new infrastructure, it is nevertheless necessary to understand the compatibility of the proposed scheme with the actions set out in the policy document. These actions are grouped into four categories and the compatibility of the Limerick Northern Distributor Road with each of these categories is reviewed below:

Actions to Encourage Smarter Travel

Actions to encourage smarter travel by reducing distance travelled by private car which includes focusing population growth in areas of employment and to encourage people to live in close proximity to places of employment

This group of actions recognises the need to focus population and employment in a way that will minimise the potential for excessive transport demand. This will be achieved through consolidation of future growth in residential, commercial and retail development within existing settlements. The provision of significant increases in transport infrastructure in urban areas can influence development patterns, leading to a risk of subsequent sprawl, which threatens the consolidation model.

Actions to Deliver Alternative Ways of Travelling

These actions are aimed at ensuring that alternatives to the car, mainly through a radically improved public transport service and through investment in cycling and walking.

The Limerick Northern Distributor Road is to be developed to provide a local distributor road along the northern fringe of Limerick City from the western area of Knockalisheen to a tie-in along the R445. As a local distributor road, any potential route developed should be designed to distribute traffic within local neighbourhood areas and form a link between district distributors and access roads, while providing a potential bus corridor. The purpose of the road, while discouraging the major through movement of general traffic, will be designed to encourage public transport use, cyclists and pedestrians.

The potential for cycling and walking is most relevant within Limerick City and South County Clare. The proposed Limerick Northern Distributor Road will support the consolidation of sustainable development in Limerick City and South County Clare, in addition to improving the walking and cycling conditions by means of removing significant volumes of traffic along many of the Regional and Local Roads in the area.

These actions are also fully supported by the proposed scheme.

Actions to Improve the Efficiency of Motorised Transport

These actions are aimed at improving the fuel efficiency of motorised transport through improved fleet structure, energy efficient driving and alternative technologies. Actions within this group are more related to vehicles and driving methods, and are therefore not particularly relevant to the proposed scheme.

Actions to Ensure Integrated Delivery of the Policy

These actions are aimed at strengthening institutional arrangements to deliver the targets. The establishment of Demonstration Towns, the formulation of the National Sustainable Travel Office and publication of the Sustainable Travel and Transport Bill are included in this heading.

The Smarter Travel document sets a target of reducing work-related commuting by car from 65% to 45% over the life of the policy, with no significant increase in vehicle km of the national car fleet between 2006 and 2020. It is important to note that the document sets these as targets which subsequent initiatives should strive to achieve. In other words, the Smarter Travel policy document alone will not lead to those targets being met, and hence the targets presented therein cannot be used as the basis for forecasting of future travel demand. As actions are progressed into projects

and subsequently delivered, their impact on travel demand can be quantified and incorporated into future analyses.

The proposed scheme will therefore support Smarter Travel through improving accessibility for public transport services, and improving the potential for strong growth in walking and cycling along Regional and Local Roads that will have a decrease in traffic flows. The alignment will support consolidation of development within South County Clare and will support more efficient driving through the provision of higher quality infrastructure

2.2.5 County and Local Development Plans

The proposed development is in accordance with the transport policies and objectives in the county and local development plans of Limerick City, Limerick County, Clare County and South Clare County Councils.

Clare County Council Development Plan 2011-2017

The transport objectives of the Clare County Council Development Plan are presented and include the following:

- *To provide a safe and efficient network of transport to serve the needs of the people, goods and services travelling to and within County Clare*
- *To provide access for all*
- *To safeguard the strategic transport function of the motorway and national road network and associated junctions in order to cater for the safe and efficient movement of inter-urban and inter-regional traffic*

CDP 11.4: Strategic Development of National Road Network outlines that the objective of Clare County Council is:

- *To seek to facilitate the development of the motorway, national primary and secondary routes in the County in accordance with Government policies, Transport 21, the National Development Plan 2007-2013, and in co-operation with the National Roads Authority.*

With this policy in mind, the Development Plan is particularly supportive of this particular scheme. CPD 11.7: Development of Regional Roads and CPD 11.8: Proposed Projects Identified for the Future Development specifically references the Northern Limerick Distributor Road, stating that Clare County Council wish :

- *To upgrade and improve, where necessary, the regional roads in the County as outlined in Table 11.1 and 11.2*
- *To provide and facilitate the projects as identified in Table 11.2 where necessary, and to ensure that such road infrastructure is designed and constructed to fulfil its intended purpose*

Table 11.2 of the County Development Plan identifies the future development of the Northern Limerick Distributor Road (Knockalisheen), providing linkage and access to UL campus between Coonagh on the N18 and the R445 main Dublin road, via a route to the north of the University of Limerick. **Refer Drawing RCSR – 201 in Volume 2.**

This scheme recognises the importance of the University of Limerick as a critical driver of economic development and the fostering of an innovative, knowledge-based economy for the County and Mid-West and West regions. There is significant potential for the University to expand further northwards into County Clare within the designated University Zone **(refer drawing RSCR-703).** However, the critical issue to be resolved is the lack of proper vehicular access to the Campus from County Clare and the Council will seek to collaborate with all relevant parties in resolving this issue over the lifetime of the Plan.

The proposed scheme will address this issue and provide linkage and access to the University of Limerick (UL) campus between Coonagh and the N18 and the R445 (old N7) to the south of the university.

South Clare Local Area Plan (2009-2015)

The South Clare local area plan refers to the Limerick Northern Distributor Scheme with importance, stating that significant development depends on its construction in the South Clare area. Such development includes the expansion of UL to provide the opportunities for the growth of a research and development industry and also of Parteen Village in which development has been constrained by the limitations of the available infrastructure.

The expansion of UL would only be supported and encouraged by the Council dependant on the following:

- *That there is provision of appropriate vehicular, pedestrian and cycle access from within County Clare to both sides of the university campus.*
- *The necessary services and roads infrastructure are in place to serve the expansion*

The plan also outlines objectives for the Parteen villages, stating that there is a requirement to:

- *To acknowledge the existing chronic deficiencies in the local road network and consolidate rather than expand the villages in the short term*
- *To work in coordination with Limerick City Council and Limerick County Council to facilitate the development of the proposed Northern Distributor Road as a matter of priority.*

Major expansion of these villages has been ruled out in the local area plan due to poor transportation. Improvement in roads infrastructure in particular depends upon the construction of the proposed scheme.

Draft South Clare Local Area Plan (2012-2018)

This draft local area plan includes a reference to the Northern Distributor Road with respect to the expansion of the Parteen villages. The plans states that future expansion will be constrained for several reasons, one being the following:

- *Poor road infrastructure, which rules out any significant expansion of the villages until such time as the Northern Limerick Distributor Road has been constructed*

Limerick County Council Development Plan 2010-2016

The Limerick County Council Development Plan sets out objectives and policies for Transport and Infrastructure in the county. The development plan initially refers to the transport objective of the Council's Corporate Plan 2003-2009 which is:

- *To provide and maintain a safe and effective transportation network within the County incorporating the principles of sustainable development, social inclusion and environmentally friendly work practices*

Policy IN P2: Suitability of Facilities states that the provision of and access to quality facilities must be suitable for the users to serve the following:

- *To serve the social, economic and recreational needs of the community*

Sustainability, good quality design and safety are also vital to the provision of these facilities. Policy IN P7: Road Safety and Capacity further expands on the need for safety and also for increase in capacity for the growing community around the county by stating that it is Council policy:

- *To seek the improvement of road safety and capacity throughout the County, through minimising existing traffic hazards, preventing the creation of additional or new traffic hazards in the road network*

Policy IN P5: Socially Inclusive Access elaborates on the users of the transport network, acknowledging the widest range of needs are considered in the design and planning of infrastructure and the integration of land use, infrastructure and transport modes, including:

- *Pedestrians, cyclists, and those with diverse cognitive, mobility and sensory abilities and impairments*

Limerick City Council Development Plan 2010-2016

The Limerick City Council Development Plan presents the key features they require for a more sustainable form of spatial development for the Limerick Area, one of which is:

- *Improved access to locations of employment, education health, leisure and residence through the provision of a high quality sustainable public transport system.*

Policy TR.1: Strategic Transportation Issues states that the Council intends to:

- *Implement the objectives and strategies of the National Development Plan, Transport 21, Smarter Travel and any other transport plans that may arise*

In support of this proposed scheme, Policy Tr.5: Enhancement of Road Infrastructure, the Council states that they wish to:

- *Maintain and enhance the planning, design and maintenance of the transportation and roads infrastructure in the City to ensure improved safety, promote economic growth, social inclusion and amenity for all road users*

by providing new road infrastructure and improvements to existing road infrastructure to meet the projected demand by traffic, public transport, cycling and pedestrians in the future.

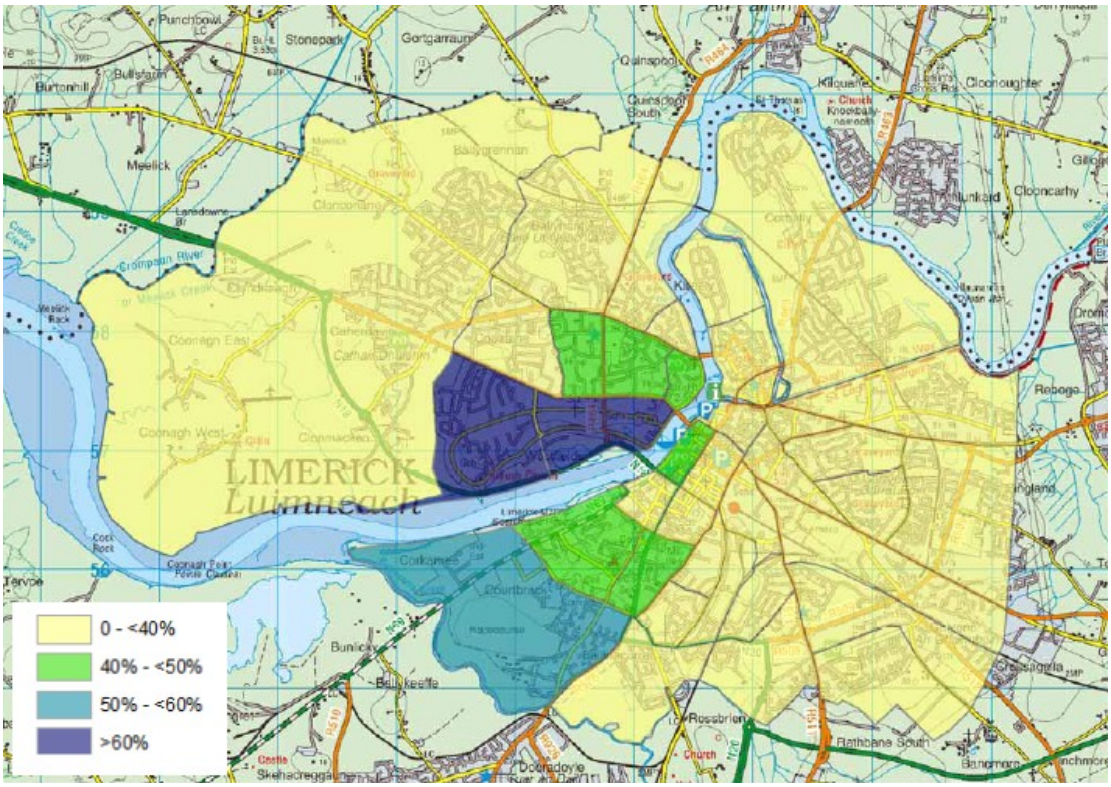
The Castletroy Local Area Plan (2009-2015) identifies the proposed Northern Distributor Road. **Refer drawing RCSR – 202** in Volume 2.

2.2.6 Census 2011

The Need for the Scheme is emphasised in the recently released publication from the Central Statistics Office in its series of Census 2011 results. The publication, "*Profile 3 At Work - Employment, occupations and industry in Ireland*", is the third Profile report examining census results in more detail and presents first results on detailed industry and occupations along with further analysis of the labour market. It looks at the industries and occupations which are rising and falling as well as examining unemployment with regard to immigration, education and other social and demographic factors.

The publication identifies that Limerick city had the highest levels of youth unemployment with rates of 50 per cent, in effect half of all young people in the labour force. In Limerick city, only 29 per cent of Limerick city's workforce labour force held third level qualifications. A further 29 per cent of Limerick city's labour force had an educational qualification no higher than lower second level. Figure 2.1 highlights the areas within Limerick city where the labour force with a Third Level Qualification are the lowest.

Figure 2.1 Percentage of the Labour Force with a Third Level Qualification



The stated objective of the Limerick Northern Distributor Road is to provide significant improvement in connectivity between different areas along the northern fringe of the city, allowing people living in residential areas to the east of Limerick to access third level and educational facilities as well as employment areas in the west of Limerick.

2.3 Development of the Scheme

The Limerick Northern Distributor Road is a Local Authority Project that will provide a local distributor road around the northern fringe of Limerick City. The road is not proposed to be a national route. The scheme is to be developed adopting the current best engineering practices within the NRA 2010 Project Management Guidelines.

The aim of this report is to present a preferred Route Corridor Option. The study for this report has been conducted following the Constraints Study, and incorporating the recommendations of Limerick City Council, Limerick County Council and Clare County Council as well as any submissions received as part of the Public Consultation Process.

Chapter 3 Constraints Study

3.1 Introduction

The initial step in the Route Selection Process is to identify the nature and extent of significant constraints within a defined Study Area. This chapter outlines the process by which the Study Area was defined and documents significant constraints identified. The constraints identified were mapped (Refer Volume 2 – Drawings) to facilitate the design of a number of feasible route options to avoid the constraints, where possible

This chapter only outlines the constraints that were identified up to the stage where a number of feasible route options were developed. The constraints gathering exercise completed to that stage was primarily a Desktop Study, with the extent and the nature of certain constraints verified by means of Windshield or Walkover Surveys. Further constraints were identified during subsequent Public Consultations through submissions received from members of the public and statutory bodies. These constraints are documented later in this Report to reflect the stage in the Route Selection Process that they were identified.

3.2 Defining the Study Area

3.2.1 Introduction

The area selected for investigation should comprise a viable Study Area holding potential for feasible route options and excludes those areas which are non-viable because of issues such as topography, urban development, protected sites and non fulfilment of purpose.

As identified in the project brief, the Limerick Northern Distributor Road is being developed in two phases as follows:

- **Phase 1 -** Coonagh Knockalisheen Distributor Road (CKDR);
- **Phase 2 -** Limerick Northern Distributor Road (LNDR) from the western tie-in around the Coonagh Knockalisheen Road Scheme to the existing R445 (Old N7) to the east of Limerick City.

This Route Selection Report does not cover the area west of the Knockalisheen Road as the design for the proposed Coonagh Knockalisheen Road has been developed to provide Phase 1 of a Northern Distributor route, providing a link from the R445 at Coonagh to Moyross with upgrades to the Knockalisheen Road.

The scope of the Study covers the area either side of Parteen/Ardnacrusha from the western tie-in of the Coonagh Knockalisheen Distributor Road Scheme to the existing R445 (Old N7) to the east of Limerick City.

A preliminary study was carried out by collecting information on the major constraints within an initial Study Area. This information was collated in order to determine the best route possible resulting in minimal environmental impact. Constraints considered as part of the Study included:

- Engineering constraints;
- Existing infrastructure, land use, topography and physical features;
- Planning, development and socio-economic character;
- Sites or areas of environmental significance or sensitivity.

Collation of the above information facilitated the creation of a Study Area within which the constraints study is based.

3.2.2 Study Area

The Study Area for the Limerick Northern Distributor Road Scheme is indicated in the Volume 2 of the Constraints Study (Refer **Drawings RCSR-3101 to RCSR-3105 in Volume 2** for detailed maps of the Study Area). The general principle that was used to define the extents of the Study Area was that it should be wide enough to include all reasonable route options, but that it should not be excessively wide as to entail collection of a large amount of information for a heavily developed urban area that would prove of little relevance to the project.

In creating an initial review of the Study Area the following broad constraints were considered:

- Land use;
- Ecology;
- Engineering;
- Archaeology;
- Purpose of the Scheme.

Land Use Constraints

In a developed urban environment, land use has a major influence on possible route corridors for a road scheme not only in terms of economic, cultural, environmental, heritage and recreational issues but on impacts on local communities. The existing land uses and strategic zoning for future developments within the Study Area have been established. Where significant open spaces are available a route could be developed. The workability of such routes in traffic and engineering terms is also investigated. The Study Area includes sections of urban development at Knockalisheen, Parteen, Ardnacrusha, Gortatogher, Newtown, Cloonlara, Roo East, Cloonougher and Gilloge. To the western end of the Study Area, a large area of land in Clare County at Garraun is zoned for the development of the University of Limerick. In County Limerick, the land bounded by the Mulkear River and the adjacent National Technology Park is zoned for Industrial Development. Further south, the land from the National Technology Park to the R445 in Castletroy is zoned for residential development.

Ecological Constraints

An examination of sites of natural heritage and areas of conservation identified the following constraints within the Study Area;

- Knockalisheen Marsh (Refer Photo 3.2.1), a proposed Natural Heritage Area (pNHA) and a candidate Special Area of Conservation (cSAC);
- Lower River Shannon, a candidate Special Area of Conservation (cSAC).

The marsh extends from the junction of the R464 and Knockalisheen Road to the Knockalisheen graveyard. The western boundary of the Study Area, running parallel to the Knockalisheen Road was extended northward beyond the graveyard and the town land of Knockalisheen/Ballycannan to facilitate the development of potential routes outside Knockalisheen Marsh.

Photo 3.2.1 – Knockalisheen Marsh

The Lower River Shannon, a candidate Special Area of Conservation (cSAC) continues along the entire length of the River Shannon within the Study Area.

Engineering

The Limerick Northern Distributor Road, from the Knockalisheen Road to the tie-in point at the R445 (Old N7) or M7, will be required to cross the River Blackwater, the Errina Canal and the River Shannon and either the Tailrace or Headrace Canals at Ardnacrusha.

Headrace/Tailrace Canal

Due to the limited open corridor space available to provide a crossing over the Tailrace Canal between Parteen and Ardnacrusha, it was determined that the Study Area should extend northwards to allow for the examination of a potential crossing over the Headrace Canal.

The extension of the northern boundary of the Study Area was restricted by the increasing ground levels to the northwest of Ardnacrusha towards Ballycannan West. Thus the northern boundary of the Study Area was set so as to allow examination of potential routes to the north of Knockalisheen and Ardnacrusha while skirting along the foothills of Ballycar.

Shannon, Blackwater and Groody Rivers

The extensive floodplain of the Shannon basin and the meandering characteristics of the River Shannon were identified as significant engineering constraints. Any potential route for the Limerick Northern Distributor Road would be required to traverse a vast floodplain and potentially cross the River Shannon at an acute angle. The Study Area was defined so as to provide a number of viable engineering options for crossing the River Shannon into East Limerick. As such, the southern boundary of the Study Area extended south of the River Shannon in the Groody Valley to facilitate

a potential tie-in with the R445. To the east of the University of Limerick, the Constraints Study was developed to provide a number of potential crossing points along the Shannon.

Archaeology

Following review of discovery mapping and subsequent site visits, numerous sites of potential archaeological interest were identified. These sites included the following;

- Knockalisheen Graveyard
- Cappavilla South Holy well
- Garraun Church and graveyard
- Srawickeen Enclosure
- Castletroy Tower House
- Mountshannon House (Refer **Plate 3.2.2**)

The Study Area was defined to allow for the development of potential route options through the Study Area that would minimise the impact of the Limerick Northern Distributor Road on these potential sites of archaeological interest.

Plate 3.2.2 – Mountshannon House

Purpose of the Scheme

The Limerick Northern Distributor Road is to be developed to provide a distributor road along the northern fringe of Limerick City from the western residential areas at Knockalisheen to potential tie-in at the R445 (Old N7) or M7. As a distributor road, any potential route developed should be designed to distribute traffic within local neighbourhood areas and form a link between district distributors and access roads, while facilitating the potential development of a bus corridor. The purpose of the road, while discouraging the major through movement of general traffic, will be designed to encourage public transport use, cyclists and pedestrians.

The objectives of the Limerick Northern Distributor Road outlined above, were used to define the eastern boundary of the Study Area. The eastern boundary of the Study Area runs from Oakfield, north of the Headrace Canal, in a south westerly direction past Newtown Cloonlara, Illaunyregan and Prospect to the M7. This was deemed to be the limit of the eastern boundary, as any extension of the boundary further east would compromise the objectives of the scheme, discourage public transport use, cyclists and pedestrians and fail to distribute traffic within local neighbourhood areas.

3.3 Public Consultation

The Limerick Northern Distributor Road, a distributor road, is being progressed in accordance with the NRA 2010 Project Management Guidelines. As outlined in the guidelines, the first public consultation is scheduled to be held when a number of feasible Route Options have been developed and agreed with members of the Technical Steering Committee. This stage of the public consultation process will be held to inform members of the public and affected landowners of these Route Options.

The Constraints Study, defined in the guidelines as the initial step in the route selection process does not envisage a formal public consultation. However the guidelines state that the public should be made aware of the proposal to develop a number of route options leading to the selection of a Preferred Route Corridor.

In accordance with NRA 2010 Project Management Guidelines, the lead Local Authority, Clare County Council undertook to raise awareness of the Scheme amongst members of the public.

Details of Publicity Information

In order to raise awareness of the proposed scheme amongst members of the public, the following measures were undertaken by the lead Local Authority:

Briefing

On the Tuesday, 26th October 2010, Clare County Council held a presentation and a briefing at the Radisson Hotel, County Limerick to notify Elected Members of the affected Local Authorities of the proposed scheme.

Newspaper Advertisements

A Press Advertisement relating to The Limerick Northern Distributor Road was published in the Clare Champion dated Friday, 12th November 2010 and the Limerick Leader dated Thursday, 11th November 2010 (county edition) and Friday, 12th November 2010 (city edition) in advance of public information leaflets being made available to the public.

Radio Advertisements

Appropriate announcements were broadcast on the Clare FM and Limerick Live 95FM over the course of the weekend of 13th and 14th November 2010.

Web Advertisements

The Press Advertisement was posted on the each of the affected Local Authorities' websites in advance of Wednesday, 17th November 2010.

Publicity Information Leaflets

Publicity Information Leaflets were made available to members of the public from Wednesday, 17th November 2010 to Wednesday, 15th December 2010 at the following Local Authority Offices:

- Clare County Council, Áras Contae an Chláir, New Road, Ennis;
- South East Clare Area Office, Westbury Centre;
- Limerick County Council, County Hall, Dooradoyle;
- Annacotty Area Office, Limerick County Council, Rivers, Castletroy;
- Limerick City Council, City Hall, Merchants Quay, Limerick City.

The publicity Information Leaflets provided details of the proposed Limerick Northern Distributor Road, explained the process involved in undertaking a Constraints Study and outlined the programme, subject to funding made available, to progress the scheme from the Constraints Study to both the first and second public consultations. The leaflet incorporated a map of the Study Area for members of the public to review. In addition, each of the above Local Authority Offices was provided with an A1 Map of the Study Area to show to members of the public if request at the above named offices.

3.3.2 Responses to the Publicity Information

The Press Advertisement and the Information Leaflet provided information to allow members of the public to email or post submissions to Clare County Council with regard to the Study Area.

Public Submissions

Following the publication of the Study Area, Clare County Council received submissions were received from the public in relation to the Study Area. The submissions received were primarily from members of the farming community. The submissions requested that full and due consideration be given to limit the impact of severance on existing farms.

A submission was also received from Parteen IFA on behalf of the farmers within the Study Area. The submission followed a briefing with representatives from the Irish Farmers' Association (IFA) held by Clare County Council at the South East Clare Area Office in the Westbury Centre on Tuesday, 7th December 2010.

The briefing, held at the request of the Parteen IFA following the publication of the Information Leaflets, outlined details of the proposed Limerick Northern Distributor Road, explained the process involved in the undertaking of a Constraints Study and outlined the programme, subject to funding made available, to progress the scheme from the Constraints Study to the first public consultation.

With regard to the extent of the Study Area, a submission received highlighted the following:

- The extent of the western boundary of the Study Area implied that a connection point with the eastern end of the Coonagh Knockalisheen Distributor Road was predetermined;
- The provision of a potential link road between the Northern Distributor Road and the Groody Roundabout would enhance the prospect of the western expansion of the University of Limerick.

Appendix 3.3.1:

Constraints Study Brochure

Need for the Scheme

The need for the scheme was identified in the 'Mid-West Regional Planning Guidelines 2010 - 2022', prepared by the Mid-West Regional Authority which consists of Clare County Council, Tipperary North County Council and Limerick City and County Councils. The guidelines identified many strategic issues that required consideration in the future planning of the region including the need for the provision of a northern distributor road around Limerick City to support the development of the region.

The Fitzgerald Report 'Addressing the issues of Social Exclusion in Moyross and other disadvantaged areas of Limerick City' (April 2007) has recommended that a distributor road to the north of Limerick City be progressed to develop economic activity and end the isolation of this deprived area.

The various local and county development plans published by Clare County Council and Limerick City and County Councils make provision for the delivery of the proposed road scheme.

Your Comments are Important

Submissions and observations, in writing, are invited from interested groups or individuals regarding the scheme. All submissions should be clearly endorsed with the project's name, Limerick Northern Distributor Road - Phase 2, and emailed to LNDR@clarecoco.ie or posted to the undersigned on or before Friday, 11th May 2012.

Administrative Officer,
Transportation Section,
Clare County Council,
Áras Contae an Chláir,
New Road,
Ennis,
Co. Clare.

Limerick City Council
Comhairle Cathrach Luimnigh

Limerick Northern Distributor Road - Phase 2

Public Consultation No. 2
Preferred Route Corridor Stage






Scheme Objectives

The proposed scheme will provide a northern distributor road around Limerick City, improving accessibility to the city from County Clare and relieving pressure on the existing river crossings in Limerick City. The road will provide significant improvement in connectivity between different areas along the northern fringe of the city, allowing people living in residential areas to the east of Limerick to access employment areas in the west of Limerick and vice versa. Improved access to the University of Limerick is another important consideration.

The Limerick Northern Distributor Road will promote balanced regional development in South Clare and Limerick. After delivery of the proposed road, it is hoped that economic development will be encouraged as improved access attracts investment to the area.

The fundamental objective of the scheme is, therefore, to provide a transport link between the eastern and western fringes of Limerick City and a link to South County Clare to facilitate economic development in this region.

It is envisaged that the Limerick Northern Distributor Road Phase 2 will be a dual carriageway, providing two lanes in each direction with pedestrian and cyclist facilities. All right turn manoeuvres directly off the dual carriageway will be prohibited and provided for by the introduction of roundabouts in conjunction with restricted left-in, left-out junctions and accesses.

What Happens Next?

Following this Public Consultation period, an analysis of all views expressed and submissions received on the emerging Preferred Route Corridor will be undertaken.

If the emerging Preferred Route Corridor is confirmed, the route corridor will be submitted to the Planning Authorities to safeguard the provision of Phase 2 of the Limerick Northern Distributor Road.

The Preferred Route Corridor will be further developed during the design stage with the completion of an Environmental Impact Statement. The Statutory Orders and the Environmental Impact Statement will be published in advance of an Oral Hearing which may be required by An Bord Pleanála.

Further Information

www.clarecoco.ie/roads-and-transport
www.limerickcity.ie/Transport
www.lcc.ie/Roads/

March 2012

The purpose of this public consultation is to inform the public of the emerging Preferred Route Corridor and invite written submissions on any aspect of the proposals. A questionnaire is included within this information leaflet to assist you in making comment. All submissions will be recorded and considered in the confirmation of the Preferred Route Corridor and the development of the proposed road during the design stage.

An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

Roughan & O'Donovan
MRG consulting engineers

Background to the Scheme

Clare County Council, in conjunction with Limerick City Council and Limerick County Council, has commenced the planning process to advance the development of the Limerick Northern Distributor Road - Phase 2 and associated infrastructure from a location in the vicinity of the eastern end of the proposed Coonagh-Knockalisheen Strategic Route to a tie-in with the R445 (Old N7) in County Limerick. The Coonagh-Knockalisheen Scheme is Phase 1 of the Limerick Northern Distributor Road Project.

The scheme will comprise the design and construction of approximately 10km of a distributor road that will include a crossing of the Ardnacrusha Tailrace and the River Shannon, together with crossings of the River Blackwater and the Errina Canal.

In December 2010, members of the public were made aware of the proposal to develop a number of route options leading to the selection of a Preferred Route Corridor. A number of route corridor options were subsequently developed and presented to the public in June 2011 at Public Consultation No. 1. Public exhibitions were held at the Greenhills Hotel, Ennis Road, Limerick. Display material was also available for inspection for a four week period at the following locations;

- Clare County Council, Áras Contae an Chláir, New Road, Ennis, Co. Clare.
- South East Clare Area Office, Westbury Centre, Knockballynameath, Co. Clare.
- Limerick County Council, County Hall, Dooradoyle, Co. Limerick.
- Annacotty Area Office, Limerick County Council, Rivers, Castletroy, Co. Limerick.
- Limerick City Council, City Hall, Merchants Quay, Limerick City.

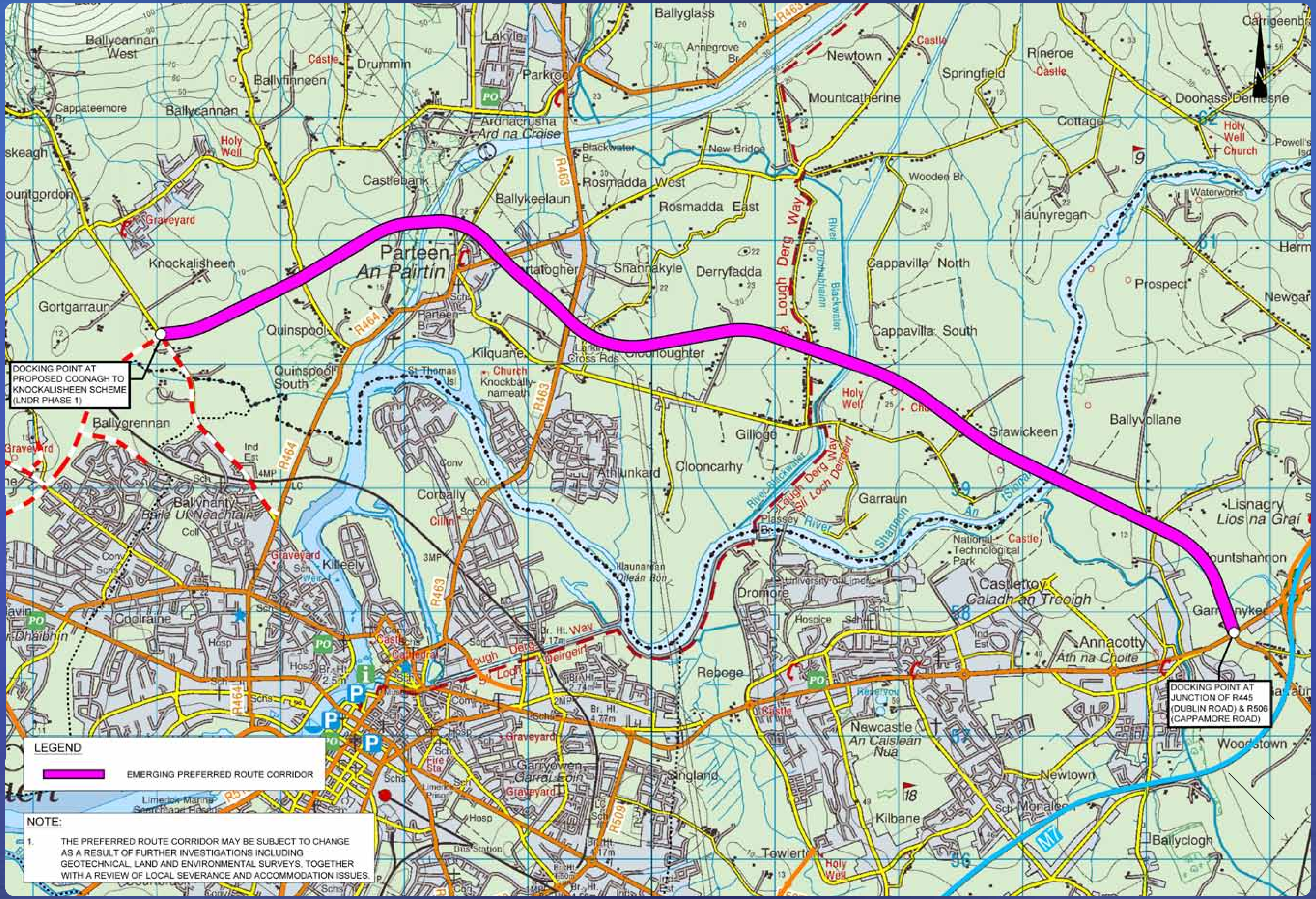
The route corridor options, together with the feedback received from the public have been carefully assessed under the following five headings;

- Environment.
- Economy.
- Safety.
- Accessibility and Social Inclusion.
- Integration.

This has led to the selection of an emerging Preferred Route Corridor which is presented on the facing page.

Programme of Public Consultations

Public Consultation	Period	Status
Constraints Stage	Q4 2010	Complete
Route Corridor Options (PC1)	Q2 2011	Complete
Preferred Route Corridor (PC2)	**Q1 -Q2 2012**	**Now in Progress**



Comhairle Contae an Chláir
Clare County Council

LIMERICK CITY COUNCIL
COMHAIRLE CATHRACH LUIMNIGH

Limerick Northern Distributor Road – Phase 2
Public Consultation No. 2 Questionnaire

We greatly appreciate your views on the proposed scheme and any additional information you would like considered in the development of the emerging Preferred Route Corridor.

Please complete this form and return it, using the prepaid envelope provided, to the undersigned on or before Friday, 11th May 2012:

Administrative Officer,
Transportation Section,
Clare County Council,
Áras Contae an Chláir,
New Road,
Ennis,
Co. Clare.

Email: LNDR@clarecoco.ie

Name _____

Address _____

_____

Telephone _____

E-mail _____

1. Do you own, rent or occupy property affected by the emerging Preferred Route Corridor?

Own ☐ Rent ☐ None of these ☐

If so address of property: _____

2. Description of Property

Residential ☐ Farm ☐ Commercial ☐ Other ☐

3. Do you agree in principle with the proposed scheme?

Yes ☐ No ☐ Unsure ☐

Reasons: _____

4. Would you be a regular user of the proposed scheme?

Yes ☐ No ☐

Further Comment

_____

_____

An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

5. Are there any areas or features you believe should be considered in the development of the emerging Preferred Route Corridor?

_____

_____

_____

_____

6. What do you regard as the main advantages/disadvantages of the proposed scheme?

_____

_____

_____

_____

7. Are there specific issues you feel should be addressed in the Environmental Impact Statement?

_____

_____

_____

_____

8. Please provide any other views or opinions.

_____

_____

_____

_____

_____

_____

_____

_____

_____

Continue on a separate sheet if required.

3.4 Engineering and Topography

3.4.1 Geographical Description

The Study Area is located within both County Clare and County Limerick. The River Shannon defines the boundary between the two counties; with Limerick County to the south of the River Shannon and County Clare to the north and west of the Shannon.

The Study Area, located within the floodplain of the lower regions of the River Shannon, is low lying and has a topography which is predominantly flat. The upland regions of Woodcock Hill and Ballycar South are located to the north of the Study Area. **Photo 3.4.1** shows the topography from the foothills of Ballycar South looking south towards Limerick City.

Photo 3.4.1 – Existing Topography of Western Extent of Constraints Area

The confluences of the River Shannon with the Blackwater and Mulkear Rivers occur within the Study Area. The other significant water bodies located within the Study Area are the Ardnacrusha Headrace and Tailrace Canals and the Errina Canal. The Headrace Canal commences at Parteen Weir, located at the southern end of Lough Derg, and is 11.6km in length. The Headrace Canal ends at Ardnacrusha Power Station and it is from here that the Tailrace Canal commences. The Tailrace Canal joins the River Shannon south of Parteen Village. Both of these canals along with the River Shannon are operated and maintained by the ESB. The headrace canal is shown on **Photo 3.4.2**.

Photo 3.4.2 – Headrace Canal at Ardnacrusha

The River Shannon flows in a south westerly direction, meandering through the south eastern end of the Study Area. The Blackwater River flows in a north-south direction through the Study Area, traversing beneath the Headrace Canal before flowing into the River Shannon to north of the University of Limerick. The Mulkear River flows in a north westerly direction through Annacotty and flows into the Shannon north of the National Technological Park. The Groody River flows in a south-north direction under the R445 before flowing into the River Shannon at Groody Valley. The Errina Canal passes through the centre of the Study Area running from the River Shannon to the south of O'Briensbridge to Limerick city.

3.4.2 Flooding and Drainage

The Study Area is dominated by the River Shannon and its expansive floodplain. The Shannon River Basin is the largest in Ireland and drains a total area of 18,000 square kilometres between its source in the Cuilcagh Mountains in Cavan and Fermanagh to the tip of the Dingle Peninsula in Kerry.

The river takes a sinuous route through the Study Area along a North East to South West axis from the townland of Prospect to Limerick City. There are no lakes along this section of the river however the low lying ground in the area is subject to flooding (Refer **Drawing RCSR-3401 in Volume 2**). The extent of flooding adjacent to the National Technological Park in November/December 2009 is shown on **Plate 3.4.3.**

Plate 3.4.3 - Extent of November/December 2009 flooding north of the National Technological Park

The nature of this extensive floodplain and the occurrence of routine flooding can be regarded as a constraint as it may give rise to difficult and unsuitable ground conditions that may require significant bridging and culverts. Furthermore, roads constructed across flood plains may, without appropriate mitigation, affect the nature and extent of flooding in the area. Bridges and road embankments can obstruct the path of floodwaters, causing re-direction and re-distribution of the flow over the floodplains and within the channel, although this can be avoided by appropriate design.

It should be noted at this point that the selected route will have to comply with Section 50 of the Arterial Drainage Act 1945, the purpose of which is to ensure that the existing conveyance and storage capacities of channels and floodplains are maintained. The selected route will also have to comply with the requirements of Waterways Ireland, the OPW and ESB Fisheries.

The proposed scheme will have to cross the River Shannon and the River Blackwater and their respective floodplains. Therefore, based on this information and from the perspective of construction difficulty, throughout the route selection process the extent of floodplain to be crossed was a key constraint in the selection of the preferred river crossing.

3.4.3 Existing & Future Road Network

Existing Road Network

The Study Area contains a road network ranging from a Motorway to a number of Regional and Local Roads however there are no National Primary or Secondary Roads within the Study Area. This is seen to contribute to the relative low levels of development which have occurred within the lands enclosed by the River Shannon and the Ardnacrusha Headrace and Tailrace Canals.

The recently constructed M7, Dublin to Limerick road runs along the eastern extremities of the Study Area where it intersects the R445 (Old N7) and the R503. The M7 continues south bypassing Limerick City where it intersects the M20 Limerick to Cork Road and the N18 Limerick to Ennis Road.

The R445 is a regional road that connects Limerick City to Nenagh. This road was downgraded to a regional road after the opening of the M7. The R503 is a regional road that passes through the southern extremities of the Study Area adjacent to the M7. This road provides a link between Limerick City and Thurles, Co. Tipperary.

The R463, R464 and R465 are three heavily trafficked regional roads that provide important strategic connections between south Co.Clare and Limerick City. In addition, existing traffic issues on the Corbally Road are a significant constraint when travelling through Limerick City.

The R464 links the village of Parteen and the western side of Limerick City. East of Parteen, the R464 intersects the R463 which runs in a north south direction between Ardnacrusha and the centre of Limerick City, south of the River Shannon. The R463 turns east after crossing the Headrace Canal and continues in a north easterly direction parallel to the canal to the town of Killaloe. At Ardnacrusha, the R463 intersects the R465 which continues in a north south direction through the northern part of the Study Area linking Ardnacrusha and the town of Broadford.

Future Road Network

Limerick City Council has proposed the construction of Phase 1 of the Limerick Northern Distributor Road along the northwest fringes of the city extending from Coonagh Roundabout on the R445 northeastwards to the Knockalisheen Road. The proposed scheme will provide a link road to Moyross and an upgrade of the Knockalisheen Road. The scheme has been identified as an important aspect of the current Moyross regeneration programme which has recommended that a distributor road providing access to Moyross be progressed from Coonagh Roundabout to the north of Limerick City. The proposed Coonagh/Knockalisheen Distributor Road is approximately 3km in length and is proposed to be dual carriageway. This scheme has now received planning approval from An Bord Pleanala and is due to progress to the construction stage in teh near future.Refer **Drawing RCSR-3701 in Volume 2** for details of the existing and future road network within the Study Area.

Railways

There are five railway lines leading in to Limerick City. The routes served by these railway lines are as follows:

1) Limerick-Dublin via Limerick Junction;
2) Limerick-Dublin via Birdhill;
3) Limerick-Ennis;
4) Limerick-Foynes;
5) Limerick-Irish Cement.

The Limerick–Dublin railway line via Birdhill is the only one of the above railway lines within the Study Area. The railway line runs along the south-eastern periphery of the Study Area for approximately 1km. This railway line serves the towns of Birdhill, Nenagh, Cloughjordan and Roscrea before rejoining the main Limerick – Dublin Railway line at Ballybrophy. It is unlikely that any railway bridges would be required as it is anticipated that the scheme will terminate west of the Limerick-Dublin (via Birdhill) railway line.

3.4.4 Watercourse Crossings

The River Shannon basin, located within the Study Area, contains an extensive network of watercourses. The existing road network crosses a significant number of these watercourses (Refer **Drawings RCSR-3402 to RCSR-3404 in Volume 2**), with the smaller watercourses culverted beneath the existing roads. With regard to the larger watercourses within the Study Area, there are a total of 13 existing bridge crossings located within the Study Area:

- Annacotty Bridge;
- Groody Bridge;
- Plassey Bridge;
- University of Limerick Shannon Bridge;
- Living Bridge (Pedestrian Bridge);
- Gilloge Bridge;
- Blackwater Bridge (Derryfadda);
- New Bridge;
- Wooden Bridge;
- Blackwater Bridge (Headrace Canal);
- Blackwater Bridge (Ardnacrusha);
- Parteen Bridge;
- Athlunkard Bridge.

Any potential route for Phase 2 of the Limerick Northern Distributor Road, subject to constraints identified, may be required to cross the following larger watercourses:

- River Shannon;
- River Blackwater;
- Errina Canal;
- Tailrace Canal;
- Headrace Canal.

River Shannon Crossings

The River Shannon has a total of six vehicular and two pedestrian crossings within the Study area. Five of the existing vehicular crossings convey traffic directly into the city centre placing significant pressure on the road network and the existing river crossings. The sixth vehicular bridge crossing at the University of Limerick provides access from the south bank of the River Shannon to the Clare Campus only and does not provide any onward connectivity within the Study Area.

A stated objective of the Limerick Northern Distributor Road is to relieve the pressure on the existing river crossings, protecting the city centre and improving accessibility from the disadvantaged areas of Limerick to educational and employment opportunities in Limerick City. It is therefore envisaged that the Limerick Northern Distributor Road will cross the River Shannon to meet these stated objectives.

The River Shannon (refer **Drawing RCSR-33402-3404 in Volume 2)** is relatively wide as it meanders through the Study Area. Typically, the shortest most direct crossing is preferable, though the wide flood plains associated with the River Shannon throughout the Study Area have an impact on the selection of the preferred crossing point. In addition, the Lower River Shannon is a candidate Special Area of

Conservation (cSAC) and any impacts of potential crossings on the cSAC will need to be assessed. This adds further complexity to identifying possible crossing locations as ideally the crossing of flood plains should be minimised.

Geotechnical constraints have been identified within the Study Area inclusive of numerous soft soil areas including alluvium and peat bog. Although the presence of soft soils in the vicinity of a crossing location will generate additional costs and construction difficulty, it is possible to develop engineering solutions to overcome these constraints and therefore, they should not preclude any crossing location from being considered.

The Shannon Crossing could be accommodated using a variety of bridge designs. The bridge selection is dependent on the alignment and general span arrangement of the structure. However other aspects including hydraulics, environmental, geotechnical and visual constraints will ultimately influence the final selection.

A simple beam or box girder bridge would generally be provided where the span lengths are relatively short. As the span lengths increase other solutions including suspended options may be more appropriate, particularly in light of environmental constraints. Ideally the bridge supports would be, where feasible, situated remote from the main river channel as this is likely to reduce the potential environmental impacts during construction stage.

Headrace Canal Crossing

The Headrace Canal has one existing crossing, the Blackwater Bridge, located within the Study Area (Refer **Photo 3.4.4**). The existing bridge, located along the R463, links the village of Parteen with Ardnacrusha. The bridge is heavily trafficked. The Study Area included areas north of the headrace, to examine a potential additional crossing of the Headrace Canal as part of the Limerick Northern Distributor Road.

The Headrace Canal at Ardnacrusha is 13km long and connects Parteen Weir to the concrete dam and power station at Ardnacrusha. Over the entire length of the Headrace Canal within the Study Area, embankments constructed on each side of the canal act as impoundment dams, impounding the water in the Headrace Canal. These embankments are categorised as Category 'A' dams. A Category 'A' dam is one where a breach could endanger lives in a community and cause extensive damage.

The Ardnacrusha Power Station and Headrace Canal upstream are key elements of Strategic National Infrastructure. These structures are vital for power generation for the mid-west region and the State. In addition, the Headrace Canal diverts water from the Lower Shannon thus alleviating flooding in areas such as Castleconnell, Montpellier, Springfield and Mountshannon between Parteen Weir and Limerick City. A breach of the Headrace Dams would require the Ardnacrusha Power Station to be shut down, preventing the generation of power and would require the diversion of 450m^3/s of water from the Headrace Canal to the River Shannon, resulting in a significant flooding event downstream of Parteen Weir.

It is evident that any potential crossing of the Headrace Canal would be required to be a significant single span bridge to sufficiently clear both the canal and the associated Category 'A' dams. Notwithstanding the additional cost of such a structure, the risk of an object falling onto the impoundment dams during construction and causing a breach cannot be discounted. The ESB have advised that the Headrace Canal and its embankments upstream of the power station should be

deemed as a significant constraint due to the safety issues of the dam and the strategic nature of the headrace embankments, both for electricity generation and flood alleviation.

Photo 3.4.4 – Blackwater Bridge

Tailrace Canal Crossing

The Tailrace Canal is 2.4km long and the entire length of the canal is located within the Study Area. The canal is cut into solid rock and is spanned by one bridge at Parteen (Refer **Photo 3.4.5)**. An existing narrow bridge located along the R464 links the village of Parteen with the western residential areas of Limerick City. The bridge is heavily trafficked and a source of congestion within Parteen Village, due to its signal controlled one-way operation.

Photo 3.4.5 – Tailrace Canal Crossing, Parteen Bridge

River Blackwater Crossing

The River Blackwater flows southwards from the northern boundary of the Study Area, traversing beneath the Headrace Canal and running parallel to the Errina Canal before joining the River Shannon to the east of Groody Valley. The cross-section of the existing River Backwater is quite narrow without any adequate provision for pedestrians on its banks.

The existing Gilloge Bridge (Refer **Photo 3.4.6**) crossing the River Blackwater and the Errina Canal at Garraun is a structure proposed for protection under the draft Clare County Development Plan and is now included within the NIAH survey.

Errina Canal Crossing

The Errina Canal commences to the south of O'Briens Bridge, to the northwest of the Study Area, traversing in a south westerly direction until it meets the River Blackwater (Refer **Drawings RCSR-3403 to RCSR-3404 in Volume 2**). Upstream of the River Blackwater, the Wooden Bridge crosses the Errina Canal. Similar to the existing Gilloge Bridge downstream at Garraun, the Wooden Bridge is a structure proposed for protection under the draft Clare County Development Plan.

Where the Errina Canal meets the River Blackwater, the canal changes direction and runs parallel to the river before joining the River Shannon at the University of Limerick. The Errina Canal is a small narrow canal with a very low flow of water and is currently disused.

The existing canal crossing, at Gillogue, is a 2-span masonry arch bridge crossing both the Errina Canal and the River Blackwater. As outlined above, the existing cross-section of the canal crossings is quite narrow, unsafe for pedestrian use, and it inhibits the economic development of lands to the east of the canal.

Photo 3.4.6 –Existing Gilloge Bridge

Existing Services

As part of the constraints gathering exercise, all of the major service providers were contacted in order to establish the utility constraints within the Study Area. The major services identified within the Study Area to date are ESB Network, Board Gáis Network, Water, Eircom and other Telecommunications (Refer **Drawings RCSR-3405 to RCSR-3410 in Volume 2**).

ESB Network

Ardnacrusha Power Station is located within the Study Area. There are overhead power lines of up to 110kv originating from this location and running in numerous directions throughout the Study Area. These are marked on the utilities **Drawings RCSR-3408 to RCSR-3410 in Volume 2**.

The power station, located at the start of the tailrace canal at Ardnacrusha dam to north of Parteen Village, is the main focal point from which four 110kv power lines radiate in different directions. Two lines run northwards and exit the Study Area at Ballycannan East. The other two run southwards towards Limerick City, crossing the River Shannon in Groody Valley.

Bord Gáis Network

There is a 200mm ST 19 Bar Bord Gáis transmission line within the Study Area along the R445 at Groody Valley.

There is also a Gas Distribution Network within the Study Area (Refer **Drawings RCSR-3405 to RCSR-3407 in Volume 2**).

Water Main

There are a number of water mains that exist within the Study Area. These generally run adjacent to local, regional and national roads.

Eircom

Eircom lines run along the majority of roads in the Study Area where housing is situated.

Telecommunications

Telecommunication services are mainly located to the south of the Study Area in Limerick City. The communications network runs from the M7, along the R445 and into the National Technological Park and the University of Limerick.

3.5 Traffic and Road Accidents

3.5.1 Introduction

This section describes the existing available traffic data and traffic modelling undertaken to date as part of previous road scheme studies and outlines additional traffic survey data and traffic modelling required as part of a traffic study to assess the proposed Limerick Northern Distributor Road Project.

The purpose of this traffic study is to facilitate the engineering and environmental (incl. air and noise) appraisal of the scheme. The findings of this study will be used for engineering design parameters such as cross sections, junction configurations and pavement design.

3.5.2 Existing Traffic Data and Reports

The Limerick Northern Distributor Road would run north of Limerick City into County Clare to the R463 and would then travel southeast back into Limerick City to connect to the R445 (Old N7) or the M7 Motorway, effectively linking the N18 to the west of Limerick City to the M7 east of Limerick City via the north of Limerick City. A number of traffic assessments and models have been prepared that overlap the Limerick Northern Distributor Road Scheme, as discussed below.

Proposed Coonagh to Knockalisheen Distributor Road

The Coonagh to Knockalisheen Distributor Road will provide a new high quality dual carriageway on the north western outskirts of Limerick City extending from the Coonagh Roundabout on the R445 northwards to the Knockalisheen Road and will provide a link road to Moyross and an upgrade of the Knockalisheen Road.

In terms of traffic impact, it is expected that the opening of the Coonagh/Knockalisheen Distributor Road will lead to a decrease in flow on the Cratloe Road, Ennis Road, Shelbourne Road and also lead to reductions in City Centre traffic. Traffic will use the distributor road to access the R445 instead of the alternative mainly residential routes in the northwest of Limerick City.

The traffic model developed to assess the Coonagh to Knockalisheen Distributor Road estimated a traffic volume of 21,000 AADT (Average Annual Daily Traffic) in the design year of 2025.

The Knockalisheen Road Roundabout is identified as a possible docking point for the Limerick Northern Distributor Road Phase 2. The traffic model for the Coonagh to

Knockalisheen Distributor Road was therefore extended to include a notional Limerick Northern Distributor Road to get indicative traffic impacts on the Coonagh to Knockalisheen Distributor Road and surrounding road network. This model indicated that the impacts of opening the Limerick Northern Distributor Road are not just confined to the northwest of the city. The provision of a cross city link will relieve pressure on the existing river crossings in the city centre, and provide a significant improvement in connectivity between different areas along the northern fringe of the city.

Mid West Strategic Model

As part of the Mid West Strategic Area Plan, a traffic model was developed by Limerick City Council, Clare County Council, North Tipperary and Limerick County Councils for the purpose of regional planning, land use and transportation studies. This model provided a Base Year Traffic Model for assessment of the Limerick Northern Distributor Road. The relevant area for investigation of the Limerick Northern Distributor Road was cordoned from this model and reviewed. Additional traffic surveys were carried out to support the Base Year Traffic Model and to refine the model in the vicinity of the proposed scheme.

3.5.3 Traffic Accidents

Traffic accident data has been obtained from the Road Safety Authority National Accident Database for the full Study Area for the period 1996 to 2009 inclusive. The results reported are for personal injury accidents only and are shown on **Drawing RCSR-3501 in Volume 2**.

These accident records within the Study Area over the period 1996 to 2009 are categorised as follows:

- 6 Fatal accidents;
- 26 Serious injury accidents;
- 197 Minor injury accidents.

3.6 Geology, Hydrology & Hydrogeology

3.6.1 Soils and Geology

Introduction

This chapter outlines the geology, hydrology and hydrogeology of the Study Area. This includes the bedrock and soil types and details of soft or unstable ground, which may affect the route of the proposed distributor road.

Methodology

An initial desktop study of the soils and bedrock conditions was undertaken with information published by Geological Survey of Ireland, and other referenced sources of information as appropriate. A windscreen survey was also undertaken in November 2010. In addition, borehole information was available for several sites in and around the Study Area, giving general information on depth to bedrock and bedrock type.

Sources of Information

The assessment consisted of a desk study of available published information from the sources listed below:

- Geology of the Shannon Estuary. A Geological description to accompany the bedrock geology Scale 1: 100,000 Map Series 17'. Geological Survey of Ireland, 1999;
- Geological Survey of Ireland, Draft Aquifer Maps, 2010;
- Geological Survey of Ireland, Draft Vulnerability Maps, 2010;
- Geological Survey of Ireland, Karst Features Database, 2010;
- Geological Survey of Ireland, Draft Quaternary Maps, 2010;
- Geological Survey of Ireland, Geotechnical Borehole Records, 2010;
- EPA, Local Authority landfill sites in Ireland 1995-1997;
- Geological Survey of Ireland, Directory of active quarries, pits and mines in Ireland, 2001.

Geomorphology

The geomorphology of the landscape of the surrounding area is quite diverse, comprising glacial till deposits overlying either limestone bedrock in the undulating lowlands alongside the River Shannon or the sandstone bedrock in the protruding hills along the northern extent of the Study Area. Features influencing the bedrock geology include the 'Limerick Ramp', associated with deep water deposition and subsidence. In the Carboniferous period, the limestone was faulted and intruded during volcanic activity, affecting the bedrock to the central and southern parts of the Study Area.

More recent deposits include marine estuarine and lacustrine silts and clays, fen and cutover peats which generally overlie tills composed of both limestone and sandstone/shale. Made ground is also frequently present on account of the man-made constructions such as the hydroelectric power station, the headrace and tailrace canals at Ardnacrusha, and for housing or commercial/institutional developments throughout the Study Area.

Solid Geology

A summary of the geological sequence and main rock types likely to be encountered along the route from southeast to west are shown in Table 3.6.1.1. These are based on the available information on the 1:100,000 scale Geological Survey of Ireland map of the area (Sheet 17 Bedrock Geology Map Series for the Shannon Estuary (1999)).

The site is shown to be underlain by undifferentiated limestone (VIS) of Visean, Carboniferous Age. Some of these rocks are non-argillaceous and should meet the NRA specifications for use in road projects. Rock outcrops and subcrops are recorded by the GSI in several locations within the Study Area. These include:

1) Between Ballyvollane/Mountshannon;
2) Prospect;
3) Along the River Blackwater between Cappavilla South and Gilloge;
4) Parteen/Quinspool;
5) From Quinspool South to Ballynanty;
6) Ballycannan.

Table 3.6.1.1: Geological formations occurring in the Study Area

PERIOD	FORMATION	ROCK TYPES	EXCAVA T-ABILITY	CUTTING STABILITY	MAP SYMBOL (WHERE USED)
Devonian/ Carboniferous	Tuff	Igneous tuff	Generally rippable	Generally stable	Tu
Carboniferous (Dinantian)	Waulsortian Limestone	Pale grey massive unbedded biomicrite Wackestone	Generally rippable	Generally stable, dip 5° to 25° syncline WSW to ENE	WA
Carboniferous (Dinantian)	Lough Gur Limestone	Dark grey to black cherty argillaceous Wackestone	Generally rippable	Generally stable, dip 5° to 20° syncline WSW to ENE	LR
Carboniferous (Dinantian)	Visean Limestone	(*undifferentiated*) Dark grey to black thinly bedded cherty argillaceous Wackestone and Packstone	Generally rippable	Generally stable, dip 5° to 20° syncline WSW to ENE	VIS
Carboniferous (Dinantian)	Volcani-clastic	(*undifferentiated*) Igneous breccia or conglomerate with ashy limestone to limestone ash, grit, slate and chert	Generally rippable	Generally stable, dip <15° to S/SW	V
Carboniferous (Dinantian)	Lower Limestone Shales	Calcareous shales with fine-grained sandstone, siltstone, mudstone and bioclastic limestone	Generally rippable	Generally stable	LLS
Devonian/ Carboniferous	Old Red Sandstone	Yellow to brown coarse-grained sandstone pebbly sandstone and conglomerate	Generally rippable	Generally stable, dip <30°	ORS

The distribution of various bedrock units within the Study Area is shown on **Drawing RCSR-3601 in Volume 2**, reproduced from the GSI mapping.

Where rock is near the surface, steeply sloping ground or hard excavations pose the main difficulties for road construction. Most rocks are amenable to ripping or hydraulic breaking but if bedding thickness and orientation are unfavourable, other techniques such as pre-splitting and blasting may be required.

Subsoil and Soil Deposits

Information on the subsoil/Quaternary geology of the Study Area has been obtained from the GSI and EPA websites. Where available, these are shown on **Drawing RCSR-3602 in Volume 2.**

The following overburden types have been identified by the GSI:

- Made Ground;
- Cutover and Fen Peats;
- Marine Estuarine Silt/Clays;

- Alluvium (undifferentiated);
- Lake sediments;
- Glacio-Lacustrine Silt/Clays;
- Till Derived from Devonian sandstones;
- Till Derived from Lower Palaeozoic limestones.

Glacial Deposits

Glacial deposits range from sandy gravelly clay to sands and gravels based on GSI data and information from nearby sites. These deposits do not pose a problem for road construction and for engineering purposes these deposits can be divided into glacial till (fine grained) and glacial till (coarse grained).

Glacial Till (Fine Grained)

Fine grained glacial tills dominate much of the Study Area.

The depth of the fine grained till occurring within the Study Area is not known and is likely to vary considerably between 0 and 10m below ground level.

The geotechnical properties of Irish glacial tills are well documented (Hanrahan, 1997). These soils are generally well graded, variable with gravel lenses, with an absence of clay minerals. The clay fraction (rock flour) typically amounts to about 15% and fines fraction (clay and silt) is about 30 to 40%. The glacial tills are generally over-consolidated and therefore possess low compressibility. These soils are usually firm to stiff, however due to their low plasticity, they are very susceptible to softening and deterioration in wet weather, especially if heavily trafficked. When the clayey tills are kept dry, they present relatively little difficulty to road construction.

Glacial Till (Coarse Grained)

Glacio-fluvial deposits of gravels may be present within the Study Area.

Gravel materials do not present problems for road construction, provided the road alignment is kept above the water table. Generally, gravels provide good formation for pavement construction and are generally suitable for reuse. Water bearing sand and silt layers, where encountered, can be problematic.

Soft Ground

More recent deposits include soft marine estuarine and lacustrine silts and clays, fen and cutover peats and alluvium. Construction in soft ground may be difficult due to the presence of groundwater and the limited bearing capacity of these soils to accommodate surcharge loading. Existing ground surface is quite often well below the level required for road design.

Engineering design of road embankments through soft ground, although not desirable, is generally feasible where soil thicknesses are modest. To accommodate road embankments and suitable pavement, the excavation and replacement of soft soils, ground improvement or piled load transfer platforms are required. Also, the NRA specification places limits on settlements experienced by the constructed roadway in its design life. There are implications on design, programme and cost to meet these requirements, if construction is required through large or deep areas of soft ground. The rate of construction can be affected and environmental impacts are increased. The identification and sufficient investigation of soft ground early in the route selection process is an important consideration and has been addressed in preliminary ground investigation carried out.

The following sections describe the soft soils present in the Study Area, based on desk study and previous project experience.

Marine Estuarine Silts and Clays

Marine estuarine sediments have been deposited at various locations along existing and former estuarine grounds close to the River Shannon. These deposits are typically high plasticity silts and clays and may have an amount of organic content. They typically consist of normally or slightly over consolidated silt and clays or marine sands.

Lake Sediments

Lake sediments are associated with former basins and channels close to the River Shannon. These deposits are typically high plasticity silts and clays and may have an amount of organic content. They typically consist of normally or slightly over consolidated silt and clays or fluvial sands and gravels.

Alluvium

Alluvial deposits are associated with the River Shannon, its tributaries and streams, primarily the River Blackwater. These deposits are typically high plasticity silts and clays and may have an amount of organic content. They typically consist of normally or slightly over consolidated silt and clays or fluvial sands and gravels.

Peat deposits

Peat soils are naturally transitional, forming from waterlogged vegetation and consequently influencing the habitat as its geochemistry and moisture contents evolve. They are highly organic due to the accumulation and decay of vegetation over time through humification. The mass characteristics and presence of fibres, sands, silts or clays can strongly influence their engineering properties but they are generally low in strength. They are typically highly plastic, settling considerably if subject to surcharge loading.

Fen peat is present as marsh-like conditions, normally high in nutrient content, and comes about from surface water and percolating groundwater.

Cutover peat is what remains following extraction of peat fuel for human use. This would normally have been limited by thickness and water levels, although drainage measures may have been provided to optimise their removal. Thickness of peat in these areas is generally less than 1.5m.

Peat deposits have been identified in the Study Area at the following locations:

- Fen peat at Newtown, Springfield;
- Cutover peat at Shannakyle, Rosmadda East, Derryfadda and Gilloge;
- Cutover peat at Ballyglass;
- Cutover peat at Glenlon North.

Made Ground

Made ground occurs frequently as a result of various human activities and patterns. Site developments associated with housing, sportsfield construction, retail and industrial constructions can cause varied changes to ground topography and drainage and may often result in instability or long term settlements where located on soft soils or at tip areas following their removal. Construction in made ground may be complicated as a result.

Dredging of alluvium from rivers and construction of flood bunds, artificial channels and canals can also result in vastly differing ground conditions in areas of geotechnical or hydrological hazards.

A summary of the typical soil properties is included in Table 3.6.2.

Table 3.6.2: Typical Soil Properties

SOIL TYPE	PARTICLE SIZE/ TYPE	STRENGTH	COMPRESSIBILITY	USE AS EARTHWORKS
Glacial Till	Coarse	Good	Low	Good
	Fine	Variable	Low-medium	Variable, generally good
Alluvium	Coarse	Variable	Medium	Variable
	Fine	Poor	High	Poor
Lake Sediments	Fine	Poor	High	Poor
Peat (Cutover)	Fine / Organic	Very poor	Very high	Not suitable
Peat (Fen)	Fine / Organic	Very poor	Very high	Not suitable
Made Ground	Variable	Variable	Variable	Variable

Contaminated Lands

Certain land uses, typically waste removal, automotive servicing or dismantling, industrial fabrication and manufacturing, railways, and abstraction of minerals or soil/rock resources can cause or lead to land contamination. This may affect soils and surface water or groundwater, with significant impacts on construction methodology where these become disturbed by development. No licensed landfill sites are apparent in the EPA mapping within the Study Area.

Economic Geology

There are no active quarries or pits situated in the Study Area. The *GSI Directory of Active Pits and Quarries 2001* lists several sources of aggregates and other products within the region, generally from crushed limestone rock or from natural sands and gravels.

There are numerous disused quarries, gravel and sand pit locations as shown on **Drawing RCSR-3603 in Volume 2**:

- Sand Pit, Ardnacrusha;
- Gravel Pit, The Cottage, Garraun/Fairy Hill;
- Quarry, Shoemaker's Hill, Parteen;
- Quarry, Castlebank;
- Quarry, Ballycannan North;
- Quarry, Mountgordon;
- Gravel Pit, Quinville House;
- Gravel Pit, Newtown;

- Quarry, Quinspool South;
- Quarry, Ilaunyregan;
- Quarry, Srawickeen;
- Quarries/Gravel Pits, Cappavilla South;
- Gravel Pits, Shanakyle;
- Lime Kiln, Ballykeelaun;
- Lime Kiln, Ballycannan North;
- Lime Kiln, Ballycannan West;
- Lime Kiln, Newtown.

Disused pits and quarries may be indicative of resources that have been fully removed or have been extracted as much as was feasible with available equipment and techniques. Depending on alignment, it could be possible, although not very likely, that further resources will become available if sufficiently deep cuttings are required. These are indicated on historic 6" and 25" OS mapping.

Mineral deposits are also present in the surroundings of the Study Area, as shown on **Drawing RCSR-3603 in Volume 2**. Mapping shows that the Study Area itself is clear of any mineral deposits, other than the disused pits and quarries listed above. Deposits in the wider region generally comprise sands, gravels, brick clays or pyrites. Pyrites contained in aggregates can have a major detrimental impact on durability of construction materials as they swell with moisture.

Geological Heritage

A geological heritage site of Upper Palaeozoic (silurian) age is present at Ballycar South, the Ballycar South member of the Cratloes Formation. This is outside the Study Area by a distance of approximately 1km. Distinct bedrock units separate it from the rock in the Study Area, so it poses no constraint and will not affect the proposed road

Landslides

Records of landslides held by the GSI note several slides affecting different soil types in the wider region. Most involve peat in upland areas, with peat flows or bog bursts presumably brought about by episodes of heavy rainfall. However there are a few slides involving embankments and bridges:

- Fort Henry, 1948, earth embankment slide on the banks of the River Shannon, Ballina, Co. Tipperary;
- Bilbao Bridge, 1995, debris slide, Cappamore, Co. Limerick;
- Castlegarde, 1708, peat slide in raised bog, Cappamore, Co. Limerick.

While these records indicate incidences of failures involving soft soils, they must have also been brought about by elevated moisture levels and in some cases steeply sloping ground or sloping substrata. As with roads in soft ground in lowland areas, design and construction of roads through soft or sloping ground in upland areas with poor drainage, high runoff and/or large catchment is feasible, although not desirable. This is dependent on the identification of conditions through sufficient investigation. In some cases, it may be difficult to differentiate sloping substrata.

Inventory of Geological Constraints

The geological constraints affecting the Study Area include the following:

- Rock outcrop/near surface rock;
- Soft ground including peat, alluvium and marine estuarine silt/clay, particularly where sloping ground or substrata are also present;

3.6.2 Hydrology

Introduction

This section outlines the general hydrological regime in the Study Area. The hydrology of the Study Area is dominated by the River Shannon with its associated network of lakes and tributaries. The River Shannon rises in a spring fed pool (the Shannon Pot) in the Cuilcagh Mountains on the Cavan-Fermanagh Border. The river flows south through Loughs Allen, Ree & Derg finally outfalling to the Atlantic Ocean via the Shannon Estuary. The Study Area falls within the reach of the river between Lough Derg and the Shannon Estuary which is characterised by a wide meandering channel and extensive floodplain.

Methodology

The hydrological constraints were established based on a review of the following information:-

- Extracts of Various Reports available on OPW Flood Hazard Mapping website;
- Flood Report November/December 2009 (Limerick County Council);
- River Shannon Flood of Winter 1999/2000 (ESB International);
- Parteen Weir to Limerick City Inundation Study (ESB International);
- Shannon River Basin Management Project – Current Management of Water Levels River Shannon.

Existing Hydrological Regime

The River Shannon drains a total area of more than 10,400km^2 from its source to Ardnacrusha Power Station (Refer **Plate** 3.6.1). The river is quite slow moving with out of bank flood waters remaining on the flood plains for long periods. The Shannon catchment is generally low lying with large areas below 50m O.D. The hydrology of the Shannon catchment and the hydraulic characteristics of its main channel, which is very flat with a series of natural and man-made controls, can be separated into the following four distinct sections;

- Upper Catchment – Source to Lough Allen Outlet
- Middle Catchment – Lough Allen Outlet to Lough Ree Outlet
- Lower Catchment – Lough Ree to Parteen Weir
- Downstream Parteen Weir

For the purposes of this Constraints Study, the section of the River Shannon downstream of the Parteen Weir is examined. The flow along this section of the River Shannon has been controlled for over 200 years to aid navigation and was further modified in the 1920's to facilitate the ESB hydro-electric power station at Ardnacrusha. Discharges through the headrace and tailrace at Ardnacrusha are controlled by the operation of the Power Station at Ardnacrusha at all times. The maximum discharge occurs when all four units at Ardnacrusha are on full load and amounts to about 400m^3/s. During floods, the ESB releases water at Parteen Weir which flows down the original river channel via O'Brien's Bridge, Castleconnell,

Mountshannon, the University of Limerick and into Limerick City where the tailrace joins up with the original channel in Corbally.

Plate 3.6.1 – Aerial View of Ardnacrusha Power Station

Surface Water Features & Flooding

All the lands within the Study Area are drained to the River Shannon through the extensive network of tributaries. The Study Area has extensive areas of a high flood risk as can be seen on **Drawing RCSR-3401 in Volume 2.** The River Shannon has a long history of flooding; a US Corps of Engineers 1956 report "River Shannon Flood Problem" states that:-

"*The problem of Shannon River flooding has been the subject of much study over the past 150 years. Because of the flat terrain through which the river flows, the almost imperceptible gradient of the stream with its series of lakes and connecting channels, and because of the large volume and long duration of flooding, no simple obvious solution has heretofore been found"*

The recent Limerick flooding event in November/December 2009 resulted in the highest discharge at Parteen Weir since the construction of Ardnacrusha Power Station. The highest discharge occurred around the 26th/27th November 2009 and was almost 500m^3/s. Refer Table 3.6.3 shows the Flood Water Levels taken by the ESB during the November/December 2009 flood at a number of locations.
The area impacted by the November/December 2009 floods stretched from Montpelier village downstream through Castleconnell, Mountshannon, and Plassey to the confluence with the Groody River. Limerick County Council closed the following roads due to flooding in the Lower Shannon Region:

- R525 Castleconnell to Mountpelier / O'Briensbridge;
- Mountshannon Road in Annacotty;

- Belmont Road, Castleconnell;
- Castleconnell village:
  - from Charco's to Scanlan Park.
  - from the car park towards the village.

Local diversions were set up in the areas affected with two pedestrian bridges in Castletroy closed. There was also substantial damage done to roads and footpaths in the Castleconnell and Mountpelier areas.

Table 3.6.3: Highest Recorded Water Levels during Flood November 2009

Gauge Location	Grid Reference (Irish Grid)		Max. Recorded Level (27-11-2009)
	Easting	Northing	
O'Briens Bridge	166390.10	166801.00	28.51m
Castleconnell Car-Park	165847.50	162364.00	25.57m
Springfield	163249.70	161749.40	12.55m
Springfield	162420.60	161764.10	12.54m
Westbury	159535.00	158578.00	7.63m
Shannon Banks	158680.90	159402.20	7.55m

Note: All levels at Poolbeg Datum

In addition to the 2009 flooding event, information was obtained from OPW mapping which were compiled from aerial photographs taken on the 9th January 2000.

Tidal Constraints

Downstream of Ardnacrusha, the Tailrace Canal is influenced by the tidal conditions of the Shannon Estuary. Water levels in the tailrace vary with the flow through the power station and tide levels. Typically, the peak tailrace level, (measured downstream of Ardnacrusha dam), associated with the Highest Astronomical Tide (HAT) and station on full load is around 7.2mO.D (Poolbeg Datum). A tidal surge and/or adverse meteorological conditions such as low barometric pressure and/or a south westerly gale could cause this level to be higher.

Ardnacrusha Power Station

The maximum normal operating level in the Headrace Canal at the Ardnacrusha Dam is 33.56mO.D. The minimum allowable operating level in the headrace at Ardnacrusha Dam is 31.50mO.D. The maximum level occurs in the headrace when there is no discharge. The minimum level occurs when the flow is at a maximum through the headrace i.e. c 400m^3/s.

A flood is deemed to occur when:

- The water level in Lough Derg as measured at Killaloe, is above 33.56mOD

- The maximum normal operating level is rising
- The inflow to Lough Derg exceeds station full load throughput i.e. 400m^3/s.

During floods the power station is operated on full load thus diverting up to 400m^3/s through the headrace and tailrace and away from areas liable to flooding along the old channel between Parteen and Limerick City. As the level in Lough Derg increases, it drives more water through the channel between Lough Derg and Parteen Weir and the spillway gates at Parteen are progressively opened to release excess water.

Catchments

Downstream of Parteen Weir the River Shannon flows a distance of approximately 20km to Limerick City. Tributaries which enter the Shannon in this reach include the Black, Kilmastulla, Mulkear, Groody and Blackwater Rivers. Flow which is diverted at Parteen Weir through Ardnacrusha Power Station via the Headrace Canal re-enters the Shannon just upstream of Limerick city via the Tailrace Canal.

3.6.3 Hydrogeology

Introduction

The hydrogeology of the area is reflective of the synclinal structure that surrounds Limerick City. As a result of the sequence and folding that features in the bedrock geological history, each bedrock unit traces a spoon-shaped ring around the city. The movement of water through the ground is governed by the permeability and connectivity of each bedrock unit.

Methodology

Review of the available GSI soil, aquifer and bedrock mapping and other records held in GIS database format, is the primary source of hydrogeological information. Interim vulnerability mapping has been prepared by GSI based on depths to rock, soil cover and bedrock characteristics.

General cross sections of the Study Area have also been assessed to identify connectivity and interaction between units. This information has been reviewed with a view to the potential road construction in each area along the route.

Aquifer Types and Classification

Table 6.3.1 outlines the bedrock aquifer classifications that occur in the Study Area. These apply to the rock units as discussed in Section 6.1.5.

Table 6.1.2: Bedrock Aquifers occurring within the Study Area

AQUIFER CLASSIFICATION	CODE	BEDROCK FORMATION	MAP SYMBOL (WHERE USED)
Regionally Important Aquifer – Bedrock which is Karstified (Diffuse)	**Rkd**	Waulsortian Limestone	WA
Locally Important Aquifer – Bedrock which is Moderately Productile only in Local Zones	**Ll**	Waulsortian Limestone	Tu
Locally Important Aquifer – Bedrock which is Moderately Productive	**Lm**	Lough Gur Limestone	LR
Locally Important Aquifer – Bedrock which is Moderately Productive	**Lm**	Visean Limestone	VIS
Locally Important Aquifer – Bedrock which is Moderately Productile only in Local Zones	**Ll**	Volcaniclastic	V
Poor Aquifer – Bedrock which is Generally Unproductive	**Pl**	Lower Limestone Shales	LLS
Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones	**Ll**	Old Red Sandstone	ORS

Code: Rkd: regionally important karstified (diffuse) aquifers
Lk: locally important karstified aquifers
Lm: locally important aquifers that are moderately productive
Ll: locally important aquifers that are moderately productive only in local zones
Pl: poor aquifer that is generally unproductive except for local zones

The Geological Survey of Ireland's bedrock mapping for the area illustrates that the Study Area is underlain by seven distinct geological formations / members as discussed above.

One formation is classified as a regionally important karstified (diffuse) aquifer (Rkd), the Waulsortian Limestone. Karst landforms include surface features such as swallow holes, dolines, dry valleys or subsurface features like solution enlarged cavities, and caves, depending on their development with time. Some features may have been previously active when levels and conditions of both sea and land were historically different. Many have since been infilled by the most recent glacial cover and are now essentially dormant. Detailed investigation of these features is required, whereever they are found to be close to a proposed route. Only one surface feature has been identified in the Study Area, a swallow hole at Mount Catherine.

It is noted that all karstified aquifers have limited attenuation capacity once a contaminant enters the aquifer. This is due to its solution enlarged fissures / conduits and fast through-flow velocities to discharge points (springs, wells, rivers, lakes etc). Further searches of aerial photographs (surface) or by geophysical survey results and preliminary site investigations (subsurface) should explore this further if the route is chosen in this aquifer where features are thought to be present. It would be advisable to avoid or minimise the length of the route through known karstified areas, as there may be implications for road foundations, structures foundations and road drainage design.

Two bedrock formations have been classified as locally important aquifers that are generally moderately productive (Lm). Groundwater flow in such aquifers is generally through a network of fractures, fissures and joints that are reasonably well connected

and dispersed throughout the rock, giving a moderate permeability and groundwater throughput. Aquifer storage is moderate and groundwater flow paths can be up to several kilometres in length. There is likely to be a substantial groundwater contribution to surface waters ('baseflow') and large (>2,000 m^3/day), dependable springs may be associated with these aquifers.

Three bedrock formations have been classified as locally important aquifers that are moderately productive only in local zones (Ll). Such aquifers are characterised by a limited and relatively poorly connected network of fractures, fissures and joints, giving a low fissure permeability which tends to decrease further with depth. A shallow zone of higher permeability may exist within the top few metres of more fractured / weathered rock, and higher permeability may also occur along fault zones. These zones may be able to provide larger 'locally important' supplies of water. In general, the lack of connection between the limited fissures results in relatively poor aquifer storage and flow paths that may only extend a few hundred metres.

One bedrock formation has been classified as a poor aquifer that is generally unproductive except for local zones (Pl). Well yields in this type of aquifer will be <40 m^3/day, contributed to by a series of poorly connected fractures, fissures and joints. This low fissure permeability tends to decrease further with depth. A shallow zone of slightly higher permeability may exist within the top few metres of more fractured/weathered rock, and higher permeability may rarely occur along large fault zones. In general, the poor fissure network results in poor aquifer storage, short flow paths (tens of metres) and low 'recharge acceptance'. Groundwater discharge to streams ('baseflow') is very limited.

Consultation with the Geological Survey of Ireland (GSI) indicates that there are no quaternary sand and gravel aquifers within the Study Area.

Aquifer Vulnerability

The GSI has produced an interim vulnerability map for the Shannon region. The Study Area includes areas of variable vulnerability from extreme (rock near surface / karst) to low vulnerability (Refer **Drawing RCSR-3604 in Volume 2**).

The most vulnerable sections of underlying aquifers are identified as being at Ballycannan, Parteen, Quinspool South, Cappavilla South, Newtown, Springfield, Ilaunyregan, Prospect, Ballyvollane and Mountshannon. Most of these are either in areas of Waulsortian or Visean Limestone bedrock.

Combining these "extreme" vulnerabilities with aquifer classifications provides an understanding of both the risk and the significance of the resource in terms of protecting groundwater from contamination during construction and operational phases.

Groundwater Resources

Groundwater resources include the aquifers themselves, particularly close to any feature which can be used for abstraction. This includes wells, boreholes, springs, spas and other surface water features that are either fed by or contribute to groundwater.

Group Water Schemes commonly abstract from boreholes drilled into rock for supply. Cuttings into rock for road construction may lead to local permanent drawdown. Water supply and quality may need supplemental measures to maintain the resource for continued use.

Springs and holy wells noted on historic 25" and 6" mapping include:

- Knockballynameath;
- Castlebank;
- Ballycannan North;
- Knockalisheen;
- Cottage;
- Prospect;
- Newgarden;
- Ballyvollane;
- Rosmadda West.

To the north of the Study Area in upland areas, the following springs are mapped:

- Ballycar South;
- Coolnalira;
- North of Roo East beside River Blackwater.

To the south of the Study Area in lowland areas, there are also springs and wells mapped, predominantly in areas of Visean limestone. The frequency and concentration of these wells in an aquifer of local importance would suggest that in this area the rock is faulted/fractured resulting in increased productivity.

GSI mapping of groundwater wells indicates that there are many in the Study Area (Refer **Drawing RCSR-3605 in Volume 2).** The yield, depth and use of each groundwater well should be checked based on existing records. A more detailed audit of baseline water supply and quality may be necessary for assessment of environmental impact when proposed route alignments are known.

Karst

Karst features manifest themselves by the progressive dissolution of pure and nearly pure carbonate minerals from limestones. The weathered rock can display several characteristics such as swallow holes, springs or caves. Groundwater movements can be complicated in such an aquifer, with connectivity and transport times between locations being difficult to predict.

There can be serious impacts for structural foundations and road construction in karst terrain. Features require careful investigation as early as Route Selection Stage.

Ecology

If there is an ecological habitat dependant on groundwater, particularly a fen or marsh, then the impacts of construction on the aquifer could have knock-on effects on wildlife habitats. For instance, at Knockalisheen there is a protected designated environment. The soils in the area are of marine estuarine silt and clay, which consequently contain significant moisture contents. Soft soils with plentiful moisture are entirely suited to many species which can thrive in the habitat.

It is unlikely that the groundwater is feeding directly through the silts and clays as cohesive soils impede drainage. It may be possible that the upstream side of the habitat receives a more constant surfacing of groundwater which slowly percolates along through the protected habitat closer to the surface.

Inventory of Hydrogeological Constraints

The hydrogeological constraints affecting the Study Area include the following:

- Karstified bedrock aquifers potentially supplying groundwater to the sensitive environment at Knockalisheen;
- Potential drawdown of groundwater where road cuttings required;
- Risk of impacts to groundwater abstraction where groundwater wells are present.

3.6.4 Sources of information & References

The following sources of information were used:

- Geological Survey of Ireland, Digital Mapping, 2010 (http://www.gsi.ie/Mapping.htm);
- Environmental Protection Agency, ENVision Digital Mapping, 2010 (http://maps.epa.ie/InternetMapViewer/mapviewer.aspx);
- Geological Survey of Ireland, Directory of active quarries, pits and mines in Ireland, 2001;
- Sleeman, A.G. & Pracht, M., 1999, Geology of The Shannon Estuary, A geological description to accompany the Bedrock Geology 1:100,000 Map Sheet 17, Geological Survey of Ireland;
- Hanrahan, E.T., 1977, Irish Glacial Till: Origin and Characteristics, Oighear-Thalamh Éireann;
- NRA, 2008, Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Hobbs, N.B., 2986, Mire Morphology and the Properties and Behaviour of some British and Foreign Peats, Quarterly Journal of Engineering Geology, London. Vol 19, p 7-80.

3.7 Socio-Economic

3.7.1 Introduction and Context

In order to identify all potential constraints it is appropriate to carry out an appraisal of the main socio-economic forces in operation within the Study Area. This chapter outlines the socio-economic profile of the Study Area and includes a review of the existing environment, the populations, profile and key economic features.

3.7.2 The Receiving Environment

Limerick City is the main conurbation in the area and has a population of approximately 60,000 (Census 2006). It has been identified as the "gateway city" for the mid-west region in the National Spatial Strategy. Limerick City is the economic driving force in the mid-west region performing the role of a regional hub supporting employment, education, services, transportation, learning and culture. In this role, Limerick is a centre for high technology, manufacturing and internationally traded services.

Within the Study Area the main population centres are based around Ardnacrusha Power Station (Refer **Drawing RCSR-3701**). These population centres include:

- Athlunkard;
- Parteen;

- Ardnacrusha;
- Parkroe;
- Ballycannan North (Meelick);
- Gortatogher;
- Cloonoughter.

Beyond the influence of Ardnacrusha, Annacotty and Lisnagry are the main centres to the east of the Study Area. All of these villages have come under considerable development pressure as commuter villages on the east side of Limerick City. To the north of Limerick City, the further development of the villages around Ardnacrusha has been substantially constrained by the limitations of the available road network.

3.7.3 Economy, Business and Tourism

Agriculture is predominant throughout the Study Area and is important to the economy of the local communities. A number of major industries are located at the National Technological Park which has been established at Castletroy on the eastern extents of Limerick City. The National Technological Park houses many large companies such as Vistakon, O2 and Cook Ireland which are major sources of employment to Limerick City and its surrounding hinterlands. The O2 and Cook facilities are shown on **Photo 3.7.1** and **Photo 3.7.2**. Within the Study Area there are some private businesses such as hardware and garden stores, haulage depots and a number of local retail outlets. There is also a horticultural business which markets cut flowers.

The University of Limerick is located adjacent to the National Technological Park which is also another large source of employment in the area. The University of Limerick has over 11,300 students and 1,300 staff. The university offers a range of educational programmes in the disciplines of Arts, Humanities and Social Sciences, Business, Education and Health Sciences, Science and Engineering. The University is situated on a campus of over 133 hectares which includes lands on both sides of the River Shannon.

Photo 3.7.1 – O2 Buildings

Photo 3.7.2 – COOK Ireland Facility

The counties of Clare and Limerick possess many tourist attractions and in recent years the profile of tourism has been greatly raised with the development of river related tourism holidays such as cruising and angling. As a consequence there has been an expansion in the number of hotel rooms, guesthouses, restaurants and public houses. This development has further enhanced the attractiveness of the area as a tourist destination and as a result tourism is now integral to the economy of Limerick City and South Clare.

The villages support primarily local services such as the petrol station and retail outlet at the crossroads at Parkroe. The main centres of employment outside of Limerick City relate to Ardnacrusha Power Station and the Dairygold Cooperative Society at Parteen.

3.7.4 Transportation and Existing Infrastructure

Most of the major infrastructure within the region is located on the eastern, southern and western extents of Limerick and are generally outside the Study Area (Refer **Drawing RCSR-3701 in Volume 2**). The M7 Limerick to Dublin Road passes through the eastern extents of the Study Area. The M7 continues south of Limerick City where it intersects the N24 Limerick to Waterford Road and the M20 Limerick to Cork Road. The N18 Limerick to Galway Road forms the western arm of the junction and continues west under the Shannon. The N18 provides a strategic connection between Shannon International Airport and Limerick City.

Many Regional Roads within the Study Area converge to Limerick City. The R463, R464 and the R465 provide an important link from South Clare to Limerick City. The R445 (Old N7) links Limerick City to Nenagh in South Tipperary.

Outside the Study Area, on the southern extents of Limerick City the R510, R511, R512 and the R526 all connect the surrounding areas to Limerick City. The Dublin – Limerick railway line via Birdhill runs along the eastern periphery of the Study Area for approximately 1km. This railway line serves the towns of Castleconnell, Birdhill, Nenagh, Cloughjordan and Roscrea before rejoining the main Limerick - Dublin

railway line at Ballybrophy. The following four lines are connected to Limerick City however they are located outside the Study Area:

- Limerick – Dublin via Limerick Junction;
- Limerick – Ennis;
- Limerick – Foynes;
- Limerick – Irish Cement.

3.7.5 Community Facilities and Amenities

The Study Area contains many community services (Refer **Drawing RCSR-3702 to RCSR-3704 in Volume 2**) including two post offices, St. Patrick's Church in Parteen, Knockalisheen Refugee Centre and the following educational facilities:

- Lisnagry Primary School;
- Parteen National School;
- University of Limerick.

There are a number of recreational facilities within the Study Area including:

- Mackey Park – Ahane GAA Club (Refer **Photo 3.7.3**);
- Knockalisheen Park - Meelick GAA Club;
- Corbally United Soccer Grounds;
- Shanakyle All Purpose Weather Pitch;
- National Kart Centre at Gilloge;
- Parteen Pitch and Putt Course;
- Landscape Leisure 9 Hole Golf Club;
- Clonlara Equestrian Centre;
- Local Gun Clubs.

These clubs and playing fields are an integral part of their respective communities and it is important that any potential interference with these playing fields is kept to a minimum.

Photo 3.7.3 – Mackey Park, Ahane GAA Club

In terms of amenity facilities the River Shannon is widely promoted with the provision of angling stands, marina and boat moorings. The river is used by the University of Limerick's Rowing Club and their boat house and moorings is located within the Study Area. The ESB Lower Shannon Salmon Fisheries provide fishing amenities along this section of the river.

The Lough Derg Way is located within the Study Area. This Walking Trail stretches from Limerick City to Killaloe. This walk through the Study Area covers a distance of approximately 5.2km and is fully marked and sign posted. Refer **Drawings RCSR - 3702-3704** inclusive in Volume 2.

3.7.6 Public and Commercial Facilities

Churches & Burial Grounds

There are 2 no. existing Churches/Chapels and 3 no. graveyards located within the Study Area. St. Patrick's Church is located along the southern boundary of the Study Area in the townland of Parteen with St. Patrick's Chapel located in Parteen. The existing Killavoher Graveyard is located along the western boundary of the Study Area in the townland of Knocknalisheen. A second graveyard is located nearby in Ballycanon North. The third graveyard, Templenoegulla Graveyard is in ruin and is located just to the north of the River Shannon in the townland of Srawickeen.

Landfill Sites & Recycling Plants

The counties of Clare, Limerick and Kerry form part of the Limerick Clare Kerry Waste Management Region and operate three landfill sites and a number of recycling plants, none of which are located within the Study Area.

Quarries

Existing quarries, both operating and disused quarries, gravel and sand pit locations are highlighted in Section 6.1.7 of this Study (Refer **Drawing RCSR-3603 in Volume 2**).

Treatment Plants

The following treatment plants, both wastewater and water, are located within the Study Area:

- Ballycannon WWTP. Ballycannon Heights, Meelick;
- Castletroy WWTP, County Limerick.

In addition to the above, treatment facilities are located at the site of the former Burlington Industries to north of the River Shannon in Gillogue. Refer **Plate 3.7.4.**

Plate 3.7.4 – Treatment Facilities, Gillogue

3.8 Planning, Development and Land-Use

3.8.1 Introduction

The proposed scheme is in accordance with both County and Local Development Plans in terms of both Strategic and Local Policy. However it is equally pertinent within the context of a Constraints Study to outline any county and local planning policy issues and pending or awarded planning decisions which may have an impact on the identification of feasible route corridors.

3.8.2 Local and County Development Plan Policy

The Study Area encompasses land which falls within the administrative jurisdiction of both Clare County Council and Limerick County Council. As such the current Clare County Development Plan (2005 – 2011) and the Limerick County Development Plan (2005 – 2011) in conjunction with both the South Clare Local Area Plan (2009 – 2015) and the Castletroy Local Area Plan (2009 – 2015) require examination.

In addition, consideration should be given to the following Draft Development Plans;

- Clare County Development Plan (2011 – 2017);
- Limerick City Development Plan (2010 – 2016);
- Limerick County Development Plan (2010 – 2016).

Land-Use Policies

The overall strategic aim of all of these development plans is to promote the sustainable development of the counties and the settlements whilst protecting the environmental assets of same.

In order to mesh the promotion of economic development with the protection of environmental assets and resources each document contains broad planning policies. These include policies designed to promote and develop sustainable transport, community facilities, employment opportunities, etc. which are countered

by policies to control indiscriminate rural settlement and to protect the landscape and visual amenity, the natural heritage and the built and architectural heritage.

By following the phases laid down by the National Roads Authority Project Management Guidelines and the NRA's Environmental Assessment and Construction Guidelines all of these potential environmental impacts will be minimised. Therefore, at this point these land-use policies cannot be considered as quantifiable constraints, however reference to them is essential throughout the Route Selection and EIA stages.

Urban Development Limits and Zoning Strategies

The County and Local Development Plans promote development which reinforces existing towns and villages. To this end, for all the larger towns, villages and settlements a development envelope or limit is identified. Within these development limits Land-use Zoning Strategies are developed with the intention of concentrating like with like and thereby promoting and strengthening the social and economic role of each town or village.

The proposed scheme should endeavour not to impact these development limits and should, where feasible, have cognisance of the proposed zoning strategies contained therein.

The development limits are mapped on **Drawing RCSR-3801 in Volume 2**, and the Zoning Strategies are shown on **Drawings RCSR-3802** to **RCSR-3804 in Volume 2.**

3.8.3 Housing and Development

The Study Area within County Clare and County Limerick contains a number of commuter towns and villages such as Parteen, Parkroe and Lisnagry. There is also a significant amount of ribbon development along many of the regional and local roads. An example of such ribbon development is the townland of Glenon South situated along the local road to the north of Ardnacrusha. Strips of ribbon development similar to this should be considered as a constraint.

There are many businesses and industries within the Study Area. Most of these businesses such as local shops, public houses and service stations are typical to most rural communities. Within the Study Area, The ESB's Hydroelectric Power Station at Ardnacrusha and the associated Headrace/Tailrace Canals is considered as a key constraint. The Study Area closer to Limerick City includes lands within Shannon Development's National Technology Park which includes major industries such as the Vistakon facility.

The Study Area also contains many community facilities such as Churches, Schools, GAA Grounds, Soccer Grounds, Golf and Pitch & Putt Courses. Knockalisheen Refugee Centre is also located along the western extremities of the Study Area which also contains large tracts of amenity areas.

An examination of the Clare and Limerick County Council planning lists was undertaken to identify any pending or awarded planning permissions within the Study Area. These are mapped on **Drawings RCSR-3805, RCSR-3806 and RCSR-3807 in Volume 2**.

3.8.4 Land-Use

The primary land-use in County Clare is agricultural. Two thirds of the land in the county is deemed suitable for agricultural purposes however only one third is classified as being good for grassland. The average farm size in County Clare is 31.3 hectares which is similar to the national average of 31.4 Hectares.

Farming in many parts of County Clare is supported by other employment occasionally through farm diversification but more usually in employment not related to agriculture. A significant amount of farmland within the Study Area in County Clare is in the floodplain of the River Shannon and the River Blackwater which is revealed by the growth of rushes in fields and wet localized ground conditions as shown on **Photo 3.8.1**. The main agricultural practice within the Study Area is dry-stock farming and silage harvesting however there are also some dairy and equine farms. The ground conditions with the Study Area do not appear to lend themselves to the production of cereal crops and it is unlikely that any cereal producing farms will be impacted. A number of equine farms were identified within the Study Area with a substantial equine farm located in the townland of Illaunyregan.

Photo 3.8.1 – Land Conditions within Study Area

Similar to County Clare, County Limerick traditionally has had a very strong agricultural base. Approximately 45% of the land area is considered disadvantaged, with the more severely affected areas mainly in the west, south and east of the County. The average farm size is 32.6 hectares, slightly higher than the national average.

Dairy farming is by far the most prevalent activity, however beef farming and horse breeding is found in certain areas. Cereal farming in Limerick is concentrated in the hands of less than 50 farmers. The agricultural lands within the Study Area in County Limerick are predominantly used for dry stock farming and silage harvesting. Some

of the lands are used for grazing horses and there are some dairy farms however these low lying and flood susceptible lands would generally not be suitable for intensive dairy or cereal farming. There is little agricultural activity in the Limerick City area within the Study Area.

Land is an important natural resource and care should be taken to minimise the impact of the preferred route on the farming community.

3.8.5 Land Ownership

A land search will be carried out at the Environmental Impact Assessment / Compulsory Purchase Order phase of the development to comprehensively identify ownership of the land in the vicinity of the preferred route. It is inevitable that some land holdings will be impacted by the development. However the scheme will be designed to minimise land take and severance and the number of landowners impacted.

3.9 Ecology

3.9.1 Introduction

The objective of this chapter is to identify the international, national, county and local ecological constraints which should be avoided or that could affect the design of the scheme, delay progress or influence the costs.

Thus the aim of the exercise is to identify all known sites designated for nature conservation, all sites outside of designated areas which are known to provide an important component of a County or locality's ecological resource and to identify all known records of rare and protected species. As such the Ecology section of the Constraints Study is primarily a desk exercise that comprises a search for all available information, assisted by site reconnaissance as deemed appropriate.

3.9.2 Methodology

This section was compiled through information obtained from a windscreen review of the Study Area in early November 2010 and through desk studies. The websites of the National Parks & Wildlife Service (NPWS), Inland Fisheries Ireland and the Environmental Protection Agency (EPA) were accessed for information on designated sites in the Study Area. The list of consultees for the Constraints Study is included in Appendix A at the end of the chapter.

Information on habitats, flora and fauna were collated following a desk study of the available ecological literature and a review of available aerial photography and OS mapping. Particular attention was focussed on the South East Clare Habitat Mapping report (*Survey and Mapping of Habitats from Cratloe to Parteen, South East Clare*, RPS December 2008) and the relevant Chapters and appendices of the Coonagh to Knockalisheen Distributor Road EIS (June 2010).

In addition information from the National Parks and Wildlife Service (NPWS) database was received following the submission of a 'Request for Information' application and the following were contacted by letter and invited to provide information and/or comment on the proposal:

- Development Applications Unit, DoEHLG; and
- Inland Fisheries Ireland – Shannon River Basin District

The NRA *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (Revision 2, 1st June 2009) recommends the following geographic frame of reference be used when determining value of the ecological resources:

- International importance;
- National Importance;
- County Importance;
- Local Importance (higher value);
- Local Importance (lower value).

This valuation method allows for the identification of the key ecological receptors, the potential impact of which will influence the identification of the preferred route corridor and the design of the scheme. Confirming the valuation of the lower order sites and accurately mapping the presence of protected species requires ongoing field surveys, and must be progressed as the project develops through the Route Corridor Selection process.

3.9.3 General Description of Study Area

The Study Area primarily encompasses the south eastern extent of County Clare and a small area of northern County Limerick and Limerick City (Refer **Drawing RCSR-3101 in Volume 2**). It extends from Knockalisheen in the west to Annacotty in the east. Watercourses, both natural and man-made, dominate the area. The Lower River Shannon weaves its way through the Study Area in a westerly direction before entering Shannon Estuary immediately west of Limerick. Within the Study Area the Shannon is intercepted by the Mulkear River, the River Blackwater and the Ardnacrusha Tailrace. The Ardnacrusha Headrace and the Errina Canal are also significant waterbodies in the Study Area.

The lands contained within the Study Area are primarily low lying floodplains which are used as pasture for cattle. The dominant habitat type is wet grassland. To the north west and above Knockalisheen the ground rises forming the hills of Ballycar South (255m) and Woodcock Hill (310m).

3.9.4 Designated Sites for Nature Conservation

Designated sites within 10km

The Designated sites for Nature Conservation within the Study Area are mapped on **Drawing RCSR-3901 in Volume 2**. All the designated sites within 10km of the Study Area are described in Table 3.9.1 below (it should be noted that site descriptions / synopses are often not publicly available for pNHAs).

Table 3.9.1: Designated sites for Nature Conservation

SITE NAME	SITE CODE	STATUS	DESCRIPTION
Lower River Shannon	002165	cSAC	Refer Section 9.4.2 below
Knockalisheen Marsh	002001	pNHA/cSAC	Refer Section 9.4.3 below
River Shannon and River Fergus Estuaries	004077	SPA	Overwintering birds
Fergus Estuary and Inner Shannon (North Shore)	002048	pNHA	unknown
Inner Shannon Estuary (South Shore)	000435	pNHA	unknown

SITE NAME	SITE CODE	STATUS	DESCRIPTION
Woodcock Hill Bog	002402	NHA	Upland Blanket Bog
Glenomra Wood	001013	cSAC/pNHA	Semi-natural Woodland
Gortacullin Bog	002401	NHA	Upland Blanket Bog
Castle Lake	000239	pNHA	unknown
Rosroe Lough	002054	pNHA	unknown
Loughmore Common Turlough	000438	pNHA	Turlough
Carrannon Wood	001012	pNHA	Semi-natural Woodland
Slievefelim to Silvermines Mountains	004165	SPA	Hen Harrier

With regard to the sites referred to in Table 9.1, it is considered that the Lower River Shannon, which passes through the Study Area, warrants special consideration.

Lower River Shannon candidate Special Area of Conservation

The Lower River Shannon candidate Special Area of Conservation (cSAC) is a significant feature of the Study Area (Refer **Drawing RCSR-3901**). This very large designated site encompasses the Shannon, Feale, Mulkear and Fergus Estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick), the freshwater stretches of much of the Feale and Mulkear catchments and the marine area between Loop Head and Kerry Head.

As a consequence of the size and extent of the site, covering marine, freshwater and terrestrial habitats it has been selected as a candidate SAC for a range of habitats listed on Annex I of the EU Habitats Directive. These are lagoons, alluvial wet woodlands, floating river vegetation, *Molinia* meadows, estuaries, tidal mudflats, Atlantic salt meadows, Mediterranean salt meadows, *Salicornia* mudflats, sand banks, perennial vegetation of stony banks, sea cliffs, reefs and large shallow inlets and bays. The following cSAC selection habitats may occur within the Study Area:

- alluvial wet woodland;
- floating river vegetation;
- *Molinia* meadows.

Alluvial woodland occurs on the banks of the Shannon and on islands in the vicinity of the University of Limerick. The woodland is up to 50m wide on the banks and somewhat wider on the largest island.

Floating river vegetation characterised by species of Water-crowfoot (*Ranunculus* spp.), Pondweeds (*Potamogeton* spp.) and the moss *Fontinalius antipyretica* are present throughout the major river systems within the site.

Molinia meadows,a wet grassland habitat, occur in several parts of the designated site and the examples at Worldsend on the River Shannon are especially noteworthy. Here the areas of wet meadow dominated by rushes and sedges and supporting a diverse and species-rich vegetation, including such uncommon species as Blue-eyed Grass (*Sisyrinchium bermudiana*) and Pale Sedge (*Carex pallescens*).

The site is also selected for the following species listed on Annex II of the EU Habitats Directive – Bottle-nosed Dolphin, Sea Lamprey, River Lamprey, Brook Lamprey, Freshwater Pearl Mussel, Atlantic Salmon and Otter. Of these species Lamprey spp., Atlantic Salmon and Otter will be present within the Study Area.

With respect to these species it is imperative that the project has no impact on salmon or lamprey spawning grounds, suitable habitat for which has been recorded upstream of the Plassey Bridge, nor on otter holts or otter movement along the River Shannon and its tributaries.

Knockalisheen Marsh pNHA

Knockalisheen Marsh proposed Natural Heritage Area (pNHA) is located at the western end of the Study Area. The pNHA is included within the larger Lower River Shannon cSAC. The following is taken from the site synopsis:

This site is situated mostly within Co. Clare but just to the north of Limerick City. It consists of grassland that slopes gradually to a wetland area, which then drains into the River Shannon.

Much of the northern part of the site is unimproved pasture, while the lower parts near the river are extremely wet and consist of wet grassland and fen communities, which are very species rich. Though the nutrient status is low throughout the area there is a mixture of calcicole and neutral grassland/marsh species. The dominant grasses are Meadow Fescue (Festuca pratensis), Yorkshire Fog (Holcus lanatus) and Rough Meadow Grass (Poa trivialis). The commonest herb species are Yellow Rattle (Rhinanthus minor), Tufted Vetch (Vicia cracca), and Devil's-bit Scabious (Succisa pratensis), along with several rush species (Juncus spp.).

At the southern end of the site there is a reedbed of Common Reed (Phragmites australis) and Bulrush (Typha spp.).

The area is notable for the occurrence of several orchid species, especially Marsh Helleborine (Epipactis palustris). There is a colony of the wetland plant Skullcap (Scutellaria galericulata), a species which is rare in Co. Clare.

The ornithological importance of this site is not known but it is likely to serve as a roosting and feeding area for birds of the adjacent Shannon.

Low intensity grazing, mostly by cattle, has maintained the high species diversity of this site and should continue. The importance of this site is that it is a good example of an unimproved grassland/wetland, with high plant species diversity. This is now a scarce habitat, especially close to a large city.

The south eastern extent of Knockalisheen Marsh, alongside the River Shannon, is also designated, under the Wildlife Act, as a Wildfowl Sanctuary *(*Refer **Drawing RCSR-3901**)**.** The objective of this designation is to control the hunting of certain species of wildfowl.

Consideration of European Sites

European sites warrant additional consideration over and above other designated conservations areas and the Habitats Directive requires an 'appropriate assessment' to be carried out where a development is likely to have a significant impact on an SAC or SPA. On that basis it is important to note that 'significant impact' relates to the impacts on the site selection features and their associated conservation

objectives. Any impact on these is likely to result in a negative finding in the appropriate assessment, which in turn requires the examination of alternative solutions, or, in the absence of alternative solutions, the identification of 'imperative reasons of over-riding public interest'.

An examination of the Study Area makes it clear that at least one crossing of the Lower River Shannon cSAC will be required. To that end Figure 3 of the NRA Guidelines for the Assessment of Ecological Impacts directs the requirement to record where, if known, the locations of the cSAC selection features. While this is not known in any detail, beyond the definite presence of alluvial wet woodland on the banks of the Shannon, it will be appropriate at this point to highlight the importance of habitat and species surveys at Route Selection Stage and consultation with NPWS. On this basis it is imperative that during the route selection process care is taken to ensure that the chosen River Shannon crossing point avoids impacting the cSAC habitat and species selection features (the Gorey Bypass was bought to a Judicial Review on the basis that the best ecological crossing point was not selected on the basis of impact on cSAC habitat) and it should be noted that detailed surveys will be required to ensure that the chosen River Shannon crossing is ecologically the most appropriate.

3.9.5 Non-designated Sites of Nature Conservation Importance

In 2008 Clare County Council in association with the Heritage Council, Clare Biodiversity and Clare Heritage Forum commissioned RPS to survey and map the habitats within south east Clare. The subsequent report 'Survey and Mapping of Habitats from Cratloe to Parteen, South East Clare' produced habitat maps for the entire area and more detailed reports of those non-designated sites which were considered to be of ecological significance. This report has been reviewed and those sites recorded by this survey as being of ecological significance have been reviewed against the aerial photography (Refer **Drawing RCSR-3902 in Volume 2**).

The Ecological Site Evaluation Scheme used by the report authors has been reviewed against the NRA Guidelines and it is considered that it is broadly representative such that 'High Ecological value in a local context' equates to NRA Guidelines ecological valuation 'County Importance' and 'Moderate Ecological value in a local context' equates to 'Local Importance (higher value)'. The following text references the NRA Guidelines valuation scheme.

Site number 1: 'Derryfadda'

This site is considered to be of National (or even International) Ecological Interest. The 47.9Ha site supports a number of viable habitats which are linked to Annex I Habitats within the Habitats Directive. These are North Atlantic Wet Heaths with *Erica tetralix*, Active Raised Bog, Bog Woodland and 'depressions on peat substrates of the *Rynchosporion*' (a sub-habitat of raised bog).

Site number 2: Cappateemore West

This 35.6Ha site is considered to be of County Importance as the oak/birch/holly woodland (WN1) present alongside the stream corresponds to the Annex I habitat 'old sessile oak woods with *Ilex* and *Blechnum* in the British Isles', although some non-native tree species are present.

Site number 3: Cappateemore

This is a semi-natural wet woodland (WN6) occurring alongside a small stream. It is comprised of Ash, Willows, Hawthorn and Blackthorn and is considered to be of County Importance.

Site number 4: Garraun

This 5Ha habitat is located on the banks of the River Blackwater where it converges with the Shannon in Garraun. It is comprised of wed Pedunculate Oak / Ash woodland (WN4) and is considered to be of County Importance as it corresponds to the the Annex I priority habitat 'alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior'.*

Site number 5: Cappavilla South

This is a small pocket of Wet pedunculate Oak Ash Woodland (WN4) located in a depression near the River Blackwater.

Site number 6: Newtown – Site A

This is a small are of wet Willow Ash Alder woodland (WN6) on the edge of a wet grassland field.

Site number 7: Newtown – Site B

This 3.8Ha site is located between the Errina Canal and the headrace canal and is comprised of species-diverse marsh and which grades into Wet Willow Alder woodland.

Site number 8: Glenlon North

This site is considered to be of local importance as it supports a range of semi-natural habitats including humid acid grassland (GS3), wet grassland (GS4) and wet Willow Alder woodland (WN6).

Site number 9: Shannakyle

This site is considered to be of Local Importance as it is an area of wet, species rich recolonising bare ground (ED3).

Site number 10: Mountcatherine – Site A

This is a mature stand of mixed broadleaf and conifer woodland and mature treeline which is considered to be of local importance.

Site number 11: Mountcatherine – Site B

This is an area of species rich wet grassland and treeline on the bank of the River Blackwater.

Site number 12: Errina Canal

The White Young Green report '*Waterway Corridor Study 2006, River Shannon and Errina and Park Canals: Final Ecology Report to the Heritage Council'* considers the Errina canal to be a "haven for wildlife" which is "likely to act as a significant wildlife corridor". The canal is described as being largely overgrown and inaccessible with the steep banks supporting dense broad-leafed woodland dominated by ash, and sycamore with occasional hawthorn and elder.

Tree Preservation Order sites

Listed tree preservation orders within the Study Area are shown on **Drawing RCSR-3902 in Volume 2**. The NRA Guidelines dictate that these should be considered as of County Importance.

3.9.6 Other Sites of Potential Ecological Importance

The south east Clare habitat survey mapped and labelled the habitats across the whole area. These map layers have been reviewed and examined against the aerial photography and additional sites of potential ecological importance are shown on **Drawing RCSR-3903 in Volume 2**.

These sites are primarily varying types of woodland or scrub habitat as the other dominant habitat type was registered as wet grassland and it is impossible at this point to view wet grassland as an ecological constraint as it is so widespread throughout the Study Area. It should be further noted that none of these sites were identified in RPS's list of Moderate Local Value sites and as such it can be concluded that survey authors considered them to be of (at best) Local Importance (lower value). These classifications will have to be confirmed by survey at Route Selection Stage.

3.9.7 Fisheries and the Aquatic Environment

Fisheries

The lower reach of the River Shannon runs along the Shannon valley from Killaloe to Loop Head, a distance of approximately 120km. The stretch of the River Shannon between Killaloe and Limerick is entirely freshwater. Within the Study Area, the Lower River Shannon cSAC is located in the eastern section. The site has been selected for the following species listed on Annex II of the Habitat's Directive – River Lamprey, Brook Lamprey, Freshwater Pearl Mussel and Atlantic Salmon. Castleconnell Salmon fishery, on the River Shannon, is owned and controlled by the Electricity Supply Board (ESB). The fishery is divided into eight beats each about 0.5 miles long.

The River Mulkear, a spate river, rises in the Slievefelim and Silvermines mountains in North Tipperary and flows north-westerly joining the river Shannon just below Annacotty in County Limerick. Its catchment area covers approximately 650km^2. Across the entire catchment of the River Mulkear, there are many types of semi-natural habitats such as wet grassland, wet woodland and marsh however, improved grassland is the most common. The Mulkear catchment is a renowned grilse fishery; although spring fish are also caught. The Mulkear River is ranked as one of Ireland's most populated salmon rivers and is home to approximately 15 fish species along with lamprey, eel and the native White-clawed crayfish. The river is also an important habitat for the kingfisher.

Response from Inland Fisheries Ireland

Inland Fisheries Ireland's Senior Environmental Officer responded to the request for information and provided the following additional information

- Smelt, one of the rarest fish in Ireland, is found in the Shannon and Fergus Estuaries and its principal spawning area is the Tailrace;
- All the rivers in the Study Area are considered salmon fisheries with the exception of the Blackwater which is a trout fishery;
- The Lower River Mulkear is a coarse fishery of match standards;

- Salmon and lamprey spawning grounds are specifically protected;
- The ESB operates a – currently suspended – commercial eel fishery on the Headrace and access to this must be maintained;
- The baseline survey must record in-stream and riparian habitat up and down stream of any proposed crossing
- The maintenance of water quality during the construction phase is of paramount importance;
- The larger rivers must be crossed with high level bridges (5 – 6m), all significant watercourses require 2m clearance on either bank for angler access, smaller water course crossing must be embedded box culverts;
- All water course crossings must be agreed with Inland Fisheries Ireland and reference should be made to the Shannon Regional Fisheries Board document "Protection and Conservation of Fisheries Habitat with Particular Reference to Road Construction".

Existing Water Quality

The EU Water Framework Directive 2000/60/EC was adopted in 2000 and implemented in 2003 on a National Level. It requires that all water bodies achieve "good" ecological status by 2015 and that this status does not deteriorate. Ecological status is determined by a Biological Quality rating system - the Q value system.

The Environmental Protection Agency (EPA) online Water Quality list several monitoring stations which provide biological water quality data on the main rivers within the area. A water quality survey was conducted by the EPA throughout Ireland in 2008 and this is currently the most up to date information available. Data was taken at Cloon and Commons above Castleconnell for the River Shannon. Results from here indicated that the water quality was of moderate status (a Q value of 3 – 4). Data was taken for the Mulkear River where the recently completed M7 crosses over the river. Results indicate that the quality of this river is of good status (a Q value of 4). For the River Blackwater, data was taken at River Crossing Point on the "The Lough Derg Way". Results indicated that the water quality here is of high status (Q5).

The Zebra mussel (*Dreissena polymorpha*) has become a national pest and is now found throughout the main River Shannon and its associated lakes. It is important that the potential for further expansion of this species is kept at a minimum and appropriate mitigation measures are put in place.

Groundwater Dependent Ecosystems

An examination of the geology in the area has identified that there is a higher permeability aquifer present in the upland area. Where this meets the less permeable area at or north of Knockalisheen Marsh there is likely to be an upwelling of groundwater which may contribute to the inherent wetness of the upper grasslands on a year-round basis. This requires further investigation at Route Selection and subsequent stages and may require mitigation or appropriate design measures to maintain the hydro-geological regime.

3.9.8 Protected Species

The information received from NPWS includes records of species recorded in the Study Area over the past 30 years. A number of these are of note as they are legally protected species and have been recorded relatively recently. In addition the National

Biodiversity Data Centre website and the Bat Conservation Ireland website (Bat records distribution maps) were reviewed for existing ecological records.

The National Parks and Wildlife Service request that the exact location of sensitive protected species is not made public and to that end supply the data locations in 10km (and where available 1km) square grid references. As it is not possible to pinpoint distinct locations or provide relevant local site names for where these species occur within the area, it is not, at this stage, plausible to accurately map their locations or to consider them as measureable constraints. However, at Route Corridor Selection consideration should be given to avoiding areas of suitable habitat and breeding or resting sites of these species (Refer Table 3.9.2). Similarly at EIA stage considerable additional survey effort will be required to ascertain the potential impact on these species and to bring forward appropriate mitigation measures.

Table 3.9.2, below, lists the protected fauna, identifies their conservation status and legal protection and Table 3.9.3 lists the protected flora for which records exist within the Study Area.

Table 3.9.2: Protected Fauna

SCIENTIFIC NAME	COMMON NAME	CONSERVATION STATUS	LEGAL PROTECTION
Pipistrellus pipistrellus	Common Pipistrelle Bat	Internationally Important	Annex IV; Wildlife Acts
Pipistrellus pygmaeous	Soprano Pipistrelle Bat	Unknown	Annex IV; Wildlife Acts
Myotis daubentii	Daubenton's Bat	Internationally Important	Annex IV; Wildlife Acts
Nyctalus leisleri	Leisler's Bat	Internationally Important	Annex IV; Wildlife Acts
Rhinolophus hipposideros	Lesser-horseshoe Bat	Internationally Important	Annex II; Wildlife Acts
Lutra lutra	Otter	Internationally Important	Annex II + IV; Wildlife Acts
Meles meles	Badger	Internationally Important	Wildlife Acts
Martes martes	Pine Marten	Internationally Important	Annex V; Wildlife Acts
Lepus timidus subsp hibernicus	Irish Hare	Internationally Important	Annex V; Wildlife Acts
Mustela erminea subsp hibernica	Irish Stoat	unknown	Wildlife Acts
Zootoca vivipara	Common Lizard	Unknown	Wildlife Act
Rana temporaria	Common Frog	Internationally Important	Annex V; Wildlife Acts
Lissotriton vulgaris	Smooth Newt	Unknown	Wildlife Acts
Lampetra fluviatilis	River lamprey	Indeterminate	Annex II + V
Petromyzon marinus	Sea Lamprey	Indeterminate	Annex II
Lampetra planeri	Brook Lamprey	Inderterminate	Annex II

SCIENTIFIC NAME	COMMON NAME	CONSERVATION STATUS	LEGAL PROTECTION
Osmerus eperlanus	Smelt	Vulnerable	

Records of Protected Plant Species

Table 3.9.3 lists the protected plant species which have been recorded in the area. It should be noted that some of these records are historic (for example the record of *Groenlandia densa* is from 1899) and the plants may not currently be present. This does not, however, pre-determine that there is an absence of those protected or rare plants listed in the Flora Protection Order and the Irish Red Data lists and ongoing field surveys will be required to determine the status of these during Route Corridor Selection and EIA stage.

Table 3.9.3: Protected Flora

SCIENTIFIC NAME	COMMON NAME	CONSERVATION STATUS	LEGAL PROTECTION
Groenlandia densa	Opposite-leaved pondweed	Vulnerable	Flora Protection Order
Hordeum secalinum	Meadow Barley	Vulnerable	Flora Protection Order
Schoenoplectus triqueter	Triangular Clubrush	Vulnerable	Flora Protection Order
Scleranthus annuus	Annual Knawel	unknown	Flora Protection Order

Protected Mammal Species

Bats

There are currently 10 known species of bat resident in Ireland, 5 of which have been recorded within the vicinity of the Study Area (Refer Table 3.9.1). Of note is the presence of the Lesser Horseshoe Bat in this vicinity in County Clare. The Lesser Horseshoe Bat is the only bat species which is protected under Annex II of the Habitats Directive. This species is considered a European priority species and as such care is required to ensure that there will be no impact on it. Its range in Ireland is limited to the six western counties - Clare, Cork, Galway, Kerry, Limerick and Mayo. It roosts mainly in roofs of old houses or in outhouses, stables or old cottages. In winter this species hibernates in caves, disused cellars, mines and souterrains. The Lesser Horseshoe Bat usually forages in woodland and scrub.

All other bats along with their breeding and resting places are protected by the Wildlife Acts and by Annex IV of the Habitats Directive and it is imperative therefore that all bat roosts are identified.

The elements of bat ecology which may be impacted by road construction projects includes the potential direct physical impact on bat roosts and also the impact the road scheme may have on the bats commuting routes, often linear landscape features, and feeding areas. Bats will utilise buildings, mature trees, caves, masonry arch bridges, etc as roosts.

The NRA's '*Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes'* highlights that habitat with good potential for bats should be identified and, where possible avoided, during the Route Corridor Selection Study. Habitat with good potential for bats (roosting or feeding) is identified as mature

woodland; agricultural pasture with a small field network and hedgerows; rivers and watercourses; wetlands; areas with mines, caves or tunnels; and old farm buildings, estate houses, castles, etc..

Otter

Otter distribution in Ireland is widespread and they have been recorded in the watercourses throughout the Study Area. Otter requirements are food source and cover to use as over ground couches or holts. Holts at riversides tend to be tunnelled holes, cavities in tree roots or rock piles. Couches are generally mats of nesting material located in vegetation on riverbanks or away from water in secluded areas. They can be created in areas of dense scrub, reedbeds, etc. Otters will not tolerate disturbance of a holt site currently in use.

Otters are protected by Annex II and Annex IV of the Habitats Directive and by the Wildlife Acts and it is therefore imperative that potential habitat be avoided during the route selection exercise and that otter surveys be undertaken to identify otter activity and otter holts at EIA stage and that pre-construction otter surveys and mitigation measures highlighted in the NRA's *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* are followed.

Other mammal species

There are also records of Badger, Pine Marten and Irish Hare, the breeding and resting places of which are protected under the Wildlife Acts.

Badgers are widely distributed across a range of habitat types with setts often being located within hedgerows, scrub and woodland edges. This wide distribution makes it likely that badgers will be encountered on most road schemes and this must be confirmed, at EIA stage, during the multi-disciplinary field surveys through the observation of field signs such as setts, paths and latrines. Where possible impacts on active setts should be avoided and reference should be made to the NRA's Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes.

Pine Marten are historically associated with woodland, although they have adapted to a variety of more open habitats. Where records of Pine Marten exist, at EIA stage it may be necessary to undertake targeted Pine Marten survey. Where feasible existing and potential den sites should be avoided and reference should be made to the mitigation measures outlined in the NRA's Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes.

Irish Hare is protected by the Wildlife Acts, although as a recognised 'quarry' species a licence can be issued for hunting hares. Annex V of the Habitats Directive allows for the species to be hunted provided that this does not impinge on the attainment of Favourable Conservation Status. The Irish Hare preferred habitat is unimproved or semi-improved pasture or uplands with sufficient cover for resting. There is unlikely to be any direct impact on the local hare population with main impact of any proposed road scheme being increased habitat fragmentation.

Protected Fish Species

Atlantic Salmon occur in the area as do all three Lamprey species. These species and their spawning habitat are protected by Annex II of the Habitats Directive. Smelt are present in the estuary and spawn in the Tailrace. The presence of potential spawning habitat should be recorded during the multi-disciplinary walk-over survey at every watercourse crossing. Subsequently the timing of works and the design of all

proposed bridges and culverts must be agreed with the Shannon Regional Fisheries Board and reference must be made to the NRA's *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes.*

Protected Bird Species

Kingfishers tend to be found close to gently flowing lowland freshwater and are likely to be present along watercourses within the Study Area. This species is protected under Annex I of the EU Birds Directive and the initial walk-over survey must determine suitability of the habitat present as directed by the NRA's *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes.*

Amphibians and Reptiles

Common (Smooth) Newts, Common Frogs and the Viviparous lizard have all been recorded as present within the Study Area. All of these species are protected by Section 23 of the Wildlife Act (1976) and as such it is imperative that they and their habitat are considered. A number of ponds, wetlands, etc which form potential habitat have been identified.

Any walk-over survey should determine suitability of the habitat present as directed by the NRA's *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes.*

Other protected species – White-clawed Crayfish

Although not recorded on the NPWS received records for the Study Area, White-clawed Crayfish (*Austopotamobius pallipes)* have been recorded on the upstream reaches of the Mulkear system and should be considered as potentially present on the River Blackwater and smaller streams within the Study Area. This species is listed on Annex II of the Habitats Directive and as a result it requires strict protection. In streams the preferred habitat for this species is a shallow riffle with large stable rocks which can provide suitable refuges. In addition the species is most often associated with high water quality (unpolluted – Q value 4 - 5). Where the scheme is likely to have an impact on suitable Crayfish habitat, targeted surveys may be required. This should be undertaken with direction from the Local Conservation staff of the National Parks and Wildlife Service and reference should be made to the mitigation measures outlined in the NRA's *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes*.

3.9.9 Conclusion

The most significant ecological constraint is undoubtedly the Lower River Shannon cSAC and the associated species and habitats. In addition the ecological sites identified by the RPS habitat mapping exercise, all the major waterbodies are considered as ecological constraints.

Throughout the Route Selection exercise, effort will be made to avoid any watercourses, or specific locations therein, identified as particularly sensitive during the Route Selection exercise. It is considered that with appropriate route selection, design and mitigation that all potentially adverse impacts can be avoided and minimised.

3.10 Archaeology, Architecture and Cultural Heritage

3.10.1 Introduction

General

The chapter details the results of a Cultural Heritage Constraint Study, which has been carried out in order to assess the archaeological and architectural resource within the environs of the proposed Limerick Northern Distribution Road. The study has been undertaken in order to inform the route options available of a proposed distribution road in this area..

The Study Area is located within County Limerick and County Clare. It includes a stretch of the River Shannon from Castleconnell to Groody Valley, along with part of the northwestern environs of Limerick City. A significant portion of the Headrace Canal is also located within the Study Area, along with a smaller section of the Errina Canal located between the River Shannon and the Headrace Canal. Although parts of the Study Area have been subject to suburban development, much of it still exists as open agricultural land.

A Cultural Heritage Constraint Study has been undertaken in order to identify all recorded archaeological and cultural heritage (including built heritage) sites and to highlight areas of archaeological or architectural potential within the Study Area. The location of these known constraints are plotted on **Drawings RCSR-31001** to **RCSR-31003 in Volume 2** and will in turn inform the future development of route options for the Northern Distribution Road.

Outline of Cultural Heritage Study

The assessment involved a study of the archaeological, architectural, historical and cultural background of the Study Area. This included information from the Record of Monuments and Places of Counties Limerick and Clare; review of all relevant County Development Plans and the National Inventory for Architectural Heritage.

The study has been carried out in accordance with the NRA Guidelines for the Assessment of Archaeological and Built Heritage Impacts of National Road Schemes (2005).

3.10.2 Statutory Protection of Cultural Heritage Sites

Protection of Cultural Heritage

The Cultural Heritage in Ireland is safeguarded through both National and International policy designed to secure the protection of the Cultural Heritage resource to the fullest possible extent (Dept. of Arts, Heritage, Gaeltacht and the Islands 1999, 35). This is undertaken in accordance with the provisions of the European Convention on the Protection of the Archaeological Heritage (Valletta Convention), ratified by Ireland in 1997. Cultural Heritage can be divided loosely into the archaeological resource covering sites and monuments from the prehistoric period to the 18th century, and the built heritage resource, encompassing standing structures and sites of cultural importance of a post-18th century date.

The Archaeological Resource

The National Monuments Act 1930 to 2004, the Heritage Act 1995 and relevant provisions of the National Cultural Institutions Act 1997 are the primary means of ensuring the satisfactory protection of archaeological remains, which are held to include all man-made structures of whatever form or date except buildings habitually

used for ecclesiastical purposes. A national monument is described as 'a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto' (National Monuments Act 1930 Section 2).

There are a number of mechanisms under the National Monuments Act, which are applied to secure the protection of archaeological monuments. These include the Register of Historic Monuments, the Record of Monuments and Places, and the placing of Preservation Orders on endangered sites.

Ownership and Guardianship of National Monuments

National monuments may be acquired by the Minister whether by agreement or by compulsory order. The State or Local Authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the Local Authority as guardian of that monument if the State or Local Authority agrees. Once the site is in ownership or guardianship of the State it may not be interfered with without the written consent of the Minister.

There are no National Monuments under state ownership or guardianship, located within the Study Area.

Register of Historic Monuments

Section 5 of the 1987 Act states that the Minister is required to establish and maintain a Register of Historic Monuments. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. Any interference of sites recorded in the Register without the permission of the Minister is illegal, and two months notice in writing is required prior to any work being undertaken on or in the vicinity of a registered monument. This list was largely replaced by the RMP following the 1994 Amendment Act, but still holds records of monuments under Preservation Orders, Temporary Preservation Orders or those under ownership or guardianship of the State. All registered monuments are now included in the Record of Monuments and Places.

Preservation Orders and Temporary Preservation Orders

Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference to the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation surrounding the site must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders by the written consent, and at the discretion, of the Minister. Consultation with the list of Preservations Orders has revealed that there is one site, AH 24 (Refer **Drawing RCSR-31001 in Volume 2**), within the Study Area that possesses a preservation order. Site AH 24 refers to a ringfort located within the townland of Ballycannan, Co. Clare. The order was made on 15th February 1973.

Record of Monuments and Places

Section 12 (1) of the 1994 Act provides that the Minister for Arts, Heritage, Gaeltacht and the Islands shall establish and maintain a record of monuments and places where the Minister believes that such monuments exist. The record comprises of a list of monuments and relevant places and a map or maps showing each monument and relevant place in respect of each county in the State. Sites recorded on the

Record of Monuments and Places all receive statutory protection under the National Monuments Act 1994.

There are 53 recorded monuments within the Study Area. Each site is known by a unique SMR File Number (Sites and Monument Record) e.g. CL053-025: CL is used as a county prefix (designating Clare); 053 refers to six inch OS sheet/map number; 025 is the individual file number and is marked on the official RMP map. The Zone of Archaeological potential is an area outlined in black on the RMP maps, which hypothetically encloses each site. The area enclosed in each case is deemed by the National Monuments Service to have archaeological potential. All recorded monuments are represented on the accompanying maps and for the purpose of this Study has been given an AH (Archaeological Heritage) designation.

Section 12 (3) of the 1994 Act provides that "where the owner or occupier (other than the Minister for Arts, Heritage, Gaeltacht and the Islands) of a monument or place included in the Record, or any other person, proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such a monument or place, he or she shall give notice in writing to the Minister of Arts, Heritage, Gaeltacht and the Islands to carry out work and shall not, except in the case of urgent necessity and with the consent of the Minister, commence the work until two months after the giving of notice".

Architectural and Built Heritage

The Built Heritage is protected by the Heritage Act 1995, the Architectural Heritage (National Inventory) and National Monuments (Misc. Provisions) Act 1999, the Local Government (Planning and Development) Acts 1963-1999 and the Planning and Development Act 2000. Planning authorities also use the Architectural Heritage Protection Guidelines. Section 2.1 of the 1995 Heritage Act describes the architectural heritage as "all structures, buildings, traditional and designed, and groups of buildings including streetscapes and urban vistas, which are of historical, archaeological, artistic, engineering, scientific, social or technical interest, together with their setting, attendant grounds, fixtures, fittings and contents, and, without prejudice to the generality of the foregoing, includes railways and related buildings and structures and any place comprising the remains or traces of any such railway, building or structure". The Heritage Act promotes the interest in, knowledge and protection of the Irish heritage, including the architectural resource, with the establishment of the Heritage Council. All heritage buildings owned by a local authority are protected from damage and destruction by the 1995 Heritage Act.

The 1999 Architectural Heritage Act requires the Minister to establish a survey that will identify, record and assess the architectural heritage of the country. The National Inventory of Architectural Heritage (NIAH) records all built heritage structures within specific counties in Ireland. As inclusion in the inventory does not provide statutory protection, the document is used to advise local authorities on compilation of a Record of Protected Structures. The Record of Protected Structures is required as part of the Planning and Development Act 2000, and is included within the County Development Plan. The act requires that a development plan is carried out every six years and is considered to be the principal act for the protection of built heritage. An inventory was published for County Clare in 1997, whilst the survey for County Limerick was only published during December 2010. There are 19 buildings listed within the NIAH that are in or within the immediate vicinity of the Study Area.

Protection under the Record of Protected Structures

Structures of architectural, cultural, scientific, historical or archaeological interest can be protected under the Planning and Development Act, 2000, where the conditions relating to the protection of the architectural heritage are set out in Part IV of the act. This act superseded the Local Government (Planning and Development) Act, 1999, and came into force on 1st January 2000.

The act provides for the inclusion of protected structures into the planning authorities' development plans and sets out statutory regulations regarding works affecting such structures. Under new legislation, no distinction is made between buildings formerly classified under development plans List 1 and List 2. Such buildings are now all regarded as 'protected structures' and enjoy equal statutory protection. Under the act the entire structure is protected, including a structure's interior, exterior, attendant grounds and also the structures within the attendant grounds.

The act defines a protected structure as (a) a structure or (b) a specified part of a structure which is included in a Record of Protected Structures (RPS), and, where that record so indicates, includes any specified feature which is in the attendant grounds of the structure and which would not otherwise be included in this definition. Protection of the structure or part thereof, includes conservation, preservation, and improvement compatible with maintaining its character and interest. Part IV of the act deals with architectural heritage, and Section 57 deals specifically with works affecting the character of protected structures or proposed protected structures and states that no works should materially affect the character of the structure or any element of the structure that contributes to its special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest.

The act requires local authorities to establish a RPS to be included in the County Development Plan (CDP). This plan includes objectives designed to protect the Cultural Heritage during the planning process. Buildings recorded in the RPS can include recorded monuments, structures listed in the NIAH or buildings deemed to be of architectural, archaeological or artistic importance by the Minister. Sites, areas or structures of archaeological, architectural or artistic interest that are listed in the RPS receive statutory protection from injury or demolition under the 2000 Planning Act. Any damage or demolition of a site registered on the RPS is considered an offence (Section 58, 4). All current RPS sites in Counties Limerick and Clare are listed in the relevant County Council Development Plans and Local Area Plans. The draft County Development Plan for County Clare (2011-2017) was also reviewed in order to assess whether any additional structures are proposed for the RPS.

There are 37 protected structures (or proposed protected structures) listed in the County Development Plans, which located in or within the immediate vicinity of the Study Area.

3.10.3 Methodology

Study Methodology

The Study Area covers a large area to the north and northeast of Limerick City. It is located within the Counties of Limerick and Clare and contains the Baronies of Pubblebrien, Clanwilliam and Municipal Borough, Kenry, Clanwilliam, Tulla Lower, and Bunratty Lower, along with all or part of six parishes within County Limerick (St. Munchins, St. Patrick's, Kildimo, Kilmurry, Killeenagarriff, Stradbally) and four parishes within County Clare (Kiltenanlea, St. Patrick's, O'Briensbridge, St. Munchins). It includes all or part of 64 townlands, which are listed below.

County Limerick

Ballygrennan, Reboge, Singland, Reboge Meadows, Dromore, Sreelane, Castletroy, Rivers, Newtown, Woodstown, Garraunykee, Carrowkeel, Ballynagowan, Mountshannon, Ballyvollane, Richhill, Knockbrack West, Lisnagry, Prospect, Newgarden North, Newgarden North

County Clare

Illaunyregan, Springfield, Cappavilla North, Cappavilla South, Srawickeen, Garraun, Ruanard, Gilloge, Clooncarhy, Athlunkard, Oakfield, Reanabrone, Newtown, Mountcatherine, Derryfadda, Cloonoughter, Shannakyle, Rosmadda East, Ballyglass, Roo East, Roo West, Glenlon North, Glenlon South, Lakyle, Parkroe, Blackwater, Drummin, Ballycannan East, Ballycannan West, Ballycannan, Ballyfinneen, Castlebank, Ballykeelaun, Knockballynameath, Fairyhill, Kilquane, Garraun, Parteen, Quinspool North, Quinspool South, Knockalisheen, Mountgordon, Gortgarraun

Assessment of the Study Area was undertaken in a number of stages. The first stage comprised research of all available documentary, cartographic and recorded information to establish the number of known monuments and built heritage sites in the area.

The second stage involved the mapping of all recorded monuments and built heritage sites. These are presented in map form to accompany the cultural heritage Constraints Study.

Research

The initial research for this project comprised a paper survey of available archaeological, historical and cartographic sources relating to the Study Area. The following sources are the basis for archaeological and historical research for the area. Each source was examined and a list of sites and areas of archaeological and Cultural Heritage potential compiled:

- Record of Monuments and Places for Counties Clare and Limerick;
- Sites and Monuments Record for Counties Clare and Limerick;
- Monuments in State Care Database Counties Clare and Limerick;
- Preservation Orders Counties Clare and Limerick;
- Register of Historic Monuments Counties Clare and Limerick;
- Cartographic and written sources relating to the Study Area;
- National Inventory of Architectural Heritage Counties Clare and Limerick (Architectural & Garden Survey);
- Excavations Bulletin (1970-2007);
- Clare County Development Plan (2005-2011);
- Draft Clare County Development Plan (2011-2017);
- Limerick County Development Plan (2010-2016);
- Castletroy Local Area Plan (2009);
- South Clare Local Area Plan (2009-2015).

Record of Monuments and Places (RMP) is a list of archaeological sites known to the National Monuments Section, which are afforded legal protection under Section 12 of the 1994 National Monuments Act and are published as a record.

Sites and Monuments Record (SMR) holds documentary evidence and field inspections of all known archaeological sites and monuments. Some information is also held about archaeological sites and monuments whose precise location is not known e.g. only a site type and townland are recorded. These are known to the National Monuments Section as 'un-located sites' and cannot be afforded legal protection due to lack of information on their location. As a result these are omitted from the Record of Monuments and Places. SMR sites are also listed on the recently launched website created by the DoEHLG – www.archaeology.ie.

National Monuments in State Care Database is a list of all the National Monuments in State guardianship or ownership. Each is assigned a National Monument number whether in guardianship or ownership and has a brief description of the remains of each Monument.

The Minister for the Department of Environment, Heritage and Local Government may acquire national monuments by agreement or by compulsory order. The state or local authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the state, it may not be interfered with without the written consent of the Minister.

Preservation Orders List contains information on Preservation Orders and/or Temporary Preservation Orders, which have been assigned to a site or sites. Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

Register of Historic Monuments was established under Section 5 of the 1987 National Monuments Act, which requires the Minister to establish and maintain such a record. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the Record of Monuments and Places.

Development Plans contain a catalogue of all the Protected Structures and archaeological sites within every county. The development plans for Counties Limerick and Clare were examined, along with the Local Area Plans for Castletroy (Limerick) and South Clare.

The **National Inventory of Architectural Heritage** is a government based organisation tasked with making a Nationwide record of significant local, regional, national and international structures, which in turn provides county councils with a guide as to what structures to list within the Record of Protected Structures. The NIAH have also carried out a nationwide desk based survey of historic gardens, including demesnes that surround large houses.

Excavations Bulletin is a summary publication that has been produced every year since 1970. This summarises every archaeological excavation that has taken place in Ireland during that year up until 2007 and since 1987 has been edited by Isabel Bennett. This information is vital when examining the archaeological content of any

area, which may not have been recorded under the SMR and RMP files. This information is also available online (www.excavations.ie) from 1970-2007.

Amalgamation of Information

Once all RMP (Archaeological Heritage) and Built Heritage (protected structures and NIAH structures) sites had been identified during the initial research and consultation stages, the information was mapped onto OS maps of the area (Refer **Drawings No. RCSR-31001 to RCSR-31003 in Volume 2**). In addition, further constraints, which may not be subject to statutory protection, but should none the less be considered as cultural heritage constraints, were also added. These include the River Shannon, which is considered to be a high Area of Archaeological Potential (AAP) and two industrial heritage sites, the 18th century Errina Canal and the 19th century Headrace Canal, which both pass through the Study Area.

3.10.4 Archaeological Heritage

Archaeological Background

Prehistoric Period

Mesolithic Period (c. 7000–4000BC)

The Mesolithic Period is the earliest time for which there is clear evidence of prehistoric activity in Ireland. During this period people hunted, foraged and gathered food and appear to have had a mobile lifestyle. The most common evidence indicative of Mesolithic activity at a site comprises of scatters of worked flint material; a by-product from the production of flint implements or rubbish middens consisting largely of shells (Stout & Stout 1997). The latter are commonly discovered in coastal regions or at the edge of lakes. Although it is likely that the River Shannon was a significant element for the Mesolithic populations in this landscape, as a food and travelling resource, there are no recorded Mesolithic sites within the boundary of the Study Area.

Neolithic Period (c. 4000–2500BC)

During the Neolithic period communities became less mobile and their economy became based on the rearing of stock and cereal cultivation. This transition was accompanied by major social change. Agriculture demanded an altering of the physical landscape, forests were rapidly cleared and field boundaries constructed. There was a greater concern for territory, which saw the construction of large communal ritual monuments called megalithic tombs, which are characteristic of the period. Despite the relatively large Study Area, there are no definite recorded Neolithic sites located in this area. The only site tentatively assigned a Neolithic date consists of two pits that were excavated within the townland of Singland in the southern part of the area (AH 53). One of these pits contained some possible Neolithic pottery (Licence Ref.: 01E0946).

Bronze Age Period (c. 2500–600BC)

The most common Bronze Age site within the archaeological record is the burnt mound or *fulacht fiadh*. Over 4500 *fulachta fiadh* have been recorded in the country making them the most common prehistoric monument in Ireland (Waddell, 1998, 174). Although burnt mounds of shattered stone occur as a result of various activities that have been practiced from the Mesolithic to the present day, those noted in close proximity to a trough are generally interpreted as Bronze Age cooking/industrial sites. *Fulacht fiadh* generally consist of a low mound of burnt stone, commonly in horseshoe shape, and are found in low lying marshy areas or close to streams or rivers. Often these sites have been ploughed out and survive as a spread of heat

shattered stones in charcoal rich soil with no surface expression in close proximity to a trough.

The term *fulacht* or *fulacht fiadh* is found in early Irish literature from at least the 9th century AD and refers to open air cooking places often associated with the young warrior hunters of the *fianna* and the legendary *fionn mac cumhail* (Waddell, 1998, 174). Even though they may have functioned as cooking sites, dates in the mid-late Bronze Age (1500–600BC) show that they significantly predate the cooking sites referred to in early Irish literature (Brindley & Lanting, 1990). There are four recorded *fulachta fiadh* located within the boundary of the Study Area (AH 7, 17, 19, 23). Further *fulachta fiadh* have been excavated recently as part of the N7 road development, located within the townland of Richhill in the eastern most part of the Study Area (Site Ref.: E2329).

Another familiar feature of the rural landscape, which may have its roots grounded in the Bronze Age, is the standing stone. These monuments are very difficult to date, with each example having the potential to belong to a number of different periods. It is likely that those with a long NE/SW axis date to the Bronze Age having close affinity in orientation to similarly dated stone rows and pairs (Ronan et al 2009, 22). Some stones have been shown to mark burials, whilst others may have functioned as route or boundary markers. Standing stones are often found in proximity to other monuments such as stone rows, stone circles, boulder burials, cairns and rock art (*ibid.*). There is one recorded standing stone located within the townland of Quinspool South (AH 33) and one boundary stone located within the townland of Knockbrack East (AH 13).

Further Bronze Age activity has been recently recorded c. 1.4km southeast of the southernmost part of the Study Area within the townland of Kilbane. Here three *fulacht fiadh* were identified, along with 22 cremation deposits and 28 possible cremation deposits. These remains have been interpreted as potential forming part of three Bronze Age flat cemeteries with some peripheral domestic activity (Licence Ref.: 03E1382).

Iron Age Period (c. 500BC – c. AD500)

Compared to the rest of Irish prehistory there is very little evidence in Ireland, as a whole, representing the Iron Age. As in Europe, there are two phases of the Iron Age in Ireland; the Hallstatt and the La Tène. The Hallstatt period generally dates from 700BC onwards and spread rapidly from Austria, across Europe, and then into Ireland. The later Iron Age or La Tène culture also originated in Europe during the middle of the 5th Century BC. For several centuries the La Tène Celts were the dominant people in Europe, until they were finally overcome by the Roman Empire. There are no known Iron Age sites located within the Study Area, although the numerous enclosure recorded within the landscape have the potential to date from this period.

Early Medieval Period (AD500–1100)

During this period Ireland was not a united country but rather a patchwork of minor monarchies all scrambling for dominance, with their borders ever changing as alliances were formed and battles fought. Kingdoms were a conglomerate of clannish principalities with the basic territorial unit known as a túath. Byrne (1973) estimates that there were probably at least one hundred and fifty kings in Ireland at any given time during this period, each ruling over his own túath. In Munster the Eóganachta formed the ruling dynasties until the middle of the 10th century. These kings were distributed strategically throughout the region and ruled over many tribal units.

During this often violent period, roughly circular defensive enclosures known as ringforts were constructed to protect farmsteads. Although most of the ringforts that have been excavated are shown to date to this period, some have earlier origins and may have been originally constructed during the Iron Age, or even earlier. The ringfort or rath is considered to be the most common indicator of settlement during the early medieval period (c. 400-1160 AD). The most recent study of the ringfort (Stout 1997) has suggested that there is a total of 45,119 potential ringforts or enclosure sites throughout Ireland. They are typically enclosed by an earthen bank and exterior ditch, and range from 25m to 50m in diameter. The smaller sized and single banked type of ringfort (univallate) were more likely to be home to the lower ranks of society while larger examples with more than one bank (bivallate/trivallate) housed the more powerful kings and lords.

There is only one site listed as a ringfort within the Study Area (AH 24). This site is located within the townland of Ballycannan and is also protected with a Preservation Order. However, there are 12 enclosures, earthworks and potential sites listed within County Limerick (AH 2, 5, 6, 8-12, 15, 18, 21, 22), which all have the potential to represent the remains of ringforts. In County Clare there are 17 such sites (AH 24, 26, 27, 29, 32, 35, 40-45, 47, 49-52). These site types are by far the most numerous within the landscape and indicate that a large rural population was present during this period surrounding the River Shannon and probably settlement at Limerick.

This period was also characterised by the introduction of Christianity to Ireland. The new religion was a catalyst for many changes, one of the most important being literacy. Irish was written down for the first time using the ogham script. The ogham alphabet is thought to be based on the Latin alphabet of the later Roman Empire and today the majority of the inscriptions that survive are located on pillar stones or boulders. As well as this form of the written word, the church created impressive tomes in their official language, Latin. Examples of these include the Book of Kells and the Book of Durrow as well as other mundane works such as the Annals, which were an account of the history of the church. Monasticism was known in St. Patrick's time (mid 5th century) but it was not until the 6th and 7th centuries that the famous monastic houses such as Glendalough, Bangor, Clonfert, Clonard, Clonmacnoise and Durrow were founded (Ryan 1994, 125).

Within the Study Area, there are two recorded church sites, which although thought to be medieval in date, may have earlier roots (AH 38, 48). Both possess sub-circular enclosures surrounding the graveyards, which may represent the remains of a circular enclosing element of early medieval date.

It was during the later part of this period that attacks by the Norse on the lower Shannon area were recorded. The Annals of Clonmacnoise record that in AD 843 Foranan, Primate of Armagh, was taken hostage by the Vikings and held on their ships in Limerick (Lenihan 1866, 5). The location of the Norse settlement in the following century is notable as the lowest fording point of the River Shannon, at the head of the tidal reach (O'Rahilly, 1988, 141). The Danes fortified a settlement on the southern part of an island bounded by the west by the Shannon and all other sides by the Abbey River. Later known as "Kings Island", this naturally defended location had the double advantage that it was navigable from the sea and was presumably a crossing point over the Shannon. This provided the Vikings with a secure base from which raids could be conducted along the river upstream of Limerick (*ibid*, 141). Coonagh, to the west of the King's Island, was also described as an ancient fishing village of Viking origin, although to date no archaeological evidence for this exists (Spellissey, 1998, 316).

The strategic importance of Limerick and its environs was appreciated by both the neighbouring native clans and the advancing Anglo-Normans in the middle ages. Brian Bóru sacked the town in AD 967 and 968, allowing the Viking inhabitants to remain within the walls on payment of heavy tributes, including 11,680 gallons of wine per annum (*ibid*, 22). By the time of the Battle of Clontarf, the Limerick Vikings had renewed their alliance with Bóru. His descendants, the O'Brien's, held sway over much of Limerick's hinterland, and by the 11th century were designated Kings of Thomond, establishing a new seat in the old Norse town of Limerick in AD 1100. St. Mary's Cathedral, built in the style of the Cistercians, was originally erected between 1168 and 1172 by Donal O'Brien, and is the sole surviving monument in the city from the pre-Norman occupation (O'Rahilly, 1988, 141).

Medieval Period (AD 1100-1600)

The beginning of the medieval period was characterised by political unrest that originated from the death of Brian Borumha in 1014. Diarmait MacMurchadha, deposed King of Leinster, sought the support of mercenaries from England, Wales and Flanders to assist him in his challenge for kingship. Norman involvement in Ireland began in 1169, when Richard de Clare and his followers landed in Wexford to support MacMurchadha. Two years later de Clare (Strongbow) inherited the Kingdom of Leinster and by the end of the 12th century the Normans had succeeded in conquering much of the country (Stout & Stout 1997, 53).

The arrival of the Anglo-Normans in 1175 took Limerick City by storm. They were forced to withdraw in 1176, and did not succeed in occupying the town until 1190. (Lee 1997, 19). Prince John granted Limerick a charter seven years later, declaring that the citizens would have all the liberties and free customs through all Ireland that were enjoyed by the citizens of Dublin (*ibid*, 24). In 1210, on a visit to Ireland, King John created counties from the portions of land under Anglo-Norman control, one of which became the county of Limerick. During this visit, John erected a castle (King John's Castle) and a bridge (Thomond Bridge) within the English town of the settlement (Dowd 1890, 33). The North Liberties of Limerick remained with Clare in Connaught until 1660 (Spellissey 1998, 36).

The importance of the town grew during the 13th century, when grants were given to fortify the town and repair King John's Castle. Municipal privileges were granted and a corporation was formed to initiate town improvements. The population at this time was growing so rapidly that in 1237 the corporation created taxes to finance the expansion and strengthening of the city defences (*ibid*, 37). A royal mint was also established between 1195 and 1199, which continued to operate sporadically until 1483 (*ibid*, 38).

The Study Area includes the north and northeast hinterlands of Limerick City. A number of castles are recorded within this area, with two located in County Limerick (AH 3 and 4) and five in County Clare (AH 25, 28, 34, 36, 37). The majority of these sites represent the remains of later castles or tower houses, which date to the 17th century. AH 36 now contains a 19th century house, although a 17th century castle belonging to the Earl of Thomond is thought to have occupied the site. It is possible that the tower house at Castletroy (AH 4) may be 16th century in date, whilst the remains of a tower house in the townland of Drummin (AH 25) are reputed to be 16th century in date. A potential medieval site exists in the form of a ring work in Fairyhill (AH 27). This is an early type of castle, which may date to the late 12th or 13th century. However, little is known about the site and it is equally possibly that the site may be earlier or later in date.

Photo 3.10.1 – Castletroy Tower House

Post Medieval Period (AD 1600-1900)

During the Desmond wars of the 16th century, sustaining loyalty to Elizabeth, Limericks chief role was as port and garrison to the incoming and outgoing troops. By the 17th century during the relatively peaceful reign in Munster of James I, Limerick had sustained two fires, which led to considerable improvement in building construction in the city. However, the protracted siege by Cromwell's forces in 1651 left the city besieged with famine, pestilence and death. The city finally surrendered with a death toll of five thousand inhabitants. The RMP records a post medieval roadway (AH 14) within the townland of Lisnagry, which is noted within the historic mapping as *Track of Cromwell's Road.* This may represent the route of Cromwell's troops to Limerick City and is partially located within the Study Area.

The Jacobean wars of the late 17th century saw the reactivation of the city mint to finance James II campaign. Gun money was minted in Dublin and Limerick, allegedly from the brass of old cannons, hence its name. The city withstood attacks by Williamite forces throughout 1690 and 1691, becoming the last Jacobean stronghold to repel William's army. After the slaughter of six hundred inhabitants who had become trapped outside the city walls and the failure of French reinforcements to arrive, Patrick Sarsfield signed the Treaty of Limerick in October 1691.

Evidence from the industrial age is also prevalent within the Study Area, as the Shannon was an important form of communications. The Errina Canal, which runs parallel to the River Blackwater, travels in a north-south direction through the Study Area. This was part of a development intended to make the River Shannon more easily navigable for transportation. One of the greatest obstacles hindering this was the Falls of Doonass further upstream. Goods had to be unloaded and taken around

the falls adding to the expense of transportation and leaving scope for theft and accidents.

Work on improving the Shannon started near Limerick in 1757, but it was not until ten years later that the Commissioners for Inland Navigation undertook remedial and construction works on the Lower Shannon. This was spasmodic, expensive and varied greatly in quality. The canals were finally completed in 1799 but were never satisfactory. There were continual complaints of poor maintenance, differences in the size of the locks and the quality of construction. This all led to the passing of the Shannon Navigation Act in 1835. A new program of lock building, dredging and widening of the river was mostly completed by 1850.

Another industrial site is recorded within the townland of Sreelane and consists of the Plassy Mill (AH 1). Plassy Mill was a corn mill built in 1824 by a Major Hedges Maunsell. It was further developed in the mid 1860s by Richard Russell J.P, when he rebuilt the nearby Plassy House (BH 27). The mill took on a fortified appearance with the addition of mock battlements and the machinery was also improved at this time. The mill continued to be used until the early 20th century until decline in competition; worker dissatisfaction and a fire closed it down. This site is also a protected structure (BH 26).

Another typical element of the post medieval landscape, which was present within the landscape surrounding Limerick, was the development of ornamental demesne landscapes surrounding large country houses. One of the houses (Mountshannon) is listed within the RMP (AH 16) as well as being a protected structure (BH 19) and included within the National Inventory of Architectural Heritage (NIAH). The house and demesne are located within the eastern part of the Study Area. The original demesne accompanying this house (as marked on the first edition OS map) was very substantial, consisting unusually of three townlands (Ballyvollane, Mountshannon and Gaurraunykee). This is the largest of the demesnes within the Study Area, although the first edition mapping shows a large amount of demesne landscapes located in or partially within the Study Area. These are marked in pale orange on the constraint mapping that accompanies this assessment.

Recorded Monuments

There are a total of 24 recorded archaeological sites within County Limerick and 29 recorded archaeological sites within County Clare. These sites are located in or within the immediate vicinity of the Study Area. All of these sites are listed within the RMP (Recorded Monuments and Places). These sites are subject to statutory protection under the National Monuments Act and should be considered as cultural heritage constraints during the design of the proposed distribution road.

County Limerick

AH No.:	RMP No.:	Townland:	Classification:	NGR:	Legal Status:
AH 1	LI005-052	Sreelane	Watermill	160822/ 158564	RMP
AH 2	LI005-024	Reboge	Earthwork	159989/ 157618	RMP
AH 3	LI005-010	Ballygrennan	Castle	156001/ 159816	RMP
AH 4	LI006-017	Castletroy	Tower house	162791/ 158610	RMP

AH No.:	RMP No.:	Townland:	Classification:	NGR:	Legal Status:
AH 5	LI006-059	Castletroy	Enclosure	163342/ 158419	RMP
AH 6	LI006-063	Rivers	Potential site	163785/ 157494	RMP
AH 7	LI006-094	Rivers	Fulacht fiadh, corn drying kiln	163832/ 157438	RMP
AH 8	LI006-019	Rivers	Enclosure	164125/ 157159	RMP
AH 9	LI006-018	Rivers	Enclosure	164070/ 157681	RMP
AH 10	LI006-062	Woodstown	Potential site	164700/ 157244	RMP
AH 11	LI006-067	Ballynagowan	Enclosure, possible	165405/ 158049	RMP
AH 12	LI006-064	Mountshannon	Enclosure, possible	165011/ 158462	RMP
AH 13	LI006-058	Knockbrack East	Boundary stone	166565/ 159068	RMP
AH 14	LI006-007	Lisnagry	Road	165480/ 159213	RMP
AH 15	LI006-006	Lisnagry	Enclosure	156415/ 159408	RMP
AH 16	LI006-085	Mountshannon	Country House	165034/ 159072	RMP
AH 17	LI006-093	Ballyvollane	Fulacht fiadh	163839/ 158910	RMP
AH 18	LI006-002	Ballyvollane	Enclosure	163527/ 159682	RMP
AH 19	LI006-089	Ballyvollane	Fulacht fiadh	164070/ 159883	RMP
AH 20	LI006-083	Prospect	Burial	163691/ 160154	RMP
AH 21	LI006-003	Prospect	Enclosure	163857/ 160693	RMP
AH 22	LI006-001	Prospect	Enclosure	163543/ 160771	RMP
AH 23	LI006-090	Prospect	Fulacht fiadh	164202/ 160985	RMP
AH 53	LI005-107	Singland	Pits	160099/ 156943	RMP

County Clare

AH No.:	RMP No.:	Townland:	Classification:	NGR:	Legal Status:
AH 24	CL053-041	Ballycannan	Ringfort	156681/ 162325	RMP & Preservation Order
AH 25	CL053-042	Drummin	Tower house	157543/ 162493	RMP
AH 26	CL053-033	Roo West	Enclosure	158915/ 164058	RMP

AH No.:	RMP No.:	Townland:	Classification:	NGR:	Legal Status:
AH 27	CL053-034	Roo West	Enclosure	159016/ 164013	RMP
AH 28	CL053-043	Newtown	Castle	162158/ 162519	RMP
AH 29	CL053-048	Newtown	Earthwork	161937/ 162025	RMP
AH 30	CL063-003	Knockalisheen	Graveyard	155791/ 161191	RMP
AH 31	CL063-004	Ballycannan	Holy well	156460/ 161694	RMP
AH 32	CL063-005	Castlebank	Enclosure, site of	157323/ 161039	RMP
AH 33	CL063-006	Quinspool South	Standing stone	157302/ 160146	RMP
AH 34	CL063-008	Parteen	Castle	157878/ 159999	RMP
AH 35	CL063-009	Castlebank	Enclosure, site of	157984/ 161543	RMP
AH 36	CL063-010	Castlebank	Castle, site of	158065/ 161400	RMP
AH 37	CL063-025	Fairyhill	Castle/ring work	158493/ 160108	RMP
AH 38	CL063-011	Kilquane	Church and graveyard	158653/ 159918	RMP
AH 39	CL063-027	Kilquane	Hearth	158572/ 159835	RMP
AH 40	CL063-012	Rosmadda West	Earthwork	159362/ 161487	RMP
AH 41	CL063-013	Gortatoger	Enclosure, site of	159438/ 160675	RMP
AH 42	CL063-014	Shannakyle	Enclosure, site of	159438/ 160675	RMP
AH 43	CL063-015	Gilloge	Enclosure	161127/ 159143	RMP
AH 44	CL063-024	Derryfadda	Enclosure, possible	161358/ 159818	RMP
AH 45	CL063-016	Derryfadda	Enclosure	161276 160942	RMP
AH 46	CL063-017	Cappavilla South	Holy well	161698/ 159858	RMP
AH 47	CL063-018	Garraun	Enclosure	161944/ 159776	RMP
AH 48	CL063-019	Garraun	Church and graveyard	162011/ 159630	RMP
AH 49	CL063-020	Srawickeen	Enclosure	162820/ 159149	RMP
AH 50	CL063-023	Srawickeen	Enclosure	163272/ 160111	RMP
AH 51	CL063-021	Illaunyregan	Enclosure	163006/ 161284	RMP

AH No.:	RMP No.:	Townland:	Classification:	NGR:	Legal Status:
AH 52	CL063-022	Illaunyregan	Enclosure	163307/ 161186	RMP

Summary of Previous Archaeological Fieldwork

Whilst the Study Area covers a relatively large area, much of it remains rural in nature and dominated by agricultural activities. Recent development is located along major route ways, such as the N7 and the eastern access road into Limerick. As a result, the majority of archaeological work has been carried out in this area.

The development of the N7 Neagh to Limerick Road Scheme (2006/2007) resulted in the excavation a *fulacht fiadh* in Lisnagry (Ref.: E2330), a hearth at Mountshannon (Ref.: E2334) along with a post medieval drain (Ref.: E2328) and burnt mounds (Ref.: E2329) at Richhill.

Within the townlands of Singland and Reboge, archaeological monitoring of topsoil stripping in association with a road upgrade was carried out in 2001 (00E0653). This resulted in the discovery of two potential Neolithic pits (AH 53), which were subsequently excavated (Licence Ref.: 01E0946).

In the townland of Rivers, further infrastructural upgrades resulted in the discovery of a *fulacht fiadh* and corn drying kiln (AH 7), which were located to the southeast of the site of an enclosure (AH 6) (Licence Ref.: 05E1251).

Pipeline schemes have also been carried out within the Study Area, which required archaeological monitoring. In 2001, monitoring of the Castleconnell Sewerage Scheme was carried out in Ballyvollane, Prospect and Newgarden North (Licence Ref.: 01E0416), although nothing of archaeological significance was identified. The development of the Clareville to Newcastle Rising Main resulted in the discovery of three *fulachta fiadh* (AH 17, AH 19, AH 23), which were excavated under licences 02E1348, 02E1403 and 02E1424.

In County Clare, only a handful of excavations have been carried out within the Study Area. These, for the most part are associated with the development of the University of Limerick campus, a new section of which is located on the northern side of the River Shannon. Monitoring and testing carried out at the site of the new fourth village resulted in the discovery of post medieval brick clamps in the townland of Garraun (Licence Ref.: 02E1216). An underwater archaeological assessment has also been carried out on the River Shannon at the site of a pedestrian bridge linking the two parts of the university campus, although nothing of archaeological significance was discovered (Licence Refs: 06D042, 06R076).

Further north, monitoring associated with the Limerick Main Drainage Scheme resulted in the discovery and excavation of a probable hearth within the townland of Kilquane (AH 29), although this site is located just outside of the Study Area.

Areas of Archaeological Potential

Areas of Archaeological Potential (AAP) can be defined as parts of the landscape that possess the potential to contain archaeological remains due to the presence of topographic features such as rivers, lakes, high defendable ground and bog. River and lakes are a focus for human habitation due to the obvious transport and food resources. They (along with bogs) also have the potential to preserve organic archaeological deposits or artefacts such as wood or leather, which do not usually

survive within the alkaline conditions associated with terrestrial archaeology. Wooden track ways dating to the Bronze Age period and later have been excavated within bog land throughout Ireland. Rivers and lakes may have also played a role in prehistoric ritual, as significant artefacts from the prehistoric periods and into the early medieval period, are often found within river bed deposits.
The largest Area of Archaeological Potential within the Study Area is the River Shannon. The second largest water way is formed by the River Blackwater, although a significant portion of this was impacted upon by the construction of the Errina Canal in the late 18th century. There are also numerous smaller waterways throughout the Study Area. These should be also be considered as possessing archaeological potential.

3.10.5 Architectural Heritage

Architectural Background

The National Inventory of Architectural Heritage survey has now been completed for County Clare and County Limerick. A total of 19 NIAH structures are located in or within the immediate vicinity of the Study Area. Of these, ten are listed as country houses, showing that this type of architectural heritage is most common within the hinterlands of Limerick City. This is a common feature of large towns and cities, where the landed gentry established a country seat that was within easy reach of urban centres. Other buildings include three churches, a power station, three mills a bridge and a vernacular cottage.

There are 31 protected structures located within the Study Area, along with a further seven proposed protected structures as listed within the Draft Clare County Development Plan (2011-2016). Of the total of 38 structures, ten of these are listed as country houses, whilst five are classed as bridges. The remainder consist of three churches, two schools, a railway station, canal lock, memorial, mill, toll house, cottage and a power station.

The largest of the country houses is Mountshannon, which is listed as a protected structure (BH 19), included within the RMP (AH 16) and listed within the NIAH survey. It once possessed a substantial demesne landscape that was the largest in the area. The house, which is now an impressive ruin, was built in c. 1790 by the Fitz Gibbon family and was subsequently enlarged c. 1813 to the design of Lewis Wyatt for John Fitz Gibbon, first Earl of Clare and Lord Chancellor of Ireland. The NIAH survey (2010) notes that the remains of the imposing two-storey Ionic portico, which dates from this period of construction, constitutes a notable example of the neo-classical style. The house was burnt down in 1921 although retains demesne related structures such as the walled garden, gate lodges and an icehouse which later became a mausoleum. The mausoleum is also a protected structure.

Another large house located on the edge of the Study Area is Woodstown House, which is now used as a nursing home. The original demesne accompanying the house has been truncated by the Limerick Relief Road. This house is a protected structure along with its gate lodge (BH 22) and both structures are included within the NIAH survey. The house was built by the Bannatyne family on the site of the earlier Mulkear House and is a notable example of mid to late 19th century domestic architecture (NIAH survey 2010).

To the west of Woodstown is Plassy House (BH 27), which although still extant, is now located within the campus of Limerick University. The main house is located to the south of the Study Area and is a protected structure as well as being included within the NIAH survey. The house is also located within an Architectural

Conservation Area, as designated by the Castletroy Local Area Plan (2009). Plassy House, a notable example of a Georgian villa style country house, was rebuilt in the Italianate style. Originally the estate was owned by Robert Clive who renamed it Plassey after his victory in India. He later became Lord Clive of Plassey. The Russell family extended it in the 1860s with the work purportedly carried out by the architect William Fogarty (NIAH Survey 2010).

The largest of the extant houses in the constraint area within County Clare is Quinsborough House (BH 1). This is a protected structure and is included within the NIAH survey. The house was built in c. 1765 and extended and renovated in c. 1850 (NIAH Survey 1997).

From the mid to late 19th century, the Anglo-Irish landowning classes began to slowly loose their grip on the thousands of acres of Irish landscape that formed a large part of their estates. The large country house and demesne were often only a small part of the visible wealth possessed by such families and their demise was brought about by a number of factors including The Famine; the loss of a younger generation to the first world war and the fight for independence by the Republicans. The lower classes resented the amount of land that was owned by the Anglo-Irish gentry and in 1922 the Land Commission was established. The purpose of the Commission was to purchase these estates (often for a greatly reduced price) so they could be re-distributed amongst the lower classes. As a result of this, many families became little more than upper class farmers and as a result many left Ireland to return to England. The large houses and demesnes were often left to decay with the houses often demolished for building materials and the demesnes subsumed back into the landscape. At least five country houses were located within the constraint area have now disappeared or are in ruins.

A number of the buildings of architectural merit within the Study Area possess an industrial heritage association. These consist of two bridges that cross the Errina Canal (BH 9, BH 12) and Annabeg Lock (BH 13), which is located close to the confluence of the canal with the River Shannon. These buildings are proposed for protection under the draft Clare County Development Plan and are now included within the NIAH survey. The post medieval historical background of this chapter provides more detail on the Errina Canal.

Further buildings include Plassy Mill (BH 26, AH 1) and the remains of mill buildings within the townland of Prospect (BH 35). The NIAH report for BH 35 states that a mill has been present adjacent to the River Shannon at this location since the 1600s, although the main mill building is no longer extant, with only outbuildings remaining.

The most recent building included within the RPS is the Ardnacrusha Power Station (BH 5) at Ballykeelaun. This was built between 1925 and 1929 and consists of a twelve bay, six storey, Germanic style Hydroelectric Power Station. The structure also possesses a number of outbuildings and wings and is still in operation. It sits across the purpose built Headrace Canal, which is connected to the River Shannon further to the northeast. Plans to harness the Shannon's power were proposed from the mid 19th century onwards, although it seems that cost was always a factor in preventing the work from going ahead. The Irish War of Independence interrupted plans from continuing during the early 1920s. However, in 1924-25 the new Irish Free State's Minister for Industry and Commerce, Patrick McGilligan commissioned the engineer Dr. Thomas McLoughlin to submit proposals. Dr McLoughlin had started working for Siemens-Schuckert, a large German engineering firm in late 1922 and produced a scheme that would cost £5.2m. This caused considerable political controversy as the new state's entire budget in 1925 was £25m, but it was accepted.

The Shannon Scheme was officially opened at Parteen Weir on 22 July 1929. One of the largest engineering projects of its day it subsequently served as a model for large-scale electrification projects worldwide. In 2002 on the 75th anniversary of the plant, its uniqueness was recognised by the American Institute of Electrical and Electronic Engineers, in partnership with the American Society of Civil Engineers, who marked the facility as an Engineering Milestone of the 20th century. The building is considered to be of national significance within the NIAH survey (1997).

Record of Protected Structures

A review of the County Development Plans for Clare and Limerick has revealed that there are a total of seven protected structures located within County Clare and 24 protected structures within County Limerick. All of these structures are located in or within the immediate vicinity of the Study Area. It should be noted that the draft County Clare Development Plan was also reviewed as this will be published in 2011. This contains a further six proposed protected structures, which have been included as cultural heritage constraints in this Study.

Seven of the structures listed within the County Limerick Development Plan have been listed within one group due to their proximity to one another (BH 28).

All protected structures are subject to statutory protection and should be considered as cultural heritage constraints during the design of the proposed distribution road.

County Clare

BH No.:	RPS No.:	Townland:	Classification:	NGR:	Legal Status:
BH 1	93	Parteen	Quinsborough House	157548/ 160372	RPS
BH 2	166	Parteen	Church	157900/ 160206	RPS
BH 3	92	Parteen	House (Parteen-A-Lax)	157958/ 160219	RPS
BH 4	168	Ballykeelaun	Church	158448/ 160673	RPS
BH 5	311	Ballykeelaun	Power Station	158614/ 161734	RPS
BH 6	84	Ballykeelaun	Former National School	158402/ 160826	RPS
BH 7	226 (proposed)	Castlebank	Country House	158065/ 161395	RPS
BH 8	94 (proposed)	Blackwater	Blackwater Bridge	159415/ 162427	RPS
BH 9	211 (proposed)	Mountcatherine/ Springfield	Wooden Bridge	161914/ 161697	RPS
BH 10	143	Cloon	Church	162352/ 163357	RPS
BH 11	225 (proposed)	Parteen	Post box	158348/ 160546	RPS
BH 12	210 (proposed)	Gilloge/Garraun	Gilloge Bridge	161369/ 159523	RPS
BH 13	209	Garraun	Annabeg Lock	160888/	RPS

BH No.:	RPS No.:	Townland:	Classification:	NGR:	Legal Status:
	(proposed)			158823	

County Limerick

BH No.:	RPS No.:	Townland:	Classification:	NGR:	Legal Status:
BH 14	130	Ballynacourty	Railway Station	166021/ 159871	RPS
BH 15	227	Carrowkeel	Roadside memorial	Exact location unknown	RPS
BH 16	457	Ballynacourty	Country House	165669/ 160195	RPS
BH 17	546	Mountshannon	Lodge	165410/ 158896	RPS
BH 18	545	Newgarden South	County House	165643/ 159603	RPS
BH 19	609/610	Mountshannon	County House (& mausoleum)	165034/ 159063	RPS
BH 20	663	Richhill	Country House	165551/ 158483	RPS
BH 21	664	Richhill	School	165447/ 158905	RPS
BH 22	748	Woodstown	County House	164665/ 157463	RPS
BH 23	1597	Rivers/ Ballyvollane	Foot Bridge	163184/ 158905	RPS
BH 24	1598	Castletroy	Tower House	162790/ 158607	RPS
BH 25	1599	Sreelane	Plassy Bridge	160818/ 158560	RPS
BH 26	1600	Sreelane	Plassy Mills	160818/ 158560	RPS
BH 27	1601/1602	Sreelane	County House (& lodge)	161433/ 158243	RPS
BH 28	1608 to 1614	Rivers	Seven buildings in a group including a creamery and mill	164237/ 157567	RPS
BH 29	1628	Reboge Meadows	Toll House	160350/ 157075	RPS
BH 30	1605	Castletroy	Country House	162796/ 157937	RPS
BH 32	1615	Newtown	Cottage	163677/ 157325	RPS

National Inventory of Architectural Heritage

A review of the National Inventory of Architectural Heritage revealed a total of six structures within the Study Area that are located within County Clare. A total of 13 structures are located within County Limerick. All of the structures listed within

County Clare are also protected structures. All but four of the structures listed for County Limerick are protected structures.

Whilst most of the NIAH structures are already protected within the relevant county development plans, four are not included within the RPS. However, they made be added at a later date and as such should be considered as cultural heritage constraints during the design of the proposed distribution road.

County Clare

BH No.:	NIAH No.:	Townland:	Classification:	NGR:	RPS
BH 1	20406302	Parteen	Quinsborough House	157548/ 160372	Yes
BH 2	20406304	Parteen	Church	157900/ 160206	Yes
BH 3	20406303	Parteen	House (Parteen-A-Lax)	157958/ 160219	Yes
BH 4	20406301	Ballykeelaun	Church	158448/ 160673	Yes
BH 5	20405308	Ballykeelaun	Power station	158614/ 161734	Yes
BH 10	20405301	Cloon	Church	162352/ 163357	Yes

County Limerick

BH No.:	NIAH No.:	Townland:	Classification:	NGR:	RPS
BH 19	21900617 & 618	Mountshannon	Country House (and mausoleum)	165034/ 159063	Yes
BH 20	21900620	Richhill	Country House	165551/ 158483	Yes
BH 22	21900604 & 0606	Woodstown	County House (and lodge)	164665/ 157463	Yes
BH 25	21900503	Sreelane	Plassy Bridge	160818/ 158560	Yes
BH 26	21900504	Sreelane	Plassy Mills	160818/ 158560	Yes
BH 27	21900505	Sreelane	County House	161433/ 158243	Yes
BH 28	21900605	Rivers	Mill		Yes
BH 30	21900610	Castletroy	Country House	162796/ 157937	Yes
BH 31	21900502	Ballygrennan	Country House	156001/ 159816	No
BH 32	21900607	Newtown	Cottage	163677/ 157325	Yes
BH 33	21900619	Garraunkee	House	164857/ 157859	No
BH 34	21900601	Prospect	Mill	164075/ 161199	No

BH No.:	NIAH No.:	Townland:	Classification:	NGR:	RPS
BH 35	21900602	Prospect	County House	164371/ 160829	No

Demesne Landscapes

The first edition Ordnance Survey maps of County Clare and Limerick, which date to 1842 and 1844, show the extent of demesne landscapes within the Study Area, as shaded portions of land (Refer to **Drawings RCSR-31001 to RCSR-31003 in Volume 2**). Whilst the landscapes themselves are not subject to specific statutory protection, if associated with a house that is a protected structure, they may contain associated curtilage features such as gate lodges, stables buildings, walled gardens, follies or elaborate entrances. As such, demesne landscapes should be considered as heritage constraints. In some instances the original ornamental landscape has been subsumed back into the landscape or has been subject to radical change due to development.

A review of the first edition OS map indicates that a demesne landscape was associated with the following country houses:

- Woodtown House (BH 22, extant)
- Mount Shannon (BH 19, extant but in ruins)
- Rich Hill (BH 20, extant)
- Prospect House (BH 33, extant but in ruins)
- Belle Isle House (extant)
- Newtown House (no longer extant)
- Mount Catherine (extant)
- Rosmadd (extant)
- Castletroy (extant)
- Roselawn (no longer extant)
- Annagrove House (extant)
- Castlepark (BH 31, extant
- Quinaborough House (BH 1, extant)
- Ballycannan House (no longer extant)
- Whitehall (extant)
- Ruanard House (extant)
- Plassy House (BH 27, extant)
- Landscape House (extant)

It should be noted that the above analysis is desk based and proper field inspection would be required to assess the nature and extent of those houses and former demesnes that are extant.

3.10.6 Architectural Conservation Area

There is one Architectural Conservation Area partially located within the Study Area. This is designated within the Castletroy Local Areas Plan (2009). It consists parts of the townlands of Sreelane, Dromore and Castletroy. A small section of the eastern part and western part of the ACA is located within the Study Area. There are a total of six protected structures located within the ACA with a further 28 located in the

remainder of the boundaries of the LAP. Structures of note within the ACA are Plassy Mill (BH 26, AH 1), Plassy Bridge (BH 25) and Plassy House (BH 27). Today the ACA is dominated by the campus associated with the University of Limerick.

The Castletroy LAP defines an ACA as a place, area or group of structures or townscapes, which are of special architectural, historical, archaeological, artistic, cultural, social, scientific or technical interest. It goes on to state that:

> *It is felt that the designation of an Architectural Conservation Area in and around the University Campus is necessary to secure the appreciation of the setting of the existing protected structures and the buildings of high architectural quality constructed since the University's foundation.*

The objective in establishing the Architectural Conservation Area has been to:

- *Safeguard the parklands associated with Plassey House in order for the evolved university complex to retain significant tree cover, green areas and vistas down to the River Shannon;*
- *Safeguard views out from, or in towards, the University's principal buildings;*
- *Safeguard elements associated with the historical evolution of the site such as waterways and water control mechanisms such as sluices or pumps;*
- *Ensure that the University's setting and amenities are safeguarded from unauthorised works and insensitive developments;*
- *Allow the University to develop on the left bank of the River Shannon in a sensitive and strategic manner without compromising the site's significance.*

The ACA should be considered as an important cultural heritage constraint during the design process of the proposed distribution road.

3.10.7 Summary and Conclusions

The purpose of this Study is to provide an analysis of the archaeological, architectural and cultural heritage resource within the defined Study Area in order to inform the design of the proposed Limerick Northern Distributior Road. The Study Area is located within the Counties of Limerick and Clare. The study has shown that there is a large archaeological resource within the area and a substantial amount of built heritage sites. The sites and areas listed within this Study and marked on the accompanying figures should be considered as constraints during the design process.

The study has been carried out in accordance with the NRA Guidelines for the Assessment of Archaeological and Built Heritage Impacts of National Road Schemes (2005).

The constraint area is located to the north and northeast of Limerick City. Whilst suburban development dominates the eastern part of the Study Area, much of the remaining landscape is characterised by scattered housing developments and agricultural activity. A total of 53 RMP sites of varying dates are listed within the Study Area indicating a continuance of activity and settlement in the region. A substantial number of these sites can be ascribed to the early medieval period, with enclosures (possible ringforts) dominating. There are also a number of Anglo-Norman (medieval and later medieval) sites indicating a steady continuance of settlement despite the changes in the political and demographic make-up of the area.

Whist there are no National Monuments in state ownership or guardianship within the Study Area, one recorded ringfort is further protected by a Preservation Order (AH 24). All recorded archaeological sites (AH sites) should be considered as cultural heritage constraints during the design of the proposed distribution road and avoided where possible.

A survey of the Excavations Bulletin (1970-2007) has revealed the nature of some of the recent excavations that have taken place within the Study Area. The majority of these have been as a result of the development of the road networks within the eastern part of the Study Area. A number of sites have been discovered as a result of pipeline schemes. Many of the excavations that yielded archaeological evidence have since been added to the RMP record.

The River Shannon passes through the Study Area. This is a significant feature of archaeological potential, which although not subject to statutory protection under the National Monuments Act, should be considered as a cultural heritage constraint. Whilst it is likely that the proposed distribution road will have to cross the River Shannon, the impact on the river should be minimised where possible.

An analysis of the built heritage within the area has provided a holistic view of the built heritage resource, with the later years of the post medieval period well illustrated by the presence of a substantial number of country houses, bridges and churches. Structures that are architecturally and socially important are listed as protected within the development plans and NIAH for Counties Clare and Limerick. These receive statutory protection that helps to ensure their preservation for the future. A total of 38 protected structures (including seven proposed) are located in or within the immediate vicinity of the Study Area. The NIAH survey has been completed for both Clare and Limerick and this contains 19 structures of architectural merit. Four of these structures are not listed within the RPS, whilst the remaining 15 are included. All protected structures and NIAH structures should be considered as cultural heritage constraints during the design of the proposed distribution road and avoided where possible.

A total of 18 former demesne landscapes have been identified within the Study Area. Some of these still retain their principal building, whilst others have been subject to large scale development resulting in the loss of the main house. However, the presence of these landscapes should be considered as cultural heritage constraints during the design of the proposed distributor road. It should be noted that analysis undertaken to date is desk based and field inspection will be required to assess the surviving nature and extent of the demesne landscapes within the Study Area.

There is one Architectural Conservation Area within the immediate vicinity of the Study Area. A small section of the eastern and western part in located within the Study Area. This ACA provides protection to the University of Limerick campus in order to prevent inappropriate development in the area and to preserve the setting of the existing protected structures. The ACA should be considered as a cultural heritage constraint during the design of the proposed distribution road and avoided if possible.

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3.11 Landscape and Visual Analysis

3.11.1 Introduction

The landscape is the visible environment in its entirety, comprised of both natural and built elements including topography, water bodies, vegetation, wildlife habitats, open spaces, buildings and structures.

The purpose of this chapter is to examine the existing landscape and highlight any potential landscape and visual impacts of the proposed scheme at an early stage. The potential impacts identified during the Constraints Study will be taken into account during the route selection and design process with measures implemented to minimise perceived negative impact.

Landscape and visual impact assessment are assessed as two discreet topics. Landscape impact assessment is concerned with the alteration to the physical landscape which may give rise to changes in its character, how it is experienced and the ascribed value of the landscape.

Visual impact assessment is concerned with changes that arise in the overall effect on the area's visual amenity. Visual change is the alteration to a view; visual impact is the assessment of the significance of that change.

3.11.2 Receiving Environment

General Description

The Study Area primarily encompasses the south eastern extent of County Clare and a small area of northern County Limerick (Refer **Drawing RCSR-3201 in Volume 2**). It extends from Knockalisheen in the west to Annacotty in the east. Watercourses, both natural and man-made, strongly dominate the area. The Lower River Shannon gently weaves its way through the Study Area before entering Shannon Estuary immediately west of Limerick, while the Headrace Canal and the Tailrace Canal divide the Study Area running from the north-east to the south-west corner of the Study Area.

The lands contained within the Study Area are primarily low lying, relatively flat floodplain pasture with strong hedgerows and treelines evident throughout (Refer **Photo 3.11.1**). Linear woodland is another significant landscape element occurring alongside the multiple streams which dissect the area.

To the north-west and above Knockalisheen the floodplains rise sharply forming the hills of Ballycar South (255m) and Woodcock Hill (310m). Bogland and conifer plantation is prominent on these hill tops.

The road network throughout the area is primarily minor and forms only a weak landscape element. In terms of landscape, transport impact is more evident in the form of the Errina and Headrace canals (Refer **Photo 3.11.2**).

The urban landscape is overpowered by the proximity of the area to Limerick City. However within the Study Area it can be described in terms of small clusters with substantial ribbon development linking neighbouring villages.

Photo 3.11.1: Typical low-lying floodplain pasture with treelines

Photo 3.11.2: Headrace Canal

Landscape Character Assessment

The "Landscape Character Assessment of County Clare" provides an analysis of the character, value, and sensitivity of landscapes identified within County Clare. The Study Area lies primarily within Landscape Character Area 9 '*River Shannon Farmlands'* as defined by County Clare's Landscape Assessment (Refer **Plate 3.11.3**). A small area is also included within Landscape Character Area 8 '*Sliabh Bernagh Uplands'*.

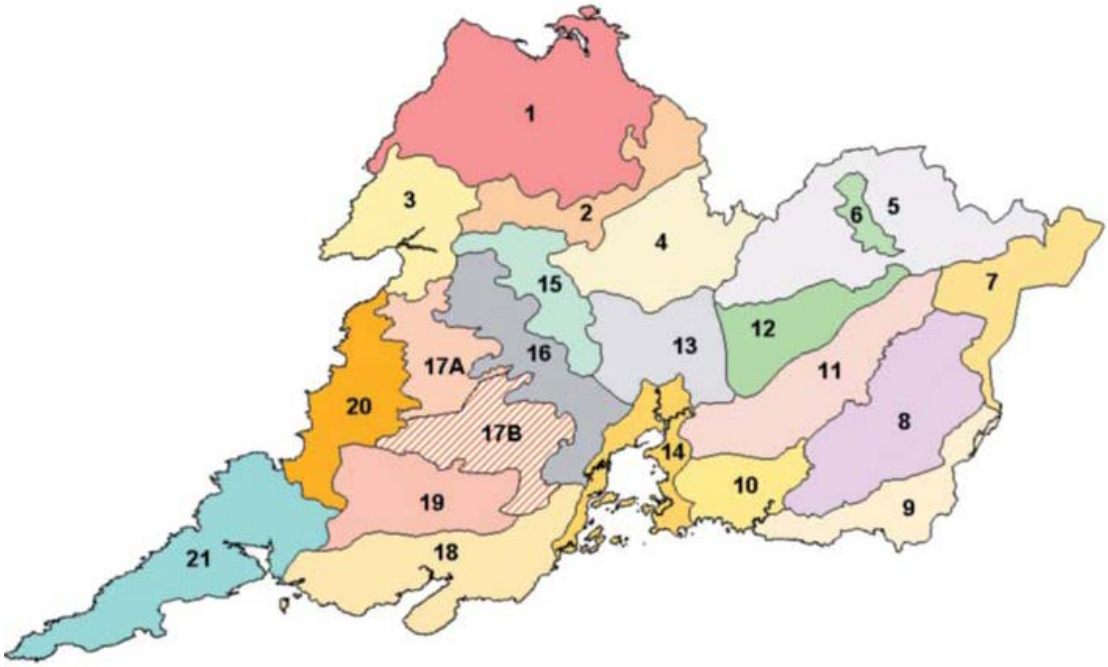

Plate 3.11.3: Landscape Character Areas

River Shannon Farmlands

The key characteristics of the River Shannon Floodplains Landscape Character Area are defined as:

- Lowland farming with meandering River Shannon providing key focus;
- Small settlements/villages;
- Well maintained agricultural/rural landscape

The area is described as "a largely rural landscape with fields usually enclosed by hedgerows, hedgebanks and trees. This helps create an intimate, well wooded landscape." The forces for change within the area are primarily development pressure from the expansion of Limerick City and the associated residential pressures on all the Study Area villages

Road upgrades are noted as a force for change, however the density of hedgerows, treelines and woodland copses make it possible to absorb new development into the landscape with minimal impact.

Sliabh Bernagh Uplands

The Slieve Bernagh Uplands extend south west to encompass Cratloe village and Woodcock Hill. The north westerly element of the Study Area is contained within this character area.

The key characteristic in this instance are rolling hills with minimal, scattered settlement and vegetation which is dominated by heather moorland with plantation forests and semi-natural woodland on the lower slopes and along watercourses.

The isolated and inaccessible nature of this landscape makes it visually vulnerable to inappropriate development, with minor access roads on hill tops to communication

masts being noted as significant. A road on the lower slopes of this area will be widely visible and is likely to be considered as a significant landscape and visual impact.

3.11.3 Landscape Planning Policy

The following designations and associated policies are considered as landscape constraints as they have been formally recognised, by the planning authority, within the relevant Development Plans. Cognisance of these designations must therefore be borne in mind throughout the route selection exercise.

Clare County Development Plan 2009 – 2015

The Clare County Development Plan recognises that the landscape is unique and valuable while also being dynamic. It is identified that the policies seeking to preserve its character must also recognise and value the changes that result from management of the land and the development of the local economy and community.

The primary policy relates to the recognition of the differing sensitivities and absorptive capacities of different landscapes. To that end the Development Plan has designated areas as Vulnerable Landscapes which are protected by restrictive planning policy such as ***CDP 46***:

"In areas identified as being vulnerable landscapes the Planning Authority will only normally permit proposals for development of the highest quality in terms of siting and design and where the development will not adversely impact to a significant extent upon the character, integrity or uniformity of the landscape."

The hills to the north west of the Study Area are contained within a Vulnerable Landscape (Refer **Drawing RCSR-3-1101 in Volume 2**).

South Clare Local Area Plan 2009 – 2015

The South Clare Local Area Plan recognises that the capacity of the landscape to absorb development is influenced by its natural and built features and that local elements of the landscape, such as woodlands, hedgerows and stone walls, make a significant contribution to the appearance and character of the local environment.

The South Clare Local Area Plan contains a number of landscape planning policies which need to be considered during the route selection exercise. These include:

Policy ENV7 Landscape Conservation

Proposals for development outside of defined settlement areas will only be considered when it can clearly be demonstrated that:

a) There will be no negative effects on the character of the landscape;
b) The proposed development will conserve and enhance the subject landscape through the incorporation of a high standard of site layout, design and building materials. In the case of proposals for residential development outside of built-up areas, regard must be had to the County Clare Rural House Design Guide and Landscape Characterisation Assessment; and
c) There will be no negative effects on the environment and/or Natura 2000 sites.

Policy ENV8 Retention, Protection and Enhancement of Landscape Features

Proposals for development will be considered where it can be clearly demonstrated that the development will retain, protect, maintain and where necessary enhance the

appearance and character of existing local landscape features, in particular native trees, hedgerows, shelter belts and stone walls.

Policy ENV9 Protection of Vulnerable Landscapes

The Vulnerable Landscapes are areas that are considered visually vulnerable. The Vulnerable Landscape designation, therefore, seeks to protect views of the sea, prominent high ground and skylines, the character and uniformity of upland areas, etc; and as such views from public roads and footways are considered important.

Therefore proposals for development must clearly demonstrate that:

a) It will not detract from or adversely affect the character, integrity or uniformity of the landscape when viewed from either a close proximity or the surrounding areas;

b) The highest standards of site selection, site layout, design and building materials have been incorporated to conserve and enhance the landscape character;

c) The landscape is able to satisfactorily absorb new development; and

d) There will be no negative effects on the environment and/or Natura 2000 sites.

Limerick County Development Plan 2005 - 2011

The element of the Study Area which lies within the administrative jurisdiction of Limerick County Council is included within the Landscape Character Area defined as the *Shannon Integrated Coastal Zone Management.* This characterisation recognises the importance of a hedgerow dominated landscape.

The County Development Plan also lists a number of protected Scenic Views and Prospects. It is considered that the location of the Study Area ensures that there will be no impact on any of these.

Policy ENV6 Landscaping and Development

It is the Policy of the Council to ensure the adequate integration of development into the landscape by the retention of trees and landscape features and / or encouraging suitable planting.

Castletroy Local Area Plan 2009 – 2015

The south eastern element of the Study Area lies within the Castletroy Local Area Plan. Within this local plan there is a general appreciation of the important contribution of landscape features to the character of Castletroy's urban area and rural fringe. It is a policy of the Council to preserve, maintain and incorporate into new development proposals where appropriate the existing stands of mature trees and field boundaries which contribute to the overall character of both the built up and as yet undeveloped areas of Castletroy.

Within this plan there is also a Land-use zoning classified as 'Groody Valley Green Wedge' (Refer **Drawing RCSR-3804 in Volume 2**).The purpose of this zoning objective is to preserve and protect the Groody Valley Green Wedge from development in order to maintain its importance in preventing the coalition of built up areas of Limerick City and suburbs and to retain its important role as a wildlife corridor and a flood risk management zone.

3.11.4 Conclusion

This desktop review has revealed that the proposed Limerick Northern Distributor Road will have a potential primary impact on the low lying farmland of the River Shannon Floodplains Landscape Character Area. It is considered that this landscape is robust enough to be capable of absorbing the proposed road provided the route is sensitively planned and uses the existing landforms and tree-lines to conceal the road from views from the hills to the north.

Throughout the planning and development of the route cognisance will have to be had to the landscape designations and the requirements of the landscape planning policies. With respect to potential landscape and visual impact the selection of the River Shannon crossing and the design of the bridge require careful consideration.

3.12 Noise and Vibration

3.12.1 Introduction

There are currently no Irish standards or limits governing the assessment of noise and/or vibration associated with either new or existing roads. The NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes lays down the procedures to be followed during the planning, design and implementation of national road schemes.

Under the Guidelines the specific objective of the noise input to the Constraints Study is to identify any receptors that may be deemed to be particularly sensitive to noise and/or vibration. Identifying the potential receptors at this stage in the process allows them to be taken into account in the route selection and design process such as to avoid or minimise adverse impact on sensitive receptors.

This input is based upon a site visit undertaken on the 9th November 2010 and a desk top review of the available OS mapping, overhead aerial photography and development plans.

3.12.2 The Receiving Environment

The prevailing noise climate of the Study Area is typically rural. The predominant noise sources throughout the Study Area include road traffic from the existing road network, especially from the M7 to the east of the Study Area, agricultural activity and the industrial activity ongoing at the technology park. The larger urban centres such as the urban fringes of Limerick City and the towns of Annacotty, Parteen and Ardnacrusha have a higher noise climate due to the nature of activity going on and the traffic within them.

Large employment zones such as that at the National Technology Park and the associated Industrial Estate will create greater noise levels through the nature of the industries and operations contained therein and through the number of employees and associated traffic movements.

An exercise has been undertaken to identify sensitive receptors within the Study Area. These include schools, churches, community and amenity facilities, sports clubs etc. In the majority of instances these sensitive receptors are located in proximity to urban areas or clusters such as at Meelick and thereby in locations which would by their nature be difficult to locate a route corridor.

In addition many of the local roads are quite densely developed with residential ribbon development. Where these are accumulated into recognisable clusters these have been mapped as sensitive receptors. Due to their rural nature these properties will be sensitive to minor increases in background noise levels.

3.12.3 Potential Mitigation Measures

At the Constraints Study stage, it is necessary to consider the location of the sensitive noise receptors so that throughout the Route Selection process the requirement to avoid them where feasible and minimise the impact on them in the second can be considered and weighted. This is done by routing of potential route corridors in areas where, in the first instance there are no sensitive receptors. The second option available is to use the existing topography and other natural features to hide the route from the sensitive receptors.

With respect to the proposed Limerick Northern Distributor Road the landform is dominated by the relatively flat Lower River Shannon floodplains. This topography will only provide limited screening and so natural features such as treelines and woodlands are important in a noise context. Other noise abatement solutions include the provision of noise bunds or barriers where no alternative is feasible. Finally the provisions of a low noise surfacing may reduce the noise levels by between 3 and 5 decibels (dB).

3.13 Air Quality

3.13.1 Introduction

Pollutant emissions from road traffic may cause health and environmental impacts at both the local and national/international level. In order to reduce the risk to human and environmental health from poor air quality, National and European statutory bodies have set limit values in ambient air for a range of pollutants.

The National Roads Authority *Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes* lays down the procedures to be followed, with respect to air quality assessment, during the planning, design and implementation of national road schemes.

With respect to the Constraints study the primary objective as outlined in the Guidelines is to characterise the existing air quality in the area and to identify sensitive receptor locations. Sensitive receptor locations will include all areas where members of the public are likely to be regularly present, ie residential housing, schools, hospitals, etc. Identifying the sensitive receptors at this stage in the process allows them to be taken into account in the route selection and design process.

This input is based upon a site visit undertaken on the 9th November 2010 and a desk top review of the available OS mapping, overhead aerial photography and development plans.

3.13.2 The Receiving Environment

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The EPA website provides both monitoring data and the results of previous air quality assessments. In terms of air monitoring and assessment Limerick is categorised as Zone C (specified population centres with greater than 15 000 inhabitants) and non-urban areas are categorised as Zone D.

Air quality in Ireland is generally of a high standard across the country due to prevailing Atlantic airflows, relatively few large cities and the lack of widespread heavy industries. However, levels of particulate matter and nitrogen dioxide remain of concern. Traffic is the primary source of nitrogen dioxide and is also one of the main sources of particulate matter.

EPA Report "Air Quality in Ireland 2009" shows that with respect to all monitored pollutants the air quality in all Zones C and D is good (considerably below set limit values).

This is corroborated by the Air Quality Assessment undertaken as part the Environmental Impact Assessment for the Coonagh to Knockalisheen Distributor Road scheme (published June 2010) which found confirmed the air quality to be good. This proposed scheme is present on the western border of the Study Area (Refer **Drawing RCSR-3201 in Volume 2**) and as such the air quality findings for this scheme can be considered to be indicative of the receiving environment of the Limerick Northern Distributor Route.

The following statement from the Coonagh to Knockalisheen EIS highlights this finding:

"...average NO_2 concentrations measured over the one month period were all well below the national and EU annual limit value, reaching at most 13% of this value."
The only significant industrial zone within proximity of the Study Area relates to the National Technology Centre and associated industrial park located to the south east. The Ardnacrusha hydroelectric power station does not impact air quality.

An exercise has been undertaken to identify sensitive receptors within the Study Area, these include the many churches, schools and community facilities. In the majority of instances these sensitive receptors are located in proximity to urban areas or residential clusters and thereby in locations which would by their nature be difficult to locate a route corridor.

A review of all live planning permissions is included in Chapter 8 of this Study and shown on **Drawings RCSR-3805 to RCSR-3807**.

3.13.3 Potential Mitigation Measures

At operation stage mitigation measures to reduce air quality are generally very limited. Therefore, at the Constraints Study stage it is necessary to consider air quality so that throughout the Route Selection process the requirement to avoid the sensitive receptors can be considered and weighted. Where feasible, this is achieved by routing of the potential route corridors away from the sensitive receptors.

3.14 Summary and Conclusion

The Constraints Study has resulted in the identification of the nature and extent of significant constraints within a defined Study Area during the initial step in the Route Selection Process for Phase 2 of the Limerick Northern Distributor Road.

The proposed scheme will provide a northern distributor road around Limerick City, improving accessibility to the City from County Clare and relieving pressure on the existing river crossings in the City Centre. The road will provide significant improvement in connectivity between different areas along the northern fringe of the City, allowing people living in residential areas to the east of Limerick to access employment areas in the west of Limerick and vice versa. This will reduce traffic flows in the city centre and facilitate public transport initiatives.

The Study Area is dominated by the Lower River Shannon and its significant floodplains, with the associated topography being relatively flat. In terms of engineering the major constraints relate to the crossing of the Lower River Shannon and the requirement to cross either the Ardnacrusha Headrace Canal or Tailrace Canal. As a result of the presence of the Ardnacrusha Power Station there are also 110kv overhead power lines originating from the power station and running throughout the Study Area.

In terms of geology, hydrology and hydrogeology the primary constraints relate to the extensive area of land subject to flooding, the high water table, areas of soft ground (including peat, alluvium and estuarine silt/clay) and the presence of multiple surface water features.

The Lower River Shannon candidate Special Area of Conservation, which includes Knockalisheen Marsh, is an important ecological constraint. The significance of crossing an area designated as Special Area of Conservation has been highlighted. In addition a number of further ecological sites, identified by previous studies, have been mapped.

A wealth of recorded sites, monuments and protected structures are present within the Study Area. The presence of the River Shannon and a high number of demesne landscapes highlight that the Study Area is of high archaeological potential.

With respect to Landscape the Study Area is predominantly within the low lying farmland of the River Shannon Floodplains Landscape Character Area. It is considered that this landscape is robust enough to be capable of absorbing the proposed road provided the route is sensitively planned and uses the existing landforms and tree-lines to conceal the road from views from the hills to the north.

This Study documents and maps these constraints which are 'work in progress' and subject to change/refinement as of the Route Selection Process continues. In light of some of the constraints identified which exist within the Study Area, surveys and data collection will be ongoing throughout the route selection stage and beyond. Similarly, further consultations with the public and with statutory consultees, such as NPWS, are imperative if an agreed route corridor is to be attained.

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Appendix A

Constraints Study – Key Consultees

CONSTRAINTS STUDY – KEY CONSULTEES

CONSULTEE
University of Limerick
Shannon Development
IDA Ireland
The Irish Farmers Association
Office of Public Works (OPW)
Eircom
Waterways Ireland
Electricity Supply Board (ESB)
ESB networks
Bord Gáis
Bus Éireann
National Parks and Wildlife Service (NPWS)
Environmental Protection Agency (EPA)
Department of Environment Heritage and Local Government
Inland Fisheries Ireland
Clare County Council
Limerick County Council
An Taisce - The National Trust
Road Safety Authority

Chapter 4 Engineering Parameters

4.1 Introduction

In this chapter, the engineering parameters to be adopted for an appropriate road type for the scheme are outlined in accordance with the functionality of the Limerick Northern Distributor Road (LNDR).

4.2 Function of the Proposed LNDR (Phase 2)

The Limerick Northern Distributor Road is being developed in two phases as follows:

- **Phase 1 -** Coonagh Knockalisheen Distributor Road (CKDR);
- **Phase 2 -** Limerick Northern Distributor Road (LNDR) Phase 2 from the western tie-in around the Coonagh Knockalisheen Road Scheme to the existing R445 (Old N7) / M7 to the east of Limerick City.

The following key functions are objectives of the LNDR Phase 2:

i) To enable cross movements between the radial routes around the northern edge of Limerick City, including the regional road network, and to improve access for local traffic;

ii) To greatly improve connectivity to and between the northern outskirts of Limerick City and the adjoining rural hinterland in southeast County Clare;

iii) To promote balanced regional development in Counties Clare and Limerick, and Limerick City;

iv) To reduce traffic flows in Limerick City Centre and to facilitate public transport initiatives including bus corridors;

v) To make better provision for safe movement of pedestrians and cyclists.

It is not an objective of the Limerick Northern Distributor Road to be an attractive route to suit long distance east-west traffic flows between the M7 and N18. That function is served by the Limerick Southern Ring Road and the Shannon Tunnel which provide a high-speed route for national traffic.

4.3 Limerick Northern Distributor Road Phase 2: Road Type

The LNDR has been identified as a "Distributor Road".

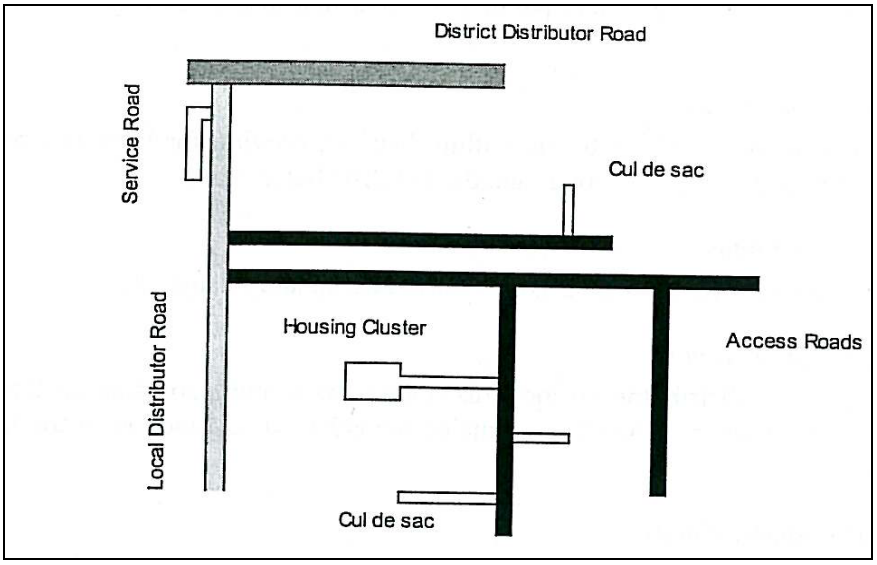
The term "Distributor Road" originated in the BUCHANAN REPORT: TRAFFIC IN TOWNS published in 1963. The concept was then included in "Roads and Traffic in Urban Areas" published in 1987 by the UK Department of Transport and the Institute of Highways and Transportation, with the predominant function defined as to serve "Medium distance traffic to Primary Network".

Of possible relevance are the following definitions from the Dun Laoghaire Rathdown County Council publication "Development Works in Residential and Industrial Areas – Guidance Document" (1998):

District Distributor Roads: These roads act as distributors to local distributor roads and also cater for through traffic between districts.

<u>Local Distributor Road</u>: These through roads distribute traffic within districts, provide for local bus routes and form a link between access roads and district distributor roads.

The diagram below describes a typical road hierarchy in an outer urban area.



It is proposed that the LNDR Phase 2 will be a ***District Distributor Road*** in that it has the potential to link the various radial routes around the northern side of Limerick City, which from west to east are as follows:

1) The Coonagh Knockalisheen Distributor Road linking to the R445 and the N18 Limerick to Ennis, Shannon and Galway, with connection to the N18 Limerick Southern Ring Road (West) at Clonmacken (and onward to N69 Foynes Road & M20/N21 for Cork and Kerry));
2) L-3032-52 – Knockalisheen Road (Local Road);
3) L-3056-16 – Quinspool Road (Local Road);
4) Directly or indirectly to R464 Longpavement Road (Parteen to Ballynanty and Hasset's Cross) R463 Limerick/Corbally/Parteen to Killaloe;
5) Indirectly to the R465 Parteen to Broadford via the R463 at Ardnacrusha;
6) L-3058-17 – Cloonlara Road (Local Road);
7) L7054-0 – Local Road between Gilloge Road and Cloonlara Road through Shannakyle;
8) L-3062-13 – Derryfadda Road (Local Road);
9) L-3062-0 – Gilloge Road (Local Road) linking the northern campus of University of Limerick and the R463 Regional Road at Athlunkard between Parteen and Corbally;
10) L-5050-0 and L-7052-0 – Local Roads in Srawickeen to the north of Clare campus of University of Limerick;
11) Plassey Park Road (Private Industrial Access Road) and access to University of Limerick main campus;
12) R445 Limerick to Nenagh linking to M7 Limerick to Dublin motorway and the M7 Limerick Southern Ring Road (East) at Annacotty (and onward to the N24 Waterford Road).

The above list shows that the LNDR when completed will potentially connect to 18 roads linking to Limerick City and the surrounding region.

- 6 no. National Roads (M7, N24, M20, N21, N69, N18) indirectly via the R445 Regional Road;
- 5 no. Regional Roads (R445 West, R463, R464, R465, R445 East) and 1 no. Private Industrial Access Road (Plassey Road);
- 8 no. Local Roads.

4.4 Characteristics of the Limerick Northern Distributor Road

The proposed road will have the following characteristics that will determine the required cross-section and design speed:

(a) It will traverse undeveloped lands near Limerick City, and will serve an urban function although sections of the route will pass through a rural environment;

(b) A speed limit of 80 km/h is proposed, which is the statutory speed for all non-national rural roads;

(c) The road designation is to be confirmed; Regional Road status may be considered;

(d) Policy for direct access or otherwise to be determined; designation of the road as a district distributor implies no direct access to the road from private properties or businesses;

(e) Facilities will be required for Pedestrians – this may be in the form of a footpaths along both sides of the road or on one side only, probably on the southern, city side, but tailored to suit local requirements;

(f) Accommodation of bus movements, including provision of possible bus lanes;

(g) Facilities will be required for Cyclists – this may be in the form of a cycle track along one side only of the road, probably on the southern, city side, but tailored to suit local requirements. Consideration will be given to relevant recent Government policies and guidance documents in relation to provision for cyclists, including:

- *National Cycle Policy Framework (2008-2020) (Published by Dept of Transport);*
- *Smarter Travel – A Sustainable Transport Future (2009-2020) (Published by Dept of Transport);*
- *National Cycle Manual* (2011) *(Published by the National Transport Authority);*
- *Draft NRA Design Standards for Pedestrian and Cycling Facilities along Rural Roads (2009)*, which recommends a desirable minimum width of 2.5m for a shared two-way pedestrian and cycling track, with a 2.0m wide segregation width (typically consisting of a 1.5m grass verge + 0.5m hard strip along the road edge).

The road carriageway type to be selected from the range available in standards TD9 and TD27 of the National Roads Authority Design Manual for Roads and Bridges (NRA DMRB) and from other references such as "Roads and Traffic in Urban Areas", according to the level of traffic demand anticipated.

For the purposes of identifying the Preferred Route Corridor, the Route Selection Process was progressed on the basis that the cross section for Phase 1 of the

Limerick Northern Distributor Road is to be maintained throughout the length of the scheme.

4.5 National Design Standards

The design standards for the scheme are the National Roads Authority's Design Manual for Roads & Bridges (NRA DMRB). In particular, the following standards from the NRA DMRB are important at the route selection stage:

- NRA TD 9 Road Link Design;
- NRA TD 27 Cross Sections and Headroom.

And to a lesser extent:

- NRA TD 16 Geometric Design of Roundabouts;
- NRA TD 40 Layout of Compact Grade Separated Junctions;
- NRA TD 41-42 Geometric Design of Major/Minor Priority Junctions and Vehicular Access to National Roads.

4.6 Proposed Design Speed

Design speed for the proposed mainline road is 85 kph.

4.7 Traffic Flow Information

Initial traffic flow information was compared with the vehicle flows (Annual Average Daily Traffic) given in Table 6/1 of NRA TD 9 that represent approximate two-way flows which correspond to Level of Service D in reasonably level terrain. Table 4.1 gives the estimated AADT in the 2033 design year compared to the nominal Capacity given in TD9.

Table 4.1 Traffic Flows

Section	Approx. Traffic Flow (AADT)	Road Type	Nominal Capacity (AADT) Table 6/1 of TD 9
1	20,500	Type 1 Dual Carriageway	42,000
2	29,000	Type 1 Dual Carriageway	42,000

4.8 Cross-Section

For the purposes of undertaking the comparison of route corridors as part of the Route Selection Stage, it was agreed that the cross-section adopted for Phase 1 of the Limerick Northern Distributor Road (Coonagh – Knockalisheen Scheme) be maintained throughout the length of Phase 2 of the scheme. The proposed cross-section for the new mainline road is as follows:

In general, the following road cross-section applies to the mainline:

- 1 x 2.6m wide central reserve;
- 2 x 7.0m carriageways, with 2 traffic lanes in each direction;
- 2 x 1.5m grass verge shoulders;
- 2 x 2.5m two-way cycle track;

- 2 x 2.0m footpath;
- 2 x 1.0m grass verge;
- Overall width to back of verges: 30.6m minimum.

Refer Volume 2 - Drawing RCSR-401 for a typical road cross-section detail for the Limerick Northern Distributor Road.

Facilities for Pedestrians and Cyclists

It is proposed that the following facilities for pedestrians and cyclists will be provided on each side of the carriageway:

- 1.5m landscaped wide separator strip from the edge of the kerb ;
- 2.5m wide shared cycleway;
- 2.0m wide footway.

The proposed cross-section will be reviewed and revised as necessary during the preliminary design stage following consideration of the requirements of pedestrians and cyclists.

4.9 Horizontal Design Standards

Horizontal alignment design standard for the route options have been based on the need to provide desirable minimum horizontal curves in accordance with NRA TD9 for a mainline design speed of 85kph.

4.10 Vertical Design Standards

Vertical alignment standards for the route options have been based on the need to provide at least Desirable Minimum crest and sag curvatures in accordance with NRA TD 9. Such a provision will ensure that Desirable Minimum stopping sight distances are achieved. Table 4.2 shows the allowable maximum and minimum gradients.

Table 4.2 Maximum and Minimum Gradients

	Gradient	Comment
Maximum Gradient	3%	Desirable maximum gradient
Absolute Maximum Gradient	4%	One step relaxation on Desirable Maximum Gradient – used at isolated locations where required
Normal Minimum Gradient	0.5%	Normal minimum grade (at rollovers for the application of superelevation a higher minimum is required).

4.11 Junction Design Standards

The principal accessibility/interaction between the Scheme and the existing road network (in the form of a preliminary junction strategy) was developed for each option. The junction type will vary along the proposed new road with the classification of the road crossing. As part of the route corridor selection process, the following junction types have been considered for comparison purposes:

(i) Roundabouts;

(ii) In urban areas, consideration was given to signalising the whole junction to address safety concerns;

(iii) Full or Compact Grade Separated Junctions; and

(iv) Left in / left out junctions.

The junction type will be selected at design stage and will depend upon the minor road classification and the predicted traffic flows and turning movements.

4.12 Access to Private Land and Houses

Access to private lands and houses off the four lane Distributor Road will be, where possible avoided by diverting either the house access or access tracks onto the local road network. By limiting the number of accesses onto the new proposed Distributor Road, the overall safety of the road will be improved. Where access cannot be gained to private land or houses via local roads or access tracks, consideration may be given to the use of a left in / left out junction as per the requirements of NRA TD 41-42.

4.13 Drainage Design Standards

In general NRA HD 33 will be followed for drainage design. Principals adopted for drainage assessment are as follows:

- Adequate surface drainage;
- Adequate subsurface drainage to lower the water table in cut areas;
- Conservation of water quality including identification of suitable outfall locations, attenuation of road run-off and pollution control.

Where the Preferred Route Corridor crosses existing watercourses, the scheme will be required to comply with the OPW Section 50 requirements.

Chapter 5 Route Corridors

5.1 Development of Potential Route Options

Following the compilation of initial constraints within the Study Area, the Route Selection Process commenced. The Design Team developed a number of feasible route options in accordance with the requirements of the NRA Design Manual for Roads & Bridges while avoiding, where possible, significant constraints identified to date in the Study Area.

The development of further route options within the Study Area was restricted by environmental, archaeological, social, geological and topographical constraints. Also engineering parameters such as length of new construction, river crossings, and connectivity to Limerick City were also been taken into account. The development of the alternative routes options was further limited by the amount of development within the Study Area.

As outlined in Chapter 3 of this Report, the northern boundary of the Study Area was initially selected to allow for the examination of a potential route corridor option crossing over the Headrace Canal. This was due to the limited open space corridor available to provide a crossing over the Tailrace Canal between Parteen and Ardnacrusha. During the consultation process with Statutory Bodies as part of the constraints gathering exercise, the ESB who own and maintain both the Headrace and Tailrace Canals were consulted. The ESB noted that they would have objections to any potential crossing of the Headrace Canal due to the following:

- The Headrace Canal is a Category A Dam. A breach would cause a severe flooding event, endanger lives and would also result in a shutdown of the power station which is of national strategic importance.
- The ESB monitor the embankments along the Headrace Canal by continuously monitoring seepage from the Headrace Canal and raised concerns regarding the impact of any proposed works on this monitoring regime.
- The ESB have undertaken numerous Karst studies along the Headrace Canal and raised concerns over the ground conditions south of the Canal at the location of a potential Headrace Canal crossing.

The above constraints associated with crossing the Headrace Canal were deemed to impact the feasibility of any route option to the north of Ardnacrusha. Any crossing of the Headrace Canal would be required to clear span in excess of 400m while addressing poor ground conditions and the H&S concerns of the ESB both at construction stage and operation stage. Such a crossing would have significant cost implications on what would be the longest route option. It is also noted that as the longest route option, this option would have a significant environmental impact and would negatively impact the functionality of the route.

Following review of this route option under the preliminary options assessment headings of Engineering, Environment and Economy, the route was considered to be least preferred under each of the headings, deemed not to be feasible and eliminated from further consideration.

5.2 Consideration of 'Do-Nothing' & 'Do-Minimum Alternatives

5.2.1 'Do-Nothing' Alternative

The 'Do-Nothing' alternative was examined to determine whether the existing road network within the Study Area could be utilised without making any improvements.

Description of 'Do-Nothing' Alternative

The 'Do-Nothing' alternative considered constitutes of the following existing roads within the Study Area:

- L-3032-5 (Knockalisheen Road) – The extent of the Knockalisheen Road to be considered as part of the 'Do-Nothing' alternative runs from the proposed Coonagh-Knockalisheen Scheme docking point to the existing junction with the R464 (Longpavement Road). This section of road is currently a narrow single carriageway in poor condition however it is scheduled to be upgraded as part of the Coonagh-Knockalisheen Scheme.
- R464 – The existing R464 is a wide single carriageway that runs from the junction with Knockalisheen Road to the R463 through Parteen Village. The section of the R464 known as Longpavement Road is in very good condition though it is noted that there is an existing manually operated level crossing directly to the north of the Longpavement Landfill site. As the R464 approaches the Tailrace Canal, the quality of the road deteriorates and reduces in cross section. This reduction is due to the cross section of the existing Parteen Bridge. The existing narrow bridge, located along the R464 is heavily trafficked and a source of congestion within Parteen Village, due to its signal controlled one-way operation. The cross section of the R464 remains reduced as it runs through the village of Parteen passing the local church and primary school before linking to the R463 to the east of Parteen Village. This section of the R464 is fronted by a large number of residential properties.
- R463 – At the junction of the R464 and the R463 at Griffins Cross, the 'Do-Nothing' alternative turns south along the R463 towards Limerick City. This section of the R463 is heavily trafficked and provides an important strategic connection between south Co. Clare and Limerick City. The road is currently the source of traffic congestion as it runs through the heavily urbanised Westbury to the north of the River Shannon. The existing River Shannon crossing, Athlunkard Bridge, along the R463 is a narrow single carriageway crossing. To the south of the River Shannon the R463 runs into Limerick City and the Corbally residential area. The Do-Nothing option considered then utilises the Corbally Link Road which connects the R445 to the R463.
- R445 – The R445 is a regional road that connects Limerick City to Nenagh. This road was downgraded to a regional road after the opening of the M7. It is main artery into Limerick City from the east, is heavily trafficked and a source of congestion. Access to the educational and employment opportunities to the east of Limerick City would be required to utilise this section of the R445.

Conclusion

On review of the 'Do-Nothing' alternative considered above, it is evident that this option does not meet the objectives of the scheme which are as follows;

- Improve accessibility to the city from County Clare and relieving pressure on the existing river crossings in the centre of Limerick City;

- Provide significant improvement in connectivity between different areas along the northern fringe of the city, allowing people living in residential areas to the east of Limerick to access employment areas in the west of Limerick and vice versa;
- Promote balanced regional development in Limerick County and South Clare.

Further to the above, the 'Do-Nothing' alternative does not improve the level of service of the existing route corridor due to the constraints at existing River and Canal crossings in addition to the heavily urbanised areas through which the route traverses. It is therefore determined that the 'Do-Nothing' alternative is not feasible and is eliminated from further consideration.

5.2.2 Do-Minimum Alternative

The 'Do-Minimum' alternative examined the feasibility of an 'on-line' upgrade of the existing route which would be capable of delivering the required levels of service and safety in accordance with the applicable design standards.

The existing road network was reviewed to identify the 'Do-Minimum' alternative and it was determined to be only partially suitable for an 'on-line' upgrade. This was due to the existing crossings of the Tailrace Canal and the River Shannon. Both crossings, the Parteen Bridge and the Athlunkard Bridge have insufficient cross-sections and would require significant works to be widened to meet the required levels of service. The bridges currently provide strategic links to Limerick City from South Clare and works requiring the temporary closure of either bridge would cause significant delays and inconvenience to road users and local communities. As a result, alternative crossing points at the Tailrace Canal and the River Shannon were included in the investigation of the 'Do-Minimum' alternative described below.

Description of 'Do-Minimum' Alternative

The 'Do-Minimum' alternative considered commences at the proposed Coonagh-Knockalisheen Scheme docking point and follows the alignment of the Knockalisheen Road to the existing junction with the R464 (Longpavement Road). At this junction, the 'Do-Minimum' alternative follows the alignment of the R464 towards Parteen Bridge. To the south of Parteen Bridge, the 'Do-Minimum' alternative diverges from the Longpavement Road in a northerly direction parallel to the Tailrace Canal for a distance of 0.6km before crossing the Tailrace Canal at a new bridge crossing. The 'Do-Minimum' alternative merges with the existing R464 at the centre of Parteen Village following the R464 through the village to Griffin's Cross at the existing junction with the R463. At Griffins Cross, the 'Do-Minimum' alternative turns in a southerly direction along the R463 for a distance of 1.2km to Larkin's Cross. The 'Do-Minimum' alternative follows the Gilloge Road from Larkin's Cross on the R463 for 1.2km to Gilloge Bridge, adjacent to the Burlington Industries site. The existing Gilloge Bridge which crosses the River Blackwater and the Errina Canal does not meet the required service levels and is identified as a protected structure in the Clare County Development Plan. As a result, an offline crossing of both the River Blackwater and the Errina Canal is required to be constructed as part of the 'Do-Minimum' alternative. To the east of Gilloge Bridge, the existing narrow local road (L-7050-0) to Srawickeen is deemed to be substandard and is not considered suitable for use as part of the 'Do-Minimum' alternative. From Burlington Industries, the 'Do-Minimum' alternative considered is entirely constructed off-line with a new River Shannon crossing to be constructed upstream of the River Mulkear before docking on the R445 at the existing Cappamore Junction.

Assessment of 'Do-Minimum' Alternative

The 'Do-Minimum' alternative is 11.8km in length of which approximately only 50% is constructed 'on-line'. The sections of the existing road network to be utilised as part of the 'Do-Minimum' alternative are predominantly substandard, do not meet the service levels required and require a significant upgrade to sections of the road. In addition, the existing structures are not suitable for use and require replacement at the following watercourses:

- Tailrace Canal
- River Blackwater
- Errina Canal
- River Shannon

Further to the above, the sections of the 'on-line' upgrade are located adjacent to the residential areas in Parteen along the R464 and the R463. In addition, a number of properties along the Gilloge Road front on to the existing road. The extent of properties fronting onto the existing roads will be significantly impacted by the requirement to upgrade to four lanes as part of the 'Do-Minimum' alternative.

The impact of increasing the width of the existing road adjacent to the large number of properties when combined with the requirement for the new structures to be built at the existing watercourses will have a severely negative impact on the economic benefits of selecting the 'Do-Minimum' alternative.

In addition to the economic implications of providing a four lane road adjacent to the properties along the existing road network, the engineering and environmental impact of the 'Do-Minimum' alternative must also be considered. It is noted that under the headings of Ecology, Agriculture and Geology, the 'Do-Minimum' alternative would be considered preferable to offline options. However the impact of the 'Do-Minimum' alternative would be deemed to be severely negative under the environmental headings of Noise & Vibration, Air Quality & Climate and Material Assets.

Under the heading of engineering which incorporates safety, the impact is deemed to be severely negative due to number of accesses to the four lane distributor that would required from the adjacent properties. This impact is further exacerbated by the large volumes of traffic that would be directed through the heart of Parteen Village passing both the local Church and Primary school.

The 'Do-Minimum' alternative does not serve to promote balanced regional development in Limerick County and South Clare with extensive residential development already adjacent to the existing roads. In addition, the existing infrastructure is not constructed to current design standards and does not distribute traffic in a sustainable manner along the northern environs of the city. In addition to the increased traffic volumes following the opening year, the upgrading of the existing road network during the construction phase would cause additional disruptions and inconvenience to local resident and road users.

Conclusion

The feasibility of the 'Do-Minimum' alternative is negatively impacted by the capacity of the existing road network within the Study Area to deliver the required levels of service and safety in accordance with the applicable design standards and the volume of residential properties adjacent to the road network. It is concluded that the

'Do-Minimum' alternative investigated does not provide a solution which is in accordance with the schemes objective and not deemed to be feasible.

5.3 Feasible Route Options

5.3.1 Section, Node and Link Numbering

Following consultation with the ESB, the proposed crossing point of the Tailrace Canal was deemed to be feasible. It should be noted that due to the limited open space corridor available to provide a crossing over the Tailrace Canal between Parteen and Ardnacrusha, all feasible route options developed for the Route Selection Process pass through this common location.

For the purposes of comparing the feasible route options developed to the west and to the east of the Tailrace Canal near Parteen, the Study Area was split into two distinct sections at this common crossing point.

Within each section, each route was divided into a number of links. Nodes were established where route corridor options merged or diverged and at the start/end points of each section. The location of each node is shown on Volume 2 – Drawings, Drawing No. RCSR-501, while Table 5.3 and Table 5.4 lists the node links with approximate lengths which form each of the routes within Sections 1 and 2.

Section 1 - West of the Tailrace Canal

Six feasible route options were identified within Section 1 of the Study Area and progressed to Stage 1: Preliminary Options Assessment of the Route Selection Process. The route options identified are outlined in Table 5.1 and shown in Volume 2 – Drawings, Drawing No. RCSR-501. This drawing also shows a revised Study Area which takes account of the reduction that was possible because of the discounting of route options crossing the Headrace as described in Section 5.1 above.

Table 5.1 – Section 1 – Route Options

No.	Route Name	Route Nodes
1	Route A1	Nodes A-F-X
2	Route A2	Nodes A-X
3	Route A2.1	Nodes A-X
4	Route A3	Nodes A-F-X
5	Route A4	Nodes A-G-H-X
6	Route A4.1	Nodes A-G-H-X

Section 2 - East of the Tailrace Canal

Sixteen feasible route options were identified within Section 2 of the Study Area and progressed to Stage 1: Preliminary Options Assessment of the Route Selection Process. The route options identified are outlined in Table 5.2 and shown in Volume 2 – Drawings, Drawing No. RCSR-501.

Table 5.2 – Section 2 – Route Options

No.	Route Name	Route Nodes
1	Route B1	X – J - B
2	Route B1/B2	X – J – B
3	Route B1/D1/C1	X – J – L – C
4	Route D2/Link D2 to D1/C1	X – K – L – C
5	Route B1/D1	X – J – L –M – N – P – D
6	Route D2/Link D2 to D1/D1	X – K – L –M – N – P – D
7	Route D2/D1	X – K – M – N – P -D
8	Route D2/E1/D1	X – K – N – P - D
9	Route B1/D1/E1	X – J – L – M – N – O - E
10	Route D2/Link D2 to D1/E1	X – K – L – M – N – O - E
11	Route D2/D1/E1	X – K – M – N – O - E
12	Route D2/E1	X – K – N – O - E
13	Route B1/D1/Link E1 to D1/D1	X – J – L – M – N – O – P - D
14	Route D2/Link D2 to D1/D1	X – K – L – M – N – O – P - D
15	Route D2/Link D2 to D1/E1/Link E1 to D1/D1	X – K – M – N – O – P - D
16	Route D2/E1/Link E1 to D1/D1	X – K – N – O – P - D

Table 5.3 and Table 5.4 below lists the node links with approximate lengths (all lengths are in kilometres) which form each of the routes options developed within Sections 1 and 2.

Table 5.3 Node and Link Lengths in Section 1

Route / Node	A1	A2	A2.1	A3	A4	A4.1
AG	-	-	-	-	2.2	2.2
AX	-	2.4	2.5	-	-	-
AF	2.1	-	-	1.9	-	-
FX	0.9	-	-	0.9	-	-
GH	-	-	-	-	1.6	1.6
HX	-	-	-	-	0.9	0.9
TOTAL	**3.0**	**2.4**	**2.5**	**2.8**	**4.7**	**4.7**

Table 5.4 Node and Link Lengths in Section 2

Route / Node	B1	B1/B2	B1/D1/ C1	B1/D1	D2/D1	Link D2 to D1	D2/E1	Link E1 to D1
XJ	1.5	1.5	1.5	1.5	-	-	-	-
JB	3.5	3.2	-	-	-	-	-	-
JL	-	-	1.8	1.8	-	-	-	-
LC	-	-	3.0	-	-	-	-	-
LM	-	-	-	1.2	-	-	-	-
MN	-	-	-	0.8	0.8	-	-	-
NP	-	-	-	1.1	1.1	-	-	-
PD	-	-	-	0.9	0.9	-	-	-
XK	-	-	-	-	1.6	-	1.6	-
KL	-	-	-	-	-	2.0	-	-
KM	-	-	-	-	3.1	-	-	-
KN	-	-	-	-	-	-	4.2	-
NO	-	-	-	-	-	-	0.9	-
OP	-	-	-	-	-	-	-	0.7
OE	-	-	-	-	-	-	1.5	-
TOTAL	**5.0**	**4.7**	**6.3**	**7.3**	**7.5**	**2.0**	**8.2**	**0.7**

5.4 Description of Route Options

5.4.1 Introduction

The section describes the route options progressed to the Stage 1: Preliminary Options Assessment of the Route Selection Process and should be read in conjunction with Drawing No. RCSR-501 to RCSR-505.

5.4.2 Route Corridor Options in Section 1

Route Option A1

The node and link arrangement of this route is A-F-X.

Route option A1 follows the alignment of the Infrastructure Safeguard Road as shown in the Clare County Development Plan 2006 – 2011. This route starts from the proposed LNDR Phase 1 tie-in with the existing L-3032-52 (Knockalisheen Road) and heads in a southern direction along the L-3032-52 for 350m before turning east across Knockalisheen Marsh. After approximately 550m, route option A1 turns in a north-easterly direction connecting to the L-3056-16 (Quinspool Road) to the north of Quinspool House. From Quinspool Road, this route option traverses to the south of Castlebank House in an easterly direction crossing the Tailrace Canal west of Parteen. This route option is approximately 3.0km in length.

Route Option A2

The node and link arrangement of this route is A -X.

Route option A2 follows the alignment of the current Infrastructure Safeguard Road as shown in the Clare County Development Plan 2011 – 2017. The route traverses Knockalisheen Marsh to the south of the Refugee Centre before crossing the L-3056-16 (Quinspool Road) to the north of Quinspool House. From Quinspool Road, this route option traverses to the south of Castlebank House in an easterly direction crossing the Tailrace Canal west of Parteen. This route option is approximately 2.4km in length.

Route Option A2.1

The node and link arrangement of this route is A-X.

Route option A2.1 runs to the south of the current Infrastructure Safeguard Road as shown in the Clare County Development Plan 2011 – 2017. The route traverses Knockalisheen Marsh to the south of the Refugee Centre before crossing the L-3056-16 (Quinspool Road) between Quinspool House and Fitzgerald Flowers Ltd. From Quinspool Road, this route option traverses to the south of Castlebank House in an easterly direction crossing the Tailrace Canal west of Parteen. This route option is approximately 2.5km in length.

Route Option A3

The node and link arrangement of this route is A-F-X.

This route starts from the proposed LNDR Phase 1 tie-in with the existing L-3032-52 (Knockalisheen Road) and heads in a northern direction along the L-3032-52 for 350m before turning eastwards to the north of the Knockalisheen Refugee Centre. The route merges with Route Option A.1 (Node F) as it crosses the L-3056-16 before continuing towards the Tailrace Canal crossing. This route option is approximately 2.8km in length.

Route Option A4

The node and link arrangement of this route is A-G-H-X.

Route Option A4 is the most northerly route of all the Route Corridor Options. This route starts from the proposed LNDR Phase 1 tie-in with the existing L-3032-52 (Knockalisheen Road) and heads in a northern direction along the L-3032-52 for 1.4km before turning eastwards to the north of Ballycannan (Meelick Village). To the north of Ballycannan Graveyard, the route turns in a south easterly direction passing Castlebank House to the south before crossing the Tailrace Canal, west of Parteen. This route option is approximately 4.7km in length.

Route Option A4.1

The node and link arrangement of this route is A-G-H-X.

Route Option A4.1 for the most part follows the same corridor as Route Option A4 but with a different alignment between nodes G and H. This route also starts from the proposed LNDR Phase 1 tie-in with the existing L-3032-52 (Knockalisheen Road) and heads in a northern direction along the L-3032-52 for 1.4km before turning eastwards to the north of Ballycannan (Meelick Village). To the north of Ballycannan Graveyard, the route option A.4.1 diverges from the route option A.4, taking a more southerly route for 1.9km before merging with route option A.4 to the east of Castlebank House. The route then passes Castlebank House to the south before crossing the Tailrace Canal, west of Parteen. This route option is approximately 4.7km in length.

5.4.3 Route Corridor Options in Section 2

Route Option B.1

The node and link arrangement of this route is X-J-B.

Route Option B.1 commences at Node X to the north of Parteen at the proposed Tailrace Canal crossing. This route runs in a south easterly direction crossing the R464 between Bishop Murphy Park and Ballykeelaun. A number of properties are within the 100m wide route corridor at the crossing point with the R464. From the R464, route option B.1 continues in a south easterly direction, crossing the R463 and the L-3062-0 (Gilloge Road). At Gilloge Road, route option B.1 runs in a southern direction parallel to the Athlunkard residential estate before crossing the River Shannon at Groody Valley. Route B.1 connects to the R445 at Docking Point B on the Groody Roundabout in the townland of Reboge. This route option is approximately 5km in length.

Route Option B.1/B.2

The node and link arrangement of this route is X-J-B.

Route Option B.2 commences at Node X to the north of Parteen at the proposed Tailrace Canal crossing. This route follows the same alignment as route option B.1 through the Regional Roads R464 and R463. At Node J on the R463, route option B.2 diverges from route option B.1 by continuing on a south easterly direction through Gilloge Road. The route crosses the River Shannon to the east of Groody Valley at the University of Limerick Rowing Club and connects to the R445 at Docking Point B on the Groody Roundabout in Reboge. This route option is approximately 4.7km in length.

Route Option B.1/D.1/C.1

The node and link arrangement of this route is X-J-L-C.

Route Option C.1 follows the alignment of route option B.1 from node X at the Tailrace Canal to node J at the R463. At the R463, route option C.1 diverges in a easterly direction along route option D.1 to the north of the Gilloge Road. At node L, directly to the west of Derryfadda Road, route option C.1 diverges in a south easterly direction, crossing the River Blackwater and the Errina Canal directly to the north of Gilloge Lock and to the south of the Cappavilla South Holy well. From the canal crossing, route option C.1 heads in a southerly direction to the east of the University of Limerick and crossing the River Shannon at Milford GAA club grounds in Limerick. The route runs between the National Technological Park and the University of Limerick connecting to the R445 at Kilmurry roundabout (Docking Point C). This route measures approximately 6.3km in length.

Route Option B.1/D.1

The node and link arrangement of this route is X-J-L-M-N-P-D.

Route Option B.1/D.1 follows the alignment of route option B.1 from node X at the Tailrace Canal to node J at the R463. At the R463, route option B.1/D.1 diverges in a easterly direction to the north of the Gilloge Road. Route option B.1/D.1 crosses the River Blackwater and the Errina Canal directly to the north of the Cappavilla South holy well and to the south of Cappavilla House. From the canal crossing, route option B.1/D.1 continues in a south easterly direction with graveyard ruins to the south. The route passes through Srawickeen along the boundary of the University zoned lands in south Clare before crossing the River Shannon at the National Technological Park. The route connects to the R445 via the private Plassey Road at Docking Point D. This route is approximately 7.3km in length.

Route Option D.2/D.1

The node and link arrangement of this route is X-K-M-N-P-D.

This route option follows the alignment of the undefined Infrastructure Safeguard Road in the Clare County Development Plan. The route option runs parallel to the Headrace Canal to the north of Parteen Village and crosses the R463 near the townland of Rosmadda West. At node K adjacent to the River Blackwater, route option D.2/D.1 turns in a southerly direction crossing the Cloonlara Road at Rosmadda East. The route option D.2/D.1 then changes to run in south easterly direction through the raised peat bog at Derryfadda crossing the River Blackwater and Errina Canal to the west of Cappavilla House. At node M to the north of the graveyard ruins in Srawickeen, this route option merges with route option D.1 and follows the same alignment to the R445. This route is approximately 7.5km in length.

Route Option Link D.2 to D.1

The node and link arrangement of this route is K-L.

To avoid a potential ecological and geological constraint at raised peat bog in Derryfadda, a route option linking D.2 to D.1 was developed. This route option linking D.2 to D.1 follows the alignment of route option D.2 before diverging at node K adjacent to the River Blackwater. Link D.2 to D.1 continues from node K in a more southerly direction, skirting the western boundary of Derryfadda raised peat bog before connecting to the route option D.1 at node L to the west of Derryfadda Road. The link between Route Option D.2 and D.1 is approximately 2.0km in length.

Route Option D2/E.1

The node and link arrangement of this route is X-K-N-O-E.

Route Option E.1 is the most easterly route and is mainly located in a rural environment as it bypasses developed areas. This route option follows the alignment of route option D.2, running parallel to the Headrace Canal and crossing the Regional Road R463 before diverging at node K adjacent to the River Blackwater. From node K, route option E.1 runs along the existing Cloonlara Road for approximately 0.6km with the River Blackwater directly to the north and the raised peat bog at Derryfadda directly to the south. The route intersects with Derryfadda Road to the south of the Wooden Bridge before crossing the River Blackwater and the Errina Canal in Cappavilla. Route option E.1 traverses Cappavilla South and Srawickeen respectively before crossing the River Shannon at the location identified in the Castletroy Local Area Plan. To the south of the River Shannon, route option E.1 crosses Mountshannon before connecting to the R445 at the Cappamore Junction (Docking Point E). This route is approximately 8.2km in length.

Route Option Link E.1 to D.1

The node and link arrangement of this route is O-P.

A route option linking E.1 to D.1 was developed to connect route option E.1 to the National Technological Park and the University of Limerick. At node O, the route option linking E.1 to D.1 turns in a westerly direction crossing the River Mulkear before connecting to the private Plassey Road. The link between Route Option E.1 and D.1 is approximately 0.7km in length.

5.5 Public Consultation No.1

5.5.1 Introduction

Public Consultation No. 1 was undertaken between June 2011 and July 2011 with the public consultation exhibition being held on Wednesday, 15th of June 2011 in the Green Hills Hotel, Ennis Road, Limerick. The objectives of the consultation were to:

- Present the route corridor options to the public;
- Inform the public of the process and programme for the project;
- Invite submissions on the route corridor options; and
- Gather local information, which may not be known to the design team.

This chapter records the consultation process and presents an analysis of the responses received.

5.5.2 Methodology

Publicity

A publicity campaign was undertaken by Clare County Council and Limerick County Council prior to the consultation. The consultation was advertised in the following papers (See Appendix 5.1):

- Limerick Leader (County and City edition); and
- Clare Champion.

Advertisements were also broadcast on Clare FM and Limerick Live 95FM radio, as well as being posted on each of the three Local Authority websites.

Public Exhibition

As stated above, the public exhibition was held in the Greenhills Hotel on Wednesday, 15th June 2011 from 3pm to 8pm. Prior to the public exhibition a preview was held for the locally elected representatives at the same venue.

The displays consisted of background information on the scheme, the project programme and maps of the Route Corridor Options on Discovery Series and Aerial Photographic mapping. Ordnance Survey (OS) mapping with the Route Corridors displayed was also available at larger scale and these drawings were used to collect land ownership information from affected landowners. These displays were attended by members of Clare County Council and Roughan & O'Donovan Consulting Engineers.

Following the exhibitions, Route Selection Public Information Leaflets were made available at the following addresses from 16th June to 18th July 2011:

- Clare County Council Offices;
- South East Clare Area Office;
- Limerick County Council;
- Annacotty Area Office;
- Limerick City Council.

Route option maps were also made available for inspection at these venues. These maps were available for inspection, but not attended by the project team.

Attendance

A total of 39 people attended the consultation exhibition. All attendees were asked for their name and address as they entered the venue and were handed the information brochure and questionnaire. The brochure and questionnaire are included in Appendix 5.1.

Feedback and Information

Throughout the consultation process the staff at the exhibitions endeavoured to obtain as much local information as possible. One of the key pieces of information gathered at the consultation was that of agricultural holdings, whereby boundaries were marked on the OS mapping and the landowner's details were also recorded. In addition, landowners provided historical information regarding recent flood events on their lands, with the event of the flooding recorded on the OS mapping. The information gathered at the consultation was reviewed and distributed to the relevant specialist or design team member.

Questionnaire Responses and Submissions

The closing date for receipt of submissions was 18th July 2011. All submissions received were recorded and taken into consideration. A total of 108 responses were received. A small number of the responses received were accompanied by letters and further information. Of these 108 responses, not all included completed questionnaires while some included individual letters and submissions from action groups.

5.5.3 Analysis of Responses

All individual submissions received were evaluated and the information they contained was recorded. Where letters were received without questionnaires the details were recorded including all comments made.

As stated above, while 108 responses were received not all questions were answered by all respondents, so the results have been calculated on the basis of the numbers of answers to each question.

As shown in Table 5.4 below, the majority of responses received were not in favour of the proposed development. However, on closer analysis of the submissions, a proportion of the negative submissions state that the reasons for not being in favour of the scheme is that their property or landholding is affected by one or more route corridor options. The majority of the submissions also believe it is a motorway or ring road that is being proposed.

Table 5.4 Are you in Favour of the Scheme?

No	Yes	No Response	Total
71	34	3	108
(66%)	(31%)	(3%)	(100%)

A significant proportion of the responses indicated that the severance of the villages of Parteen and Ardnacrusha was the least favourable aspect of the overall scheme, as the impact upon community was considered the most important factor in relation

to this scheme. The impact upon the Landscape was the second most important factor while agriculture was considered third.

Table 5.5.1 below shows the preferred individual routes as indicated by the public for Section 1. Routes A2 and A4 were indicated as the most preferred individual routes by the public. Route A2.1 was the medium preferred individual route, with route options A1, A3 and A4.1 the least preferred individual route options.

Table 5.5.2 below shows the preferred Docking Points as indicated by the public for Section 2. Docking Point E was indicated as the most preferred terminal for the Limerick Northern Distributor road in Section 2. Docking Point D was indicated as the medium preferred terminal, while Docking Points B and C were considered the least preferred terminals.

Table 5.5.1 Preferred Route Corridor – Section 1

Section 1	A1	A2	A2.1	A3	A4	A4.1
Number	2	21	14	4	19	0
%	3.3%	35%	23.3%	6.7%	31.7%	0%

Table 5.5.2 Preferred Docking Point – Section 2

Section 2	B	C	D	E
Number	6	5	17	42
%	8.6%	7.1%	24.3%	60.0%

Several of the submissions received indicated preferred route option combinations. The most preferred route combination as identified by the public was A4/D2/E1. The route combinations A2/D2/E1 and A2.1/B1 were identified as the medium preferred combinations.

The results presented in Table 5.5.1 and Table 5.5.2 are influenced by the higher number of responses from residences in comparison with the number of responses from agricultural and commercial holdings potentially affected by the implementation of the scheme.

Responses were also received from the following groups or from individuals representing Communities and Associations:

- Community of Parteen and Ardnacrusha (representing an additional 276 households and 1 commercial holding);
- Irish Farmers Association

Analysis of the submissions also revealed previously unknown local information, such as wildlife habitats which could be adversely affected by the proposed route corridors. Such information included:

- A red squirrel habitat through which route A4 would pass through;
- A length of historic wall along route A2.1;
- Salmon resting area in the Tailrace Canal;
- Bird Sanctuaries potentially dissected by routes D1 and D2;
- Local gun club potentially dissected by routes D1 and D2;

- Greyhound training track where route A2.1 is proposed;
- Badger set potentially affected by route A2.1.

A number of businesses also made submissions including Shannon Development (the National Technological Park) and the University of Limerick. These submissions are outlined below.

Shannon Development

During the Public Consultation process, Shannon Development expressed a strong objection to any route option crossing the Shannon and docking at the National Technological Park. Shannon Development noted that existing companies within the National Technological Park have outlined to them their concerns regarding the volumes of traffic docking at Plassey Park Road which is a private road. Shannon Development also noted that docking at the National Technological Park would negatively impact future investment and employment opportunities within the park.

Shannon Development expressed a preference for either route B1 or E1.

University of Limerick

The University of Limerick made a detailed submission as part of the Public Consultation process. The University of Limerick outlined in their submission, their plans for the growth of the Clare Campus providing both employment and educational opportunities. The submission outlined that the need to improve the existing infrastructure in South Clare to facilitate this development.

The University of Limerick submission stated that the Route B.1 did not serve to facilitate the future expansion of the Clare Campus and that they were not in favour of this route. The University of Limerick submission expressed a preference for Route D.1 running adjacent to the university zones lands in Clare.

ESB

In response to the route options public consultation ESB highlighted the hydrogeological sensitivity of the area immediately south of the Headrace Canal, in the vicinity of the most northerly route options (Refer Drawing No. RCSR-505). The Headrace Canal is formed by 'Category A' earthen embankment dams. This categorisation is one where a breach of the structure could lead to loss of life downstream. This constraint had previously been recognised as a restriction on the construction of routes that cross the headrace, but had not previously been understood to constrain route options south of the canal.

Further clarifications received from the ESB have advised that over the years incidents have occurred relating to drainage, mainly minor in nature, that were deemed to have a connection to the Headrace Canal. These incidents were detected by ESB as part of its routine monitoring of the headrace and were dealt with without any adverse impact on the headrace. However these incidents indicate that route options to the north traverse ground with very poor drainage qualities. Excavation and construction work on the scale required to deliver these routes could alter the groundwater flow patterns in the area, with potential adverse consequences for the stability of the headrace.

Appendix 5.1

Public Consultation Brochure and Questionnaire

5.6 Stage 1 – Preliminary Options Assessment

5.6.1 Introduction

At the time of the first public consultation, six feasible route options were identified within Section 1 of the Study Area and sixteen feasible route options were identified in Section 2 of the Study Area. During the course of the public consultation, further constraints were identified and mapped following consultation with statutory authorities and the completion of detailed site surveys undertaken by the Ecology specialist. The constraints identified required the feasibility of a number of the route options displayed to the public to be re-assessed.

5.6.2 Hydrogeological Constraints

As outlined previously in this chapter, the submission received from ESB International highlighted the hydrogeological sensitivity of the area immediately south of the Headrace Canal, in the vicinity of the most northerly route options. The historical records submitted by the ESB in relation to hydrogeological incidents highlighted the risk of undertaking excavation and construction works in the proximity of the Headrace Canal.

The ESB submission highlighted the potential outcome should the Headrace Canal be undermined by works in the hydrogeological sensitivity area as follows;

- The Headrace Dam is a Category A Type Dam, meaning any breach would result in a significant loss of life.
- A breach of the Headrace Canal would result in a shutdown of the Ardnacrusha Power Station, nationally strategic infrastructure.
- The Headrace Canal conveys a flow of 400m3/s. If the dam was breached, the Parteen Weir would be automatically closed resulting in significant widespread flooding further downstream on the River Shannon.

In conjunction with the risk to Health & Safety, the constraint also identified a significant project risk in terms of both cost and construction management. The ESB stated that due to the significant consequences of any Headrace Dam breach, the ESB would seek for Clare County Council to indemnify the ESB during both the construction phase and the ongoing operation phase. In addition, the ESB noted that should a route through the hydrogeological sensitivity area be selected as the Preferred Route Corridor, the ESB would seek to ensure that the construction method employed would mitigate against this risk.

Following the identification of the above risks and taking into account the Principles of Prevention, it was determined that the risk should be avoided and routes through the area of hydrogeological sensitivity were excluded from further consideration. As a result, the route corridors D2, Link D2 to D1 and part of E1 were excluded from further consideration.

5.6.3 Ecological Constraints

Following the completion of the Environmental Assessments of the route corridor options, including the completion of specific detailed surveys of the Knockalisheen Marsh and the River Shannon (both included within the Lower River Shannon SAC), a meeting was held with the National Parks and Wildlife Service to review the route corridor options and the findings of the Ecological Assessment (Chapter 10 of this Report).

At this meeting, it was noted that the Routes A.2 & A.3 within Knockalisheen Marsh have a significant impact on the integrity of the SAC due to both routes traversing Alluvial Woodland habitat, Molinia Meadow habitat and Marsh habitat. NPWS confirmed that the Alluvial Woodland habitat and the Molinia Meadow habitat conform to Annex I priority habitat and are qualifying interests of the site. In addition the Marsh habitat present conforms to the Annex 1 habitat '*Hydrophilous tall herb fringe communities'*, although this habitat is not a qualifying interest of the SAC.

The qualifying habitat Alluvial Woodland also occurs on the banks of the Shannon, to a greater or lesser extent, at all crossing points. The proposed crossing points for the Route Corridor Options C.1 and D.1 were identified as having a significant impact on this habitat. In addition, construction and operation of Routes C.1and D.1 were identified as having a potentially significant impact on a number of the species which are qualifying interests of the SAC with respect to the impact on salmon and lamprey spawning habitat and otter habitat.

The National Roads Authority '*Guidelines for Assessment of Ecological Impacts of National Roads Schemes'* in Figure 5, Page 41 directs the requirement to '*disregard those feasible alternative solutions that adversely affect priority habitats and continue with those which affect only non-priority habitats or species.*' Consequently and in accordance with the guidelines as feasible alternatives to Routes A.2 & A.3 in Section 1 and Routes C.1, D.1 & Link E.1 to D.1 in Section 2 exist, these route corridors are disregarded from further consideration.

5.6.4 Refinement of Feasible Route Options

In accordance with the NRA 2010 Project Management Guidelines, a Stage 1 Preliminary Options Assessment shall be carried out on all feasible route options developed for the scheme utilising the assessment criteria of Engineering, Environment and Economy. The objective of this exercise is to reduce the number of feasible route options to a more manageable number of routes (3 to 5) that shall progress to the Project Appraisal Stage of Route Selection (Stage 2).

Following the exclusion from further consideration of the routes impacted by the hydrogeological and ecological constraints outlined above, the remaining number of feasible route corridors was significantly reduced.

Section 1 - West of the Tailrace Canal
Six feasible route options were identified within Section 1 of the Study Area and progressed to Stage 1: Preliminary Options Assessment of the Route Selection Process. This number was subsequently reduced to four following the confirmation of ecological constraints within Knockalisheen Marsh (part of Lower River Shannon SAC). The remaining feasible route options identified are outlined in Table 5.6

Table 5.6 – Section 1 – Route Options

No.	Route Name	Route Nodes
1	Route A1	Nodes A-X
2	Route A2.1	Nodes A-X
3	Route A4	Nodes A-G-H-X
4	Route A4.1	Nodes A-G-H-X

In accordance with the NRA 2010 Project Management Guidelines and as part of the process to refine the number of route options, it was determined that due to their

similar characteristics, Route A4 and Route A4.1 should be assessed under the headings of Environment, Engineering and Economy leading to the elimination of one of these options.

Environment

Under the heading of environment, both options have been assessed by the relevant qualified specialists. Both routes, given their length have a more negative impact under the headings of Agriculture, Noise, Air Quality and Archaeology. Neither route crosses the Knockalisheen Marsh (Lower River Shannon SAC) and therefore is preferred under the heading of Ecology despite both routes having a significant impact on ecological sites of County Importance. The similar environmental impacts and the proximity of both routes to one another between Nodes G-H have resulted in both routes being deemed medium preferred.

Engineering

As both route options are similar in length and proximity, there is no significant difference between both routes under the heading of engineering.

The principle difference between the options occurs under the two sub headings for safety; these are accident reduction and security which is incorporated into the heading of engineering. It is considered that accident reduction is a significant factor in the selection of an emerging Preferred Route Corridor. As all route corridors would be designed to the same cross section and standard it is considered that the greatest impact in terms of safety are the number of direct accesses required. It is considered that the solution with least direct access would be the preferred route corridor option.

While there is no significant difference between Route Corridor A.4 and A.4.1, Route Corridor A.4.1 requires an additional junction with the existing local road infrastructure and therefore has a greater number of direct accesses. It is the least preferred route corridor in terms of accident reduction and security.

Overall Route Corridor A.4 is the preferred route corridor.

Economy

There is no discernible difference between each of the Route Corridor Options under the heading for economy.

Matrix No.1 - Route A.4 versus Route A.4.1

Route Options	Environment	Economy	Engineering	Progress to Stage 2?
Route A.4	Medium Preference	Medium Preference	High Preference	**Yes**
Route A.4.1	Medium Preference	Medium Preference	Medium Preference	**No**

Route Option A4 is progressed to Stage 2 Project Appraisal and Route A4.1 is disregarded from further consideration.

Section 2 - East of the Tailrace Canal

Sixteen feasible route options were identified within Section 2 of the Study Area and progressed to Stage 1: Preliminary Options Assessment of the Route Selection Process. This number was subsequently reduced to three following the confirmation

of ecological constraints within Lower River Shannon SAC and identification of constraints to the south of the Headrace Canal. The remaining feasible route options identified are outlined in Table 5.7

Table 5.7 – Section 2 – Route Options

No.	Route Name	Route Nodes
1	Route B1	X – J - B
2	Route B2	X – J – B
3	Route B1/D1/E1	X – J – L – M – N – O - E

Similar to Section 1 and as part of the process to refine the number of route options, it was determined that due to their similar characteristics, Route B1 and Route B2 should be assessed under the headings of Environment, Engineering and Economy leading to the elimination of one of these options.

Environment

When assessed under the various sub-headings for Environment, both routes have slightly different impacts under each of the headings however when examined as a collective, the impact of both routes is quite similar.

The largest distinction between the route corridors is at the crossing points of the River Shannon. As a result, Route B1 emerges as the preferred option under Environment as the crossing point of the Lower River Shannon SAC is preferred. Similar to Route B1, Route B2 crosses River Shannon SAC impacting on small block of riparian woodland on north bank and linear strip of riparian woodland on south bank (conforms to Annex I Habitat Alluvial Woodland - a Qualifying Interest of the SAC). However in addition, Route B2 also crosses through an area of wet grassland and willow-alder dominated scrub in the proximity of a well used otter couch and significantly impacts the University of Limerick Boat Club which is deemed a material asset.

Engineering

As both route options are similar in length and proximity, there is no significant difference between both routes under the heading of engineering. Both route corridors traverse through significant section of floodplain and impact ESB high voltage power lines.

Economy

There is a marginal difference in the costs associated with both route corridors due the impact of the crossing point at Route B2. As a result, Route B1 is determined to be the preferred route corridor under the heading for economy.

Matrix No.2 - Route B1 versus Route B2

Route Options	Environment	Economy	Engineering	Progress to Next Stage?
Route B1	High Preference	High Preference	Medium Preference	Yes
Route B2	Medium Preference	Medium Preference	Medium Preference	No

Route Corridor B1 is progressed to Stage 2 Project Appraisal and Route Corridor B2 is disregarded from further consideration.

The remaining route options in each section are deemed to be feasible under the Stage 1 Preliminary Options Assessment criteria:

- Engineering Assessment (including Road Safety Impact Assessment)
- Environment Assessment
- Economy Assessment

Following the elimination of Route Corridor A4.1 and Route Corridor B2 from further consideration, only three remaining route options are deemed feasible in Section 1 and two within Section 2. It was recommended that these Route Corridors proceed to be assessed under the Stage 2 - Project Appraisal of Route Options.

Chapter 6 Stage 2 Project Appraisal

6.1 Introduction Route Corridor Option Assessment

This chapter summarises the results of the route corridor options technical assessments as discussed in detail in the subsequent chapters of this Route Corridor Selection Report.

The route corridor options assessments were undertaken in line with the NRA Project Appraisal Guidelines under the headings of.

- Environment;
- Economy;
- Safety;
- Accessibility and Social Inclusion; and
- Integration.

To assist in the selection of an emerging Preferred Route Corridor the specialist who undertook each of the assessments identified the impact for each of the route corridor options under their specialist topic. Having considered the quantitative and qualitative impacts of each route corridor under the above five headings, a scaling statement was used to indicate the degree of impact of the project options under each element.

The scaling statement indicates whether the impact is:

- Highly positive (7 marks);
- Moderately positive (6 marks);
- Slightly positive (5 marks);
- Neutral (4 marks);
- Slightly negative (3 marks);
- Moderately negative (2 marks), or
- Highly negative (1 marks).

The following steps explain the process by which the emerging Preferred Route Corridor was selected:

Step 1 Divide scheme into two distinct sections with common nodes:

Section 1 Node A to Node X

Section 2 Node X to Node E

Step 2 Section 1 – Select Preferred Route Corridor in Section 1 from Node A to Node X (Route Corridor A1, A2.1 or A4)

Step 3 Section 2 – Select Preferred Route Corridor from Node X to Node E, either via Route B1 (docking the LNDR at the Groody Roundabout on the R445) or via Route E1 (docking at Cappamore Junction on the R445)

For ease of understanding the selection process a separate assessment matrix has been prepared for each decision and is presented at the end of Steps 2 and 3.

6.1.1 Analysis of Route Corridor Selection Matrix

The following is a brief analysis of the assessment of the route corridor options and the decisions taken which have enabled the selection of the emerging Preferred Route Corridor.

Step 1 Divide scheme into two distinct sections with common nodes:
Section 1 Node A to Node X
Section 2 Node X to Node E

All assessments have been undertaken and reporting completed in accordance with this approach as shown on Drawing RCSR-601 in Volume 2.

Step 2 Section 1 – Select Preferred Route Corridor

Following the completion of a detailed habitat survey within Knockalisheen Marsh, it was identified that by slightly modifying the Route A2.1, the impact of the Route Corridor on areas of the Annex I habitat Molinia meadows could be avoided. As result, Route A2.2 was developed to avoid the Annex I habitat (Refer Volume 2 - Drawing No. RCSR-602). This amendment was accepted and for the remainder of this document, the revised alignment will be referred to as Route A.2.2.

As a result of this amendment, the following routes within Section 1 will be assessed as part of the Stage 2 – Project Appraisal.

No.	Route Name	Route Nodes
1	Route A1	Nodes A-X
2	Route A2.2	Nodes A-X
3	Route A4	Nodes A-G-H-X

Route A.1 versus Route A.2.2 versus Route A.4

The appraisal of route options from Section 1 under the five heading is summarised below.

Environment

There are 10 sub-headings for environment which have all been assessed by the relevant qualified specialist. The sub-headings are as follows:

- Ecology;
- Water Quality;
- Geology & Hydrogeology;
- Air Quality & Climate;
- Noise & Vibration;
- Landscape & Visual;
- Material Assets (Non - Agricultural Properties);
- Agriculture;
- Architectural Heritage;
- Archaeology & Cultural Heritage.

Due to the location of the Knockalisheen SAC within Section 1 of the Study Area, each route corridor impacting the SAC was carefully considered under the sub-heading ecology with detailed habitat surveys of the route corridors undertaken.

Furthermore, the route corridor alignments within Section 1 were largely dictated by the location of the Coonagh Knockalisheen docking point adjacent to the Knockalisheen March SAC. Route A4, the longest of the route options, was selected as it would have the least impact on Knockalisheen SAC. As this ecological site is deemed to be of international importance, this Route Corridor has the least impact under the sub-heading ecology despite route A4 having a significant impact on ecological sites of county importance. When considered under all of the environmental sub-headings, Route A4 is nevertheless determined to be the least preferred option under the heading of environment as it has the more significant impact under the remaining environmental sub-headings such as Air Quality & Climate, Noise & Vibration, Agriculture, Landscape & Visual, Archaeology and Material Assets.

Route Corridors A1 and A2.2 both traverse Knockalisheen SAC and are deemed to have a major negative impact under the sub-heading despite avoiding the qualifying features of the SAC as confirmed by the additional detailed habitat surveys undertaken by the specialist. Route Corridor A1 which runs along lower fields at the southern boundary of the SAC is deemed to be the least preferred of the two options under the remaining environmental sub-headings. This route traverses the area of the Knockalisheen Marsh that is more prone to flooding and is of greater hydrogeological sensitivity. In addition, Route Corridor A1 has a greater impact on existing properties and farms as it runs along Knockalisheen Road before turning eastwards towards the Tailrace Canal through existing farm holdings.

Under the heading of environment, Route A2.2 is emerging as the preferred option. This route corridor is the shortest option and has the least impact under the sub-headings of Agriculture, Noise & Vibration, Landscape and Visual and Material Assets.

<u>Economy</u>

There are four sub-headings for economy, these are as follows:

- Traffic Efficiency and Effectiveness;
- Wider Economic Impacts;
- Funding Impacts;
- Relative Traffic Dis-benefits (Millions).

The three route corridors are largely similar in terms of funding and wider economic impacts, however in terms of efficiency and effectiveness there are some minor differences between the route corridors. The rankings for efficiency and effectiveness have been taken from the Benefit Cost Ratio (BCR) for the Route Corridor Options. In this respect Route Corridor A1 and A2.2 are the preferred corridors with Route Corridor A4 the least preferred. It should be noted however that in Assessment Matrix No. 1 below, Route Corridor A2.2 has been identified as "Preferred" as it has a more beneficial Cost Benefit Ratio than Route Corridor A1.

<u>Safety</u>

There are two sub-headings for safety, these are as follows:

- Accident Reduction;
- Security.

It is considered that accident reduction is a significant factor in the selection of an emerging Preferred Route Corridor. As all route corridors would be designed to the

same cross section and standard, it is considered that the greatest impact in terms of safety is the number of direct accesses required. It is considered that the solution with least direct access would be the preferred route corridor option under the heading of safety.

Route Corridor A4 is the longest route corridor and includes an online upgrade of the existing Knockalisheen Road. As a number of properties front the road, it would require a greater number of direct accesses. In addition, Route A4 will require a greater number of junctions thus increasing the risk to the road user. This is the least preferred route corridor in terms of accident reduction and security.

Route A1 is slightly longer than Route A2.2 and requires additional accesses and junctions. Route Corridor A2.2 has the least number of accesses and junctions and is therefore ranked as the preferred option.

Accessibility & Social Inclusion

There are two sub-headings for Accessibility & Social Inclusion, these are as follows:

- Impact on Vulnerable Groups;
- Impact on deprived geographic areas;
- Social Inclusion.

Route Corridor A4 is the longest route corridor that heads northward from the docking point along the Knockalisheen Road directing traffic away from the RAPID area Moyross. This option is the least preferred option under the heading of Accessibility & Social Inclusion.

There is no discernible difference between Route Corridor Options A1 and A2.2 and both are preferred under this heading due to their proximity to the RAPID area Moyross.

Integration

There are four sub-headings which together make up integration, these are:

- Transport Integration;
- Land Use Integration;
- Geographical Integration;
- Government Policy.

There is no significant difference between any of route corridors in Section 1 thereby allowing a relative ranking as all of the route corridors broadly serve the same functions. The only difference in ranking is that Route Corridor A4 which is the least preferred option in terms of transport use whilst Route Corridor A1 and A2.2 are deemed to be equivalent. This is due the increased length of Route Corridor A4 and the associated longer in-vehicle times.

Selection of Preferred Route Corridor in Section 1

As summarised above and shown in the Assessment Matrix No. 1 (overleaf) developed for Section 1, Route Corridor A4 is clearly the least preferred of the three Route Corridors under the headings of Environment, Accessibility and Social Inclusion, Safety and Economy and is therefore eliminated.

Route Corridor A1 and A2.2 are equally positive under the headings of Integration and Accessibility, Economy and Social Inclusion. However Route Corridor A2.2 is the Preferred Route Corridor in terms of both Environment and Safety.

It is therefore recommended that Route Corridor A2.2 is selected as the Preferred Route Corridor for Section 1.

Assessment Matrix No.1 - Route A1 versus Route A2.2 versus Route A4

-	Route A1		Route A2.2		Route A4	
	A-X		A-X		A-X	
ENVIRONMENT						
Ecology	Major Negative	1	Major Negative	1	Minor Negative	**3**
Water Quality	Major Negative	1	Minor Negative	3	Moderate Negative	**2**
Geology & Hydrogeology	Major Negative	1	Moderate Negative	2	Minor Negative	**3**
Air Quality & Climate	Moderate Negative	2	Minor Negative	3	Major Negative	**1**
Noise & Vibration	Moderate Negative	2	Minor Negative	3	Major Negative	**1**
Landscape & Visual	Moderate Negative	2	Minor Negative	3	Major Negative	**1**
Material Assets (Non - Agricultural Properties)	Minor Negative	3	Neutral	4	Major Negative	**1**
Agriculture	Major Negative	**1**	Moderate Negative	2	Major Negative	**1**
Architectural Heritage	Moderate Negative	2	Moderate Negative	2	Major Negative	**1**
Archaeology & Cultural Heritage	Minor Negative	3	Moderate Negative	2	Major Negative	**1**
Sub-Total	**18**		**25**		**15**	
ECONOMY						
Traffic Efficiency and Effectiveness	Highly Positive	7	Highly Positive	7	Moderately Positive	6
Wider Economic Impacts	Moderately Positive	6	Moderately Positive	6	Slightly Positive	5
Funding Impacts	Neutral	4	Neutral	4	Neutral	4
Relative Traffic Dis-benefits (Millions)	Neutral	4	Neutral	4	Neutral	4
Sub-Total	**21**		**21**		**19**	
SAFETY						
Accident Reduction	Moderately Positive	**6**	Highly Positive	**7**	Slightly Positive	**5**
Security	Moderately Positive	**6**	Highly Positive	**7**	Slightly Positive	**5**
Sub-Total	**12**		**14**		**10**	
ACCESSIBILITY AND SOCIAL INCLUSION						
Impact on Vulnerable Groups	Highly Positive	**7**	Highly Positive	**7**	Slightly Positive	**5**
Impact on deprived geographic areas	Moderately Positive	**6**	Moderately Positive	**6**	Slightly Positive	**5**
Social Inclusion	Highly Positive	**7**	Highly Positive	**7**	Slightly Positive	**5**
Sub-Total	**20**		**20**		**15**	
INTEGRATION						
Transport Integration	Moderately Positive	**6**	Moderately Positive	**6**	Slightly Positive	**5**
Land Use Integration	Slightly Positive	**5**	Slightly Positive	**5**	Slightly Positive	**5**
Geographical Integration	Moderately Positive	**6**	Moderately Positive	**6**	Moderately Positive	**6**
Government Policy	Slightly Positive	**5**	Slightly Positive	**5**	Slightly Positive	**5**
Sub-Total	**22**		**22**		**21**	

Assessment Matrix No.1 (Cont'd) - Route A1 versus Route A2.2 versus Route A4

	Route A1	Route A2.2	Route A4
	A-X	A-X	A-X
Environment	Intermediate	Preferred	Least Preferred
Economy	Intermediate	Preferred	Least Preferred
Safety	Intermediate	Preferred	Least Preferred
Accessibility and Social Inclusion	Intermediate	Intermediate	Least Preferred
Integration	Intermediate	Intermediate	Intermediate
Overall	Intermediate	Preferred	Least Preferred
Ranking	**2**	**1**	**3**

Step 3 Section 2 – Select Preferred Route Corridor

Following an on-site assessment of the proposed Lower River Shannon SAC crossing, it was identified that by amending the alignment of Route Corridor D1/E1 at the crossing, the impact of this route crossing on the Lower River Shannon SAC is reduced (Refer Volume 2 - Drawing No. RCSR-602). This amendment was accepted and for the remainder of this document, the revised alignment will be referred to as Route D1/E1.1.

As a result of this amendment, the following routes within Section 2 will be assessed as part of the Stage 2 – Project Appraisal.

No.	Route Name	Route Nodes
1	Route B1	X – J - B
2	Route B1/D1/E1.1(1)	X – J – L – M – N – O - E

Note (1): To avoid potential confusion with Route Corridor B1, for the remainder of the Report this Route Corridor will be named Route D1/E1.1

Route B1 versus Route D1 /E1

The appraisal of route options from Section 2 under the five heading are summarised below.

Environment

Route Corridor B1 is the shorter of the route options on Section 2. It emerges as the preferred option under the majority of sub-headings in Environment. It is noted though that Route Corridor B1 has a greater impact under the sub-headings of Noise & Vibration and Air Quality & Climate. The reason for this greater impact is the proximity of the route to the Athlunkard housing estate and the fact that this route significantly increases traffic volumes along the R445 between Groody Roundabout and the Cappamore junction.

Route Corridor D1/E1.1, the longer of the two routes, has a greater impact on existing properties and farm holdings due to its increased length. Therefore from an ecological perspective, Route D1/E1.1 is the least preferred though it should be

noted that the impact of the proposed crossing of the Lower Shannon SAC is deemed to be equivalent.

Route B1 is the preferred route under the heading Environment.

Economy

Both route options have a very high cost benefit analysis ratio. Route B1 has a lower cost input but Route D1/E1.1 has a greater return. The difference in the initial cost input is not significant given the requirement to upgrade the R445 and construct a viaduct across the Groody Valley floodplain should Route B1 emerge as the preferred route corridor.

Both routes are deemed to be similar under the heading of Economy due to the very high cost benefit ratios achieved.

Safety

There are two sub-headings for safety; these are accident reduction and security. It is considered that accident reduction is a significant factor in the selection of an emerging Preferred Route Corridor. As all route corridors would be designed to the same cross section and standard, it is considered that the greatest impact in terms of safety is the number of direct accesses required. It is considered that the solution with least direct access would be the preferred route corridor option under the heading of safety.

Route Corridor B1 includes an online upgrade of the existing R445 between the Groody Roundabout and the Cappamore junction, a significant number of direct accesses will be required to be maintained. In addition, the increased number of junctions along the R445 increases the risk to the road user along Route B1. Route B1 will bring significantly large traffic volumes (approx. 30,000 AADT) to the Groody Roundabout and increasing traffic volumes along the R445.This is the least preferred route corridor in terms of accident reduction and security.

Route D1/E1.1 is the preferred route under the heading of Safety.

Accessibility and Social Inclusion

Route D1/E1.1 is the preferred Route Corridor under this heading. Route D1/E1.1 provides greater accessibility for the South Clare region to UL and provides a direct link to education and employment opportunities in both UL and the National Technological Parks from Moyross (RAPID area).

Integration

Route D1/E1.1 is emerging as the preferred route under this heading. This route was identified in the Clare County Development Plan as a key objective in providing suitable access to the UL Clare Campus. In addition, this route opens up the South Clare Region for balanced development in accordance with the stated objectives of the Mid West Regional Planning Guidelines. Route B.1 runs adjacent to the heavily developed Athlunkard estate with a significant proportion of the route in a floodplain (Groody Valley). As a result, Route Corridor B1 is the least preferred route under the heading of Integration.

Assessment Matrix No.2 - Route B1 versus Route D1/E1.1

-	B1		D1/E1.1	
	X – J – B		X –J – L – M – N – O – E	
ENVIRONMENT				
Ecology	Major Negative	1	Major Negative	1
Water Quality	Moderate Negative	2	Moderate Negative	2
Geology & Hydrogeology	Major Negative	1	Major Negative	1
Air Quality & Climate	Major Negative	1	Minor Negative	3
Noise & Vibration	Major Negative	1	Minor Negative	3
Landscape & Visual	Moderate Negative	2	Major Negative	1
Material Assets (Non - Agricultural Properties)	Moderate Negative	2	Major Negative	1
Agriculture	Minor Negative	3	Major Negative	1
Architectural Heritage	Minor Negative	3	Moderate Negative	2
Archaeology & Cultural Heritage	Minor Negative	3	Moderate Negative	2
Sub-Total	**19**		**17**	
ECONOMY				
Traffic Efficiency and Effectiveness	Highly Positive	7	Highly Positive	7
Wider Economic Impacts	Moderately Positive	6	Moderately Positive	6
Funding Impacts	Neutral	4	Neutral	4
Relative Traffic Dis-benefits (Millions)	Neutral	4	Neutral	4
Sub-Total	**21**		**21**	
SAFETY				
Accident Reduction	Moderately Positive	**6**	Highly Positive	**7**
Security	Moderately Positive	**6**	Highly Positive	**7**
Sub-Total	**12**		**14**	
ACCESSIBILITY AND SOCIAL INCLUSION				
Impact on Vulnerable Groups	Highly Positive	**7**	Highly Positive	**7**
Impact on deprived geographic areas	Moderately Positive	**6**	Highly Positive	**7**
Social Inclusion	Moderately Positive	**6**	Highly Positive	**7**
Sub-Total	**19**		**21**	
INTEGRATION				
Transport Integration	Moderately Positive	**6**	Moderately Positive	**6**
Land Use Integration	Slightly Positive	**5**	Moderately Positive	**6**
Geographical Integration	Moderately Positive	**6**	Moderately Positive	**6**
Government Policy	Slightly Positive	**5**	Highly Positive	**7**
Sub-Total	**22**		**25**	

Assessment Matrix No. 2 (Cont'd) - Route B.1 versus Route D.1/E.1.1

	B1	D1/E1.1
	X – J – B	X –J – L – M – N – O – E
Environment	Preferred	Intermediate
Economy	Intermediate	Intermediate
Safety	Intermediate	Preferred
Accessibility and Social Inclusion	Intermediate	Preferred
Integration	Intermediate	Preferred
Overall	Intermediate	Preferred
Ranking	2	1

Selection of Preferred Route Corridor in Section 2

As summarised above and shown in the assessment matrix developed for Section 2, Route Corridor D1/E1.1 is the Preferred Route Corridor under the headings of Social Inclusion, Integration and Safety. Both routes B.1 and D1/E1.1 are deemed to be equivalent under the heading of Economy with both routes offering a highly positive benefit to cost ratio.

Route Corridor B.1 is preferred in terms of Environment due largely to its shorter length. The crossings of the Lower Shannon SAC for both routes are deemed to be equivalent.

It is therefore recommended that Route Corridor D1/E1.1 is selected as the Preferred Route Corridor for Section 1.

6.1.2 Recommendation of emerging Preferred Route Corridor

As described in Section 6.1.1 above, the recommended emerging Preferred Route Corridor displayed to the public was a combination of Route Corridor Option A2.2 in Section 1 and Route Corridor Option D1/E1 in Section 2 as shown on Drawings RCSR - 603 to RCSR - 605 in Volume 2.

6.2 Public Consultation No.2

6.2.1 Introduction

Following on from Public Consultation No. 1 (PC1) – Route Corridor Options and the Route Corridor Selection process which determined the emerging Preferred Route Corridor, Public Consultation No. 2 (PC2) was undertaken between January 2012 and May 2012, with public consultation exhibitions being held on the 18th of January 2012 and the 27th March 2012.

The objective of this consultation exercise was to:

- Present the emerging Preferred Route Corridor to the public;
- Further inform the public of the process and the programme for the project;
- Invite submissions on the emerging Preferred Route Corridor;
- Gather local information including land ownership, which may not be known to the design team;
- Answer questions from the public;
- Consider and review the information received.

This chapter records the consultation process and presents an analysis of the submissions received. Arising from the consultation a number of possible adjustments to the emerging Preferred Route Corridor have been investigated.

6.2.2 Methodology

Publicity

Prior to commencement of Public Consultation No. 2, a preview was held for the locally elected representatives in the Radisson Hotel on Friday, 6th January 2012.

A publicity campaign was undertaken by Clare County Council prior to both consultations above. Advertisements were broadcast on Clare FM and Limerick 95FM and the consultations were also advertised in the following papers:

- The Clare Champion; and
- The Limerick Leader (both County & City editions).

All those who recorded their attendance or submitted responses during Public Consultation No. 1 were notified by letter dated 6th January 2011. Those who were notified were invited to attend the public exhibition of the Emerging Preferred Route Corridor on the 18th of January 2012. An information brochure and questionnaire was supplied to all who attended on the 18th January 2012 and the 27th March 2012. The brochure & questionnaire are included in Appendix 19.1

Public Exhibitions

Both public exhibitions were held at the Radisson Hotel on the Ennis Road, Limerick the afternoons of the 18th January 2012 and the 27th March 2012. During the first public exhibition, the following information on the scheme was displayed to members of the public:

- Aerial Photography for the scheme showing the emerging Preferred Route Corridor;
- Discovery Series Mapping showing the emerging Preferred Route Corridor;

- Information on the background of the scheme and programme for the project (i.e. what happens next following the consultation).

The exhibition was attended by a number of staff from Clare County Council, Limerick County Council and Roughan & O'Donovan. The staff were available to answer questions on the emerging Preferred Route Corridor and gather any information which may not be known to the design team and record on OS mapping (A1 size).

Following the first public exhibition, a second briefing was held for elected representatives in the Radisson Hotel on Monday, 6th February 2012. During this briefing, the elected representatives noted that members of the public were of the opinion that they were not fully aware of all the constraints the led to the identification of the emerging Preferred Route Corridor.

Addressing the comments raised following the public exhibition, additional display information on the scheme was presented to the public. The information displayed consisted of the following:

- Aerial Photography for the scheme showing the emerging Preferred Route Corridor;
- Discovery Series Mapping showing the emerging Preferred Route Corridor;
- Discovery Series Mapping showing the Route Corridor Options presented during Public Consultation No. 1;
- Discovery Series Mapping showing the Route Corridor Options with the key constraints identified to date highlighted;
- Information on the background of the scheme and programme for the project (what happens next following the consultation).

Following the first public exhibition, the display material was made available for exhibition at the following offices:

- Clare County Council, Áras Contae an Chláir, New Road, Ennis, County Clare;
- South East Clare Area Office, Westbury Centre, Knockballynameath, County Clare;
- Limerick County Council, County Hall, Dooradoyle, County Limerick;
- Annacotty Area Office, Limerick County Council, Rivers, Castletroy, County Limerick;
- Limerick City Council, City Hall, Merchants Quay, Limerick City.

These displays were available for inspection but were not attended by the project team. Brochures & questionnaires were available at both locations.

Attendance

A total of 250 attendees were registered at the first public exhibition held on the 18th January 2012 however it is estimated that in excess of 400 people attended the consultation with 550 Public Consultation Leaflets taken by members of the public. A total of 125 attendees were registered at the second public exhibition held on the 27th March 2012, all attendees were handed the information brochure and questionnaire.

Table 6.1 Attendance at Public Consultation No. 2 Exhibition

Date	Registered attendees	Note
18th January 2012	250	Landowners & General Public
27th March 2012	125	Landowners & General Public
Total	**375**	

Feedback and Information

Throughout the consultation process the staff at the exhibition endeavoured to obtain as much local information as possible. As with Public Consultation No. 1, one of the key pieces of information gathered, was that of agricultural holdings, whereby boundaries and landownership were marked on the landownership plans. The information gathered at the consultation was reviewed and distributed to the relevant design team member.

Submissions

Anyone wishing to make a written submission was requested to do so by the closing date of Friday, 11th May 2012, however all submissions received were recorded and taken into consideration if possible.

6.2.3 Analysis of Individual Submission Responses

All individual submissions received were cross-referenced with previous submissions, evaluated and the information recorded. All submissions were reviewed and analysed by the design team.

As part of the questionnaire the public were asked the following two questions

- Do you agree in principle with the proposed scheme?
- Would you be a regular user of the proposed scheme?

Table 6.2 Public Consultation No. 2 Response

Question	Yes	No	Unsure or No Comment
Do you agree in principle with the proposed scheme?	4.8%	75.1%	20.1%

Table 6.3 Public Consultation No. 2 Response

Question	Yes	No	Unsure or No Comment
Would you be a regular user of the proposed scheme?	8.6%	32.9%	58.5%

A total of 477 individual responses were received, with many of the submissions dealing with similar issues. The main issues raised included the following:

- Impacts on agriculture including:
  - Accommodation works;
  - Severance of lands;
- The perceived severance of Parteen Village;
- Concerns over affects of scheme on existing homes and structures;

- Impacts of road embankments and the scheme on the area when River Shannon floods;
- Safety issues regarding children crossing dual carriageway when cycling and walking to school;
- Impact on the local communities regarding potential increased road use and investigation of route options
- Visual impact of the scheme on the Landscape;
- Questions relating to the need for the scheme and sustainability of road transport;
- The impact of the scheme on the Limerick – Clare Tunnel;
- Questions relating to the traffic modelling and the impact of traffic docking at the R445;
- Need for scheme east of the University of Limerick Clare Campus;
- Questions relating to the Ecological Surveys undertaken as part of the Constraints gathering exercise.

6.2.4 Alternative Route Corridors Proposed by the Public

A number of the individual submissions received from the public suggested alternative route corridors in lieu of the emerging Preferred Route Corridor. The following alternative route corridors (refer Volume 2 – Drawing No. RCSR – 606) were submitted:

- Alternative Route Corridor P1 – Submitted by a member of the public with a view to minimising the impact of the emerging Preferred Route Corridor on the village of Parteen
- Alternative Route Corridor P2 – Submitted by a member of the public with a view to minimising the impact of the emerging Preferred Route Corridor on the village of Parteen
- Alternative Route Corridor P3 – Submitted by a member of the public with a view to minimising the impact of the emerging Preferred Route Corridor on the village of Parteen
- Alternative Route Corridor P4 – Submitted by a member of the public with a view to minimising the impact of the emerging Preferred Route Corridor on local farms at Cappavilla and Srawickeen
- Alternative Route Corridor P5 – Submitted by a member of the public with a view to improving access to the M7 from the Limerick Northern Distributor Road. It should be noted that a number of variants to this alternative option were submitted including providing direct access to the Newport Roundabout.

Parteen Village – Alternative Routes

As outlined above, 3 no. alternative routes were submitted by members of the public with a view to reducing the impact of the emerging Preferred Route Corridor on the village of Parteen and the Headrace Canal. The routes in question diverge from the emerging Preferred Route Corridor at the Tailrace Canal (Node X) following the alignment of the previously eliminated Route Corridor D2 towards the Headrace Canal. At Ballykeelaun, each alternative route corridor deviates from the alignment of Route Corridor D2, turning in south easterly direction away from the Headrace Canal and connecting to the R464 at alternative locations. Although each of the alternative routes is further from the Headrace Canal than the Route Corridor D2, none of the options proposed satisfactorily avoids the risk associated with constructing a four lane distributor road through the hydrogeologically sensitive area directly to the south

of the Headrace Canal. As outlined in Chapter 5 of this Report, it has been determined that this risk should be avoided and routes through the area of hydrogeological sensitivity were therefore excluded from further consideration. Notwithstanding the above, other issues have been identified in the consideration of the alternative route options submitted and these are outlined below.

The first of these route alternatives to cross the R464 is the alternative Route Corridor P1. This route corridor turns sharply to rear of the Firhill Housing Estate through open land connecting to the R464 at the site of a derelict farm shed and crossing the existing treelines designated as County Importance . The location of this junction is halfway between the existing access to the Dairygold Co-Operative and the Inis Gile Nursing Home on an incline with a gradient of approximately 5%. In accordance with the Design Standards, the gradient of R464 as it approaches the junction should not exceed 2% either uphill or downhill. Downhill approaches in excess of this figure can induce traffic speeds above those desirable through the junction, and lead to a misjudgement of the approach speed by drivers entering from the R464. Uphill approaches are also undesirable since it is difficult for drivers to appreciate the layout of a junction when they are approaching it on an up gradient. They cannot see the full layout from the approaches immediately on either side of the crest. For the junction that would need to be located on the R464 on this incline, significant works will be required to upgrade the vertical alignment to comply with standards. The R464 will be required to be re-graded and this change in road level will severely impact existing properties either side of the junction. From the R464, the proposed alternative route corridor runs to the rear of Corbally United Soccer Grounds between Gortagother and Parteen before merging with the emerging Preferred Route Corridor at the R463.

During Public Consultation No.2, submissions were received from the public regarding this alternative route corridor. From the submissions received, a number of members of the public appear to have been made aware of the alternative route option P1. This alternative route corridor was not presented to the public as part of either Public Consultation No.1 or Public Consultation No.2. For information purposes only, it is noted that a significant number of the submissions received in relation to Route Corridor P1 raised objections to this alternative route corridor.

The alternative Route Corridor P2 crosses the R464 at the existing junction with the R463 at O'Connors/Griffins Cross in a south easterly direction. From O'Connors/Griffins Cross, the route runs adjacent to Shanakyle all weather pitch before merging with the emerging Preferred Route Corridor to the west of Derryfadda Road at Node L. This route corridor would require a significant junction at O'Connors/Griffins Cross to accommodate traffic flows from the R463, the R464 and the Limerick Northern Distributor Road. The scale of the junction required would severely impact existing properties and business located adjacent to Griffins Cross.

The alternative Route Corridor P3 crosses the R463 to the north of the local service station at Griffins Cross. This alternative route corridor then crosses the local road L-3058-17 within 300m of the junction with the R463. This route corridor, similar to the other route corridors that intersect the R464, will severely impact existing properties along the L-3058-17.

Cappavilla/Srawickeen – Alternative Routes

Alternative Route Corridor P4 was submitted by a member of the public with a view to minimising the impact of the emerging Preferred Route Corridor on the local farms at Cappavilla and Srawickeen. The alternative route corridor turns southwards to the

east of the Errina Canal and runs parallel to the Route Corridor C1 before crossing the Lower River Shannon SAC. This route is very similar to the previously considered Route Corridor C1 that was disregarded from further consideration following the completion of detailed ecological surveys of potential River Shannon crossings. The qualifying habitat Alluvial Woodland occurs at this crossing point. The proposed crossing point was identified as having a significant impact on this habitat. The construction and operation of this alternative route corridor was identified as having a potentially significant impact on a number of the species which are qualifying interests of the SAC with respect to the impact on salmon and lamprey spawning habitat and otter habitat. Similar to Route C1, the alternative Route Corridor P4 is therefore disregarded from further consideration.

Further to the above, it is also noted that the alternative route corridor proposed severely impact sites of archaeological interest. Assuming that the route corridor was designed in accordance to the appropriate design standards, the archaeological sites referenced AH46 and AH47 would be within the proposed route corridor and be determined to be severely impacted. In addition, it is noted that the alternative route submitted does not take into consideration the issue of an appropriate docking point for the alternative route. The proposal submitted indicates the route crosses the River Shannon before connecting to the O'Halloran Road between Cook Industries and Telefónica/O2 Industries. Such a docking point would have a severely negative impact of existing industries located within the National Technological Park.

Docking Point E

During Public Consultation No. 2, a number of queries were received regarding the impact of traffic docking at the Cappamore Junction and the feasibility of connecting the emerging Preferred Route Corridor to the Newport Roundabout or further east along the R445. These options are deemed to be similar and are reflected by the alternative Route Corridor P5 shown on Drawing No. RCSR-606.

By connecting the Limerick Northern Distributor Road to the Newport Roundabout or to the R445 further east, the functionality of the route is altered. The route takes on the functionality of a by-pass road rather than a distributor road with the demand increased on the proposed route corridor.

The LNDR is not intended as an attractive route to suit long distance east-west traffic flows between the M7 and N18. That functionality is served by the Limerick Southern Ring Road which provides a free-flow/high-speed route for national traffic.

As stated in Chapter 4, the following key functions are proposed for the Limerick Northern Distributor Road:

i) To enable cross movements between the radial routes around the northern edge of Limerick City, including the regional road network, and to improve access for local traffic;

ii) To greatly improve connectivity to and between the northern outskirts of Limerick City and the adjoining rural hinterland in southeast County Clare;

iii) To promote balanced regional development in Counties Clare and Limerick, and Limerick City;

iv) To reduce traffic flows in Limerick City Centre and to facilitate public transport initiatives including bus corridors;

v) To make better provision for safe movement of pedestrians and cyclists.

Relocating the Docking Point E to the Newport Roundabout or further east to the old R445 does not meet the objectives of the scheme and the alternative Route Corridor P5 is disregarded from further consideration.

6.2.5 Summary

Following completion of Public Consultation No. 2 and a review of all submissions received, it is noted that no new constraints were identified that impacted the alignment of the emerging Preferred Route Corridor. It is noted that a number of submissions raised issues regarding the emerging Preferred Route Corridor and these will have to be carefully considered during the Design Stage.

6.3 Recommendation of the Preferred Route Corridor

The recommended Preferred Route Corridor is a combination of Route Corridor Option A2.2 in Section 1 and Route Corridor Option B1/D1/E1.1 in Section 2 as shown on Drawings RCSR-603 to RCSR-605 in Volume 2.

Appendix 6.1

Public Consultation Brochure and Questionnaire

Chapter 7 Planning, Land-Use & Socio Economic Impacts

7.1 Introduction

This section of the report outlines the findings of the planning, land-use and socio-economic assessment of the route corridor options. The planning aspects are presented in the context of the strategic and regional impacts. The impact on land-use examines the potential impact of each route corridor option on residential, community and commercial property and planning applications in close proximity to the route corridors options. The existing socio-economic conditions are briefly reviewed and then the socio-economic impacts of the route corridors are discussed, highlighting the main issues affecting the selection of a preferred route corridor.

7.2 Route Corridor Options

The scheme and associated route corridor options are defined as two distinct sections; Section 1 originates at Docking Point A along the Knockalisheen Road, northwest of Limerick City and terminates at Node X along the Ardnacrusha Tailrace Canal. Section 2 originates at Node X, along the Tail Race Canal and terminates at a number of possible locations along the R445, the old N7 east of Limerick City. The route corridor options are described in Chapter 5 of this Report.

7.3 Assessment Methodology

7.3.1 Assessment Criteria

To address the breakdown of elements contained within this single chapter it is proposed to examine the issues under the following headings:

- *Strategic Planning Impacts*

  An overall assessment has been carried out to look at the strategic context of the development, and the conformity or otherwise to nationally stated policies and objectives. Simple conclusions are drawn here, where the proposal is identified, either as beneficial (in conformity) or adverse.

- *Regional and Local Planning Impacts*

  The planning policies in the County Development Plans and, where available, Local Area Plans have been reviewed and the route corridor options checked for possible non-conformity to the plan. Again, relatively simple conclusions are drawn here with route corridor options being identified as either beneficial or adverse.

- *Land-use Impacts*

  This section looks at the number of properties, planning applications and community facilities which are within 300m of each of the route corridor options. Significance criteria are then used to rank the route corridor options.

- *Socio-economic Impacts*

  The purpose of the socio-economic assessment is to identify the potential impacts on local people and communities associated with each route corridor. The selection of a preferred route corridor therefore takes into consideration criteria such as journey length, community severance, amenity and economic impacts.

The assessments are based on a review of the following sources and a number of windscreen surveys undertaken in Q4 of 2010 and Q1 and Q2 of 2011. Information on planning applications was provided by Clare County Council, Limerick County Council and Limerick City Council.

7.3.2 Information Sources

The following sources were consulted:

- Information contained in the Constraints Study dated January 2011;
- Population and Employment data was obtained from the Central Statistics Office website (www.cso.ie); and
- The route corridor options drawings showing the route corridor options (Refer to Drawings RCSR-501 to RCSR-505) on the Ordnance Survey 1:50,000 scale Discovery Series and background Aerial Mapping which was used to determine the proximity of the routes to the towns and villages along the proposed corridors.
- National Development Plan 2007 – 2013;
- National Spatial Strategy for Ireland 2002 – 2020;
- Clare County Development Plan (2011 – 2017);
- South Clare Local Area Plan (2009 – 2017);
- Draft South Clare Local Area Plan (2012 - 2018);
- Limerick City Development Plan (2010 – 2016);
- Limerick County Development Plan (2010 – 2016);
- Castletroy Local Area Plan (2009 – 2015).

In addition to the above, cognisance was taken of information resulting from Public Consultation No. 1 and Public Consultation No. 2 on the emerging Preferred Route Corridor.

7.4 County and Local Development Plans - Specific Policies / Objectives

Employment and Enterprise

The development plans recognise the need for further infrastructural development, including the transport infrastructure, to allow them to continue to develop economically.

The Clare County Development 2011 - 2017 within the Strategic Aims of Chapter 6 'Employment, Economy and Enterprise' recognises the importance of the University of Limerick as a critical driver of economic development and the fostering of an innovative, knowledge-based economy for the County and Mid-West and West regions. The plan notes that there is significant potential for the University to expand further northwards into County Clare within the designated University Zone (refer Drawing RCSR-703), however, a critical issue to be resolved is the lack of proper vehicular access to the Campus from County Clare. It is an objective of the Clare County Development Plan to safeguard the provision of a link road off the future northern distributor route to serve future development within this designated University Zone.

Policy CP 07 of the Limerick County Development Plan 2010 – 2016 notes that one of its objectives is *'To facilitate the provision of the County's infrastructure in a sustainable and efficient manner that promotes the social, economic and physical development of the County and the people living therein'.*

Furthermore, Objective 1 of the South Clare Plan (2009 – 2015) is as follows; *'Enhance the ability and capacity of South Clare to assist in the development of the region in respect of its 'gateway' status and as a counterbalance to the Dublin Region'.*

The development of enhanced infrastructure is seen as being of paramount importance in the enticement of industry and business to the area and the subsequent development of employment opportunities. The proposed road project is therefore in broad conformity with planning policy in terms of employment and enterprise.

The Limerick Northern Distributor Road will assist in the promotion of balanced regional development in Limerick County and South Clare County regions. Poor accessibility within the north City has been a barrier to economic development to date. After delivery of the proposed road it is hoped economic development will be encouraged as improved access attracts investment to the area.

A number of the route corridor options have an impact under this heading:

- Route Corridor Options D1 and C1 pass close to the National Technological Park at Castletroy before joining the existing R445. The proximity of these routes enhances the economic attractiveness of this industrial area.
- Route C.1 could result in the loss of parking facilities within the existing GHQ facility.
- Route Option D.1 could have a direct impact on Vistakon Pharmaceuticals should the existing road need to be widened.
- The 'Park Nursing Home' could be directly impacted if Route Corridor Options B.1 or B.2 is selected.

The provision of a new distributor will provide improved connectivity and access to this area which contains many large industrial and educational facilities.

Rural Development and Tourism

The counties of Clare and Limerick possess many tourist attractions and in recent years the profile of tourism has been greatly raised with the development of river related tourism holidays such as cruising and angling. As a consequence there has been an expansion in the number of hotel rooms, guesthouses, restaurants and public houses. This development has further enhanced the attractiveness of the area as a tourist destination and as a result tourism is now integral to the economy of Limerick City and South Clare.

Recreation and Amenity

The following extract from the Clare County Development Plan (2005 – 2011) succinctly captures the intention behind the Recreation policies contained within the development plans:

Objective No. 17 '*To promote and facilitate the growth of the tourism product through the integration of tourist facilities, including sites, attractions and recreational and*

leisure infrastructure, identification of locations for appropriate developments, the conservation of landscape and the conservation of the natural and built environment'.

There are a number instances where a route corridor option runs contrary to this policy, as follows:

- Route Corridor Option A.3 will have a direct impact on the sports pitches and facilities (Parkville Football Club & Ballynanty Rovers AFC) adjacent to the Department of Justice Knockalisheen Centre.
- Route Option A.2 will have a direct impact on the Department of Justice Knockalisheen Centre.
- Route Corridor Option A.2 and A.2.1 will both have a direct impact on Thomond Rugby Football Club Pitch and Limerick Football Club Pitch at the Department of Justice Knockalisheen Centre.
- Route Corridor Option A.2.1 will have a severe impact on an existing Plant Nursery at Quinspool.
- Route Corridor Option B.2 will have a severe impact on the University of Limerick Rowing Club boat House. It is anticipated that this entire facility would need to be acquired if this route option is selected.

Protected Views and Prospects

Both County Development Plans recognise the importance of Landscape and Landscape Character. Areas of Outstanding Natural Beauty and High Visual Amenity are recognised and policy is in place to protect them from inappropriate development. Similarly views and prospects of high amenity value are specified and protected.

Land-use zoning strategies

Limerick County Council and Clare County Council have all had zoning strategy maps developed as directed by the relevant County Development Plan (refer to Drawings RCSR-701 to RCSR-703). In addition, both the South Clare Local Area Plan (2009 - 2015) and the Castletroy Local Area Plan (2009 – 2015) are within the Study Area. Development proposals are expected to be compatible with these zoning strategies. The impacts on these zones are summarised below:

Ballycannan North (Meelick Village)

Route Corridor Option A.4 encroaches on zoned lands within Ballycannan North. The encroachments, which are minor, are within zoned *residential* lands along the Knockalisheen Road and with lands zoned *community* north of the village. The lands zoned *community* are currently in use as a cemetery.

Ardnacrusha and Parkroe

Route Corridor Option A.4 passes along the southern extremities of Ardnacrusha Village zoning and in the process just encroaches on lands *zoned other settlement land.*

Parteen Village

Route Corridor Option B.1 passes through lands which are zoned *other settlement land*. The lands are currently occupied by ribbon development. Route Corridor Option B.1 would have a severe impact on these lands.

University of Limerick Campus

The south Clare Local Area Plan includes the University of Limerick Campus as a strategic development area. The plan notes that *'the area is currently poorly connected to the road network but the development of the future Limerick Northern Distributor road together with other transport improvements to the Ennis-Limerick rail network will make the area attractive in the longer term'.*

Route Corridor option C.1 slices through the centre of these lands however as these lands are poorly serviced the provision of a road through these lands would be greatly beneficial to the development of the site.

Route Corridor Options D.1 and D.2 also encroach on these lands to a much lesser degree along the north eastern extremities. Both corridor options would have a negligible impact on the lands.

Castletroy Area Local Plan

Route corridor Options B.1, B.2, C.1 and D.1 all pass through lands zoned under this local plan before docking along the R445. Route B1 passes through lands zoned *agriculture* and also encroaches on an *architectural conservation area*. This corridor option also encroaches on lands zoned residential and university with a negligible impact.

Route B.2 passes through lands zoned *architectural conservation areas* having a direct impact. This route also encroaches on lands zoned *agriculture*, *residential* and *university*.

Route Option C.1 has a direct impact on lands zoned *industrial* and on an *architectural conservation area.* The route also encroaches on lands zoned *residential* and *university*.

Route Corridor Option D.1 passes through the National Technological Park which has an industrial zoning status. This route option would provide improved access to the park from South County Clare and would therefore result in a positive impact.

Table 7.3 at the end of this Chapter identifies which route corridor options will have the greatest potential planning impact. In arriving at this ranking it considers the number of businesses directly affected and the compliance with planning policies as discussed above.

7.5 Land-use Impacts

7.5.1 Introduction and Methodology

This section examines the impacts on land-use for each of the route corridor options. The Study Area is primarily rural and as such the associated land-use is primarily agriculture. Impacts on agriculture are addressed separately in Chapter 13. This section therefore examines the impact of each route on property, community facilities and planning applications in close proximity to each of the routes. The number of properties within 50m, 100m, 200m and 300m of the centreline of each route has

been accurately counted and this is used to make a simple assessment of the impact the route corridor options will have on land-use.

Refer to Drawings RCSR-704 to RCSR-705 in Volume 2 for main land uses other than agriculture.

7.5.2 Assessment of Effects

Section 1

Section 1 runs from Node A, linking with the proposed Coonagh – Knockalisheen scheme, to Node X, which crosses the Tailrace Canal at the southern extremities of Ardnacrusha Village. There are 6 possible route corridor options to be considered in Section 1. Route Corridor Option A.1 travels online for a short section of the route (approximately 0.34km) in a south easterly direction and offline for the remainder of the route. The route travels from Node A – F – X. This route will have the potential to impact a total of 12 properties, 2 of which fall within 50m either side of the centreline with no granted planning applications. Planning Applications are shown on Drawing RCSR 706-707.

Route Corridor Option A.2 travels offline along the entire length of the route from Node A – X, potentially impacting on a total of 6 properties, of which there are none within the 50m centreline boundary.

Route Corridor Option A.2.1 is similar to A.2 and travels offline along its entire length from Node A – X. There are a total of 13 properties, of which none are within 50m either side of the centreline.

Route Corridor Option A.3 is similar to route A.1 and runs from Nodes A – F – X, crossing two football club sites and the Department of Justice lands. This route travels online for a short section of its route (approximately 0.3km) in a north westerly direction before travelling offline for the remainder of the route. Of a total of 15 properties potentially impacted by the scheme, none are within 50m either side of the centreline.

Route Corridor A.4 traverses the northern boundaries of the Study Area from Nodes A – G – H – X and is the longest Route Corridor in Section 1. The route travels online for 1.32km in a north westerly direction before travelling offline for the remainder of the route. This route potentially impacts upon 94 properties, with 12 of these properties being within 50m of either side of the centreline and two of those with planning permission granted.

Route Corridor A.4.1 follows the alignment of route A.4 from Node A – G and rejoining from Node H – X, travelling online for 1.32km and travelling offline for the remainder of the route. The portion of the route between Nodes G – H encroaches on the existing Ballycannon North Graveyard. A potential 107 properties are impacted by this route, of which 12 properties are within 50m of either side of the centreline and two of those with planning permission granted.

Section 2

Section 2 runs from Node X and terminates at 4 different end points, Nodes B, C, D and E. There are 16 different possible combinations of routes in Section 2.

Section 2 is made up of 6 Route Corridors, namely routes B.1, B.2, C.1, D.1, D.2 and E.1, and 2 Links from D.2 to D.1 and from D.1 to E.1. Table 7.3 demonstrates the

impact each of these route combinations have in terms of the number of properties affected within 50m either side of the centreline and the number of these properties granted planning permission.

Route Corridor D.1 is the only Route Corridor in Section 2 where portion of its route travels online (0.96km – within the National Technology Park in the south east). Route Corridor D2/E.1 (Nodes X – K – N – O – E) is the longest Route Corridor combination of 8.31km and potentially impacts on 71 properties, of which 10 are within 50m of either side of the centreline and 2 of these 10 properties have been granted planning permission. Both Route Corridor combinations incorporating Route Corridor C.1 (Nodes X – J – L – C, and Nodes X – K – L – C) potentially impacts on the most number of properties within the 50m boundary either side of the centreline, with 12 properties impacted and 5 of these properties having been granted planning permission.

7.6 Socio-Economic Impacts

7.6.1 Introduction and Methodology

This section evaluates the potential socio-economic impacts of the route corridor options. A comparative evaluation of the impacts of each route corridor option is provided in order to assist in the identification of the preferred route.

The assessment has been undertaken in line with the EPA 'Guidelines on the information to be contained in Environmental Impact Statements (2002)', the EPA 'Advice Notes on Current Practice (in the preparation of EIS)' (2003) and the NRA 'Environmental Impact Assessment of National Road Schemes – A Practical Guide' (NRA 2006). Reference has also been made to the detailed guidelines provided in the UK DMRB Volume 11, Section 3, Part 8 'Pedestrians, Cyclists, Equestrians and Community Effects'.

7.6.2 Socio-economic Impact Categories

The purpose of the socio-economic assessment is to identify the potential impacts on local people and communities associated with each route corridor. Socio-economic or community, impacts fall into four key categories, namely:

- *Journey length*

  New roads have an inevitable effect on local journey times and travel patterns for vehicle journeys, journeys by public transport, journeys by bicycle and for pedestrians.

  The following criteria will be referred to in assessing the impact the route corridor options will have on journey time and journey pattern:

Table 7.1: Journey Length Assessment Criteria

Impact Level	Significance Criteria
Imperceptible	No appreciable change to present journeys, i.e. less than 10% change in typical journey length or duration
Slight	Some inconvenience but journey patterns likely to be maintained, i.e. 10-30% change in typical journey length or duration
Moderate	Journeys become longer and some groups may be dissuaded from making trips, i.e. 30 – 60% change in typical journey length or duration
Significant	Considerable inconvenience. Many people will be deterred from making trips, i.e. 60 – 100% change in typical journey length or duration.
Profound	More than 100% increase in journey length or duration sufficient to cause marked change in behaviour of sizeable proportion of population

- *Community Severance*

  Severance occurs whenever access to community facilities, such as schools, surgeries, hospitals, churches, post offices and shops, is impeded by the physical barrier of the road itself (e.g. due to traffic load or fencing) or any lengthening of journey time.

  New or increased severance is a negative impact that occurs where either a new road, or increased traffic on an existing road, forms a barrier between people and community facilities.

  The following criteria, adapted from the UK DMRB Guidelines will be referred to in assessing the impact of the route corridor options:

Table 7.2: Community Severance Assessment Criteria

Impact Level	Significance Criteria
Imperceptible	Journey patterns maintained
Slight	Present journey patterns likely to be maintained, albeit with some hindrance to movement
Moderate	Some residents, particularly children and elderly people, are likely to encounter some severance, perhaps due to a need to access a pedestrian crossing / OR At grade crossing of a road carrying 5000 – 10 000 vehicles AADT when unassisted by pedestrian lights
Significant	Most residents are likely to encounter severance which, in some cases, will cause them to make less frequent use of particular community facilities / OR At grade crossing of a road carrying 10000 – 15 000 vehicles AADT when unassisted by pedestrian lights
Profound	People are likely to be deterred from making more important trips to an extent sufficient to induce a re-organisation of their habits / OR Crossing of a road carrying more than 15 000 vehicle AADT when unassisted by pedestrian lights

It is also worth noting that above a certain threshold people may be deterred from making certain casual journeys to an extent that an element of psychological severance arises. In such instances, people's accessibility is restricted or communities become identified by their containment within certain road boundaries.

- *Amenity*

  Amenity is defined as the relative pleasantness of a journey. The UK DMRB describes it as being concerned with:

  - Changes in the degree and duration of people's exposure to traffic, i.e. fear/safety, noise, dirt and air quality; and
  - The impact of the road itself – primarily any visual intrusion associated with the scheme and its structures.

  Aspects such as the level of traffic on a road, the availability of footpaths, and cycle-paths and the nature of the crossings or junctions to be negotiated are of particular importance when assessing amenity, as are the numbers and type of people affected.

  In addition environmental impacts affecting the pleasantness of journeys such as pollution, noise and landscape impacts can also affect the general amenity or quality of life for people living in the vicinity. Environmental impacts can also have direct impacts on particular community facilities and recreational sites. While these environmental issues are considered in other chapters they can also have a community dimension and such are considered here.

- *Economic Impacts*

  Economic and employment impacts will occur at both regional and local levels, and can be either positive or negative. In terms of road development these impacts can be difficult to quantify. Much road development is proposed with the intention of improving the business environment, particularly in relation to reducing journey time and improving journey time reliability for commercial goods and for travel and commuting by employees. However, there can also be negative impacts in relation to loss of passing trade to businesses such as newsagents, grocery stores, coffee shops, filling stations, guest houses, etc.

  The specific economic impacts will be largely influenced by the chosen route and the location of junctions. At this stage in the selection of a preferred route corridor only broad assumptions can be made about junction locations. Taking cognisance of this limitation, 'slight' impacts are broadly defined as those to which a small effect on the business environment can be attributed to the scheme. 'Moderate' economic impacts are defined as those to which a somewhat greater effect on the business environment can be identified; and 'significant' impacts would be such as to substantially affect business performance or to influence the location of new business.

7.6.3 Route Corridor Analysis

The Receiving Environment – Considerations for the Entire Study Area

Settlement Pattern

The main urban conurbation within the Study Area is formed by Ardnacrusha and Parteen Villages. Outside of this Castletroy and Rebogue lie immediately south east of the study area and Athlunkard lies within the study area to the south. Smaller settlements within the study area include Meelick to the west, and Cloonougther and Gilloge near Parteen.

Elsewhere within the study area, settlement generally takes the form of scattered individual houses. There is also significant ribbon development along some of the existing roads near Ballycannon, Quinspool and Derryfadda.

Economic Functions

Outside of agriculture, Ardnacrusha and Parteen Villages combine as the main communities providing economic function within the Study Area. The majority of employment, administrative, and service functions are based in Ardnacrusha Village.

Ardnacrusha and Parteen Villages' administrative and service role also contributes significantly to its economy. The presence of the Garda Station, Power Station and Nursing Home in Ardnacrusha and the National School in Parteen are pertinent in this instance.

In recent years, following the opening of the Shannon-Erne waterway, the profile of the tourism industry has been greatly raised with the development of river related tourism holidays (cruising and angling). As a consequence there has been an expansion in the number of quality hotel rooms, restaurants and public houses in the vicinity of the River Shannon in South Clare and Limerick City. This development has further enhanced the attractiveness of the area as a tourism destination and as a result tourism is now integral to the economy of South Clare and Limerick City.

University of Limerick is located to the south east of the Study Area next to the National Technological Park in Castletroy, both with a significant economic function to the Study Area and its surroundings. Several other commercial activities exist within the Study Area, such as the Stud Farm and Plant Nursery in Quinspool.

Existing Infrastructure

The townlands contained within the Study Area are served by a small network of regional roads. The R463 and the R464 are the two roads connecting Athlunkard and Parteen Village with Ardnacrusha Village to the north and with Limerick City to the south. The R463 and the R463 intersect at O'Connors/Griffins Cross to the south of the Headrace Canal.

Within the Study Area, the R465 (old N7) has been downgraded from a National Primary route to a Regional route, links the M7 to Limerick City via the Newport Roundabout. The R463 and the R464 connect the townlands within the Study Area to the R445 at Grove Island via the Corbally Link Road.

There are also a significant number of local and minor roads traversing the study area. Refer to Drawing RCSR-708.

Facilities and Amenities

The communities of Ardnacrusha and Parteen are linked with key facilities and amenities, which are essential to the prosperity of any urban area, shared between the two villages.

There is a primary school located in the centre of Parteen village along with St. Patrick's Chapel and St. Patrick's Church serving the communities of both Parteen and Ardnacrusha in particular, as well as other townlands close by.

Outside of these villages there is a primary school located in Meelick. University of Limerick undeveloped lands are located to the north of the River Shannon within the Study Area. The campus is located to the south of the River Shannon.

In terms of amenity facilities, the River Shannon is widely promoted with the provision of angling stands, marinas and boat moorings.

There are also a range of clubs and recreational facilities, including University of Limerick rowing club, a local gun club, greyhound track, Pitch and Putt and GAA, rugby and soccer clubs in various locations within the Study Area.

Potential Impacts of Route Corridor Options

Section 1

Section 1 runs from Node A, linking with the proposed Coonagh – Knockalisheen scheme, to Node X, which crosses the Tailrace Canal at the southern extremities of Ardnacrusha Village. There are six possible route corridor options to be considered in Section 1.

Economic Impacts

All the route corridor options in Section 1 will produce the reduced journey times and increased reliability of journey times required to consider the road as economically beneficial from a regional and national perspective. In terms of negative economic impacts, effects may be felt as a result of loss of passing trade in Meelick and Ballycannon. All six routes will divert traffic around these areas, in particular diverting any potential additional trade from increased traffic on the proposed Coonagh – Knockalisheen Scheme.

Route Corridor Options

Route Corridor A.4 and A.4.1 (A- G-H-X)

Route Corridor Options A.4 and A.4.1 share the majority of the same route from Nodes A – G and Nodes G – H and as such share the same impacts along these sections of the routes.

- Journey Characteristics

  Route Corridor Options A.4 and A.4.1 are the two longest routes of the six route corridor options in Section 1. The offline element for both routes between Nodes G and X crosses local roads a total of three times between Nodes G – H and one farm access road at Node X. There is also some minor impact on agricultural accesses which are discussed in Chapter 12. At present it is proposed to provide overbridges or underpasses for all impacted local roads. As such it is considered that the impact on local journey times and journey patterns will be imperceptible.

  The online element of Route Corridor Options A.4 and A.4.1 extends for 1.32km along Knockalisheen Road and affects several property accesses. There are also several local roads on both sides of the existing road affected by these route corridor options as well as the Knockalisheen Road itself. The requirement for a grade separated junction or roundabout at the affected side roads and where the offline element of the route corridor and the Knockalisheen Road converge lowers any potential impact on journey times.

  Access to west side of Meelick Village is located on the proposed online section of the route corridor options A.4 and A.41. It is considered that the maintenance and improvement of the existing grade separated junction will ensure only slight impact on journey patterns occurs. Route Corridor Option A.4.1 also impacts on the eastern access of Meelick Village. The provision of an overbridge or underpass at this access will minimise any effect on journey patterns and journey times.

- Severance

  To the north of the point where the offline element of the route corridor options and the Knockalisheen Road converge, there is significant ribbon development. This is also the case for the local road to the north of Node H. While these developments may suffer some element of psychological severance the provision of overbridges, underpasses and footpaths will ensure that journey patterns are maintained and as such the impact is imperceptible.

- Amenity

  The extensive offline rural nature of Route Corridor Options A.4 and A.4.1 and its distance from the main conurbation results in it having primarily minimal negative impact on amenity for residents. The online element of the route corridor options will not create any additional visual impact to the surrounding areas.

Route Corridors A.2 and A.2.1 (A-X)

Route Corridor Options A.2 and A.2.1 are similar in alignment and would generally have the same impacts on the surrounding areas.

- Journey Characteristics

  Both route corridor options are offline for their entire lengths from Node A – X and are the shortest routes in Section 1. Both routes cross one local road, which provides access to the R464, and a farm access road at Node X. At present it is proposed to provide overbridges or underpasses for all impacted local roads. As such it is considered that the impact on local journey times and journey patterns will be imperceptible.

- Severance

  A number of properties are scattered along the affected local road to the north of the proposed route corridor options. These properties may experience a psychological feeling of severance. The provision of underbridges or underpasses at such locations will ensure that journey patterns are maintained and as such the impact would be imperceptible.

- Amenity

  These route corridor options would have a significant effect on amenities in the area. Thomond RFC and Limerick FC both have facilities located where both route corridors traverse, with A.2 having the most significant adverse impact. These lands have also been granted cSAC status.

Route Corridors A.1 and A.3 (A-F-X)

Route Corridor Options A.1 and A.3 share the same alignment from Nodes F – X and as a result will have the same impacts along this section of the proposed route.

- Journey Characteristics

  Both route corridor options have an online section to the route which affects several property accesses. There is one local road the east side of the existing road potentially affected by route corridor option A.3, as well as the Knockalisheen Road itself to the north. Route corridor option A.1 affects access to and from the Knockalisheen road to the south. The requirement for a grade separated junction or roundabout at the affected side road and where the offline element of the route corridor and the Knockalisheen Road converge lowers any potential impact on journey times.

The offline elements of routes A.1 and A.3 cross one local road at Node F, and one farm access road at Node X. At present it is proposed to provide overbridges or underpasses for all impacted local roads. As such it is considered that the impact on local journey times and journey patterns will be imperceptible.

- Severance

  As before, Route Corridor Options A.1 and A.3 will have an imperceptible impact on journey patterns as a result of the maintenance of existing access points. However this element does 'separate' a greater number of properties and as such the psychological feeling of severance may occur.

- Amenity

  No recreational or community facilities will be impacted by route corridor option A.1.Route Corridor Option A.3 however will affect both Ballynanty Rovers AFC and Parkville FC between Node A – F. These lands have also been granted cSAC status.

Section 2

Section 2 runs from Node X to one of several docking points along the N7 Limerick to Dublin road. There are six routes in section 2 of which a total of 19 combinations can be formed.

Economic Impacts

All the route corridor options in Section 2 will produce the reduced journey times and increased reliability of journey times required to consider the road as economically beneficial from a regional and national perspective. In terms of negative economic impacts, effects may be felt by the surrounding villages as a result of loss of passing trade. All route corridor options will have varying impacts on passing trade in these villages.

Route Corridor Options

Route Corridor Options B.1 (X-J-B) and B.2 (J-B)

Route Corridor Options B.1 and B.2 are both offline for almost their entire length and pass through Parteen Village. Both routes follow a similar alignment and as such have been considered and assessed together. The difference in potential impact between these nodes is used to differentiate between Route Corridor Options B.1 and B.2.

- *Journey Characteristics*

  Route Corridor Option B.1 from Node X – J will impact two regional roads, both the R463 and the R464, along with one local road and one farm access road. From Node J – B, route B.1 impacts on one local road before crossing the River Shannon and docking at an existing roundabout on the N7 Limerick to Dublin road. Route B.2, which extends from Nodes J – B, impacts on the same local road as B.1 and also a farm access road before crossing the River Shannon and docking at the same point as route B.1. The proposed provision of compact overbridges or underpasses, and roundabouts along this section and the relative proximity of existing local roads ensures that there will be no appreciable change to present journey lengths or duration and the impact will be imperceptible.

- *Severance*

  Route Corridor Option B.1 from Node X – J passes between Parteen and Ardnacrusha village. While these two villages are physically separated by the Headrace Canal, many of the facilities and amenities are shared between them. The facilitation of local accesses onto the proposed roundabouts ensures that the vehicular journey patterns will be maintained, however the design and access for pedestrians and cyclists between these two villages is exceedingly important. If the access for pedestrians or cyclists is physically unattractive of difficult then people will be cut off from the facilities in both villages and severance will occur.

  At Node J, route corridor option B.1 crosses the R463 between Athlunkard and Gortatogher where ribbon development exists. These properties may experience a psychological feeling of severance. The provision of underbridges or underpasses and roundabouts at such locations will ensure that journey patterns are maintained and as such the impact would be imperceptible.

  Between Node J – B both routes B.1 and B.2 cross the local road between Cloonoughter and Athlunkard. While there are no properties scattered along the road, properties within these two villages may experience a psychological feeling of severance. The provision of underbridges or underpasses at such locations will ensure that journey patterns are maintained and as such the impact would be imperceptible.

- *Amenity*

  These route corridor options would have a significant effect on amenities in the area. Corbally United Soccer grounds, St. Patrick's Church and Chapel, the Greyhound track, the Lough Derg Way and the River Shannon would be affected by the construction of both route corridor options due to potential severance in the communities. Route B.2 would also directly impact on University of Limerick Rowing Club.

Route Corridor Option D.1 (J-L-M-N-P-D) and C.1 (L-C)

Route Corridor Option D.1 is offline for the majority of its length which terminates at docking point D in the National Technological Park on the N7 Limerick to Dublin road. Route Corridor Option C.1 branches from route corridor option D.1 offline for its entire length before terminating at a separate docking point C.

- Journey Characteristics

  Route Corridor Option D.1 is offline for the majority of its length and affects one access road and one local road. The local road connects the scattered properties along the route with Gilloge while the access road connects several properties with the local road network. At present it is proposed to provide overbridges or underpasses for all impacted local roads. As such it is considered that the impact on local journey times and journey patterns will be imperceptible.

  Route Corridor C.1 is offline for its entire length, affecting just one local road which links Garraun to Cloonoughter. The provision of overbridges or underpasses for all impacted local roads throughout the scheme will render any impacts on local journey times and journey patterns imperceptible.

- Severance

  Route Corridor Option D.1 crosses an access road potentially causing severance of one property from the main local road between Nodes J – L. The scattered properties along the local roads affected by route D.1 and C.1 may also experience a psychological feeling of severance from the townlands in the area. The provision of underbridges or underpasses and roundabouts at such locations will ensure that journey patterns are maintained and as such the impact would be imperceptible.

  Route corridor option C.1 bisects the University of Limerick zoned lands along Nodes L – C. While there is currently no development on the lands, this route corridor would affect future campus development, potentially causing a psychological sense of severance within the potential campus.

- Amenity

  Both route corridor options would have a significant effect on several amenities in the area. The Lough Derg Way would be impacted upon by both routes, potentially creating a visually unattractive atmosphere to the walkway. Visual amenities along the River Blackwater, Errina Canal and the River Shannon would also be affected by these two route corridor options.

Route Corridor Option D2 (X-K-M)

Route corridor option D.2 is an offline route running to the north of all the townlands within the study area.

- Journey Characteristics

  Route corridor option D.2 crosses one access road, three local roads and one regional road (R463). At present it is proposed to provide overbridges or underpasses for all impacted local roads. As such it is considered that the impact on local journey times and journey patterns will be imperceptible.

- Severance

  Nodes X – K cross the R463 regional road which link Parteen and Ardnacrusha villages which would inevitably cause a severance between the two communities. While vehicular access would be maintained, as with route B.1, it is imperative that pedestrian and cyclist facilities be adequately designed and easily accessed. If the access for pedestrians or cyclists is physically unattractive of difficult then people will be cut off from the facilities in both villages and severance will occur.

  A number of properties are scattered along the affected local roads on either side of the proposed route corridor options. These properties may experience a psychological feeling of severance. The provision of underbridges or underpasses at such locations will ensure that journey patterns are maintained and as such the impact would be imperceptible.

- Amenity

  Route corridor option D.2 would have a significant effect on several amenities in the area. The Lough Derg Way would be impacted upon by the route, potentially creating a visually unattractive atmosphere to the walkway. Visual amenities along the River Blackwater and the Errina Canal would also be affected by this route corridor option.

Route Corridor Option E1 (K-N-O-E)

Route corridor option E1 is the most northerly circulating route option in Section 2, travelling offline for its entire length.

- Journey Characteristics

  Route corridor option E.1 is the longest continuous route in Section 2 and the most northerly circulating route. The route affects 5 local roads in total along its length, the most significant impact on local roads between Node G – N. At present it is proposed to provide overbridges or underpasses for all impacted local roads. As such it is considered that the impact on local journey times and journey patterns will be imperceptible.

- Severance

  A number of properties are scattered along the affected local roads on either side of the proposed route corridor options. These properties may experience a psychological feeling of severance. The provision of underbridges or underpasses at such locations will ensure that journey patterns are maintained and as such the impact would be imperceptible.

- Amenity

  Route corridor option E.1 would have a significant effect on several amenities in the area. The Lough Derg Way would be impacted upon by the route between Nodes K – N, potentially creating a visually unattractive atmosphere to the walkway. Visual amenities along the River Blackwater, Errina Canal and the River Shannon would also be affected by this route corridor option.

7.7 Accessibility, Social Inclusion and Integration

As discussed in section 7.5.3, the need for a distributor route is highlighted by the developments plans from Clare County Council in conjunction with Limerick City Council and Limerick County Council to provide a balanced regional development in Limerick County and South Clare county regions. Poor accessibility within the north city has led to a barrier in social inclusion and economic development. Route A.4 and Route A.4.1 would reduce the feeling of social inclusion for the properties on the Knockalisheen Road as they may experience a sense of psychological severance with potential difficulties in accessibility to Meelick. In Section 2, certain route corridor combinations may also create a sense of severance between the various townlands, properties and communities.

It is proposed that the northern distributor route would improve accessibility to various focal points including Limerick City, the National Technological Park and University of Limerick while relieving pressure on the existing river crossings in to the City Centre. Certain route combinations within Section 2 provide such accessibility as well as integration of land use. The impact of this accessibility to the above locations varies depending on the route corridor combinations.

7.8 Ranking of Route Options

This review of the potential impacts on planning policy, land-use and socio-economic impacts allows a ranking of the route corridor options to be undertaken. Table 7.3.1 and Table 7.3.2 below highlight the ranking of each route corridor against each of the headings. The conclusion reached by this assessment is that all of the routes have varying effects in terms of planning, land use and socio economic impacts.

For Section 1, the primary finding of this chapter is that Routes A.4 and A.4.1 clearly have a significantly higher impact. This is a direct consequence of its proximity to Meelick and the ribbon development north of the Knockalisheen Road. For Section 2 the main issue is the degree of severance which will occur as a result of the route corridor options which incorporate Nodes (X-J), in particular routes B1 and B2

Although all of the route options were assessed within this section, it should be noted that only the refined route options that progress from the Stage 1: Preliminary Options Assessment will be further appraised using the 5 Common Appraisal Criteria of Economy, Safety, Environment, Accessibility & Social Inclusion and Integration.

Table 7.3.1 Ranking of Route Options – Section 1

Route Corridor Options						
Section 1						
	A-F-X	A-X	A-X	A-F-X	A-G-H-X	A-G-H-X
	(Route A.1)	(Route A.2)	(Route A.2.1)	(Route A.3)	(Route A.4)	(Route A.4.1)
Planning Impact Ranking	2nd	1st	1st	3rd	4th	4th
Houses (0 – 50m of Centreline)	3	0	0	4	12	12
Granted Planning Applications (0 – 50m of Centreline)	0	0	0	0	2	2
Land-use Ranking	1st	2nd	2nd	3rd	4th	5th
Journey Length	3082	2443	2447	2925	4701	4592
Community Severance	Imperceptible	Imperceptible	Imperceptible	Imperceptible	Slight	Slight
Amenity	Imperceptible	Moderate	Moderate	Moderate	Imperceptible	Slight
Economics	Imperceptible	Imperceptible	Imperceptible	Slight	Severe	Severe
Socio-Economic Impact Ranking	1st	1st	1st	1st	6th	6th
Accessibility & Social Inclusion	1st	1st	1st	1st	6th	6th
Integration	1st	1st	1st	1st	6th	6th

Table 7.3.2 Ranking of Route Options – Section 2

Route Corridor Options																
Section 2																
	X – J - B	X – J – B	X – J – L – C	X – G – L – C	X – J – L – M – N – P – D	X – G – L –M – N – P – D	X – G – M – N – P -D	X – G – N – P - D	X – J – L – M – N – O - E	X – G – L – M – N – O - E	X – G – M – N – O - E	X – G – N – O - E	X – J – L – M – N – O – P - D	X – G – L – M – N – O – P - D	X – G – M – N – O – P - D	X – G – N – O – P - D
Planning Impact Ranking	4th	5th	13th	12th	7th	3rd	1st	6th	11th	9th	8th	10th	7th	3rd	2nd	6th
Houses (0 – 50m of Centreline)	7	7	18	17	8	7	6	8	11	10	9	11	8	7	6	8
Granted Planning Applications (0 – 50m of Centreline)	3	4	1	1	1	1	0	0	2	2	1	1	1	1	1	0
Land-use Ranking	6th	7th	3rd	2nd	4th	2nd	1st	1st	5th	2nd	1st	1st	5th	2nd	1st	1st
Journey Length	5022	4904	6414	6806	7234	7627	7518	7855	7698	8201	8002	8310	7814	8214	8139	7861
Community Severance	Profound	Profound	Severe	Moderate	Moderate	Moderate	Moderate	Moderate	Severe	Moderate	Moderate	Moderate	Severe	Moderate	Moderate	Moderate
Amenity	Moderate	Severe	Moderate	Slight	Moderate	Slight	Slight	Slight	Moderate	Slight	Slight	Slight	Moderate	Slight	Slight	Slight
Economics	Profound	Profound	Severe	Moderate	Profound	Moderate	Slight	Slight	Profound	Moderate	Slight	Slight	Profound	Moderate	Slight	Slight
Socio-Economic Impact Ranking	16th	16th	14th	10th	11th	3rd	1st	1st	12th	5th	5th	5th	13th	7th	7th	7th
Accessibility & Social Inclusion	16th	16th	14th	10th	13th	3rd	1st	1st	13th	5th	5th	5th	13th	7th	7th	7th
Integration	16th	16th	14th	4th	11th	3rd	1st	1st	12th	5th	5th	5th	13th	8th	8th	8th

Chapter 8 Noise & Vibration

8.1 Introduction

This section of the Route Corridor Selection Report addresses the potential noise and vibration impacts of the proposed route corridor options on the receiving environment.

8.2 Methodology

The Route Corridor Selection Study has been completed in accordance with the NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes (Revision 1, 25th October 2004).

The NRA Guidelines state the elements that need to be assessed as part of the noise assessment section of the route selection study:

"There are three elements to the noise element of Route Corridor Selection. These elements consist of an assessment of potential impact based upon property counts, consideration of likely changes in traffic flow and a review of the need for, and difficulties associated with, noise mitigation measures. Once these three elements have received detailed consideration, route corridor options should be ranked with respect to noise."

The NRA Guidelines also state that as a starting point *"work undertaken as part of the Constraints Study is used by the project engineers responsible to refine the broad corridor into a small number of route corridor options".*

The assessment of the potential noise and vibration impacts was completed in a two staged process, as defined by the NRA Guidelines. Stage 1 of the process, to identify the Potential Impact Rating (PIR), was completed on all of the Route Options presented as part of Public Consultation No. 1. Stage 2 of the process, to assess the impact of Changes in Traffic Flow, was completed following the elimination of a number of routes following Public Consultation No. 1.

8.3 Assessment of Route Corridor Options

8.3.1 Stage 1 - Potential Impact Rating (PIR)

As per the requirements of the Guidelines for the Treatment of Noise and Vibration in National Road Schemes (Revision 1, 25th October 2004) all receptors within 300 metres of the centreline of each of the route corridor options have been identified and put into one of four "bands". The four bands are defined by their distance to either side of the centre line and the number of receptors counted within the bands as follows:

- Band 1 is from 0 to 50m of the centre line;
- Band 2 is from 50 to 100m of the centre line;
- Band 3 is from 100 to 200m of the centre line; and
- Band 4 is from 200 to 300m of the centre line.

The NRA Guidelines define a receptor as being *"any dwelling house, hotel, hostel, health building, educational establishment, place of worship, entertainment venue or*

any other facility or area of high amenity which benefits from, or requires the absence of, high noise levels."

The total number of receptors in each band is multiplied by an arbitrary rating factor in each band in order to calculate the Potential Impact Rating (PIR). The rating factor is 4 for Band 1, 3 for Band 2, 2 for Band 3 and 1 for Band 4. The resultant values are summed to give a single number for each route option, termed the Potential Impact Rating (PIR). The PIR values are used to assess the potential impact of each route option, the larger the PIR the greater the potential impact.

The Study Area for Limerick Northern Distributor Road has been divided into two sections, Section 1 and Section 2. In this instance, the PIR rating is used to assess the potential noise and vibration impact of each of the route corridor options within each section (Sections 1 – Nodes A-B and Section 2 – Nodes B-C).

Section 1

The property counts within each of the four bands and the PIR for each route option within Section 1 are provided in Table 8.1 and 8.2.

Table 8.1 Number of Receptors in Each Band for Section 1

Band	Route Corridor A.1	Route Corridor A.2	Route Corridor A.2.1	Route Corridor A.3	Route Corridor A.4	Route Corridor A.4.1
0-50m	4	2	2	4	13	15
50-100m	4	3	4	1	8	4
100-200m	7	5	11	5	13	18
200-300m	4	4	8	11	79	80

Table 8.2 Potential Impact Rating for Section 1

Band	Rating Factor	Route Corridor A.1	Route Corridor A.2	Route Corridor A.2.1	Route Corridor A.3	Route Corridor A.4	Route Corridor A.4.1
0-50m	**4**	16	8	8	16	52	60
50-100m	**3**	12	9	12	3	24	12
100-200m	**2**	14	10	22	10	26	36
200-300m	**1**	4	4	8	11	79	80
Potential Impact Rating		**46**	**31**	**50**	**40**	**181**	**188**
Ranking		**3rd**	**1st**	**4th**	**2nd**	**5th**	**6th**

Table 8.2 shows that the route corridor options furthest from Meelick and the ribbon development on the Knockalisheen road close to Meelick have significantly lower PIR and therefore are ranked the best in terms of the least number of receptors in proximity to the route corridor. Route corridor options A.4 and A.4.1 are the two least preferred routes as they are closest to Meelick, with route A.4.1 having over 8 times more receptors than route A.2. It is noted that Routes A.4 and A.4.1 utilise a considerably longer length of the existing Knockalisheen Road which has more frontage and receptors than the routes through existing greenfield areas.

Section 2

The property counts within each of the four bands and the PIR for each route option within Section 2 are provided in Tables 8.3 and 8.4. The property counts and PIR ratings for Section 2 also include the receptors along the R445 (old N7) within the four bands from each docking point to docking point E.

Table 8.3 Number of Receptors in Each Band for Section 2

Band	X – J - B	X – J – B	X – J – L – C	X – K – L – C	X – J – L –M – N – P – D	X – K – L –M – N – P – D	X – K – M – N – P -D	X – K – N – P - D
0-50m	191	58	56	18	17	13	21	10
50-100m	337	96	79	55	38	36	30	31
100-200m	599	218	155	139	76	84	79	86
200-300m	785	390	343	171	124	120	121	82

Table 8.3 (cont'd) Number of Receptors in Each Band for Section 2

Band	X – J – L – M – N – O - E	X – K – L – M – N – O - E	X – K – M – N – O - E	X – K – N – O - E	X – J – L – M – N – O – P - D	X – K – L – M – N – O – P - D	X – K – M – N – O – P - D	X – K – N – O – P - D
0-50m	191	8	4	12	19	17	13	21
50-100m	337	14	11	6	55	38	35	30
100-200m	599	23	31	26	138	75	83	78
200-300m	785	35	31	32	171	124	120	121

Table 8.4 Potential Impact Rating for Section 2

Band	Rating Factor	X – J - B	X – J – B	X – J – L – C	X – K – L – C	X – J – L –M – N – P – D	X – K – L –M – N – P – D	X – K – M – N – P -D	X – K – N – P - D
0-50m	**4**	760	764	232	224	72	68	52	84
50-100m	**3**	939	1011	288	237	165	114	108	90
100-200m	**2**	1320	1198	436	310	278	152	168	158
200-300m	**1**	918	785	390	343	171	124	120	121
Potential Impact Rating		**3937**	**3758**	**1346**	**1114**	**686**	**458**	**448**	**453**
Ranking		**16th**	**15th**	**14th**	**13th**	**11th**	**10th**	**6th**	**8th**

Table 8.4 (cont'd) Potential Impact Rating for Section 2

Band	Rating Factor	X – J – L – M – N – O - E	X – K – L – M – N – O - E	X – K – M – N – O - E	X – K – N – O - E	X – J – L – M – N – O – P - D	X – K – L – M – N – O – P - D	X – K – M – N – O – P - D	X – K – N – O – P - D
0-50m	**4**	40	32	16	48	76	68	52	84
50-100m	**3**	93	42	33	18	165	114	105	90
100-200m	**2**	172	46	62	52	276	150	166	156
200-300m	**1**	82	35	31	32	171	124	120	121
Potential Impact Rating		**387**	**155**	**142**	**150**	**688**	**456**	**443**	**451**
Ranking		**4th**	**3rd**	**1st**	**2nd**	**12th**	**9th**	**5th**	**7th**

As above, Table 8.4 also shows that the route corridors furthest from the main urban areas, in this case Parteen, Cloonoughter, Gortatogher and Athlunkard, have the lowest PIR and therefore are ranked best in terms of the reduced number of receptors in proximity to the route corridors. In Section 2, the largely green field route (Nodes X-K-M-N-O-E) is the best in terms of PIR. The routes ranked 1st to 4th traverse predominantly through green fields and end at docking point E.

One issue not considered by the NRA Guidelines is that generally only properties within 100 metres of the centreline of the route will require noise mitigation; outside of this, levels are generally below the threshold requiring mitigation (60dB Lden). It is considered prudent that as well as the overall assessment of PIR a similar assessment should be undertaken to look at only those receptors within 100 metres of the centreline of each route corridor option.

Table 8.5 (i) PIR for Section 1 within 100 metres of the centreline only

Band	Route Corridor A.1	Route Corridor A.2	Route Corridor A.2.1	Route Corridor A.3	Route Corridor A.4	Route Corridor A.4.1
0-50m	4	2	2	4	13	15
50-100m	4	3	4	1	8	4

Table 8.5 (ii) PIR for Section 1 within 100 metres of the centreline only

Band	Rating Factor	Route Corridor A.1	Route Corridor A.2	Route Corridor A.2.1	Route Corridor A.3	Route Corridor A.4	Route Corridor A.4.1
0-50m	**4**	16	8	8	16	52	60
50-100m	**3**	12	9	12	3	24	12
Potential Impact Rating		**28**	**17**	**20**	**19**	**76**	**72**
Ranking		**4th**	**1st**	**3rd**	**2nd**	**6th**	**5th**

Table 8.5 (ii) shows that the four route corridors furthest away from Meelick and the surrounding ribbon development have the least impact on receptors within 100 metre corridors. The northern Route Corridor Options (Route A.4 and A.4.1) continue to have the greater impact. The variation in PIR for the receptors within 100m of the centreline in Section 1 is slight in comparison with those for all four bands.

Table 8.6 (i) PIR for Section 2 within 100 metres of the centreline only

Band	X – J - B	X – J – B	X – J – L – C	X – G – L – C	X – J – L –M – N – P – D	X – G – L –M – N – P – D	X – G – M – N – P -D	X – G – N – P - D
0-50m	190	191	58	56	18	17	13	21
50-100m	313	337	96	79	55	38	36	30

Table 8.6 (i) (cont'd) PIR for Section 2 within 100 metres of the centreline only

Band	X – J – L – M – N – O - E	X – G – L – M – N – O - E	X – G – M – N – O - E	X – G – N – O - E	X – J – L – M – N – O – P - D	X – G – L – M – N – O – P - D	X – G – M – N – O – P - D	X – G – N – O – P - D
0-50m	10	8	4	12	19	17	13	21
50-100m	31	14	11	6	55	38	35	30

Table 8.6 (ii) PIR for Section 2 within 100 metres of the centreline only

Band	Rating Factor	X – J - B	X – J – B	X – J – L – C	X – G – L – C	X – J – L –M – N – P – D	X – G – L –M – N – P – D	X – G – M – N – P - D	X – G – N – P - D
0-50m	**4**	760	764	232	224	72	68	52	84
50-100m	**3**	939	1011	288	237	165	114	108	90
Potential Impact Rating		**1699**	**1775**	**520**	**461**	**237**	**182**	**160**	**174**
Ranking		**15th**	**16th**	**14th**	**13th**	**11th**	**9th**	**6th**	**7th**

Table 8.6 (ii) (cont'd) PIR for Section 2 within 100 metres of the centreline only

Band	Rating Factor	X – J – L – M – N – O - E	X – G – L – M – N – O - E	X – G – M – N – O - E	X – G – N – O - E	X – J – L – M – N – O – P - D	X – G – L – M – N – O – P - D	X – G – M – N – O – P - D	X – G – N – O – P - D
0-50m	**4**	40	32	16	48	76	68	52	84
50-100m	**3**	93	42	33	18	165	114	105	90
Potential Impact Rating		**133**	**74**	**49**	**66**	**241**	**182**	**157**	**174**
Ranking		**4th**	**3rd**	**1st**	**2nd**	**12th**	**9th**	**5th**	**7th**

Table 8.6 (ii) does not show a great variation in PIR for the receptors within 100m of the centreline in Section 2 in comparison with those within 300m of the centreline. This analysis of receptors within 100m either side of the centreline continues to demonstrate that route corridor options that avoid areas of dense population have a much better PIR than those that are in close proximity to built up areas, such as Parteen, Athlunkard, Gortatogher and Cloonoughter within this Section.

8.3.2 Stage 2 - Assessment of Changes in Traffic Flow

Following completion of the Stage 1: Preliminary Options Assessment, the refined Route Options were further assessed in relation to Changes in Traffic Flow. Only the routes that progressed from the Stage 1: Preliminary Options Assessment to the Stage 2: Project Appraisal were assessed on this basis. The findings of this assessment are outlined below.

Table 8.7 below shows the links in the existing road network in close proximity to residential areas that will experience a change in traffic flow with each of the route corridors in place. This can be an increase or a reduction in traffic. Drawing RCSR-801 in Volume 2: Route Selection Report shows the locations of each of these road network links.

Table 8.7 Percentage Changes in Traffic Flow

Location	A1-B1 (B2)	A2 (A2.1) - B1(B2)	A4 (A4.1) - B1(B2)	A1-D1/E1	A2 (A2.1) -D1/E1	A4 (A4.1) - D1/E1
R445 - NTP	14.67%	14.67%	17.49%	-5.99%	-16.97%	-16.95%
R445 - Groody	-19.89%	-19.89%	-23.90%	-3.68%	-11.86%	-12.15%
R463	-33.97%	-33.97%	-30.94%	-20.96%	-18.83%	-20.03%
R494	-55.73%	-55.73%	-40.46%	-50.22%	-45.71%	-35.77%
Gilloge Road	-55.99%	-55.99%	-16.37%	-74.03%	-75.19%	-76.19%

Note: This table uses Traffic Volumes (AADT) for 2033 Design Year (Medium Growth)

As can be seen from the table above, Route Corridor Option A2.1-D1/E1 has the greatest benefit to the existing and already heavily congested R445 by reducing traffic levels by 17%. The R445 passes through the heavily urbanised areas of Castletroy, Kilmurry and Groody.

Due to the heavily urbanised areas adjacent to the R445 and the extent of receptors, the impact of the increase in traffic along the R445 from the routes docking at the Groody Valley roundabout are deemed to be least preferable. Furthermore, the routes to the north of Meelick and the surrounding ribbon development are also of low preference.

The preferred route option is Route A2.1 & Route D1/E1 as it avoids the built up areas of Meelick and Athlunkard while reducing traffic along the R445.

8.3.3 Assessment of the Likely Need for Mitigation Measures

Mitigation measures are deemed necessary when the following three conditions are satisfied at designated sensitive receptors:

(a) the combined expected maximum traffic noise level, i.e. the relevant noise level, from the proposed road scheme together with other traffic in the vicinity is greater than the design goal (60dB Lden);

(b) the relevant noise level is at least 1dB more than the expected traffic noise level without the proposed road scheme in place;

(c) the contribution to the increase in the relevant noise level from the proposed road scheme is at least 1dB.

These conditions will ensure that mitigation measures arising out of this process are based upon the impact of the scheme under consideration.

8.3.4 Ranking of Route Corridor Options

The ranking of the route corridor options considers the Potential Impact Rating (PIR), the likely need for mitigation measures and the relative benefits/disbenefits to the existing road network. Having considered each of the above headings the overall ranking of route corridor options in terms of noise and vibration is as follows:

Table 8.8 Section 1 Ranking

Route	Nodes	Length	Rank
A1-B1	A – F – X – J – B	8104	10
A1-B2	A – F – X – J – B	7986	6
A1-B.1/D.1/E.1	A – F – X – J – L – M – N – O – E	10780	2
A2.1-B1	A – X – J – B	7469	9
A2.1-B2	A – X – J – B	7351	5
A2.1-B.1/D.1/E.1	A – X – J – L – M – N – O – E	10145	1
A4-B1	A – G – H – X – J – B	9723	12
A4-B2	A – G – H – X – J – B	9605	8
A4-B.1/D.1/E.1	A – G – H – X – J – L – M – N – O – E	12399	4
A4.1-B1	A – G – H – X – J – B	9614	11
A4.1-B2	A – G – H – X – J – B	9496	7
A4.1-B.1/D.1/E.1	A – G – H – X – J – L – M – N – O – E	12290	3

Chapter 9 Air Quality

9.1 Introduction

AWN Consulting was commissioned by Roughan & O'Donovan to conduct an air quality route selection assessment for the route options proposed for Phase 2 of the Limerick Northern Distributor Road.

The Stage 1 route selection has considered six routes for the western section of the scheme between the Knockalisheen Road and the Tailrace Canal (Section 1) and sixteen routes for the eastern section of the scheme from the Tailrace Canal to the R445 (Section 2). For the Stage 1 assessment, the route options were ranked based on the number of sensitive buildings within 50m of the edge of each route, the greatest impact and least preferred route relating to that will affect the most buildings.

Following completion of the Stage 1: Preliminary Options Assessment the refined Route Options were further assessed during Stage 2 of the route selection process.

This report assesses the various route options from their points of deviation and presents the most favourable routes in terms of air quality impact.

9.2 Assessment Methodology

The National Roads Authority document entitled *"Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes"*[1] provides guidance on the route selection assessment procedures in *"Chapter 2 - Route Selection"*. The primary aspects of the assessment relate to existing ambient air quality, proximity of sensitive locations and a review of the overall significance of potential changes in air quality.

Sections 1 and 2 will both be assessed using a two-step process as part of the Stage 1 assessment of the various routes. The first step will compare specific sections of the routes with common start and end nodes. The second step will assess the complete route from the start of the section to the docking point. During each step, the route options compared will be ranked in order of preference.

9.2.1 Stage 1 Route Options Assessment

The methodology employed for the Stage 1 assessment is property counts undertaken using available mapping and aerial photography of the lands surrounding each of the route options. Sensitive ecosystems (designated sites) within 200m of each route were also taken into account when grading each of the routes although no methodology is available as to explicitly account for the presence of these areas.

9.2.2 Stage 2 Route Options Assessment

The objective at Stage 2 of the route selection process is to indicate whether there are likely to be significant air quality impacts associated with particular broadly defined routes. In the current assessment, the number of sensitive receptors within 50m of the edge of each route has been identified. Preliminary estimates of traffic data for the opening year of 2018 have been used in the model. A comparison of the proposed routes has been carried out based on a calculation of the Index of Overall Change in Exposure to NO_2 and PM_{10} resulting from each individual route. All route options are described in terms of the magnitude of their impact on air quality and assigned a relevant score in line with the NRA Project Appraisal Guidelines for

Secondary Road Projects. The scoring system for air quality is outlined in Table 9.1 below. This has been modified from the scoring system outlined in the NRA Project Appraisal Guidelines for Secondary Road Projects as there was no "Do Minimum" scenario for this project. Each route has also been assigned a preference rating in line with the NRA Project Management Guidelines 2010.

Table 9.1: Scoring System for Air Quality

Description	NO_x Exposure Index Range	Score Range
Highly Negative	≥ 75,000	1.0 to 1.5
Moderately Negative	≥ 25,000	1.5 to 2.5
Slightly Negative	> 500	2.5 to 3.5
Neutral	- 500 to 500	3.5 to 4.5
Slightly Positive	< -500	4.5 to 5.5
Moderately Positive	≤ -25,000	5.5 to 6.5
Highly Positive	≤ -75,000	6.5 to 7

9.3 Baseline Air Quality

9.3.1 Air Pollution Sources

The major existing source of air pollution within the Study Area is road traffic, predominantly that from the R464, R463 and R445. Air quality is variable and subject to significant spatial variation, with concentrations generally falling significantly with distance from major road sources[4]. The highest levels of air pollution are experienced close to the R445 with the remainder of the Study Area generally experiencing background concentrations of pollutants.

A review of IPPC licences issued by the EPA for the region has shown that there is one industrial facility with emissions to atmosphere in the Study Area[5]. This is Johnson and Johnson Vision Care Ireland trading as Vistakon Ireland and is located in Plassey. The facility must comply with emission limit values as stipulated in their IPPC licence.

9.3.2 Meteorological Data

A key factor in assessing temporal and spatial variations in air quality is the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e. traffic levels). Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM_{10}, the situation is more complex due to the range of sources of this pollutant, and thus measured levels of PM_{10} can be a non-linear function of wind speed.

The nearest representative weather station collating detailed weather records is Shannon Airport meteorological station, which is located approximately 17 km west of

the scheme. For data collated during five representative years (2000 – 2002, 2004 and 2005) the predominant wind ranges from southeast to northwest in direction. The mean wind speed is approximately 9.8 knots over the period 1961-1990.

9.3.3 Air Quality Zones in Ireland

As part of the implementation of the Framework Directive on Air Quality (1996/62/EC), four air quality zones have been defined in Ireland for air quality management and assessment purposes. Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 21 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000 is defined as Zone D. In terms of air monitoring, the majority of the Study Area is categorised as Zone D with the exception of the area south of the River Shannon which is Zone C.

9.3.4 EPA / Local Authority Monitoring Programmes

Air quality monitoring programs have been undertaken throughout Ireland in recent years by the EPA and Local Authorities. The most recent EPA annual report on air quality monitoring undertaken throughout Ireland is entitled *"Air Quality In Ireland 2010 - Key Indicators of Ambient Air Quality"*[7].

Although no EPA or Local Authority monitoring has been carried out within the Study Area, data from representative Zone C and Zone D locations in Ireland can be used to provide an indication of the prevailing air quality conditions.

9.3.5 Review of EPA Monitoring Data

The NRA Guidelines state that the local air quality assessment should focus on NO_2 and PM_{10}, as these are the pollutants of greatest concern with respect to road traffic conditions.

Long-term NO_2 monitoring is carried out at the two rural Zone D locations, Glashaboy and Kilkitt[7]. The NO_2 annual average in 2010 for both sites was 10 and 3 µg/m^3, respectively. The results of NO_2 monitoring carried out at the urban Zone D location in Castlebar in 2010 indicated an average NO_2 concentration of 10 µg/m^3[7], with no exceedences of the 1-hour limit value[7]. Hence, the long-term average concentration measured at this location was significantly lower than the annual average limit value of 40 µg/m^3. The concentrations at Kilkitt and Glashaboy would be broadly representative of the prevailing NO_2 concentrations at distances of 200m or greater from the major roads within the Study Area. Based on the above information, a conservative estimate of the current background NO_2 concentration in the Study Area away from existing roads is 11 µg/m^3. This corresponds to a current background NO_x concentration of 14 µg/m^3.

NO_2 monitoring was carried out at three Zone C locations in 2010. These locations were Limerick Park Road, Newbridge and Celbridge. The NO_2 annual average in 2010 for these sites ranged from 12 - 17 µg/m^3 [7]. The concentrations at the Zone C locations would be broadly representative of concentrations close to the R445 at the south-eastern section of the Study Area. Based on the above information, a conservative estimate of the current background NO_2 concentration close to the R445 is 17 µg/m^3. This corresponds to a current background NO_x concentration of 20.9 µg/m^3.

Long-term PM_{10} monitoring is carried out at the rural Zone D location of Kilkitt[7]. The average PM_{10} concentration measured at Kilkitt in 2010 was 10 µg/m^3. The results of

PM_{10} monitoring carried out at the urban Zone D locations of Longford and Castlebar in 2010 indicated average PM_{10} concentrations of 21 and 15 µg/m^3, respectively. Based on the above information, a conservative estimate of the current background PM_{10} concentration at distances of 200m or greater from the R445 in the Study Area is 20 µg/m^3.

Long-term PM_{10} measurements carried out at five Zone C locations of Galway, Newbridge, Celbridge, Ennis and Bray in 2010 gave average levels ranging from 13 to 27 µg/m$^{3(7)}$. Data from the Phoenix Park in Dublin also provides a good indication of urban background levels, with an annual average in 2010 of 11 µg/m$^{3(7)}$. Hence long-term average concentrations measured at these locations were significantly lower than the annual average limit value for PM_{10} of 40 µg/m^3. Based on the above information, a conservative estimate of the background PM_{10} concentration close to the existing R445 is 25 µg/m^3.

9.4 Stage 1 - Route Options Assessment

For the Stage 1 assessment, it is considered reasonable to rank the route options based on the number of sensitive receptors within 50m of each route to eliminate routes which will affect the greatest number of receptors. The tables below illustrate the preliminary route options ranking for each section. The route with the lowest property count is the one likely to experience the lowest air quality impact and is assigned the highest preference in relation to air quality.

Table 9.2: Preliminary Route Options Ranking Section 1

Nodes (Route)	Sensitive Receptors	Rank	Notes
A – F – X (Route A.1)	4	**3**	Medium Preference
A-X (Route A.2)	1	**2**	High Preference
A-X (Route A.2.1)	0	**1**	High Preference
A – F – X (Route A.3)	4	**3**	Medium Preference
A – G – H – X (Route A.4)	14	**5**	Low Preference
A – G – H – X (Route A.4.1)	14	**5**	Low Preference

Based on the Stage 1 assessment the preferred options in Section 1 from an air quality perspective are Route Options A2 and A2.1 (both A-X) which impact the lowest number of receptors. Route options A1 and A3 (both A-F-X) are "Medium Preference" as they impact a marginally higher number of receptors. All six Route Options have a similar impact on sensitive ecosystems encroaching on the Knockalisheen Marsh Proposed Natural Heritage Area (part of Lower River Shannon Special Area of Conservation).

The least preferred Route Options in Section 1 are Route Options A4 and A4.1 (both A-G-H-X) which impact the highest number of receptors. It should be noted that all Route Options for Section 1 of the proposed scheme impact on a relatively low number of residential receptors.

Table 9.3: Preliminary Route Options Ranking Section 2

Nodes (Route)	Sensitive Receptors	Rank	Notes
X – J – B (Route B.1)	5	**4**	High Preference
X – J – B (Route B.2)	7	**7**	Medium Preference
X – J – L – C (Route C.1)	32	**16**	Low Preference
X – K – L – C	31	**15**	Low Preference
X – J – L – M – N – P – D (Route D.1)	7	**7**	Medium Preference
X – K – L – M – N – P – D	6	**5**	Medium Preference
X – K – M – N – P – D (Route D.2)	2	**1**	High Preference
X – K – N – P – D	10	**12**	Low Preference
X – J – L – M – N – O – E	9	**11**	Medium Preference
X – K – L – M – N – O – E	8	**10**	Medium Preference
X – K – M – N – O – E	4	**3**	High Preference
X – K – N – O – E (Route E.1)	12	**14**	Low Preference
X – J – L – M – N – O – P – D	7	**7**	Medium Preference
X – K – L – M – N – O – P – D	6	**5**	Medium Preference
X – K – M – N – O – P – D	2	**1**	High Preference
X – K – N – O – P – D	10	**12**	Low Preference

Based on the Stage 1 assessment, the preferred options in Section 2 from an air quality perspective are Route Options B1 (X-J-B), D2 (X-K-M-N-P-D), Route Option X-K-M-N-O-P-D and Route Option X-K-M-N-O-E which all impact the lowest number of receptors. Route options B2 (X-J-B), D1 (X-J-L-M-N-P-D), X-K-L-M-N-P-D, X-J-L-M-N-O-E, X-K-L-M-N-O-E, X-J-L-M-N-O-P-D and X-K-L-M-N-O-P-D are "Medium Preference" as they impact a marginally higher number of receptors. All sixteen Route Options have a similar impact on sensitive ecosystems encroaching on the Lower River Shannon Special Area of Conservation.

The least preferred Route Options in Section 2 are Route Options C1 (X-J-L-C), E1 (X-K-N-O-E), X-K-L-C, X-K-N-P-D and X-K-N-O-P-D which impact the highest number of receptors. It should be noted that all Route Options in Section 2 of the proposed scheme impact on a relatively low number of residential receptors with the exception of Route Options C1 (X-J-L-C) and X-K-L-C.

9.5 Stage 2 - Route Options Assessment

Following completion of the Stage 1: Preliminary Options Assessment the refined Route Options were further assessed were fully assessed during Stage 2 of the route selection process.

9.5.1 Calculation of the Index of Overall Change in Exposure

The calculation of the Index of Overall Change in Exposure allows a comparison of the overall impact on people from each route to be carried out. The Index is based on identifying the number of sensitive receptor locations within 50m of the edge of all road links that would experience a significant change in traffic for each of the routes. The change in emissions is influenced by changes in traffic flow, composition and speed. The analysis was carried out using the methodology of the NRA using the UK DMRB air dispersion model.

Pollution from traffic sources increases at low traffic speeds and during congested traffic conditions. An improvement in the road infrastructure is likely to reduce traffic levels and congestion relative to the existing roads which travel through Limerick City. In addition, the number of receptors directly impacted by individual routes will be significantly less than the current impact along the existing R445 and other city centre routes.

A summary of the calculated Index of Overall Change in Exposure for the routes is provided in Table 9.4. The route option with the lowest exposure index is the preferred option from an air quality perspective, as it leads to the smallest increase in air pollution. The results of the Index of Overall Change in Exposure have been used to rank the route options in order of their potential impact on air quality as shown below in Table 9.5. All route options are described in terms of the magnitude of their impact on air quality and assigned a relevant score in line with the NRA Project Appraisal Guidelines for Secondary Road Projects. The scoring system for air quality is outlined in Table 9.1. Each route has also been assigned a preference rating in line with the NRA 2010 Project Management Guidelines.

Table 9.4: Summary of Index of Overall Change in Exposure for Each Route

Route (Nodes)	NO_x Exposure Index	PM_{10} Exposure Index	Ranking
Route 1 (A-X-J-B)	150619	3914	6
Route 2 (A-F-X-J-B)	41668	397	5
Route 3 (A-X-J-L-M-N-O-E)	-84534	-3852	1
Route 4 (A-F-X-J-L-M-N-O-E)	-77116	-3641	2
Route 5 (A-X-K-L-M-N-O-E)	-66157	-3216	3
Route 6 (A-F-X-K-L-M-N-O-E)	-56367	-2936	4

Table 9.5: Results of Stage 2 Air Quality Assessment

Route (Nodes)	Ranking	Description	Preference
Route 3 (A-X-J-L-M-N-O-E)	1	Highly Positive	Preferred
Route 4 (A-F-X-J-L-M-N-O-E)	2	Highly Positive	
Route 5 (A-X-K-L-M-N-O-E)	3	Moderately Positive	Intermediate
Route 6 (A-F-X-K-L-M-N-O-E)	4	Moderately Positive	
Route 2 (A-F-X-J-B)	5	Moderately Negative	Least Preferred
Route 1 (A-X-J-B)	6	Highly Negative	

Routes 1 and 2 would have a negative impact on ambient air quality. This negative impact is mainly caused by a significant increase in traffic along the existing R445 between Docking Points B and E with either Route 1 or 2 in place and therefore a high number of sensitive receptors identified along this link will experience increased air pollution.

The results show that Routes 3, 4, 5 and 6 would have a positive impact on ambient air quality with Route 3 being the preferred route from an air quality perspective.

9.6 Impacts on Sensitive Ecosystems

The EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the "Habitats Directive") requires an Appropriate Assessment to be carried out where the likelihood of significant effects on the European site cannot be excluded. The NRA requires the Air Quality Specialist to liaise with an ecologist on schemes where there is a European protected site within 2km of the route. However, as the potential impact of a scheme is limited to local level, detailed consideration need only be given to roads where there is a significant change to traffic flows (>5%) and the designated site lies within 200m of the road centre line. Where these two requirements are fulfilled, the assessment at the route selection stage involves a calculation of nitrogen oxides (NO_x) concentrations using the DMRB screening method and a calculation of dry deposition using the methodology of the NRA.

All six routes encroach on the Knockalisheen Marsh proposed NHA and the Lower River Shannon SAC in the townland of Quinspool at the western end of the scheme. Routes 1 and 2 traverse the Lower River Shannon SAC again at the eastern end of the scheme close to Dromroe and Routes 3, 4, 5 and 6 traverse the SAC near Ballyvollane. The UK DMRB air dispersion model was used to determine the impact of each of the routes on ambient levels of NO_x and dry deposition rates of nitrogen at the Knockalisheen Marsh proposed NHA and the Lower River Shannon SAC at the locations described above. The results of the assessment are detailed in Table 9.6.

Predicted NO_x concentrations are below the limit value for the protection of ecosystems for each of the routes assessed at the north-western end of the scheme close to Quinspool. Thus ambient NO_x concentrations resulting from the each individual route in this location will not have a significant impact on the Knockalisheen Marsh proposed NHA and the Lower River Shannon SAC.
Predicted NO_x concentrations are below the limit value for the protection of ecosystems for each of the routes assessed at the south-eastern end of the scheme

where all routes cross the Lower River Shannon SAC. However, the NO_x concentrations predicted ranged from 90 – 91% of the limit value for the protection of ecosystems. The NRA guidelines state in Appendix 9 that where the scheme is expected to cause an increase of more than 2 □g/m^3 and the predicted concentrations (including background) are close to, or exceed the standard, then the sensitivity of the habitat to NO_X should be assessed by the project ecologist.

The contribution of each route to the NO_2 dry deposition rate at the locations described above is also detailed in Table 9.6. The maximum NO_2 dry deposition rate from any route at the Lower River Shannon SAC is 0.8 Kg(N)/ha/yr in 2018. This reaches only 16% of the critical load for inland and surface water habitats of 5-10 Kg(N)/ha/yr. The maximum NO_2 dry deposition rate from any route at the Knockalisheen Marsh pNHA is 0.8 Kg(N)/ha/yr in 2018. This reaches only 8% of the critical load for moist and wet oligotrophic grasslands (*Juncus* meadows) of 10-20 Kg(N)/ha/yr(1).

Table 9.6: Impact of Routes on Sensitive Ecosystems – Predicted NOx Concentrations in 2018 at the Knockalisheen Marsh pNHA and Lower River Shannon SAC.

Route	Townland/Ecosystem	NO_x (µg/m^3) Note 1	NO_2 Dry Deposition Rate (Kg(N) /ha/yr)
Route 1 (A-X-J-B)	Quinspool, Lower River Shannon SAC and Knockalisheen Marsh pNHA	24.2	0.8
	Dromroe, Lower River Shannon SAC	27.2	0.7
Route 2 (A-F-X-J-B)	Quinspool, Lower River Shannon SAC and Knockalisheen Marsh pNHA	24.1	0.8
	Dromroe, Lower River Shannon SAC	27.2	0.7
Route 3 (A-X-J-L-M-N-O-E)	Quinspool, Lower River Shannon SAC and Knockalisheen Marsh pNHA	22.6	0.7
	Ballyvollane, Lower River Shannon SAC	27.4	0.7
Route 4 (A-F-X-J-L-M-N-O-E)	Quinspool, Lower River Shannon SAC and Knockalisheen Marsh pNHA	22.9	0.7
	Ballyvollane, Lower River Shannon SAC	27.3	0.7
Route 5 (A-X-K-L-M-N-O-E)	Quinspool, Lower River Shannon SAC and Knockalisheen Marsh pNHA	23.3	0.7
	Ballyvollane, Lower River Shannon SAC	27.0	0.6
Route 6 (A-F-X-K-L-M-N-O-E)	Quinspool, Lower River Shannon SAC and Knockalisheen Marsh pNHA	22.8	0.7
	Ballyvollane, Lower River Shannon SAC	26.9	0.6
Limit Value		30 Note 2	5-10 Kg(N)/ha/yr / 10-20 Kg(N)/ha/yr

Note 1 Including a conservative background NO_x concentration for 2018 of 9.8 µg/m^3 at Quinspool (Zone D) and 14.6 µg/m^3 at Dromroe and Ballyvollane (Zone C).

Note 2 EU Council Directive 2008/50/EC (as an annual average)

9.7 Opportunities for Mitigation

No mitigations measures are recommended at this stage as concentrations of NO_2, PM_{10}, $PM_{2.5}$, CO and benzene are not expected to exceed 90% of their limit values at any sensitive receptors along the proposed routes.

9.8 Conclusion

Six proposed routes were examined as part of this assessment. These six routes have been refined through a two stage route selection process. The results show that Routes 3, 4, 5 and 6 would all have a positive impact on ambient air quality with Route 3 being the preferred route from an air quality perspective. Routes 1 and 2 would have a negative impact on ambient air quality in the vicinity of the proposed scheme and are the least preferred from an air quality perspective. All six routes have a similar impact on sensitive ecosystems in the Study Area. The results of the Stage 2 route selection assessment for air quality are shown in Table 9.5 and repeated below:

Route (Nodes)	Ranking	Description	Preference
Route 3 (A-X-J-L-M-N-O-E)	1	Highly Positive	Preferred
Route 4 (A-F-X-J-L-M-N-O-E)	2	Highly Positive	
Route 5 (A-X-K-L-M-N-O-E)	3	Moderately Positive	Intermediate
Route 6 (A-F-X-K-L-M-N-O-E)	4	Moderately Positive	
Route 2 (A-F-X-J-B)	5	Moderately Negative	Least Preferred
Route 1 (A-X-J-B)	6	Highly Negative	

9.9 References

NRA (2011) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes.

(NRA (2011) Project Appraisal Guidelines, Unit 12: National Secondary Roads Projects.

NRA (2010) Project Management Guidelines.

UK DEFRA (2003) Design Manual for Roads and Bridges Vol 11 Chapter 3 (Document & Calculation Spreadsheet).

EPA (2011) http://www.epa.ie/whatwedo/licensing/ippc

World Health Organisation (2006) Air Quality Guidelines - Global Update 2005 (and previous Air Quality Guideline Reports 1999 & 2000)

EPA (2011) Air Quality in Ireland 2010 - Key Indicators of Ambient Air Quality (& previous annual reports 1997-2009)

EPA (2011) http://www.epa.ie/whatwedo/monitoring/air

Chapter 10 Ecology

10.1 Introduction

The objective of this chapter is to identify the principal ecological sites and constraints impacted by the various route options, and to provide a comparison between the options on the basis of potential impacts on the ecological environment.

Ecological sites have been identified from a variety of sources including the Constraints Study for the scheme, existing literature and data sets, consultations with statutory authorities and other sources holding records of protected species, and a review of the aerial photography.

10.2 Methodology

10.2.1 Consultations

A consultation meeting was held with the National Parks and Wildlife Service (NPWS) on the 12th April 2011 to discuss designated sites and protected species within the study area and specific survey requirements in relation to qualifying interests (both habitats and species). Following the initial surveys of the route alignments and detailed mapping of the vegetation in the vicinity of the Lower River Shannon Special Area of Conservation at Knockalisheen and along the river at Plassey, a second meeting was held to discuss the results on the 18th October 2011. As a result of queries raised during this meeting relating to the conformity of specific vegetation types to Annex listed habitats under the EU Habitats Directive, a site meeting was held with NPWS staff (Southern Divisional Ecologist, District Conservation Officer and Local Wildlife Rangers) to review riparian woodland habitats along the River Shannon. A summary of this visit was presented to the NPWS Scientific Officer responsible for woodlands (Dr. John Cross) to confirm the classification of riparian woodland habitats.

Inland Fisheries Ireland Shannon River Basin District (IFI) were consulted with regard to information on the fisheries value of watercourses crossed by the proposed routes.

BirdWatch Ireland (BWI) was consulted with regards to records of breeding owls and other birds of conservation concern from within the study area. Irish Wetland Bird Survey (IWeBS) data was also sourced from BWI in order to determine existing records of Whooper Swan from the study area (refer to IWeBS data, Appendix 10.2). Additional information on the distribution and abundance of Whooper Swans in the study area was requested from Graham McElwaine, head of the Irish Whooper Swan Study Group.

The Botanical Society of the British Isles (BSBI) recorders for County Clare (Dr Sharon Parr), and Limerick (Dr Sylvia Reynolds) were consulted with regards to records of rare or protected species of flora from within the study area.

Bat Conservation Ireland (BCI) was consulted with regard to existing records of bat activity including roosts, foraging and lekking sites from within the study area. A review of known bat roosts and bat activity within 10km of the proposed routes was conducted using the Bat Conservation Ireland database. Other bat specialists including members of Bat Conservation Ireland and the local Conservation Ranger with the National Parks and Wildlife Service (David Lyons) were contacted regarding any surveys or detector work that they had carried out in the area.

10.2.2 Field Surveys

Potential habitats of ecological value were identified from a review of aerial photography covering the study area (OSI 2005 imagery) in addition to reviewing available ecological literature including the Limerick Northern Distributor Route Constraints Study (ROD December 2010), Survey and Mapping of Habitats from Cratloe to Parteen, South East Clare, (RPS December 2008) and the Coonagh to Knockalisheen Distributor Road EIS (ROD June, 2010).

Habitats were visited in the field and surveyed to identify and map habitats in accordance with the Heritage Council Habitat classification (Fossitt, 2000). Particular emphasis was placed on mapping habitats within the Lower River Shannon Special Area of Conservation (SAC) to identify habitats listed as qualifying interests for the SAC or for their links with habitats listed on Annex I of the EU Habitats Directive (92/EEC/43). Surveys at these locations involved detailed vegetation community level surveys of wet grassland and wet woodland habitats in particular. The vegetation of the grassland habitats was surveyed in more detail following the National Grassland Survey (O'Neill et al. 2009) approach. The criteria for determining if a grassland habitat corresponds to an Annex I habitat is outlined in 'Appendix 5: Annex I assessment indicator species and criteria' of that report (ibid). Detailed vegetation surveys were undertaken by Katherine Duff at Knockalisheen and along the River Shannon in June 2011 and again in October 2011. While the latter survey was sub-optimal in terms of seasonality, the vegetation was sufficiently intact to allow determination of the key species.

The watercourses in the vicinity of the proposed crossing points of the various route options were surveyed for all protected aquatic species recorded from the areas or likely to occur. Surveys for salmon and lamprey species aimed to identify potential spawning and nursery habitat for, at and in the vicinity of crossing points on the River Shannon and Mulkear River. These surveys were undertaken by one instream operator using mask and snorkel while another bankside operator acted as data recorder and safety person. The survey was undertaken in July 2011 during a period of low flow in bright conditions. Determination of lamprey ammocoete beds was carried out by combined visual assessment and probing in suitable substrates. Substrate type, flow regime and water depth was recorded for each survey location.

Surveying for otter and kingfisher was undertaken during the summer period (July 2011) and in the winter period (November and December 2011) in order to determine potential variation in activity and to aid in the identification of holts and nest sites which may have been undetected by vegetation during the summer period. The survey area for both species extended up to approximately 300m either side of each route corridor. The survey aimed to identify active or potential otter holts along with all signs of activity including spraints, slides and couches. River banks over the study area were surveyed for Kingfisher nest holes or potentially suitable breeding sites (steep or vertical exposed sand and earth banks over the river). In addition to these dedicated surveys, continuous observation for signs or evidence of both species was maintained during all other field surveys undertaken along the riparian zone of each route option.

A dusk survey of potentially suitable habitat within the study area was undertaken in May 2011 to determine nesting or occurrence of barn owl and long-eared owl. The survey aimed to identify owl activity by picking up on the begging calls of juvenile birds, which would also confirm breeding status. The high-pitched calls of juvenile long-eared owls carries for up to 1km, though the wheezy calls of juvenile barn owls is audible only over a couple of hundred meters at most (dependant on background

noise levels). Adults of both species are generally silent apart from the beginning of the breeding season (normally in early spring).

A series of dedicated monthly surveys were carried out over the winter period (November 2011 to March 2012) for whooper swan. They surveys aimed to determine the range of a wintering flock known to periodically utilise lands to the east of the Mulkear River (in the vicinity of Route E.1) and to determine the importance of the Mulkear site for their foraging requirements. Existing sources of information on the flock were also used to identify the known range of the flock including key areas for both foraging and roosting. This included a review of IWeBS data and direct communication with the Irish Whooper Swan Study Group and NPWS district staff.

The monthly field survey involved visiting all known and potential foraging sites for the flock to locate the flock and thus identify the priority areas utilised over the course of the winter period. From the combined survey and desk data an interpolation of the location and importance of the foraging and roosting sites was made and potential interconnecting flight paths between sites was mapped. Information on influencing factors such as flooding, disturbance was also gathered to help interpret the results.

Bat detector surveys were carried out on key habitats and sites identified from a review of aerial photography and based on previous records of bat activity. All surveys were carried out in accordance with the National Roads Authority Ecological Surveying Techniques for Protected Flora and Fauna During the Planning of National Road Schemes (NRA, 2010).

Bat activity surveys at areas likely to be of interest for bats along the various routes and in the wider landscape were assessed using bat detectors. These included areas based on the habitats recorded within the constraints study and additional areas identified as part of the ecological surveys. The surveys were conducted by Faith Wilson and Conor Kelleher (licensed bat specialists) during July 2011. Dusk emergence activity focused on a property at Castlebank (R 580 613) which is located to the north of the proposed crossing point of all routes on the Ardnacrusha tail race below the hydro-scheme at Ardnacrusha.

These areas were visited during the survey and bat activity was recorded using two types of bat detectors (Heterodyne Bat Detector: Pettersson D100; Frequency Division Bat Detector: Bat Box Duet). Areas of suitable habitat were walked on foot listening for bats with the detectors. Sections of local roads in the vicinity of the routes were also driven slowly at night with the bat box mounted on the sun roof of the vehicle pointing upwards to record any bat passes. Bats were identified by their ultrasonic calls coupled with behavioural and flight observations.

10.2.3 Reporting

The NRA *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (Revision 2, 1st June 2009) recommends the following geographic frame of reference be used when determining value of the ecological resources:

- International importance
- National Importance
- County Importance
- Local Importance (higher value)
- Local Importance (lower value)

This method of evaluation was applied to the identified ecological receptors and serves the basis for assigning a preference for the various route options. The assessment is made without reference to potential mitigation.

10.3 General Description of Study Area

The study area primarily encompasses the south eastern extent of County Clare and a small area of northern County Limerick and Limerick City (refer **Drawing RCSR-3101 - Study Area**). It extends from Knockalisheen in the west to Annacotty in the east. Watercourses, both natural and man-made, dominate the area. The Lower River Shannon weaves its way through the study area in a westerly direction before entering the Shannon Estuary immediately west of Limerick. Within the study area the Shannon is intercepted by the Mulkear River, the River Blackwater and the Ardnacrusha Tailrace. The Ardnacrusha Headrace and the Errina Canal are also significant waterbodies in the study area.

The lands contained within the study area are primarily low lying floodplain which are used as pasture for cattle. The dominant habitat type is wet grassland. To the north west and above Knockalisheen the ground rises forming the hills of Ballycar South (255m) and Woodcock Hill (310m).

10.4 Designated Sites for Nature Conservation

10.4.1 Designated Sites within 10km

The Designated sites for Nature Conservation within the study area are mapped on **Drawing RCSR-1001 in Volume 2**. All designated sites within 10km are described in Table 10.1 below.

Table 10.1: Designated sites for Nature Conservation

Site name	Site code	Status	Description
Lower River Shannon	002165	SAC	Refer Section 10.4.2 below
Knockalisheen Marsh	002001	pNHA/SAC	Refer Section 10.4.3 below
River Shannon and River Fergus Estuaries	004077	SPA	Overwintering birds
Fergus Estuary and Inner Shannon (North Shore)	002048	pNHA	unknown
Inner Shannon Estuary (South Shore)	000435	pNHA	unknown
Woodcock Hill Bog	002402	NHA	Upland Blanket Bog
Glenomra Wood	001013	SAC/pNHA	Semi-natural Woodland
Gortacullin Bog	002401	NHA	Upland Blanket Bog
Castle Lake	000239	pNHA	unknown
Rosroe Lough	002054	pNHA	unknown
Loughmore Common Turlough	000438	pNHA	Turlough
Carrannon Wood	001012	pNHA	Semi-natural Woodland
Slievefelim to Silvermines Mountains	004165	SPA	Hen Harrier

The Lower River Shannon, which encompasses Knockalisheen Marsh pNHA and the Mulkear River, is the only designated site impacted by the proposed route options.

10.4.2 Lower River Shannon Special Area of Conservation

The Lower River Shannon candidate Special Area of Conservation (SAC) is a significant feature of the study area (refer **Drawing RCSR-1001**). This very large designated site encompasses the Shannon, Feale, Mulkear and Fergus Estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick), the freshwater stretches of much of the Feale and Mulkear catchments and the marine area between Loop Head and Kerry Head.

As a consequence of the size and extent of the site, covering marine, freshwater and terrestrial habitats it has been selected as a candidate SAC for a range of habitats listed on Annex I of the EU Habitats Directive. These are lagoons, alluvial wet woodlands, floating river vegetation, *Molinia* meadows, estuaries, tidal mudflats, Atlantic salt meadows, Mediterranean salt meadows, *Salicornia* mudflats, sand banks, perennial vegetation of stony banks, sea cliffs, reefs and large shallow inlets and bays.

The site is also selected for the following species listed on Annex II of the EU Habitats Directive – Bottle-nosed Dolphin, Sea Lamprey, River Lamprey, Brook Lamprey, Freshwater Pearl Mussel, Atlantic Salmon and Otter.

Habitats within the Lower River Shannon SAC

The proposed LNDR has a number of route options which cross the Lower River Shannon SAC at two locations:

a) **Plassey:** where the routes cross the River Shannon upstream and downstream of the University of Limerick. The banks of the River Shannon at this location are typically fringed with freshwater swamp (FS1), Marsh (GM1) and riparian woodland (WN5) with areas of wet grassland further inland.

b) **Knockalisheen**: where the routes cross the Knockalisheen Stream and adjacent swamp, marsh, riparian woodland and extensive areas of wet grassland.

The habitats within the SAC are illustrated on Drawings **RCSR-1003 – RCSR-1005**.

All of the woodland habitat within the SAC crossed by the proposed routes corresponds to the priority Annex I habitat ***'Alluvial forests (91EO)***, a qualifying interest for the Lower River Shannon SAC. The marsh along the floodplain of both the River Shannon and Knockalisheen Stream includes some areas of the Annex I habitat '***Hydrophilous tall herb fringe communities' (6430)***. This habitat is not a qualifying interest for the Lower River Shannon SAC.

Some of the grassland at Knockalisheen conforms to the Annex I habitat ***Molinia meadows on calcareous, peaty or clayey-silt laden soils (Molinion Caerulea) (6140).*** The remaining grassland areas within the SAC at Knockalisheen are classified as Wet Grassland (GS4) which includes elevated areas with impeded drainage to the west of Knockalisheen as well as the lower lying meadows to the north. These grasslands support a good diversity of species and while they include some of the indicator species associated with '***Lowland hay meadows (6510)***, there are not enough to meet the criteria for inclusion in this Annex I habitat type. There are also some areas of amenity grassland associated with football pitches to the south and west of the Ministry of Defence buildings at this location.

The Habitat types within the SAC are described in detail below and shown on **Drawings RCSR-1003 to RCSR-1005**. The relevee data collected in the field upon which the classification of the Annex habitats is based is presented in **Appendix 10.1**.

Swamp (FS1)

The swamp along the banks of the River Shannon is mainly dominated by reed canary grass (*Phalaris arundinacea*) with localised areas of common reed (*Phragmites australis*), reedmace (*Typha latifolia*), and (*Glyceria maxima*). It forms a fringe along the water's edge and adjoining low river bank. It varies in width from 2m wide to approximately 15m wide, but is mostly a narrow band of less than 5m.

At Knockalisheen, at the northern end of the site there is an extensive area of reedmace swamp dominated by (*Typha latifolia*) and horsetail (*Equisetum fluviatile*) on floodplain adjacent to the Knockalisheen Stream.

Marsh (GM1)

The swamp vegetation along the River Shannon grades into marsh higher up the river bank. This vegetation is still subject to flooding though less frequently than the swamp. Reed canary grass is still frequent with the occurrence of a diversity of other herbaceous species including occasional water dropwort (*Oenanthe crocata*), meadow sweet (*Filipendula ulmaria*), willowherb (*Epilobium hirsutum*), Iris (*iris pseudacorus*), nettle (*Urtica dioica*), wild turnip (*Brassica rapa*) and (*Poa trivialis*). The invasive alien plants Canadian balsam (*Impatiens glandulifera*) is frequently dominant within this habitat along with locally abundant giant hogweed (*Heracleum mantegazzianum*). The substrate is alluvial silty, sandy loam and is moist. This habitat becomes colonised with sapling woody species; willows (*Salix spp*.) and alder (*Alnus glutinosa*) over time.

There are three locations of tall herbaceous marsh vegetation dominated by meadowsweet with some of the above species and also horsetail (*Equisetum arvense*), bindweed (*Calystegia sepium*) and purple loosestrife (*Lythrum salicaria*) which correspond to the Annex I habitat ***Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430),*** as listed in the EU Habitats Directive and described in the *Irish Semi-natural Grassland Survey* (O'Neill et al. 2009). It includes the diagnostic and differential species listed in the Filipendulion vegetation alliance (White and Doyle, 1982). This habitat is crossed by Routes A2 and A3. This habitat is not listed as a qualifying interest of the SAC.

Riparian woodland (WN5)

The woodland growing on alluvial substrate along the low-lying river banks of the River Shannon and the Knockalisheen Stream has a canopy dominated by alder and willow species (which include *Salix alba, S. fragilis, S. cinerea* and *S. viminalis* and likely hybrids of the latter). The ground flora includes many of the marsh species listed above. On the landward side of this habitat where the substrate is somewhat drier other species such as angelica (*Angelica sylvestris*), meadowsweet, remote sedge (*Carex remota*), cleavers (*Galium aparine*), bramble (*Rubus fruticosus aggr*.) and giant hogweed are found as well. Where the canopy is fairly open, there is a greater extent of marsh vegetation beneath. Trees are up to 15m high, and are mainly semi-mature to mature (15–30cm diameter at breast height), though there is considerable variation at different locations.

This habitat is described in *The Classification of Native Woodlands in Ireland* (Cross 2010) under sub-type ***Salix-Urtica*** **(SU)** and corresponds to the Priority Annex I

habitat ***Alluvial Forest with Alnus Glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0)***, as listed in the EU Habitats Directive and described in the Interpretation Manual of European Union Habitats (2007). The extent of the habitat along the River Shannon bank is generally from 8m-20m wide and is usually delimited on the landward side by an embankment and pathway. Ash (*Fraxinus excelsior*) trees may be also be found close to the embankment. There is a wider band of alluvial woodland (40-60m) along the southern bank of the Shannon in the vicinity of Route D.1 crossing. At Knockalisheen, the alluvial woodland is widest (up to 60 m wide) at the northern end of the site where it is crossed by Routes A2, and A3. Where A.2.1 crosses the stream, the riparian vegetation is comprised of a treeline of alder and willow along a section of steep river bank.

Wet grassland (GS4)

Two of the proposed River Shannon crossings traverse areas of wet grassland, adjacent to the northern bank of the river near Castletroy. The grassland situated on former floodplain is a lush meadow with vegetation height 90cm. Meadow foxtail (*Alopecurus pratensis*) is abundant, along with meadowsweet, sweet vernal grass (*Anthoxanthum odoratum),* red fescue (*Festuca rubra*), ribwort plantain (*Plantago lanceolata),* greater bird's foot trefoil (*Lotus pedunculatus*), red clover (*Trifolium pratense*) and buttercup (*Ranunculus acris)* among others. It has some of the species associated with lowland hay meadows. The grassland area traversed by Route D.1 is at a slightly lower elevation and the vegetation is typical of a wetter soil as indicated by the presence of jointed rush (*Juncus articulatus)*, two-ranked sedge (*Carex distica*) and occasional iris. Although this habitat has very few of the negative species associated with agricultural intensification and has a good diversity of grasses and herbs, it does not have enough of the positive indicator species as outlined in O'Neill et al. (2009) to classify as the EU Annex I habitat ***Lowland hay meadows (6510).***

At Knockalisheen, the grassland west of Knockalisheen Stream occurs on poorly drained soil which slopes to the north towards the stream. It is generally very species rich with a good diversity of grasses, rushes, sedges and herbs including sweet vernal grass*,* red fescue Yorkshire fog *(Holcus lanatus),* rough meadow grass *(Poa trivialis},* creeping bent grass (*Agrostis stolonifera)*. Rushes (*Juncus acutiflorus)* are locally frequent as well as occasional soft rush (*J. Effusus)* and heath wood rush *(Luzula multiflora)*. Among the sedges are *Carex flacca, C. panacea, C. hirta, C. ovalis* and *C. nigra* with occasional pale sedge *Carex pallescens*. There is a good diversity of herbs including ragged robin (*Lychnis floscuculi*) and rarely marsh orchid (*Dactylorhiza maculata*). Also greater bird's foot trefoil, meadow buttercup*,* self-heal *(Prunella vulgaris),* silverweed *(Potentilla anserina),* lady's smock *(Cardamine pratensis),*marsh bedstraw *(Galium palustre),* meadowsweet, sorrel *(Rumex acetosa),* meadow vetchling *(Lathyrus pratensis),* and red clover *(Trifolium pratense)*. Yellow rattle (*Rhinanthus minor)* and fleabane *(Pulicaria dysinterica)* are local. The moss cover is locally frequent and includes mainly *Calliergonella cuspidata* with occasional *Rhytidiadelphus squarrosus* and *Brachythecium rutabulum*.

While purple moor grass (*Molinia caerulea)* does not occur within the grassland, localised areas have enough positive indicator species as identified by O'Neill et al. (2009) to correspond to the Annex I habitat ***Molinia meadows on calcareous, peaty or clayey-silt laden soils (Molinion Caerulea) (6140)***. Those areas that do not support a sufficient number of indicator species are classified as Wet Grassland (GS4).

On the steeper slopes at Knockalisheen, the grassland community is comprised of drier species, with a reduction in the abundance of rushes and many of the sedges and an increase in the cover of grasses including crested dogs-tail (*Cynosurus cristatus),* and sweet vernal grass*,* along with ribwort plantain *(Plantago lanceolata)* and cat's ear (*Hypochaeris radicata)*. Drainage works to a field south of the Refugee Centre have altered the grassland composition and the drainage channels expose the soil profile which includes a shallow brown silty loamy substrate with underlying marl.

There is another wetter marshy grassland on low-lying former floodplain at the southern end of the Knockalisheen site traversed by Route A.1 and also behind the north bank of the River Shannon at Route D.1 Here the grass *Alopecurus pratensis* dominates reaching a height of >90cm. *Juncus acutiflorus* is frequent and at Route D.1 *Carex distica* occurs. There is a good proportion of herbaceous species notably iris and meadowsweet, however there is much less overall species diversity and it does not correspond with the Annex I habitat '***Lowland hay meadows' (6510).***

10.4.3 Knockalisheen Marsh proposed Natural Heritage Area

Knockalisheen Marsh proposed Natural Heritage Area (pNHA) is located at the western end of the study area. The pNHA is included within the larger Lower River Shannon SAC and is therefore addressed under 10.4.2 above.

10.4.4 Consideration of European Sites

European sites warrant additional consideration over and above other designated conservations areas. The Habitats Directive requires an 'appropriate assessment' to be carried out where a development is likely to have a significant impact on an SAC or SPA. On that basis it is important to note that 'significant impact' relates to the impacts on the site selection features and their associated conservation objectives. Any impact on these is likely to result in a negative finding in the appropriate assessment, which in turn requires the examination of alternative solutions, or, in the absence of alternative solutions, the identification of 'imperative reasons of over-riding public interest'.

10.5 Non Designated Sites of Nature Conservation Importance

A total of 16 non-designated sites of ecological importance have been identified within the study area. A summary of the ecological interests of these sites and their ecological evaluation is presented in Table 10.2, below and shown on **Drawing RCSR-1006**. In addition to these sites, there are networks of hedgerows and treelines in a number of locations across the study area which would be impacted by some or all of the route options. The impacts on these features are considered primarily in relation to habitat fragmentation as the level of survey at this stage of process has not extended to include survey of field boundaries and their associated flora and fauna. This network of features will support a variety of associated higher and lower plant life, along with resident and migratory populations of invertebrates, birds and mammals. Their importance extends to include foraging, roosting and breeding habitat, as well as functioning as a corridor for movement between other areas of ecological value.

Table 10.2: Ecological Sites within the Study Area

Site	Site Name	Description	Evaluation
1	Cappateemore West	Dominated by oak/birch/holly woodland (WN1) along stream valley (corresponds to the Annex I habitat 'old sessile oak woods with *Ilex* and *Blechnum* in the British Isles'). Some mixed broadleaved woodland (WD1) on upper fringe.	C
2	Cappateemore	Willow, gorse, hawthorn and blackthorn scrub (WS1) along minor stream valley.	D
3	Ballycannan	Wet woodland (WN6) within stream valley with Ash, hazel & willow (WN2) on upper slopes.	C
4	Ballycannan South	Treeline along road listed as TPO dominated by semi-mature ash to c20m in height.	C
5	River Shannon SAC	See Section 9.4.3 above for detail.	A
6	Ardnacrusha / Castlebank	Oak, ash, hazel dominated woodland with willow, alder and birch (WN2) along tailrace. Extensive mixed woodland (WD1) with network of mature treelines within Castlebank Estate to west of tailrace.	C
7	Cloonoughter North	Two areas of neglected pasture with dry neutral / wet grassland (GS3/4) and developing scrub (WS1).	D
8	River Blackwater	Wet woodland (WN6) dominated by alder and willow with ash, along upper part of Blackwater River. Some wet grassland (GS4).	C
9	Rosmadda	Area of neglected pasture with dry neutral / wet grassland (GS3/4) and developing scrub (WS1).	D
10	Derryfadda	Large site (48ha) of Raised Bog (PB1) with mosaic of cut-over recolonizing bog (PB4), Atlantic Wet Heaths (HH3), developing Bog Woodland (WN7) and 'Depressions on peat substrates of the *Rhynchosporion*'.	B
11	Errina Canal & Blackwater River corridor	Linear woodland dominated by alder, willow and ash (WN6) with mosaic of dry grassland (GS3) along Errina Canal and Blackwater River.	C
12	Errina Canal	Linear woodland dominated by alder, willow and ash (WN6) with mosaic of dry grassland (GS3) and scrub (WS1) along upper Errina Canal	C
13	Cloonoughter South	Area of neglected pasture with dry neutral / wet grassland (GS3/4) and developing scrub (WS1).	D
14	Castletroy	Mosaic of neglected pasture with dry neutral / wet grassland (GS3/4) and developing scrub (WS1).	D
15	Castletroy West	Linear belt of wet woodland (WN6) dominated by alder & willow with occasional beech.	D
16	Dromore	Area of filled land with mosaic of dry neutral / wet grassland (GS3/4) and developing alder – willow scrub (WS1). South-western corner used as compensatory Alluvial Woodland Habitat for Pedestrian Bridge at University of Limerick.	D/C
17	Mountshannon	Block of mixed woodland (WD1) around artificial pond (FL8)	D

10.6 Fisheries and the Aquatic Environment

10.6.1 Fisheries

The Lower River Shannon SAC extends from Killaloe to Loop Head, a distance of approximately 120km. The stretch of the River Shannon between Killaloe and Limerick is entirely fresh water. The tail race of the Ardnacrusha Hydro-electric Power Plant is not part of the Lower River Shannon SAC thought he SAC includes the Mulkear River which is crossed by the Link E.1 to D.1. The tailrace runs in a generally north-south direction dividing the study area in two with all routes crossing in the same general location. The qualifying interests for the SAC includes a number of freshwater species listed on Annex II of the Habitat's Directive, namely River Lamprey, Brook Lamprey, Freshwater Pearl Mussel and Atlantic Salmon.

The River Shannon supports an important salmon fishery at Castleconnell which is owned and controlled by the Electricity Supply Board (ESB). The river receives large runs of fish and a fish lift at Ardnacrusha provides upstream passage for migrating salmon that run up the tailrace. Spawning habitat for salmon, sea lamprey, river lamprey and brook lamprey occurs on the Shannon in the vicinity of Plassey, mainly in the vicinity of the island chains where flow is constricted and the gradient of the river increases. There is no spawning habitat at the route crossings of E.1, D.1 or C.1 where the flow is a gentler glide, though immediately downstream of C.1 the flow increase and suitable flow regime and substrate occurs for spawning by both salmon and lamprey. The river in the vicinity of route options B.2 and B.1 is deep (2-3m) with a slack flow and no spawning habitat occurs in this area or further downstream.

Smelt, one of the rarest fish in Ireland is found in the Shannon and Fergus Estuaries has its principal spawning area within the Tailrace. The ESB has previously operated a commercial eel fishery on the tailrace and will require continued access to this facility.

The River Mulkear which flows into the Shannon upstream of Plassey (between Route E.1 and D.1), rises in the Slievefelim and Silvermines mountains in North Tipperary. Its catchment area covers approximately 650km^2. The Mulkear catchment is a renowned grilse fishery; although spring fish are also caught. The Mulkear River is ranked as one of Ireland's most populated salmon rivers and is home to approximately 15 fish species along with lamprey, eel and the native White-clawed crayfish. The river is also an important habitat for the kingfisher (listed under Annex I of the EU Birds Directive). The Lower River Mulkear is also a coarse fishery of match standards. The flow regime in the vicinity of option E.1 to D.1 link crossing point is a glide flow with a sandy substrate and does not provide suitable spawning habitat for salmon or lamprey.

The Blackwater River is a trout fishery and has some valuable spawning habitat for trout along its reaches in the vicinity of the route crossings. This habitat may also support spawning by both river lamprey and brook lamprey. The Errina Canal and Knockalisheen Stream also support trout though are not subject to regular angling activity. The other watercourses crossed by the various route options are minor streams with limited fisheries value though likely to support populations of minnow and stickleback.

Table 10.3 presents a brief description of the watercourses crossed by the proposed route and their evaluation. The water courses are indicated on **Drawing RCSR-1006.**

Table 10.3 Watercourses Crossed by the Route Options

Watercourse Number	Site Name	Description	Evaluation*
W1	Cappateemore	Minor stream with limited fisheries potential	D
W2	Knockalisheen tributary	Minor stream with limited fisheries potential	D
W3	Ballycannan Stream	Minor stream with limited fisheries potential – forms Knockalisheen Stream	D
W4	Ballycannan tributary	Minor stream with no fisheries potential – dries completely.	E
W5	Knockalisheen Stream	Medium sized stream with resident population trout and spawning habitat	C
W6	Castlebank Stream	Minor stream with limited fisheries potential	D
W7	Shannon Tailrace	Smelt, one of the rarest fish in Ireland has principal spawning area in the Tailrace. Important movement of salmon.	B
W8	River Blackwater	Important trout population with good spawning and nursery habitat.	C
W9	Errina Canal	Supports stocks of trout with limited spawning areas.	C
W10	River Shannon	Internationally important salmon river with spawning by salmon and all three lamprey species in reaches around Plassey.	A
W11	Mulkear River	Ranked as one of Ireland's most populated salmon rivers and supports approximately 15 fish species along with white-clawed crayfish.	A
W12	River Groody	Locally important river with resident trout population with good spawning and nursery habitat.	D/C
W13	Athlunkard Stream	Minor stream with limited fisheries potential	D

Evaluation; A = International, B = National, C = County, D = High Local, E = Low Local

10.6.2 Existing Water Quality

The EU Water Framework Directive 2000/60/EC was adopted in 2000 and implemented in 2003 on a National Level. It requires that all water bodies achieve "good" ecological status by 2015 and that this status does not deteriorate. Ecological status is determined by a Biological Quality rating system - the Q value system.

The Environmental Protection Agency (EPA) online Water Quality list several monitoring stations which provide biological water quality data on the main rivers within the area. A water quality survey was conducted by the EPA throughout Ireland in 2008 and this is currently the most up to date information available. Data was taken at Cloon and Commons above Castleconnell for the River Shannon. Results from here indicated that the water quality was of moderate status (a Q value of 3 – 4). Data was taken for the Mulkear River where the recently completed M7 crosses over the river. Results indicate that the quality of this river is of good status (a Q value of 4).

For the River Blackwater, data was taken at River Crossing Point on the "The Lough Derg Way". Results indicated that the water quality here is of high status (Q5).

10.7 Invasive Species

The Zebra mussel (*Dreissena polymorpha*) has become a national pest and is now found throughout the main River Shannon and its associated lakes. A number of other alien invasive species occur within the general study area including giant hogweed, Himalayan balsam and Japanese knotweed. It is important that the potential for further expansion of these species is kept at a minimum and appropriate mitigation measures are put in place during the construction or any associated works for the LNDR.

10.8 Protected Species

10.8.1 Desk Study Record

Records of protected species of flora and fauna were sourced from NPWS, IFI, the National Biodiversity Data Centre and Bat Conservation Ireland. The Botanical Society of the British Isles data recorders from Clare and Limerick were also requested to provide records of rare plants. A record for the Flora Protection Order listed species opposite-leaved pondweed (*Groenlandia densa*) occurs from the Groody River which flows into the River Shannon approximately 150m downstream of Route option B.1. This record dates from 2006 (S. Reynolds pers. com.). Opposite-leaved pondweed occurs in slow-flowing waters, typically canals or in pool-like conditions. It is also recorded from the Abbey River and the Corbally Canal.

Table 10.4 below, lists protected fauna recorded from the general study area, and gives their conservation status and legal protection

Table 10.4: Protected Fauna from the Study Area

Scientific Name	Common Name	Conservation Status	Legal Protection
Pipistrellus pipistrellus	Common Pipistrelle	Internationally Important	Annex IV; Wildlife Acts
Pipistrellus pygmaeous	Soprano Pipistrelle	Unknown	Annex IV; Wildlife Acts
Myotis daubentii	Daubenton's Bat	Internationally Important	Annex IV; Wildlife Acts
Nyctalus leisleri	Leisler's Bat	Internationally Important	Annex IV; Wildlife Acts
Rhinolophus hipposideros	Lesser-horseshoe Bat	Internationally Important	Annex II; Wildlife Acts
Lutra lutra	Otter	Internationally Important	Annex II + IV; Wildlife Acts
Meles meles	Badger	Internationally Important	Wildlife Acts
Martes martes	Pine Marten	Internationally Important	Annex V; Wildlife Acts
Lepus timidus subsp hibernicus	Irish Hare	Internationally Important	Annex V; Wildlife Acts
Mustela erminea subsp hibernica	Irish Stoat	unknown	Wildlife Acts

Scientific Name	Common Name	Conservation Status	Legal Protection
Cygnus cygnus	Whooper Swan	Internationally Important	Annex I (Birds Dir.); Wildlife Acts
Alcedo athis	Kingfisher	Internationally Important	Annex I (Birds Dir.); Wildlife Acts
Tyto alba	Barn owl	Unknown	Wildlife Acts. Red list – Birds of Conservation Concern
Asio otus	Long-eared owl	Unknown	Wildlife Acts.
Zootoca vivipara	Common Lizard	Unknown	Wildlife Act
Rana temporaria	Common Frog	Internationally Important	Annex V; Wildlife Acts
Lissotriton vulgaris	Smooth Newt	Unknown	Wildlife Acts
Lampetra fluviatilis	River lamprey	Indeterminate	Annex II + V
Petromyzon marinus	Sea Lamprey	Indeterminate	Annex II
Lampetra planeri	Brook Lamprey	Indeterminate	Annex II
Osmerus eperlanus	Smelt	Vulnerable	

Table 10.5 lists the protected plant species which have been recorded from the 10km squares within which the study area lies.

Table 10.5: Protected Flora from the 10km squares

Scientific Name	Common Name	Conservation Status	Legal Protection
Groenlandia densa	Opposite-leaved pondweed	Vulnerable	Flora Protection Order
Hordeum secalinum	Meadow Barley	Vulnerable	Flora Protection Order
Schoenoplectus triqueter	Triangular Clubrush	Vulnerable	Flora Protection Order
Scleranthus annuus	Annual Knawel	unknown	Flora Protection Order

10.8.2 Bats

All Irish species of bats are strictly protected under both the Wildlife Act (1976, amended 2000), the Bern and Bonn Convention and under Annex IV of the EU Habitats Directive.

Lesser Horseshoe Bat

The proposed routes are within the known range of the lesser horseshoe bat (*Rhinolophus hipposideros*). This species is restricted in its distribution to the west of Ireland and is found in Counties Mayo, Galway, Clare, Limerick, Kerry and Cork (Kelleher, 2004). This species is given additional protection under Annex II of the EU Habitats which requires member states to designate Special Areas of Conservation for the species.

No records of any lesser horseshoe bat roosts are located within the study area defined for the various routes. The closest known lesser horseshoe roost is at Doonass Demesne which is just below Castleconnell on the River Shannon (c.3.7km from Castletroy to the N/NE of the proposed routes) and a number of lesser horseshoe bat roosts are known from around Sixmilebridge village, which is located to the west of the route. The closest of these roosts is 6.8km from Knockalisheen. An additional roost of lesser horseshoe is located c.9km to the south of the study area at Ballynagarde.

Table 10.6: Known lesser horseshoe bat roosts within a 10km radius of the proposed routes (Source: Bat Conservation Ireland database)

Grid Ref	Name	Comment
R 64 59	Mountshannon House, Mountshannon, Co. Limerick	c.2km to the NE of Castletroy
R 64 61	Doonass, Castleconnell, Co. Limerick	c.3.7km from Castletroy to the N/NE
R 61 48	Ballynagarde, Co. Limerick	c.9km to the south of the old N7
R 49 64	Ballyrogan, Cratloe, Co. Clare	c. 6.8km west from Knockalisheen

Nathusius's pipistrelle

The rare Nathusius's pipistrelle (*Pipistrellus nathusii*) has at present not been recorded from either Co. Clare or County Limerick (Bat Conservation Ireland database) but has been recorded from Co. Tipperary (Brian Keeley, pers. comm.).

Records of bat roosts in close proximity to the proposed routes.

There was a former roost of brown long-eared bats (*Plecotus auritus*) from the grounds of the University of Limerick, Dromore, Co. Limerick (Conor Kelleher, pers. comm.). This roost was subsequently excluded under a bat derogation licence as part of developments in the University. Other bats recorded from the general vicinity of the university include common (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmaeus*), Leisler's bat (*Nyctalus leisleri*), Daubenton's bat (*Myotis daubentonii*), Natterer's bat (*Myotis nattereri*) and brown long-eared bat (Conor Kelleher, pers. comm. and Niamh Roche, pers. comm.).

Table 10.7: Previously known bat roosts within close vicinity to the proposed routes (Source: Bat Conservation Ireland database)

Grid Ref	Name	Species	Comment
R 61 58	Private residence, University of Limerick, Dromore, Co. Limerick	*Plecotus auritus*	Roost subsequently demolished under bat derogation licence
R61 58	Black Bridge area of University of Limerick, Dromore, Co. Limerick	*Myotis daubentonii*	Roost not defined but within vicinity of Black Bridge.

Records of bat activity within 10 km of the routes

Bats recorded from a 10km radius of the wider study area are documented from a variety of data sources. These include reports prepared by licensed bat specialists and ecological consultants, records of activity recorded during Bat Conservation Ireland projects such as the BATLAS 2010 project and the All Ireland Daubenton's Bat Waterways Survey and other records collated in the Bat Conservation Ireland Database. Bats recorded from the grounds of the University of Limerick by Conor Kelleher (during 2004 and 2005), and during the BATLAS 2010 project in this area include;

- soprano pipistrelle;
- common pipistrelle;
- Daubenton's bat;
- Brown long eared bat;
- Leisler's bat;
- Unidentified *Myotis* sp.

Elsewhere in Limerick City the BATLAS 2010 project and other EIS studies recorded;

- soprano pipistrelle;
- common pipistrelle;
- Leisler's bat.

The BATLAS 2010 project also recorded a good diversity of species from the general area. These include:

- Daubenton's bat and common pipistrelle from Parkroe north of Ardnacrusha;
- Leisler's bat and whiskered/Brandt's bat) from Cloonlara upstream of Ardnacrusha;
- Daubenton's bat, Leisler's bat and soprano pipistrelle from Doorass near Castleconnell;
- Daubenton's bat and Leisler's bat from upstream on the Blackwater River near Killally's Bridge;
- soprano pipistrelle at Kilmore;
- Daubenton's bat, common pipistrelle, soprano pipistrelle and Leisler's bat were recorded from the Mulkear River.

Bats recorded as part of the pre-construction bat survey for the southern Limerick ring road (Conor Kelleher, pers. comm.), include:

- Daubenton's bat;
- common pipistrelle;
- soprano pipistrelle;
- Leisler's bat.

High levels of Daubenton's bat activity have been recorded in the vicinity of Black Bridge at Plassey (Elaine Keegan NPWS pers. comm.) and it is likely that a roost for this species is located nearby, possibly in the ruined Plassey Mills on the south bank.

Confirmed and potential roosts

The detector survey confirmed an important roost of several bat species at Castlebank (R 580 614) and good levels of bat activity across the general landscape impacted by the proposed routes. Surprisingly no Leisler's bats were recorded during the field surveys but are known from the area from other surveys.

The house and estate buildings at Castlebank offer unlimited potential for roosting bats and common and soprano pipistrelle were recorded emerging from the southern gable end of the house, while brown long-eared emerged from the western side of the roof. Natterer's bat was recorded foraging below mature trees adjoining the avenue and a lesser horseshoe bat was briefly recorded twice on the detector and seen once within the yards adjoining the house. Suitable roosting habitat for both the latter species exists within the site.

Castle Troy on the banks of the River Shannon (at R 628 586) has potential both as a maternity roost and hibernation site for bats.

The location of known and potential bat roosts are indicated on **Drawing RCSR-1006**.

Areas of importance for foraging and commuting bats

The main watercourses in the area (River Shannon, River Blackwater, River Mulkear, Errina Canal, Ardnacrusha tailrace) as well as smaller watercourses such as local streams at Cappateemore West, Cappatee, and Ballycannan, are all important features in the landscape for bats providing connectivity across open areas as well as important commuting routes and foraging areas.

Soprano pipistrelle and Daubenton's bat were recorded foraging over the Ardnacrusha tailrace at Parteen south of Castlebank and additional species such as those recorded from Castlebank would also be expected along this watercourse. Activity levels were low at the time of survey on this watercourse but the mature trees and watercourse provide rich hunting ground s for bats.

Foraging soprano pipistrelle and Daubenton's bat were recorded over the Blackwater River and were joined by Natterer's bat along the Errina Canal at the southern end of the Blackwater River/Errina corridor.

Species recorded along the River Shannon within the grounds of the University of Limerick included foraging common and soprano pipistrelles and Daubenton's bat. Leisler's bat and other unidentified Myotis species in addition to brown long eared bat have been recorded from here in the past.

Soprano and common pipistrelle were recorded on a widespread basis across the landscape crossed by the various route and were commonly encountered along local roads. They would be expected to be recorded foraging along most hedgerows and treelines across the study area as depicted in Drawing No. CS – 903 prepared as part of the constraints study.

Details on the observations made are summarised below in Table 10.8 and coupled with the existing data held by Bat Conservation Ireland has allowed the status of bats in the study are to be determined (Table 10.9).

Table 10.8: Bat activity recorded at the identified ecological sites during the detector survey of the various route options

Site Number	Site Name	Bat fauna recorded
1	Cappateemore West	Foraging common and soprano pipistrelle in the general area.
2	Cappateemore	Foraging common and soprano pipistrelle in the general area.
3	Ballycannan	Foraging common and soprano pipistrelle in the general area.
4	Ballycannan South	Foraging common and soprano pipistrelle in the general area.
5	River Shannon SAC	Foraging common and soprano pipistrelle, Daubenton's bat were recorded. Other species previously recorded from the grounds of the University of Limerick adjoining the River Shannon include; Leisler's bat , Natterer's bat and brown long-eared bat.
6	Ardnacrusha / Castlebank	Important site for roosting bats – common and soprano pipistrelle, brown long-eared bat, Natterer's bat and lesser horseshoe bat as well as important foraging area and commuting route along the tailrace and mature treelines in the area (soprano pipistrelle and Daubenton's recorded).
7	Cloonoughter North	
8	River Blackwater	Foraging soprano pipistrelle and Daubenton's bat.
9	Rosmadda	Foraging common and soprano pipistrelle in the general area.
10	Derryfadda	
11	Errina Canal & Blackwater River corridor	Foraging soprano pipistrelle, Natterer's and Daubenton's.
12	Errina Canal	Foraging soprano pipistrelle, Natterer's and Daubenton's.
13	Cloonoughter South	Foraging common and soprano pipistrelle in the general area.
14	Castletroy	
15	Castletroy West	Foraging common and soprano pipistrelle would be expected.
16	Dromore	Foraging common and soprano pipistrelle, Daubenton's bat.
17	Mountshannon	

Table 10.9: Adjudged status of Irish bat species within the study area

Common name	Scientific name	Occurrence	Confirmed Roosts	Source
Common pipistrelle	*Pipistrellus pipistrellus*	Present	Yes	BCI database and field survey
Soprano pipistrelle	*Pipistrellus pygmaeus*	Present	Yes	BCI database and field survey
Nathusius' pipistrelle	*Pipistrellus nathusii*	Potential – recorded in adjoining counties	No	BCI database and field survey
Leisler's	*Nyctalus leisleri*	Present	No	BCI database and field survey
Brown long-eared	*Plecotus auritus*	Present	Yes	BCI database and field survey
Lesser horseshoe	*Rhinolophus hipposideros*	Present	Yes	BCI database and field survey
Daubenton's	*Myotis daubentonii*	Present	No	BCI database and field survey
Natterer's	*Myotis nattereri*	Present	Potential	BCI database and field survey
Whiskered	*Myotis mystacinus*	Present	No	BCI database and field survey
Brandt's	*Myotis brandtii*	Potential – rare	No	BCI database and field survey

Assessment of route options in relation to bats

The lands contained within the study area are primarily low lying floodplain, which are used as pasture for cattle. The dominant habitat type is wet grassland. To the north-west and above Knockalisheen the ground rises forming the hills of Ballycar South (255m) and Woodcock Hill (310m). The lands are bisected by a number of watercourses, both natural and man-made, which dominate the area.

The Lower River Shannon weaves its way through the study area in a westerly direction before entering Shannon Estuary immediately west of Limerick. Within the study area the Shannon is intercepted by the Mulkear River, the River Blackwater and the Ardnacrusha Tailrace. The Ardnacrusha Headrace and the Errina Canal are also significant waterbodies in the study area. All of these rivers, streams and canals and their riparian habitats are of high conservation interest for bats and are used extensively for commuting and foraging purposes. Agricultural field boundaries within the study areas are also diverse with good quality hedgerows and tall treelines and these are therefore of local value being used for commuting and foraging by bats. Areas of scrub are also of value for foraging bats.

At this stage it is not possible to ascertain many individual roosts for bats within the wider study area - these will be identified during the detailed four season bat surveys which will be conducted to accompany the EIS for the final selected route.

Ecological sites of particular note from the perspective of bats:

Ardnacrusha / Castlebank and the Headrace Canal

The presence of five bat species at Ardnacrusha / Castlebank including lesser horseshoe bat is of particular importance. The buildings in this area and the adjoining habitats offer unlimited roosting opportunities for these species and bats from this site will use the well wooded habitats adjoining the Headrace Canal for foraging and commuting purposes. It is important that the proposed crossing of the

Headrace Canal and adjoining wooded areas is designed in a sensitive way to ensure that riparian and mature woodland is retained and commuting routes are not interfered with, particularly for lesser horseshoe bat. All routes potentially impact on this area similarly.

Lower River Shannon SAC (and Mulkear River)

The River Shannon corridor supports a rich diversity of species as would be expected given the quality of the habitats present and the significance this watercourse plays in the wider landscape. Six species of bats have been recorded from the grounds of the University of Limerick which adjoins the River Shannon SAC. These include; common (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmaeus*), Leisler's bat (*Nyctalus leisleri*), Daubenton's bat (*Myotis daubentonii*), Natterer's bat (*Myotis nattereri*) and brown long-eared bat (*Plecotus auritus*). In addition there are numerous roosting opportunities for bats in the area including a potential hibernation site in an old castle at Castletroy.

The Mulkear River which joins the Lower River Shannon supports common and soprano pipistrelle, Leisler's, an unidentified *Myotis* sp. and an unidentified pipistrelle sp.

River Blackwater/Errina Canal

The River Blackwater and Errina Canal are used by foraging soprano pipistrelle, Natterer's bat and Daubenton's bat. Other species that would be expected include soprano pipistrelle, Leisler's bat, brown long-eared and other Myotis sp.

Ecological sites and general landscape features

Ecological sites such those identified at Cappateemore West, Cappateemore, Ballycannan, Ballycannan South, Rosmadda, Cloonoughter South are all used extensively by both common and soprano pipistrelle bats. Other species might also be expected such as Leisler's bat, brown long-eared and a variety of Myotis sp. in such areas. Local roads within the study area were used regularly by foraging common and soprano pipistrelles.

Common and soprano pipistrelle bats would also be expected to use linear features and other areas of natural vegetation for foraging and commuting across the landscape such as the extensive network of treelines and hedgerows present throughout the study area (**Drawing RCSR-1006**) and over other ecological sites such as Derryfadda Bog.

10.8.3 Otter

Otter distribution in Ireland is widespread and they have been recorded in the watercourses throughout the study area. Otter requirements are food source and cover to use as over ground couches or holts. Holts at river sides tend to be tunnelled holes, cavities in tree roots or rock piles. Couches are generally mats of nesting material located in vegetation on riverbanks or away from water in secluded areas. They can be created in areas of dense scrub, reedbeds, etc. Otters will not tolerate disturbance of a holt site currently in use.

A specific survey of watercourses in the vicinity of crossing points by the various route options on all watercourses was undertaken in July 2011. However, the survey was undertaken in high summer when vegetation was at its densest and while evidence of activity (spraints and tracks) was recorded at a number of locations, no holts or couches were found. A second series of surveys was undertaken in November and December 2011 when vegetation had died back and a number of potential holt sites

and active couches were identified. Specific details of the locations for both holts and couches are being withheld in order to ensure full protection for these sites.

A number of potential holt sites were identified along the various watercourse crossed by the various route options though no holts were recorded within approximately 100m of any of the route options. There was no evidence of occupancy at any of the holts as the breeding season normally occurs from early spring through the summer period, though breeding can occur at any time of the year (Hayden and Harrington, 2000).

Three potential holts were identified along the lower reaches of the Mulkear River. While no holts were noted along the banks of the River Shannon, the islands within the vicinity of the Plassey are very probably used due to the lack of disturbance at these sites and the presence of abundant mature willow trees which could provide crevices amongst roots, under fallen limbs, etc.

A number of active couch sites were identified on the banks of the River Shannon. Couches are temporary lie-ups for otter and are frequently above ground under dense vegetation, under tree roots or other cavities. One active and regularly used couch is located in the immediate vicinity of the Route B.2 crossing on the south bank of the River Shannon. A second is located upstream of Route E.1 also on the southern bank. Evidence of high levels of otter activity was also recorded in the vicinity of route crossing D.1 and there is potential for a couch within the dense marginal reedswamp in this area. Regular activity was recorded at the confluence of the Groody River with the Shannon downstream of Route B.1 along with a potential couch site nearby. Otter activity is evidently very high along the entire section of both the Shannon and Mulkear Rivers.

Otter activity was recorded at a number of locations along the Errina Canal and Blackwater River. A well used trail exists between the canal and a pond to the south of Route C.1. A potential couch was identified under a fallen tree immediately upstream of Route D.2. A potential holt is present on the eastern bank of the canal midway between Route D.1 and C.1 in close proximity to a badger sett, though this is located approximately 300m from either route.

Evidence of regular otter activity was identified along the Ardnacrusha Tailrace with well used trails connecting to the Castlebank Stream running to the west of the tailrace. A single potential holt site was identified on the western bank of the tailrace approximately 250m south of the route crossing point. Spraints were also recorded at a number of locations along the east bank in the vicinity of the proposed crossing point. A potential holt site was recorded also on the east bank in bank-side boulders approximately 100m south of the route crossing point. The nature of the tailrace banks (being steep and heavily vegetated) however makes surveying this location very difficult and the results are therefore not considered conclusive.

Evidence of otter activity (spraints) was recorded on the lower section of the Knockalisheen Stream towards the Long Pavement Road. There was no spraints, tracks or potential holts recorded in the vicinity of the route crossings at Knockalisheen or upstream. However, as there is suitable habitat and fish stocks within the stream otter activity is to be expected upstream as far as Ballycannan.

Additional surveys will be undertaken to determine otter activity at identified holts at EIA stage. Appropriate mitigation measures will be prescribed accordingly based on the NRA's *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes*.

10.8.4 Other Mammal Species

There are also records of Badger, Pine Marten and Irish Hare, the breeding and resting places of which are protected under the Wildlife Acts.

Badgers are widely distributed across a range of habitat types with setts often being located within hedgerows, scrub and woodland edges. This wide distribution makes it likely that badgers will be encountered on most road schemes and this must be confirmed at EIA stage through dedicated field surveys. Where possible impacts on active setts should be avoided and mitigation will be prescribed in accordance with the NRA's *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes*.

Pine Marten are historically associated with woodland, although they have adapted to a variety of more open habitats. Where records of Pine Marten exist, at EIA stage it may be necessary to undertake targeted Pine Marten survey. Where feasible existing and potential den sites should be avoided and reference should be made to the mitigation measures outlined in the NRA's *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes*.

Irish Hare is protected by the Wildlife Acts, although as a recognised 'quarry' species a licence can be issued for hunting hares. Annex V of the Habitats Directive allows for the species to be hunted provided that this does not impinge on the attainment of Favourable Conservation Status. The Irish Hare preferred habitat is unimproved or semi-improved pasture or uplands with sufficient cover for resting. There is unlikely to be any direct impact on the local hare population with main impact of any proposed road scheme being increased habitat fragmentation.

10.8.5 Protected Fish Species

Atlantic Salmon occur in the area as do all three Lamprey species. These species and their spawning habitat are protected by Annex II of the Habitats Directive. Surveys of the route option crossing points on the River Shannon were undertaken to determine the presence of potential spawning habitat in the vicinity or downstream. Review of previous data including the suite of surveys and monitoring undertaken for the construction of the Road Bridge and Pedestrian Bridge at the University of Limerick. Potential spawning habitat was identified a short distance (approx 20m) downstream of Route C.1 (Drawing RCSR 1005) and more extensive spawning areas occur a further 200m downstream in the vicinity of the suite of islands near the Pedestrian Bridge.

Smelt are present in the Shannon Estuary and spawn in the Tailrace (IFI pers. comm.). The extent of spawning is not known and more detailed surveys will be required at EIA stage. Subsequently the timing of works and the design of all proposed bridges and culverts must be agreed with the IFI and reference must be made to the NRA's *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes.*

10.8.6 Protected Bird Species

Kingfisher (Alcedo athis) typically breeds in excavated tunnels in earthen or sand banks by lowland rivers. They are present on the River Shannon and Mulkear and are likely to occur along a number of other watercourses within the study are including the Blackwater River, Mulkear River and Errina Canal. This species is protected under Annex I of the EU Birds Directive. Specific surveys were undertaken to determine whether any potential or actual nest sites occur in the vicinity of any of

the proposed crossing points (c300m) of the various route options. No suitable nesting banks were identified in the vicinity of any of the proposed route crossing points on any of the watercourses during the surveys. Suitable banks do occur at a few locations along the Mulkear River and at one point on the banks of the Blackwater River, though these are well removed from the route crossing locations.

Both barn owl (*Tyto alba*) and long-eared owl (*Asio otus*) are recorded from the general study area and specific surveys were undertaken to determine if breeding was occurring in the vicinity of any of the proposed route options. The survey focussed on the period during which young recently fledged owls were most active and calling in July. No owls were recorded during these dusk surveys though a barn owl was present at the farm buildings at Castlebank House and the site is most likely used for breeding by this species. Castletroy (located approximately 300m west of Route D.1) is a potential nest site for barn owl though there was no evidence of feathers or pellets noted during a search around the base of the structure. BirdWatch Ireland have no records of breeding owls from the study area but indicate that the mid-west and Limerick area in general support good densities of both owl species. Previous records of barn owl exist for Mungret, Birdhill and Clonlara.

A series of dedicated monthly surveys were carried out over the winter period (November 2011 to March 2012) for whooper swan (*Cygnus cygnus*). Whooper swan are afforded protection under Annex I of the EU Birds Directive. The surveys aimed to determine the range of a wintering flock known to periodically utilise lands (NPWS pers. comm.) to the east of the Mulkear River (in the vicinity of Route E.1) and to determine the importance of the Mulkear site for their foraging requirements.

This data was augmented by reviewing previous studies and reports on Whooper Swan undertaken in the area. The Irish Wetland Bird Survey (IWeBS) data for Limerick City and the upper part of the Shannon Estuary was sourced from BirdWatch Ireland. Consultation was undertaken with the National Parks and Wildlife Service (NPWS) and with the Irish Whooper Swan Study Group (specifically Graham McElwaine and Gerry Murphy).

No observations were made of Whooper Swan at the confluence of the Mulkear and Shannon Rivers during any of the surveys. From casual discussion with anglers and walkers in the area during the survey periods, there were no anecdotal records for Whooper Swan at the site. Gerry Murphy of the Whooper Swan Study Group has a single record for swan from the site (grid reference R633588) for the 15/1/1998, when 23 birds were present comprising 15 adults and 8 juveniles. Seamus Hassett (NPWS) has also indicated occasional occurrence of Whooper Swan at the site though does not have any specific records of dates and numbers. During the site survey on 31-1-12, two adult whooper swans were observed with a flock of feral greylag geese approximately 3km to the west (R600 581 on the north bank of the River Shannon.

From the results of these surveys and the available data it appears that the site at the confluence of the Mulkear and Shannon Rivers is not a regularly used foraging area for Whooper Swan. The main foraging sites for flocks in the Shannon Estuary are all to the west of Limerick on improved, low-lying grasslands.

There remains potential for Whooper swans to utilise the site at the confluence of the Mulkear and Shannon Rivers on occasion. Their occurrence at this location may be influenced by a number of factors such as disturbance at other sites, weather events (including flooding levels) and grassland management at the site. However, the Limerick Northern Distributor Road Route Option E.1.1 is unlikely to interfere with the

ongoing utilization of the site at the confluence of the Mulkear and Shannon Rivers during operation as Whooper Swan habituate to predictable disturbance associated with roads.

10.8.7 Amphibians and Reptiles

Common (Smooth) Newts, Common Frogs and the Viviparous lizard have all been recorded as present within the study area. All of these species are protected by the Wildlife Acts. These species are likely to be widespread in areas of wet grassland and other wetland habitats with breeding potentially occurring in the various ditches and other seasonal pools. Viviparous lizard is likely to occur on Derryfadda Bog (Site 10) though may also occur in other locations.

10.8.8 Other Protected Species – White-clawed Crayfish

Although not recorded on the NPWS received records for the study area, White-clawed Crayfish (*Austropotamobius pallipes)* have been recorded on the upstream reaches of the Mulkear system and should be considered as potentially present on the River Blackwater and smaller streams within the study area. This species is listed on Annex II of the Habitats Directive and as a result it requires strict protection. In streams the preferred habitat for this species is a shallow riffle with large stable rocks which can provide suitable refuges. In addition the species is most often associated with high water quality (unpolluted – Q value 4 - 5). Where the scheme is likely to have an impact on suitable Crayfish habitat, targeted surveys may be required. This should be undertaken with direction from the Local Conservation staff of the National Parks and Wildlife Service and reference should be made to the mitigation measures outlined in the NRA's *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes*.

10.9 Route Options Assessment

The ecological impacts of the various route options are itemised and compared in a matrix in Tables 10.10, 10.11, 10.12 and 10.13. A brief description of the impacts of the principle route options is outlined below.

10.9.1 Section 1

This section extends from the docking point at Node A on the Knockalisheen Road eastwards to Node X where all routes cross the Ardnacrusha Tailrace.

Route A1

Route A.1 crosses an area of wet grassland within the SAC and then the Knockalisheen Stream at a point where it is bounded by a treeline of alder and willow (which does not conform to the priority habitat Alluvial Woodland). East of the SAC it links to Route A.3 and crosses a series of mature treelines and hedgerows along with a minor stream (W6) of limited fisheries value within the Castlebank Estate before crossing Site 6, the mixed woodland along the Ardnacrusha Tailrace, rated as being of county importance.

Route A2

Route A.2 crosses a broad area of wet grassland within which pockets of the Annex I habitat **Molinia meadows on calcareous, peaty or clayey-silt laden soils (*Molinion Caerulea*) (6140)** occur (refer **Figure RCSR-903).** Further east the route crosses a mosaic of wet / dry grassland which grades to a narrow fringe of marsh (GM1) as the land drops towards the Knockalisheen Stream. The stream at this

point is bounded to the west by a broad band of riparian woodland which conforms to the Priority Annex I habitat ***Alluvial Forest with Alnus Glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0***). East of the SAC it also crosses a series of mature treelines and hedgerows along with a minor stream (W6) within the Castlebank Estate before crossing mixed woodland along the Ardnacrusha Tailrace (Site 6), rated of county importance.

Route A.2.1

This variant on Route A.2 tracks slightly south of the former route crossing a series of fields of wet grassland within which pockets of the Annex I habitat **Molinia meadows on calcareous, peaty or clayey-silt laden soils (*Molinion Caerulea*) (6140)** occur. The wet grassland extends right up to the Knockalisheen Stream, clipping an area of wet grassland / dry grassland immediately west of the stream. The stream is bounded by a treeline of alder and willow at this point which does not conform to the priority habitat Alluvial Woodland. East of the SAC it also crosses a series of mature treelines and hedgerows along with a minor stream (W6) within the Castlebank Estate before crossing mixed woodland along the Ardnacrusha Tailrace (Site 6), rated of county importance.

Route A3

Route A.3 runs to the north of Ministry of Defence buildings crossing a series of fields of wet grassland within which pockets of the Annex I habitat **Molinia meadows on calcareous, peaty or clayey-silt laden soils (*Molinion Caerulea*) (6140)** occur. The route crosses some dry calcareous / neutral grassland (GS1) before descending into the low-lying floodplain of the Knockalisheen Stream. The floodplain grades from wet / dry grassland (GS4/GS1) into marsh (GM1) along its western side and then into a broad band of reed and large sedge swamp (FS1). The stream is fringed with riparian woodland which conforms to the Priority Annex I habitat ***Alluvial Forest with Alnus Glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0***). East of the SAC it links to Route A.1 and crosses a series of mature treelines and hedgerows along with a minor stream (W6) within the Castlebank Estate before crossing Site 6, the mixed woodland along the Ardnacrusha Tailrace rated of county importance.

Route A4

This route extends from Node A northwest along the existing Knockalisheen Road before swinging north-east where it crosses more elevated land than the other route options. A series of minor wooded stream valleys are crossed at Cappateemore (Site 2) and Ballycannan (Site 3), while Site 1 at Cappateemore West is marginally clipped. Site 2 supports a minor stream with predominantly scrub along the shallow valley; Site 3 is a more significant feature supporting a mixture of wet woodland and ash-hazel woodland. There are two streams joining at this site both of limited fisheries value, though together with the stream from site 2 converge to form the Knockalisheen Stream. East of Site 3, the route curves to the south-west before crossing a series of mature treelines and hedgerows along with a minor stream (W6) within the Castlebank Estate before crossing mixed woodland along the Ardnacrusha Tailrace (Site 6), rated as being of county importance.

Route A.4.1

This variant on Route A.4 diverges to the south-west of the former route immediately west of Site 3 resulting in a slightly lower crossing in the stream valley and a marginally lower potential impact. The route crosses through a section of treeline along the minor road at Ballycannan South which is listed with a Tree Preservation

Order. The treeline (Site 4) is dominated by semi-mature ash. It rejoins with Route A.4 at Node H in the vicinity of the minor stream crossing (W6) before crossing the series of mature treelines and hedgerows within the Castlebank Estate and then the mixed woodland along the Ardnacrusha Tailrace (Site 6), rated as being of county importance.

10.9.2 Section 2

This section extends from Node X where all routes cross the Ardnacrusha Tailrace to the various docking point options (B, C, D and E) along the R506 Road.

Route B1

This route option is the most westerly route option. It crosses through Site 7, an area of neglected pasture with developing scrub of local value immediately north of Parteen. After this it crosses open agricultural grasslands primarily with occasional treelines and hedgerows, and obliquely crosses the upper section of a minor watercourse (W13). South of this it crosses the River Shannon at a section where the river has a deep and uniform flow regime and no spawning potential for salmon or lamprey, though ammocoete beds may occur along the shoreline. A small treeline of willow occurs along the northern bank while the southern bank has a narrow fringe of riparian woodland which conforms to the Priority Annex I habitat ***Alluvial Forest with Alnus Glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0)***. The southern SAC boundary encompasses a mature treeline which separates adjacent grassland. Immediately north of the route is an area of compensatory alluvial woodland habitat (part of Site 16) developed by the University of Limerick during the construction of the Living Bridge further north across the Shannon.

Route B2

This route option is a variant of the former route and diverges to the east at Node J. It crosses through Site 7, further north, while to the south of Node J it obliquely crosses the extreme upper section of the minor watercourse (W13) and thereafter mainly open agricultural grasslands with occasional treelines and hedgerows as far as the SAC boundary. An isolated copse of willow occurs on the northern bank while the southern bank is fringed with a narrow belt of woodland which conforms to the Priority Annex I habitat ***Alluvial Forest with Alnus Glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0)***.The River Shannon at the crossing point is deep with a uniform flow regime and no spawning potential for salmon or lamprey, though ammocoete beds may occur along the shoreline. A well-used otter couch occurs along the line of this proposed route option. A mature treeline forms the southern boundary between the SAC and Site 16, an area of infilled land which has developed in a mosaic of dry to wet grassland with alder and willow scrub. This site is rated of local to county value as the southern portion is an area of compensatory alluvial woodland habitat developed by the University of Limerick during the construction of the Living Bridge further north.

Route C1

This route option commences as for Route B.1, B.2 and D.1 as far as Node J. Thereafter, along with Route D.1 it swings to the east and skirts to the north of Site 13 at Cloonoughter South, an area of neglected pasture with developing scrub of local value as far as Node L. It then sings more southerly and crosses Site 11 which is a linear feature containing the Blackwater River and Errina Canal with adjacent mosaic of dry and wet grassland with linear wet woodland. The site is rated of County importance as are both river and canal. The route crosses an adjacent area

of wet grassland and freshwater marsh which is within the site. To the south, the route crosses agricultural grasslands with a number of treelines and hedgerows before the land drops to the River Shannon. The river is bounded by an extensive area wet grassland and freshwater marsh along the north bank which is within the SAC boundary. Some of this habitat conforms to the habitat **Hydrophilous Tall Herb Fringe Communities of plains (6430)**, an Annex I habitat but not a qualifying interest for the Lower River Shannon SAC. The river at this point has a series of islands supporting a mixture of reed and large sedge swamp, with larger islands supporting riparian woodland immediately north and south of the crossing point. This woodland conforms to the Priority Annex I habitat ***Alluvial Forest with Alnus Glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0***). While there is no spawning habitat at the crossing point, good riffle habitat likely to be used by both salmon and lamprey species occurs a short distance downstream. The south bank of the river has a broad band of marsh as far as the SAC boundary. A linear belt of wet woodland (Site 15) rated of local value, extends from the SAC boundary and is cut obliquely by the route.

Route D1

This route option commences as for Route C.1 as far as Node L. Thereafter it swings slightly more easterly crossing site 11 at a narrower point. It then crosses agricultural grasslands with occasional treelines and hedgerows before the land drops to the River Shannon. The SAC at this point includes an adjacent field of wet grassland bounded by treelines to the north of the river with a narrow fringe of marsh. The river is deep and slow flowing in the vicinity with no spawning habitat for salmon or lamprey though ammocoete beds may occur along the shoreline. The southern river bank has a broad band of riparian woodland that conforms to the Priority Annex I habitat ***Alluvial Forest with Alnus Glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0***). South of the SAC boundary a mosaic of wet and dry grassland and developing scrub (Site 14) is crossed which is rated of local value.

Route D2

This route option extends from Node X at the Ardnacrusha tailrace in an easterly direction as far as Node K where it swings to the south across a number of treelines before crossing Derryfadda Bog (Site 10), an extensive raised bog rate of county importance. It traverses through the centre of the site and then obliquely crosses the Blackwater River and Errina Canal (Site 11), also rated of county importance. At Node M it rejoins Route D.1 to cross the River Shannon and SAC. The SAC incorporates an adjacent field of wet grassland bounded by treelines to the north of the river with a narrow fringe of marsh. The river is deep and slow flowing in the vicinity with no spawning habitat for salmon or lamprey though ammocoete beds may occur along the shoreline. The southern river bank has a broad band of riparian woodland that conforms to the Priority Annex I habitat ***Alluvial Forest with Alnus Glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0***). South of the SAC boundary a mosaic of wet and dry grassland and developing scrub (Site 14) is crossed which is rated of local value.

Link D2 to D1

This variant extends from Node K to L and brings Route D2 to the west of Derryfadda Bog (Site 10) where it crosses agricultural grassland with an extensive network of treelines and hedgerows. Thereafter it follows the D.1 route option from Node L to the Docking Point D crossing agricultural grasslands with occasional treelines and hedgerows before the land drops to the River Shannon. The SAC at this point

includes an adjacent field of wet grassland bounded by treelines to the north of the river with a narrow fringe of marsh. The river is deep and slow flowing in the vicinity with no spawning habitat for salmon or lamprey though ammocoete beds may occur along the shoreline. The southern river bank has a broad band of riparian woodland that conforms to the Priority Annex I habitat ***Alluvial Forest with Alnus Glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0***). South of the SAC boundary a mosaic of wet and dry grassland and developing scrub (Site 14) is crossed which is rated of local value.

Route E1

Route E.1 commences as for Route D.2 as far as Node G and thereafter continues in an easterly direction to the north of Derryfadda Bog (Site 10). It skirts to the south of the Blackwater River (Site 8) before crossing it immediately upstream of the point where the Errina Canal (Site 12) meets the river. East of this the route crosses open agricultural land with a network of treelines and hedgerows as far as Node N. It enters the SAC a short distance further south where the SAC includes a field of wet grassland bounded by treelines to the north of the river. The river which is deep and slow flowing in the vicinity with no spawning habitat for salmon or lamprey though ammocoete beds may occur along the shoreline. The north bank of the river is fringed by freshwater marsh which conforms to the habitat **Hydrophilous Tall Herb Fringe Communities of plains (6430)**, an Annex I habitat but not a qualifying interest for the Lower River Shannon SAC. A narrow band of riparian woodland occurs along the southern bank (c 5m at its narrowest) which conforms to the Priority Annex I habitat ***Alluvial Forest with Alnus Glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0***). South of the SAC the route crosses open agricultural land with occasional hedgerows and treelines before docking at Point E. There are records of a flock of Whooper swan utilising the open grassland areas periodically during the winter for foraging. Three potential otter holts have been identified along the banks of the Mulkear River within approximately 100m west of the route corridor respectively.

Link E1 to D1

This link extends from Node O to Node P and crosses the River Mulkear which is part of the Lower River Shannon SAC. The river which is deep and slow flowing has no spawning habitat for salmon or lamprey in the vicinity though ammocoete beds may occur along the shoreline. The lands to the west of the river are part of Site 14 at Castletroy, a mosaic of wet and dry grassland with developing scrub rated of local importance. Three potential otter holts have been identified along the banks of the Mulkear River approximately 300m downstream of the route corridor.

10.9.3 Route Options Assessment – Section 1

Table 10.10 Step 1 – Initial Route Comparison

Comparison No.	Nodes (Route)	Length	Rank	Impacts
CN1 Rank (1-2)	A-F (Route A.1)	2131m	1	Commences south of SAC crossing into at narrow point. Crosses wet grassland and narrow band of Riparian Woodland / treeline along stream. No habitats conforming to Annex I or QI.
	A-F (Route A.3)	1929m	2	Crosses broad section of SAC. Crosses series of fields within which pockets of Annex I habitat **Molinia Meadows** occur and marsh (which conforms to the Annex habitat Hydrophilous Tall Herb Fringe Communities), reed and large sedge swamp and band of Riparian woodland. The latter habitat conforms to Annex I Alluvial Woodland and is a QI for the SAC.
CN2 Rank (1-2)	G-H (Route A.4)	1610m	1	Crosses upper section of Wet woodland within stream valley with oak-ash-hazel woodland on upper slopes (site 3) rated of County importance. Minor Stream with limited fisheries value – headwaters of Knockalisheen Stream. Also crosses Castlebank Stream rated of high local importance.
	G-H (Route A4.1)	1500m	2	Crosses upper section of site 3 as for Route A.4 though in slightly narrower location. Crosses treeline along minor road listed as TPO (site 4) rated as County Importance. Also crosses Castlebank Stream rated of high local importance.

Table 10.11: Step 2 – Final Route Comparison

Comparison No.	Nodes (Route)	Length	Rank	Impacts
CN3 Rank (1-6)	A – F – X (Route A.1)	3082m	3	Commences south of SAC crossing into at narrow point. Crosses wet grassland and narrow band of Riparian Woodland / treeline along Knockalisheen stream. No habitats conforming to Annex I or QI. Crosses network of mature treelines and minor stream within Castlebank Estate with mixed woodland along tailrace (site 6 - entire complex rated of County importance).
	A-X (Route A.2)	2443m	5	Commences in SAC, crossing series of fields within which pockets of Annex I habitat **Molinia Meadows** occur; also crosses marsh (which conforms to the Annex habitat Hydrophilous Tall Herb Fringe Communities) and band of riparian woodland (conforms to Annex I Alluvial Woodland and is a QI for the SAC) along Knockalisheen Stream. Crosses network of mature treelines and minor stream within Castlebank Estate with mixed woodland along tailrace (site 6 - entire complex rated of County importance).
	A-X (Route A.2.1)	2447m	4	Commences in SAC, crosses series of fields within which pockets of Annex I habitat **Molinia Meadows** occur; narrow band of Riparian Woodland / treeline along Knockalisheen stream (no habitats conforming to Annex I or QI). Crosses network of mature treelines and minor stream within Castlebank Estate with mixed woodland along tailrace (site 6 - entire complex rated of County importance).
	A – F – X (Route A.3)	2925m	6	Crosses broad section of SAC. Crosses series of fields within which pockets of Annex I habitat **Molinia Meadows** occur; marsh (which conforms to the Annex habitat Hydrophilous Tall Herb Fringe Communities), reed and large sedge swamp and band of Riparian woodland alongside Knockalisheen stream. The latter habitat conforms to Annex I Alluvial Woodland and is a QI for the SAC. Crosses network of mature treelines and minor stream within Castlebank Estate with mixed woodland along tailrace (site 6 - entire complex rated of County importance).
	A – G – H – X (Route A.4)	4701m	1	Runs adjacent to SE corner of site 1 rated of high local importance. Crosses scrub along minor stream valley (rated of high local importance).Crosses upper section of Wet woodland within stream valley with oak-ash-hazel woodland on upper slopes (site 3) rated of County importance. Stream minor with limited fisheries value – headwaters of Knockalisheen Stream. Crosses network of mature treelines and minor stream within Castlebank Estate with mixed woodland along tailrace (site 6 - entire complex rated of County importance).
	A – G – H – X (Route A.4.1)	4592m	2	Runs adjacent to SE corner of site 1 rated of high local importance. Crosses scrub along minor stream valley (rated of high local importance).Crosses upper section of site 3 as for Route A.4 though in slightly narrower location. Crosses treeline along minor road listed as TPO (site 4) rated as County Importance. Crosses network of mature treelines and minor stream within Castlebank Estate with mixed woodland along tailrace (site 6 - entire complex rated of County importance).

10.9.3 Route Options Assessment – Section 2

Table 10.12: Step 1 – Initial Route Comparison

Comparison No.	Nodes (Route)	Length	Rank	Impacts
CN4 Rank (1-2)	J – B (Route B.1)	3242m	1	Route crosses open agricultural land with occasional treeline. Crosses River Shannon SAC impacting on small block of riparian woodland on north bank and linear strip of riparian woodland on south bank (conforms to Annex I Alluvial Woodland and is a QI for the SAC). Crosses to west of site 16 crossing treeline along riverside walk on south bank.
	J – B (Route B.2)	3557m	2	Route crosses open agricultural land with occasional treeline. Crosses River Shannon SAC impacting on small block of riparian woodland on north bank and linear strip of riparian woodland on south bank (conforms to Annex I Alluvial Woodland and is a QI for the SAC). Crosses through area of wet grassland and willow-alder dominated scrub (site 16) on area of previously disturbed land to south of UL Boat Club building.
CN5 Rank (1-2)	X – J – L (Route D.1)	3206m	1	Route passes along southern tip of site 7 - areas of neglected pasture with dry neutral / wet grassland and developing scrub (rated of high local importance). Route crosses through treeline and then runs to north of site 13 – an area of dry neutral / wet grassland and developing scrub (rated of high local importance).
	X – K – L (Route D.2 & Link D.2 to D.1)	3619m	2	Route passes through occasional treeline as far a node G and then through a network of treelines and hedgerows in agricultural grassland to the west of site 10.
CN6 Rank (1-4)	X – J – L – M – N (Route D.1)	5206m	1	This route passes along southern tip of site 7, two areas of neglected pasture with dry neutral/wet grassland and developing scrub (of high local importance). The route crosses through treelines and then runs north of site 13 – an area of dry neutral/wet grassland and developing scrub (of high local importance). The route crosses the combined corridor of the Blackwater River and Errina Canal (Site 11) which has associated linear wet woodland and dry grassland. This site is rated of County importance as are both watercourses.
CN6 Rank (1-4)	X – K – L – M – N (Route D.2 & Link D.2 to D.1 & Route D1)	5600m	2	This route passes through occasional treeline as far a node G and then through a network of treelines and hedgerows to the west of site 10 in agricultural grassland before joining D1 at Node L. It then crosses the combined corridor of the Blackwater River and Errina Canal (Site 11) rated of County importance as are both watercourses.

Comparison No.	Nodes (Route)	Length	Rank	Impacts
	X – K – M – N (Route D.2)	5490m	4	This route passes through occasional treelines as far a node G and then through a network of treelines and hedgerows to the west of site 10. Route D.2 crosses through the centre of Site 10, a Raised Bog with a mosaic of cut-over recolonizing bog, Atlantic Wet Heaths, developing Bog Woodland (WN7) and 'Depressions on peat substrates of the Rhynchosporion' – all Annex listed habitats. The site is rated of National importance. D2 then crosses corridor of the Blackwater River and Errina Canal (Site 11) which has associated linear wet woodland dominated by alder, willow and ash with dry grassland. This site and both watercourses are rated of County importance.
	X – K – N	5830m	3	This route passes through occasional treelines as far a node G and then runs adjacent to the south of the Blackwater River (site 8) for a considerable distance before crossing it a short distance upstream of where it joins the Errina Canal. Both the river and canal and associated habitats are rated of County importance. East of the Errina Canal the route crosses through open agricultural grassland with dividing hedgerows and treelines.
CN7 Rank (1-3)	N – P – D	2031	2	Crosses SAC – series of mature treelines encompassing field of wet grassland with fringing marsh on north of river. Wide block of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. Crosses area of wet grassland / scrub in site 14 (rated of County importance).
	N – O – P – D	2582m	3	Crosses SAC - two mature treelines encompassing field of wet grassland with fringing marsh on north of river. Linear strip of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. From Node O crosses Mulkear River (also within SAC) and area of wet grassland / scrub comprising site 14 (rated of County importance).
	N – O – E	2482m	1	Crosses SAC - two mature treelines encompassing field of wet grassland with fringing marsh on north of river. Linear strip of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. Beyond Node O crosses occasional treeline and hedgerow before docking point at E.

Table 10.13: Step 2 – Final Route Comparison

Comparison No.	Nodes (Route)	Length	Rank	Impacts
CN7 Rank (1-16)	X – J – B (Route B.2)	5022m	2	Route passes along southern tip of site 7 - areas of neglected pasture with dry neutral / wet grassland and developing scrub (rated of high local importance). From Node J route crosses open agricultural land with occasional treeline. Crosses River Shannon SAC impacting on small block of riparian woodland on north bank and linear strip of riparian woodland on south bank (conforms to Annex I Alluvial Woodland and is a QI for the SAC). A well used otter couch occurs in the vicinity of the crossing point. Crosses through area of wet grassland and willow-alder dominated scrub (site 16) on area of previously disturbed land to south of UL Boat Club building.
	X – J – B (Route B.1)	4904m	1	Route passes along southern tip of site 7 - areas of neglected pasture with dry neutral / wet grassland and developing scrub (rated of high local importance). From Node J Route crosses open agricultural land with occasional treeline. Crosses River Shannon SAC impacting on small block of riparian woodland on north bank and linear strip of riparian woodland on south bank (conforms to Annex I Alluvial Woodland and is a QI for the SAC). Crosses to west of site 16 crossing treeline along riverside walk on south bank.
	X – J – L – C	6414m	12	Route passes along southern tip of site 7 - areas of neglected pasture with dry neutral / wet grassland and developing scrub (rated of high local importance). Route crosses through treeline and then runs to north of site 13 – an area of dry neutral / wet grassland and developing scrub (rated of high local importance). After Node L route runs through agricultural land before crossing SAC with extensive blocks of marsh on both banks of river. Crosses through chain of islands instream supporting riparian woodland to east and west of crossing and reed and large sedge swamp on line (conforms to Annex I Alluvial Woodland and is a QI for the SAC). Area of riffle habitat downstream likely to support salmon and lamprey spawning. Linear block of wet woodland on south of river (site 15 - rated of high local value) crossed diagonally by route.
	X – K – L – C	6806m	13	Route passes through occasional treeline as far as node G and then through a network of treelines and hedgerows in agricultural grassland to the west of site 10. After Node L route runs through agricultural land before crossing SAC with extensive blocks of marsh on both banks of river. Crosses through chain of islands instream supporting riparian woodland to east and west of crossing and reed and large sedge swamp on line (conforms to Annex I Alluvial Woodland and is a QI for the SAC). Area of riffle habitat downstream likely to support salmon and lamprey spawning. Linear block of wet woodland on south of river (site 15 - rated of high local value) crossed diagonally by route.

Comparison No.	Nodes (Route)	Length	Rank	Impacts
	X – J – L – M – N – P – D	7234m	8	Route passes along southern tip of site 7 - areas of neglected pasture with dry neutral / wet grassland and developing scrub (rated of high local importance). Route crosses through treeline and then runs to north of site 13 – an area of dry neutral / wet grassland and developing scrub (rated of high local importance). Crosses SAC at series of mature treelines encompassing field of wet grassland with fringing marsh on north of river. Wide block of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. Crosses area of wet grassland / scrub in site 14 (rated of County importance) to south of river.
	X – K – L – M – N – P – D	7627m	8	This route passes through occasional treeline as far a node G and then through a network of treelines and hedgerows to the west of site 10 in agricultural grassland before joining D1 at Node L. It then crosses the combined corridor of the Blackwater River and Errina Canal (Site 11) rated of County importance as are both watercourses. Crosses SAC – series of mature treelines encompassing field of wet grassland with fringing marsh on north of river. Wide block of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. Crosses area of wet grassland / scrub in site 14 (rated of County importance).
	X – K – M – N – P – D	7518m	14	This route passes through occasional treelines as far a node G and then through a network of treelines and hedgerows to the west of site 10. Route D.2 crosses through the centre of Site 10, a Raised Bog with a mosaic of cut-over recolonizing bog, Atlantic Wet Heaths, developing Bog Woodland (WN7) and 'Depressions on peat substrates of the Rhynchosporion' – all Annex listed habitats. The site is rated of National importance. D2 then crosses corridor of the Blackwater River and Errina Canal (Site 11) which has associated linear wet woodland dominated by alder, willow and ash with dry grassland. This site and both watercourses are rated of County importance. Crosses SAC – series of mature treelines encompassing field of wet grassland with fringing marsh on north of river. Wide block of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. Crosses area of wet grassland / scrub in site 14 (rated of County importance).
	X – K – N – P – D	7855m	7	This route passes through occasional treelines as far a node G and then runs adjacent to the south of the Blackwater River (site 8) for a considerable distance before crossing it a short distance upstream of where it joins the Errina Canal. Both the river and canal and associated habitats are rated of County importance. East of the Errina Canal the route crosses through open agricultural grassland with dividing hedgerows and treelines. Crosses SAC – series of mature treelines encompassing field of wet grassland with fringing marsh on north of river. Wide block of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. Crosses area of wet grassland / scrub in site 14 (rated of County importance).

Comparison No.	Nodes (Route)	Length	Rank	Impacts
	X – J – L – M – N – O – E	7698m	3	This route passes along southern tip of site 7, two areas of neglected pasture with dry neutral/wet grassland and developing scrub (of high local importance). The route crosses through treelines and then runs north of site 13 – an area of dry neutral/wet grassland and developing scrub (of high local importance). The route crosses the combined corridor of the Blackwater River and Errina Canal (Site 11) which has associated linear wet woodland and dry grassland. This site is rated of County importance as are both watercourses. Crosses SAC - two mature treelines encompassing field of wet grassland with fringing marsh on north of river. Linear strip of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. Beyond Node O crosses occasional treeline and hedgerow before docking point at E.
	X – K – L – M – N – O – E	8201m	4	This route passes through occasional treeline as far as node G and then through a network of treelines and hedgerows to the west of site 10 in agricultural grassland before joining D1 at Node L. It then crosses the combined corridor of the Blackwater River and Errina Canal (Site 11) rated of County importance as are both watercourses. Crosses SAC - two mature treelines encompassing field of wet grassland with fringing marsh on north of river. Linear strip of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. Beyond Node O crosses occasional treeline and hedgerow before docking point at E.
	X – K – M – N – O – E	8002m	6	This route passes through occasional treelines as far as node G and then through a network of treelines and hedgerows to the west of site 10. Route D.2 crosses through the centre of Site 10, a Raised Bog with a mosaic of cut-over recolonizing bog, Atlantic Wet Heaths, developing Bog Woodland (WN7) and 'Depressions on peat substrates of the Rhynchosporion' – all Annex listed habitats. The site is rated of National importance. D2 then crosses corridor of the Blackwater River and Errina Canal (Site 11) which has associated linear wet woodland dominated by alder, willow and ash with dry grassland. This site and both watercourses are rated of County importance. Crosses SAC - two mature treelines encompassing field of wet grassland with fringing marsh on north of river. Linear strip of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. Beyond Node O crosses occasional treeline and hedgerow before docking point at E.

Comparison No.	Nodes (Route)	Length	Rank	Impacts
	X – K – N – O – E	8310m	5	This route passes through occasional treelines as far a node G and then runs adjacent to the south of the Blackwater River (site 8) for a considerable distance before crossing it a short distance upstream of where it joins the Errina Canal. Both the river and canal and associated habitats are rated of County importance. East of the Errina Canal the route crosses through open agricultural grassland with dividing hedgerows and treelines. Crosses SAC - two mature treelines encompassing field of wet grassland with fringing marsh on north of river. Linear strip of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. Beyond Node O crosses occasional treeline and hedgerow before docking point at E.
	X – J – L – M – N – O – P – D	7814m	10	This route passes along southern tip of site 7, two areas of neglected pasture with dry neutral/wet grassland and developing scrub (of high local importance). The route crosses through treelines and then runs north of site 13 – an area of dry neutral/wet grassland and developing scrub (of high local importance). The route crosses the combined corridor of the Blackwater River and Errina Canal (Site 11) which has associated linear wet woodland and dry grassland. This site is rated of County importance as are both watercourses. Crosses SAC - two mature treelines encompassing field of wet grassland with fringing marsh on north of river. Linear strip of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. From Node O crosses Mulkear River (also within SAC) and area of wet grassland / scrub comprising site 14 (rated of County importance).
	X – K – L – M – N – O – P – D	8214m	11	This route passes through occasional treeline as far a node G and then through a network of treelines and hedgerows to the west of site 10 in agricultural grassland before joining D1 at Node L. It then crosses the combined corridor of the Blackwater River and Errina Canal (Site 11) rated of County importance as are both watercourses. Crosses SAC - two mature treelines encompassing field of wet grassland with fringing marsh on north of river. Linear strip of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. From Node O crosses Mulkear River (also within SAC) and area of wet grassland / scrub comprising site 14 (rated of County importance).

Comparison No.	Nodes (Route)	Length	Rank	Impacts
	X – K – M – N – O – P – D	8139m	16	This route passes through occasional treelines as far as node G and then through a network of treelines and hedgerows to the west of site 10. Route D.2 crosses through the centre of Site 10, a Raised Bog with a mosaic of cut-over recolonizing bog, Atlantic Wet Heaths, developing Bog Woodland (WN7) and 'Depressions on peat substrates of the Rhynchosporion' – all Annex listed habitats. The site is rated of National importance. D2 then crosses corridor of the Blackwater River and Errina Canal (Site 11) which has associated linear wet woodland dominated by alder, willow and ash with dry grassland. This site and both watercourses are rated of County importance. Crosses SAC - two mature treelines encompassing field of wet grassland with fringing marsh on north of river. Linear strip of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. From Node O crosses Mulkear River (also within SAC) and area of wet grassland / scrub comprising site 14 (rated of County importance).
	X – K – N – O – P – D	7861m	15	This route passes through occasional treelines as far as node G and then runs adjacent to the south of the Blackwater River (site 8) for a considerable distance before crossing it a short distance upstream of where it joins the Errina Canal. Both the river and canal and associated habitats are rated of County importance. East of the Errina Canal the route crosses through open agricultural grassland with dividing hedgerows and treelines. Crosses SAC - two mature treelines encompassing field of wet grassland with fringing marsh on north of river. Linear strip of riparian woodland along south bank conforms to Annex I Alluvial Woodland and is a QI for the SAC. From Node O crosses Mulkear River (also within SAC) and area of wet grassland / scrub comprising site 14 (rated of County importance).

10.10 Refined Routes to Minimise Impacts within Lower River Shannon SAC

The ecological impacts of the various route options are itemised and compared in the matrices in Table 10.13, above. The key ecological receptors within the study area are the Lower River Shannon SAC at Knockalisheen and along the Shannon at Plassey. A key objective of the route selection process has been the selection of a route which avoids impacting on any of the qualifying interests for the site and results in no significant impact on the integrity of the SAC. The conclusion of this process is that the preferred route option from Node A to X is Route A.4 followed by Route A.4.1 (both of which are outside of the SAC) and then route A.1. The preferred route option from Node X to any of the docking points is Route B.1.

However, due to the ecological sensitivity of the study area as a whole there are potential impacts arising on all route options, including Routes A.4 and A.4.1. As a result, there has been some refinement of route options in order to present a route that both minimises impacts on sensitive ecological receptors but also fulfils the design criteria for the Limerick Northern Distributor Road Scheme. Two variants of route options have been developed and are considered below.

The adjusted route corridor options are illustrated on **Drawing RCSR-602.**

Route A.2.2:

The western extent of Route Option A.2.1 at Knockalisheen was realigned further to the south to avoid impacting on areas of the Annex I habitat **Molinia meadows on calcareous, peaty or clayey-silt laden soils (*Molinion Caerulea*) (6140)** (Refer Drawings RCSR-601 and RCSR-602). It entails a slight refinement of the docking point, but rejoins the original route option A.2.1 east of the Knockalisheen Stream. This option runs across wet grassland in the vicinity of quadrats Q11, Q12 and Q13 which were surveyed as part of the detailed vegetation mapping (see Appendix 10.1) and which were found not to conform to the Molinia meadows habitat. The Knockalisheen Stream at this location does not support Alluvial Woodland and thus the variation avoids impacting on any of the qualifying interests for the SAC.

When the route variant A.2.2 is compared to the other route options from Node A to X, it comes out as the most favourable option of those routes that cross the SAC at Knockalisheen. While Routes A.4 and A.4.1 avoid the SAC entirely at Knockalisheen, they nonetheless would result in significant habitat loss within the two wooded valleys on the headwaters of the Knockalisheen Stream, an impact which could not be mitigated for. With appropriate design of Route A.2.2 to avoid any alteration of the existing hydrological conditions in the wet grassland habitat and to maintain ecological connectivity along the Knockalisheen Stream corridor, this route option would have no significant impact on any of the qualifying interests or the integrity of the SAC.

Route E.1.1:

Route E.1 was refined at the River Shannon crossing such that it was shifted further east in the vicinity of the crossing point. As a result, there is a reduced impact on the freshwater marsh habitat along the northern river bank which is confined to a very narrow strip at this point (refer RCSR-1005 and RCSR-602). This vegetation conforms to the Annex I habitat **Hydrophilous Tall Herb Fringe Communities of plains (6430)**, though is not a qualifying interest for the Lower River Shannon SAC. While the route corridor does not entirely avoid the priority Annex I habitat ***Alluvial Forest with Alnus Glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae) (91E0*)** along the south bank of the river, it crosses at a

point where the woodland forms a narrower fringe (c 5m at its narrowest) than any of the other crossing points and where the habitat is significantly interspersed with areas of open reed swamp. The route variation also avoids crossing the large open field to the east of the Mulkear River which is periodically utilised by wintering whooper swan. In addition, this variation also provides a higher degree of separation between the route and the potential otter holts along the Mulkear River. Otter are an Annex II species and a qualifying interest of the Lower River Shannon SAC.

All of the route options between Node X to any of the docking points will cross the SAC and impact to some extent on the priority Annex I habitat Alluvial Forest which forms an extensive fringe along the southern river bank primarily. When Route E.1.1 is compared to the other route options, it emerges as comparable to Route B.1 (the ecologically preferred option) impacting as it does on a very narrow fringe of Alluvial woodland and avoiding any of the spawning areas for salmon and lamprey. The SAC boundary is slightly broader at Route E.1.1 and encompasses an area of wet grassland and a narrow strip of freshwater marsh along the northern bank, neither habitat being a qualifying interest for the SAC. The bridge design for the river crossing will clear span the riparian zones on both banks thus maintaining the ecological connectivity along the river corridor and avoiding the loss of the riparian vegetation. Acquisition of additional lands adjacent to the road on the south bank of the river will allow for the development of additional wetland habitats ensuring no net loss of woodland and grassland.

10.11 Conclusion

The preferred route option from Node A to X is Route A.4 with Route A.4.1 second, as both these routes avoid impacting on the SAC at Knockalisheen. Route A.1 which crosses the SAC is ranked third. However, Route variant A.2.2 would have no significant impact on any of the qualifying interests or the integrity of the SAC (with appropriate design to avoid any alteration of the existing hydrological conditions in the wet grassland habitat and to maintain ecological connectivity along the Knockalisheen Stream corridor). Subject to appropriate design, Route A.2.2 would have less of an ecological impact overall than either Route A.4 or A.4.1, though in accordance with the NRA guidelines, these latter route options rank higher as they avoid the SAC entirely.

The preferred route option from Node X to any of the docking points is Route B.1 with Route B.2 second and combined Route X – J – L – M – N – O – E third. All of the route options between Node X to any of the docking points will cross the SAC and impact to some extent on the priority Annex I habitat Alluvial Forest. The Route variant E.1.1 emerges as comparable to Route B.1 impacting as it does on a very narrow fringe of Alluvial Forest and avoiding any of the spawning areas for salmon and lamprey. For all crossing options, bridge design will clear span the riparian zones on both banks thus maintaining the ecological connectivity along the river corridor and avoiding the loss of the riparian vegetation. Acquisition of additional lands adjacent to the road but outside of the SAC will allow for the development of additional wetland habitats ensuring no net loss of woodland and grassland.

Appendix 10.1

VEGETATION SURVEY OF ROUTE OPTIONS WITHIN THE LOWER RIVER SHANNON cSAC

Relevee Data

Relevee ID	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**	**Q12**	**Q13**	**Q14**	**Q15**
Grid Ref:	R63003 58765	R56105 60628	R56273 60375	R56302 60347	R56394 60536	R56562 60580	R56367 60916	R56762 60272	R62938 58985	R62925 58998	R56292 60304	R56448 60397	R56645 60482	R56582 60176	R56094 60279
Plant species															
Agrostis capillaris															**3**
Agrostis gigantea											**2**				
Agrostis stolonifera		3										3	4	4	
Alopecurus pratensis	6				4	7		6	5						
Anthoxanthum odoratum		5		6	7	7	6	5		7	2				
Brachythecium rutabulum		1													
Bromus racemosus					2										
Calliergonella cuspidata		5	2								2	4			4
Cardamine pratensis		4													
Carex distica			4						5			3	1		3
Carex flacca		4	6												3
Carex hirta								2			1				
Carex nigra			2												
Carex ovalis					2										
Carex pallescens			2												
Carex panacea			3												
Centaurea nigra				4		3					2				
Cerastium fontanum		3	2							2	2			3	
Cirsium arvense	5														
Cirsium palustre			2								4		2		
Crepis sp.															
Cynosurus cristatus		2			6										
Dactylis glomerata	1			2							3		3		3
Epilobium sp.												3			2
Equisetum arvense	2														

Relevee ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Grid Ref:	R63003 58765	R56105 60628	R56273 60375	R56302 60347	R56394 60536	R56562 60580	R56367 60916	R56762 60272	R62938 58985	R62925 58998	R56292 60304	R56448 60397	R56645 60482	R56582 60176	R56094 60279
Plant species															
Festuca pratensis						4			2			2			
Festuca rubra		6	5	7			8		2	6	3	3	4		3
Filipendula ulmaria		1	2						6	5		4	4		1
Galium palustre			1												
Holcus lanatus		4			4		2	4	2		5	4	6	7	5
Hypericum tetrapterum			2								3				1
Hypochaeris radicata				1	2		2								
Iris pseudacorus								2	1						
Isolepis setacea			1												
Juncus acutiflorus/articulatus		7	7		6			4	7		6	7	5	2	8
Juncus conglomeratus			1												
Juncus effusus		3						4	2		2		5	1	
Juncus inflexus												3		3	
Kindbergia praelongum													1		
Lathyrus pratensis	1		2						1	2		1	1		
Lotus pedunculatus		4	2	2	2	2	4			2	2	2			
Luzula multiflora			2		3		1								
Lychnis flos-cuculi		2	2						1						1
Mentha aquatica			2									4			4
Phleum pratense											1	1			
Plantago lanceolata			2	4		3	4			4					2
Poa pratensis						3				2				3	
Poa trivialis		5						1	5	3					
Polygonum bistorta	1														

Relevee ID	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**	**Q12**	**Q13**	**Q14**	**Q15**
Grid Ref:	R63003 58765	R56105 60628	R56273 60375	R56302 60347	R56394 60536	R56562 60580	R56367 60916	R56762 60272	R62938 58985	R62925 58998	R56292 60304	R56448 60397	R56645 60482	R56582 60176	R56094 60279
Plant species															
Potentilla anserina											2			1	
Potentilla erecta		1								1					
Prunella vulgaris					2						4				
Pullicaria dysenterica			1									4			2
Ranunculus acris			2	1		2		2	1	4					
Ranunculus repens		5	2				3		4		3	4	4	3	4
Rhinanthus minor										1					
Rhytidiadelphus squarosus		2		2	2										3
Rumex acetosa					1	5		4		2	2			2	
Senecio jacobea											2				
Stellaria graminea			2	1		4	2			2					
Taraxacum agg.			1	1						1					
Trifolium pratense		1	2				2			2					
Trifolium repens			1											1	
Urtica dioica	1														
Total species no.	**7**	**20**	**28**	**10**	**13**	**10**	**11**	**10**	**13**	**17**	**19**	**16**	**12**	**12**	**17**
soil pH	7	6.8	6.9		5.7	6	5	5.8	7.2	7					
Fossitt habitat Classification	GS2	GS4	GS4	GS1/GS4	GS4	GS2/GS4	GS1/GS4	GS4	GS4	GS4	GS4	GS4	GS4	GS4	GS4
Annex I Assessment criteria															
Broadleaf herb %		35	75	25	20	20	20	25	35	35	10	35	15	5	15
Sward height cm		50	35	35	45	40	50	30	85	40	45	65	60	35	65
Litter cover %		10	15	15	15	18	15	2	5	10	25	15	25	15	20
Bare ground %		0	1	0	0	0	0	10	0	0	0	0	0	0	0

Relevee ID	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**	**Q12**	**Q13**	**Q14**	**Q15**
Grid Ref:	R63003 58765	R56105 60628	R56273 60375	R56302 60347	R56394 60536	R56562 60580	R56367 60916	R56762 60272	R62938 58985	R62925 58998	R56292 60304	R56448 60397	R56645 60482	R56582 60176	R56094 60279
Plant species															
Grazing and disturbance		No	No	No	No	No	No	grazed	No	No	No	N0	N0	No	grazed
No. High quality species present	0	1	1	0	0	0	0	0	0	1	0	0	0	0	1
No. positive indicator species present	1	7	7	3	1	5	2	2	4	4	4	3	2	1	3
Correspondance to Annex I habitat:															
Molinia meadows (6410)	Fail	**Pass**	**Pass**	Fail	Fail	Fail	Fail	Fail	Fail	Fail	Fail	Fail	Fail	Fail	Fail
Lowland hay meadow (6510)	Fail		Fail	Fail	Fail	Fail	Fail	Fail	Fail	Fail					

Appendix 10.2

IWeBS Data Showing Whooper Swan Records

(Source: BirdWatch Ireland)

I-WeBS

Coonagh - Bunratty R490587

Species	1% National	1% International	2005/06	2006/07	2007/08	2008/09	2009/10	Mean	Peak
Mute Swan	110		11	9	5	7	24	11	24
Whooper Swan	130	210	167	89	95	110	70	106	167
Greylag Goose	50	870				30		6	30
Shelduck	150	3,000	1	25			6	6	25
Wigeon	820	15,000	302	72	94	503	830	360	830
Teal	450	5,000	25			199	173	79	199
Mallard	380	20,000			2	12	16	6	16
Tufted Duck	370	12,000	4			16		4	16
Goldeneye	95	11,500	15			5		4	15
Cormorant	140	1,200				1	6	1	6
Little Egret		1,300				1	6	1	6
Grey Heron	30	2,700		2		1	2	1	2
Golden Plover	1,700	9,300	50			300	20	74	300
Lapwing	2,100	20,000	1		3	350	100	91	350
Sanderling	65	1,200					100	20	100
Dunlin	880	13,300	90	1,060	130	63	680	405	1,060
Curlew	550	8,500	183	303	180		165	166	303
Greenshank	20	2,300				1		0	1
Redshank	310	3,900		5	3	2		2	5
Turnstone	120	1,500					20	4	20
Black-headed Gull		20,000	146	238	67	67	230	150	238
Common Gull		16,000	2				3	1	3
Herring Gull		13,000	2	2			3	1	3
Great Black-backed Gull		4,800	1			1		0	1

Castleconnell 2004/05

Species	1% National	1% International	Aug	Sep	Jan	Annual peak
Whooper Swan	130	210			22*	22
Mute Swan	110			25		25
Greylag Goose	50	870	1	1		1
Feral/hybrid Goose			1			1
Mallard	380	20,000		29		29
Cormorant	140	1,200		7		7
Grey Heron	30	2,700		2		2

* Swan census, survey undertaken on 15/01/05

Chapter 11 Archaeology, Architecture and Cultural Heritage

11.1 Introduction

The following report details the results of a Cultural Heritage Route Selection Study, which has been carried out in order to assess the archaeological, architectural and cultural heritage resource within route corridors associated with the proposed Limerick Northern Distribution Road. The study has been undertaken in order to inform the selection of the most preferable route and follows on from a Constraints Study, the cultural heritage section of which was also carried out by IAC Ltd in December 2010.

The study area is located within County Limerick and County Clare. It includes a stretch of the River Shannon to, along with part of the north-western environs of Limerick City. A significant portion of the Tailrace Canal is also located within the study area, along with a smaller section of the Errina Canal located between the River Shannon and the Tailrace Canal. Although parts of the study area have been subject to suburban development, much of it still exists as open agricultural land.

There are six route options to be considered on the western side of the Tailrace Canal (as there is only one available point to cross the canal) and sixteen options to consider on the eastern side. All options travel from the existing local road within the townland of Knockalisheen (Co. Clare) across the 'pinch-point' of the Tailrace Canal and in a southeast direction to join with the R445.

This study determines, as far as reasonably possible from existing records, the nature of the cultural heritage resource surrounding the route options for the Limerick Northern Distribution Road, using appropriate methods of study. Desk based research is defined as an assessment of the known or potential archaeological resource within a specified area consisting of a collation of existing written and graphic information. The assessment takes place in order to identify the likely character, extent, quality and worth of the known or potential archaeological and architectural heritage resource in order to make an assessment of its merit in context.

The study has been carried out in accordance with the NRA Guidelines for the Assessment of Archaeological and Built Heritage Impacts of National Road Schemes (2005).

11.2 Methodology

The study involved detailed interrogation of the archaeological, historical and architectural background of the Study Area containing the route options, with specific attention paid to a corridor of 250m either side of the route options (all of which possess a width of 100m).

Research has been undertaken in two phases. The first phase comprised a paper survey of all available archaeological, architectural, historical and cartographic sources. The second phase involved a drive over of the Study Area containing the route options in an attempt to assess the current state of any recorded archaeological and built heritage sites that were accessible from the existing road network.

All measurements referenced in the report are taken from the centre of the route option to the upstanding remains of the recorded site (or to the centre of the site, where no remains occur).

- Record of Monuments and Places for Counties Clare and Limerick;
- Sites and Monuments Record for Counties Clare and Limerick;
- Monuments in State Care Database Counties Clare and Limerick;
- Preservation Orders Counties Clare and Limerick;
- Register of Historic Monuments Counties Clare and Limerick;
- Cartographic and written sources relating to the study area;
- National Inventory of Architectural Heritage Counties Clare and Limerick (Architectural & Garden Survey);
- Excavations Bulletin (1970-2008);
- Clare County Development Plan (2011-2017);
- Limerick County Development Plan (2010-2016);
- Castletroy Local Area Plan (2009);
- Aerial photographic coverage.

Record of Monuments and Places (RMP) is a list of archaeological sites known to the National Monuments Section, which are afforded legal protection under Section 12 of the 1994 National Monuments Act and are published as a record.

Sites and Monuments Record (SMR) holds documentary evidence and field inspections of all known archaeological sites and monuments. Some information is also held about archaeological sites and monuments whose precise location is not known e.g. only a site type and townland are recorded. These are known to the National Monuments Section as 'un-located sites' and cannot be afforded legal protection due to lack of locational information. As a result these are omitted from the Record of Monuments and Places. SMR sites are also listed on the recently launched website created by the DoEHLG – www.archaeology.ie.

National Monuments in State Care Database is a list of all the National Monuments in State guardianship or ownership. Each is assigned a National Monument number whether in guardianship or ownership and has a brief description of the remains of each Monument.

The Minister for the Department of Environment, Heritage and Local Government may acquire national monuments by agreement or by compulsory order. The state or local authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the state, it may not be interfered with without the written consent of the Minister.

Preservation Orders List contains information on Preservation Orders and/or Temporary Preservation Orders, which have been assigned to a site or sites. Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

Register of Historic Monuments was established under Section 5 of the 1987 National Monuments Act, which requires the Minister to establish and maintain such a record. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the Record of Monuments and Places.

Cartographic sources are important in tracing land use development within the development area as well as providing important topographical information on areas of archaeological potential and the development of buildings. Cartographic analysis of all relevant maps has been made to identify any topographical anomalies or structures that no longer remain within the landscape.

Barony Maps of Co. Clare and Limerick
Ordnance Survey 6" and 25" maps of Co. Clare and Limerick

Documentary sources were consulted to gain background information on the archaeological, architectural and cultural heritage landscape of the proposed development area.

Aerial photographic coverage is an important source of information regarding the precise location of sites and their extent. It also provides initial information on the terrain and its likely potential for archaeology. Ordnance Survey aerial photographs (1995, 2000, 2005) and Google Earth coverage were examined for this assessment.

Development Plans contain a catalogue of all the Protected Structures and archaeological sites within ever county. The development plans for Counties Limerick and Clare were examined, along with the Local Area Plans for Castletroy (Limerick) and South Clare.

The **National Inventory of Architectural Heritage** is a government based organisation tasked with making a nationwide record of significant local, regional, national and international structures, which in turn provides county councils with a guide as to what structures to list within the Record of Protected Structures. The NIAH have also carried out a nationwide desk based survey of historic gardens, including demesnes that surround large houses.

Excavations Bulletin is a summary publication that has been produced every year since 1970. This summarises every archaeological excavation that has taken place in Ireland during that year up until 2008 and since 1987 has been edited by Isabel Bennett. This information is vital when examining the archaeological content of any area, which may not have been recorded under the SMR and RMP files. This information is also available online (www.excavations.ie) from 1970-2007.

Once all the baseline data had been assembled for each route option, an assessment of how many impacts the route might potentially have on the archaeological, architectural and cultural heritage resource was made. Based on this assessment, the most preferable route was selected for both the western and eastern part of the proposed scheme.

11.3 Definitions

For the purposes of this report a number of designations will be applied to the sites that are identified within the vicinity of the route options:

Architectural Heritage (AH) will refer to recorded archaeological sites listed within the SMR / RMP, which are subject to protection under the National Monuments Act. This numbering system will carry on from those sites identified in the Constraints Study.

(RMP sites that are referenced in the text but not located within to the Study Area of the route options will be identified by their RMP number).

Built Heritage (BH) will be applied to sites of an architectural heritage nature, such as Protected Structures, buildings listed in the NIAH and any additional structures identified during the assessment. This numbering system will carry on from those sites identified in the Constraints Study.

For the purposes of this report the terms 'architectural heritage' and 'built heritage' have the same intended meaning and are used interchangeably.

Area of Archaeological Potential (AAP) will be applied to areas such as rivers, streams, riverine environments and bogland, which are recognised as possessing archaeological potential.

Determination of Impacts

A potential impact assessment has been prepared along with a detailed route appraisal based on potential impacts. The impact assessment is undertaken to outline potential adverse impacts that the proposed route may have on the cultural heritage resource and allow the selection of the most preferable route.

Impacts are generally categorised as either:

(i) *Direct Impact* – where an archaeological or architectural feature or site is physically located within the footprint of a route option and entails the removal of part, or all of the monument or feature.

(ii) *Indirect Impact* – where a feature or site of archaeological or architectural heritage merit or its setting is located within close proximity to the footprint of a route option.

(iii) *Neutral* – a change that does not affect the setting of a site.

The level of impact in accordance with the EPA guidelines / NRA guidelines can be:

(i) *Imperceptible Impact* - An impact capable of measurement but without noticeable consequences

(ii) *Slight Impact* - An impact which caused changes in the character of the environment, which are not significant or profound and do not directly impact or affect and archaeological or architectural feature.

(iii) *Moderate Impact* – Where a change to a site is proposed which though noticeable, is not such that the archaeological or architectural integrity of the

site is compromised and which is reversible. This arises where a feature can be incorporated into a modern day development without damage and that all procedures used to facilitate this are reversible.

(iv) *Significant Impact* – An impact which, by its magnitude, duration or intensity, alters an important aspect of the environment. An impact like this would be where part of the site, including the immediate setting, would be permanently impacted upon, leading to a loss of character, integrity and data about an archaeological or architectural site.

(v) *Profound Impact* – This applies where mitigation would be unlikely to remove adverse effects. Reserved for adverse, negative effects only. These effects arise where an archaeological or architectural site is completely and irreversibly destroyed by a proposed development.

11.4 Receiving Environment

Refer **Drawings RSCR 1101 and RSCR 1102**.

11.4.1Archaeological and Historical Background

Prehistoric Period

Mesolithic Period (c. 7000–4000BC)

The Mesolithic Period is the earliest time for which there is clear evidence of prehistoric activity in Ireland. During this period people hunted, foraged and gathered food and appear to have had a mobile lifestyle. The most common evidence indicative of Mesolithic activity at a site comprises of scatters of worked flint material; a by-product from the production of flint implements or rubbish middens consisting largely of shells (Stout & Stout 1997). The latter are commonly discovered in coastal regions or at the edge of lakes. Although it is likely that the River Shannon was a significant element for the Mesolithic populations in this landscape, as a food and travelling resource, there are no recorded Mesolithic sites within the receiving environment of the route options.

Neolithic Period (c. 4000–2500BC)

During the Neolithic period communities became less mobile and their economy became based on the rearing of stock and cereal cultivation. This transition was accompanied by major social change. Agriculture demanded an altering of the physical landscape, forests were rapidly cleared and field boundaries constructed. There was a greater concern for territory, which saw the construction of large communal ritual monuments called megalithic tombs, which are characteristic of the period. Despite the relatively large receiving environment, there are no definite recorded Neolithic sites located in this area. The only site tentatively assigned a Neolithic date consists of two pits that were excavated within the townland of Singland c. 700m west southwest of route options B.1 and B.2. One of these pits contained some possible Neolithic pottery (Licence Ref.: 01E0946).

Bronze Age Period (c. 2500–600BC)

The most common Bronze Age site within the archaeological record is the burnt mound or *fulacht fiadh*. Over 4500 *fulachta fiadh* have been recorded in the country making them the most common prehistoric monument in Ireland (Waddell, 1998, 174). Although burnt mounds of shattered stone occur as a result of various activities that have been practiced from the Mesolithic to the present day, those noted in close proximity to a trough are generally interpreted as Bronze Age cooking/industrial sites.

Fulacht fiadh generally consist of a low mound of burnt stone, commonly in horseshoe shape, and are found in low lying marshy areas or close to streams or rivers. Often these sites have been ploughed out and survive as a spread of heat shattered stones in charcoal rich soil with no surface expression in close proximity to a trough.

The term *fulacht* or *fulacht fiadh* is found in early Irish literature from at least the 9th century AD and refers to open air cooking places often associated with the young warrior hunters of the *fianna* and the legendary *fionn mac cumhail* (Waddell, 1998, 174). Even though they may have functioned as cooking sites, dates in the mid-late Bronze Age (1500–600BC) show that they significantly predate the cooking sites referred to in early Irish literature (Brindley & Lanting, 1990). There are two recorded *fulachta fiadh* located within the receiving environment of the route options. AH 7 is located c. 80m southeast of route D.1 and AH 17 is located 120m north of E.1 in Ballyvollane.

Within the wider area significant Bronze Age activity has been recently recorded c. 1.4km southeast of the southern most part of the eastern route options, within the townland of Kilbane. Here three *fulacht fiadh* were identified, along with 22 cremation deposits and 28 possible cremation deposits. These remains have been interpreted as potentially forming part of three Bronze Age flat cemeteries with some peripheral domestic activity (Licence Ref.: 03E1382). It is likely that there are a large number of unrecorded *fulacht fiadh* within the vicinity of the many water courses that are crossed by the proposed route options.

Iron Age Period (c. 500BC – c. AD500)

Compared to the rest of Irish prehistory there is very little evidence in Ireland, as a whole, representing the Iron Age. As in Europe, there are two phases of the Iron Age in Ireland; the Hallstatt and the La Tène. The Hallstatt period generally dates from 700BC onwards and spread rapidly from Austria, across Europe, and then into Ireland. The later Iron Age or La Tène culture also originated in Europe during the middle of the 5th century BC. For several centuries the La Tène Celts were the dominant people in Europe, until they were finally overcome by the Roman Empire. There are no known Iron Age sites located within the receiving environment of the proposed route although the numerous enclosures recorded within the landscape have the potential to date from this period. Furthermore two Roman coins are recorded as being discovered in the banks of the River Shannon at Sreelane in the 1970s (Appendix 11.3).

Early Medieval Period (AD500–1100)

During this period Ireland was not a united country but rather a patchwork of minor monarchies all scrambling for dominance, with their borders ever changing as alliances were formed and battles fought. Kingdoms were a conglomerate of clannish principalities with the basic territorial unit known as a túath. Byrne (1973) estimates that there were probably at least one hundred and fifty kings in Ireland at any given time during this period, each ruling over his own túath. In Munster the Eóganachta formed the ruling dynasties until the middle of the 10th century. These kings were distributed strategically throughout the region and ruled over many tribal units.

During this often violent period, roughly circular defensive enclosures known as ringforts were constructed to protect farmsteads. Although most of the ringforts that have been excavated are shown to date to this period, some have earlier origins and may have been originally constructed during the Iron Age, or even earlier. The ringfort or rath is considered to be the most common indicator of settlement during

the early medieval period (c. 400-1160 AD). The most recent study of the ringfort (Stout 1997) has suggested that there is a total of 45,119 potential ringforts or enclosure sites throughout Ireland. They are typically enclosed by an earthen bank and exterior ditch, and range from 25m to 50m in diameter. The smaller sized and single banked type of ringfort (univallate) were more likely to be home to the lower ranks of society while larger examples with more than one bank (bivallate/trivallate) housed the more powerful kings and lords.

There is only one site listed as a ringfort within the constraints area (AH 24). This site is located within the townland of Ballycannan, c. 120m north of option A.1 and is also protected with a Preservation Order. There are a further 12 enclosures and earthworks listed within the receiving environment, which all have the potential to represent the remains of ringforts (AH 32, 35, 5, 9, 40, 41, 42, 44-47, 49). One of these sites (AH 49) is partially located within the corridor of D.1. One further site (AH 5) is located within the path of the D.1-link-E.1. These site types are by far the most numerous within the landscape and indicate that a large rural population was present during this period surrounding the River Shannon and probable settlement at Limerick.

This period was also characterised by the introduction of Christianity to Ireland. The new religion was a catalyst for many changes, one of the most important being literacy. Irish was written down for the first time using the ogham script. The ogham alphabet is thought to be based on the Latin alphabet of the later Roman Empire and today the majority of the inscriptions that survive are located on pillar stones or boulders. As well as this form of the written word, the church created impressive tomes in their official language, Latin. Examples of these include the Book of Kells and the Book of Durrow as well as other mundane works such as the Annals, which were an account of the history of the church. Monasticism was known in St. Patrick's time (mid 5th century) but it was not until the 6th and 7th centuries that the famous monastic houses such as Glendalough, Bangor, Clonfert, Clonard, Clonmacnoise and Durrow were founded.

There are three recorded church and graveyard sites within the receiving environment of the route options. AH 30 is located c. 275m east of route A.4. AH 48 is located c. 120m northeast of option C.1 and c. 120m southwest of option D.1. This site may possess an early medieval foundation date, due to the circular nature of the graveyard enclosure. AH 55 is located 140m west of option C.1 and forms the site of the medieval parish church of Kilmurray.

It was during the later part of this period that attacks by the Norse on the lower Shannon area were recorded. The Annals of Clonmacnoise record that in AD 843 Foranan, Primate of Armagh, was taken hostage by the Vikings and held on their ships in Limerick (Lenihan 1866, 5). The location of the Norse settlement in the following century is notable as the lowest fording point of the River Shannon, at the head of the tidal reach (O'Rahilly, 1988, 141). The Danes fortified a settlement on the southern part of an island bounded by the west by the Shannon and all other sides by the Abbey River. Later known as "Kings Island", this naturally defended location had the double advantage that it was navigable from the sea and was presumably a crossing point over the Shannon. This provided the Vikings with a secure base from which raids could be conducted along the river upstream of Limerick (*ibid*, 141). Coonagh, to the west of the King's Island, was also described as an ancient fishing village of Viking origin, although to date no archaeological evidence for this exists (Spellissey, 1998, 316).

The strategic importance of Limerick and its environs was appreciated by both the neighbouring native clans and the advancing Anglo-Normans in the middle ages. Brian Bóru sacked the town in AD 967 and 968, allowing the Viking inhabitants to remain within the walls on payment of heavy tributes, including 11,680 gallons of wine per annum (*ibid*, 22). By the time of the Battle of Clontarf, the Limerick Vikings had renewed their alliance with Bóru. His descendants, the O'Brien's, held sway over much of Limerick's hinterland, and by the 11th century were designated Kings of Thomond, establishing a new seat in the old Norse town of Limerick in AD 1100. St. Mary's Cathedral, built in the style of the Cistercians, was originally erected between 1168 and 1172 by Donal O'Brien, and is the sole surviving monument in the city from the pre-Norman occupation (O'Rahilly, 1988, 141).

Medieval Period (AD 1100-1600)

The beginning of the medieval period was characterised by political unrest that originated from the death of Brian Borumha in 1014. Diarmait MacMurchadha, deposed King of Leinster, sought the support of mercenaries from England, Wales and Flanders to assist him in his challenge for kingship. Norman involvement in Ireland began in 1169, when Richard de Clare and his followers landed in Wexford to support MacMurchadha. Two years later de Clare (Strongbow) inherited the Kingdom of Leinster and by the end of the 12th century the Normans had succeeded in conquering much of the country (Stout & Stout 1997, 53).

The arrival of the Anglo-Normans in 1175 took Limerick City by storm. They were forced to withdraw in 1176, and did not succeed in occupying the town until 1190. (Lee 1997, 19). Prince John granted Limerick a charter seven years later, declaring that the citizens would have all the liberties and free customs through all Ireland that were enjoyed by the citizens of Dublin (*ibid*, 24). In 1210, on a visit to Ireland, King John created counties from the portions of land under Anglo-Norman control, one of which became the county of Limerick. During this visit, John erected a castle (King John's Castle) and a bridge (Thomond Bridge) within the English town of the settlement (Dowd 1890, 33). The North Liberties of Limerick remained with Clare in Connaught until 1660 (Spellissey 1998, 36).

The importance of the town grew during the 13th century, when grants were given to fortify the town and repair King John's Castle. Municipal privileges were granted and a corporation was formed to initiate town improvements. The population at this time was growing so rapidly that in 1237 the corporation created taxes to finance the expansion and strengthening of the city defences (*ibid*, 37). A royal mint was also established between 1195 and 1199, which continued to operate sporadically until 1483 (*ibid*, 38).

As well as the potential medieval church at AH 55, there are three recorded castle sites within the vicinity of the route options. AH 3 is located c. 220m east of route A.1 and AH 5, is located c. 200m southwest of route D.1. AH 36 now contains a 19th century house (BH 7), although a 17th century castle belonging to the Earl of Thomond is thought to have occupied the site. AH 36 is located c. 30m northeast of route A.4. These sites represent the sites or remains of later castles or tower houses, which date to the 17-18th century.

Post Medieval Period (AD 1600-1900)

During the Desmond wars of the 16th century, sustaining loyalty to Elizabeth, Limericks chief role was as port and garrison to the incoming and outgoing troops. By the 17th century during the relatively peaceful reign in Munster of James I, Limerick had sustained two fires, which led to considerable improvement in building

construction in the city. However, the protracted siege by Cromwell's forces in 1651 left the city besieged with famine, pestilence and death. The city finally surrendered with a death toll of five thousand inhabitants.

The Jacobean wars of the late 17th century saw the reactivation of the city mint to finance James II campaign. Gun money was minted in Dublin and Limerick, allegedly from the brass of old cannons, hence its name. The city withstood attacks by Williamite forces throughout 1690 and 1691, becoming the last Jacobean stronghold to repel William's army. After the slaughter of six hundred inhabitants who had become trapped outside the city walls and the failure of French reinforcements to arrive, Patrick Sarsfield signed the Treaty of Limerick in October 1691.

Evidence from the industrial age is also prevalent within the constraints study area, as the Shannon was an important form of communications. The Errina Canal (BH 41), which runs parallel to the River Blackwater, emerges travels in a north-south direction through the receiving environment. This was part of a development intended to make the River Shannon more easily navigable for transportation. One of the greatest obstacles hindering this was the Falls of Doonass further upstream. Goods had to be unloaded and taken around the falls adding to the expense of transportation and leaving scope for theft and accidents. Four of the route options will cross the Errina Canal. The canal itself is now falling derelict and is very overgrown in places.

Work on improving the Shannon started near Limerick in 1757, but it was not until ten years later that the Commissioners for Inland Navigation undertook remedial and construction works on the Lower Shannon. This was spasmodic, expensive and varied greatly in quality. The canals were finally completed in 1799 but were never satisfactory. There were continual complaints of poor maintenance, differences in the size of the locks and the quality of construction. This all led to the passing of the Shannon Navigation Act in 1835. A new program of lock building, dredging and widening of the river was mostly completed by 1850.

Another industrial site is recorded within the townland of Sreelane and consists of the Plassy Mill (AH 1), located c. 200m east of option B.2. Plassy Mill was a corn mill built in 1824 by a Major Hedges Maunsell. It was further developed in the mid 1860s by Richard Russell J.P, when he rebuilt the nearby Plassy House, located outside of the receiving environment. The mill took on a fortified appearance with the addition of mock battlements and the machinery was also improved at this time. The mill continued to be used until the early 20th century until decline in competition; worker dissatisfaction and a fire closed it down. This site is also a protected structure (BH 26).

11.4.2 Summary of Previous Archaeological Fieldwork

Whilst the proposed route options travel through a relatively large area, much of it remains rural in nature and dominated by agricultural activities. Recent development is located along major route ways, such as the N7 and the eastern access road into Limerick. As a result, the majority of archaeological work has been carried out in this area.

The development of the N7 Neagh to Limerick Road Scheme (2006/2007) resulted in the excavation a *fulacht fiadh* in Lisnagry (Ref.: E2330), a hearth at Mountshannon (Ref.: E2334) along with a post medieval drain (Ref.: E2328) and burnt mounds (Ref.: E2329) at Richhill.

Within the townlands of Singland and Reboge, archaeological monitoring of topsoil stripping in association with a road upgrade was carried out in 2001 (00E0653). This resulted in the discovery of two potential Neolithic pits (AH 53), which were subsequently excavated (Licence Ref.: 01E0946).
In the townland of Rivers, further infrastructural upgrades resulted in the discovery of a *fulacht fiadh* and corn drying kiln (AH 7), which were located to the southeast of the site of an enclosure (AH 6) (Licence Ref.: 05E1251). These are located to the immediate southeast of Docking Point D.

Pipeline schemes have also been carried out within the constraints area, which required archaeological monitoring. In 2001, monitoring of the Castleconnell Sewerage Scheme was carried out in Ballyvollane, Prospect and Newgarden North (Licence Ref.: 01E0416), although nothing of archaeological significance was identified. The development of the Clareville to Newcastle Rising Main resulted in the discovery of three *fulachta fiadh* (AH 17, AH 19, AH 23), which were excavated under licences 02E1348, 02E1403 and 02E1424.

In County Clare, only a handful of excavations have been carried out within the constraints area. These, for the most part are associated with the development of the University of Limerick campus, a new section of which is located on the northern side of the River Shannon. Monitoring and testing carried out at the site of the new fourth village resulted in the discovery of post medieval brick clamps in the townland of Garraun (Licence Ref.: 02E1216). An underwater archaeological assessment has also been carried out on the River Shannon at the site of a pedestrian bridge linking the two parts of the university campus, although nothing of archaeological significance was discovered (Licence Refs: 06D042, 06R076).

11.4.3 Areas of Archaeological Potential

Areas of Archaeological Potential (AAP) can be defined as parts of the landscape that possess the potential to contain archaeological remains due to the presence of topographic features such as streams, rivers, lakes, high defendable ground and bogland. A total of 45 AAPs have been identified during the course of this assessment.

River and lakes are a focus for human habitation due to the obvious transport and food resources. They (along with bogs) also have the potential to preserve organic archaeological deposits or artefacts such as wood or leather, which do not usually survive within the alkaline conditions associated with terrestrial archaeology. Wooden track ways dating to the Bronze Age period and later have been excavated within bog land throughout Ireland. Rivers and lakes may have also played a role in prehistoric ritual, as significant artefacts from the prehistoric periods and into the early medieval period, are often found within river bed deposits. This is certainly the case with regards to the River Shannon where an extensive range of archaeological artefacts have been recovered from the river further to the northeast at Killaloe. All the proposed Section 2 routes will have to cross the River Shannon (AAP 19).

A total of 13 stream crossings (AAPs 1, 3, 6, 7, 11, 12, 13, 14, 17, 20, 21, 39) and four river crossings (AAPs 19, 23, 33, 41) have been identified during this assessment, with a further two areas of riverine environment that possess the potential to contain archaeological remains (AAPs 40, 43). Two areas of wet and boggy land were also identified. AAP 45 is located within the environs of a stream within the townlands of Knockalisheen and Quinspool North and AAP 43 is a larger area located within the townlands of Derryfadda and Rosmadda East.

AAPs can also be defined as features that have the potential to contain archaeological remains, such as townland boundaries or as specific sites identified from historic mapping or aerial photograph analysis. The townland is an Irish land unit of considerable longevity as many of the units are likely to represent much earlier land divisions. However, the term townland was not used to denote a unit of land until the Civil Survey of 1654. It bears no relation to the modern word 'town' but like the Irish word *baile* refers to a place. It is possible that the word is derived from the Old English *tun land* and meant 'the land forming an estate or manor' (Culleton 1999, 174).

Gaelic land ownership required a clear definition of the territories held by each sept and a need for strong, permanent fences around their territories. It is possible that boundaries following ridge tops, streams or bog are more likely to be older in date than those composed of straight lines (*ibid.* 179).

The vast majority of townlands are referred to in the 17th century, when land documentation records begin. Many of the townlands are mapped within the Down Survey of the 1650s, so called as all measurements were carefully 'laid downe' on paper at a scale of forty perches to one inch. Therefore most are in the context of pre-17th century landscape organisation (McErlean 1983, 315).

A total of 39 townland boundaries have been identified during the course of this assessment, which will be crossed by the proposed routes. Many are formed by a stream or road, whereas others are marked by a field boundary.

Three AAPs have been identified during the analysis of aerial photography and historic maps. AAP 44 is a potential enclosure or circular anomaly located within the townland of Parteen. It is shown within the aerial photographs as a circular anomaly marked by a change in the vegetation. It is not marked as a feature on any of the historic maps. AAP 42 is a field system located within the townland of Clooncarthy. This site is very visible on the Google Earth coverage of the study area. Although the field system is not marked on the historic mapping, the first edition does show a road running adjacent to the area, the path of which is visible in the aerial photography. The field system, which may include buildings, is roughly rectangular in shape. Agricultural furrows are visible within the area. It is likely to be post medieval (17th-early 19th century) in date, but may be earlier. AAP 25 consists of the site of a lime kiln that is marked on the 25 inch OS mapping, which dates to the late 19th or early 20th century. It is located within the townland of Ballykeelaun and a structure is shown adjacent to the feature. Neither is extant today.

11.4.4 Architectural Background

Despite the relatively rural nature of the receiving environment for the proposed route options, there are only 11 protected structures and five NIAH structures located within it. Desk top assessment and a wind screen survey has identified an additional 13 structures of architectural heritage merit within the receiving environment, which are not subject to specific statutory protection. However, much of the vernacular built heritage that would have once characterised the receiving environment has been removed and replaced with modern residential structures.

Vernacular Architecture is defined in James Steven Curl's Encyclopedia of Architectural Terms as 'a term used to describe the local regional traditional building forms and types using indigenous materials, and without grand architectural pretensions', i.e. the homes and workplaces of the ordinary people built by local people using local materials. This is in contrast to formal architecture, such as the

grand estate houses of the gentry, churches and public buildings, which were often designed by architects or engineers. The majority of vernacular buildings are domestic dwellings. Examples of other structures that may fall into this category include shops, outbuildings, mills, limekilns, farmsteads, forges, gates and gate piers. Typically the single storied thatched cottage would be considered to represent the real vernacular style in Ireland.

While farmhouses may belong to any period, in terms of architectural heritage they can be taken as post-dating 1700. They are generally built of stone and there are many variations in the design, size and structure of farmhouses and their associated outbuildings. Stone cottages were traditionally built from random rubble covered with lime mortar or coats of whitewash, and roofed with locally quarried slate, thatch or corrugated iron. They were often grouped around the farmyard, forming a central courtyard. Smallholdings had a single-storied house, occasionally with a second storey extended from the original. Agricultural outbuildings are mostly single storey, again on a rectangular floor plan. They are generally built from roughly coursed rubble, with either thatched or slated roof coverings. In recent years, the erection of large metal hay sheds with barrel roofs has been widespread. This has led to widespread dereliction of original farm buildings. It is therefore important to fully document the building materials, techniques and uses of any existing structures before this important part of our architectural heritage is completely obliterated.

There are no recorded vernacular structures located within the receiving environment of the proposed route options. However, several structures were noted during the field survey. One thatched cottage is present within the townland of Garraun (BH 50), whereas several vernacular houses and cottages were identified in both Section 1 and 2 (BH 43, 44, 49, 52). BH 52 still possesses a small vernacular farm yard. The first and second edition OS maps shows hundreds of small buildings scattered throughout the receiving environment. However, very few of these survive today and they are noticeable by their absence.

Another characteristic of the post medieval built heritage landscape was the large house, which was often surrounded by an ornamental demesne. These houses belonged to the upper classes and a number were constructed within the environs of Limerick City. Castlebank House (BH 7, AH 36) is one such house and is a protected structure. It incorporates an earlier house, which is marked on the first edition OS map, but does not appear to have possessed a demesne. No area is shown as shaded on the first edition map, although gardens and an orchard are shown to the south of the house. It is probable that the house represents a large farm house rather than the seat of landed gentry. Two similar types of house are located within the townland of Garraun (BH 51) and another within Athlunkard (BH 53), although neither are protected.

From the mid to late 19th century, the Anglo-Irish landowning classes began to slowly lose their grip on the thousands of acres of Irish landscape that formed a large part of their estates. The large country house and demesne were often only a small part of the visible wealth possessed by such families and their demise was brought about by a number of factors including The Famine; the loss of a younger generation to the first world war and the fight for independence by the Republicans. The lower classes resented the amount of land that was owned by the Anglo-Irish gentry and in 1922 the Land Commission was established. The purpose of the Commission was to purchase these estates (often for a greatly reduced price) so they could be re-distributed amongst the lower classes. As a result of this, many families became little more than upper class farmers and as a result many left Ireland to return to England. The large houses and demesnes were often left to decay with the houses often

demolished for building materials and the demesnes subsumed back into the landscape. Five large houses have been lost from within the receiving environment of the proposed route options. These include Ballycannan House, Stream Mount, Roselawn, Willowbank and Castletroy House.

As well as the domestic architecture located within the receiving environment, there are also some industrial heritage structures. The Errina Canal (BH 41) is one such feature. The background of the canal is given in the post medieval section of 4.1. Although falling into disrepair, the canal also possesses several locks, one of which is located within the receiving environment of route options C.1 and D.1. This is Gilloge Lock (BH 42), which is not subject to any specific protection.

The most recent building included within the RPS is the Ardnacrusha Power Station (BH 5) at Ballykeelaun. This structure is located on the edge of the recievinig environment, to the north of option D.2. The station was built between 1925 and 1929 and consists of a twelve bay, six storey, Germanic style Hydroelectric Power Station. The structure also possesses a number of outbuildings and wings and is still in operation. It sits across the purpose built Tailrace Canal (BH 40), which is connected to the River Shannon further to the northeast. Plans to harness the Shannon's power were proposed from the mid-19th century onwards, although it seems that cost was always a factor in preventing the work from going ahead. The Irish War of Independence interrupted plans from continuing during the early 1920s. However, in 1924-25 the new Irish Free State's Minister for Industry and Commerce, Patrick McGilligan commissioned the engineer Dr. Thomas McLoughlin to submit proposals. Dr McLoughlin had started working for Siemens-Schuckert, a large German engineering firm in late 1922 and produced a scheme that would cost £5.2m. This caused considerable political controversy as the new state's entire budget in 1925 was £25m, but it was accepted.

The Shannon Scheme was officially opened at Parteen Weir on 22 July 1929. One of the largest engineering projects of its day it subsequently served as a model for large-scale electrification projects worldwide. In 2002 on the 75th anniversary of the plant, its uniqueness was recognised by the American Institute of Electrical and Electronic Engineers, in partnership with the American Society of Civil Engineers, who marked the facility as an Engineering Milestone of the 20th century. The building is considered to be of national significance within the NIAH survey (1997).

11.4.5 Record of Protected Structures

A review of the County Development Plans for Clare and Limerick and the Castletroy Local Area Plan has revealed that there are a total 11 protected structures located within the receiving environment of the proposed route options. Of these, three are located in County Clare and eight in County Limerick. (Additional detail is given for the structures in Appendix 11.3 of this report).

County Clare

BH No.:	RPS No.:	Townland:	Classification:	NGR:	Legal Status:
BH 5	311	Ballykeelaun	Power Station	158614/ 161734	RPS
BH 6	84	Ballykeelaun	Former National School	158402/ 160826	RPS
BH 7	653	Castlebank	Country House	158065/ 161395	RPS

County Limerick

BH No.:	RPS No.:	Townland:	Classification:	NGR:	Legal Status:
BH 23	1597	Rivers/ Ballyvollane	Foot Bridge	163184/ 158905	RPS
BH 24	1598	Castletroy	Tower House	162790/ 158607	RPS
BH 25	1599	Sreelane	Plassy Bridge	160818/ 158560	RPS
BH 26	1600	Sreelane	Plassy Mills	160818/ 158560	RPS
BH 36	1623	Dromore	House	160899/ 157473	RPS
BH 37	1606	Newcastle	Rectory	162396/ 157744	RPS
BH 38	1607	Newcastle	Church & Graveyard	162310/ 157618	RPS
BH 39	1616	Newcastle	Coaching Inn	162296 157507	RPS

11.4.6 National Inventory of Architectural Heritage

A review of the National Inventory of Architectural Heritage revealed a total of five NIAH structures within the receiving environment of the proposed route. Of these, one structure is located within County Clare and four structures are located within County Limerick. All of the structures listed are also protected structures with the exception of BH 31 and 33. (Additional detail is given for the structures in Appendix 11.3 of this report).

County Clare

BH No.:	NIAH No.:	Townland:	Classification:	NGR:	RPS?
BH 5	20405308	Ballykeelaun	Power station	158614/ 161734	Yes

County Limerick

BH No.:	NIAH No.:	Townland:	Classification:	NGR:	RPS?
BH 25	21900503	Sreelane	Plassy Bridge	160818/ 158560	Yes
BH 26	21900504	Sreelane	Plassy Mills	160818/ 158560	Yes
BH 31	21900502	Ballygrennan	Country House	156001/ 159816	No
BH 33	21900619	Garraunkee	House	164857/ 157859	No

11.4.7 Architectural Conservation Areas

There is one Architectural Conservation Area within the receiving environment of the proposed route options (B.1, B.2, C.1). This is designated within the Castletroy Local Areas Plan (2009). It consists of parts of the townlands of Sreelane, Dromore and Castletroy. A small section of the eastern part and western part of the ACA was located within the original constraints area. There are a total of six protected

structures located within the ACA. Structures of note within the ACA are Plassy Mill (BH 26, AH 1), Plassy Bridge (BH 25) and St. Senan's House (BH 36). Today the ACA is dominated by the campus associated with the University of Limerick.

The Castletroy LAP defines an ACA as a place, area or group of structures or townscapes, which are of special architectural, historical, archaeological, artistic, cultural, social, scientific or technical interest. It goes on to state that:

> *It is felt that the designation of an Architectural Conservation Area in and around the University Campus is necessary to secure the appreciation of the setting of the existing protected structures and the buildings of high architectural quality constructed since the University's foundation.*

The objective in establishing the Architectural Conservation Area has been to:

- Safeguard the parklands associated with Plassey House in order for the evolved university complex to retain significant tree cover, green areas and vistas down to the River Shannon;
- Safeguard views out from, or in towards, the University's principal buildings;
- Safeguard elements associated with the historical evolution of the site such as waterways and water control mechanisms such as sluices or pumps;
- Ensure that the University's setting and amenities are safeguarded from unauthorised works and insensitive developments;
- Allow the University to develop on the left bank of the River Shannon in a sensitive and strategic manner without compromising the site's significance.

The corridor of the proposed route option B.1 will impact upon the western most corner of the ACA. Route option B.1 will travel through the western part of the ACA, but this will not directly impact on the setting of the protected structures or group value of the ACA. No severance of features will take place, although the construction of a new road bridge across the River Shannon will be an addition to the built environment and create an indirect impact. Route option C.1 will travel through the eastern most part of the ACA. Once again, no severance will take place and the receiving environment of the protected structures will not radically alter.

11.4.8 Demesne Landscapes

Another typical element of the post medieval landscape, which was present within the landscape surrounding Limerick, was the development of ornamental demesne landscapes surrounding large country houses. One of the houses (Mountshannon), which is located outside of the receiving environment of route option E.1, is listed within the RMP as well as being a protected structure. It is also included within the National Inventory of Architectural Heritage (NIAH). The original demesne that accompanied the house was very large consisting, unusually, of three townlands (Ballyvollane, Mountshannon and Gaurraunykee). The demesne is marked as a shaded area on the first edition OS map of 1844. Route option E.1 will pass through the original demesne lands (D.4).

Three other smaller demesnes will also be impacted upon by the proposed route options. D 1 forms the original demesne area accompanying Quinborough House, which is located outside of the receiving environment of route option A.2.1. The route will impact upon the northern section of the demesne lands. An accompanying wall (BH 45) skirts the edge of this demesne and then continues to the north and northeast (possibly part of Stream Mount estate, which is no longer present). All

section 1 route options will impact on this wall. Quinsborough House is a protected structure and in good condition.

D 2 was a demesne area originally associated with St. Senan's House (BH 36). It is marked on the first edition OS map and it is possible to confuse it with the demesne of Plassey House or Milford House, located outside of the receiving environment of both B.1 and B.2. These routes will impact slightly on the western edge of the former demesne. However, its demesne character has been lost completely due to large scale residential development and the development of the University Campus.

D 3 was a demesne area originally associated with Roselawn House, within the townland of Castletroy. The house is no longer extant and part of the demesne has been subject to industrial development. It now exists as scrub land and has lost most of its demesne characteristics. Route option C.1 will travel through the western section.

11.4.9 Wind Screen Survey

A wind screen survey was carried out within the receiving environment of the proposed route options on the 21st July 2011. This was carried out in order to verify the surviving remains of any recorded archaeological or architectural heritage sites, which could be accessed from the existing road network. It also aimed to identify any other cultural heritage features that may be of significance but are not subject to statutory protection.

Section 1

The only archaeological monument accessible from the existing road network was AH 24, a recorded ringfort, which is also further protected by a preservation order. The site is very densely overgrown (Plate 1) and as such it is not possible to view the condition of the monument.

Plate 1 – AH 24 (ringfort), facing southwest

Both BH 7 and BH 31 are extant structures, but not visible from the existing road. However, three additional structures of architectural merit were identified during the survey. BH 43 is located to the immediate east of the existing roadway in Gortgarraun (Plate 2) (Route option A.4). This consists of a vernacular house with adjacent Victorian post box (Plate 3). The house is marked on the first edition OS map and is vernacular in character. It is in good condition and still inhabited. In the townland of Ballyfinneen, a vernacular farmhouse was identified to the immediate northeast of the route corridor A.4 (BH 44). Although subject to some alteration, the original form of the house is apparent (Plate 4) and it is accompanied by a range of out buildings, although some of them are in a ruinous condition. The structure is not marked on the first or second edition OS maps, although the outbuildings are. It is present by the third edition of 1939. It is likely to be early 20th century in date with the outbuildings slightly older in date.

Plate 2 - BH 43 (vernacular house), facing north

Plate 3 – BH 43 (Victorian post box), facing east northeast

Plate 4 – BH 44 (vernacular farmhouse), facing northeast

A demesne wall was identified along the western boundary of the lands associated with Quinsborough House (D 1). This was found to extend in a northerly direction beyond the known extent of the Quinsborough demesne lands (as depicted on the first edition OS map). The wall has a total length of c. 1.7km. It is possible that part of this was associated with a house called Stream Mount, which was located within Castlebank. The house is no longer extant, but no demesne land was depicted in the OS maps as being associated with this house. The wall varies in condition along its

length. The taller section is located to the south, closer to Quinsborough House. Here the wall is over 2m in height and constructed of roughly coursed masonry (Plate 5). The wall is not as tall at its northern extent and has collapsed in places.

Plate 5 – BH 45 (demesne wall), facing southeast

All of the route options will cross the Tailrace Canal (BH 40). The canal itself is not a protected structure. However, it is directly associated with Ardnacrusha Power Station (BH 5), which is a protected structure and deemed of being of national importance by the NIAH. The proposed crossing point is c. 600m southeast of the power station. The canal is a massive piece of early 20th century engineering. Today the southern section is flanked by mature woodland (Plate 6).

Plate 6 – BH 40 (Tailrace Canal), facing northeast

Section 2

Both AH 40 (earthwork) and 44 (enclosure) were inspected during the survey, but no upstanding remains were identified at either site. AH 1 (mill, in ruins) was also found to be extant (Plate 7), along with the footbridge across the River Shannon (BH 26). It is not possible to access the footbridge. The two features are located on the northern edge of the Limerick University Campus and are within the designated ACA. BH 36, also within the ACA, was present, although the character of the building has suffered slightly due to the insertion of a modern door and window fittings. In the eastern part of the campus (outside of the ACA) BH 37 (Glebe House) was noted as present, but was not properly visible from the road. BH 38/AH 54 (church and graveyard) are also present, but the graveyard is overgrown and the church is not in use (Plate 8). The possible coaching inn (BH 39) was present to the south of the church and graveyard. Two further AH sites were accessible from the road network. No visible surface remains were present at AH 45. At AH 44 the overgrown remains of a probable ringfort are present.

Plate 7 – AH 1/BH 26 (Plassy Mill ruins), facing south

Plate 8 – AH 54/BH 38 (church and graveyard) facing northwest

In the northern part of section 2 is Ardnacrusha Power Station (BH 5). This is a protected structure of national significance. The Headrace Canal travels in a west-east direction towards the power station (Plate 9). The canal is characterised by large embankments and as such is a significant landscape feature.

Plate 9 – BH 5 (Ardnacrusha Power Station), facing west

Whilst no additional archaeological sites were identified during the survey within Section 2, a number of built heritage sites were noted, which were initially flagged during the review of the historic mapping. A bridge (BH 46) is present across the River Blackwater, which divides the townlands of Rosmadda East and Ballyglass. The bridge is marked on the first edition OS map as *New Bridge.* It is a substantial structure and consists of a single arched span. The bridge is faced in coursed and dressed masonry (Plate 10, 11). Approximately 800m to the east is another bridge

across the river (BH 48). This is not marked on the first edition, but it is present by the time of the second edition. It is of similar construction as BH 46, with a single arched span and dressed, coursed masonry (Plate 12). To the northeast of BH 46 is Ballyglass House (BH 47), which is located within a small, but well preserved demesne.

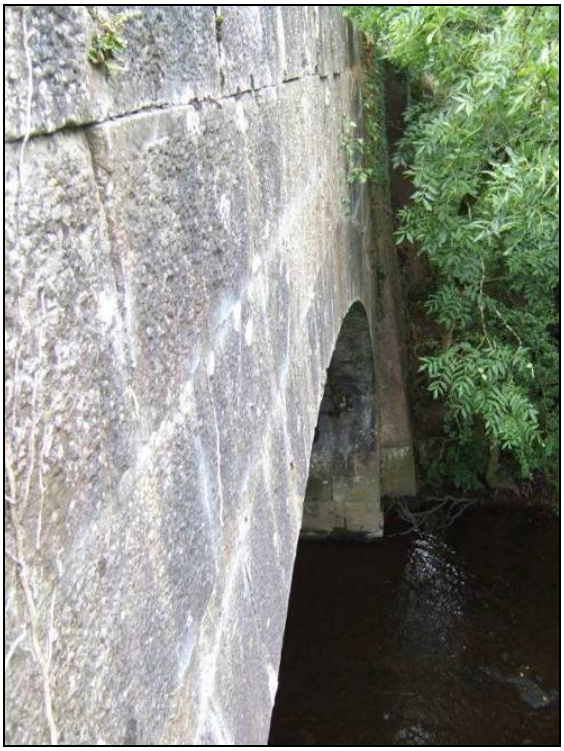


Plate 10 – BH 46 ('New Bridge'), facing southeast

Plate 11 – The parapet walls of BH 46, facing south southwest

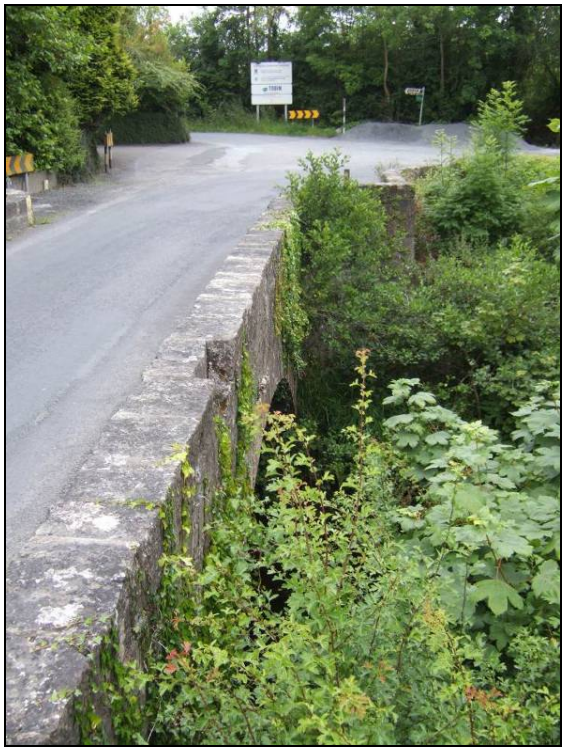


Plate 12 – BH 48 (bridge), facing south

Further east, within the townland of Derryfadda a small vernacular complex was noted (BH 49). One cottage is inhabited and one was noted as being in a ruinous state, along with a number of stone outbuildings. Several structures are shown here on the first edition OS map but the present structures are shown on the second edition OS map.

In the southern part of section 2 a total of four built heritage structures were identified during the survey. In the townland of Garraun a thatched cottage was identified (BH 50), adjacent to a tertiary road (Plate 13). This building is marked on the first edition OS map and is in good condition with replacement thatch. Further to the southeast was another house (BH 51), also within the townland of Garraun. This is a large, two storey farm house that retains many architectural features (Plate 14). It is marked on the second edition OS map, although buildings are shown at this location on the first edition map.

Plate 13 – BH 50 (vernacular cottage), facing northwest

Plate 14 – BH 51 (large farm house), facing east northeast

Further to the west a vernacular complex was noted within the townland of Clooncarthy (BH 52). This consists of a single storey cottage and a number of outbuildings (Plate 15). The cottage is marked on the second edition OS map but the outbuildings are slightly later in date. In the adjacent townland of Athlunkard to the west a large house was noted (BH 53). This is located to the south of a tertiary road and possesses ruinous stone outbuildings adjacent to the road. Buildings are shown at this location on the first edition OS map, but the house is not shown until the second edition map. The main southern façade of the house was not visible from the road. However, it is a substantial two storey structure.

Plate 15 – BH 52 (vernacular farmyard), facing west

11.5 Route Option Assessment: Section 1

11.5.1 Route A.1 (Nodes A-F-X)

Archaeological Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 3 LI005-010	Ballygrennan 156001/159816	Castle	250m	Indirect	Imperceptible negative
AH 32 CL063-005	Castlebank 157323/161039	Enclosure, site of	120m	Indirect	Slight negative
AH 35 CL063-009	Castlebank 157984/161543	Enclosure, site of	290m	Indirect	Imperceptible negative
AH 36 CL063-010	Castlebank 158065/161400	Castle, site of ?	140m	Indirect	Slight negative

Built Heritage

BH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 7 RPS 658	Castlebank 158065/161395	Country House	140m	Indirect	Slight negative
BH 31 NIAH 21900502	Ballygrennan 156001/159816	Country House	250m	Indirect	Imperceptible negative
BH 40	Ballykeelaun 158205/161189	Tailrace Canal	0m	Direct	Significant Negative
BH 45	Quinspool North/ Castlebank 157093/161109	Demesne wall	0m	Direct	Moderate negative

Areas of Archaeological Potential (AAPs)

AAP No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 1	Knockalisheen/ Quinspool North	Townland & parish boundary, stream	0m	Direct	Moderate negative
AAP 2	Quinspool North/ Castlebank	Townland boundary	0m	Direct	Moderate negative
AAP 12	Castlebank	Stream	0m	Direct	Moderate negative
AAP 13	Castlebank/ Ballykeelaun	Townland boundary, stream	0m	Direct	Moderate negative

11.5.2 Route A.2 (Nodes A-X)

Archaeological Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 32 CL063-005	Castlebank 157323/161039	Enclosure, site of	70m	Indirect	Moderate negative
AH 36 CL063-010	Castlebank 158065/161400	Castle, site of ?	220m	Indirect	Imperceptible negative

Built Heritage

BH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 7 RPS 658	Castlebank 158065/161395	Country House	220m	Indirect	Imperceptible negative
BH 40	Ballykeelaun 158205/161189	Tailrace Canal	0m	Direct	Significant Negative
BH 45	Quinspool North/ Castlebank 157138/160876	Demesne wall	0m	Direct	Moderate negative

Areas of Archaeological Potential (AAPs)

AAP No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 1	Knockalisheen/ Quinspool North	Townland & parish boundary, stream	0m	Direct	Moderate negative
AAP 2	Quinspool North/ Castlebank	Townland boundary	0m	Direct	Moderate negative
AAP 12	Castlebank	Stream	0m	Direct	Moderate negative
AAP 13	Castlebank/ Ballykeelaun	Townland boundary, stream	0m	Direct	Moderate negative

11.5.3 Route A.2.1 (Nodes A-X)

Archaeological Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 32 CL063-005	Castlebank 157323/161039	Enclosure, site of	200m	Indirect	Slight negative
AH 36 CL063-010	Castlebank 158065/161400	Castle, site of ?	200m	Indirect	Slight negative

Built Heritage

BH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 7 RPS 658	Castlebank 158065/161395	Country House	200m	Indirect	Slight negative
BH 40	Ballykeelaun 158205/161189	Tailrace Canal	0m	Direct	Significant Negative
D 1	Parteen	Quinsborough House Demesne	0m	Direct	Moderate negative
BH 45	Quinspool North/ Castlebank 157184/160701	Demesne wall	0m	Direct	Moderate negative

Areas of Archaeological Potential (AAPs)

AAP No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 1	Knockalisheen/ Quinspool North	Townland & parish boundary, stream	0m	Direct	Moderate negative
AAP 2	Quinspool North/ Parteen	Townland boundary	0m	Direct	Moderate negative
AAP 3	Parteen/ Castlebank	Townland boundary & stream	0m	Direct	Moderate negative
AAP 12	Castlebank	Stream	0m	Direct	Moderate negative
AAP 13	Castlebank/ Ballykeelaun	Townland boundary, stream	0m	Direct	Moderate Negative
AAP 44	Parteen 157276/160742	Potential enclosure	10m	Direct	Significant negative

11.5.4 Route A.3 (Nodes A-F-X)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 32 CL063-005	Castlebank 157323/161039	Enclosure, site of	120m	Indirect	Slight negative
AH 35 CL063-009	Castlebank 157984/161543	Enclosure, site of	290m	Indirect	Imperceptible negative
AH 36 CL063-010	Castlebank 158065/161400	Castle, site of ?	140m	Indirect	Slight negative

Built Heritage

BH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 7 RPS 658	Castlebank 158065/161395	Country House	140m	Indirect	Slight negative
BH 40	Ballykeelaun 158205/161189	Tailrace Canal	0m	Direct	Significant Negative
BH 45	Quinspool North/ Castlebank 157088/161200	Demesne wall	0m	Direct	Moderate negative

Areas of Archaeological Potential (AAPs)

AAP No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 1	Knockalisheen/ Quinspool North	Townland & parish boundary, stream	0m	Direct	Moderate negative
AAP 2	Quinspool North/ Castlebank	Townland boundary	0m	Direct	Moderate negative
AAP 12	Castlebank	Stream	0m	Direct	Moderate negative
AAP 13	Castlebank/ Ballykeelaun	Townland boundary, stream	0m	Direct	Moderate Negative
AAP 45	Knockalisheen/ Quinspool North	Boggy area	0m	Direct	Significant negative

11.5.5 Route A.4 (Nodes A-G-H-X)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 24 Cl053-041 Pres. order	Ballycannan 156681/162325	Ringfort	180m	Indirect	Slight negative
AH 30 CL063-003	Knockalisheen 155792/161191	Graveyard	300m	Neutral	None anticipated
AH 35 CL063-009	Castlebank 157984/161543	Enclosure, site of	290m	Indirect	Imperceptible negative
AH 36 CL063-010	Castlebank 158065/161400	Castle, site of ?	140m	Indirect	Slight negative

Built Heritage

BH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 7 RPS 658	Castlebank 158065/161395	Country House	70m	Indirect	Moderate negative
BH 40	Ballykeelaun 158205/161189	Tailrace Canal	0m	Direct	Significant Negative
BH 43	Gortgarraun	Vernacular house	0m	Direct	Significant

BH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
	157318/161727	& post box			Negative
BH 44	Ballyfinneen 156802/162127	Vernacular farm house & yard	30m	Indirect	Moderate negative
BH 45	Ballyfinneen/ Castlebank 157138/160876	Demesne wall	0m	Direct	Moderate negative

Areas of Archaeological Potential (AAPs)

AAP No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 4	Knockalisheen/ Gortgarraun	Townland boundary	0m	Direct	Moderate negative
AAP 5	Gortgarraun/ Knockalisheen	Townland boundary	0m	Direct	Moderate negative
AAP 6	Knockalisheen/ Ballycannan West	Townland boundary & stream	0m	Direct	Moderate negative
AAP 7	Ballycannan West/ Ballycannan North/ Ballycannan East/ Ballycannan	Three townland boundaries & two streams	0m	Direct	Moderate negative
AAP 8	Ballycannan/ Ballyfineen	Townland boundary	0m	Direct	Moderate negative
AAP 10	Ballyfineen/ Castlebank	Townland boundary	0m	Direct	Moderate negative
AAP 11	Castlebank	Stream	0m	Direct	Moderate negative
AAP 13	Castlebank/ Ballykeelaun	Townland boundary, stream	0m	Direct	Moderate negative

11.5.6 Route A.4.1 (Nodes A-G-H-X)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 30 CL063-003	Knockalisheen 155792/161191	Graveyard	300m	Neutral	None anticipated
AH 31 Cl063-004	Ballycannan 156460/161694	Holy well	200m	Indirect	Slight negative
AH 35 CL063-009	Castlebank 157984/161543	Enclosure, site of	290m	Indirect	Imperceptible negative
AH 36 CL063-010	Castlebank 158065/161400	Castle, site of ?	140m	Indirect	Slight negative

Built Heritage

BH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 7 RPS 658	Castlebank 158065/161395	Country House	70m	Indirect	Moderate negative
BH 40	Ballykeelaun 158205/161189	Tailrace Canal	0m	Direct	Significant Negative
BH 43	Gortgarraun 157318/161727	Vernacular house & post box	0m	Direct	Significant Negative
BH 45	Ballyfinneen/ Castlebank 157228/161674	Demesne wall	0m	Direct	Moderate negative

Areas of Archaeological Potential (AAPs)

AAP No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 4	Knockalisheen/ Gortgarraun	Townland boundary	0m	Direct	Moderate negative
AAP 5	Gortgarraun/ Knockalisheen	Townland boundary	0m	Direct	Moderate negative
AAP 6	Knockalisheen/ Ballycannan West	Townland boundary & stream	0m	Direct	Moderate negative
AAP 7	Ballycannan West/ Ballycannan North/ Ballycannan East/ Ballycannan	Three townland boundaries & two streams	0m	Direct	Moderate negative
AAP 9	Ballycannan/ Quinspool North/ Ballyfineen	Two townland boundaries	0m	Direct	Moderate negative
AAP 10	Ballyfineen/ Castlebank	Townland boundary	0m	Direct	Moderate negative
AAP 11	Castlebank	Stream	0m	Direct	Moderate negative
AAP 13	Castlebank/ Ballykeelaun	Townland boundary, stream	0m	Direct	Moderate negative

11.5.7 Section 1: Summary of Potential Impacts & Preferred Option

Route Impact type	A.1	A.2	A.2.1	A.3	A.4	A.4.1
Profound Negative	-	-	-	-	-	-
Significant Negative	BH 40	BH 40	BH 40 AAP 44	BH 40 AAP 45	BH 40 BH 43	BH 40 BH 43
Moderate Negative	AAP 1 AAP 2 AAP 12 AAP 13 BH 45	AH 32 AAP 1 AAP 2 AAP 12 AAP 13 BH 45	AAP 1 AAP 2 AAP 3 AAP 12 AAP 13 D 1 BH 45	AAP 1 AAP 2 AAP 12 AAP 13 BH 45	BH 7 AAP 4 AAP 5 AAP 6 AAP 7 AAP 8 AAP 10	BH 7 AAP 4 AAP 5 AAP 6 AAP 7 AAP 9 AAP 10

Route Impact type	A.1	A.2	A.2.1	A.3	A.4	A.4.1
					AAP 11 AAP 13 BH 44 BH 45	AAP 11 AAP 13 BH 45
Slight Negative	AH 32 AH 36 BH 7	-	AH 32 AH 36 BH 7	AH 32 AH 36 BH 7	AH 24 AH 36	AH 31 AH 36
Imperceptible Negative	AH 3 AH 35 BH 31	AH 36 BH 7	-	AH 35	-	AH 35
Neutral	-	-	-	-	AH 30	AH 30
Ranking	6 Best	4	3	5	1 Worst	2

11.6 Route Option Assessment: Section 2

11.6.1 Route B.1 (Nodes X-J-B)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 41 CL063-013	Gortatoger 159438/160675	Enclosure, site of	310m	Indirect	Imperceptible negative
AH 42 CL063-014	Shannakyle 159438/160675	Enclosure, site of	290m	Indirect	Imperceptible negative

Built Heritage

BH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 6 RPS 84	Ballykeelaun 158402/160826	Former National School	290m	Neutral	None anticipated
BH 36 RPS 1623	Dromore 160899/157473	House	120m	Indirect	Sight negative
D 2	Dromore	Shannon Park Demesne	0m	Direct	Slight negative
BH 53	Cloonoughter 159439/159848	House	220m	Indirect	Slight negative
BH 52	Clooncarthy 160131/158951	Vernacular farm	190m	Indirect	Slight negative
ACA	Dromore	Architectural Conservation Area	0m	Direct	Slight negative

Areas of Archaeological Potential (AAPs)

AAP No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 14	Ballykeelaun/ Gortatogher	Townland boundary & stream	0m	Direct	Moderate Negative
AAP 15	Gortatogher/ Knockballymeath	Townland boundary	0m	Direct	Moderate Negative
AAP 16	Knockballymeath/	Townland boundary	0m	Direct	Moderate Negative

AAP No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
	Shannakyle				
AAP 17	Shannakyle/ Cloonoughter	Townland boundary & stream	0m	Direct	Moderate Negative
AAP 18	Cloonoughter/ Clooncarthy	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 19	Clooncarthy/ Dromore	River Shannon crossing	0m	Direct	Significant Negative
AAP 20	Dromore/ Newcastle	Townland boundary & stream	0m	Direct	Moderate Negative
AAP 42	Clooncarthy	Field system and road	0m	Direct	Moderate negative
AAP 43	Clooncarthy	Riverine promontory	0m	Direct	Significant negative

11.6.2 Route B.2 (Nodes X-J-B)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 41 CL063-013	Gortatoger 159438/160675	Enclosure, site of	310m	Indirect	Imperceptible negative
AH 42 CL063-014	Shannakyle 159438/160675	Enclosure, site of	290m	Indirect	Imperceptible negative
AH 1 LI005-052	Sreelane 160822/158564	Watermill	260m	Indirect	Slight negative

Built Heritage

BH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 6 RPS 84	Ballykeelaun 158402/160826	Former National School	290m	Neutral	None anticipated
BH 41	Garraun 160812/158739	Errina Canal	160m	Indirect	Slight negative
BH 25 RPS 1599	Garraun/ Sreelane 160818/158560	Footbridge	260m	Indirect	Slight negative
BH 26 RPS	Sreelane 160822/158564	Watermill	260m	Indirect	Slight negative
BH 36 RPS 1623	Dromore 160899/157473	House	120m	Indirect	Sight negative
D 2	Dromore	Shannon Park Demesne	0m	Direct	Slight negative
BH 53	Cloonoughter 159439/159848	House	250m	Indirect	Imperceptible Negative
ACA	Dromore	Architectural Conservation Area	0m	Direct	Moderate negative

Areas of Archaeological Potential (AAPs)

AAP No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 14	Ballykeelaun/ Gortatogher	Townland boundary & stream	0m	Direct	Moderate Negative
AAP 15	Gortatogher/ Knockballymeath	Townland boundary	0m	Direct	Moderate Negative
AAP 16	Knockballymeath/ Shannakyle	Townland boundary	0m	Direct	Moderate Negative
AAP 17	Shannakyle/ Cloonoughter	Townland boundary & stream	0m	Direct	Moderate Negative
AAP 18	Cloonoughter/ Clooncarthy	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 21	Clooncarthy/ Gilloge/ Clooncarthy	Two townland boundaries & stream	0m	Direct	Moderate Negative
AAP 19	Clooncarthy/ Dromore	River Shannon crossing	0m	Direct	Significant Negative
AAP 20	Dromore/ Newcastle	Townland boundary & stream	0m	Direct	Moderate Negative

11.6.3 Route B.1/D.1/C.1 (Nodes X-J-L-C)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 41 CL063-013	Gortatoger 159438/160675	Enclosure, site of	310m	Indirect	Imperceptible negative
AH 42 CL063-014	Shannakyle 159438/160675	Enclosure, site of	290m	Indirect	Imperceptible negative
AH 44 CL063-024	Derryfadda 161358/159818	Enclosure, possible	250m	Indirect	Imperceptible negative
AH 46 CL063-017	Cappavilla South 161698/159858	Holy well	70m	Indirect	Moderate negative
AH 47 CL063-018	Garraun 161944/159776	Enclosure	90m	Indirect	Moderate negative
AH 48 CL063-019	Garraun 162011/159630	Church & graveyard	180m	Indirect	Slight negative
AH 54 LI005-026	Newcastle 162310/157618	Church & graveyard	180m	Indirect	Imperceptible negative

Built Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 6 RPS 84	Ballykeelaun 158402/160826	Former National School	290m	Neutral	None anticipated
BH 41	Garraun 161614/160016	Errina Canal	0m	Direct	Significant negative
BH 42	Garraun 161450/159802	Gilloge Lock	120m	Indirect	Moderate negative
BH 50	Garraun	Vernacular cottage	220m	Indirect	Imperceptible

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
	161557/159536				negative
BH 51	Garraun 161642/159201	House	300m	Neutral	None predicted
BH 37 RPS 1606	Newcastle 162396/157744	Glebe House	60m	Indirect	Slight negative
BH 38 RPS 1607	Newcastle 162310/157618	Church & graveyard	180m	Indirect	Slight negative
BH 39 RPS 1616	Newcastle 162296/157507	Coaching Inn	240m	Neutral	None anticipated
D 3	Castletroy	Roselawn demesne	0m	Direct	Moderate Negative
ACA	Castletroy	University of Limerick Campus ACA	0m	Direct	Moderate negative

Areas of Archaeological Potential (AAPs)

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 14	Ballykeelaun/ Gortatogher	Townland boundary & stream	0m	Direct	Moderate Negative
AAP 15	Gortatogher/ Knockballymeath	Townland boundary	0m	Direct	Moderate Negative
AAP 16	Knockballymeath/ Shannakyle	Townland boundary	0m	Direct	Moderate Negative
AAP 17	Shannakyle/ Cloonoughter	Townland boundary & stream	0m	Direct	Moderate Negative
AAP 22	Cloonoughter/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 23	Derryfadda/ Garraun	River Blackwater & townland boundary	0m	Direct	Moderate Negative
AAP 19	Garraun/ Castletroy	River Shannon crossing	0m	Direct	Significant Negative
AAP 24	Castletroy/ Newcastle	Townland boundary	0m	Direct	Moderate Negative

11.6.4 Route D.2/Link/C.1 (Nodes X-K-L-C)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification	Dist. from option:	Impact type:	Potential Impact level:
AH 40 CL063-012	Rosmadda West 159362/161487	Earthwork	120m	Indirect	Slight negative
AH 44 CL063-024	Derryfadda 161358/159818	Enclosure, possible	250m	Indirect	Imperceptible negative
AH 46 CL063-017	Cappavilla South 161698/159858	Holy well	70m	Indirect	Moderate negative

AH No.:	Townland/ NGR:	Classification	Dist. from option:	Impact type:	Potential Impact level:
AH 47 CL063-018	Garraun 161944/159776	Enclosure	90m	Indirect	Moderate negative
AH 48 CL063-019	Garraun 162011/159630	Church & graveyard	180m	Indirect	Slight negative
AH 54 LI005-026	Newcastle 162310/157618	Church & graveyard	180m	Indirect	Imperceptible negative

Built Heritage

AH No.:	Townland/ NGR:	Classification	Dist. from option:	Impact type:	Potential Impact level:
BH 5 RPS 311	Ballykeelaun 158614/161734	Power station & dam	250m	Indirect	Imperceptible negative
BH 41	Garraun 161526/159900	Errina Canal	0m	Direct	Significant negative
BH 42	Garraun 161450/159802	Gilloge Lock	120m	Indirect	Moderate negative
BH 50	Garraun 161557/159536	Vernacular cottage	220m	Indirect	Imperceptible negative
BH 51	Garraun 161642/	House	300m	Neutral	None predicted
BH 37 RPS 1606	Newcastle 162396/157744	Glebe House	60m	Indirect	Slight negative
BH 38 RPS 1607	Newcastle 162310/157618	Church & graveyard	180m	Indirect	Slight negative
BH 39 RPS 1616	Newcastle 162296/157507	Coaching Inn	240m	Neutral	None anticipated
D 3	Castletroy	Roselawn demesne	0m	Direct	Moderate Negative
ACA	Castletroy	University of Limerick Campus ACA	0m	Direct	Moderate negative

Areas of Archaeological Potential (AAPs)

AH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 25	Ballykeelaun 158403/161286	Lime kiln site	0m	Direct	Profound negative
AAP 26	Ballykeelaun/ Rosmadda West	Townland boundary	0m	Direct	Moderate Negative
AAP 27	Rosmadda West/ Rosmadda East	Townland boundary	0m	Direct	Moderate Negative
AAP 28	Rosmadda East/ Shannakyle	Townland boundary	0m	Direct	Moderate Negative
AAP 29	Shannakyle/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 23	Derryfadda/ Garraun	River Blackwater & townland boundary	0m	Direct	Moderate Negative
AAP 19	Garraun/ Castletroy	River Shannon crossing	0m	Direct	Significant Negative
AAP 24	Castletroy/	Townland	0m	Direct	Moderate

AH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
	Newcastle	boundary			Negative
AAP 43	Shannakyle/ Derryfadda	Boggy area	0m	Direct	Significant negative

11.6.5 Route B.1/D.1 (Nodes X-J-L-M-N-P-D)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from Option:	Impact type:	Potential Impact level:
AH 41 CL063-013	Gortatoger 159438/160675	Enclosure, site of	310m	Indirect	Imperceptible negative
AH 42 CL063-014	Shannakyle 159438/160675	Enclosure, site of	290m	Indirect	Imperceptible negative
AH 44 CL063-024	Derryfadda 161358/159818	Enclosure, possible	250m	Indirect	Imperceptible negative
AH 46 CL063-017	Cappavilla South 161698/159858	Holy well	70m	Indirect	Moderate negative
AH 47 CL063-018	Garraun 161944/159776	Enclosure	90m	Indirect	Moderate negative
AH 48 CL063-019	Garraun 162011/159630	Church & graveyard	180m	Indirect	Slight Negative
AH 49 CL063-020	Srawickeen 162820/159149	Enclosure	20m	Direct	Significant negative
AH 4 LI006-017	Castletroy 162791/158610	Tower house	250m	Indirect	Imperceptible negative
AH 5 LI006-059	Castletroy 163342/158419	Enclosure	190m	Indirect	Slight Negative
AH 6 LI006-063	Rivers 163785/157494	Potential site	50m	Neutral	None anticipated
AH 7 LI006-094	Rivers 163832/157438	*Fulacht fiadh* & corn drying kiln	125m	Neutral	None anticipated

Built Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from Option:	Impact type:	Potential Impact level:
BH 6 RPS 84	Ballykeelaun 158402/160826	Former National School	290m	Neutral	None anticipated
BH 41	Garraun 161614/160016	Errina Canal	0m	Direct	Significant negative
BH 42	Garraun 161450/159802	Gilloge Lock	250m	Indirect	Imperceptible negative
BH 24 RPS 1598	Castletroy 162790/158607	Tower house	250m	Indirect	Imperceptible negative
BH 23	Rivers/ Ballyvollane 163184/158905	Foot bridge	200m	Indirect	Slight negative

Areas of Archaeological Potential (AAPs)

AH No.:	Townland/ NGR:	Classification:	Dist. from Option:	Impact type:	Potential Impact level:
AAP 14	Ballykeelaun/ Gortatogher	Townland boundary & stream	0m	Direct	Moderate Negative
AAP 15	Gortatogher/ Knockballymeath	Townland boundary	0m	Direct	Moderate Negative
AAP 16	Knockballymeath/ Shannakyle	Townland boundary	0m	Direct	Moderate Negative
AAP 17	Shannakyle/ Cloonoughter	Townland boundary & stream	0m	Direct	Moderate Negative
AAP 22	Cloonoughter/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 23	Derryfadda/ Cappavilla South	River Blackwater & townland boundary	0m	Direct	Moderate Negative
AAP 30	Cappavilla South/ Srawickeen	Townland boundary	0m	Direct	Moderate Negative
AAP 19	Srawickeen/ Castletroy	River Shannon crossing	0m	Direct	Significant Negative
AAP 31	Castletroy/ Rivers	Townland boundary	0m	Direct	Moderate Negative

11.6.6 Route D.2/Link/D.1 (Nodes X-K-L-M-N-P-D)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification	Dist. from option:	Impact type:	Potential Impact level:
AH 40 CL063-012	Rosmadda West 159362/161487	Earthwork	120m	Indirect	Slight negative
AH 44 CL063-024	Derryfadda 161358/159818	Enclosure, possible	250m	Indirect	Imperceptible negative
AH 46 CL063-017	Cappavilla South 161698/159858	Holy well	70m	Indirect	Moderate negative
AH 47 CL063-018	Garraun 161944/159776	Enclosure	90m	Indirect	Moderate negative
AH 48 CL063-019	Garraun 162011/159630	Church & graveyard	180m	Indirect	Slight Negative
AH 49 CL063-020	Srawickeen 162820/159149	Enclosure	20m	Direct	Significant negative
AH 4 LI006-017	Castletroy 162791/158610	Tower house	250m	Indirect	Imperceptible negative
AH 5 LI006-059	Castletroy 163342/158419	Enclosure	190m	Indirect	Slight Negative
AH 6 LI006-063	Rivers 163785/157494	Potential site	50m	Neutral	None anticipated
AH 7 LI006-094	Rivers 163832/157438	*Fulacht fiadh* & corn drying kiln	125m	Neutral	None anticipated

Built Heritage

AH No.:	Townland/ NGR:	Classification	Dist. from option:	Impact type:	Potential Impact level:
BH 5 RPS 311	Ballykeelaun 158614/161734	Power station & dam	250m	Indirect	Imperceptible negative
BH 41	Garraun 161614/160016	Errina Canal	0m	Direct	Significant negative
BH 42	Garraun 161450/159802	Gilloge Lock	250m	Indirect	Imperceptible negative
BH 24 RPS 1598	Castletroy 162790/158607	Tower house	250m	Indirect	Imperceptible negative
BH 23	Rivers/ Ballyvollane 163184/158905	Foot bridge	200m	Indirect	Slight negative

Areas of Archaeological Potential (AAPs)

AH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 25	Ballykeelaun 158403/161286	Lime kiln site	0m	Direct	Profound negative
AAP 26	Ballykeelaun/ Rosmadda West	Townland boundary	0m	Direct	Moderate Negative
AAP 27	Rosmadda West/ Rosmadda East	Townland boundary	0m	Direct	Moderate Negative
AAP 28	Rosmadda East/ Shannakyle	Townland boundary	0m	Direct	Moderate Negative
AAP 29	Shannakyle/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 43	Shannakyle/ Derryfadda	Boggy area	0m	Direct	Significant negative
AAP 23	Derryfadda/ Cappavilla South	River Blackwater & townland boundary	0m	Direct	Moderate Negative
AAP 30	Cappavilla South/ Srawickeen	Townland boundary	0m	Direct	Moderate Negative
AAP 19	Srawickeen/ Castletroy	River Shannon crossing	0m	Direct	Significant Negative
AAP 31	Castletroy/ Rivers	Townland boundary	0m	Direct	Moderate Negative

11.6.7 Route D.2/D.1 (Nodes X-K-M-N-P-D)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 40 CL063-012	Rosmadda West 159362/161487	Earthwork	120m	Indirect	Slight negative
AH 45 CL063-016	Derryfadda 161276/160942	Enclosure	240m	Indirect	Imperceptible negative
AH 46 CL063-017	Cappavilla South 161698/159858	Holy well	200m	Indirect	Slight negative

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 47 CL063-018	Garraun 161944/159776	Enclosure	110m	Indirect	Slight negative
AH 48 CL063-019	Garraun 162011/159630	Church & graveyard	180m	Indirect	Slight Negative
AH 49 CL063-020	Srawickeen 162820/159149	Enclosure	20m	Direct	Significant negative
AH 4 LI006-017	Castletroy 162791/158610	Tower house	250m	Indirect	Imperceptible negative
AH 5 LI006-059	Castletroy 163342/158419	Enclosure	190m	Indirect	Slight Negative
AH 6 LI006-063	Rivers 163785/157494	Potential site	50m	Neutral	None anticipated
AH 7 LI006-094	Rivers 163832/157438	*Fulacht fiadh* & corn drying kiln	125m	Neutral	None anticipated

Built Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 5 RPS 311	Ballykeelaun 158614/161734	Power station & dam	250m	Indirect	Imperceptible negative
BH 41	Garraun 161629/160199	Errina Canal	0m	Direct	Significant negative
BH 24 RPS 1598	Castletroy 162790/158607	Tower house	250m	Indirect	Imperceptible negative
BH 23	Rivers/ Ballyvollane 163184/158905	Foot bridge	200m	Indirect	Slight negative

Areas of Archaeological Potential (AAPs)

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 25	Ballykeelaun 158403/161286	Lime kiln site	0m	Direct	Profound negative
AAP 26	Ballykeelaun/ Rosmadda West	Townland boundary	0m	Direct	Moderate Negative
AAP 27	Rosmadda West/ Rosmadda East	Townland boundary	0m	Direct	Moderate Negative
AAP 28	Rosmadda East/ Shannakyle	Townland boundary	0m	Direct	Moderate Negative
AAP 29	Shannakyle/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 43	Shannakyle/ Derryfadda	Boggy area	0m	Direct	Significant negative
AAP 23	Derryfadda/ Cappavilla South	River Blackwater & townland boundary	0m	Direct	Moderate Negative
AAP 30	Cappavilla South/ Srawickeen	Townland boundary	0m	Direct	Moderate Negative

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 19	Srawickeen/ Castletroy	River Shannon crossing	0m	Direct	Significant Negative
AAP 31	Castletroy/ Rivers	Townland boundary	0m	Direct	Moderate Negative

11.6.8 Route D.2/E.1/D.1 (Nodes X-K-N-P-D)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 40 CL063-012	Rosmadda West 159362/161487	Earthwork	120m	Indirect	Slight negative
AH 45 CL063-016	Derryfadda 161276/160942	Enclosure	300m	Neutral	None anticipated
AH 49 CL063-020	Srawickeen 162820/159149	Enclosure	20m	Direct	Significant negative
AH 4 LI006-017	Castletroy 162791/158610	Tower house	250m	Indirect	Imperceptible negative
AH 5 LI006-059	Castletroy 163342/158419	Enclosure	190m	Indirect	Slight Negative
AH 6 LI006-063	Rivers 163785/157494	Potential site	50m	Neutral	None anticipated
AH 7 LI006-094	Rivers 163832/157438	*Fulacht fiadh* & corn drying kiln	125m	Neutral	None anticipated

Built Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 5 RPS 311	Ballykeelaun 158614/161734	Power station & dam	250m	Indirect	Imperceptible negative
BH 46	Rosmadda East/ Ballyglass 160412/161696	Bridge	90m	Indirect	Slight Negative
BH 47	Ballyglass 160662/161907	Ballyglass House	270m	Indirect	Imperceptible negative
BH 48	Derryfadda/ Mount Catherine 161193/161563	Bridge	150m	Indirect	Slight negative
BH 49	Derryfadda 161281/161133 7	Vernacular complex	0m	Direct	Significant negative
BH 41	Derryfadda 161638/161108	Errina Canal	0m	Direct	Significant negative
BH 24 RPS 1598	Castletroy 162790/158607	Tower house	250m	Indirect	Imperceptible negative
BH 23	Rivers/ Ballyvollane 163184/158905	Foot bridge	200m	Indirect	Slight negative

Areas of Archaeological Potential (AAPs)

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 25	Ballykeelaun 158403/161286	Lime kiln site	0m	Direct	Profound Negative
AAP 26	Ballykeelaun/ Rosmadda West	Townland boundary	0m	Direct	Moderate Negative
AAP 27	Rosmadda West/ Rosmadda East	Townland boundary	0m	Direct	Moderate Negative
AAP 32	Rosmadda East/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 33	Derryfadda	River Blackwater	0m	Direct	Moderate Negative
AAP 34	Derryfadda/ Cappavilla North	Townland boundary	0m	Direct	Moderate Negative
AAP 35	Cappavilla North/ Cappavilla South	Townland boundary	0m	Direct	Moderate Negative
AAP 36	Cappavilla South/ Srawickeen	Townland boundary	0m	Direct	Moderate Negative
AAP 40	Rosmadda East/ Derryfadda	Riverine area	0m	Direct	Significant Negative
AAP 19	Srawickeen/ Castletroy	River Shannon crossing	0m	Direct	Significant Negative
AAP 31	Castletroy/ Rivers	Townland boundary	0m	Direct	Moderate Negative

11.6.9 Route B.1/D.1/E.1 (Nodes X-J-L-M-N-O-E)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 41 CL063-013	Gortatoger 159438/160675	Enclosure, site of	310m	Indirect	Imperceptible negative
AH 42 CL063-014	Shannakyle 159438/160675	Enclosure, site of	290m	Indirect	Imperceptible negative
AH 44 CL063-024	Derryfadda 161358/159818	Enclosure, possible	250m	Indirect	Imperceptible negative
AH 46 CL063-017	Cappavilla South 161698/159858	Holy well	70m	Indirect	Moderate negative
AH 47 CL063-018	Garraun 161944/159776	Enclosure	90m	Indirect	Moderate negative
AH 48 CL063-019	Garraun 162011/159630	Church & graveyard	180m	Indirect	Slight negative
AH 49 CL063-020	Srawickeen 162820/159149	Enclosure	110m	Indirect	Slight Negative
AH 17 LI006-093	Ballyvollane 163839/158910	*Fulacht fiadh*	200m	Indirect	Imperceptible Negative

Built Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 6 RPS 84	Ballykeelaun 158402/160826	Former National School	290m	Neutral	None anticipated
BH 41	Garraun 161614/160016	Errina Canal	0m	Direct	Significant negative
BH 42	Garraun 161450/159802	Gilloge Lock	250m	Indirect	Imperceptible negative
BH 23	Rivers/ Ballyvollane 163184/158905	Foot bridge	70m	Indirect	Moderate negative
BH 33 NIAH 21900619	Garraunkee 164857/157859	House	130m	Indirect	Slight negative
D.4	Rivers/ Ballyvollane/ Mountshannon/ Garraunykee	Mountshannon demesne	0m	Direct	Moderate

Areas of Archaeological Potential (AAPs)

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 14	Ballykeelaun/ Gortatogher	Townland boundary & stream	0m	Direct	Moderate Negative
AAP 15	Gortatogher/ Knockballymeath	Townland boundary	0m	Direct	Moderate Negative
AAP 16	Knockballymeath/ Shannakyle	Townland boundary	0m	Direct	Moderate Negative
AAP 17	Shannakyle/ Cloonoughter	Townland boundary & stream	0m	Direct	Moderate Negative
AAP 22	Cloonoughter/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 23	Derryfadda/ Cappavilla South	River Blackwater & townland boundary	0m	Direct	Moderate Negative
AAP 30	Cappavilla South/ Srawickeen	Townland boundary	0m	Direct	Moderate Negative
AAP 19	Srawickeen/ Rivers	River Shannon crossing	0m	Direct	Significant Negative
AAP 37	Rivers/ Ballyvollane	Townland boundary	0m	Direct	Moderate Negative
AAP 38	Ballyvollane/ Mountshannon	Townland boundary	0m	Direct	Moderate Negative
AAP 39	Mountshannon/ Garraunykee	Townland boundary & stream	0m	Direct	Moderate Negative

11.6.10 Route D.2/Link/D.1/E.1 (Nodes X-K-L-M-N-O-E)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 40 CL063-012	Rosmadda West 159362/161487	Earthwork	120m	Indirect	Slight negative
AH 44 CL063-024	Derryfadda 161358/159818	Enclosure, possible	250m	Indirect	Imperceptible negative
AH 46 CL063-017	Cappavilla South 161698/159858	Holy well	110m	Indirect	Slight negative
AH 47 CL063-018	Garraun 161944/159776	Enclosure	90m	Indirect	Moderate negative
AH 48 CL063-019	Garraun 162011/159630	Church & graveyard	180m	Indirect	Slight Negative
AH 49 CL063-020	Srawickeen 162820/159149	Enclosure	110m	Indirect	Slight negative
AH 17 LI006-093	Ballyvollane 163839/158910	*Fulacht fiadh*	200m	Indirect	Imperceptible Negative

Built Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 5 RPS 311	Ballykeelaun 158614/161734	Power station & dam	250m	Indirect	Imperceptible negative
BH 41	Derryfadda/ Cappavilla South 161614/160016	Errina Canal	0m	Direct	Significant negative
BH 42	Garraun 161450/159802	Gilloge Lock	250m	Indirect	Imperceptible negative
BH 23	Rivers/ Ballyvollane 163184/158905	Foot bridge	70m	Indirect	Moderate negative
BH 33 NIAH 21900619	Garraunkee 164857/157859	House	130m	Indirect	Slight negative
D.4	Rivers/ Ballyvollane/ Mountshannon/ Garraunykee	Mountshannon demesne	0m	Direct	Moderate

Areas of Archaeological Potential (AAPs)

AH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 25	Ballykeelaun 158403/161286	Lime kiln site	0m	Direct	Profound negative
AAP 26	Ballykeelaun/ Rosmadda West	Townland boundary	0m	Direct	Moderate Negative
AAP 27	Rosmadda West/ Rosmadda East	Townland boundary	0m	Direct	Moderate Negative

AH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 28	Rosmadda East/ Shannakyle	Townland boundary	0m	Direct	Moderate Negative
AAP 29	Shannakyle/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 43	Shannakyle/ Derryfadda	Boggy area	0m	Direct	Significant negative
AAP 23	Derryfadda/ Cappavilla South	River Blackwater & townland boundary	0m	Direct	Moderate Negative
AAP 30	Cappavilla South/ Srawickeen	Townland boundary	0m	Direct	Moderate Negative
AAP 19	Srawickeen/ Rivers	River Shannon crossing	0m	Direct	Significant Negative
AAP 37	Rivers/ Ballyvollane	Townland boundary	0m	Direct	Moderate Negative
AAP 38	Ballyvollane/ Mountshannon	Townland boundary	0m	Direct	Moderate Negative
AAP 39	Mountshannon/ Garraunykee	Townland boundary & stream	0m	Direct	Moderate Negative

11.6.11 Route D.2/D.1/E.1 (Nodes X-K-M-N-O-E)

Archaeological Heritage:

AH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 40 CL063-012	Rosmadda West 159362/161487	Earthwork	120m	Indirect	Slight negative
AH 45 CL063-016	Derryfadda 161276/160942	Enclosure	240m	Indirect	Imperceptible negative
AH 46 CL063-017	Cappavilla South 161698/159858	Holy well	200m	Indirect	Slight negative
AH 47 CL063-018	Garraun 161944/159776	Enclosure	110m	Indirect	Slight negative
AH 48 CL063-019	Garraun 162011/159630	Church & graveyard	180m	Indirect	Slight Negative
AH 49 CL063-020	Srawickeen 162820/159149	Enclosure	110m	Indirect	Slight Negative
AH 17 LI006-093	Ballyvollane 163839/158910	*Fulacht fiadh*	200m	Indirect	Imperceptible Negative

Built Heritage

AH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 5 RPS 311	Ballykeelaun 158614/161734	Power station & dam	250m	Indirect	Imperceptible negative
BH 41	Derryfadda/ Cappavilla South	Errina Canal	0m	Direct	Significant negative

AH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
	161629/160199				
BH 23	Rivers/ Ballyvollane 163184/158905	Foot bridge	70m	Indirect	Moderate negative
BH 33 NIAH 21900619	Garraunkee 164857/157859	House	130m	Indirect	Slight negative
D.4	Rivers/ Ballyvollane/ Mountshannon/ Garraunykee	Mountshannon demesne	0m	Direct	Moderate

Areas of Archaeological Potential (AAPs)

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 25	Ballykeelaun 158403/161286	Lime kiln site	0m	Direct	Profound negative
AAP 26	Ballykeelaun/ Rosmadda West	Townland boundary	0m	Direct	Moderate Negative
AAP 27	Rosmadda West/ Rosmadda East	Townland boundary	0m	Direct	Moderate Negative
AAP 28	Rosmadda East/ Shannakyle	Townland boundary	0m	Direct	Moderate Negative
AAP 29	Shannakyle/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 43	Shannakyle/ Derryfadda	Boggy area	0m	Direct	Significant negative
AAP 23	Derryfadda/ Cappavilla South	River Blackwater & townland boundary	0m	Direct	Moderate Negative
AAP 30	Cappavilla South/ Srawickeen	Townland boundary	0m	Direct	Moderate Negative
AAP 19	Srawickeen/ Ballyvollane	River Shannon crossing	0m	Direct	Significant Negative
AAP 37	Rivers/ Ballyvollane	Townland boundary	0m	Direct	Moderate Negative
AAP 38	Ballyvollane/ Mountshannon	Townland boundary	0m	Direct	Moderate Negative
AAP 39	Mountshannon/ Garraunykee	Townland boundary & stream	0m	Direct	Moderate Negative

11.6.12 Route D.2/E.1 (Nodes X-K-N-O-E)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 40 CL063-012	Rosmadda West 159362/161487	Earthwork	120m	Indirect	Slight negative

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 45 CL063-016	Derryfadda 161276/160942	Enclosure	300m	Neutral	None anticipated
AH 49 CL063-020	Srawickeen 162820/159149	Enclosure	110m	Indirect	Slight Negative
AH 17 LI006-093	Ballyvollane 163839/158910	*Fulacht fiadh*	200m	Indirect	Imperceptible Negative

Built Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 5 RPS 311	Ballykeelaun 158614/161734	Power station & dam	250m	Indirect	Imperceptible negative
BH 46	Rosmadda East/ Ballyglass 160412/161696	Bridge	90m	Indirect	Slight Negative
BH 47	Ballyglass 160662/161907	Ballyglass House	270m	Indirect	Imperceptible negative
BH 48	Derryfadda/ Mount Catherine 161193/161563	Bridge	150m	Indirect	Slight negative
BH 49	Derryfadda 161281/161133 7	Vernacular complex	0m	Direct	Significant negative
BH 41	Derryfadda/ Cappavilla North 161638/161108	Errina Canal	0m	Direct	Significant negative
BH 23	Rivers/ Ballyvollane 163184/158905	Foot bridge	70m	Indirect	Moderate negative
BH 33 NIAH 21900619	Garraunkee 164857/157859	House	130m	Indirect	Slight negative
D.4	Rivers/ Ballyvollane/ Mountshannon/ Garraunykee	Mountshannon demesne	0m	Direct	Moderate

Areas of Archaeological Potential (AAPs)

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 25	Ballykeelaun 158403/161286	Lime kiln site	0m	Direct	Profound negative
AAP 26	Ballykeelaun/ Rosmadda West	Townland boundary	0m	Direct	Moderate Negative
AAP 27	Rosmadda West/ Rosmadda East	Townland boundary	0m	Direct	Moderate Negative
AAP 32	Rosmadda East/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 33	Derryfadda	River Blackwater	0m	Direct	Moderate Negative
AAP 34	Derryfadda/	Townland	0m	Direct	Moderate

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
	Cappavilla North	boundary			Negative
AAP 35	Cappavilla North/ Cappavilla South	Townland boundary	0m	Direct	Moderate Negative
AAP 36	Cappavilla South/ Srawickeen	Townland boundary	0m	Direct	Moderate Negative
AAP 40	Rosmadda East/ Derryfadda	Riverine area	0m	Direct	Significant Negative
AAP 19	Srawickeen/ Castletroy	River Shannon crossing	0m	Direct	Significant Negative
AAP 37	Rivers/ Ballyvollane	Townland boundary	0m	Direct	Moderate Negative
AAP 38	Ballyvollane/ Mountshannon	Townland boundary	0m	Direct	Moderate Negative
AAP 39	Mountshannon/ Garraunykee	Townland boundary & stream	0m	Direct	Moderate Negative

11.6.13 Route B.1/D.1/E.1/Link/D.1 (Nodes X-J-L-M-N-O-P-D)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 41 CL063-013	Gortatoger 159438/160675	Enclosure, site of	310m	Indirect	Imperceptible negative
AH 42 CL063-014	Shannakyle 159438/160675	Enclosure, site of	290m	Indirect	Imperceptible negative
AH 44 CL063-024	Derryfadda 161358/159818	Enclosure, possible	250m	Indirect	Imperceptible negative
AH 46 CL063-017	Cappavilla South 161698/159858	Holy well	70m	Indirect	Moderate negative
AH 47 CL063-018	Garraun 161944/159776	Enclosure	90m	Indirect	Moderate negative
AH 48 CL063-019	Garraun 162011/159630	Church & graveyard	180m	Indirect	Slight negative
AH 17 LI006-093	Ballyvollane 163839/158910	*Fulacht fiadh*	200m	Indirect	Imperceptible Negative
AH 5 LI006-059	Castletroy 163342/158419	Enclosure	0m	Direct	Significant Negative
AH 6 LI006-063	Rivers 163785/157494	Potential site	50m	Neutral	None anticipated
AH 7 LI006-094	Rivers 163832/157438	*Fulacht fiadh* & corn drying kiln	125m	Neutral	None anticipated

Built Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 6 RPS 84	Ballykeelaun 158402/160826	Former National School	290m	Neutral	None anticipated

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 41	Derryfadda/ Cappavilla South 161614/160016	Errina Canal	0m	Direct	Significant negative
BH 42	Garraun 161450/159802	Gilloge Lock	250m	Indirect	Imperceptible negative
BH 23	Rivers/ Ballyvollane 163184/158905	Foot bridge	70m	Indirect	Moderate Negative
D.4	Rivers	Mountshannon demesne	0m	Direct	Moderate

Areas of Archaeological Potential (AAPs)

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 14	Ballykeelaun/ Gortatogher	Townland boundary & stream	0m	Direct	Moderate Negative
AAP 15	Gortatogher/ Knockballymeath	Townland boundary	0m	Direct	Moderate Negative
AAP 16	Knockballymeath/ Shannakyle	Townland boundary	0m	Direct	Moderate Negative
AAP 17	Shannakyle/ Cloonoughter	Townland boundary & stream	0m	Direct	Moderate Negative
AAP 22	Cloonoughter/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 23	Derryfadda/ Cappavilla South	River Blackwater & townland boundary	0m	Direct	Moderate Negative
AAP 30	Cappavilla South/ Srawickeen	Townland boundary	0m	Direct	Moderate Negative
AAP 19	Srawickeen/ Rivers	River Shannon crossing	0m	Direct	Significant Negative
AAP 41	Rivers/ Castletroy	River crossing	0m	Direct	Moderate Negative
AAP 31	Castletroy/ Rivers	Townland boundary	0m	Direct	Moderate Negative

11.6.14 Route D.2/Link/D.1/E.1/Link/D.1 (Nodes X-K-L-M-N-O-P-D)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 40 CL063-012	Rosmadda West 159362/161487	Earthwork	120m	Indirect	Slight negative
AH 44 CL063-024	Derryfadda 161358/159818	Enclosure, possible	250m	Indirect	Imperceptible negative
AH 46 CL063-017	Cappavilla South 161698/159858	Holy well	110m	Indirect	Slight negative
AH 47	Garraun	Enclosure	90m	Indirect	Moderate

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
CL063-018	161944/159776				negative
AH 48 CL063-019	Garraun 162011/159630	Church & graveyard	180m	Indirect	Slight Negative
AH 49 CL063-020	Srawickeen 162820/159149	Enclosure	110m	Indirect	Slight negative
AH 17 LI006-093	Ballyvollane 163839/158910	*Fulacht fiadh*	200m	Indirect	Imperceptible Negative
AH 5 LI006-059	Castletroy 163342/158419	Enclosure	0m	Direct	Significant Negative
AH 6 LI006-063	Rivers 163785/157494	Potential site	50m	Neutral	None anticipated
AH 7 LI006-094	Rivers 163832/157438	*Fulacht fiadh* & corn drying kiln	125m	Neutral	None anticipated

Built Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 5 RPS 311	Ballykeelaun 158614/161734	Power station & dam	250m	Indirect	Imperceptible negative
BH 41	Derryfadda/ Cappavilla South 161614/160016	Errina Canal	0m	Direct	Significant negative
BH 23	Rivers/ Ballyvollane 163184/158905	Foot bridge	70m	Indirect	Moderate Negative
D.4	Rivers	Mountshannon demesne	0m	Direct	Moderate

Areas of Archaeological Potential (AAPs)

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 25	Ballykeelaun 158403/161286	Lime kiln site	0m	Direct	Profound negative
AAP 26	Ballykeelaun/ Rosmadda West	Townland boundary	0m	Direct	Moderate Negative
AAP 27	Rosmadda West/ Rosmadda East	Townland boundary	0m	Direct	Moderate Negative
AAP 28	Rosmadda East/ Shannakyle	Townland boundary	0m	Direct	Moderate Negative
AAP 29	Shannakyle/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 43	Shannakyle/ Derryfadda	Boggy area	0m	Direct	Significant negative
AAP 23	Derryfadda/ Cappavilla South	River Blackwater & townland boundary	0m	Direct	Moderate Negative
AAP 30	Cappavilla South/ Srawickeen	Townland boundary	0m	Direct	Moderate Negative

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 19	Srawickeen/ Rivers	River Shannon crossing	0m	Direct	Significant Negative
AAP 41	Rivers/ Castletroy	River crossing	0m	Direct	Moderate Negative
AAP 31	Castletroy/ Rivers	Townland boundary	0m	Direct	Moderate Negative

11.6.15 Route D.2/D.1/E.1/Link/D.1 (Nodes X-K-M-N-O-P-D)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 40 CL063-012	Rosmadda West 159362/161487	Earthwork	120m	Indirect	Slight negative
AH 45 CL063-016	Derryfadda 161276/160942	Enclosure	240m	Indirect	Imperceptible negative
AH 46 CL063-017	Cappavilla South 161698/159858	Holy well	200m	Indirect	Slight negative
AH 47 CL063-018	Garraun 161944/159776	Enclosure	110m	Indirect	Slight negative
AH 48 CL063-019	Garraun 162011/159630	Church & graveyard	180m	Indirect	Slight Negative
AH 49 CL063-020	Srawickeen 162820/159149	Enclosure	110m	Indirect	Slight Negative
AH 17 LI006-093	Ballyvollane 163839/158910	*Fulacht fiadh*	200m	Indirect	Imperceptible Negative
AH 5 LI006-059	Castletroy 163342/158419	Enclosure	0m	Direct	Significant Negative
AH 6 LI006-063	Rivers 163785/157494	Potential site	50m	Neutral	None anticipated
AH 7 LI006-094	Rivers 163832/157438	*Fulacht fiadh* & corn drying kiln	125m	Neutral	None anticipated

Built Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 5 RPS 311	Ballykeelaun 158614/161734	Power station & dam	250m	Indirect	Imperceptible negative
BH 41	Derryfadda/ Cappavilla South 161629/160199	Errina Canal	0m	Direct	Significant negative
BH 23	Rivers/ Ballyvollane 163184/158905	Foot bridge	70m	Indirect	Moderate Negative
D.4	Rivers	Mountshannon demesne	0m	Direct	Moderate

Areas of Archaeological Potential (AAPs)

AH No.:	Townland:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 25	Ballykeelaun 158403/161286	Lime kiln site	0m	Direct	Profound negative
AAP 26	Ballykeelaun/ Rosmadda West	Townland boundary	0m	Direct	Moderate Negative
AAP 27	Rosmadda West/ Rosmadda East	Townland boundary	0m	Direct	Moderate Negative
AAP 28	Rosmadda East/ Shannakyle	Townland boundary	0m	Direct	Moderate Negative
AAP 29	Shannakyle/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 43	Shannakyle/ Derryfadda	Boggy area	0m	Direct	Significant negative
AAP 23	Derryfadda/ Cappavilla South	River Blackwater & townland boundary	0m	Direct	Moderate Negative
AAP 30	Cappavilla South/ Srawickeen	Townland boundary	0m	Direct	Moderate Negative
AAP 19	Srawickeen/ Rivers	River Shannon crossing	0m	Direct	Significant Negative
AAP 41	Rivers/ Castletroy	River crossing	0m	Direct	Moderate Negative
AAP 31	Castletroy/ Rivers	Townland boundary	0m	Direct	Moderate Negative

11.6.16 Route D.2/E.1/Link/D.1 (Nodes X-K-N-O-P-D)

Archaeological Heritage:

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AH 40 CL063-012	Rosmadda West 159362/161487	Earthwork	120m	Indirect	Slight negative
AH 45 CL063-016	Derryfadda 161276/160942	Enclosure	300m	Neutral	None anticipated
AH 49 CL063-020	Srawickeen 162820/159149	Enclosure	110m	Indirect	Slight Negative
AH 17 LI006-093	Ballyvollane 163839/158910	*Fulacht fiadh*	200m	Indirect	Imperceptible Negative
AH 5 LI006-059	Castletroy 163342/158419	Enclosure	0m	Direct	Significant Negative
AH 6 LI006-063	Rivers 163785/157494	Potential site	50m	Neutral	None anticipated
AH 7 LI006-094	Rivers 163832/157438	*Fulacht fiadh* & corn drying kiln	125m	Neutral	None anticipated

Built Heritage

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
BH 5 RPS 311	Ballykeelaun 158614/161734	Power station & dam	250m	Indirect	Imperceptible negative
BH 46	Rosmadda East/ Ballyglass 160412/161696	Bridge	90m	Indirect	Slight Negative
BH 47	Ballyglass 160662/161907	Ballyglass House	270m	Indirect	Imperceptible negative
BH 48	Derryfadda/ Mount Catherine 161193/161563	Bridge	150m	Indirect	Slight negative
BH 49	Derryfadda 161281/161133 7	Vernacular complex	0m	Direct	Significant negative
BH 41	Derryfadda/ Cappavilla North 161638/161108	Errina Canal	0m	Direct	Significant negative
BH 23	Rivers/ Ballyvollane 163184/158905	Foot bridge	70m	Indirect	Moderate Negative
D.4	Rivers	Mountshannon demesne	0m	Direct	Moderate

Areas of Archaeological Potential (AAPs)

AH No.:	Townland/ NGR:	Classification:	Dist. from option:	Impact type:	Potential Impact level:
AAP 25	Ballykeelaun 158403/161286	Lime kiln site	0m	Direct	Profound negative
AAP 26	Ballykeelaun/ Rosmadda West	Townland boundary	0m	Direct	Moderate Negative
AAP 27	Rosmadda West/ Rosmadda East	Townland boundary	0m	Direct	Moderate Negative
AAP 32	Rosmadda East/ Derryfadda	Townland, parish & barony boundary	0m	Direct	Moderate Negative
AAP 33	Derryfadda	River Blackwater	0m	Direct	Moderate Negative
AAP 34	Derryfadda/ Cappavilla North	Townland boundary	0m	Direct	Moderate Negative
AAP 35	Cappavilla North/ Cappavilla South	Townland boundary	0m	Direct	Moderate Negative
AAP 36	Cappavilla South/ Srawickeen	Townland boundary	0m	Direct	Moderate Negative
AAP 40	Rosmadda East/ Derryfadda	Riverine area	0m	Direct	Significant Negative
AAP 19	Srawickeen/ Rivers	River Shannon crossing	0m	Direct	Significant Negative
AAP 41	Rivers/ Castletroy	River crossing	0m	Direct	Moderate Negative
AAP 31	Castletroy/ Rivers	Townland boundary	0m	Direct	Moderate Negative

11.6.17Section 2: Summary of Potential Impacts & Preferred Route

Route Impact type	B.1	B.2	B.1/D.1/C.1	D.2/Lk/C.1	B.1/D.1	D.2/Lk/D.1
Profound Negative	-	-	-	AAP 25	-	AAP 25
Significant Negative	AAP 19 AAP 43	AAP 19	AH 41 AAP 19	BH 41 AAP 19 AAP 43	AH 49 BH 41 AAP 19	AH 49 BH 41 AAP 19 AAP 43
Moderate Negative	AAP 14 AAP 15 AAP 16 AAP 17 AAP 18 AAP 20 AAP 42	AAP 14 AAP 15 AAP 16 AAP 17 AAP 18 AAP 20 ACA	AH 46 AH 47 BH 42 AAP 14 AAP 15 AAP 16 AAP 17 AAP 22 AAP 23 AAP 24 D 3 ACA	AH 46 AH 47 BH 42 AAP 26 AAP 27 AAP 28 AAP 29 AAP 23 AAP 24 D 3 ACA	AH 46 AH 47 AAP 14 AAP 15 AAP 16 AAP 17 AAP 22 AAP 23 AAP 30 AAP 31	AH 46 AH 47 AAP 26 AAP 27 AAP 28 AAP 29 AAP 23 AAP 30 AAP 31
Slight Negative	BH 36 D 2 BH 53 BH 52 ACA	AH 1 BH 41 BH 25 BH 26 BH 36 D 2	AH 48 BH 37 BH 38	AH 40 AH 48 BH 37 BH 38	AH 5 AH 48 BH 23	AH 40 AH 48 AH 5 BH 23
Imperceptible Negative	AH 41 AH 42	AH 41 BH 42 BH 53	AH 41 AH 42 AH 44 AH 54 BH 50	AH 44 AH 54 BH 5 BH 50	AH 41 AH 42 AH 44 AH 4 BH 42 BH 24	AH 44 AH 4 BH 5 BH 42 BH 24
Neutral	BH 6	BH 6	BH 6 BH 39 BH 51	BH 39 BH 51	AH 6 AH 7 BH 6	AH 6 AH 7
Ranking	16 best	15	6	10	7	4

Route Impact type	D.2/D.1	D.2/E.1/D.1	B.1/D.1/E.1	D.2/Lk/D.1/ E.1	D.2/D.1/E.1	D.2/E.1
Profound Negative	AAP 25	AAP 25	-	AAP 25	AAP 25	AAP 25
Significant Negative	AH 49 BH 41 AAP 19 AAP 43	AH 49 BH 41 AAP 40 AAP 19 BH 49	BH 41 AAP 19	BH 41 AAP 19 AAP 43	BH 14 AAP 19 AAP 43	BH 41 AAP 19 AAP 40 BH 49
Moderate Negative	AAP 26 AAP 27 AAP 28 AAP 29 AAP 23 AAP 30 AAP 31	AAP 26 AAP 27 AAP 32 AAP 33 AAP 34 AAP 35 AAP 36 AAP 31	AH 46 AH 47 BH 23 AAP 14 AAP 15 AAP 16 AAP 17 AAP 22 AAP 23 AAP 30	AH 47 BH 23 AAP 26 AAP 27 AAP 28 AAP 29 AAP 23 AAP 30 AAP 37 AAP 38	BH 23 AAP 26 AAP 27 AAP 28 AAP 29 AAP 23 AAP 30 AAP 37 AAP 38 AAP 39	BH 23 AAP 26 AAP 27 AAP 32 AAP 33 AAP 34 AAP 35 AAP 36 AAP 37 AAP 38

Route Impact type	D.2/D.1	D.2/E.1/D.1	B.1/D.1/E.1	D.2/Lk/D.1/ E.1	D.2/D.1/E.1	D.2/E.1
			AAP 37 AAP 38 AAP 39 D 4	AAP 39 D 4	D 4	AAP 39 D 4
Slight Negative	AH 40 AH 46 AH 47 AH 48 AH 5 BH 23	AH 40 AH 5 BH 23 BH 46 BH 48	AH 48 AH 49 BH 33	AH 40 AH 46 AH 48 AH 49 BH 33	AH 40 AH 46 AH 47 AH 48 AH 49 BH 33	AH 40 AH 49 BH 33 BH 46 BH 48
Imperceptible Negative	AH 45 AH 4 BH 5 BH 24	AH 4 AH 5 BH 24 BH 47	AH 41 AH 42 AH 44 AH 17 BH 42	AH 44 AH 17 BH 5 BH 42	AH 45 AH 17 BH 5	AH 17 BH 5 BH 47
Neutral	AH 6 AH 7	AH 45 AH 6 AH 7	BH 6	-	-	AH 45
Ranking	9	3	12	13	14	11

Route Impact type	B.1/D.1/E.1/ Lk/D.1	D.2/Lk/D.1/ E.1/Lk/D.1	D.2/D.1/E.1/ Lk/D.1	D.2/E.1/Lk/D.1
Profound Negative	-	AAP 25	AAP 25	-
Significant Negative	AH 5 BH 41 AAP 19	AH 5 BH 41 AAP 19 AAP 43	AH 5 BH 41 AAP 19 AAP 43	AH 5 BH 41 AAP 40 AAP 19 BH 49
Moderate Negative	AH 46 AH 47 BH 23 AAP 14 AAP 15 AAP 16 AAP 17 AAP 22 AAP 23 AAP 30 AAP 41 AAP 31 D 4	AH 47 AH 23 AAP 26 AAP 27 AAP 28 AAP 29 AAP 23 AAP 30 AAP 41 AAP 31 D 4	BH 23 AAP 26 AAP 27 AAP 28 AAP 29 AAP 23 AAP 30 AAP 41 AAP 31 D 4	BH 23 AAP 25 AAP 26 AAP 27 AAP 32 AAP 33 AAP 34 AAP 35 AAP 36 AAP 41 AAP 31 D 4
Slight Negative	AH 48	AH 40 AH 46 AH 48 AH 49	AH 40 AH 46 AH 47 AH 48 AH 49	AH 40 AH 49 BH 46 BH 48
Imperceptible Negative	AH 41 AH 42 AH 44 AH 17 BH 42	AH 44 AH 17 BH 5	AH 45 AH 17 BH 5	AH 17 BH 5 BH 47
Neutral	AH 6 AH 7 BH 6	AH 6 AH 7	AH 6 AH 7	AH 45 AH 6 AH 7

Route Impact type	B.1/D.1/E.1/ Lk/D.1	D.2/Lk/D.1/ E.1/Lk/D.1	D.2/D.1/E.1/ Lk/D.1	D.2/E.1/Lk/D.1
Ranking	5	1 worst	8	2

11.7 Route Options Ranking

Section 1

	Nodes	Length	Rank
A.1	A – F – X	3082m	1
A.2	A-X	2443m	3
A.2.1	A-X	2447m	4
A.3	A – F – X	2925m	2
A.4	A – G – H – X	4701m	6
A.4.1	A – G – H – X	4592m	5

This assessment has identified proposed option A.1 as the preferred option for section 1 of the proposed Limerick Northern Distribution Road. This recommendation has been based on comparison of routes with a view to determining which option has least impact on archaeology, architectural and cultural heritage resource of the area.

There are no recorded archaeological sites or protected/NIAH structures located within the immediate vicinity of the proposed route. One potential significant impact was identified at BH 40 (Tailrace Canal), but all route options will potentially have this impact. The route will have a direct, but moderate adverse impact on four AAPs and BH 45 (demesne wall). However, all route options will impact upon BH 45.

The potential impacts identified along route option A.1 are very similar to the second preference A.3. The only difference is that A.3 travels through a boggy area, which has the potential to contain archaeological remains. The third preference (A.2) also contains similar potential impacts, but will result in an indirect moderate impact on a recorded archaeological monument (AH 32).

The route of least preference is A.4 due to a significant impact on BH 43 and a large number of direct and indirect moderate impacts. Very little separates A.4 and A.4.1. It should also be noted that these are the longest route options and therefore the chance of finding more previously unrecorded archaeological remains within greenfield areas is higher than the shorter routes.

Section 2

Route	Nodes	Length	Rank
B.1	X – J – B	5022m	1
B.2	X – J – B	4904m	2
B.1/D.1/C.1	X – J – L – C	6414m	11
D.2/Lk/C.1	X – G – L – C	6806m	7
B.1/D.1	X – J – L – M – N – P – D	7234m	10
D.2/Lk/D.1	X – G – L – M – N – P – D	7627m	13
D.2/D.1	X – G – M – N – P – D	7518m	8
D.2/E.1/D.1	X – G – N – P – D	7855m	14
B.1/D.1/E.1	X – J – L – M – N – O – E	7698m	5
D.2/Lk/D.1/E.1	X – G – L – M – N – O – E	8201m	4
D.2/D.1/E.1	X – G – M – N – O – E	8002m	3
D.2/E.1	X – G – N – O – E	8310m	6

Route	Nodes	Length	Rank
B.1/D.1/E.1/Lk/D.1	X – J – L – M – N – O – P – D	7814m	12
D.2/Lk/D.1/E.1/Lk/D.1	X – G – L – M – N – O – P – D	8214m	16
D.2/D.1/E.1/Lk/D.1	X – G – M – N – O – P – D	8139m	9
D.2/E.1/Lk/D.1	X – G – N – O – P – D	7861m	15

This assessment has identified proposed option B.1 as the preferred option for section 2 of the proposed Limerick Northern Distribution Road. This recommendation has been based on comparison of routes with a view to determining which option has least impact on archaeology, architectural and cultural heritage resource of the area.

There are no recorded archaeological sites or protected/NIAH structures located within the immediate vicinity of the proposed route, with the exception of BH 36. This house is located c. 110m east of the centre of the route corridor, within the built up area of the Limerick University Campus.

The potential impacts identified along route option B.1 are very similar to the second preference B.2, although B.2 will travel within a larger part of the ACA of Limerick University Campus. All routes within Section 2 will have to cross the River Shannon. This is a significant waterway and has been designated as AAP 19. River and lakes are a focus for human habitation due to the obvious transport and food resources. They also have the potential to preserve organic archaeological deposits or artefacts such as wood or leather, which do not usually survive within the alkaline conditions associated with terrestrial archaeology. They may have also played a role in prehistoric ritual, as significant artefacts from the prehistoric periods and into the early medieval period, are often found within river bed deposits. This is certainly the case with regards to the River Shannon where an extensive range of archaeological artefacts have been recovered from the river further to the northeast at Killaloe.

The route of least preference is D.2/Lk/D.1/E.1/Lk/D.1 due to a significant impact on AH 5, as well as BH 41 (Errina Canal) and two AAPs (19, 43). It will also have an indirect moderate impact on AH 47 and AH 23, as well as a direct moderate impact on a large number of townland boundaries. It should be noted that there is little to choose between the route of least preference and those ranked second and third least preferable. All possess a large amount of potential significant and moderate impacts. The least preferred and third least preferred will also have a potential profound impact on the site of the lime kiln (AAP 25).

The preferred and second preferred route option, represent the shortest of the proposed routes. Therefore the risk of these options travelling through previously unrecorded archaeological deposits is lower than those routes that cover a greater area.

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APPENDIX 11.1 – DETAILS OF RECORDED ARCHAEOLOGICAL SITES SURROUNDING THE ROUTE CORRIDORS

Section 1

AH No:	3
RMP No:	LI005-010
Townland:	Ballygrennan
Parish:	St. Munchins
Barony:	Pubblebrien
County:	Limerick
Classification:	Castle
Route Corridor:	A.1
Description:	Site is titled '*Castle*' on the 1st edition OS map. The site is also marked on the 2nd edition mapping and is titled '*Castle Park* 'on the site on the 1938 3rd OS map edition. Castle built and occupied in 1620 by the O'Brien's of Thomond. No further details available in file. Site now occupied by derelict 18th century country house (BH 31).
Reference:	SMR Archive, OSL Vol. I Pg 57, Westropp PRIA 1906-07 Pg 81, Ffolliott R. TIA No. 1 1971 Pg 50.

AH No:	24
RMP No:	CL053-041
Townland:	Ballycannan
Parish:	St. Patrick's
Barony:	Bunratty Lower
County:	Clare
Classification:	Ringfort
Route Corridor:	A.4
Description:	Visible on the 1st edition OS mapping & hachured on the 1938 3rd edition. Univallate ringfort. Preservation Order 2/73. Hit OD. 200-300 *Ryan, W.G. MA Thesis 1980 Vol. 2 597-9*: "Oval nature, N-S axis. Part of the E bank is missing at this site. It is shown as such on the 1842 OS mapping. The single bank area and part of the interior are covered by heavy vegetation. The surrounding ground in the area also has a high water table and as a result is quite swampy. The single bank is 2.5-3m high on the N side (near the road) and is 3.5m wide. The average bank height in the S is less than 1.5m with an average width of 3.5-4m. The fosse can be traced in the SW corner of the site. It now survives to an average depth of 0.5m and a width of 3m. There are two entrances into the site. In the N there is a gap of c. 6m wide and to the S the entrance area is 3m. Due to the dense vegetation only an estimate of the internal diameter is possible; approx. 38m (N-S) by 34m (E-W)."
Reference:	SMR Archive

AH No:	30
RMP No:	CL063-003
Townland:	Knockalisheen
Parish:	St. Munchin's

Barony:	Bunratty Lower
County:	Clare
Classification:	Graveyard
Route Corridor:	A.4, A.4.1
Description:	Marked on the 1st edition OS mapping and titled 'Killiavoher Grave Yard on the 1938 3rd edition mapping. No further description on file.
Reference:	RMP file

AH No:	31
RMP No:	CL063-004
Townland:	Ballycannan
Parish:	St. Patrick's
Barony:	Bunratty Lower
County:	Clare
Classification:	Holy Well
Route Corridor:	A.4.1
Description:	Site is visible on the 1st edition OS mapping and is titled '*Holy Well'* on the 1938 3rd edition map. No further description on file.
Reference:	SMR Archive

AH No:	32
RMP No:	CL063-005
Townland:	Castlebank
Parish:	St. Patrick's
Barony:	Bunratty Lower
County:	Clare
Classification:	Enclosure (site of)
Route Corridor:	A.3, A.1, A.2, A.2.1
Description:	Site is visible on the 1st edition OS mapping and is hachured on the 1938 3rd OS map edition. Locally known as the site of a ringfort; no visible remains. *Ryan G Pg 604* "All editions of OS sheets from 1842 show a ringfort at this site; however field examination failed to find any evidence of it. A large natural rise in a level field crowned by trees is visible."
Reference:	SMR Archive, Ryan G MA Thesis Vol II, 1980 Pg 604

AH No:	35
RMP No:	CL063-009
Townland:	Castlebank
Parish:	St. Patricks'
Barony:	Bunratty Lower
County:	Clare
Classification:	Enclosure (site of).
Route Corridor:	A.3, A.4, A.1, A.4.1
Description:	Visible as hachured on the 1842 1st edition OS map. NM on the 2nd and 3rd editions. No local knowledge or evidence of site. *Ryan G. 1980 Pg 605* "By the time 'Castlebank House' appears on the OS sheet the site is gone-perhaps it was levelled during the construction of that house? The 1842

	map shows a small site with an internal diameter of c. 18m. No field traces visible."
Reference:	SMR Archive, Ryan G. 1980 Vol. II Pg 605.

AH No:	36
RMP No:	CL063-010
Townland:	Castlebank
Parish:	St. Patrick's
Barony:	Bunratty Lower
County:	Clare
Classification:	Castlebank House
Route Corridor:	A.3, A.4, A.1, A.2, A.2.1, A.4.1
Description:	Site is marked on the 1st OS map edition and is titled '*Castlebank House'* on the 1938 3rd OS map edition. Was a castle of the earl of Thomond, besieged in 1642; now a 19th C house. No further description on file. Also a protected structure (BH 7)
Reference:	SMR Archive, Down Survey Map of Bunratty, Moir H. 1986 Pg 65-66, Crotter C. 1842 Pg 10.

Section 2

AH No:	1
RMP No:	LI005-052
Townland:	Sreelane
Parish:	Kilmurry
Barony:	Clanwilliam
County:	Limerick
Classification:	Watermill
Route Corridor:	B.2
Description:	Plassy Mill was a corn mill built in 1824 by a Major Hedges Maunsell. It was further developed in the mid 1860s by Richard Russell J.P, when he rebuilt the nearby Plassy House. The mill took on a fortified appearance with the addition of mock battlements and the machinery was also improved at this time. The mill continued to be used until the early 20th century until decline in competition, worker dissatisfaction and a fire, closed it down. In an attempt to make the building safer, it was partly destroyed by explosives in 1956, and now lies in ruins. The mill is marked on all the editions of the OS maps (1841, 1903) but in the third edition of 1938 is marked as a ruin. Also a protected structure (BH 26)
Reference:	SMR Archive.

AH No:	4
RMP No:	LI006-01701/02/03
Townland:	Castletroy
Parish:	Kilmurry
Barony:	Clanwilliam
County:	Limerick
Classification:	Tower House & possible bawn & gateway
Route Corridor:	D.1, D.2

Description:	Site shown on the 1st and 2nd edition mapping. Titled '*Castle Troy (in ruins)*' on the 1938 3rd edition. Tower house with possible bawn and gate feature. The ruins of the castle are extant. Also a protected structure (BH 24)
Reference:	SMR Archive

AH No:	5
RMP No:	LI006-059
Townland:	Castletroy
Parish:	Kilmurry
Barony:	Clanwilliam
County:	Limerick
Classification:	Enclosure
Route Corridor:	D.1, D.2
Description:	Site not marked on any of the three OS map editions. O'Rahilly EIS 1991 "Site situated on flat low-lying grazing ground bounded to the N by the River Shannon and to the E by the Mulcaire River. Located in the SE corner of the area on flat ground is a possible Ring Barrow. It consists of a trace of a circular feature defined by a very low bank c. 30m in diameter, in the centre of which is a depression. This appears to have been recently in-filled with clay."
Reference:	SMR Archive, Cahe O'Rahilly EIS for Euro Technepale at Castletroy of Limerick 1991.

AH No:	6
RMP No:	LI006-063
Townland:	Rivers
Parish:	Kilmurry
Barony:	Clanwilliam
County:	Limerick
Classification:	Potential Site
Route Corridor:	D.1, D.2
Description:	Potential Site from Aerial Photos (Limerick Ring Road 053 9195). Site not marked on any of the three OS map editions. Possible circular enclosure no further details given.
Reference:	SMR Archive

AH No:	7
RMP No:	LI006-094001/02
Townland:	Rivers
Parish:	Kilmurry
Barony:	Clanwilliam
County:	Limerick
Classification:	*Fulacht fiadh* & Corn drying Kiln
Route Corridor:	D.1, D.2
Description:	Not shown on OS map editions. *05E1251:* Test excavation was carried out in a Greenfield area adjacent to the N7 Limerick-Dublin road. The site retains a monument along its NW boundary identified by aerial photography. It is possible that it had previously been impacted upon by the construction of the roundabout at the

	NW corner of the site. The excavation achieved depths of 0.6m. No materials or artefacts were encountered in the course of testing that could be resolutely related to the monument. However six features were identified as archaeological. Three possible ditches/field boundaries retain the potential for some antiquity. F1 is consistent with *fulacht fiadh* structures. F2 is consistent with a kiln structure. The evidence indicates that the monument has been totally removed both above and below ground archaeology. It will not be included in the revised RMP.
Reference:	SMR Archive

AH No:	9
RMP No:	CL063-018
Townland:	Garraun
Parish:	Kiltenanlea
Barony:	Tulla Lower
County:	Clare
Classification:	Enclosure
Route Corridor:	D.1, D.2
Description:	Site is marked on the 1st edition OS mapping and is partially hachured on the 1938 3rd edition map. No other description on file.
Reference:	SMR Archive

AH No:	17
RMP No:	LI006-093
Townland:	Ballyvollane
Parish:	Stradbally
Barony:	Clanwilliam
County:	Limerick
Classification:	*Fulacht fiadh*
Route Corridor:	E.1
Description:	No information in file
Reference:	SMR Archive

AH No:	40
RMP File:	CL063-012
Townland:	Rosmadda West
Parish:	St. Patrick's
Barony:	Bunratty Lower
County:	Clare
Classification:	Earthwork
Route Corridor:	E.1, D.2
Description:	Not marked on the 1st and 2nd edition OS mapping, hachured on the 3rd edition. *Bennett 2000 Pg 19* "During January 1999 testing was carried out in the environs of a linear earthwork at Rosmadda West Co. Clare before the laying of a gas pipeline from Limerick to the village of Parteen. Field inspection identified an earthen ridge 8.2m long by 2-3m wide by 0.4m high. The ridge lay c. 8m in from the road line.

	The proposed pipeline crossed the zone of archaeological potential for the earthwork. A test-trench was inserted no finds, features or deposits of archaeological interest were noted."
Reference:	SMR Archive

AH No:	41
RMP No:	CL063-013
Townland:	Gortatoger
Parish:	St. Patrick's
Barony:	Bunratty Lower
County:	Clare
Classification:	Enclosure (site of)
Route Corridor:	B.1, B.2, D.1, C.1
Description:	Partially hachured on the 1842 1st edition OS mapping, not marked on the 2nd or 3rd edition maps. *Ryan G. 1980* "The place name comes from the Irish '*Gort an Tohuir'* meaning the field beside the causeway. However, no location of a causeway is visible in the townland. Field inspection found that houses have been built on the site of the E part of the ringfort destroying any traces. The W half had been removed prior to 1842 with the construction of the Limerick to Broadford road."
Reference:	SMR Archive, Ryan G. 1980 MA Thesis Vol. II Pg 609.

AH No:	42
RMP No:	CL063-014
Townland:	Shannakyle
Parish:	Meelick-Parteen
Barony:	Bunratty Lower
County:	Clare
Classification:	Enclosure (site of)
Route Corridor:	B.1, B.2, D.1, C.1
Description:	Site is marked on the 1st edition OS mapping and is indicated & hachured as '*Knockauneevin*' on the 3rd edition map. No trace remains.
Reference:	SMR Archive, Ryan G. MA Thesis 1980 Pg 616-7

AH No:	44
RMP No:	CL063-015
Townland:	Gilloge
Parish:	Kiltenanlea
Barony:	Tulla Lower
County:	Clare
Classification:	Enclosure
Route Corridor:	D.1, C.1
Description:	Site is marked on the 1st edition OS mapping and is hachured on the 1938 3rd edition map. No other description on file.
Reference:	SMR Archive

AH No:	45
RMP No:	CL063-016

Townland:	Derryfadda
Parish:	Kiltenanlea
Barony:	Tulla Lower
County:	Clare
Classification:	Enclosure
Route Corridor:	E.1, D.2
Description:	Site is marked on the 1st edition OS map and is hachured on the 1938 3rd edition. No other description on file.
Reference:	SMR Archive

AH No:	46
RMP No:	CL063-016
Townland:	Derryfadda
Parish:	Kiltenanlea
Barony:	Tulla Lower
County:	Clare
Classification:	Enclosure
Route Corridor:	D.1, C.1, D.2
Description:	Site is marked on the 1st edition OS map and is hachured on the 1938 3rd edition. No other description on file.
Reference:	SMR Archive

AH No:	47
RMP No:	CL063-018
Townland:	Garraun
Parish:	Kiltenanlea
Barony:	Tulla Lower
County:	Clare
Classification:	Enclosure
Route Corridor:	D.1, C.1, D.2
Description:	Site is marked on the 1st edition OS mapping and is partially hachured on the 1938 3rd edition map. No other description on file.
Reference:	SMR Archive

AH No:	48
RMP No:	CL063-01901/02
Townland:	Garraun
Parish:	Kiltenanlea
Barony:	Tulla Lower
County:	Clare
Classification:	Church and graveyard
Route Corridor:	D.1, C.1, D.2
Description:	Site is marked on the 1st edition mapping and is titled '*Templemochulla*' on the 1938 edition. A late 15th century ruin. *Westropp PRIA 1900-1902* "Garruan (Teampul Mochulla) 28ft of the S wall and 18ft of the N remain. The S window is of the late 15th century with a chamfered angular head cut out of one block." *OSL 1839* "In the townland of Garraun....are the ruins of a church dedicated to Saint Machuille or Mochuille the brother of Saint Senan Liath. The gables of this Church are

	destroyed down to the foundation stones but a fragment of the S wall 29ft in length and 10ft in height remains as well as about 18ft o the N wall."
Reference:	SMR Archive, Westropp PRIA 1900-1902 Pg 161, Frost J. 1893 Pg. 180, OSL Vol. II 1839 Pg 366.

AH No:	49
RMP No:	CL063-020
Townland:	Srawickeen
Parish:	Kiltenanlea
Barony:	Tulla Lower
County:	Clare
Classification:	Enclosure
Route Corridor:	D.1, D.2, E.1
Description:	Site shown on the 1st edition OS map and hachured on the 1938 3rd edition mapping. No further description or details on file. Several photographs showing a slight bank with tree coverage and vegetation.
Reference:	SMR Archive

AH No:	AH 54
RMP File:	LI005-026
Townland:	Newcastle
Parish:	Kilmurray
Barony:	Clanwilliam
County:	Limerick
Classification:	Church and graveyard
Route Corridor:	C.1
Description:	The present building here dates from 1812, but it is known to be built on the site of a medieval parish church. Also listed as a protected structure (BH 38)
Reference:	SMR Archive

APPENDIX 11.2 – DETAILS OF RECORDED BUILT HERITAGE SITES SURROUNDING THE ROUTE CORRIDORS

Section 1

BH No:	7
RPS No:	653
NIAH No:	N/a
Townland:	Castlebank
Parish:	St. Patrick's
Barony:	Bunratty Lower
County:	Clare
Classification:	Country House
Route Corridor:	A.1, A.2.1, A.2, A.3, A.4, A.4.1
Description:	"An irregular stone faced, gabled breakfront house with central front door situated in a gabled breakfront, facing west. This incorporates an earlier house, and a wide fan and side lights, doorway leads from the porch into the main hallway. To the south a double pile gable-end gives two bays with one-storey bay windows with lean-to roofs." Hugh Weir – 'Houses of Clare' 1990. *Additional Information* Extensive outbuildings form a quadrangle. Window and door openings are brick while the main structures are built of cut-stone. A Stone Shield dated 1578 possibly from the Earl of Thormond's Castle is set into a gable wall. Also a Recorded Monument CL063-010 (AH 36).
Categories of special interest:	Architectural, historical
Rating:	Regional
Reference:	County Clare Development Plan (2011-2017)

BH No:	31
RPS No:	N/a
NIAH No:	21900502
Townland:	Ballygrennan
Parish:	St. Munchins
Barony:	Pubblebrien
County:	Limerick
Classification:	Country House
Route Corridor:	A.1
Description:	Detached five-bay two-storey country house, built c. 1750, comprising floating pediment to front (south) elevation, full-height canted bay to east elevation having extension adjoining remodelled tower house to east with crenellated curtain wall. Two-bay four-storey extension to rear (north) elevation. Now in disuse. Rendered parapet with limestone eaves course, rendered chimneystacks and remains of limestone crenellations to roofline. Rendered walls having limestone quoins, plinth course and cornice. Square-headed window openings with limestone sills, some with remains of timber sliding sash windows. Venetian window to first floor having limestone surround, keystone to central opening and limestone sill.

	Lunette to pediment with limestone surround, keystone and sill. Square-headed opening with carved limestone surround comprising pilasters, pediment and scrolled consoles over spoked fanlight over timber panelled double-leaf doors with flanking square-headed sidelights having limestone surrounds. Square-plan remodelled tower house to east having rendered walls with limestone quoins. Square-headed window openings having limestone sills. Pair of square-profile limestone piers with sweeping rendered walls having crenellated limestone copings and plinth courses. *NIAH Appraisal* This substantial house, attributed to Francis Bindon, displays characteristic features of his work such as the lunette resting on the Venetian window's keystone. Built in different phases, the house retains its 18th century façade with earlier fabric to the rear elevation. Castle Park is distinguished by its finely carved limestone dressings, which are indicative of the skill of 18th century craftsmen. Battlements were added in the 19th century, when the castle style of architecture was in vogue. Also a recorded castle site AH 3.
Categories of special interest:	Architectural, artistic, archaeological
Rating:	Regional
Reference:	County Limerick NIAH Survey (2010)

Section 2

BH No:	5
RPS No:	311
NIAH No:	20405308
Townland:	Ballykeelaun
Parish:	St. Patricks
Barony:	Bunratty Lower
County:	Clare
Classification:	Power Station
Route Corridor:	C.1
Description:	Hydroelectric power station complex, built 1925-1929, engineered by German company Siemens Schuckertwerke. Detached twelve-bay six-storey power station with double attic built over river, having nine-bay two-storey flat-roofed projecting wing to front, two-bay advanced bay to left and four-bay side elevation. Pitched and hipped slate roofs with concrete ridge tiles, two courses of gabled dormers, pyramidal steel-framed glazed lantern left apex, cast-iron downpipes and flat-roof to projecting wing. Rendered and roughcast rendered walls with moulded eaves course. Square-headed openings with slate sills, concrete mullions and multiple paned steel casement windows. Timber panelled doors. Interior completed c. 1940-1950. Three turbines replaced, 1993-1997. Attached T-plan twenty-bay three-storey flat-roofed dam/sluice house to rear with four penstock tubes. Single-arch cast-concrete road bridge over river with pair of cast-concrete pylons, (one of four bridges over 'canal'). Pair of detached four- and six-bay three-storey flat-roofed weirs over river. Group of detached three-

	bay single-storey flat-roofed outbuildings.
Categories of special interest:	Architectural, Historical, Technical, Interior, Group, Setting, Materials (RPS) Architectural, Historical, Scientific, Social, Technical (NIAH)
Rating:	National
Reference:	County Clare NIAH Survey (1997), County Clare Development Plan (2011-2017)

BH No:	6
RPS No:	84
NIAH No:	N/a
Townland:	Ballykeelaun
Parish:	St. Patricks
Barony:	Bunratty Lower
County:	Clare
Classification:	Former National School
Route Corridor:	B.1, B.2, D.1
Description:	19th century single-storey, six-bay, gabled N.S., now community hall.
Categories of special interest:	Setting, cultural
Rating:	Local
Reference:	County Clare Development Plan 2011-2017

BH No:	23
RPS No:	1597
NIAH No:	N/a
Townland:	Rivers/Ballyvollane
Parish:	Kilmurry/Stradbally
Barony:	Clanwilliam
County:	Limerick
Classification:	Footbridge
Route Corridor:	D.1, E.1
Description:	Iron foot bridge
Categories of special interest:	Not specified
Rating:	Not specified
Reference:	County Limerick Development Plan (2010-2016)

BH No:	24
RPS No:	1598
NIAH No:	N/a
Townland:	Castletroy
Parish:	Kilmurry
Barony:	Clanwilliam
County:	Limerick
Classification:	Towerhouse
Route Corridor:	D.1, D.2
Description:	Towerhouse, in ruins. Also a recorded monument (AH 4).
Categories of special interest:	Not specified
Rating:	Not specified
Reference:	County Limerick Development Plan (2010-2016)

BH No:	25
RPS No:	1599
NIAH No:	21900503
Townland:	Sreelane
Parish:	Kilmurry
Barony:	Clanwilliam
County:	Limerick
Classification:	Plassy Bridge
Route Corridor:	B.2
Description:	Multiple-arch pedestrian bridge over the River Shannon, built c. 1940. Cast-iron handrail, balustrades and stringcourse with scrolled iron consoles. Tapering limestone parapet walls at both ends. Carriageway resurfaced with tarmacadam and preformed concrete pylon supports replacing earlier supports. *NIAH Appraisal* Plassy Bridge is a well built example of an early 20th-century cast-iron and concrete bridge. It was constructed on the site of the horse ferry which dated to 1830. The current bridge forms a group with the nearby Plassy Mills. Also listed as RPS 2 in the Castletroy LAP 2009.
Categories of special interest:	Architectural, technical, artistic
Rating:	Regional
Reference:	County Limerick Development Plan (2010-2016), County Limerick NIAH survey (2010), Castletroy Local Area Plan (2009)

BH No:	26
RPS No:	1600
NIAH No:	21900503
Townland:	Sreelane
Parish:	Kilmurry
Barony:	Clanwilliam
County:	Limerick
Classification:	Plassy Mills
Route Corridor:	B.2
Description:	Detached L-plan multiple-bay six-storey former corn mill, built in 1824, with extension to west. Now in ruins. Dressed limestone walls having cast-iron patris plates, limestone quoins and red brick flue. Square-headed window openings with cut limestone label mouldings and sills. Pointed arch window openings to south elevation with limestone hoodmoulding to ground floor opening. Cross loop openings to east and west elevations, having limestone surrounds. Remains of internal round-headed door opening to north elevation with brick voussoirs, now partially blocked up. Cut limestone internal spiral staircase. South elevation partially rebuilt c. 1970. *NIAH Appraisal* These striking remains of Plassy Mills, situated on the banks of the River Shannon, was built by Robert Hedges Maunsell and later taken over in the 1860s by the Russell family, who were the most prominent millers in Munster at the time. This

	large former corn mill was built of high quality materials, as illustrated by the limestone dressings such as the label and hoodmouldings, quoins and sills. Prominently sited, the mill presents a striking silhouette within the Limerick landscape and forms a group with the nearby Plassy Bridge. Also a recorded archaeological site (AH 1). Also listed as RPS 3 in the Castletroy LAP 2009. This designation also includes a length of the original mill race, which runs from the River Shannon to the Mill in an east-west direction for a distance of 1.2km.
Categories of special interest:	Architectural, technical
Rating:	Regional
Reference:	County Limerick Development Plan (2010-2016), County Limerick NIAH survey (2010), Castletroy Local Area Plan (2009)

BH No:	33
RPS No:	N/a
NIAH No:	21900619
Townland:	Garraunykee
Parish:	Kilmurry
Barony:	Clanwilliam
County:	Limerick
Classification:	House
Route Corridor:	E.1
Description:	Detached three-bay two-storey house, built c. 1810, with recent extension to rear (south-east) elevation. Hipped slate roof having rendered chimneystacks. Roughcast rendered walls with render plinth course. Square-headed-openings having tooled limestone sills and replacement uPVC windows. Round-headed opening with cast-iron spoked fanlight over timber panelled door. Pair of square-profile rusticated limestone piers to north-west having limestone caps, double-leaf metal gates and pebbledash rendered boundary walls. *NIAH Appraisal* The massing of this modest house is representative of the enduring popularity of the simple three-bay two-storey architectural form. Features such as the slate roof and limestone sills enhance the façade and help conserve its original appearance. The finely crafted fanlight adds artistic interest to the façade.
Categories of special interest:	Architectural, artistic
Rating:	Local
Reference:	County Limerick NIAH Survey (2010)

BH No:	36
RPS No:	1623
NIAH No:	N/a
Townland:	Dromore
Parish:	Kilmurry
Barony:	Clanwilliam

County:	Limerick
Classification:	House
Route Corridor:	B.1, B.2
Description:	St. Senans House, now known as Dromroe. This single storey house fronts a vernacular farmyard of the highest quality which is deemed to comprise the curtilage of the protected structure. Also listed in Castletroy LAP as RPS 20.
Categories of special interest:	Not specified
Rating:	Not specified
Reference:	County Limerick Development Plan (2010-2016), Castletroy Local Area Plan (2009)

BH No:	37
RPS No:	1606
NIAH No:	N/a
Townland:	Newcastle
Parish:	Kilmurry
Barony:	Clanwilliam
County:	Limerick
Classification:	Rectory
Route Corridor:	C.1
Description:	Former rectory now known as Glebe House. Also listed in Castletroy LAP as RPS 9
Categories of special interest:	Not specified
Rating:	Not specified
Reference:	County Limerick Development Plan (2010-2016), Castletroy Local Area Plan (2009)

BH No:	38
RPS No:	1607
NIAH No:	N/a
Townland:	Newcastle
Parish:	Kilmurry
Barony:	Clanwilliam
County:	Limerick
Classification:	Church and graveyard
Route Corridor:	C.1
Description:	Former Church of Ireland. Also listed in Castletroy LAP as RPS 10 and is an Archaeological Heritage site (AH 54).
Categories of special interest:	Not specified
Rating:	Not specified
Reference:	County Limerick Development Plan (2010-2016), Castletroy Local Area Plan (2009)

BH No:	39
RPS No:	1616
NIAH No:	N/a
Townland:	Newcastle

Parish:	Kilmurry
Barony:	Clanwilliam
County:	Limerick
Classification:	Coaching Inn
Route Corridor:	C.1
Description:	The history of this structure is not yet fully understood but it is believed to have functioned as a coaching inn in the past. Also listed in Castletroy LAP as RPS 18
Categories of special interest:	Not specified
Rating:	Not specified
Reference:	County Limerick Development Plan (2010-2016), Castletroy Local Area Plan (2009)

APPENDIX 11.3 – DETAILS OF STRAY FINDS FOUND WITHIN THE LANDSCAPE SURROUNDING THE PROPOSED ROUTES

Find No:	2011:25-47
Find Place:	Reboge
Parish:	St. Patricks
County:	Limerick
Type:	Prehistoric lithics
Description:	One pebble, twelve flints, six flint flakes, one flint scraper and two flint chunks.
Reference:	NMI Topographical Files

Find No:	2005:8 2005:116
Find Place:	Prospect
Parish:	Stradbally
County:	Limerick
Type:	Human remains and an iron nail
Description:	Disturbed, upper portion of a skeleton found during ground works associated with agricultural practices. Found with a corroded iron nail with a flat head (116).
Reference:	NMI Topographical Files

Find No:	Record Only
Find Place:	Sreelane. Found in 1979 in the bank of the River Shannon, 2 miles north of Limerick city, opposite the shallows known as Plassy.
Parish:	Kilmurray
County:	Limerick
Type:	Two Roman Coins
Description:	Both coins are in poor condition but seem to be Antoninani of Tetricus c. 270AD. These coins were widely imitated by unofficial mints and these coins are thought to be contemporary forgeries. They are frequently found in British hordes.
Reference:	NMI Topographical Files

APPENDIX 11. 4: LEGISLATIVE FRAMEWORK PROTECTING THE ARCHAEOLOGICAL RESOURCE

Protection of Cultural Heritage

The cultural heritage in Ireland is safeguarded through national and international policy designed to secure the protection of the cultural heritage resource to the fullest possible extent (Department of Arts, Heritage, Gaeltacht and the Islands 1999, 35). This is undertaken in accordance with the provisions of the *European Convention on the Protection of the Archaeological Heritage* (Valletta Convention), ratified by Ireland in 1997.

The Archaeological Resource

The *National Monuments Act 1930 to 2004* and relevant provisions of the *National Cultural Institutions Act 1997* are the primary means of ensuring the satisfactory protection of archaeological remains, which includes all man-made structures of whatever form or date except buildings habitually used for ecclesiastical purposes. A National Monument is described as 'a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto' (National Monuments Act 1930 Section 2).

A number of mechanisms under the National Monuments Act are applied to secure the protection of archaeological monuments. These include the Register of Historic Monuments, the Record of Monuments and Places, and the placing of Preservation Orders and Temporary Preservation Orders on endangered sites.

Ownership and Guardianship of National Monuments

The Minister may acquire national monuments by agreement or by compulsory order. The state or local authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the state, it may not be interfered with without the written consent of the Minister.

Register of Historic Monuments

Section 5 of the 1987 Act requires the Minister to establish and maintain a Register of Historic Monuments. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. Any interference with sites recorded on the register is illegal without the permission of the Minister. Two months notice in writing is required prior to any work being undertaken on or in the vicinity of a registered monument. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the Record of Monuments and Places.

Preservation Orders and Temporary Preservation Orders

Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

Record of Monuments and Places

Section 12(1) of the 1994 Act requires the Minister for Arts, Heritage, Gaeltacht and the Islands (now the Minister for the Environment, Heritage and Local Government) to establish and maintain a record of monuments and places where the Minister believes that such monuments exist. The record comprises a list of monuments and relevant places and a map/s showing each monument and relevant place in respect of each county in the state. All sites recorded on the Record of Monuments and Places receive statutory protection under the National Monuments Act 1994. All recorded monuments on the proposed development site are represented on the accompanying maps.

Section 12(3) of the 1994 Act provides that 'where the owner or occupier (other than the Minister for Arts, Heritage, Gaeltacht and the Islands) of a monument or place included in the Record, or any other person, proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such a monument or place, he or she shall give notice in writing to the Minister of Arts, Heritage, Gaeltacht and the Islands to carry out work and shall not, except in the case of urgent necessity and with the consent of the Minister, commence the work until two months after the giving of notice'.

Under the National Monuments (Amendment) Act 2004, anyone who demolishes or in any way interferes with a recorded site is liable to a fine not exceeding €3,000 or imprisonment for up to 6 months. On summary conviction and on conviction of indictment, a fine not exceeding €10,000 or imprisonment for up to 5 years is the penalty. In addition they are liable for costs for the repair of the damage caused.

In addition to this, under the European Communities (Environmental Impact Assessment) Regulations 1989, Environmental Impact Statements (EIS) are required for various classes and sizes of development project to assess the impact the proposed development will have on the existing environment, which includes the cultural, archaeological and built heritage resources. These document's recommendations are typically incorporated into the conditions under which the proposed development must proceed, and thus offer an additional layer of protection for monuments which have not been listed on the RMP.

The Planning and Development Act 2000

Under planning legislation, each local authority is obliged to draw up a Development Plan setting out their aims and policies with regard to the growth of the area over a five-year period. They cover a range of issues including archaeology and built heritage, setting out their policies and objectives with regard to the protection and enhancement of both. These policies can vary from county to county. The Planning and Development Act 2000 recognises that proper planning and sustainable development includes the protection of the archaeological heritage. Conditions relating to archaeology may be attached to individual planning permissions.

APPENDIX 11.5: LEGISLATIVE FRAMEWORK PROTECTING THE ARCHITECTURAL RESOURCE

The main laws protecting the built heritage are the *Architectural Heritage (National Inventory) and National Monuments (Miscellaneous Provisions) Act 1999* and the *Local Government (Planning and Development) Acts 1963-1999*, which has now been superseded by the *Planning and Development Act, 2000*. The Architectural Heritage Act requires the Minister to establish a survey to identify, record and assess the architectural heritage of the country. The background to this legislation derives from Article 2 of the 1985 Convention for the Protection of Architectural Heritage (Granada Convention). This states that:

For the purpose of precise identification of the monuments, groups of structures and sites to be protected, each member state will undertake to maintain inventories of that architectural heritage.

The National Inventory of Architectural Heritage (NIAH) was established in 1990 to fulfil Ireland's obligation under the Granada Convention, through the establishment and maintenance of a central record, documenting and evaluating the architecture of Ireland (NIAH Handbook 2005:2). As inclusion in the inventory does not provide statutory protection, the survey information is used in conjunction with the *Architectural Heritage Protection Guidelines for Planning Authorities* to advise local authorities on compilation of a Record of Protected Structures as required by the *Planning and Development Act, 2000*.

Protection under the Record of Protected Structures and County Development Plan

Structures of architectural, cultural, social, scientific, historical, technical or archaeological interest can be protected under the Planning and Development Act, 2000, where the conditions relating to the protection of the architectural heritage are set out in Part IV of the act. This act superseded the Local Government (Planning and Development) Act, 1999, and came into force on 1st January 2000.

The act provides for the inclusion of Protected Structures into the planning authorities' development plans and sets out statutory regulations regarding works affecting such structures. Under new legislation, no distinction is made between buildings formerly classified under development plans as List 1 and List 2. Such buildings are now all regarded as 'Protected Structures' and enjoy equal statutory protection. Under the act the entire structure is protected, including a structure's interior, exterior, attendant grounds and also any structures within the attendant grounds.

The act defines a Protected Structure as (a) a structure, or (b) a specified part of a structure which is included in a Record of Protected Structures (RPS), and, where that record so indicates, includes any specified feature which is in the attendant grounds of the structure and which would not otherwise be included in this definition. Protection of the structure, or part thereof, includes conservation, preservation, and improvement compatible with maintaining its character and interest. Part IV of the act deals with architectural heritage, and Section 57 deals specifically with works affecting the character of Protected Structures or proposed Protected Structures and states that no works should materially affect the character of the structure or any element of the structure that contributes to its special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest. The act does not provide specific criteria for assigning a special interest to a structure. However, the National Inventory of Architectural Heritage (NIAH) offers guidelines to its field workers as to how to designate

a building with a special interest, which are not mutually exclusive. This offers guidance by example rather than by definition:

Archaeological

It is to be noted that the NIAH is biased towards post-1700 structures. Structures that have archaeological features may be recorded, providing the archaeological features are incorporated within post-1700 elements. Industrial fabric is considered to have technical significance, and should only be attributed archaeological significance if the structure has pre-1700 features.

Architectural

A structure may be considered of special architectural interest under the following criteria:

- Good quality or well executed architectural design
- The work of a known and distinguished architect, engineer, designer, craftsman
- A structure that makes a positive contribution to a setting, such as a streetscape or rural setting
- Modest or vernacular structures may be considered to be of architectural interest, as they are part of the history of the built heritage of Ireland.
- Well designed decorative features, externally and/or internally

Historical

A structure may be considered of special historical interest under the following criteria:

- A significant historical event associated with the structure
- An association with a significant historical figure
- Has a known interesting and/or unusual change of use, e.g. a former workhouse now in use as a hotel
- A memorial to a historical event.

Technical

A structure may be considered of special technical interest under the following criteria:

- Incorporates building materials of particular interest, i.e. the materials or the technology used for construction
- It is the work of a known or distinguished engineer
- Incorporates innovative engineering design, e.g. bridges, canals or mill weirs
- A structure which has an architectural interest may also merit a technical interest due to the structural techniques used in its construction, e.g. a curvilinear glasshouse, early use of concrete, cast-iron prefabrication.
- Mechanical fixtures relating to a structure may be considered of technical significance.

Cultural

A structure may be considered of special cultural interest under the following criteria:

- An association with a known fictitious character or event, e.g. Sandycove Martello Tower, which featured in Ulysses.
- Other structure that illustrate the development of society, such as early schoolhouses, swimming baths or printworks.

Scientific

A structure may be considered of special scientific interest under the following criteria:

- A structure or place which is considered to be an extraordinary or pioneering scientific or technical achievement in the Irish context, e.g. Mizen Head Bridge, Birr Telescope.

Social

A structure may be considered of special social interest under the following criteria:

- A focal point of spiritual, political, national or other cultural sentiment to a group of people, e.g. a place of worship, a meeting point, assembly rooms.
- Developed or constructed by a community or organisation, e.g. the construction of the railways or the building of a church through the patronage of the local community
- Illustrates a particular lifestyle, philosophy, or social condition of the past, e.g. the hierarchical accommodation in a country house, philanthropic housing, vernacular structures.

Artistic

A structure may be considered of special artistic interest under the following criteria:

- Work of a skilled craftsman or artist, e.g. plasterwork, wrought-iron work, carved elements or details, stained glass, stations of the cross.
- Well designed mass produced structures or elements may also be considered of artistic interest.

(From the NIAH Handbook 2003 & 2005 pages 15-20)

The Local Authority has the power to order conservation and restoration works to be undertaken by the owner of the protected structure if it considers the building to be in need of repair. Similarly, an owner or developer must make a written request to the Local Authority to carry out any works on a protected structure and its environs, which will be reviewed within three months of application. Failure to do so may result in prosecution.

APPENDIX 11.6: IMPACT ASSESSMENT AND THE CULTURAL HERITAGE RESOURCE

Potential Impacts on Archaeological and Historical Remains

Impacts are defined as 'the degree of change in an environment resulting from a development' (Environmental Protection Agency 2003: 31). They are described as profound, significant or slight impacts on archaeological remains. They may be negative, positive or neutral, direct, indirect or cumulative, temporary or permanent.

Impacts can be identified from detailed information about a project, the nature of the area affected and the range of archaeological and historical resources potentially affected. Development can affect the archaeological and historical resource of a given landscape in a number of ways.

- Permanent and temporary land-take, associated structures, landscape mounding, and their construction may result in damage to or loss of archaeological remains and deposits, or physical loss to the setting of historic monuments and to the physical coherence of the landscape.
- Archaeological sites can be affected adversely in a number of ways: disturbance by excavation, topsoil stripping and the passage of heavy machinery; disturbance by vehicles working in unsuitable conditions; or burial of sites, limiting accessibility for future archaeological investigation.
- Hydrological changes in groundwater or surface water levels can result from construction activities such as de-watering and spoil disposal, or longer-term changes in drainage patterns. These may desiccate archaeological remains and associated deposits.
- Visual impacts on the historic landscape sometimes arise from construction traffic and facilities, built earthworks and structures, landscape mounding and planting, noise, fences and associated works. These features can impinge directly on historic monuments and historic landscape elements as well as their visual amenity value.
- Landscape measures such as tree planting can damage sub-surface archaeological features, due to topsoil stripping and through the root action of trees and shrubs as they grow.
- Ground consolidation by construction activities or the weight of permanent embankments can cause damage to buried archaeological remains, especially in colluviums or peat deposits.
- Disruption due to construction also offers in general the potential for adversely affecting archaeological remains. This can include machinery, site offices, and service trenches.

Although not widely appreciated, positive impacts can accrue from developments. These can include positive resource management policies, improved maintenance and access to archaeological monuments, and the increased level of knowledge of a site or historic landscape as a result of archaeological assessment and fieldwork.

Predicted Impacts

The severity of a given level of land-take or visual intrusion varies with the type of monument, site or landscape features and its existing environment. Severity of impact can be judged taking the following into account:

- The proportion of the feature affected and how far physical characteristics fundamental to the understanding of the feature would be lost;

- Consideration of the type, date, survival/condition, fragility/vulnerability, rarity, potential and amenity value of the feature affected;
- Assessment of the levels of noise, visual and hydrological impacts, either in general or site specific terms, as may be provided by other specialists.

APPENDIX 11.7: MITIGATION MEASURES AND THE CULTURAL HERITAGE RESOURCE

Potential Mitigation Strategies for Cultural Heritage Remains

Mitigation is defined as features of the design or other measures of the proposed development that can be adopted to avoid, prevent, reduce or offset negative effects.

The best opportunities for avoiding damage to archaeological remains or intrusion on their setting and amenity arise when the site options for the development are being considered. Damage to the archaeological resource immediately adjacent to developments may be prevented by the selection of appropriate construction methods. Reducing adverse effects can be achieved by good design, for example by screening historic buildings or upstanding archaeological monuments or by burying archaeological sites undisturbed rather than destroying them. Offsetting adverse effects is probably best illustrated by the full investigation and recording of archaeological sites that cannot be preserved *in situ*.

Definition of Mitigation Strategies

Archaeological Resource

The ideal mitigation for all archaeological sites is preservation *in situ*. This is not always a practical solution, however. Therefore a series of recommendations are offered to provide ameliorative measures where avoidance and preservation *in situ* are not possible.

Full Archaeological Excavation involves the scientific removal and recording of all archaeological features, deposits and objects to the level of geological strata or the base level of any given development. Full archaeological excavation is recommended where initial investigation has uncovered evidence of archaeologically significant material or structures and where avoidance of the site is not possible.

Archaeological Test Trenching can be defined as 'a limited programme... of intrusive fieldwork which determines the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts within a specified area or site on land or underwater. If such archaeological remains are present test trenching defines their character and extent and relative quality.' (IFA 2001c, 1)

Archaeological Monitoring can be defined as a 'formal programme of observation and investigation conducted during any operation carried out for non-archaeological reasons within a specified area or site on land or underwater, where there is possibility that archaeological deposits may be disturbed or destroyed. The programme will result in the preparation of a report and ordered archive.' (IFA 2001b, 1)

Geophysical survey is used to create 'maps' of subsurface archaeological features. Features are the non-portable part of the archaeological record, whether standing structures or traces of human activities left in the soil. Geophysical instruments can detect buried features when their electrical or magnetic properties contrast measurably with their surroundings. In some cases individual artifacts, especially metal, may be detected as well. Readings taken in a systematic pattern become a dataset that can be rendered as image maps. Survey results can be used to guide excavation and to give archaeologists insight into the patterning of non-excavated parts of the site. Unlike other archaeological methods, geophysical survey is not invasive or destructive.

Underwater Archaeological Assessment consists of a programme of works carried out by a specialist underwater archaeologist, which can involve wade surveys, metal detection surveys and the excavation of test pits within the sea or riverbed. These assessments are able to access and assess the potential of an underwater environment to a much higher degree than terrestrial based assessments.

Architectural Resource

The architectural resource is generally subject to a greater degree of change than archaeological sites, as structures may survive for many years but their usage may change continually. This can be reflected in the fabric of the building, with the addition and removal of doors, windows and extensions. Due to their often more visible presence within the landscape than archaeological sites, the removal of such structures can sometimes leave a discernable 'gap' with the cultural identity of a population. However, a number of mitigation measures are available to ensure a record is made of any structure that is deemed to be of special interest, which may be removed or altered as part of a proposed development.

Conservation Assessment consists of a detailed study of the history of a building and can include the surveying of elevations to define the exact condition of the structure. These assessments are carried out by Conservation Architects and would commonly be carried out in association with proposed alterations or renovations on a Recorded Structure.

Building Survey may involve making an accurate record of elevations (internal and external), internal floor plans and external sections. This is carried out using an EDM (Electronic Distance Measurer) and GPS technology to create scaled drawings that provide a full record of the appearance of a building at the time of the survey.

Historic Building Assessment is generally specific to one building, which may have historic significance, but is not a Protected Structure or listed within the NIAH. A full historical background for the structure is researched and the site is visited to assess the standing remains and make a record of any architectural features of special interest. These assessments can also be carried out in conjunction with a building survey.

Written and Photographic record provides a basic record of features such as stone walls, which may have a small amount of cultural heritage importance and are recorded for prosperity. Dimensions of the feature are recorded with a written description and photographs as well as some cartographic reference, which may help to date a feature.

Chapter 12 Agriculture

12.1 Introduction

As part of the works associated with the proposed Limerick Northern Distributor Road specialist advisers were appointed by Clare County Council, being the lead authority on the project, to assess the soil type and current land use on each of the route options currently been considered. This will form part of the "Route Selection Report" that is currently been prepared for the project and will be used to assess the agricultural impact of the route corridors under consideration.

The constraints study area together with the various route options is set out in the plate below and shown more clearly on Drawing RCSR-501.

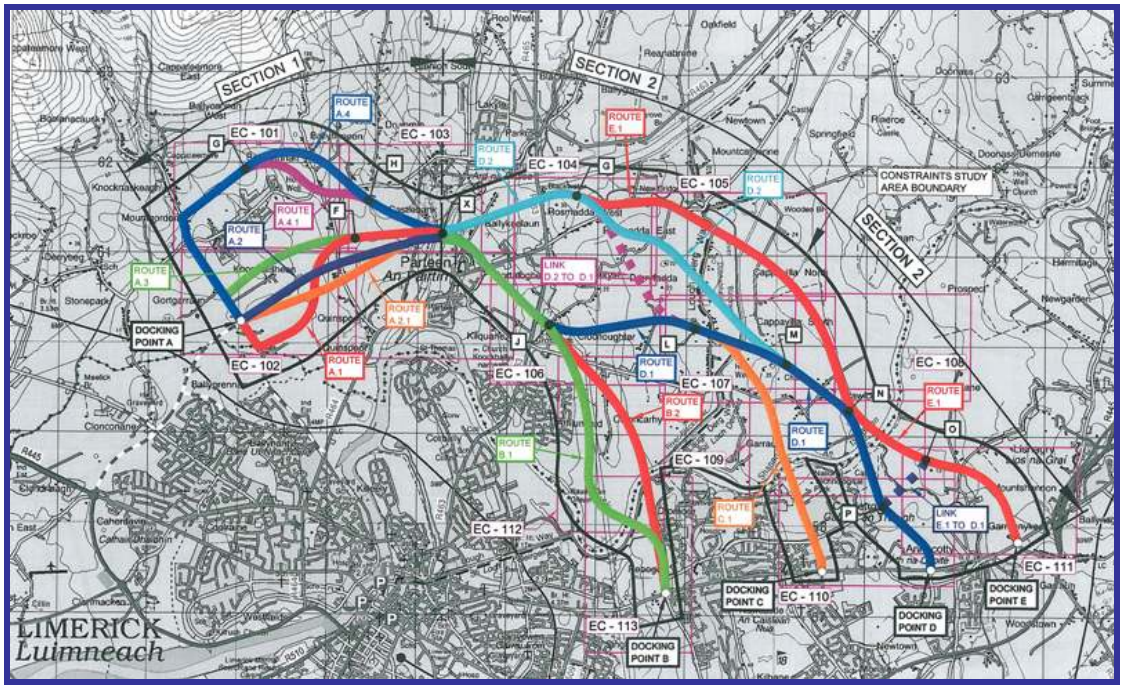


Plate 12.1: Route Options

The various route options and variations thereof are as follows:

Section 1 – The Knockalisheen Road to the Tailrace Canal

- Route A.1 (red);
- Route A.2.1 (orange);
- Route A.2 (indigo);
- Route A.3 (green);
- Route A.2 (dark blue);
- Route A.4.1 (pink).

Section 2 – The Tailrace Canal to the R445

- Route D.2 (light blue);
- Route B.1 (Green);
- Route E.1 (red);
- Route D.1 (dark blue);

- Route B.2 (red) (short section);
- Route C.1 (orange);
- Link D.2 to D.1 (pink);
- Link E.1 to D.1 (indigo).

In principal there are 5 no. route options which commence at the Knockalisheen Road and terminate at the R445. In between the Knockalisheen Road and the R445 the routes branch off at different locations and further options arise. All of the key options merge at one point as they cross the Tailrace Canal while there are 5 separate crossings over the River Shannon.

The area within this study comprises good quality agricultural lands. The farming actives and uses within the study area range from beef, dairy, grazing, silage, etc. Some areas would also appear to be in use for equestrian purposes.

The majority of the farmland in the study area is in grassland with a significant proportion of the lands in use as grazing or silage grounds. Within the study area there are seven dairy farms which may be adversely impacted upon depending on the final route option. There is also one significant equine business within the study which, depending on the final option, has the potential to be significantly impacted upon.

The greater proportion of the holdings, which are either in grassland or set down as silage grounds, appear to be associated with beef operations with only a minor proportion engaged in mixed operations i.e. beef/sheep/equine. There are also limited areas of woodland and bog land.

Sections of the study area come within the Lower River Shannon Special Area of Conservation (SAC) and the Knockalisheen Marsh Natural Heritage Area (NHA)

12.2 Study Methodology

The route options were assessed based on drawings and mapping as supplied by the lead consultant, Roughan & O'Donovan, together with a field survey of the area in June 2011. During the field survey an assessment was made of the land quality and the current land use recorded.

Other sources of information used in the assessment include:

- Landowner submissions;
- Landowners comments from Public Consultation No. 2 held in Limerick City on the 15th June 2011;
- National Parks and Wildlife Service (NPWS);
- Soil Map of Ireland, Environmental Protection Agency (EPA);
- Soil Associations of Ireland and their land use potential", An Foras Taluntais (1980).

The quantity of land required for each route option is calculated on the basis of each corridor being 100m wide. Whilst in many cases the actual width required for the construction of the road will be less, due allowance has been made for cut and fill provisions, together with land drainage channels, agricultural access roads and for potential side road diversions. The exact width of the road and consequently the land take can only be calculated from a detailed scheme drawing which will be developed

after the completion of the Route Selection Process. The assessments are made based on a general appraisal of the area and information available at this stage.

12.3 Assessment Criteria

In assessing the impact of the various route options we have hard regard to the Environmental Protection Agency (EPA) glossary of impacts as set out in Table 12.1 below.

Table 12.1 Impact Significance

EPA Glossary of Impacts	Significance Level (EIS)	Criteria
Neutral, Imperceptible or Slight Impact	Not Significant	An impact is not significant where the farm enterprise suffers a slight inconvenience such as relocation of access or loss of shelter.
Significant impact: Positive or Negative	Minor	Minor impact occurs where the farm enterprise suffers inconvenience as a result of the proposed scheme. Severance will not occur or is insignificant and the farm buildings and facilities will be left in place. Typically only a small portion of land will be removed at the boundary of the farm.
	Moderate	Moderate impact occurs where the farm enterprise can be continued as before but with increased management or operational difficulties. While portions of the land would be severed the enterprise mix will be such that the farming system could continue perhaps with reduced stock numbers or with additional labour, contractor or other charges.
	Major	Major impact occurs where the farm enterprise cannot be continued without considerable management or operational changes. There would be significant severance on the affected land parcel(s). The route may affect farm buildings and / or facilities. Access to the severed portions of land can only be achieved through the use of non-farm roadways to access severed lands. Where the impact is major an enterprise change may be necessitated e.g. from dairy to dry stock.
Profound or Significant Impact: Negative Only	Severe	Severe impact occurs where the farm enterprise cannot be continued as a result of the proposed scheme. This would occur where land-take and severance was of such a nature to make the holding unworkable and/or where important farm buildings and facilities were removed. Impact of this degree would be rare and is most likely to occur on a dairy or stud farm.

12.4 Soil Types within the Study Area

The soil types within the study area were identified using the General Soil Map of Ireland and we set out here under the main soil types, as follows:

Soil Association No.25

Principal Soil:	Gleys (50%)
Associated Soils:	Acid Brown Earths (40%) & Interdrumlin Peat and Peaty Gleys (10%)
Parent Material:	Mostly Ordovician – Silurian shale sandstone glacial till

Soil Association No. 43

Principal Soil:	Gleys (60%)
Associated Soils:	Acid Brown Earths (20%) & Peaty Gleys (20%)
Parent Material:	Alluvium

In addition to the General Soil Map of Ireland the An Foras Taluntais book-"Soil Associations of Ireland and their land use potential" has been consulted and further comment is added, as follows:

Soil Association No.25

This association occupies approximately 2.57% of the country and is mainly found in counties Cavan, Monaghan, west Mayo, Longford, Clare, Donegal and Leitrim.

The main associated soil consists of a moderately well-drained Acid Brown Earth of loam to clay loam texture and low base status. This soil is freely drained to approximately 60 cm below which some drainage impedance is evidenced.

Soil Association No. 43

This association occupies approximately 1.34% of the country and is mainly found in counties Wexford, Donegal and Wicklow. This association is also found inland at river and lake side locations.

The soil is generally only suitable for summer grazing, however, it can be brought into good use where arterial drainage is feasible.

Soil Association No.25 is found in Section 1 of the study area and in the north western part of Section 2. Soli Association No.43 is found in the south eastern area of Section 2 in the areas adjacent to the River Shannon and River Blackwater.

12.5 Route Option Details

The following nodes within the route options have been assessed:

Section 1

No.	Route	Nodes	Length (metres)	Width	Area (ha)
1.1	A.1	A-F	2,131	100 m	21.31
1.2	A.3	A-F	1,929	100 m	19.29
1.3	A.4	G-H	1,610	100 m	16.10
1.4	A4.1	G-H	1,500	100 m	15.00
1.5	A.1	A-F-X	3,082	100 m	30.82
1.6	A.2	A-X	2,443	100 m	24.43
1.7	A.2.1	A-X	2,447	100 m	24.47
1.8	A.3	A-F-X	2,925	100 m	29.25
1.9	A.4	A-G-H-X	4,701	100 m	47.01
1.10	A.4.1	A-G-H-X	4,492	100 m	44.92

Section 2

No.	Route	Nodes	Length (metres)	Width	Area (ha)
2.1	B.1	J-B	3,557	100 m	35.57
2.2	B.2	J-B	3,242	100 m	32.42
2.3	B.1 / D.1	X-J-L	3,206	100 m	32.06
2.4	D.2 / Link D.2 to D.1	X-K-L	3,619	100 m	36.19
2.5	B.1 / D.1	X-J-L-M-N	5,206	100 m	52.06
2.6	D.2 / Link D.2 to D.1 / D.1	X-K-L-M-N	5,600	100 m	56.00
2.7	D.2 / D.1	X-K-M-N	5,490	100 m	54.90
2.8	D.2 / E.1	X-K-N	5,830	100 m	58.30
2.9	D.1	N-P-D	2,031	100 m	20.31
2.10	E.1 / Link E.1 to D.1 / D.1	N-O-P-D	2,582	100 m	25.82
2.11	E.1	N-O-E	2,482	100 m	24.82
2.12	B.1	X-J-B	5,022	100 m	50.22
2.13	B.2	X-J-B	4,904	100 m	49.04
2.14	B.1 / D.1 / C.1	X-J-L-C	6,414	100 m	64.14
2.15	D.1 / Link D.2 to D.1 / C.1	X-K-L-C	6,806	100 m	68.06
2.16	B.1 / D.1	X-J-L-M-N-P-D	7,234	100 m	72.34
2.17	D.2 / Link D.2 to D.1 / D.1	X-K-L-M-N-P-D	7,627	100 m	76.27
2.18	D.2 / D.1	X-K-M-N-P-D	7,518	100 m	75.18

No.	Route	Nodes	Length (metres)	Width	Area (ha)
2.19	D.2 / E.1 / D.1	X-K-N-P-D	7,855	100 m	78.55
2.20	B.1 / D.1 / E.1	X-J-L-M-N-O-E	7,698	100 m	76.98
2.21	D.2 / Link d.2 to d.1 / D.1 / E.1	X-K-L-M-N-O-E	8,201	100 m	82.01
2.22	D.2 / D.1 / E.1	X-K-M-N-O-E	8,002	100 m	80.02
2.23	D.2 / E.1	X-K-N-O-E	8,310	100 m	83.10
2.24	B.1 / D.1 / E.1 / Link E.1 to D.1 / D.1	X-J-L-M-N-O-P-D	7,814	100 m	78.14
2.25	D.2 Link D.2 to D.1 / D.1 / E.1	X-K-L-M-N-O-P-D	8,214	100 m	82.14
2.26	D.2 / D.1 / Link E.1 to D.1 / D.1	X-K-M-N-O-P-D	8,139	100 m	81.39
2.27	D.2 / E.1 / Link E.1 to D.1 / D.1	X-K-N-O-P-D	7,861	100 m	78.61

12.6 Route Options Impact Assessment

12.6.1 Section 1 - The Knockalisheen Road to the Tailrace Canal

Route Option 1.1 (Route A.1 – Nodes A - F)

Key Details		
Length	2,131 metres	
Area	21.13 hectares	
No. of agricultural properties impacted upon	4	
Breakdown		
Dry Stock	3	75%
Dairy	0	0%
Equine	1	25%
Sheep	0	0%
Impact		
Not significant	0	0%
Minor	2	50%
Moderate	0	0%
Major	1	25%
Severe	1	25%

This option will impact upon 4. no holdings, three of which are in use as grazing/silage grounds while a fourth property is in use as an equine business.

Route Option 1.2 (Route A.3 – Nodes A - F)

Key Details		
Length	1,929 metres	
Area	19.29 hectares	
No. of agricultural properties impacted upon	2	
Breakdown		
Dry Stock	1	50%
Dairy	0	0%
Equine	1	50%
Sheep	0	0%
Impact		
Not significant	0	0%
Minor	0	0%
Moderate	0	0%
Major	2	100%
Severe	0	0%

This option will impact upon 2. no holdings, one of which is used for grazing/silage grounds while the second property is in use as an equine business.

Route Option 1.3 (Route A.4 – Nodes G - H)

Key Details		
Length	1,610 metres	
Area	16.10 hectares	
No. of agricultural properties impacted upon	7	
Breakdown		
Dry Stock	5	71.4%
Dairy	1	14.3%
Equine	1	14.1%
Sheep	0	0%
Impact		
Not significant	0	0%
Minor	1	14.3%
Moderate	1	14.3%
Major	5	71.4%
Severe	0	0%

This option will impact upon 7. no holdings, five of which are in use for grazing/silage with one in used as a dairy operation while the remaining holding is in use as part an equine business.

Route Option 1.4 (Route A.4.1 – Nodes G - H)

Key Details		
Length	1,500 metres	
Area	15.10 hectares	
No. of agricultural properties impacted upon	7	
Breakdown		
Dry Stock	5	71.4%
Dairy	1	14.3%
Equine	1	14.3%
Sheep	0	0%
Impact		
Not significant	0	0%
Minor	3	42.9%
Moderate	1	14.3%
Major	3	42.9%
Severe	0	0%

Option 1.4 will impact upon 7. no holdings, five of which are in use for grazing/silage with one in used as a dairy operation while the remaining holding is in use as part an equine business.

Route Option 1.5 (Route A.1 – Nodes A - F - X)

Key Details		
Length	3,082 metres	
Area	30.82 hectares	
No. of agricultural properties impacted upon	5	
Breakdown		
Dry Stock	4	80%
Dairy	0	0%
Equine	1	20%
Sheep	0	0%
Impact		
Not significant	0	0%
Minor	2	40%
Moderate	0	0%
Major	2	40%
Severe	1	20%

This option will impact upon 5. no holdings, four of which are in use as grazing/silage grounds while a fifth property is in use as an equine business.

Route Option 1.6 (Route A.2 – Nodes A - X)

Key Details		
Length	2,443 metres	
Area	24.43 hectares	
No. of agricultural properties impacted upon	3	
Breakdown		
Dry Stock	2	66.6%
Dairy	0	0%
Equine	1	33.3%
Sheep	0	0%
Impact		
Not significant	0	0%
Minor	0	0%
Moderate	1	33.3%
Major	1	33.3%
Severe	1	33.3%

This option will impact upon 3. no holdings, two of which are in use as grazing/silage grounds while a third property is in use as an equine business.

Route Option 1.7 (Route A.2.1 – Nodes A - X)

Key Details		
Length	2,447 metres	
Area	24.47 hectares	
No. of agricultural properties impacted upon	6	
Breakdown		
Dry Stock	4	66.6%
Dairy	0	0%
Equine	1	16.7%
Horticulture	1	16.7%
Impact		
Not significant	0	0%
Minor	3	50%
Moderate	1	16.7%
Major	1	16.7%
Severe	1	16.7%

This option will impact upon 6. no holdings, four of which are in use as grazing/silage grounds, one is in use as an equine business and one in use as a horticultural business.

Route Option 1.8 (Route A.3 – Nodes A - F - X)

Key Details		
Length	2,925 metres	
Area	29.25 hectares	
No. of agricultural properties impacted upon	3	
Breakdown		
Dry Stock	2	66.6%
Dairy	0	0%
Equine	1	33.3%
Sheep	0	0%
Impact		
Not significant	0	0%
Minor	0	0%
Moderate	0	0%
Major	3	100%
Severe	0	0%

This option will impact upon 3. no holdings, two of which are in use as grazing/silage grounds with one in use as an equine business.

Route Option No. 1.9 (Route A.4 – Nodes A - G - H - X)

Key Details		
Length	4,701 metres	
Area	47.01 hectares	
No. of agricultural properties impacted upon	18	
Breakdown		
Dry Stock	16	89%
Dairy	1	5.5%
Equine	1	5.5%
Sheep	0	0%
Impact		
Not significant	0	0%
Minor	3	16.7%
Moderate	4	22.2%
Major	11	61.1%
Severe	0	0%

This option will impact upon 18. no holdings, sixteen of which are in use as grazing/silage grounds, one is in use as a dairy operation and one as an equine business.

Route Option 1.10 (Route A.4.1 – Nodes A - G - H - X)

Key Details		
Length	4,592 metres	
Area	45.92 hectares	
No. of agricultural properties impacted upon	18	
Breakdown		
Dry Stock	16	89%
Dairy	1	5.5%
Equine	1	5.5%
Sheep	0	0%
Impact		
Not significant	0	0%
Minor	5	27.8%
Moderate	4	22.2%
Major	9	50%
Severe	0	0%

This option will impact upon 18. no holdings, sixteen of which are in use as grazing/silage grounds, one is in use as a dairy operation and one as an equine business.

12.6.1 Section 2 - The Tailrace Canal to the R445

Route Option 2.1 (Route B.1 – Nodes J - B)

Key Details		
Length	3,557 metres	
Area	35.57 hectares	
No. of agricultural properties impacted upon	8	
Breakdown		
Dry Stock	5	62.5%
Dairy	1	12.5%
Dry Stock/Equine	1	12.5%
Dry Stock/Sheep	1	12.5%
Impact		
Not significant	1	12.5%
Minor	1	12.5%
Moderate	1	12.5%
Major	3	37.5%
Severe	2	25%

This option will impact upon 8. no holdings, five of which are in use as grazing/silage grounds, one is in use as a mixed beef and sheep operation, one is in use for grazing dry stock and horses, and one is in use as a dairy operation.

Route option 2.2 (Route B.2 – Nodes J - B)

Key Details		
Length	3,242 metres	
Area	32.42 hectares	
No. of agricultural properties impacted upon	12	
Breakdown		
Dry Stock	9	75%
Dairy	1	8.3%
Dry Stock/Equine	1	8.3%
Dry Stock/Sheep	1	8.3%
Impact		
Not significant	4	33.2%
Minor	2	16.7%
Moderate	1	8.3%
Major	3	24.9%
Severe	2	16.7%

This option will impact upon 12. no holdings, nine of which are in use as grazing/silage grounds, one is in use as a mixed beef and sheep operation, one is in use for grazing dry stock and horses and one is in use as a dairy operation.

Route option 2.3 (Route B.1 / D.1 – Nodes X - J - L)

Key Details		
Length	3,206 metres	
Area	32.06 hectares	
No. of agricultural properties impacted upon	12	
Breakdown		
Dry Stock	11	91.7%
Dairy	0	0%
Dry Stock/Equine	1	8.3%
Dry Stock/Sheep	0	0%
Impact		
Not significant	1	8.3%
Minor	0	0%
Moderate	6	50%
Major	4	33.2%
Severe	1	8.3%

This option will impact upon 12. no holdings, eleven of which are in use as grazing/silage grounds while one is a mixed dry stock and equine operation.

Route option 2.4 (Route D.2 / Link D.2 to D.1 – Nodes X-K - L)

Key Details		
Length	3,619 metres	
Area	36.19 hectares	
No. of agricultural properties impacted upon	11	
Breakdown		
Dry Stock	7	63.6%
Dairy	2	18.2%
Dry Stock/Equine	2	18.2%
Dry Stock/Sheep	0	0%
Impact		
Not significant	1	9.1%
Minor	0	0%
Moderate	2	18.2%
Major	1	9.1%
Severe	7	63.6%

This option will impact upon 11. no holdings, eight of which are in use as grazing/silage grounds, two are is in use as dairy operations while two are mixed dry stock and equine operations.

Route option No. 2.5 (Route B.1 / D.1 – Nodes X - J - L - M - N)

Key Details		
Length	5,206 metres	
Area	52.06 hectares	
No. of agricultural properties impacted upon	16	
Breakdown		
Dry Stock	14	87.5%
Dairy	1	6.25%
Dry Stock/Equine	1	6.25%
Dry Stock/Sheep	0	0%
Impact		
Not significant	2	12.5%
Minor	0	0%
Moderate	6	37.5%
Major	6	37.5%
Severe	2	12.5%

This option will impact upon 16. no holdings, fourteen of which are in use as grazing/silage grounds, one is in use as a dairy operation while one is in use as a mixed dry stock and equine operation.

Route option 2.6 (Route D.2 / Link D.2 to D.1 / D.1 – Nodes X-K - L - M - N)

Key Details		
Length	5,600 metres	
Area	56 hectares	
No. of agricultural properties impacted upon	15	
Breakdown		
Dry Stock	10	66.6%
Dairy	3	19.9%
Dry Stock/Equine	2	13.3%
Dry Stock/Sheep	0	0%
Impact		
Not significant	2	13.3%
Minor	0	0%
Moderate	2	13.3%
Major	3	29.9%
Severe	8	53.3%

This option will impact upon 15. no holdings, ten of which are in use as grazing/silage grounds, three are in use as dairy operations while two are use as mixed dry stock and equine operations.

Route option 2.7 (Route D.2 / D.1 – Nodes X-K - M - N)

Key Details		
Length	5,490 metres	
Area	54.90 hectares	
No. of agricultural properties impacted upon	19	
Breakdown		
Dry Stock	11	57.8%
Dairy	3	15.7%
Dry Stock/Equine	2	10.5%
Woodland	3	15.8%
Impact		
Not significant	3	15.8%
Minor	3	15.8%
Moderate	1	5.2%
Major	7	36.8%
Severe	5	26.3%

This option will impact upon 19. no holdings, eleven of which are in use as grazing/silage grounds, three are in use as dairy operations, three are planted while two are mixed dry stock and equine operations.

Route option 2.8 (Route D.2 / E.1 – Nodes X-K - N)

Key Details		
Length	5,830 metres	
Area	58.30 hectares	
No. of agricultural properties impacted upon	15	
Breakdown		
Dry Stock	10	66.6%
Dairy	4	26.6%
Dry Stock/Equine	1	6.6%
Woodland	0	0%
Impact		
Not significant	0	0%
Minor	3	20%
Moderate	1	6.6%
Major	6	40%
Severe	5	33.3%

This option will impact upon 15. no holdings, eleven of which are in use as grazing/silage grounds, four are in use as dairy operations while one is a mixed dry stock and equine operation.

Route option 2.9 (Route D.1 – Nodes N - P - D)

Key Details		
Length	2,031 metres	
Area	20.31 hectares	
No. of agricultural properties impacted upon	2	
Breakdown		
Dry Stock	2	100%
Dairy	0	0%
Dry Stock/Equine	0	0%
Woodland	0	0%
Impact		
Not significant	0	0%
Minor	0	0%
Moderate	0	0%
Major	2	100%
Severe	0	0%

This option will impact upon 2. no holdings, both of which are in use as grazing/silage grounds.

Route option No. 2.10 (Route E.1 / Link E.1 to D1 / D.1 – Nodes N - O - P - D)

Key Details		
Length	2,582 metres	
Area	25.82 hectares	
No. of agricultural properties impacted upon	3	
Breakdown		
Dry Stock	3	100%
Dairy	0	0%
Dry Stock/Equine	0	0%
Woodland	0	0%
Impact		
Not significant	0	0%
Minor	1	33.3%
Moderate	0	0%
Major	1	33.3%
Severe	1	33.3%

This option will impact upon 3. no holdings, all of which are in use as grazing/silage grounds.

Route option 2.11 (Route E.1 – Nodes N - O - E)

Key Details		
Length	5,830 metres	
Area	58.30 hectares	
No. of agricultural properties impacted upon	8	
Breakdown		
Dry Stock	8	100%
Dairy	0	0%
Dry Stock/Equine	0	0%
Woodland	0	0%
Impact		
Not significant	1	12.5%
Minor	2	25%
Moderate	0	0%
Major	4	50%
Severe	1	12.5%

This option will impact upon 15. no holdings, eleven of which are in use as grazing/silage grounds, three are in use as a dairy operation while one is a mixed dry stock and equine operation.

Route option 2.12 (Route B.1 – Nodes X - J - B)

Key Details		
Length	5,022 metres	
Area	58.30 hectares	
No. of agricultural properties impacted upon	12	
Breakdown		
Dry Stock	8	66.6%
Dairy	1	8.3%
Dry Stock/Equine	2	16.6%
Dry Stock/Sheep	1	8.3%
Impact		
Not significant	1	8.3%
Minor	1	8.3%
Moderate	3	25%
Major	5	41.6%
Severe	2	16.6%

This option will impact upon 12. no holdings, eight of which are in use as grazing/silage grounds, one is in use as a mixed beef and sheep operation, two are in use for grazing/dry stock and horses, and one is in use as a dairy operation.

Route option 2.13 (Route B.2 – Nodes X - J - B)

Key Details		
Length	4,904 metres	
Area	49.04 hectares	
No. of agricultural properties impacted upon	16	
Breakdown		
Dry Stock	12	75%
Dairy	1	6.25%
Dry Stock/Equine	2	12.5%
Dry Stock/Sheep	1	6.25%
Impact		
Not significant	4	25%
Minor	2	12.5%
Moderate	3	18.75%
Major	5	31.25%
Severe	2	12.5%

This option will impact upon 16. no holdings, twelve of which are in use as grazing/silage grounds, one is in use as a mixed beef and sheep operation, two are in use for grazing dry stock and horses and one is in use as a dairy operation.

Route option 2.14 (Route B.1 / D.1 / C.1– Nodes X - J – L - C)

Key Details		
Length	6,414 metres	
Area	64.14 hectares	
No. of agricultural properties impacted upon	18	
Breakdown		
Dry Stock	15	83.3%
Dairy	2	11.1%
Dry Stock/Equine	1	5.5%
Dry Stock/Sheep	0	0%
Impact		
Not significant	3	16.7%
Minor	0	0%
Moderate	8	44.4%
Major	5	27.8%
Severe	2	11.1%

This option will impact upon 18. no holdings, fifteen of which are in use as grazing/silage grounds, two are in use as dairy operations while one is a mixed dry stock and equine operation.

Route option 2.15 (Route D.2 / Link D.2 to D.1 / C1 – Nodes X-K – L - C)

Key Details		
Length	6,806 metres	
Area	68.06 hectares	
No. of agricultural properties impacted upon	17	
Breakdown		
Dry Stock	11	64.7%
Dairy	4	23.5%
Dry Stock/Equine	2	11.7%
Dry Stock/Sheep	0	0%
Impact		
Not significant	3	17.6%
Minor	0	0%
Moderate	4	23.5%
Major	2	11.7%
Severe	8	47%

This option will impact upon 17. no holdings, eleven of which are in use as grazing/silage grounds, four are in use as dairy operations while two are mixed dry stock and equine operations.

Route option 2.16 (Route B.1 / D.1 – Nodes X - J - L - M - N - P - D)

Key Details		
Length	7,234 metres	
Area	72.34 hectares	
No. of agricultural properties impacted upon	17	
Breakdown		
Dry Stock	15	88.2%
Dairy	1	5.9%
Dry Stock/Equine	1	5.9%
Dry Stock/Sheep	0	0%
Impact		
Not significant	2	11.7%
Minor	0	0%
Moderate	6	35.3%
Major	7	41.2%
Severe	2	11.7%

This option will impact upon 17. no holdings, fifteen of which are in use as grazing/silage grounds, one is in use as a dairy operation while one is in use as a mixed dry stock and equine operation.

Route option 2.17 (Route D.2 / Link D.2 to D.1 / D.1 – Nodes X-K - L - M - N - P - D)

Key Details		
Length	7,627 metres	
Area	76.27 hectares	
No. of agricultural properties impacted upon	16	
Breakdown		
Dry Stock	11	68.7%
Dairy	3	18.7%
Dry Stock/Equine	2	12.5%
Dry Stock/Sheep	0	0%
Impact		
Not significant	2	12.5%
Minor	0	0%
Moderate	2	12.5%
Major	4	25%
Severe	8	50%

This option will impact upon 16. no holdings, eleven of which are in use as grazing/silage grounds, three are in use as dairy operations while two are in use as mixed dry stock and equine operations.

Route option 2.18 (Route D.2 / D.1 – Nodes X-K - M - N - P - D)

Key Details		
Length	7,518 metres	
Area	75.18 hectares	
No. of agricultural properties impacted upon	20	
Breakdown		
Dry Stock	12	60%
Dairy	3	15%
Dry Stock/Equine	2	10%
Woodland	3	15%
Impact		
Not significant	3	15%
Minor	3	15%
Moderate	1	5%
Major	8	40%
Severe	5	25%

This option will impact upon 20. no holdings, twelve of which are in use as grazing/silage grounds, three are in use as dairy operations, three are planted while two are mixed dry stock and equine operations.

Route option 2.19 (Route D.2 / E.1 / D.1 – Nodes X-K - N - P - D)

Key Details		
Length	7,855 metres	
Area	78.55 hectares	
No. of agricultural properties impacted upon	16	
Breakdown		
Dry Stock	11	68.7%
Dairy	4	25%
Dry Stock/Equine	1	6.2%
Woodland	0	0%
Impact		
Not significant	0	0%
Minor	3	18.8%
Moderate	1	6.2%
Major	7	43.8%
Severe	5	31.2%

This option will impact upon 16. no holdings, eleven of which are in use as grazing/silage grounds, four are in use as dairy operations while one is a mixed dry stock and equine operation.

Route option 2.20 (Route B.1 / D.1 / E.1 – Nodes X - J - L - M - N - O - E)

Key Details		
Length	7,698 metres	
Area	76.98 hectares	
No. of agricultural properties impacted upon	23	
Breakdown		
Dry Stock	21	91.3%
Dairy	1	4.3%
Dry Stock/Equine	1	4.3%
Dry Stock/Sheep	0	0%
Impact		
Not significant	3	13%
Minor	2	8.7%
Moderate	6	26%
Major	9	39.1%
Severe	3	13%

This option will impact upon 23. no holdings, twenty one of which are in use as grazing/silage grounds, one is in use as a dairy operation while one is in use as a mixed dry stock and equine operation.

Route option 2.21 (Route D.2 / Link D.2 to D.1 / D.1 / E.1 – Nodes X-K - L - M - N - O - E)

Key Details		
Length	8,201 metres	
Area	82.01 hectares	
No. of agricultural properties impacted upon	22	
Breakdown		
Dry Stock	17	77.3%
Dairy	3	13.6%
Dry Stock/Equine	2	9%
Dry Stock/Sheep	0	0%
Impact		
Not significant	3	13.6%
Minor	2	9%
Moderate	2	9%
Major	6	27.3%
Severe	9	40.9%

This option will impact upon 22. no holdings, seventeen of which are in use as grazing/silage grounds, three are in use as dairy operations while two are in use as mixed dry stock and equine operations.

Route option 2.22 (Route D.2 / D.1 / E.1 – Nodes X-K - M - N - O - E)

Key Details		
Length	8,002 metres	
Area	80.02 hectares	
No. of agricultural properties impacted upon	26	
Breakdown		
Dry Stock	18	62.2%
Dairy	3	11.5%
Dry Stock/Equine	2	7.7%
Woodland	3	11.5%
Impact		
Not significant	4	15.4%
Minor	5	19.2%
Moderate	1	3.8%
Major	10	38.4%
Severe	6	23%

This option will impact upon 26. no holdings, eighteen of which are in use as grazing/silage grounds, three are in use as dairy operations, three are planted while two are mixed dry stock and equine operations.

Route option 2.23 (Route D.2 / E.1 – Nodes X-K - N - O - E)

Key Details		
Length	8,310 metres	
Area	83.10 hectares	
No. of agricultural properties impacted upon	22	
Breakdown		
Dry Stock	17	77.3%
Dairy	4	18.2%
Dry Stock/Equine	1	4.5%
Woodland	0	0%
Impact		
Not significant	1	4.5%
Minor	5	22.7%
Moderate	1	4.5%
Major	9	41%
Severe	6	27.3%

This option will impact upon 22. no holdings, seventeen of which are in use as grazing/silage grounds, four are in use as dairy operations while one is a mixed dry stock and equine operation.

Route option 2.24 (Route B.1 / D.1 / E.1 / Link E.1 to D.1 / D.1 – Nodes X - J - L - M - N - O - P - D)

Key Details		
Length	7,814 metres	
Area	78.14 hectares	
No. of agricultural properties impacted upon	18	
Breakdown		
Dry Stock	16	89%
Dairy	1	5.5%
Dry Stock/Equine	1	5.5%
Dry Stock/Sheep	0	0%
Impact		
Not significant	2	11.1%
Minor	1	5.5%
Moderate	6	33.3%
Major	6	33.3%
Severe	3	16.6%

This option will impact upon 18. no holdings, sixteen of which are in use as grazing/silage grounds, one is in use as a dairy operation while one is in use as a mixed dry stock and equine operation.

Route option 2.25 (Route D.2 / Link D.2 to D.1 / D.1 / E.1 / Link E.1 to D.1 / D.1 – Nodes X-K - L - M - N - O - P - D)

Key Details		
Length	8,214 metres	
Area	82.14 hectares	
No. of agricultural properties impacted upon	17	
Breakdown		
Dry Stock	12	70.5%
Dairy	3	17.6%
Dry Stock/Equine	2	11.8%
Dry Stock/Sheep	0	0%
Impact		
Not significant	2	11.8%
Minor	1	5.8%
Moderate	2	11.8%
Major	3	17.6%
Severe	9	52.9%

This option will impact upon 17. no holdings, twelve of which are in use as grazing/silage grounds, three are in use as dairy operations while two are use as mixed dry stock and equine operations.

Route option 2.26 (Route D.2 / D.1 / E.1 / Link E.1 to D.1 / D.1 – Nodes X-K - M - N - O - P - D)

Key Details		
Length	8,139 metres	
Area	81.39 hectares	
No. of agricultural properties impacted upon	21	
Breakdown		
Dry Stock	13	61.9%
Dairy	3	14.3%
Dry Stock/Equine	2	9.5%
Woodland	3	14.3%
Impact		
Not significant	3	14.3%
Minor	4	19%
Moderate	1	4.7%
Major	7	33.3%
Severe	6	28.5%

This option will impact upon 21. no holdings, thirteen of which are in use as grazing/silage grounds, three are in use as dairy operations, three are planted while two are mixed dry stock and equine operations.

Route option 2.27 (Route D.2 / E.1 / Link E.1 to D.1 / D.1 – Nodes X-K - N - O - P - D)

Key Details		
Length	7,861 metres	
Area	78.61 hectares	
No. of agricultural properties impacted upon	17	
Breakdown		
Dry Stock	12	70.5%
Dairy	4	23.5%
Dry Stock/Equine	1	5.8%
Woodland	0	0%
Impact		
Not significant	0	0%
Minor	4	23.5%
Moderate	1	5.8%
Major	6	35.3%
Severe	6	35.5%

This option will impact upon 17. no holdings, twelve of which are in use as grazing/silage grounds, four are in use as dairy operations while one is a mixed dry stock and equine operation.

12.7 Key Agricultural Enterprises within Routes

Section 1 - The Knockalisheen Road to the Tailrace Canal

Within the study area there is one significant equine enterprise in section 1 which is impacted upon by all of the proposed route options – routes A.4 / A.4.1 & A.2.1 will have the least impact on this property.

The remaining enterprises comprise, for the most part, dry stock operations with the land used either for grazing or silage ground. There is one significant dry stock operation which adjoins the Tailrace Canal and this property will be significantly impacted upon by all of the proposed options. There is one dairy operation impacted upon by routes A.4 / A.4.1 – route A.4 has the greater impact. The largest holding in this section is owned by the Department of Justice and used, in part, as an asylum centre. The lands surrounding the centre are used as silage and grazing grounds. Route A.3 will have a significant impact on this holding.

Section 2 - The Tailrace Canal to the R445

There are a number of significant dairy farms in operation within the study area in section 2. Route B.1 will have a significant impact upon one of these holdings. Route D.2 and Route D.2 / E.1 will also impact upon a number of the dairy operations.

The lands within the study area in section 2 are mainly used as grazing and/or silage grounds. There are also small areas of woodland within this section.

12.8 Mitigation Measures Proposed

Measures to minimise the impact of the route on specific agricultural enterprises cannot be outlined until such time as the exact location of the preferred route corridor is known. The main mitigation measures at this stage would be in relation to the selection of the preferred route corridor and the provision of access to, and facilities for severed lands.

If possible, the route should be positioned as close as possible to the external boundaries of individual farm holdings. This will minimise the severance caused to farms and cause the least disruption. Given the irregular field shape and field size in the Irish countryside this will prove extremely difficult to resolve satisfactorily for all farms in the affected area. Priority should be given to the enterprises which will suffer most from severance i.e. dairy operations.

Access to severed lands is essential. The reinstatement of services such as water, farm roadways and animal handling facilities to severed lands will also be required.

At the preliminary design stage, in cases where small portions of land are severed from the main holding are identified it may be more cost efficient to simply include such areas in the Compulsory Purchase Order (CPO) as opposed to seeking to provide access to same.

12.9 Conclusion

The proposed road scheme will have a significant effect on farming in the study area and in particular on individual holdings directly affected. The area in question comprises, for the most part, productive land and the majority of this land is intensively farmed at present. The area is currently used for a mixture of farming operations.

The level of dairy farming in the area is not overly intensive but where it is carried out the holdings are significant. There are seven dairy farms that may be affected and the level of impact varies greatly depending on the route options, for example the combination of options (A.4 / D.2 / Link D.2 to D.1 / E.1 – Nodes A - G - H - X-K - L - M - O - E) would have the greatest impact on the dairy farms. Route B1 (Nodes J – B) will also have a significant impact on one of the dairy operations.

The following table shows the hierarchy of route options, from an agricultural point of view, ranging from the option most preferred to the option least preferred.

Section 1 - The Knockalisheen Road to the Tailrace Canal

Comparison No.	Nodes (Route)	Rank
CN1	A-F (Route A.1)	2
	A-F (Route A.3)	1
CN2	G-H (Route A.4)	2
	G-H (Route A.4.1_	1

* Level 1 = Most preferred route

Comparison No.	Nodes (Route)	Rank
CN3	A-F-X (Route A.1)	4
	A-X (Route A.2)	3
	A-X (Route A.2.1)	1
	A-F-X (Route A.3)	2
	A-G-H-X (Route A.4)	6
	A-G-H-X (Route A.4.1)	5

* Level 1 = Most preferred route

Section 2 - The Tailrace Canal to the R445

Comparison No.	Nodes (Route)	Rank
CN4	J-B (Route B.1)	2
	J-B (Route B.2)	1

* Level 1 = Most preferred route

Comparison No.	Nodes (Route)	Rank
CN5	X-J-L (Route D.1)	1
	X-K-L (Route D.2 / Link D.2 to D.1)	2

* Level 1 = Most preferred route

Comparison No.	Nodes (Route)	Rank
CN6	X-J-L-M-N (Route D.1)	1
	X-K-L-M-N (Route D.2 / Link D.2 to D.1 / D.1)	4
	X-K-M-N (Route D.2 /D.1)	2
	X-K-N (Route D.2 / E.1)	3

* Level 1 = Most preferred route

Comparison No.	Nodes (Route)	Rank
CN7	N-P-D (Route D.1)	1
	N-O-P-D (Route E.1 / Link E.1 to D.1 / D.1)	2
	N-O-E (Route E.1)	3

* Level 1 = Most preferred route

Comparison No.	Nodes (Route)	Rank
CN7	X-J-B (Route B.1)	3
	X-J-B (Route B.2)	1
	X-J-L-C (Route B.1 / D.1 / C.1)	2
	X-K-L-C (Route D.2 / Link D.2 to D.1 / C.1)	9
	X-J-L-M-N-P-D (Route B.1 / D.1)	4
	X-K-L-M-N-P-D (Route D.2 / Link D.2 to D.1 / D.1	12
	X-K-M-N-P-D (Route D.2 / D.1)	14
	X-K-N-P-D (Route D.2 / E.1 / D.1)	15
	X-J-L-M-N-O-E (Route B.1 / D.1 / E.1)	6
	X-K-L-M-N-O-E (Route D.2 / Link D.2 to D.1 / D.1 / E.1)	16
	X-K-M-N-O-E (Route D.2 / D.1 / E.1)	11
	X-K-N-O-E (Route D.2 / E.1)	8
	X-J-L-M-N-O-P-D (Route B.1 / D.1 / E.1 / Link E.1 to D.1 / D.1)	5
	X-K-L-M-N-O-P-D (Route D.2 / Link D.2 to D.1 / D.1 / E.1)	13
	X-K-M-N-O-P-D (D.2 / D.1 / Link E.1 to D.1 / D.1)	10
	X-K-N-O-P-D (Route D.2 / E.1 / Link E.1 to D.1 / D.1)	7

* Level 1 = Most preferred route

12.10 Summary

The route option that would have least impact upon the farming community within the study area is the combination of Route A.2.1 from Section 1 and Route B.2 in Section 2. This combination is one of the shortest route options available and thus impacts upon the least number of holdings and will result in the smallest area of acquired land. This option will however significantly impact upon a horticultural business as well as a number of other significant holdings.

The next option would be the combination of Route A.3 from Section 1 and Route B.1 / D.1 / C.1 in Section 2. Again this combination is one of the shortest route options available thus reducing its impact upon on the number of affected holdings.

The combination of Route A.4 from Section 1 and Route D.2 / Link D.2 to D.1 / D.1 / E.1 in Section 2 is the route which will have the greatest impact on the farming community within the study area. This is the longest option available.

All of the available options investigated would have a considerable impact on individual farming operations. It will be important for the preferred route corridor

selected that all possible mitigation measures are taken to minimise the impact to agricultural holdings in the area.

Chapter 13 Landscape & Visual

13.1 Introduction

Cunnane Stratton Reynolds (CSR) was appointed as sub-consultant to Roughan & O'Donovan Consulting Engineers to provide Landscape and Visual Impact Assessment Services for the Route Options Assessment for the proposed Limerick Northern Distributor Road.

13.2 Methodology

The methodology for the assessment is as follows:

- Desk-top analysis of the receiving environment landscape, making use of aerial photography and Ordnance Survey vector mapping, to identify the landscape character, constraints and sensitivities to development;
- Analysis of the Clare County Development Plan and the Limerick County and City Development Plans to identify policy pertaining to the landscape and views/visual amenity;
- Survey of the receiving environment, to verify and supplement the findings of the desk-top analysis;
- Comparative analysis of the route options, identifying the main characteristics and elements of the route corridors, and the potential impacts, with reference to a number of assessment criteria:
  - *Q1 - Conformity with Existing Landscape Pattern:* This refers to the extent to which the route aligns with, and would comfortably integrate with, the field pattern (in rural areas) or the urban grain (the spatial arrangement of roads, junctions, blocks and open space in urban areas) of the receiving environment.
  - *Q2 – Accordance with Topography:* This refers to the extent to which the route is potentially discordant with the topography, and the amount of cut, fill and/or bridging which would be required in the landscape to accommodate the road.
  - *Q3 - Exposure to Sensitive Visual Receptors – Residents:* This refers to the proximity of the route to the most sensitive visual receptors in the receiving environment. According to the *Guidelines for Landscape and Visual Impact Assessment* (2nd edition, 2002 published by the Landscape Institute and Institute of Environmental Management and Assessment), these include the occupiers of dwellings and users of outdoor recreation facilities (see Q4 below). As well as the relative proximity and number of dwellings to the route the assessment considers the orientation of buildings and gardens, the elevation of the route relative to the building in the landscape, the existence of screening (such as vegetation) and the context of the dwelling (and associated quality/character of existing views). This criterion is considered the most important and is awarded additional weighting in the assessment exercise.
  - *Q4 - Exposure to Sensitive Visual Receptors – Recreation Facilities:* This refers to the relative proximity of the route to outdoor recreation facilities whose users would be focussed on and appreciative of the surrounding landscape.
  - *Q5 - Exposure to Sensitive Landscape Features:* This refers to the proximity of the route to valuable and sensitive features in the landscape,

such as sites and monuments of archaeological, architectural or historical interest, which might be directly impacted (wholly or partially demolished) by the road or have their landscape setting (and views to and from the site) altered.

- *Q6 - Loss of Hedgerows or Trees:* This refers to the quantity of woody vegetation which would be lost as a result of development of the route. The assessment takes account of the maturity, condition, function (e.g. field enclosure, visual amenity, screening, habitat connectivity, etc.) and context (including historic) of the vegetation.
- *Q7 - Potential for Beneficial Contribution to Landscape or Views:* This refers to the extent to which a route - particularly a bridge - could make a positive contribution to the landscape, by adding a structure of aesthetic merit, in an appropriate location, to the receiving environment.

  The assessment is a qualitative exercise. The criteria are used to guide the comparative analysis of route options rather than quantify potential impacts exactly (resources do not allow for more detailed, quantitative assessment at this stage).

Based on the comparative assessment the route options for each section and sub-section of the road are ranked in order of preference.

13.3 Policy Context

Clare County Development Plan 2011–2017 – Provisions for Landscape Protection

The most relevant policies contained in the Clare County Development Plan 2011-2017 (CCDP) are identified below:

Chapter 6 – Employment, Economy & Enterprise

The CCDP recognises the importance of the University of Limerick as a driver of economic development and of an innovative, knowledge-based economy for the county and the Mid-West and West regions. The Council is actively working with UL to expand the campus into Co. Clare within the designated University Zone, but it has identified that the lack of proper vehicular access to the campus from Co. Clare as a critical issue that needs to be resolved. In its vision for UL the CCDP states that a Master Plan for the University Zone will be prepared, providing for *"significant growth around a new access corridor off the future northern distributor road"*. (own emphasis)

Chapter 8 – Water Supply and Wastewater Services

Objective CDP 8.3 states that *"proposals for development which infringe on a river boundary, or an associated habitat, including their connection by groundwater, will only be considered where it can be clearly demonstrated that:*

a) The character of the area will be conserved

b) An acceptable physical riparian zone will be maintained with all natural vegetation preserved

c) There will be no impact on the ecological or aquatic or fishing potential of the waters or associated waters." (own emphasis)

Chapter 9 – Environment

Objective CDP 9.3 states that development will be permitted *"where it can be clearly demonstrated that the proposal would not have unacceptable impact on the water environment, including surface water, groundwater quality and quantity, designated*

source protection areas, river corridors and associated wetlands, estuarine waters, coastal and transitional waters". (own emphasis)

Chapter 11 – Transportation and Access

Table 11.2 identifies the Proposed Projects for Future Development and includes the *"Northern Limerick Distributor Road (Knockalisheen) providing linkage and access to UL campus between Coonagh and the N18 and the N7 main Dublin road north of the University of Limerick."*

Chapter 16 – Landscape

The CCDP divides the county into a series of 'living landscapes', informed by their different potential for use which is determined by characteristics such as heritage and scenery, proximity to major roads or power lines, etc. The Study Area falls into the Ennis to Limerick Working Landscape, which contains the highest concentrations of population and jobs and the strongest transport links and connectivity. It is recognised as being the economic driver of the county and an important asset for the Mid-West Region.

The CCDP Objective for the area (CDP 16.3) is as follows:

a) *"To permit development in these areas that will sustain economic activity, and enhance social well-being and quality of life - subject to conformity with all other relevant provisions of the Plan and the availability and protection of resources;*
b) *That selection of appropriate sites in the first instance within this landscape, together with consideration of the details of siting and design, are directed towards minimising visual impact;*
c) *That particular regard should be given to avoiding intrusions on scenic routes and on ridges or shorelines. Developments in these areas will be required to demonstrate:*
    i. *That sites have been selected to avoid visually prominent locations*
    ii. *That site layouts avail of existing topography and vegetation to reduce visibility from scenic routes, walking trails, public amenities and roads.*
    iii. *That design for buildings and structures reduce visual impact through careful choice of form, finishes and colours and that any site works seek to reduce visual impact of the development."*

There are no designated scenic routes in the Study Area.

It is a Strategic Aim of the CCDP to encourage the utilisation of the Clare County Landscape Character Assessment (CLCA) in the preparation and assessment. This document is reviewed in 8.2.2 below.

Chapter 17 – Natural Heritage

In addition to protecting NHA, SAC and SPA it is an objective of the CCDP to *"ensure the protection and conservation of sites, species and ecological networks/corridors of local biodiversity value outside of the designated sites"*. This includes landscape elements such as hedgerows, tree lines, woodland and scrub patches, waterway corridors, etc.

In relation to the protection of inland waters, river corridors and riparian zones the CCDP quotes the Shannon Regional Fisheries Board document *Development and Management of the Riparian Zone*, which is incorporated into the CCDP as Appendix 5. It requires that sufficient land be set aside along a river margin to protect the

ecological integrity of the river, the riparian zone (bank side vegetation including trees), and the 'human history' of the area (presumed to refer to the river's recreational usage). CDP 17.10 states that it is an objective of the Council to:

a) *"… protect and manage inland waters, river corridors and their floodplains, turloughs and other water bodies from degradation and damage, and to recognise and promote them as natural assets of the urban and rural environment;*
b) *To protect and improve the appropriate access to rivers of the County while ensuring the conservation and protection of the resource and water quality;*
c) *To reduce the development of hard engineering structures along the banks of rivers, lakes etc;*
d) *To look favourably upon developments that:*

   - Maintain an acceptable width for the riparian zone.

   - Improve access and compatible leisure activities.

   - Maintain and enhance the fishing potential for both local interests and tourism by protecting the natural spawning beds of trout and salmon".

There is a peatland in the Study Area at Derryfadda. CDP 17.11 seeks to protect the heritage and environmental value of peatland areas.

A number of the sub-objectives of CDP 17.12 regarding woodlands, trees and hedgerows, are relevant to this study, including:

b) *"To preserve and conserve individual or groups of trees identified in Volume 2 of this Plan as 'Trees for Preservation' which will enhance the character and appearance of an area;*
   There are no Trees for Preservation in the Study Area.
c) *To work with landowners, local communities and other relevant groups to promote the retention and conservation of existing trees and hedgerows and encourage development proposals that enhance the landscape through positive management and additional planting/sensitive replanting of native tree species;*
d) *To protect woodlands and hedgerows from damage and/or degradation and work to prevent the disruption of the connectivity of the woodlands and hedgerows of the County;*
e) *To ensure, where required, applications for development include proposals for planting /leave a suitable ecological buffer zone, between the development works and areas /features of ecological importance;*
f) *Where hedgerows are required to be removed in the interests of traffic safety or where breaches to hedgerows occur due to river drainage/maintenance works and flood repair, to require the applicant/developer to reinstate the hedgerows with a suitable replacement of native species to the satisfaction of the Council;*
g) *To require, where possible, that all trees felled as a result of development proposals be replaced at a minimum ratio of 10 new native species per 1 tree felled."* (own emphasis)

Chapter 18 – Architectural and Archaeological Heritage

CDP 18.1 states that it is an objective of the Council to protect all structures listed in the Record of Protected Structures. The Architectural Heritage (National Inventory) Act 1999 is quoted, which defines architectural heritage as: *"structures and buildings together with their settings and attendant grounds…"*. The protection of Protected Structures therefore has broader landscape implications, since their settings too must be protected.

The CCDP makes special mention of the county's industrial heritage, which is well represented in the Study Area. It states: *"Various industrial buildings throughout the County form part of its architectural heritage. Structures such as mills, quays, canals and warehouses from different times represent the evolution of industrialisation and industrial processes within the County. This evolution has continued, for example, from the motive power of early watermills through hydro-electric generation to newer wind energy developments. The wide range of structures of industrial provenance provide a visible timeline from early industry to modern times within County Clare and many are of special interest."*

County Clare Landscape Character Assessment (CLCA)

The Study Area falls into the River Shannon Farmlands Landscape Character Area. Its key characteristics are defined as follows:

- *"Lowland farming area with meandering River Shannon providing key focus.*
- *Small settlements/villages such as Parteen and Cloonlara.*
- *Agricultural, rural landscape with intact features and well maintained.*
- *Framed by undulating lowland farmland with Sliabh Bernagh and Broadford Hills in the distance.*
- *O'Briensbridge is an Architectural Conservation Area (ACA)."*

The CLCA identifies that the area remains largely rural although the influence of Limerick is increasingly apparent, reflected in increased pressure for housing and the expansion of settlements. It is noted that the hedgerows, hedgebanks and trees enclosing fields create an intimate, well-wooded landscape, and that the Shannon River is an important landscape feature.

Among the Forces for Change affecting the area it is recognised that the expansion of the Limerick-Shannon-Ennis area as a regional gateway to the West of Ireland will have landscape consequences. Regarding new development it states that the low lying nature of the landscape means that large scale development is likely to be highly visible. Among the Principles for Landscape Management the CLCA recommends that the riverside grounds, walks and woodlands at Parteen be preserved.

Limerick County Development Plan 2010-2016

Trees, Tree Preservation Orders and Hedgerows

Objective EH O5: Enhancing Tree Cover states: *"It is the objective of the Council to preserve and enhance the general level of tree cover within the County, both in the countryside at large and also in the County's towns. The Council strongly encourages the establishment of native species, in particular broadleaf species."*

Objective EH O6: Landscaping and Development states: *"It is the objective of the Council to…*

a) *Ensure the adequate integration of development into the landscape by the retention of existing trees and landscape features and/or suitable planting.*

b) *Encourage, where appropriate, the use of native species. The lay out of landscaping planting and features to act as wildlife corridors within developments, particularly residential developments, and linking with other habitats in the area will be encouraged.*

c) *Resist the removal of substantial lengths of roadside boundaries. Where an alternative, suitable site is available for the development, applicants should*

consider such an alternative on the basis that avoids the necessity for widespread boundary removal. Only in exceptional circumstances should roadside boundaries be removed."

Landscape Character Areas

The Study Area falls into the Agricultural Lowlands Landscape Character Area. The most relevant objectives for this area are as follows:
(b) "Encourage retention of existing landscape features such as hedgerows and trees and their incorporation into landscaping for new developments.
(c) Discourage development of locally prominent sites.
(e) Encourage development within existing settlements."

Views and Prospects

There are no designated views and prospects in the Study Area.

Limerick City Draft Development Plan 2010-2016

Landscape, Biodiversity & Recreation

Policy LBR.1 states: *"It is the policy of Limerick City Council to ensure that Limerick's landscape, biodiversity and recreational facilities are preserved and enhanced, and that the overall combined potential and value of the network of open spaces and related assets within the City is recognized, retained and enhanced."*

It is stated in the Development Plan that Limerick's unique and distinctive landscape character is generated by the combination and interplay of elements including the landscape, built environment, riverscape and natural heritage. It states that since landscape is largely a non-renewable resource it is in the City's interest to ensure that its landscape assets are protected for their visual, functional, natural heritage and other values. It identifies that many of Limerick's landscape assets, and particularly those that have an open '*greenfield*' character, have been lost over a period of time.

Policy LBR.2 states: "*It is the policy of Limerick City Council to:*

- *preserve and enhance Limerick's Landscape Assets and Key Landscape Sites;*
- *preserve and enhance Limerick's Views and Prospects of Special Amenity Value".*

Policy LBR.3: *"It is the policy of Limerick City Council to take a proactive approach to the landscape with polices that seek to conserve and enhance the strongly distinctive landscape character of the City by protecting landscape elements of significance that are either intrinsically important or contribute to the general amenity of Limerick City. Landscape assets are a non-renewable resource that the City Council shall seek to protect."* (own emphasis - the Shannon River corridor, i.e. the river and adjacent open space, is the city's most important landscape asset in terms of biodiversity, visual amenity and recreation. Any development that erodes these values would be contrary to the above policies.)

It is stated in the Development Plan that planning applications within areas benefiting from landscape protection meet specific standards, and in particular demonstrate by means of a design statement that includes a landscape assessment and visual impact assessment of the impact on the landscape of the proposal in question.

Views and Prospects

"The City at large is appreciated by most people along important viewpoints such as the River Shannon or panoramic views from vantage points both inside and outside the City. The amenity views indicate the outer visual border of the City [own emphasis], the main character areas, and principle elements of the City skyline. These special views are of strategic significance to Limerick City and the City Council will seek to protect and enhance them, where appropriate. In order to fully appreciate and legislate for the unique size, scale and distinctive topography of Limerick City, three different view types (below) were identified. Limerick City Council will have a presumption against development that threatens to obstruct strategic views or compromise the quality or setting of these views. In addition to these strategic views and prospects of special amenity value which are enjoyed by large numbers of people, local views of significance are also very important to the character and legibility of areas within Limerick. Local views will be identified on a case-by-case basis through the planning process. There will also be a presumption against proposals that would cause unacceptable harm to local views of significance and their settings. Amenity views types and prospects which are particularly relevant to Limerick City and shall be considered in the assessment of development proposals are as follows:

View types

Linear Views of Landmark Buildings, the City Walls & City Skyline: *"Linear Views occur when a single landmark building (e.g. King John's Castle) is the main point of focus within the view path. Views tend to be framed within relatively narrow viewing corridors. The city skyline is a combination of elements - the general scale of buildings, streets and spaces from area to area, major landmarks on the skyline, other individual higher buildings, higher building groups and landscape elements."*

River Prospects: *"River Prospects are usually (though not exclusively so) experienced while crossing a bridge. While many bridge crossings allow opportunities to pause and appreciate views, many of these views can also be enjoyed in motion as a viewer moves across a bridge. River Prospects in this instance refer to the ability to see landmark building(s) from bridges."*

Approach Road Views: *"Approach Road prospects often give the visitor the vital 'first impressions' of a city. The approach roads into Limerick City give the viewer an instant appreciation of the topography and character of Limerick. New developments in these areas will be required to take due cognisance of these qualities and clearly demonstrate how they will preserve and enhance their visual appearance and amenity."*

Policy LBR.5: "*It is the policy of Limerick City Council to protect the intrinsic character and scale of the City and the City skyline."*

Policy LBR.6: "*It is the policy of Limerick City Council to protect key views and vistas and the visual prominence of important city landscape and townscape features such as areas of woodland, important tree groupings and areas of special architectural or heritage value*

13.4 Description of the Study Area Landscape

General Overview

The Study Area is predominantly agricultural in use, but the landscape character is heavily influenced by the area's relationship to Limerick City. The landscape and views around the inner edge (south and west, where the Study Area skirts the city) incorporate urban characteristics and elements. The urban influence extends along the road network through the Study Area, with some stretches of the roads lined by almost continuous rows of houses generating a peri-urban character. In places however, especially towards the outer edge of the Study Area (north and east) but also in pockets closer to the urban edge, the landscape is sparsely settled and rural in character.

The relatively high concentration of settlement in the Study Area generates a high level of visual sensitivity, constitutes the main challenge to the integration of a new road into the landscape.

Three waterways which traverse the Study Area can be considered the defining elements of the landscape. The Shannon River flows east to west across the southern part of the Study Area. To the north are the head- and tailrace of the Shannon Hydroelectric Scheme, separated by the power station at Ardnacrusha. The disused 18th century Errina Canal runs north-south across the Study Area alongside the canalised Blackwater River.

All of the waterways function as recreation resources and generate a high degree of visual amenity locally (complementing their cultural-historic and ecological values). All of the route options cross these waterways at some point, and significant landscape and visual impacts are inevitable at the bridging points. Some bridging locations however present opportunities for a beneficial contribution to the landscape and views by the addition of a structure of aesthetic merit.

13.4.1 Topography and Drainage

The complex topography of the Study Area is derived from the underlying geology (soft carboniferous limestone except towards the north west where a ridge of Old Red Sandstone projects through the limestone), from fluvial forces and from human intervention.

The Shannon River flows east to west across the Study Area along a meandering path. It is wide (exceeding 100m in places) and slow-flowing, with a broad, shallow flood plain except where ridges of higher ground extend towards the river from the north, at Clooncarhy, Garraun and Srawickeen. The Blackwater River flows north to south across the Study Area, merging with the Shannon at Plassey. The Mulkear River meets the Shannon a little to the east, flowing into the Study Area from the south.

A broad strip of low-lying, relatively flat ground extends north from the Shannon flood plain between Clooncarhy and Gilloge as far as a large bog that lies to the west of the townland of Derryfadda, which occupies a long, linear hill. To the east of this beyond the V-shaped Blackwater River valley and the Errina Canal in the townlands of Cappavilla North and South there is another north-south-aligned linear hill overlooking the Shannon to the east.

This pattern – of pockets of low-lying, flat, wet ground enclosed by rounded hills (often linear), with a general fall towards the Shannon in the south - extends throughout the Study Area.

A sparse pattern of lesser streams drains the southern and eastern parts of the Study Area, while in the elevated north western area a number of parallel streams flow into the Study Area from the hills to the north. These streams drain into an extensive, low-lying wet grassland area known as Knockalisheen Marsh.

The topography of the Study Area has been dramatically altered by the Shannon Hydroelectric Scheme, which was constructed in the 1920s. The headrace above (east of) the power station at Ardnacrusha is a canal some 80m wide, elevated above the surrounding landscape by up to 18m. In combination the canal and the tall, steep embankments to both sides are some 200m wide in places, forming a massive linear obstruction in the landscape. The tailrace below (west of) the power station has the character of a natural watercourse, being sunken into the landscape, of variable width and its path responding to the surrounding topography.

The Errina Canal was built in the latter part of the 18th century as part of the Limerick-Killaloe navigation, to bypass a series of rapids in the Shannon. The canal splits from the Shannon at Plassey and runs alongside the Blackwater River for some 2.5km before diverting to the north east in a straight line roughly parallel to the Ardacrusha headrace, rejoining the Shannon near O'Briensbridge (outside of the Study Area).

Summary of Constraints – Topography and Drainage

- The topography of the Study Area is complex. There is a general pattern of pockets of low-lying, flat, wet ground enclosed by rounded hills (often linear), with a general fall towards the Shannon in the south. Roads over or cutting through the hills, or raised above the wet ground on embankments, might be visible from some distance across the landscape.
- Whereas generally the gradients in the landscape are relatively shallow, there are locations where slopes are steep, where greater amounts of cut and/or fill would be required to accommodate a road.
- The Shannon and its floodplain are wide. Any bridge over the river would require a wide span, and as such would constitute a significant addition to the landscape.
- The Ardnacrusha headrace forms an insurmountable obstacle to the proposed road, forcing the route of the proposed road to the west and south of Ardnacrusha, near the village of Parteen.
- As well as the Shannon the proposed road would be required to bridge the Blackwater River, the Errina Canal, the tailrace west of Ardnacrusha and possibly a number of lesser watercourses.
- Parts of the Study Area, for example Knockalisheen Marsh, perform an important drainage function, rendering them sensitive to disturbance.

Plate 13.1: The Shannon River is wide and slow flowing, in a broad floodplain.

Plate 13.2: The slope down from the hill to the bog land to the west at Derryfadda.

Plate 13.3: An undulating grassland field enclosed by hedgerows, typical of the higher lying parts of the Study Area.

Plate 13.4: The elevated Ardnacrusha headrace forms a substantial barrier in the landscape.

Plate 13.5: The embankment between the Blackwater River and the Errina Canal, and a double humpback bridge crossing the two waterways.

Plate 13.6: The slope above Knockalisheen Marsh in the north west of the Study Area.

13.4.2 Land Use, Vegetation and Habitats

The Study Area boundary traces the north eastern edge of Limerick City, only penetrating the urban area at Rhebogue along a corridor of open space between the city and Castletroy/University of Limerick (UL). Therefore land use in the Study Area is predominantly agricultural although there is a high density of residential development along the roads outside of the city.

The majority of the agricultural land in the Study Area is used for dairy farming, and the landscape comprises grassland fields of varying size divided by hedgerows. The field pattern is generally angular. In the floodplain of the Shannon River and on higher lying ground the fields tend to be larger and the hedgerows well maintained. In the lower-lying, wet areas - for example around the bog land west of Derryfadda and either side of the stream entering the Knockalisheen Marsh - the fields tend to be smaller and the hedgerows less well tended. These areas have greater species diversity and higher volume of woody vegetation, lending them particular character and ecological value. The vegetation also provides potential screening for development however.

Woodland is scarce in the Study Area. There is one substantial area of scrub/woodland surrounding the bog west of Derryfadda. There is a large planted broadleaf woodland surrounding a substation beside Ardnacrusha, and this woodland extends along both sides of the tailrace towards its junction with the Shannon. There is a similar strip of broadleaf vegetation alongside the Blackwater River and Errina Canal.

Along the banks of the Shannon the vegetation is variable. There is a substantial belt of mature alluvial woodland on and upstream from the UL campus, as far as the mouth of the Mulkear River. Elsewhere the river is lined by less substantial strips of

woodland, hedgerows and in places only grassland. The entire length of the Shannon corridor as it crosses the Study Area, including the stream, adjacent vegetation and parts of the broader floodplain, is designated candidate Special Area of Conservation (cSAC).

Due to a combination of its wet condition and low intensity of agricultural use, the Knockalisheen Marsh at the western extent of the Study Area presents a good example of unimproved grassland/wetland with high species diversity, and is designated proposed Natural Heritage Area (pNHA).

Summary of Constraints – Land Use, Vegetation and Habitats

- The riverside vegetation along the Shannon has ecological and amenity value and is highly sensitive to disturbance and loss.
- The vegetation along the Ardnacrusha tailrace and the Errina Canal/Blackwater River corridor has ecological and amenity value and is sensitive to disturbance and loss.
- Planted broadleaf woodlands, e.g. beside Ardnacrusha and on historic demesnes have ecological, amenity and cultural heritage value and are sensitive to disturbance and loss.
- Grassland and scrubland are generally of lesser sensitivity in landscape and visual terms, although hedgerows on field boundaries are a valuable landscape feature sensitive to disturbance and loss.
- Conifer plantations are least sensitive to disturbance and loss.
- The Knockalisheen Marsh and parts of the Shannon floodplain are subject to conservation designations due to their drainage functions and associated habitat provision.
- There are several areas where the fields are generally smaller or have a common shape and/or size. These areas have greater woody vegetation coverage, which has habitat and amenity value, and are sensitive to disturbance. However the vegetation and low-lying topography also provide screening for new development.
- The Study Area is predominantly used for dairy farming. The agricultural use is of greatest value in defining the landscape character towards the outside (north and east) of the Study Area, and less to towards the inside (south and west) of the corridor where the character is rather defined by urban elements.

Plate 13.7: Willow-dominated woodland beside Shannon River on the UL campus, and woodland lining the Ardnacrusha tailrace.

Plate 13.8: The small wet grassland fields, species rich hedgerows and numerous mature trees lend the area west of the bog in the townland of Derryfadda a particular landscape character.

Plate 13.9: Roadside and field boundary hedgerows at Derryfadda combine with the topography to generate a high degree of visual enclosure in the landscape.

Plate 13.10: In some of the more elevated areas the fields are larger and the field boundaries less substantial, allowing greater visual exposure to the broader landscape.

13.4.3 Cultural Heritage, Recreation and Amenity

The most significant cultural heritage features in the Study Area are the waterways. The Shannon River, which is artificially controlled along this stretch, the Ardnacrusha head- and tailrace and the Errina Canal are individually significant elements in their locality, and in combination contribute to the landscape character of the Study Area.

As well as having natural heritage value all three waterways provide visual and recreational amenity. The banks/towpaths are well used locally as walking routes (particularly the Shannon from the city centre to Annacotty), and the Lough Derg Way follows stretches of all three waterways. The channel of the Shannon is used for rowing and kayaking and the head- and tailrace are used (though not heavily) for cruising, providing access from the city to Lough Derg. The Errina canal is no longer

used for navigation. The Shannon along this stretch is a nationally significant angling resource.

Other sites of cultural heritage significance in the Study Area include the Ardnacrusha hydroelectric power station, a cluster of sites in Parteen (including the former national school, two churches, two houses and a letter box), Castlebank House (set in woodland west of the Ardnacrusha tailrace), Annabeg Lock and Gilloge Bridge on the Errina Canal near Plassey, Plassey House on the UL campus, Castle Troy nearby to the east on the southern bank of the Shannon beside the National Technology Park, and Mountshannon House just to the east of the Study Area. These protected structures are - or have the potential to become - visitor attractions, and they are sensitive to changes in their landscape settings.

There are also a number of recorded archaeological monuments and places in the Study Area. These tend to have less presence in the landscape but where they occur in clusters they have potential as visitor attractions. For example, there is a cluster of a church ruin, cemetery and holy well in the townland of Garraun south of Cappavilla South.

There are a number of demesnes (historic designed landscapes associated with big houses) in the Study Area. The most significant of these is Mountshannon in the southern part of the Study Area, bounded by the Shannon and Mulkear Rivers. Much of the parkland including the planted woodland has been replaced by grassland fields, although some areas of woodland remain beside the river and it is likely that the modern hedgerows contain trees dating from the demesne landscape. The demesne of Castle Park lies immediately to the west of the Study Area, west of the Knockalisheen Road. Much of its planted woodland framework remains in place in the landscape. The historic demesnes of Quinspool South and Parteen/Quinsborough (west of the modern-day village of Parteen, and the Ardnacrusha tailrace) are less recognisable in the landscape, with much of the woodland having been removed.

Some of the hedgerows in the Study Area mark townland boundaries. They date from medieval times or earlier and as such are significant cultural historic landscape features. As well as having cultural and visual amenity value, townland boundary hedgerows are known to generally have higher species diversity than other hedgerows. They are of greater sensitivity to severance and disturbance than other hedgerows.

Summary of Constraints – Cultural Heritage, Recreation and Amenity

- The hydroelectric power station at Ardnacrusha is a notable structure and a visitor attraction. It is potentially sensitive to development that would change the character of its setting.
- Users of the Lough Derg Way would be sensitive to the visual impact of new development in sight of the route.
- Users of the footpaths along the banks of the Shannon would be sensitive to the impact of new development, particularly a bridge over the river.
- Users of the Shannon Navigation, i.e. the head- and tailrace, would be sensitive to development in view from the canal. Sensitivity would lessen on approach to Limerick city as urban elements in the landscape begin to dominate.
- The remaining broadleaf woodlands and tree lines on historic demesnes are of cultural heritage (as well as biodiversity) value.

- Hedgerows defining field patterns are a valuable element of the landscape. Hedgerows along townland boundaries are of particular value.
- Various Protected Structures in the Study Area are sensitive to changes in their landscape settings.

13.4.4 Settlement Pattern - South and East of the Ardnacrusha Head and Tailrace

The town of Annacotty is situated at the south eastern corner of the Study Area, straddling the Dublin Road/R445. It lies at the eastern edge of the urban complex of Limerick. Docking Point E is located to the east of Annacotty. The Mountshannon Road runs north from Annacotty east of the Mulkear River. There is a continuous row of houses for some distance along the road, before it curves to the east into the rural environs towards the historic Mountshannon House.

Plate 13.11: The R445 approaching Annacotty near Docking Point E.

Plate 13.12: Houses along Mountshannon Road north of Annacotty.

In the corridor to each side of the R445 approaching the city there is a mix of urban land use including residential estates interspersed by retail and services.

North of the R445 corridor, between Plassey Park Road and the Shannon River, the lands are occupied by the National Technology Park and the University of Limerick (UL), forming a distinct campus-type landscape character area. Recent developments by UL north of the river facilitated by two new bridges (one road, one pedestrian) have extended the campus landscape to the north of the river. By contrast development of the National Technology Park has stalled. Between the large, widely spaced buildings set in a park-like landscape extensive sites remain undeveloped, and the landscape gives the impression of being underutilised.

Plate 13.13: The National Technology Park.

West of UL overlooking the low-lying riverside grasslands of Rhebogue are the estates of Harvard Close, Castlebrook (east of the Groody River) and Rhebogue (west of the River). These are low density neighbourhoods comprised of mostly semi-detached two-storey houses. Views of the Study Area are restricted by vegetation on the field boundaries and the river banks but a bridge over the Shannon in this area would be prominent. A recently developed high rise hotel beside the R445 just west of the Groody roundabout (Docking Point B) indicates this location's gateway status/function.

Plate 13.14 A view west down Harvard Close, with the wet grassland beside the Groody River visible in the middle distance.

Plate 13.15: A view east from a hotel beside the Dublin Road, over the floodplain of the Groody and Shannon Rivers.

Athlunkard is situated north and east of the Shannon in Co. Clare alongside the R463. Categorised as a large village in the Clare CDP, Athlunkard functions as an outlying residential neighbourhood of Limerick and has a distinctly suburban landscape character. The houses of the Fernleigh and Clonard estates around the northern and eastern edge of Athlunkard abut the agricultural landscape, but views of the rural surroundings are restricted by mature hedgerow vegetation on the estate boundary.

Plate 13.16: Houses inside the eastern boundary of the Fernleigh estate in Athlunkard.

The R463 north from Athlunkard is lined by an almost continuous row of houses east of the Road. Approaching Griffins Cross the corridor of development expands both sides of the road, forming a somewhat urbanised landscape (including two sports clubs) but lacking a distinct settlement centre.

Plate 13.17: Approaching Griffins Cross along the R463 from the south.

The R463 continues north through a rural landscape and rises to cross the Ardnacrusha headrace beside an isolated farm at Rosmadda West.

Parteen is situated to the west of the R463 and Griffin's Cross, beside the Ardnacrusha tailrace. Defined as a large village in the Clare CDP, it is comprised of a number of residential estates spread around a loosely arranged centre with a school, church and a few shops, on a hill. The R464 is the main road through the village, aligned east-west and bridging the tailrace just west of the village. The Ballykeelaun estate and adjacent Bishop Murphy Park occupy a prominent position on the hillside north of the village centre, affording a view of the low-lying lands to the north and east. The village extends to the east from the centre along the R464 towards the Firhill estate, and beyond that to Griffins Cross.

A minor local road north out of Parteen, the Ballykeelaun Road, gives access to the Ardnacrusha power station and a small cluster of houses to the south of the station.

School Road extends south east out of Parteen, giving access to a distribution centre and lined on one side by a row of houses as far as Larkin's Cross on the R463.

Plate 13.18: The houses of Ballykeelaun overlooking Bishop Murphy Park and the wet grassland fields to the east.

Plate 13.19: A view north from Ballykeelaun over the agricultural landscape towards Ardnacrusha.

Plate 13.20: The row of houses along the R464 east of Parteen Village centre.

The landscape in the corridor of the R463 (including Athlunkard) and to the west of the R463 (Parteen and the ribbon development on its approach roads) is appreciably influenced by the nearby city. The landscape to the east of the R463 is more rural in character but there is a high density of residential development along stretches of the sparse road network.

A road running directly east from Larkin's Cross is free of roadside development as far as a small settlement cluster in the townland of Cloonoughter. A local road diverts to the south from Cloonoughter along a ridgeline into the townland of Clooncarhy overlooking the Shannon River. A number of isolated houses are dispersed along this road. Another local road running north from Cloonoughter is lined by a row of houses west of the road.

Plate 13.21: A house beside the road in the townland of Clooncarhy, and a view west from the road towards Athlunkard and the city.

Plate 13.22: The row of houses along the lane north of Cloonoughter.

A short distance east of Cloonoughter, beyond an isolated bus and truck depot, there is another linear settlement cluster in the townland of Gilloge. There is a massive, disused industrial/warehouse building south of these houses, and a wastewater treatment plant south of the warehouse.

The road bridges the Blackwater River and Errina Canal and gives access to the townlands of Garraun, Cappavilla South and Srawickeen where there are small linear settlement clusters as well as large isolated farms accessed by lanes off the road.

Plate 13.23: A linear cluster of houses in the townland of Srawickeen.

Plate 13.24: An isolated house in Srawickeen.

Plate 13.25: A large, isolated farm in the townland of Cappavilla South.

Just to the west of Gilloge Bridge a road runs directly north, parallel and to the west of the Blackwater River/Errina Canal. This road runs up and along a linear hill in the townland of Derryfadda. There is an almost continuous row of houses both sides of the road for some distance north of Gilloge. The properties are generally well enclosed by mature vegetation however, so the road corridor retains a rural character. For a stretch of the road as it crosses the crest of the hill there is a gap in the roadside housing. There is a further linear cluster south of where the Derryfadda Road meets the Rosmadda Road, and there are a number of isolated roadside houses in the vicinity of this junction.

Plate 13.26: A house beside the Derryfadda Road north of Gilloge.

Plate 13.27: A view north along the Derryfadda Road approaching the crest of the hill.

The Rosmadda Road is aligned east-west and connects to the R464 at Griffins Cross to the west. The road is relatively free of development, except for three dispersed houses towards the east approaching the junction with the Derryfadda Road, and a linear cluster towards the west approaching Griffins Cross. There is a row of mature trees across the road from these houses. A local road runs north from the Rosmadda Road, bridging the Blackwater River and giving access to a number of isolated houses on the slope below the Ardnacrusha headrace.

Plate 13.28: The easternmost of the row of houses at Rosmadda East.

There is a narrow lane that runs north from Larkins Cross, parallel and to the east of the R463 before winding north east through the townland of Shanakyle towards Rosmadda and Derryfadda. The road terminates at two isolated houses near the bog west of Derryfadda. There is a linear cluster of houses along the Shanakyle Road, one field to the rear (east) of the houses fronting the R463, and further along the road three very isolated houses in a densely vegetated landscape.

Plate 13.29: A row of houses along the Shanakyle Road. The houses beside the R463 are visible to the right.

Plate 13.30: An isolated house along the Shanakyle Road, enclosed by garden and field boundary vegetation.

Plate 13.31: One of two houses at the terminus of the Shanakyle Road.

13.4.5 Settlement Pattern – West of the Ardnacrusha Tailrace

In the north western part of the Study Area, to the north of Limerick City and west of the Ardnacrusha tailrace, the landscape and settlement pattern are rural in character. The knockalisheen Road along the western edge of the Study Area gives access to the city from Cappateemore in the hills to the north west. A number of houses are located along this road, increasing in density towards the north beyond Brennan's Cross as the road ascends the hillside.

Plate 13.32: View north up the Knockalisheen Road, towards Docking Point A.

The R464 runs north from the city to the townland of Quinspool where there is a linear concentration of houses. The R464 continues alongside the Ardnacrusha tailrace for 500m giving access to a pub and a number of houses (fronting the main road and along a side road/track leading to Castlebank), before bridging the tailrace to arrive in Parteen.

The Quinspool Road runs north from the R464 towards Ballycannon. Beyond the continuous ribbon of houses at Quinspool there are houses at fairly regular intervals along the road, as well as along the Castlebank Road which branches to the east.

Plate 13.33: A row of houses beside the Quinspool Road, and a view east from the road towards the tailrace.

The village of Meelick/Ballycannon is situated between the two north-south aligned roads described above. The settlement consists of a number of relatively modern estates (Glen Abhainn and Elmwood north of the road, and Elton Court, Kylevoher Heights and Ballycannon Heights to the south) set back from the road behind a row of roadside houses, a pub and a shop. Towards the eastern end of the village north of the road beside the Glen Abhainn estate there is a cemetery in a particularly attractive setting.

The Knockalisheen Accommodation Centre for refugees situated some 500m to the south of Meelick/Ballycannon in an isolated location.

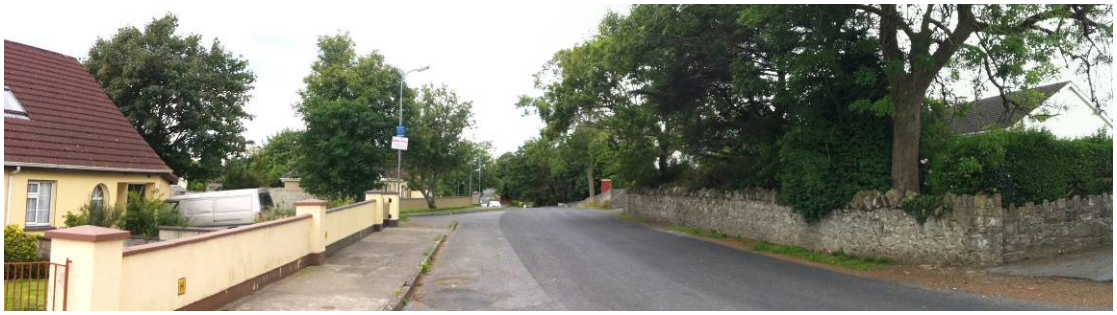


Plate 13.34: A view west along the main road in the village of Meelick.

Plate 13.35: A view north across the cemetery at Ballycannon.

The northern areas of Limerick city closest to the Study Area, including the estates of Castlepark and Sarsfield Gardens, St. Mary's Park on King's Island, and Corbally to the east, are suburban in character. They are generally composed of two storey semi-detached and terraced houses in a variety of low density layouts. Views north from these neighbourhoods towards the Study Area are restricted by a combination of topography and vegetation.

Summary of Constraints – Settlement and Transport

- There is a concentration of settlement in the corridor of, and to the west of, the R463, including the villages of Parteen and Athlunkard. Despite the relative density of settlement and the proximity to Limerick this area (except for Athlunkard) retains a rural character distinct from the urban area, and is sensitive to urban-generated landscape change.
- Although the road network is sparse, to the east of the R463 and west of the Ardnacrusha tailrace the density of residential development in linear clusters along the roads is high. Only towards the northern and eastern edge of the Study Area is the settlement pattern truly rural/dispersed in nature.

13.5 Route Comparisons

13.5.1 Section 1: Step 1 – Initial Route Comparison CN1

Route A.1 follows a route south from Docking Point A along the alignment of the existing Knockalisheen Road, past the entrance to the Castle Park estate (west of the road) and three roadside houses and one set further back east of the road, before branching east across the agricultural landscape. It traverses a large field approximately 150m south of the latter house (accessed by a tree-lined lane) and to the north of a commercial/distribution premises (Flogas) before winding to the north east through a landscape of small fields divided by hedgerows, and crossing a stream with wooded embankments. It passes 100m to the west of Quinspool House stud farm before crossing the Quinspool Road. It crosses the road 150m south of a row of roadside houses, and 250m north of a house beside the stud farm. The route

continues through a landscape of fields divided by mature hedgerows to the east of the Quinspool Road to Node F.

Route A.3 follows a route north from Docking Point A along the existing Knockalisheen Road past a row of four roadside houses (west of the road) and the entrance to the Knockalisheen Accommodation Centre, before turning east. It passes through two large fields north of the Centre, 50m from the residential buildings. This section is some 275m south of Elton Court, the southernmost residential estate in Meelick. The route crosses an area of wet land west of a stream with wooded embankments, the stream, and two fields east of the stream before traversing a large field beside the Quinspool Road. It crosses the road approximately 100m south of a row of roadside houses (with no intervening vegetation between the route and the southernmost house), and approximately 300m north of a house beside the stud farm. The route continues through a landscape of fields divided by mature hedgerows to the east of the Quinspool Road to Node F.

Summary: Route A.3 passes close to the Knockalisheen Accommodation Centre, relatively close to the village of Meelick, bridges a broader area of wet land beside the stream, and crosses the Quinspool Road closer to a residence with no existing screening vegetation. Therefore it would have the greater visual impact. Route A.1 follows a longer route through lower, wetter ground and bisects a greater number of fields and field boundaries. This route would have the greater impact on the landscape/field pattern and vegetation, but lesser visual impact. Route A.1 is preferred.

13.5.2 Section 1: Step 1 – Initial Route Comparison CN2

Routes A.4 and A.4.1 share a route north along the Knockalisheen Road from Docking Point A, through Brennan's Cross (where the road to the east gives access to the village of Meelick). North of the crossroads the routes pass a row of four roadside houses (east of the road), before branching to the east in the fields beside the northernmost of these houses (some 60m from the house). The routes cut straight across a landscape of mid- to large fields divided by mature hedgerows north of and parallel to the linear settlement of Meelick/Ballycannan, approximately 250m from the northernmost houses. Towards the eastern end of the village Routes A.4 and A.4.1 split.

Route A.4 follows a more northerly route with a wider curve crossing a relatively broad scrub/woodland area above the convergence of two streams. The route traverses one large and one small field before crossing the Ballycannan Road. It crosses the road between a row of three roadside houses (west of the road) and a farm (east of the road), less than 50m from the northernmost house and the nearest farm building (there is vegetation screening for both buildings). It then veers south across fields, crossing a farm lane some 120m to the east of a house (with limited screening vegetation) and passing 50m to the west of a farm (in the adjacent field, with no screening) before crossing the Castlebank Road. South of the road it passes through two fields divided by mature hedgerows before reaching Node H which is 50m from a farm house.

Route A.4.1 follows a more southerly route with a tighter curve, below the convergence of the streams therefore crossing a narrower scrub/woodland area. The route comes within 50m of the cemetery at Meelick and within 150m of the houses of the Glen Abhainn estate, but would most likely be screened from these by existing vegetation. It veers south across several fields divided by broad, mature hedgerows and tree lines crossing two roads in quick succession at Quinspool North, passing

within 50m of the southernmost of three houses east of the junction of these roads and 50m from a single house to the south. It traverses two fields before crossing the Castlebank Road, then crossing two fields divided by mature hedgerows before reaching Node H.

Summary: Route A.4 takes out a broader scrub/woodland area above the cemetery but less hedgerow vegetation overall. It crosses the Ballycannan Road close to houses but these properties have some existing screening vegetation. It passes close to a single farm house with no screening beside Castlebank Road. Route A.4.1 passes closer to the cemetery and Glen Abhainn estate. It bisects a number of mature hedgerows with significant tree lines. It would result in a significant rearrangement of the landscape where it crosses two roads in succession at Quinspool North, close to four houses, two of which have no vegetation screening. Route A.4 is preferred.

Comparison No.	Nodes (Route)	Length	Rank	Notes
CN1 **Rank (1-2)**	**A-F** (Route A.1)	**2131m**	1	A comparison is to be undertaken between **Route A.1** and **Route A.3** between Node A on the Knockalisheen Road and Node F with each option ranked in order of preference.
	A-F (Route A.3)	**1929m**	2	
CN2 **Rank (1-2)**	**G-H** (Route A.4)	**1610m**	1	A comparison is to be undertaken between **Route A.4** and **Route A.4.1** between Node G and Node H with each option ranked in order of preference.
	G-H (Route A4.1)	**1500m**	2	

13.5.3 LNDR Section 1: Step 2 – Final Route Comparison CN3

Route A.1 follows a route south from Docking Point A along the alignment of the existing Knockalisheen Road, past the entrance to the Castle Park estate (west of the road) and a cluster of three roadside houses and one set further back east of the road, before branching east across the agricultural landscape. It traverses a large field approximately 150m south of the latter house (accessed by a tree-lined lane) and to the north of a commercial/distribution premises (Flogas) before winding to the north east, crossing a stream with wooded embankments and passing through a landscape of small fields divided by hedgerows. It passes 100m to the west of Quinspool House stud farm before crossing the Quinspool Road. It crosses the road approximately 150m south of a row of roadside houses, and approximately 250m north of a house beside the stud farm. The route continues east through a landscape of relatively large fields divided by mature hedgerows, remote from any dwellings, to arrive at Node X.

Route A.2 follows a direct route east from Docking Point A across two large fields divided by poor hedgerows, and passes to the south of the Knockalisheen Accommodation Centre some 275m from the buildings. It crosses a relatively narrow wet area either side of a stream, and four mid-sized fields with maintained hedgerows before passing within 100m of the Quinspool House stud farm and 50m

from the adjacent house as it crosses the Quinspool Road. The route continues east through a relatively flat and low lying landscape of large fields divided by mature hedgerows, remote from any dwellings, to arrive at Node X.

Route A.2.1 follows a direct route east from Docking Point A but to the south of Route A.2. The route crosses four low-lying and relatively flat fields divided by poor hedgerows, passing some 350m to the south of the Knockalisheen Accommodation Centre buildings before crossing a stream. East of the stream it traverses two relatively large fields, passes some 60m to the south of Quinspool stud farm and takes out two outlying polytunnels of a vegetable farm (passing 150m from the main buildings) before crossing the Quinspool Road. There is a continuous row of houses to the west of the Quinspool Road south of the vegetable farm. East of the Quinspool Road the route continues east through a relatively flat and low lying landscape of large fields and one conifer plantation (the corner of which it severs) divided by mature hedgerows, to arrive at Node X.

Route A.3 follows a route north from Docking Point A along the existing Knockalisheen Road past a row of four roadside houses (west of the road) and the entrance to the Knockalisheen Accommodation Centre, before branching to the east. It passes through two large fields north of the Centre, and only 50m from the residential buildings. This section is some 275m south of Elton Court, the southernmost residential estate of the village of Meelick to the north. The route crosses a wet field west of a stream with wooded embankments, and two fields east of the stream before traversing a large field beside the Quinspool Road. It crosses the road approximately 100m south of a row of roadside houses (with no intervening vegetation between the route and the southernmost house), and approximately 300m north of a house beside the Quinspool stud farm. The route continues through a landscape of mid- to large fields divided by mature hedgerows, remote from any houses, to the east of the Quinspool Road to Node X.

Routes A.4 and A.4.1 share a route north along the Knockalisheen Road from Docking Point A, up the hill through Brennan's Cross (where the road to the east gives access to the village of Meelick. North of the crossroads the routes pass a row of four roadside houses (east of the road), before branching to the east in the fields beside the northernmost of these houses (some 60m from the house). The routes cut straight across a landscape of mid- to large fields divided by mature hedgerows north of and parallel to the linear settlement of Meelick, approximately 250m from the northernmost houses. Towards the eastern end of the village Routes A.4 and A.4.1 split.

Route A.4 follows a more northerly route with a wider curve crossing a relatively broad scrub/woodland area above the convergence of two streams. It traverses one large and one small field before crossing the Ballycannan Road. It crosses the road between a row of three roadside houses (west of the road) and a farm (east of the road), less than 50m from the northernmost house and the nearest farm building (there is vegetation screening for both buildings). It then veers south across fields, crossing a farm lane some 120m to the east of a house (with limited screening vegetation) and passing 50m to the west of a farm (in the adjacent field, with no screening) before crossing the Castlebank Road. South of the road it passes through large fields divided by mature hedgerows, crossing (at an oblique angle) a small tree-lined stream in a V shaped valley and continuing through large fields divided by mature hedgerows to Node X.

Route A.4.1 follows a more southerly route with a tighter curve, below the convergence of the streams therefore crossing a narrower scrub/woodland area. It

comes within 50m of the cemetery at Meelick/Ballycannan and within 150m of the houses of the Glen Abhainn estate, but would be screened from these by existing vegetation. It veers south across several fields divided by broad, mature hedgerows and tree lines, crossing two roads (the road to Meelick village and the Ballycannan Road) in quick succession at Quinspool North, passing within 50m of the southernmost of three houses east of the junction of these roads and 50m from a single house to the south. It traverses two fields before crossing the Castlebank Road. South of the road it passes through large fields divided by mature hedgerows, crossing (at an oblique angle) a small tree-lined stream in a V shaped valley and continuing through large fields divided by mature hedgerows to Node X.

Summary: Routes A.4 and A.4.1 would have significant impact in all of the assessment themes/areas, in particular affecting the visual amenity and setting of a number of rural houses. Route A.3 has a similar effect on the Knockalisheen Accommodation Centre, while having generally low impact in other areas. Route A.1 avoids dwellings but in taking a long, winding route it has poor alignment with the established landscape pattern and cuts through a large number of field boundary hedgerows. Routes A.2 and A.2.1 are the most direct and best aligned with the field pattern. They are generally remote from dwellings and other intensive land use except where they cross the Quinspool Road. A.2.1 takes out two polytunnels of a vegetable farm, but these could be replaced; while A.2 passes closer to a dwelling. Route A.2.1 is preferred.

Comparison No.	Nodes (Route)	Length	Rank	Notes
CN3 **Rank (1-6)**	**A – F – X (Route A.1)**	**3082m**	**2**	A comparison is to be undertaken between all the routes in Section 1 (between docking Point A on the Knockalisheen Road and the Tailrace Canal) from Node A to Node X with each option ranked in order of preference.
	A-X (Route A.2)	**2443m**	**3**	
	A-X (Route A.2.1)	**2447m**	**1**	
	A – F – X (Route A.3)	**2925m**	**4**	
	A – G – H – X (Route A.4)	**4701m**	**5**	
	A – G – H – X (Route A.4.1)	**4592m**	**6**	

13.5.4 Section 2: Step 1 – Initial Route Comparison CN4

Route B.1 from node J traverses a large tillage field fringed by wet grassland before crossing the road to Cloonoughter some 200m from the nearest building (a farm to the west, with screening) and 300m from the houses at the western end of Cloonoughter. It then traverses a low-lying landscape of angular, mid-sized fields divided by relatively sparse hedgerows (except for one small field surrounded by mature tree lines in scrubby hedgerows), running parallel to the eastern edge of

Athlunkard. At its closest it comes to within 50m of the edge of the suburban area, but the estates (Fernleigh and Clonard) are enclosed by a dense, mature hedgerow along a townland boundary. A local road (accessing a small number of houses/farms in Clooncarhy) runs parallel to the east of the route along a spur of elevated land. Passing to the south of Athlunkard and Clooncarhy the route swings in a broad arc to the east across large fields enclosed by a loop in the Shannon River, before crossing the river (on a perpendicular alignment – and directly aligned with the Park Canal and the Lough Derg Way, generating potential for creation of a landmark) to arrive in a landscape of low-lying fields separated by drainage ditches in Rhebogue. The route approaches to within 80m of the houses of the Castlebrook estate before arriving at Docking Point B.

Route B.2 from node J takes a more easterly route, traversing the large tillage field fringed by wet grassland before crossing the road to Cloonoughter at a more oblique angle than B.1 and closer to the houses at the western end of Cloonoughter. It passes 50m from one house, through the adjacent field, then crosses the Clooncarhy Road at an oblique angle, passing close to (50m) from two farm houses. Contrary to B.1 which follows low-lying land B.2 crosses the Clooncarhy spur. East of Clooncarhy it descends to lower ground across mid- to large fields divided by (relatively) more woody field boundaries before crossing the River Shannon at an oblique angle. It arrives on the southern bank at the location of the UL rowing club (requiring that the extensive building be bridged, or removed). The route then runs parallel and to the west of Castlebrook Road to Docking Pont B, passing within 50m of the Harvard Close and College Close estates.

Summary: Route B.1 would have substantially less impact than B.2 despite passing relatively close to the eastern estates of Athlunkard. The elevation of the road above grade along that section would be significant. If the road is above grade it will be visible from the houses of the Fernleigh and Clonard estates, but if not it would be screened by existing hedgerow vegetation and new mitigation planting along the road corridor. The bridge location of Route B.1 provides potential for creation of a landmark structure at a gateway location. Route B.1 is preferred.

13.5.5 Section 2: Step 1 – Initial Route Comparison CN5

Route D.1, from Node X, veers south towards Parteen. It crosses two fields, a tree-lined lane and the Ballykeelaun Road, before veering to the south around the Ballykeelaun estate and Bishop Murphy Park. The estate is situated on a hillside overlooking the surrounding lower-lying lands. The route passes within 50m of the Bishop Murphy Park boundary (marked by a mature hedgerow) and less than 100m from the nearest houses. It passes through a large, wet field before crossing the R464 taking out one house south of the road and passing close by the houses to either side of this. South of the R464 it traverses a landscape of large fields over a low ridge, and one significant hedgerow, before crossing the R463. There are no houses west of the road but there is a continuous row of houses east of the road except for a gap of some 100m through which the route passes, arriving at Node J. East of the R463 it crosses a field, then crosses the Shanakyle Road within 50m from the nearest of a linear cluster of houses. It then traverses an undulating landscape of large fields with sparse hedgerows, remote from any houses, before crossing a lane north of Cloonoughter, passing 160m from the nearest house and continuing through low wet fields to Node L.

Route D.2 from Node X veers to the north away from Parteen. It traverses two fields divided by a tree-lined lane, passes 50m to the north of a farm building complex (including a house) and crosses the Ballykeelaun Road at an oblique angle. It passes

through large fields within 100m to the south of a cluster of houses beside the Ardnacrusha power station, continuing eastwards along a path parallel to the headrace, before crossing the R463 as it begins to rise steeply to cross the elevated headrace, less than 50m from a farm building complex beside and below the R463. East of the R463 it crosses several fields and one mature tree line, arriving at Node K.

From Node K the route veers south through large fields divided by mature hedgerows and tree lines and crosses the R464 50m to the east of a farm house and buildings, which is the first of a row of houses extending west along the R464. There is a line of mature trees along the R464 (northern side) at this location, which would be severed. South of the R464 the route follows a straight line south east towards Node L, traversing a distinctive landscape of undulating topography, relatively small, wet fields (and a conifer plantation) enclosed by dense hedgerows with many mature trees. The route passes 50m to the west of an isolated house (which orientates east and has dense surrounding vegetation), in the adjacent field, before crossing the Shanakyle Road. It continues through this landscape passing close to a cluster of agricultural buildings at the end of a lane from Cloonoughter before veering east to Node L.

Summary: Route D.2 and the Link follows a path through an exclusively rural landscape, avoiding settlement concentrations, however impacting on a small number of isolated farm houses. It would change the character of the rural landscape in its immediate corridor, and result in the loss of a significant quantity of mature hedgerow vegetation including trees. Route D.1 skirts the northern suburb/estate of Parteen, within view of the houses and adjacent open space, and effectively severs the settlement (albeit linear and dispersed) where it crosses the R464, with substantial visual impacts locally as well as change to the structure and character of the village. Route D.2 and the Link is preferred.

13.5.6 Section 2: Step 1 – Initial Route Comparison CN6

Route D.1 (X – J – L – M – N)

Route D.1, from Node X, veers south towards Parteen. It crosses two fields, a tree-lined lane and the Ballykeelaun Road, before veering to the south around the Ballykeelaun estate and Bishop Murphy Park. The estate is situated on a hillside overlooking the surrounding lower-lying lands. The route corridor passes within 50m of the Bishop Murphy Park boundary (marked by a mature hedgerow) and is approximately 100m from the nearest houses. It passes through a large, wet field before crossing the R464 where a number fo residential properties could be affected. South of the R464 it traverses a landscape of large fields over a low ridge, and one significant hedgerow, before crossing the R463. There are no houses west of the road but there is a continuous row of houses east of the road except for a gap of some 100m through which the route passes, arriving at Node J. East of the R463 it crosses a field, then the Shanakyle Road, within 50m from the nearest of a linear cluster of houses. It then traverses an undulating landscape of large fields with sparse hedgerows, remote from any houses, before crossing a lane north of Cloonoughter, passing 160m from the nearest house and continuing through low wet fields to Node L.

East from Node L the route climbs the side of a hill and crosses the Derryfadda Road in a narrow gap between houses along the road, some 20m from the nearest house to the north and 30m form the nearest house to the south. The house to the south has vegetation screening but two houses north of the route have no screening. The route descends the hill through a large field before crossing the Blackwater River and

the adjacent Errina Canal at a bend in the alignment of the waterways. The route climbs the side of a hill of large grassland fields, passing 150m from an isolated farm building complex in the townland of Cappavilla South, then drops down the hillside to Node M.

East from Node M the route follows a straight line through large fields divided by sparse hedgerows, crossing a lane between two houses, 50m from each (the houses have limited vegetation screening), arriving at Node N.

D.2 & Link to D.1 and Route D.1 (X – K – L – M – N)

Route D.2 from Node X veers to the north away from Parteen. It traverses two fields divided by a tree-lined lane, passes 50m to the north of a farm building complex (including a house) and crosses the Ballykeelaun Road at an oblique angle. It passes through large fields within 100m to the south of a cluster of houses beside the Ardnacrusha power station, continuing eastwards along a path parallel to the headrace, before crossing the R463 as it begins to rise steeply to cross the elevated headrace, less than 50m from a farm building complex beside and below the R463. East of the R463 it crosses several fields and one mature tree line, arriving at Node K.

From Node K the route veers south through large fields divided by mature hedgerows and tree lines and crosses the R464 50m to the east of a farm house and buildings, which is the first of a row of houses extending west along the R464. There is a line of mature trees along the R464 (northern side) at this location, which would be severed. South of the R464 the route follows a straight line south east towards Node L, traversing a distinctive landscape of undulating topography, relatively small, wet fields (and a conifer plantation) enclosed by dense hedgerows with many mature trees. The route passes 50m to the west of an isolated house (which orientates east and has dense surrounding vegetation), in the adjacent field, before crossing the Shanakyle Road. It continues through this landscape passing close to a cluster of agricultural buildings at the end of a lane from Cloonoughter before veering east to Node L.

East from Node L the route climbs the side of a hill and crosses the Derryfadda Road in a narrow gap between houses along the road, some 20m from the nearest house to the north and 30m form the nearest house to the south. The house to the south has vegetation screening but two houses north of the route have no screening. The route descends the hill through a large field before crossing the Blackwater River and the adjacent Errina Canal at a bend in the alignment of the waterways. The route climbs the side of a hill of large grassland fields, passing 150m from an isolated farm building complex in the townland of Cappavilla South, then drops down the hillside to Node M. East from Node M the route follows a straight line through large fields divided by sparse hedgerows, crossing a lane between two houses, 50m from each (the houses have limited vegetation screening), arriving at Node N.

Route X – K – M – N

From Node X the route veers to the north away from Parteen. It traverses two fields divided by a tree-lined lane, passes 50m to the north of a farm building complex (including a house) and crosses the Ballykeelaun Road at an oblique angle. It passes through large fields within 100m to the south of a cluster of houses beside the Ardnacrusha power station, continuing eastwards along a path parallel to the headrace, before crossing the R463 as it begins to rise steeply to cross the elevated headrace, less than 50m from a farm building complex beside and below the R463.

East of the R463 it crosses several fields and one mature tree line, arriving at Node K.

From Node K the route veers south through large fields divided by mature hedgerows and tree lines and crosses the R464 50m to the east of a farm house and buildings, which is the first of a row of houses extending west along the R464. There is a line of mature trees along the R464 (northern side) at this location, which would be severed. South of the R464 the route veers to the east, crossing several fields and a conifer plantation and passing 80m from a house, in the adjacent field. It traverses the Derryfadda bog land for approximately 600m, then climbs the wooded hillside diagonal to the contours, crossing the Derryfadda Road 120m from the nearest house. It descends the hill through long fields to the rear of several houses fronting the road before crossing the Blackwater River and Errina Canal at an oblique angle. It cuts across the side of a hill at Cappavilla South, passing 70m from an isolated farm building complex to arrive at Node M.

East from Node M the route follows a straight line through large fields divided by sparse hedgerows, crossing a lane between two houses, 50m from each (the houses have limited vegetation screening), arriving at Node N.

Route X – K – N

From Node X the route veers to the north away from Parteen. It traverses two fields divided by a tree-lined lane, passes 50m to the north of a farm building complex (including a house) and crosses the Ballykeelaun Road at an oblique angle. It passes through large fields within 100m to the south of a cluster of houses beside the Ardnacrusha power station, continuing eastwards along a path parallel to the headrace, before crossing the R463 as it begins to rise steeply to cross the elevated headrace, less than 50m from a farm building complex beside and below the R463. East of the R463 it crosses several fields and one mature tree line, arriving at Node K.

From Node K the route veers east, following the Rosmadda Road alignment for a stretch then veering to the south east before the junction with the Derryfadda Road. It passes within 20m of four houses and within 50m of several other properties before crossing the Derryfadda Road, causing a significant rearrangement of the road network at this location. It passes diagonally through three fields before crossing the Blackwater River and the Errina Canal 100m north of where the paths of the two waterways diverge, requiring two separate bridges or a bridge with a wide span. The route then crosses a saddle between two low hills at Cappavilla North, 150m from an isolated farm house, and continues through the most remote/least populated part of the Study Area, through a landscape of large fields divided by well-tended hedgerows and treelines, finally passing 150m from another isolated farm to arrive at Node N.

Summary: Route D.1 skirts the northern suburb/estate of Parteen, within view of the houses and adjacent open space, and effectively severs the settlement (albeit linear and dispersed) where it crosses the R464, with substantial visual impacts locally as well as change to the structure and character of the village. The other routes avoid Parteen, traversing the rural landscape. X – K – M – N takes the route most remote from dwellings, but crosses the Derryfadda bog and woodland and cuts diagonally across the hill. X – K – N also takes a route relatively remote from houses except for a stretch near the Rosmadda and Derryfadda Roads junction, where it passes extremely close to several houses and would require a significant re-arrangement of the road network locally. Furthermore it requires a double bridge or wide span bridge

to cross the Blackwater River and the Errina Canal. Route D.2 with the Link to D.1 (X – K – L – M – N) crosses a landscape of particularly wooded character west of the bog, leading to the severance of numerous hedgerows and treelines, and crosses the Derryfadda Road closer to houses than the other routes. However there is existing vegetation screening at this road crossing. D.2 with the Link to D.1 is preferred.

13.5.7 Section 2: Step 1 – Initial Route Comparison CN7

Route N – P - D

From Node N the route passes close to the edge of a wooded enclosure, then crosses two fields separated by a hedgerow/treeline, running alongside another, before cutting through a row of mature trees on the north bank and bridging the Shannon, arriving in a broad belt of riverine scrub/woodland on the south bank. It continues through several fields which surround the central built up sites of the National Technology Park, arriving at an incomplete roundabout at the centre of the incomplete Technology Park, Node P. It continues then along the existing access road to the technology park, to arrive at Node D on the R445/Dublin Road.

Route N – O – P - D

From Node N the route traverses two large and one narrow field all divided by hedgerows/treelines, cutting through a treeline (less substantial than that on Route N – P – D) on the north bank and bridging the Shannon to arrive in a small field with a fringe of riverside woodland (narrower than the belt of scrub/woodland on Route N – P – D). It crosses a large field and climbs to the top of a low hill to arrive at Node O.

The route turns 90 degrees on the hill top, drops through a large field then bridges the Mulkear River, fringed by hedgerows on both banks. It continues across two scarred, disused fields which surround the central built up sites of the National Technology Park, arriving at an incomplete roundabout at the centre of the park, Node P. It turns south then along the existing access road to the Technology Park, to arrive at Node D on the Dublin Road.

Route N – O – E

From Node N the route traverses two large and one narrow field all divided by hedgerows/treelines, cutting through a treeline (less substantial than that on Route N – P – D) on the north bank and bridging the Shannon to arrive in a small field with a fringe of riverside woodland (narrower than the belt of scrub/woodland on Route N – P – D). It crosses a large field and climbs to the top of a low hill to arrive at Node O.

It continues over the hill through a large field and crosses the Mountshannon Road at an existing junction (where a spur of the road leads to a number of houses and a nursery), passing metres from a recently built house, the northernmost of a row of houses overlooking the field through which the road approaches. The junction would require re-arrangement. The route continues through a landscape of large fields divided by mature hedgerows, and passes 50m from a single house north of the Dublin Road to arrive at Node E, east of Annacotty.

Summary:

Route N – O – E affects an exclusively rural landscape, and impacts significantly on the setting and views of a cluster of houses on the Mountshannon Road, arriving at the Dublin Road at a lesser junction than the other two options. N – P – D takes the most direct route to the Dublin Road, affecting the smallest portion of the rural landscape and a larger portion of the National Technology Park - potentially to its

benefit (creating access to sites and possibly encouraging their development). N – O – P – D also arrives at the Dublin Road via the incomplete Technology Park but via a longer route. It requires a second bridge, to cross the Mulkear River, and affects a greater part of the rural landscape, imposing a particularly engineered pattern of infrastructure on the landscape. Route N – P – D is preferred.

Comparison No.	Nodes (Route)	Length	Rank	Notes
CN4 **Rank (1-2)**	**J – B (Route B.1)**	**3557m**	**1**	A comparison is to be undertaken on the route options between Node J and Node B with each option ranked in order of preference.
	J – B (Route B.2)	**3242m**	**2**	
CN5 **Rank (1-2)**	**X – J – L (Route D.1)**	**3206m**	**2**	A comparison is to be undertaken on the route options between Node X and Node L with each option ranked in order of preference.
	X – K – L (Route D.2 & Link D.2 to D.1)	**3619m**	**1**	
CN6 **Rank (1-4)**	**X – J – L – M – N (Route D.1)**	**5206m**	**3**	A comparison is to be undertaken on the route options between Node X and Node N with each option ranked in order of preference.
	X – K – L – M – N (Route D.2 & Link D.2 to D.1 & Route D1)	**5600m**	**1**	
	X – K – M – N	**5490m**	**2**	
	X – K – N	**5830m**	**4**	
CN7 **Rank (1-3)**	**N – P – D**	**2031**	**1**	A comparison is to be undertaken on the route options from Node N to Docking Point D and Docking Point C with each option ranked in order of preference.
	N – O – P – D	**2582m**	**2**	
	N – O – E	**2482m**	**3**	

13.5.8 Section 2: Step 2 – Final Route Comparison CN8

X – J – B (Route B.1)
X – J – B (B.2)
The routes (X - J) affect the village of Parteen equally, skirting the northern suburb/estate within view of the houses and adjacent open space, and effectively severing the settlement (albeit linear and dispersed) where they cross the R464, with substantial visual impacts locally as well as change to the structure and character of the village.

The routes from J – B differ significantly. B.2 imposes greater landscape change and visual impact on the settlement of Cloonoughter and several houses on the Clooncarhy Road, crossing both roads and the linear hill at oblique angles. B2 also bridges the Shannon at an oblique angle arriving on the site of the UL rowing club, requiring it to be removed or additionally bridged. This route is ranked 16.

B.1 would have substantially less impact than B.2 despite passing relatively close to the eastern estates of Athlunkard. The elevation of the road relative to grade along that section would be significant. The bridge location of Route B.1 provides potential for creation of a landmark structure at a gateway location, in view of the Groody roundabout and the Park Canal. This route is ranked 5.

X – J – L – C
X – K – L – C
Refer to 13.5.5 for X – J – L vs X – K – L..

East from Node L the route climbs the side of the hill and crosses the Derryfadda Road in a narrow gap between houses along the road, some 20m from the nearest house to the north and 30m from the nearest house to the south. The house to the south has vegetation screening but two houses north of the route have no screening. The route descends the hill through a large field before crossing the Blackwater River and the adjacent Errina Canal perpendicular to their alignment. It crosses over a hill (at higher elevation than the other route options) to the south of Cappavilla South, to the rear of a row of houses along the road to Garraun and Srawickeen. It crosses the lane to Cappavilla South and the Garraun Road at oblique angles, then continues south through a landscape of mid-sized fields divided by hedgerows, alongside a long, straight field boundary, passing 150m to the east of a new UL students residence complex which occupies a hill overlooking the Shannon. The route bridges the Shannon at an elbow in the river where it is flanked by a broad wet grassland strip north of the river, passing just to the west of an island in the river, arriving on a grassy south bank. Although the bridging point avoids any substantial woodland it would require a wide span at this location. The route passes through a playing field to the east of a student residence complex enclosed by a belt of woodland before entering the National Technology Park, cutting through a car park and roughly following the alignment of an existing access road to Plassey Park Road. It crosses the road beside the easternmost house of an estate that extends to the west. The route continues along an existing road along the side of E Park Industrial Estate, a cemetery across the road and between a hotel and retail centre, to arrive at Node C on the Dublin Road.

Node C's position adjacent to the National Technology Park is considered beneficial but less so than Node D since it is in a more attractive, mixed use landscape which includes a sensitive housing element. The bridging point of the Shannon is potentially more problematic than that of N – P as the river channel is wider, requiring a greater span, and is in view of two riverside students residence complexes. Therefore routes terminating at Docking Point D are generally preferred to Docking Point C. However,

the combined route X – K – L – C provides a reasonable option, ranked 5. Route X – J – L – C is ranked 9, due to its impact on Parteen.

X – J – L – M – N – P – D
X – K – L – M – N – P – D
X – K – M – N – P – D
X – K – N – P – D

N – P – D is the preferred approach to the preferred docking point, D, on the R445/Dublin Road.

The routes via Node K are preferred to those via Node J as they avoid Parteen, traversing instead a more rural landscape thus affecting fewer dwellings. X – J – L – M – N – P – D is ranked 8.

X – K – N takes the furthest route from the city, and is generally remote from houses except for a stretch near the Rosmadda and Derryfadda Roads junction, where it passes close to several houses and would require a significant re-arrangement of the road network locally. Furthermore it requires a double bridge or wide span bridge to cross the Blackwater River and the Errina Canal. X – K – N – P – D is ranked 5.
X – K – M – N takes the route most remote from dwellings, and therefore ranks highly. However, it crosses the Derryfadda bog and woodland, leading to the loss of a substantial quantity of (natural) vegetation, and cuts diagonally across the hill to cross the Derryfadda Road. X – K – M – N – P – D is ranked 2.

X – K – L – M – N takes a route relatively remote from dwellings, except where it crosses the Derryfadda Road. It avoids the bog and its fringe of woodland; however it crosses a landscape of small fields west of the bog, severing hedgerows and treelines. This vegetation does provide potential screening for the road and traffic. X – K – L – M – N – P – D is ranked 1.

X – J – L – M – N – O – E
X – K – L – M – N – O – E
X – K – M – N – O – E
X – K – N – O – E

N – O – E is the least preferred approach to the least preferred docking point, E, on the R445/Dublin Road. It affects an exclusively rural landscape, and impacts significantly on the setting and views of a cluster of houses on the Mountshannon Road, arriving at the Dublin Road at a location requiring the development of a new roundabout (as opposed to the other docking points which are at existing roundabouts). The other docking points (particularly D) present opportunities for landscape enhancement, while E would result in detrimental landscape change locally. Therefore all routes terminating at Node E rank poorly, from 9 to 15.

X – J – L – M – N – O – P – D
X – K – L - M – N – O – P – D
X – K – M – N – O – P – D
X – K – N – O – P – D

N – O – P – D is less preferable a route to docking point D (compared to N – P – D) as (a) it takes a longer route affecting a greater part of the rural landscape, (b) it requires two bridges (the second to cross the Mulkear River) and (c) it incorporates a 90 degree turn on a hilltop, generally imposing greater engineered change on the landscape. However it is preferred to routes terminating at Node E.

X – K – L – M – N – O – P – D is ranked 3 and X – K – M – N – O – P – D is ranked 4. The others are ranked 9.

Comparison No.	Nodes (Route)	Length	Rank	Notes
CN8 Rank (1-16)	X – J – B	5022m	5	A comparison is to be undertaken between all the routes in Section 2, from Node X at the Tailrace Canal to the Docking Points on the R445 with each option ranked in order of preference.
	X – J – B	4904m	16	
	X – J – L – C	6414m	9	
	X – K – L – C	6806m	5	
	X – J – L – M – N – P – D	7234m	8	
	X – K – L – M – N – P – D	7627m	1	
	X – K – M – N – P – D	7518m	2	
	X – K – N – P – D	7855m	5	
	X – J – L – M – N – O – E	7698m	15	
	X – K – L – M – N – O – E	8201m	9	
	X – K – M – N – O – E	8002m	13	
	X – K – N – O – E	8310m	13	
	X – J – L – M – N – O – P – D	7814m	9	
	X – K – L – M – N – O – P – D	8214m	3	
	X – K – M – N – O – P – D	8139m	4	
	X – K – N – O – P – D	7861m	9	

Chapter 14 Engineering Assessment

14.1 Alignment

14.1.1 General

The engineering assessments have generally been carried out based on the Ordnance Survey 1:2,500 mapping, supplemented by aerial photography. LIDAR survey which provides the level information covering the whole study area was available and a Digital Terrain Model (DTM) has been developed based on this data. Using above noted data a reasonable accurate topography of the Study Area has been developed.

14.1.2 Methodology

Each of the route corridor options has been modelled in three dimensions within the road design package MX. The route corridor modelled is based on the provisionally established road type identified in Chapter 4 with a Design Speed of 85kph.

Both horizontal and vertical alignments were developed for each route option (using the Digital Terrain Model) in order to establish an indicative footprint and indicative earthworks quantities, including depths of cuttings and heights of embankments. The horizontal and vertical alignments have been developed in accordance with the engineering parameters described in Chapter 4 with particular attention to the following:

- ***River / Water Courses Crossing***
  The Study Area contains four water courses which require crossing, which are;
  - Tailrace Canal;
  - River Blackwater;
  - Errina Canal;
  - River Shannon.

  The vertical alignment for various route corridor options has been developed to ensure that these can be crossed at appropriate elevations. Where these existing watercourses are utilised for navigation, the requirements of Waterways Ireland have been taken into consideration when developing the vertical alignment.

- ***Flood Plain***
  As the Study Area is low lying with a number of watercourses, flooding in the region is a common occurrence. The Shannon River Basin is the largest in Ireland and drains a total area of 18,000 square kilometres between its source in the Cuilcagh Mountains in Cavan and Fermanagh to Kerry Head in north Kerry. The flood events which have occurred over the years have been recorded and have been taken into consideration when developing the vertical alignment.

- ***Junctions***
  Design-related issues such as principal accessibility/interaction between the Scheme and the existing road network (in the form of a preliminary junction strategy) was developed for each option.

- ***Local Roads***
  An initial assessment of the local topography and constraints has been undertaken at each local road crossing to establish that the preliminary junction strategy can be achieved if required, or that an appropriate local diversion could be implemented.

14.1.3 Route Lengths

For the route corridor selection process the study area has been split into two sections, east and west of the Tailrace Canal.

i) ***Section 1***

Six feasible route options were identified within Section 1 of the Study Area and progressed to Stage 1: Preliminary Options Assessment of the Route Selection Process. The route options identified are outlined in Table 14.1 and shown in Volume 2 – Drawings, Drawing No. RCSR-501.

Table 14.1 – Section 1 – Route Options

No.	Route Name	Route Nodes
1	Route A1	Nodes A-F-X
2	Route A2	Nodes A-X
3	Route A2.1	Nodes A-X
4	Route A3	Nodes A-F-X
5	Route A4	Nodes A-G-H-X
6	Route A4.1	Nodes A-G-H-X

ii) ***Section 2***

Sixteen feasible route options were identified within Section 2 of the Study Area and progressed to Stage 1: Preliminary Options Assessment of the Route Selection Process. The route options identified are outlined in Table 14.2 and shown in Volume 2 – Drawings, Drawing No. RCSR-501.

Table 14.2 – Section 2 – Route Options

No.	Route Name	Route Nodes
1	Route B1	X – J - B
2	Route B2	X – J – B
3	Route B1/D1/C1	X – J – L – C
4	Route D2/Link D2 to D1/C1	X – K – L – C
5	Route B1/D1	X – J – L –M – N – P – D
6	Route D2/Link D2 to D1/D1	X – K – L –M – N – P – D
7	Route D2/D1	X – K – M – N – P -D
8	Route D2/E1/D1	X – K – N – P - D
9	Route B1/D1/E1	X – J – L – M – N – O - E
10	Route D2/Link D2 to D1/E1	X – K – L – M – N – O - E

No.	Route Name	Route Nodes
11	Route D2/D1/E1	X – K – M – N – O - E
12	Route D2/E1	X – K – N – O - E
13	Route B1/D1/Link E1 to D1/D1	X – J – L – M – N – O – P - D
14	Route D2/Link D2 to D1/D1	X – K – L – M – N – O – P - D
15	Route D2/Link D2 to D1/E1/Link E1 to D1/D1	X – K – M – N – O – P - D
16	Route D2/E1/Link E1 to D1/D1	X – K – N – O – P - D

Within each section, the route corridors have been divided into a number of links. Nodes were established where route corridors merged or diverged and at the start/end points of each Section.

Table 14.3 and Table 14.4 below lists the node links with approximate lengths (all lengths are in kilometres) which form each of the routes options developed within Sections 1 and 2.

Table 14.3 Route Lengths (Section 1)

Route / Node	A1	A2	A2.1	A3	A4	A4.1
AG	-	-	-	-	2.2	2.2
AX	-	2.4	2.5	-	-	-
AF	2.1	-	-	1.9	-	-
FX	0.9	-	-	0.9	-	-
GH	-	-	-	-	1.6	1.6
HX	-	-	-	-	0.9	0.9
TOTAL	**3.0**	**2.4**	**2.5**	**2.8**	**4.7**	**4.7**

Table 14.4 Route Lengths (Section 2)

Route / Node	B1	B1/B2	B1/D1/ C1	B1/D1	D2	Link D2 to D1	D2/E1	Link E1 to D1
XJ	1.5	1.5	1.5	1.5	-	-	-	-
JB	3.5	3.2	-	-	-	-	-	-
JL	-	-	1.8	1.8	-	-	-	-
LC	-	-	3.0	-	-	-	-	-
LM	-	-	-	1.2	-	-	-	-
MN	-	-	-	0.8	0.8	-	-	-
NP	-	-	-	1.1	-	-	-	-
PD	-	-	-	0.9	0.9	-	-	-
XK	-	-	-	-	1.6	-	1.6	-
KL	-	-	-	-	-	2.0	-	-
KM	-	-	-	-	3.1	-	-	-
KN	-	-	-	-	-	-	4.2	-

Route / Node	B1	B1/B2	B1/D1/ C1	B1/D1	D2	Link D2 to D1	D2/E1	Link E1 to D1
NO	-	-	-	-	0.9	-	0.9	-
OP	-	-	-	-	-	-	-	0.7
OE	-	-	-	-	-	-	1.5	-
TOTAL	**5.0**	**4.7**	**6.3**	**7.3**	**7.3**	**2.0**	**8.2**	**0.7**

In addition to the mainline, an allowance of 500m of local road diversion has been included for route corridor comparison purposes wherever it is anticipated that the vertical alignment of the local road will have to be amended to achieve grade separation.

14.1.4 Geometric Design

The desirable minimum design standards have been maintained for horizontal and vertical design of all route options. As outlined earlier in the Report, both the horizontal and vertical alignments developed at Route Corridor Selection Stage are indicative and further topographical surveys will be required at the preliminary design stage.

14.1.5 Junctions

For the route corridor comparison, a number of assumptions were necessary to determine the types of junctions at the intersection between the proposed Limerick Northern Distributor Road and other roads. The types of junctions assumed for the comparison are based on the following:

- The recommended junction types in TD 41-42 recommended for the proposed road cross section is as follows:
  - Roundabouts;
  - Compact grade separation;
  - Left-in/left-out;
  - In urban areas, consideration will be given to signalising the whole junction to address safety concerns;
- Requirements for connection and allowable turning manoeuvres;
- Preliminary estimates of turning traffic at the junctions.

The actual junction requirements, layouts and capacities do not form part of this Report and will be developed further during the preliminary design stage. As the proposed Limerick Northern Distributor Road is to employ at grade junctions throughout the scheme the use of roundabouts and signalised junctions will be extensively used. For the purposes of comparison between the route corridor options, the junction type used is a roundabout with all existing roads.

Table 14.5 Junction Type (Section 1)

Nodes	Section	Junction Type
AG	Tie in with LNDR Phase 1	Roundabout
	With the L-3068-0	Roundabout
	With the L-3032-24	Roundabout
AX	Tie in with LNDR Phase 1	Roundabout
	With the L-3056-16(Quinspool Road)	Roundabout
AF	Tie in with LNDR Phase 1	Roundabout
	L-3032-52 (Knockalisheen Road)	Roundabout
	With the L-3056-16(Quinspool Road)	Roundabout
FX	None	None
GH	With the L-3056-16(Quinspool Road)	Roundabout
	With the L-3056 (Meelick to Ardnacrusha)	Roundabout
HX	None	None

Table 14.6 Junction Type (Section 2)

Nodes	Section	Junction Type
XJ	With L-7058-0 (Ballykeelaun)	Roundabout
	With R464 (Parteen)	Roundabout
	With R463 (Limerick to Killaloe Road)	Roundabout
JB	With L-3062-0 (Gilloge Road)	Roundabout
	With the R445	Roundabout
JL	With L-7054-0	Roundabout
LC	With L-3062-13(Derryfada Road)	Roundabout
	With L-3062-0 (Gilloge Road)	Roundabout
	Plassey Park Road	Roundabout
	With the R445	Roundabout
LM	With L-3062-13(Derryfada Road)	Roundabout
MN	L-7052-0 (Maddens Cross)	Roundabout
NP	None	None
PD	Plassey Park Road	Roundabout
	With the R445	Roundabout
XK	With R463 (Limerick to Killaloe Road)	Roundabout
KL	With L-3058-17 (Clonlara Road)	Roundabout
	With L-7054-0	Roundabout
KM	With L-3058-17 (Clonlara Road)	Roundabout
	With L-7054-0	Roundabout
	With L-3062-13 (Derryfada Road)	Roundabout
KN	With L-3058-17 (Clonlara Road)	Roundabout

Nodes	Section	Junction Type
	With L-7054-0	Roundabout
	With L-3062-13 (Derryfada Road)	Roundabout
	With L-70481-0 (Cappavilla)	Roundabout
NO	With E1 to D1*	Roundabout
OP	With E1 to D1*	Roundabout
	Plassey Park Road	Roundabout
OE	LS 5006 (Mountshannon Road)	Roundabout
	With the R445	Roundabout

* Roundabout required if link (E1 to D1) with Plassey Park Road is constructed

14.1.6 Service Roads

Service roads have been considered where the access of private property will be extinguished. In general for all off-line route corridors, service roads equal to the length of the mainline have been assumed for comparison purposes.

14.1.7 Overbridge/Underbridge on Local Roads

An initial assessment has been carried out of the crossings with other local roads. Grade separated structures in the form of overbridge / underbridge will be considered at a number of locations at preliminary design stage inclusive of the following local road crossings:

- L-7058-0 (Ballykeelaun);
- L-7054-0;
- L-3062-13 (Derryfada Road);
- LS 5006 (Mountshannon Road).

14.2 Drainage

Based on the design criteria as described in Chapter 4, all the route corridor options are assessed for road drainage, outfall and river / stream crossings. All route corridor options are feasible and drainage does not pose any major constraints on the route corridor options.

14.3 Earthworks

The Study Area has a predominantly low lying undulating topography. This low lying topography is subject to severe flooding as the lower River Shannon traverses the Study Area. The preliminary vertical alignments were developed for each route options were developed to be above the recently recorded 2009 flooding event.

For the purpose of comparing the cut and fill quantities, each route corridor has been assessed within the MX design model. A preliminary vertical alignment has been designed for each route corridor using the parameters as described in Chapter 4 and with consideration of streams and road crossings. The interface of the preliminary vertical alignments and the digital terrain model has been examined and a bulk earthwork output has been measured. The analysis shows a maximum depth of cutting of 10m and maximum height of fill of approximately 10m.

As described in Chapter 15, there is a significant amount of soft ground of varying depths along the different sections of the study area. It is anticipated that major ground improvements will be necessary prior to road construction. It is assumed that a portion of this soft ground will be replaced by good quality material. A rough estimation of the import material required has been carried out.

Table 14.7 Earthworks

Section	Route Corridor	Max Depth/Height (m)		Quantities		Surplus / Deficit (+/-) (Fill – Cut)	Sum Total of Earthworks (Fill + Cut)
		Cut	Fill	Cut	Fill		
1	A1	7.0	7.5	34,200	397,800	363,600	432,000
	A2.1	7.0	7.0	2,592	257,255	254,663	259,847
	A4	8.0	15.0	221,596	395,380	173,784	616,976
2	B1	7.0	5.0	181,631	271,464	89,833	453,095
	D1	7.0	6.0	248,771	462,035	213,264	710,806
	E1	6.0	7.0	82,967	726,542	643,575	809,509

14.4 Utilities

During the Constraints gathering exercise, all of the major service providers were contacted in order to establish the utility constraints along different route corridors within the Study Area. The major services identified within the study area to date are ESB Network, Water Main, Bord Gais, Eircom, UPC, BT and other utility providers (refer to Volume 2 - Drawings RCSR-1403 to RCSR - 1408).

14.4.1 ESB Network

There are a number of substations in the study area where up to 110kv over head power lines originate and run in every direction throughout the Study Area. These are shown in Volume-2 Drawing RCSR-1405 to 1406.

These 110kv lines cross the route corridors at different locations and also run parallel along different routes. These are presented in Table 14.8.

Table 14.8 Crossing of 110kv Lines

Route	Crossing Locations	Running Parallel
B1	Two crossings located at the townlands of Ballykeelaun and Clooncarhy	Running parallel for a length of 3500m and runs through the townlands of Parteen and Clooncarhy.
B2	Two crossings located at the townlands of Ballykeelaun and Cloonoughter	Runs parallel for 1000m in the townland of Shanakyle
C1	Two crossings located at the townlands of Ballykeelaun and Cloonoughter	Runs parallel for 1000m in the townland of Shanakyle
D1	Two crossings located at the townlands of Ballykeelaun and Cloonoughter	Runs parallel for 1000m in the townland of Shanakyle

Route	Crossing Locations	Running Parallel
D2	One crossing is located at the townland of Ballykeelaun	Not Applicable
E1	One crossing is located at the townland of Ballykeelaun	Not Applicable

14.4.2 Bord Gáis Network

There are a number of gas mains running along the throughout the Study Area. These generally run adjacent to local, regional and national roads. These are shown in Volume-2 Drawing RCSR-1403 to 1404.

The Bord Gáis network which is present in the Study Area and which affects the various Route Corridor Options and are listed in Table 14.9.

Table 14.9(i) Bord Gáis Network (Section 1)

Route	Crossing Locations (Townland and Road)	Running Parallel
A1	Quinspool North on the L-3056-16	Not Applicable
A4	Mountgordan on the L-3068-0	Not Applicable
A4.1	Ballycannon on the L-7062-44	Not Applicable

Table 14.9(ii) Bord Gáis Network (Section 2)

Route	Crossing Locations (Townland and Road)	Running Parallel
B1	Parteen on the L-3058-17, Knockballynameth on the R463, Knockroe on the L-3062-0, Reboge on the Plassey Park Road	Not Applicable
B2	Parteen on the L-3058-17, Knockballynameth on the R463, Knockroe on the L-3062-0, Reboge on the Plassey Park Road	Not Applicable
C1	Parteen on the L-3058-17, Knockballynameth on the R463 and Castletroy on the Plassey Park Road	Not Applicable
D1	Parteen on the L-3058-17 and Knockballynameth on the R463	Runs parallel for approximately 500m in the townland of Castletroy on the Plassey Park Road
D2	Rosmadda West on the R463	Runs parallel for approximately 500m in the townland of Castletroy on the Plassey Park Road
E1	Rosmadda West on the R463, Mountshannon on the LS-5006 and Garraunykee on the R445	Not Applicable

14.4.3 Water Services

There are a number of water mains and foul sewers within the Study Area. These generally run adjacent to local, regional and national roads. These service the localities

near the route corridors. They are presented on Volume-2 Drawings RCSR-1402 to 1403. In general there are very minimal impacts on the routes and minor re-routing would be sufficient at most locations. The water services affected on the route corridors are listed in Table 14.10.

Table 14.10(i) Water Services (Section 1)

Route	Water Main	Group Water Schemes	Combined Sewer
A1	Water main runs parallel on the route corridor for approximately 400m on the L-3032-52. Water main crosses route corridor option in the townland of Quinspool North	A group water scheme water main crosses route corridor option in the townland of Quinspool North	Not Applicable
A2	Water main crosses the route corridor at node A and a water main crosses the route corridor option in the townland of Quinspool North	A group water scheme water main crosses route corridor option in the townland of Quinspool North	Not Applicable
A2.1	Water main crosses the route corridor at node A.	A group water scheme water main crosses route corridor option in the townland of Quinspool North	Not Applicable
A3	Water main crosses the route corridor at tie in with L-3032-52 and a water main crosses the route corridor at Knockalisheen	A group water scheme water main crosses route corridor option in the townland of Quinspool North	Not Applicable
A4	Water main runs parallel on the route corridor for approximately 1300m on the L-3032-52. A water main crosses the route corridor at Mountgordan.	A group water scheme water main crosses route corridor option in the townland of Ballycannan	Not Applicable
A4.1	Water main runs parallel on the route corridor for approximately 1300m on the L-3032-52. A water main crosses the route corridor at Mountgordan.	A group water scheme water main crosses route corridor option in the townland of Ballycannan	Not Applicable

Table 14.10(ii) Water Services (Section 2)

Route	Water Main	Group Water Schemes	Combined Sewer
B1	Water main crosses the route corridor in the townland of Gortatogher on the L-3058-17 and on the R463.	Two group water scheme water mains crosses the route corridor option in the townland of Cloonoughter	Existing combined sewer within the corridor for a distance of 600m
B2	Water main crosses the route corridor in the townland of Gortatogher on the L-3058-17 and on the R463.	Two group water scheme water mains crosses the route corridor option in the townland of Cloonoughter and one group water scheme crosses the route in the townland of knockroe	Existing combined sewer within the corridor for a distance of 980m
C1	Water main crosses the route corridor in the townland of Gortatogher on the L-3058-17 and on the R463.	A group water scheme water main crosses the route corridor option in the townland of Cloonoughter and two group water schemes cross the route in the townland of Derryfadda. A group water scheme crosses the scheme in Tobermochulla	Existing combined sewer within the corridor for a distance of 600m in the National Technology Park with an additional 450m impacted at the proposed docking point
D1	Water main crosses the route corridor in the townland of Gortatogher on the L-3058-17 and on the R463.	Two group water schemes cross the route in the townland of Derryfadda and a group water scheme crosses the route in the townland of Srawickeen.	Existing combined sewer crosses the route corridor in the National Technology Park with an additional 450m impacted at the proposed docking point
D2	A water main crosses the route corridor in the townland of Rosmadda West on the R463 and a water main also crosses the corridor in the townland of Derryfadda	A group water scheme water main crosses the route corridor option in the townland of Srawickeen	Extent of impact on the existing combined sewer in the National Technological Park is subject to docking point. Refer comments for Docking Points C, D & E.
E1	A water main crosses the route corridor in the townland of Rosmadda West on the R463 and a water main also crosses the corridor in the townland of Derryfadda	Not Applicable	Existing combined sewer crosses the route corridor within the Mountshannon area.

14.4.4 Telecoms and Broadband

There are a number of telecom and broadband within the Study Area. These generally run adjacent to local, regional and national roads. These service the localities near the route corridors. They are presented on Volume-2 Drawings RCSR-1402 to 1403. In general there are very minimal impacts on the routes and minor re-routing would be sufficient at most locations. The telecom and broadband utilities affected on the route corridors are listed in Table 14.11.

Table 14.11(i) Telecom/Broadband Services (Section 1)

Route	Telecoms	Broadband
A1	Eircom infrastructure runs parallel on the route corridor for approximately 350m on the L-3032-52.	Not Applicable
A2	Eircom infrastructure crosses the route corridor at node A	Not Applicable
A2.1	Not Applicable	Not Applicable
A3	Eircom infrastructure crosses the route corridor at tie in with L-3032-52	Not Applicable
A4	Eircom infrastructure runs parallel on the route corridor for approximately 1300m on the L-3032-52 and the route corridor also crosses an Eircom duct in the townland Castlebank	Not Applicable
A4.1	Eircom infrastructure runs parallel on the route corridor for approximately 1300m on the L-3032-52	Not Applicable

Table 14.11(ii) Telecom/Broadband Services (Section 2)

Route	Telecoms	Broadband
B1	Eircom infrastructure crosses the route corridor in the townland of Gortatogher on the R463. The route also crosses Eircom equipment on Plassey Park Road at the tie in with the R445	The route corridor crosses a fibre optic cable and UPC infrastructure on Plassey Park Road at the tie in with the R445
B2	Eircom infrastructure crosses the route corridor in the townland of Gortatogher on the R463. The route also crosses Eircom equipment on Plassey Park Road at the tie in with the R445	The route corridor crosses a fibre optic cable and UPC infrastructure on Plassey Park Road at the tie in with the R445
C1	Eircom infrastructure crosses the route corridor in the townland of Gortatogher on the R463. The route crosses an Eircom duct on the L-3062-13	BT infrastructure crosses the route corridor in the townland of Castletroy on the Plassey Park Road.
D1	Eircom infrastructure crosses the route corridor in the townland of Gortatogher on the R463. The route crosses an Eircom duct on the L-3062-13 the route corridor also crosses Eircom ducts in the townland of Srawickeen on the L-7052-0	The Route corridor also runs directly over BT and fibre optic cable for approximately 900m
D2	Eircom infrastructure crosses the route corridor in the following locations; Ballykeelaun on the L-7058-0, Rosmadda West on the R463, Rosmadda East on the L-3058-17, Derryfadda on the L-3062-13 and Srawickeen on the L-7052-0	The Route corridor also runs directly over BT and fibre optic cable for approximately 900m
D2 to D1	Eircom infrastructure crosses the route corridor in Rosmadda East on the L-3058-17 and on the L-7054-0	Not Applicable
E1	Eircom infrastructure crosses the route corridor in the following locations; Ballykeelaun on the L-7058, Rosmadda West on the R463, Rosmadda East on the L-3058-17 and the L-3062-13, Cappavilla North on the L-70481-0 and adjacent to the tie in with the R445	The Route corridor also crosses a fibre optic cable at the tie in with the R445

14.5 Cost Estimation

14.5.1 General

For the Route Corridor Selection Phase of this scheme a Point Cost Estimate is required for each of the route corridor options and parts thereof in accordance with the NRA Cost Management Manual.

For the purposes of this estimate, the point estimate requires that costs are allocated to each of the Route Corridor options under the seven headings described in Table 14.12.

Table 14.12 Cost Headings

A.	**Planning & Design**
B.	**Land & Property**
C.	**Archaeology** (13.5% VAT Investigation and On Site Resolution and 21.5% VAT for reporting and Post Ex)
D.	**Advance Works and Other Contracts**
E.	**Main Contract Construction**
F.	**Main Contract Supervision** (Employer's costs)
G.	**Residual Network**

The total of these seven elements gives the total for each option being considered in the route corridor selection. Under the NRA Cost Management Manual, this is known as the Option Comparison Estimate (OCE) – Phase 3. This estimate type is required to undertake and complete the Cost Benefit Analysis (COBA) for the considered options. All final costs for each of the points and the final estimate are inclusive of VAT.

14.5.2 Planning and Design

The rate for planning and design is based on a total estimate cost of € 3.75 Million excluding VAT for the scheme with an estimate length of 15km – taking into account junctions and link roads.

This gives an estimate cost of €0.25 Million per km.

14.5.3 Land & Property

Land

Land costs have been estimated at a rate per hectare. The area of land required on each off-line route has been calculated by measuring the area of footprint of the road and then a 15m strip of land has been added to it for the full length for maintenance corridor, drainage & other road works etc. On the online routes a 10m strip of land has been measured for the full length of the routes. Another 50 percent of over all land requirement also been added to each route for junctions, Junctions and side roads & access roads.

For the zoned land Clare County Council's Land Valuer has been consulted and the valuation is listed below in Table 14.13.

Table 14.13 Zoned Land Cost

Land Category	Cost Per Hectare (€)
Agriculture	€37,065.00
Leisure & Tourism	€370,650.00
Mixed Residential & Commercial	€555,975.00
Public Utility	€61,775.00
University zoned lands	€494,200.00
Recreation & Amenity	€61,775.00
Business Enterprise Park / Light Industry	€308,875.00
Industrial	€247,100.00
Transitional Agriculture	€308,875.00
Commercial Property	€617,750.00

Zoned land through the Study Area is shown in Volume-2 Drawing RCSR-701 and RCSR-702.

Property

For the purposes of the cost estimation, costs for acquisition of houses have been averaged at €0.3 Million per property.

Severance, Injurious Affection, Disturbance, Reinvestment Costs

Severance, Injurious Affection, Disturbance, Reinvestment Costs has been considered as €60,000 per hectare.

14.5.4 Archaeology

Archaeological Investigation with follow-on Resolution and Post Excavation reporting works will be required. The value for the entire archaeological works is estimated at €3 Million for the entire works while VAT rates are at 13.5% for On-site works and 21.5% for reporting and specialist examinations.

The estimate cost is €0.2 Million per km.

14.5.5 Advance Works and Other Contracts

Advance works are likely to include hedgerow clearance and preliminary fencing contracts as well as service relocation works to enable advancement of the main works contracts. Detailed and supplementary ground investigation contracts for the design and build tenderers may also be required. These works are estimated at €0.08 Million per km.

Other than the above a separate item for relocating ESB pylons has been assumed as follows.

- 100 kv pylons are estimated at €0.5 Million each;
- 38 kv pylons are estimated at €0.2 Million each.

14.5.6 Main Contract Construction

The main construction costs are built up from the following elements:

- Length of Mainline:
  - Lengths of mainline / link roads;
  - Lengths of online upgrading and widening along the existing local roads.
- Lengths of side roads;
- General Structures, overbridges, underbridges, river and canal bridges;
- Junctions – roundabouts;
- Other costs.

A summary of the rates for each element is given in Table 14.14.

Table 14.14 Base Rates for Main Contract Construction (excluding VAT)

Item	Unit	Rate	Notes
Distributor Road	km	€2.90M	Assumes average 4m earthworks height
Online Widening to Type 2 Dual Carriageway	km	€1.45M	Assume approximately 50% full costs
Side Roads	km	€0.80M	
Roundabout on Type 2 Dual	No.	€1.50M	Assuming 100m Inscribed Circle Diameter (ICD) and free flow slips
Underbridge/Overbridge	No.	€0.91M	
Earthwork	Cu M	€12.50	

Mainline

The cost of the mainline has been calculated as a rate per kilometre for the route corridor being considered and the road type being considered. This rate comprises all the costs including preliminary items for the construction of the road and actual items required including; site clearance, earthworks, pavement and surfacing, culverts, drainage, barriers, fencing, signage, communication, ducting lighting, landscaping, accommodation works and other ancillary items.

For online sections of the mainline, it is proposed that costs per kilometre for the length of carriageway are reduced by 50% from the normal rates. This is based on 25% of the normal required earthworks, 50% of the normal pavement and 100% of the normal drainage.

Side Roads

Similarly for the side roads a rate per kilometre for each side road diversion has been applied. In general a road construction of 500m length with reduced single carriageway cross-section has been considered at each underbridge / overbridge location.

Junctions

For each roundabout a base cost for the junction has been applied.

Structures

For the general structures, overbridges, underbridges and river bridges an average base cost per structure has been applied for the estimate. In the case of the Shannon Crossing the cost of the bridge includes for appropriate approach viaducts over the flood plain. Refer to the Table 14.15 for details of the bridge costs.

Table 14.15 Bridge Costs

Bridges	Cost
Shannon Crossing	€52.84M
Tailrace Canal Crossing	€2.00M
Errina Canal and River Blackwater Crossing	€2.00M
Underbridge/Overbridge	€0.91M
Pedestrian Bridge	€1.50M

Adjustment for Earthworks

For the earthworks it has been assumed, in the cost estimate for the lengths of mainline, that the average earthworks height will vary between 4m of cut and fill. This cost of earthworks is covered in mainline road construction cost. However an estimation of earthworks has been carried out using MX Software and an adjustment on earthworks has been applied along all routes. For the purpose of cost estimation a rate of €12.50 per Cu M. has been applied for earthworks.

14.5.7 Main Contract Supervision

Site Supervision is estimated at €3 million for each of the route corridors considered. This includes Project Administration costs, Liaison Engineer costs and Resident Engineer costs.
The estimate cost is €0.20 Million per km.

14.5.8 Residual Network

At the route corridor selection stage the costs for the residual network are expected to entail the costs of repairing and upgrading existing local and regional roads where local traffic could be diverted along once the proposed LNDR is completed. Further analysis of the residual network may be required at preliminary design stage once the junction location and strategies are addressed.

These works are estimated €0.08 Million per km.

14.5.9 Point Estimates for Individual Route Corridors

For the purpose of the cost estimation, the cost of each sub-route within the two sections was calculated separately. The cost of each sub-route was estimated by applying the individual costs element for each of the seven cost headings. A factor for contingencies was also been taken in to consideration under each of the seven cost headings.

The costs for the sub-routes of each section along with the elements comprising the total costs are presented in Table 14.16 and Table 14.17.

Table 14.16 Route Corridor Selection Stage Costing (Point Estimate)

Route	Length of Mainline	Planning and Design	Land Costs		Property Cost		Archaeology	Advance Works	Construction Cost												Construction Costs	Site Supervision	Residual Network	Overall Cost
									Type 2 Dual Offline	Online Upgrade	R445 Upgrade	Side Road	Shannon Bridge	Other River / Canal Bridges	Railway Level Crossing	Pedestrian Overbridge	Grade Separated Junction	Roundabouts	Underbridges / Overbridges	Adjustment for Earthworks on Mainline				
	km	€ (Mil)	Ha.	€ (Mil)	No.	€ (Mil)	€ (Mil)	€ (Mil)	km	km	km	km	No.	No.	No.	No.	No.	No.	No.	Cum	€ (Mil)	€ (Mil)	€ (Mil)	€ (Mil)
Section 1																								
Route Option A1 (A-F-X)	3.08	0.77	29	3.9	3.00	0.90	0.73	0.65	2.74	0.34	0.00	0.00	0.00	1.00	0.00	0.00	0.00	3.00	3.00	134374.00	19.85	0.25	0.25	27.30
Route Option A2.1 (A-X)	2.45	0.62	20	4.67	2.00	0.60	0.58	0.80	2.45	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	2.00	3.00	49401.00	15.94	0.25	0.20	23.65
Route Option A4 (A-G-H-X)	4.70	1.18	38	4.12	12.00	3.60	1.11	1.98	3.38	1.32	0.00	1.00	0.00	1.00	0.00	0.00	0.00	3.00	5.00	62259.00	24.85	0.25	0.38	37.47
Route Option A4.1 (A-G-H-X)	4.59	1.15	36	3.94	12.00	3.60	1.09	1.77	3.27	1.32	0.00	1.00	0.00	1.00	0.00	0.00	0.00	3.00	4.00	62259.00	22.84	0.25	0.37	35.01
Section 2																								
Route Option B1 (X-J-B-E)	5.02	1.26	40	4.53	4.00	1.20	1.19	2.70	5.02	0.00	4.00	0.00	1.00	0.00	0.00	1.00	0.00	5.00	1.00	-348877.00	84.95	0.25	0.40	96.48
Route Option B1/B2 (X-J-B-E)	4.90	1.23	45	5.50	4.00	1.20	1.16	3.89	4.90	0.00	4.00	0.00	1.00	0.00	0.00	1.00	0.00	5.00	1.00	-348877.00	84.61	0.25	0.39	98.23
Route Option B1/D1/E1 (X-J-L-M-N-O-E)	7.70	1.92	56	5.73	7.00	2.10	1.82	5.02	7.70	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	7.00	5.00	-472992.00	86.80	0.25	0.62	104.26

Table 14.17 Base Cost Broken down into the Seven Expenditure Headings for Each Route Option

Route Number	1	2	3	4	5	6
Route Name	A2.1 - B1	A1 - B1	A2.1 - D1 - E1	A1 - D1 - E1	A2.1 - D2 - Link D2 to D1 - D1 - E1	A1 - D2 - Link D2 to D1 - D1 - E2
Route Nodes	A-X-J-B	A-F-X-J-B	A-X-J-L-M-N-O-E	A-F-X-J-L-M-N-O-E	A-X-G-L-M-N-O-E	A-F-X-G-L-M-N-O-E
Main Contract Construction	100.89	104.80	102.54	106.45	98.70	103.13
Main Contract Supervision	0.50	0.50	0.50	0.50	0.50	0.50
Archaeology	1.77	1.92	2.40	2.55	2.51	2.65
Advance Works and other contracts	3.50	3.35	5.82	5.67	5.16	4.99
Residual Network	0.60	0.65	0.82	0.87	0.96	1.02
Land & Property	10.99	9.62	13.10	11.73	13.63	13.15
Planning and Design	1.87	2.03	2.53	2.69	3.23	3.43
Total (€m)	**120.12**	**122.87**	**127.71**	**130.46**	**124.69**	**128.87**

Chapter 15 Geology, Hydrology & Hydrogeology

15.1 Introduction

This section of the report describes the geology, hydrology and hydrogeology along the route corridors and considers how they contribute to the selection of an emerging preferred route corridor.

15.2 Geology

15.2.1 Introduction

The Limerick Northern Distributor Road is to be developed to provide a local distributor road along the northern fringe of Limerick City from the western residential areas at Knockalisheen to potential tie-in at the R445 (Old N7). The Route Corridor selection for the Scheme, Section 1 originates at Docking Point A along the Knockalisheen Road, northwest of Limerick City and terminates at node X along the Ardnacrusha Tail Race Canal. Within Section 1 there are 6 principle route corridor options. Section 2 originates at node X, along the Tail Race Canal and terminates at a number of possible locations along the R445, the old N7 east of Limerick City. Section 2 compromises of 6 route corridor options. The route corridor options are described in Chapter 5 and can be seen on Drawing RCSR 501-503. These route corridor options were reduced in number to a total of 3 corridors in Section 1 and three route corridor options in Section 2. The reasoning behind this reduction is clarified earlier in this report.

15.2.2 Methodology & Data Sources

In preparation of the Route Corridor Selection Report, the geological, hydrological and hydrogeological impacts of all the route corridor options (Section 1) A1, A2.1 and A4 and the route corridor options (Section 2) B1, D1 and E1 were assessed and reported in general accordance with the NRA Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, Chapter 4.

The majority of the data was collected and assessed in the form of a desk study of available published information from the sources listed at the end of this chapter together with additional sources of information included as references. Additional information from borehole logs were assessed alongside the details gathered from the desk study. Borehole information was available for several sites in and around the Study Area, giving general information on depth to bedrock and bedrock type.

A site reconnaissance was made by Roughan and O'Donovan Consulting Engineers staff on Tuesday 9th November 2010 to identify any particular constraints evident in the study area.

A Preliminary Ground Investigation contract was also undertaken to identify the range of conditions present in several key areas of geotechnical and strategic interest on each of the route options. Further site visits were made during these works, supervised by Roughan and O'Donovan Consulting Engineers and MRG Consulting Engineers.

15.2.3 Solid Geology, Subsoils and Soils

The Geological Survey of Ireland (GSI) has detailed maps showing the various ground conditions that exist around the country. From these maps and reports it can be determined what existing ground conditions exist in the study area. Areas of solid geology, subsoil's and soils which are located in the region can be seen in drawings RCSR-1501 & RCSR-1502, which also shows each of the route options considered.

The following sections describe the ground conditions assumed / encountered along each route corridor option and a brief assessment of the associated geotechnical issues.

Solid Geology

A summary of the geological sequence and main rock types likely to be encountered along the route from southeast to west are shown in Table 15.1. These are based on the available information on the 1:100,000 scale Geological Survey of Ireland map of the area (Sheet 17 Bedrock Geology Map Series for the Shannon Estuary (1999)).

Table 15.1: Geological formations occurring in the Study Area

PERIOD	FORMATION	ROCK TYPES	EXCAVAT-ABILITY	CUTTING STABILITY
Devonian/ Carboniferous	Tuff	Igneous tuff	Generally rippable	Generally stable
Carboniferous (Dinantian)	Waulsortian Limestone	Pale grey massive unbedded biomicrite Wackestone	Generally rippable	Generally stable, dip 5° to 25° syncline WSW to ENE
Carboniferous (Dinantian)	Lough Gur Limestone	Dark grey to black cherty argillaceous Wackestone	Generally rippable	Generally stable, dip 5° to 20° syncline WSW to ENE
Carboniferous (Dinantian)	Visean Limestone	(*undifferentiated*) Dark grey to black thinly bedded cherty argillaceous Wackestone and Packstone	Generally rippable	Generally stable, dip 5° to 20° syncline WSW to ENE
Carboniferous (Dinantian)	Volcani-clastic	(*undifferentiated*) Igneous breccia or conglomerate with ashy limestone to limestone ash, grit, slate and chert	Generally rippable	Generally stable, dip <15° to S/SW
Carboniferous (Dinantian)	Lower Limestone Shales	Calcareous shales with fine-grained sandstone, siltstone, mudstone and bioclastic limestone	Generally rippable	Generally stable
Devonian/ Carboniferous	Old Red Sandstone	Yellow to brown coarse-grained sandstone pebbly sandstone and conglomerate	Generally rippable	Generally stable, dip <30°

The site is shown to be underlain by undifferentiated limestone (VIS) of Visean, Carboniferous Age. Some of these rocks are non-argillaceous and should meet the NRA specifications for use in road projects. Rock outcrops and subcrops are recorded by the GSI in several locations within the Study Area. These include:

1) Between Ballyvollane/Mountshannon;

2) Prospect;

3) Along the River Blackwater between Cappavilla South and Ginoge;
4) Parteen/Quinspool;
5) From Quinspool South to Ballynanty;
6) Ballycannan.

The following sections describe the bedrock formations assumed / encountered along each route corridor option and a brief assessment of the associated geotechnical issues. Rock coring in boreholes is assumed to be indicative of general rock conditions throughout each of the bedrock formations. Certain formations are more likely to have variable profiles and conditions, such as the Waulsortian Limestone for instance, which is present at the proposed Tailrace Crossing for all routes.

Section 1

Route A1

Route A1 corridor starts in an area underlain by Visean Limestone, then crosses the Lough Gur Formation for a short length, before passing into an area of Waulsortian Limestone. Variable rockhead depth and conditions are anticipated, with shallow rock only expected close to the Tailrace Crossing.

Route A2.1

Route A2.1 corridor is predominantly underlain by Visean Limestone, but crosses into the Lough Gur and Waulsortian Limestones for considerable lengths before reaching the Tailrace Crossing. Variable rockhead depth and conditions are anticipated, with shallow rock only expected close to the Tailrace Crossing.

Route A4

Route A4 corridor is in an area underlain entirely by Waulsortian Limestone with variable rockhead and shallow rock expected in several locations. Cuts in rock are therefore likely to be encountered, with favourable dip/strike conditions on one side of the road, and unfavourable anticipated on the other side. This has not yet been proven by coring.

Section 2

Route B1

Route B1 corridor starts in an area of Waulsortian Limestone, then crosses the Lough Gur Formation for a short length, with the majority of its length underlain by Visean Limestone. Rockhead is typically 10m or more below ground level, with poor core recovery obtained from weathered rock near the River Shannon. At the southern tie-in it enters an area where volcaniclastic bedrock is present and rockhead is at shallow depth.

Route D1

Similar to the Route B1 corridor, Route D1 corridor starts in an area of Waulsortian Limestone, then crosses the Lough Gur Formation for a short length, with the majority of its length underlain by Visean Limestone. The Visean Limestone rockhead is shallow near Derryfadda/Cappavilla South, although it is typically 10m to 15m below ground level elsewhere. Rock cores obtained near the River Shannon proved comparatively good, with better recovery, strength and weathering characteristics evident.

Route E1

Route E1 corridor covers a significant areas of ground underlain by each of the Waulsortian Limestone, Lough Gur Formation and Visean Limestone Formations, with more frequent changes. Shallow rock is expected in several areas based on aquifer vulnerability mapping. Rockhead is typically 10m to 15m below ground level elsewhere. Rock cores obtained near the River Shannon proved comparatively good, with better recovery, strength and weathering characteristics evident.

Table 15.2: Geological formations occurring in the Study Area

Section	Route Option	Bedrock Formation Encountered	Depths proven by Rotary Coring	Comments / Reference
1	A1	Visean Limestone	Rockhead at 13.5m, cored to 18.5m	RC103
		Lough Gur Limestone	N/A	
		Waulsortian Limestone	Rockhead at 11.6m, cored to 20.2m	RC105A
	A2.1	Visean Limestone	Rockhead at 18m, cored to 23m	Moderately weathered, RC102
		Lough Gur Limestone	N/A	
		Waulsortian Limestone	Rockhead at 11.6m, cored to 20.2m	RC105A
	A4	Visean Limestone	N/A	
		Lough Gur Limestone	N/A	
		Waulsortian Limestone	Rockhead at 11.6m, cored to 20.2m	RC105A
2	B1	Visean Limestone		Poor core recovery in weathered rock, RC110
		Lough Gur Limestone	N/A	
		Volcaniclastic	N/A	
	D1	Visean Limestone	Rockhead at 2.6m, cored to 13.0m Rockhead at 14.7m, cored to 25.0m	RC111 Comparatively good rock core obtained, with some clay infilling RC116
		Lough Gur Limestone	N/A	
	E1	Visean Limestone	Rockhead at 14.7m, cored to 25.0m	Comparatively good rock core obtained, with some clay

Section	Route Option	Bedrock Formation Encountered	Depths proven by Rotary Coring	Comments / Reference
				infilling RC116
		Lough Gur Limestone	N/A	
		Waulsortian Limestone	N/A	

Soils and Subsoils

Information on the subsoil/Quaternary geology of the Study Area has been obtained from the GSI and EPA websites. Where available, these are shown in **Volume 2 on Drawings RCSR-1501 and RCSR-1502.**

Glacial Deposits

Glacial deposits range from sandy gravelly clay to sands and gravels based on GSI data and information from nearby sites. These deposits do not pose a problem for road construction and for engineering purposes these deposits can be divided into glacial till (fine grained) and glacial till (coarse grained).

Glacial Till (Fine Grained)

Fine grained glacial tills dominate much of the Study Area.

The depth of the fine grained till occurring within the Study Area is not known and is likely to vary considerably between 0 and 10m below ground level.

The geotechnical properties of Irish glacial tills are well documented (Hanrahan, 1997). These soils are generally well graded, variable with gravel lenses, with an absence of clay minerals. The clay fraction typically consists of rock flour, with fines fraction (clay and silt) amounting from about 15% up to about 50%. The glacial tills are generally over-consolidated and therefore possess low compressibility. These soils are usually firm to stiff, however due to their low plasticity, they are very susceptible to softening and deterioration in wet weather, especially if heavily trafficked. When the clayey tills are kept dry, they present relatively little difficulty to road construction.

Glacial Till (Coarse Grained)

Glacio-fluvial deposits of gravels may be present within the Study Area.

Gravel materials do not present problems for road construction, provided the road alignment is kept above the water table. Generally, gravels provide good formation for pavement construction and are generally suitable for reuse. Water bearing sand and silt layers, where encountered, can be problematic.

Soft Ground

More recent deposits include soft marine estuarine and lacustrine silts and clays, fen and cutover peats and alluvium. Construction in soft ground may be difficult due to the presence of groundwater and the limited bearing capacity of these soils to accommodate surcharge loading. Existing ground surface is quite often well below the level required for road design.

Engineering design of road embankments through soft ground, although not desirable, is generally feasible where soil thicknesses are modest. To accommodate

road embankments and suitable pavement, the excavation and replacement of soft soils, ground improvement or piled load transfer platforms are required. Also, the NRA specification places limits on settlements experienced by the constructed roadway in its design life. There are implications on design, programme and cost to meet these requirements, if construction passes through large or deep areas of soft ground. The rate of construction can be affected and environmental impacts are increased. The identification and sufficient investigation of soft ground early in the route selection process is advised.

The following sections describe the soft soils present in the Study Area, based on desk study and previous project experience.

Marine Estuarine Silts and Clays

Marine estuarine sediments have been deposited at various locations along existing and former estuarine grounds close to the River Shannon. These deposits are typically high plasticity silts and clays and may have an amount of organic content. They typically consist of normally or slightly over consolidated silt and clays or marine sands.

Lake Sediments

Lake sediments are associated with former basins and channels close to the River Shannon. These deposits are typically high plasticity silts and clays and may have an amount of organic content. They typically consist of normally or slightly over consolidated silt and clays or fluvial sands and gravels.

Alluvium

Alluvial deposits are associated with the River Shannon, its tributaries and streams, primarily the River Blackwater. These deposits are typically high plasticity silts and clays and may have an amount of organic content. They typically consist of normally or slightly over consolidated silt and clays or fluvial sands and gravels.

Peat deposits

Peat soils are naturally transitional, forming from waterlogged vegetation and consequently influencing the habitat as its geochemistry and moisture contents evolve. They are highly organic due to the accumulation and decay of vegetation over time through humification. The mass characteristics and presence of fibres, sands, silts or clays can strongly influence their engineering properties but they are generally low in strength. They are typically highly plastic, settling considerably if subject to surcharge loading.

Fen peat is present as marsh-like conditions, normally high in nutrient content, and comes about from surface water and percolating groundwater.

Cutover peat is what remains following extraction of peat fuel for human use. This would normally have been limited by thickness and water levels, although drainage measures may have been provided to optimise their removal. Thickness of peat in these areas is generally less than 1.5m.

The following Table 15.3 gives a brief summary of the type and depths of soft ground that were encountered during Preliminary Ground Investigation in 2011. The areas are identified by both the townland names.

Table 15.3 Summary of Soft Ground Conditions

Section	Route Corridor	Node	Length & Soil Type	Depths Proven (m)			Townland
				Min	Max	Avg	
1	A1	A-F	590m MEsc	1.0m	2.0m	1.5m	Quinspool
	A2.1	A-X	610m MEsc	0.8m	3.3m	1.6m	Quinspool/ Castlebank
	A4	A-G	180m Alluvium	No information available			Gortgarraun
2	B1	X-J	280m MEsc	No information available			Gortatogher
		J-B	2725m MEsc	0.5m	8.0m	2.8m	Cloonougher /Clooncarhy
	D1	J-L	260m MEsc	No information available			Cloonougher
		N-P	380m MEsc	No information available			Castletroy
			785m Alluvium	1.0m	3.2m	2.1m	
	E1	G-N	650m Alluvium	0.4m	1.3m	0.9m	Rosmadda
			325m MEsc	No information available			Cappavilla North
			760m MEsc	1.8m	3.9m	2.5m	Cappavilla South
		N-O	550m MEsc	4.0m	6.8m	5.0m	Srawickeeen

The following paragraphs outline in more descriptive detail the soft ground conditions assessed by these investigations and the implications of the conditions summarised in Table 15.3 as they affect each route option.

Section 1

Route Corridor Option A1

From Dynamic Probe in-situ tests carried out at Quinspool it was determined that an average depth of 1.5m was measured for marine estuarine sediments. Due to the small depth, removing the soft soil and replacing with a more stable soil may be the most simple solution, although this could potentially be avoided if alternative local ground improvement methods are suitable. BH103 and BH105 indicate generally firm soils, which can be left in place locally.

Route Corridor Option A2.1

Route Corridor Option A2.1 passes through approximately 600m of marine estuarine sediments in which Dynamic Probe in-situ testing was carried out. They were determined to be between 0.8m and 3.3m in depth at Quinspool. Cable percussion borehole BH104 proved very soft to soft soils to greater than 4.0m depth. As there are areas of deep soft soils it may be required to dig out and replace so that a stable formation is provided to the embankments and carriageways.

Route Corridor Option A4

Route corridor option A4 passes over approximately 180m of Alluvium deposits located in the townland of Gortgarraun. No direct investigations of soft deposits on this route option were undertaken.

Section 2

Route Corridor Option B1

A significant deposit of marine estuarine sediments is present in the townlands of Cloonougher and Clooncarhy where route corridor option B1 passes through. From reviewing Dynamic Probe Test information on the depth of these deposits it can be determined that a significant depth of soft soils is present, locally up to 8.0m depth. Due to the considerable depth of marine estuarine sediments it may be required to excavate and replace, pile embankment supports or develop an alternative ground improvement method locally to provide a stable formation for the proposed road.

Route Corridor Option D1

A small length of marine estuarine sediments is present in the townlands of Cloonougher and Castletroy and a considerable deposit of Alluvium is found to the south of the River Shannon crossing. The average depth of the Alluvium deposit is 2.1m, while the other areas have not been directly investigated. Excavation and replacement of the soft soils is probably the best solution where soft ground is this shallow.

Route Corridor Option E1

A significant deposit of marine estuarine sediments is present in various locations throughout route corridor options E1. Alluvium deposits at Rosmadda, adjacent to the River Blackwater, have an average depth of 0.9m over an approximate length of 650m. Further deposits of marine estuarine sediments can be found further east and vary in depths at the three locations. No investigation was undertaken at Cappavilla North / Mountcatherine. At Cappavilla South, deposits to a maximum depth of 3.9m and average depth of 2.5m were proven. At Srawickeen, deposits of between 4.0 and 6.8m were identified. The shallower deposits are suitable for excavate and replace, while the deeper ones consistently greater than 3.5m depth shall probably require alternative treatments such as ground improvement or pile supports.

15.2.4 Earthworks Volumes

Each route option is an offline section which will require cuts in areas of higher elevation and embankment construction in areas of low lying topography so as to ensure that the route options are above the existing flood level. The following paragraphs detail the earthworks volumes associated with the various route corridors.

It is anticipated that major ground improvement will be necessary in some areas prior to road construction. It is assumed that a portion of this soft ground will be replaced with good quality material and an estimation of the import material required has been carried out in this assessment. Earthworks quantities have also been assumed at each bridge over the River Blackwater and the River Shannon. Refer to Table 15.4 and Table 15.5.

Section 1

Route Corridor Option A1

Route corridor option A1 has 4 embankment sections and 5 cut sections. None of the embankments are greater than 10m. Two of the embankments are over 5m in height, and all of the areas of cuts are below 10m. The greatest cut section is approximately 350m long and 7.5m at its deepest point.

This Route corridor option has overall cut and fill volumes of approximately 34,200m^3 and 397,800m^3 respectively. This leaves a deficit of approximately 363,600m^3.

Route Corridor Option A2.1

Route corridor option A2.1 has 4 embankment sections and 2 cut sections. None of the embankments are greater than 10m. Two of the embankments are over 5m in height, and all of the areas of cuts are below 10m. The greatest cut section is approximately 300m long and 7m at its deepest point.

This Route corridor option has overall cut and fill volumes of approximately 2,592m^3 and 257,255m^3 respectively. This leaves a deficit of approximately 254,663m^3.

Route Corridor Option A4

Route corridor option A4 has 6 embankment sections and 7 cut sections. One of the embankments is greater than 10m. The remaining embankments are not over 5m in height, and all of the areas of cuts are below 10m. The greatest embankment is approximately 350m long and is 15m at its peak height. The greatest cut section is approximately 470m long and 8m at its deepest point.

This Route corridor option has overall cut and fill volumes of approximately 221,596m^3 and 395,380m^3 respectively. This leaves a deficit of approximately 173,784m^3.

Section 2

Route Corridor Option B1

Route corridor option B1 has 4 embankment sections and 3 cut sections. None of the embankments are greater than 10m. One of the embankments is over 5m in height, and all of the areas of cuts are below 10m. The greatest cut section is approximately 500m long and 7m at its deepest point.

This Route corridor option has overall cut and fill volumes of approximately 181,631m^3 and 271,464m^3 respectively. This leaves a deficit of approximately 89,833m^3.

Route Corridor Option D1

Route corridor option D1 has 10 embankment sections and 10 cut sections. None of the embankments are greater than 10m. One of the embankments is over 5m in height, and all of the areas of cuts are below 10m. The greatest cut section is approximately 350m long and 7m at its deepest point.

This Route corridor option has overall cut and fill volumes of approximately 248,771m^3 and 462,035m^3 respectively. This leaves a deficit of approximately 213,264m^3.

Route Corridor Option E1

Route corridor option E1 has 10 embankment sections and 11 cut sections. None of the embankments are greater than 10m. Two of the embankments are over 5m in height, and all of the areas of cuts are below 10m. The greatest cut section is approximately 560m long and 6m at its deepest point.

This Route corridor option has overall cut and fill volumes of approximately 82,967m^3 and 726,542m^3 respectively. This leaves a deficit of approximately 643,576m^3.

Table 15.4: Significant Earthwork Zones

Section	Route Corridor	Alignment Profile		Max Depth/Height (m)		Largest Cut & Fill Zones			
						Cut		Fill	
		Cuttings	Embankments	Cut	Fill	Length	Depth	Length	Height
1	A1	4	5	7.0	7.5	320	7.0	1720	6.0
	A2.1	4	2	7.0	7.0	300	7.0	1140	4.5
	A4	6	7	8.0	15.0	480	8.0	740	8.0
2	B1	4	3	7.0	5.0	560	7.5	2050	4.0
	D1	10	10	7.0	6.0	400	7.0	1200	6.5
	E1	10	11	6.0	7.0	560	6.0	1240	6.5

Table 15.5: Earthwork Volumes

Section	Route Corridor	Alignment Profile		Max Depth/Height (m)		Quantities		Surplus / Deficit (+/-) (Fill – Cut)	Sum Total of Earthworks (Fill + Cut)
		Cuttings	Embankments	Cut	Fill	Cut	Fill		
1	A1	4	5	7.0	7.5	34,200	397,800	363,600	432,000
	A2.1	4	2	7.0	7.0	2,592	257,255	254,663	259,847
	A4	6	7	8.0	15.0	221,596	395,380	173,784	616,976
2	B1	4	3	7.0	5.0	181,631	271,464	89,833	453,095
	D1	10	10	7.0	6.0	248,771	462,035	213,264	710,806
	E1	10	11	6.0	7.0	82,967	726,542	643,575	809,509

15.2.5 Ground Conditions Affecting Major Structures

Tailrace Canal Crossing (Section 1)

All routes, A1, A2.1 and A4 cross the Tailrace Canal north of the village of Parteen which is located to the east of Limerick City. All crossings are proposed to be located in the same location and all have the following properties:

Bridge Foundations

Bridge foundations for the Tailrace Canal crossing will either be piled foundations or shallow pad foundations if excavations to suitable bearing strata are feasible. Waulsortian bedrock is present at the proposed location of the bridge structure to the east and west of the proposed crossing.

Access Route corridors

From the west approach there is a wooded area where there is a disused rail track where machinery may be able to use to gain access to the work site. From the east approach there is a small lane from where machinery and workers will be able to gain access to carry out required bridge works.

Embankment Foundations

The approach embankments to the Tailrace Canal crossing cross low lying ground for several hundred metres. Based on results from BH105, the ground consists of firm to stiff glacial till over dense gravels and bedrock. These soils should be suitable for embankment construction.

River Blackwater and River Shannon Crossing (Section 2)

Route B1

Bridge Foundations

Bridge foundations for the Route Option B1 are anticipated to be bored pile foundations. The rock formation that makes up the majority of bedrock at the location of the proposed crossing location is Visean. Results from coring in BH110 during fieldworks were poor, indicating low percentage recovery and frequent loss of core in weathered rock with clay bands.

Access Route corridors

The most direct access route corridors to this Shannon Bridge Crossing from the east approach lies through traffic side road located off the R445. A temporary access track will have to be constructed off this side road to the proposed route corridor through an area where flooding is encountered and ground conditions may be difficult.

Access to the west of the proposed crossing will also involve the construction of a temporary access road. It is envisaged, if possible, that the temporary access will be constructed through agricultural land in the townland of Clooncarhy. This agricultural land is liable to flood so ground conditions may prove difficult.

Approach Embankments

Approach embankments on the east side will be founded on very soft, deep peat deposits. Remedial solutions such as a piled embankments, or excavation and replacement will have to be considered in this area. Surcharging with wick drains and stone columns are solutions that may be used for the soft clay/ alluvium layers

beneath Peat; if it is economical to remove the top layer of Peat. Further investigation will be required to determine the more practical and economical solution in this area. The approach embankment on the west will most likely be founded on boulder clay and may not prove problematic for road construction.

Route D1

Bridge Foundations

Bridge foundations for the River Blackwater crossing for Route Option D1 are anticipated to be either bored piled or pad foundations as rock is strong and shallow. The rock formation that makes up the majority of bedrock at the location of the proposed crossing location is Visean.

Bridge foundations for the River Shannon crossing for Route Option D1 are anticipated to be bored pile foundations. The rock formation that makes up the majority of bedrock at the location of the proposed crossing location is Visean. The rock has been proven to be comparatively strong and slightly weathered in BH116, at depths of between 15m and 25m.

Access Route Corridors

There is an access road to the west of River Blackwater but a short temporary access road may be required to reach the construction site from the local road.

There is an access road on the west side of the River Shannon which can provide sufficient access to construction traffic. The road is quite narrow and may require some temporary works to allow for the use of large construction traffic. There is no access available to the east approach of the River Shannon and a temporary access road will need to be constructed.

Approach Embankments

The approach embankments for the west and east side of the River Blackwater is located on Marine/estuarine silts and clays according to GSI mapping.

The approach embankment to the west side of the River Shannon is founded on an area of glaciofluvial sands and gravels. The approach embankment to the east of the River Shannon is also founded on alluvial soils. Both of these approaches should not cause any problems for construction.

Route E1

Bridge Foundations

Bridge foundations for the Route Option E1 are anticipated to be either bored piled or pad foundations if rock is strong and shallow. The rock formation on both approaches to the River Blackwater crossing is made up of Waulsortian, Lough Gur and Visean rock types. The rock formation that makes up the majority of bedrock at the location of the proposed River Shannon crossing location is Visean.

Access Route Corridors

There is no access close to the proposed crossing point at the River Blackwater and a temporary access road may be required for each approach to the crossing.

There is an access road on the west approach which can provide sufficient access to construction traffic. The road is quite narrow and may require some temporary works to allow for the use of large construction traffic.

There is no access available to the east approach of the River Shannon and a temporary access road will need to be constructed.

Approach Embankments

Both approaches embankment to the east of the River Blackwater is founded on an area of Marine/estuarine silts and clays. The approach embankment to the east of the River Shannon crossing is to founded on Marine/estuarine silts and clays while the west side of the crossing is mainly till derived chiefly from limestone. These approaches should not cause any problems for construction.

15.2.6 Contaminated Land

There are numerous sections along all of the Route corridors that encounter made ground that may prove problematic for road construction if contaminated materials are present. Many of the route options cross artifically channelled watercourses and are located near urban areas so made ground occurs often.

The likelihood of encountering contaminated materials may vary depending on previous landfill and waste disposal practices. One licensed landfill site has been identified within the Study Area, at Clonoughter.

No instances of illegal dumping or infilling of old quarries were observed during site visits.

15.2.7 Karst Features

Karst features manifest themselves by the progressive dissolution of pure and nearly pure carbonate minerals from limestones. The weathered rock can display several characteristics such as swallow holes, springs or caves. Acidic rainwater speeds up the process just as clearly defined bedding is also makes rocks more susceptible. Groundwater movements can be complicated in such an aquifer, with connectivity and transport times between locations being difficult to predict.

Several surface features have been identified in the Study Area, in particular ones near the Holy Well at Gillogue/Derryfadda. Other known features identified from GSI mapping are typically just outside of the Study Area such as at Parteen, Quinspool, Gortgarraun and Castlebank. The possibility of undisclosed Karst features along any of the Route Corridors cannot be completely discounted but the risk is considered to be relatively low.

15.2.8 Historical Land Use

It was observed on the site visit that much of the lands identified as peat by the GSI on the outskirts of Limerick City and in particular to the west of the city, have been improved by local farmers to be used for cattle grazing and to grow silage. The key farming activities in the area are beef and mixed grazing, typical for farms in this region.

Made ground impacts on the existing soils and geology also include the works construct to implement the Ardnacrusha Hydroelectric Scheme, such as the Tailrace and the River Blackwater. This may also include high voltage overhead electric power lines, which can pose hazardous to site investigation and earthworks machinery.

Around Limerick City and environs, there is much residential and commercial use of the lands, which have been developed for the construction of the University of

Limerick and National Technology Park. These are primarily to the south of the River Shannon and already influence the docking points of the route corridors.

15.2.9 Unstable Land

The lands surrounding the Ardnacrusha Headrace channel near Rosmadda and Mountcatherine has been monitored by the ESB as part its long term maintenance. The embankments act as Cateogry A Dams, which are of high importance, as any breach of their stability could arise in loss of life downstream. Hence reports of boiling in soils around the embankments have been monitored ever since for re-occurence. General construction and drainage would potentially lead to high geotechnical risk. The assessed route corridors B1 and D1 avoid these areas of the Headrace that are of highest risk.

15.2.10 Economic Geology

There are no active quarries or pits situated in the Study Area. The GSI Directory of Active Pits and Quarries 2001 lists several sources of aggregates and other products within the region, generally from crushed limestone rock or from natural sands and gravels. There are a number of disused pits in the study area which may indicate that local resources have been fully removed or have been extracted as much as was feasible with available equipment and techniques. As there are some route options where cuttings are envisaged it is possible but not likely that further resources will become available if sufficiently deep cuttings are required.

The route which is closest to several of these disused pits and quarries is Route D1.

15.2.11 Geological Heritage

A geological heritage site of Upper Palaeozoic (Silurian) age is present at Ballycar South, the Ballycar South member of the Cratloes Formation. This is outside the Study Area by a distance of approximately 1km. Distinct bedrock units separate it from the rock in the Study Area, so it poses no constraint and will not affect any development.

15.2.12 Impact Assessment

Excavations for deep cuttings (greater than 10 meters) through steep, sloping ground are at risk of encountering both short term and long term stability problems. The Route selection should avoid alignments with excessive depths or quantities in cutting on the basis of both safety and economic assessments. From this point of view, all options have cuttings below 10m in height and any other steep cuttings which are just below 10m, suitable engineering mitigation methods can be deployed to allay this concern when necessary.

To minimise the geotechnical requirements it would also be best to avoid the construction of high embankments (over 5m especially) on the low-lying ground close to the River Shannon that contain significant depths of soft alluvium and peaty deposits. The ground in these areas is more likely to be marshy and wet so differential settlements and instability are concerns which may require engineering solutions at increased cost to the project.

15.2.13 Comparison of the Route Corridors

The comparison and ranking of the route corridors was divided into two sections.

Section 1

The route corridors were compared on geotechnical criteria for the length of the Route that passed through or impacted a) cut and fill balance, b) total earthworks volume, c) peat and soft ground deposits and d) the Tailrace Canal bridge approach. Other factors relating to Karst, Land Use, Economic Geology and Geological Heritage are not likely to have significant impact for any of the alternative route corridors and therefore were not ranked.

The Route Corridor with the worst conditions was given the highest marks on a scale of 1 to 3 i.e. 3 being the worst Route and 1 being the best.

Cut and Fill Balance was determined from MX modelling and they were ranked on the basis that a surplus of 20 to 30% was preferred. As none of the Route Corridor Options provide a surplus the Route Options are ranked in relation to the smallest deficit, Route Option A4 has the smallest deficit and therefore was ranked 1st; all other options also produced deficits and were ranked from the lowest to highest accordingly.

The overall earthworks volume indicating the quantity of materials to be excavated, transported, deposited and compacted was also assessed. The lowest total in Section 1 was in Route Option A2.1 and therefore was ranked 1st. The lowest total in Section 2 was in Route Option B1 and therefore was ranked 1st.

The criteria of Peat and other soft ground were ranked based on the length of route that passed through this type of material. Route Corridor Option A2.1 impacts on soft ground conditions as approximately 30% of the entire length passes through such unfavourable ground conditions. Route Corridor Options A1 and A4 impact on such soft ground conditions totalling 20% and 4% respectively.

The Tailrace Canal bridge crossing was ranked on the accessibility of access roads and the length of soft ground that the approach embankment would be founded on. As all the routes converged at the same point all routes were ranked 1st.

Section 2

Similarly the route corridors of Section 2 were compared on geotechnical criteria of the length of the Route that passed through or impacted a) cut and fill balance, b) total earthworks volumes, c) peat and soft ground deposits and d) the Shannon River bridge approach.

Cut and Fill Balance was determined as above and as in Section 1 none of the Route Corridor Options provide a surplus. The Route Options are ranked in relation to the smallest deficit given, Route Option B1 has the smallest deficit and therefore was ranked 1st; all other options also produced deficits and were ranked from the lowest to highest accordingly.

Route corridor option D1 was the least impacted by peat and soft ground, as only approximately 22% of the entire length passed through these unfavourable ground conditions. In contrast Route corridor options B1 has approximately 50% and Route Corridor Option E1 has approximately 32% of their total length affected by these ground conditions.

The Shannon River bridge crossing was ranked on the accessibility of access roads and the length of soft ground that the approach embankment would be founded on. Route Corridor Option B1 passes through Marine Estuarine Silts and Clay (MEsc) on both approaches to the River Shannon. Route Corridor Option D1 passes through Marine Estuarine Silts and Clay to the western approach and Alluvial soils to the eastern approach. Route Corridor E1 only passes through Marine Estuarine Silts and Clay on the western approach to the crossing.

Overall Route Corridor Options A4 and D1 emerged as the preferred route, based on the soils and geology of the region, while Options A1 and E1 emerged as the least favourable. The overall assessment of this preference over Option A2.1 in Section 1 may be marginal as the differences in Total Earthworks Volume are much greater than the differences in Cut/Fill Balance and alternative ground improvement methods may proven to be feasible.

Table 15.6: Route Corridor Option Ranking

SECTION 1	Marks	Marks	Marks
Route Corridor Option	**A1**	**A2.1**	**A4**
Cut & Fill Balance	3	2	1
Total Earthworks Volume	2	1	3
Peat and Soft Ground	2	3	1
Tailrace Canal Crossing	1	1	1
Total	**8**	**7**	**6**
Ranking	**3rd**	**2nd**	**1st**

SECTION 2	Marks	Marks	Marks
Route Corridor Option	**B1**	**D1**	**E1**
Cut & Fill Balance	1	2	3
Total Earthworks Volume	1	2	3
Peat and Soft Ground	2	1	3
Shannon Bridge Crossing	3	1	2
Total	**7**	**6**	**11**
Ranking	**2nd**	**1st**	**3rd**

15.3 Hydrology

Introduction

All the lands within the Study Area are drained to the River Shannon through a network of tributaries. The Study Area has extensive areas at risk of flooding in a 1% AEP (Annual Exceedence Probability) event. **Drawing RCSR-1505 & 1506 in Volume 2** show areas at risk of flooding based on OPW maps which were in turn compiled based on aerial photographs taken on the 9th January 2000.

15.3.1 Methodology

This section of the Route Corridor Report has been prepared by expanding the desk study work carried out for the Constraints Study to look at all available data specifically relating to the selected route corridor options. It includes an assessment of no. of watercourses and length of floodplain crossed based on aerial photography and available mapping & survey.

The principal criteria used to assess and evaluate the route corridor options are:

- No. of significant watercourses crossed;
- Length of floodplain crossed;
- Surface water features.

Any areas that have been highlighted as being of significant potential hydrological significance are targeted for walkover surveys and the collection of field data in order to assess the significance of any likely environmental impacts at EIS phase.

Data sources

The following list of data sources were the main information sources reviewed as part of this route corridor selection report:
Ordnance Survey of Ireland (OSi)

- Discovery Series Mapping (1:50,000);
- Six Inch Raster Maps (1:10,560).

Office of Public Works (OPW)

- Historical Flood Records;
- Hydrometric water level and flow records;
- Arterial drainage scheme maps.

Environmental Protection Agency (EPA)

- Water Quality Monitoring Database and Reports;
- Water Framework Directive Classification.

Limerick & Clare County Council

- County development plans.

Other sources

- Flood Study Reports – (NERC, 1975).

Impact Assessment

In order to assess the relative merits of each of the identified route corridors, an assessment of the likely impact each route will have on the hydrological attributes along each route has been made. Consideration has been given to both the importance of the attributes and the predicted scale and duration of the likely impacts.

The following are typical impacts associated with road schemes on the hydrological environment:

- Interference with river, streams and flood plains at road crossing points, requirement for correct sizing of bridges and culverts;
- Removal of flood storage as a result of construction within floodplains;
- Diversion of water between drainage basins;
- Interference with local drainage, relocation, discontinuation and combination of existing land drains;
- Modifications to runoff characteristics (due to impervious road pavement area and increased transmission time and point loading) resulting in a possible increase in the overall flood peak magnitude and flooding frequency in the receiving stream;
- Water quality impact on receiving streams from routine carriageway runoff (heavy metals, organics, nutrients, hydrocarbons, suspended solids, coliforms, etc) and from accidental spillages (agricultural, oil/chemical spillages, bulk liquid cement).

As only very limited engineering design details and site specific data is available at this stage, much of the preliminary impact assessment is of a qualitative rather than a quantitative nature. A significant degree of professional judgement has therefore been used in identifying and rating the likely impacts. For each route corridor a summary of these associated impacts has been presented in a tabular format.

Comparison of Route Corridor Options

A comparison of route corridors has been made based on the number and degree of likely impacts and along each corridor. This has established an order of preference from a hydrological perspective.

Where a similar number of likely impacts have been identified then the route corridor which affects the least number of high value attributes has been given preference.

Limitations and Gaps in Available Data

Limitations for this stage of reporting exist in the lack of field and site investigation data for various route corridors. Most of the conclusions and recommendations have been arrived at through desk study research and basic site walkovers. Until the final alignment is known it will not be possible to make detailed appraisals regarding how any cut or fill sections will impact on the hydrological environs.

15.3.2 Catchments and Sub-Catchments

Overview of Catchments within Study Area

Under the EU Water Framework Directive (2000/60/EC) eight River Basin Districts (RBDs) have been established throughout the island of Ireland. The boundaries of these have been largely based on a 1971 classification by the Water Resources

Division of An Foras Forbartha (AFF) which divided the 26 counties of Ireland into seven Water Resource Regions.

The River Shannon rises in a spring fed pool (the Shannon Pot) in the Cuilcagh Mountains on the Cavan-Fermanagh Border. The river flows south through Loughs Allen, Ree and Derg, as well as a number of smaller lakes between Lough Allen and Lough Ree, finally outfalling to the Atlantic Ocean via the Shannon Estuary. This study area falls within the lower reaches of the river to the north of Limerick City.

The River Shannon is Ireland's largest river having a catchment area from its source to the Shannon Estuary at Limerick City of some 11,330km^2. The Shannon, with its series of natural and artificial controls, has a slow response to rainfall events requiring heavy prolonged rainfall conditions to produce flooding. The river flows through three major lakes, Lough Allen (36km^2), Lough Ree (106km^2) and Lough Derg (120km^2) as well as widening out into a number of smaller lakes between Lough Allen and Lough Ree. The natural fall between the outlets of Lough Allen and Lough Derg is 13m over a distance of approximately 190km (0.000068). Such a low hydraulic gradient and the attenuating effect of the large lakes results in a slow moving river with floodwaters remaining on the floodplains for long periods of time and thus producing significant lag time (often of many days) between rainfall and resultant runoff in the middle and lower reaches.

The Limerick Northern Distributor Route Corridors all fall within the Lower River Shannon Catchment. The River Shannon, a canal and a number of smaller tributary channels are intersected by the various route corridors. The minor watercourses intersected are all minor tributaries of the River Shannon.

The Lower River Shannon has a number of hydrometric gauging stations operated by the Office of Public Works (OPW) and the ESB/EPA. Table 15.7 lists the principal gauging stations relevant to this study.

Table 15.7 Details of Relevant Automatic Gauging Stations

St No.	St. Name	River	NGR	AREA	Record	Comment
25076	Park Lock	Shannon Canal	R589576		1980 - 2005	No rating curve A.M. flood levels only
25061	Ball's Bridge	Abbey Estuary	R582578		1957 - 2005	No rating curve A.M. flood levels only Levels are tidal peaks Station removed 8/10/2001 to 07/08/2002 due to canal restoration works
25056	Meelick Weir U/S	Shannon	M949139		1985 - 2005	No rating curve A.M. flood levels only
25001	Annacotty	Mulkear	R642576	646	1953 - 2011	No rating curve A.M flow series available
25002	Barrington's Bridge	Newport	R678549	223	1953 - 2011	No rating curve A.M. flow series available

15.3.3 Guidelines on Flood Risk and Development

The following guidelines in relation to flood risk are listed in the Limerick County Development Plan.

- It is the policy of the Council not to permit development, which is sensitive to the effects of flooding in floor prone or marginal areas unless adequate mitigation measures, which may involve a Flood Impact Analysis, are proposed;
- Development consisting of construction of embankments, wide bridge piers, or similar structures will not normally be permitted in or across flood plains or river channels;
- Appropriately designed development, which is not sensitive to the effects of flooding may be permissible in flood plains, provided it does not significantly reduce the flood plain area or otherwise restrict flow across floodplains;
- Developments adjacent to water courses in the county will be required to ensure that there is adequate provision for access to allow maintenance and clearance, future improvement works or emergency works.

The Clare County Council Draft Development Plan does not list their policies in relation to flood risk but does state that these policies will be included in the Local Area Plans. The Draft Development Plan highlights the following policies as ones that may be included in the Local Area Plans:

- Policies to avoid development in areas of flood risk, and application of Justification Test;
- Policies to improve and or restore natural flood risk management functions of flood plains or coastal margins;
- Policies to align natural flood risk management with recreation and amenity functions;
- Policies to align natural flood risk management functions with habitat protection and management of water quality;
- Policies for sustainable drainage;
- Policies for improving existing flood risk management infrastructure and the provision of new infrastructure;
- Policies for emergency planning;
- Policy to restore riparian strips along side river channels and keep them free of development.

Floodplains within study area

The principle floodplains within the route corridor study area are the River Shannon fluvial & tidal floodplains. These flood plains were mapped by JBA Consulting on behalf of Limerick County Council. The fluvial extents are derived from 2D hydraulic modelling and the coastal outlines are a projection of the Extreme Still Water Sea Level (ESWSL) inland. The fluvial and coastal sources of flooding are modelled separately and assume no interaction with each other.

Table 15.8 Total Route length within River Shannon Flood Plain Area

	Section 1			Section 2		
	A1	**A2.1**	**A4**	**B1**	**D1**	**E1**
Total floodplain width	1273m	675m	0m	2013m	1120m	3253m
Permanent channel	42m	42m	42m	130m	105m	121m
Rank	3rd	2nd	1st	2nd	1st	3rd

15.3.4 Historical Flood Records

The Arterial Drainage Act 1945 (Amended 1995) deals with the improvement of lands by drainage and preventing or sustainably reducing the flooding of lands. The Acts set up the process of Arterial Schemes and provides for the maintenance of these works. The act also provides for the implementation of a number of drainage and flood reduction related measures such as approval procedures for the bridges and weirs. Reporting requirements for maintained Drainage Districts are also iterated.

The EU Floods Directive (2007/60/EC) applies to river basins and coastal areas at risk of flooding.

The River Shannon has a long history of flooding with a US Corps of Engineers 1956 report 'River Shannon Flood Problem' stating that:-

"The problem of Shannon River flooding has been the subject of much study over the past 150 years. Because of the flat terrain through which the river flows, the almost imperceptible gradient of the stream with its series of lakes and connecting channels, and because of the large volume and long duration of flooding, no simple or obvious solution has heretofore been found."

Between Lough Allen and Lough Derg, a distance of 190km, there is only a small fall of 13m in elevation. The river velocities are low and numerous meanders have developed indicating a low energy level.

The River Shannon has contributed to numerous recent flooding events including:

- November/December 2009 - large volumes of rainfall which led to an increase in the volume of water being discharged from Parteen Weir. The impacted area in County Limerick stretched from Montpelier village downstream through Castleconnell, Mountshannon, and Plassey to the confluence with the Groody River;
- February 2002 – County-wide flooding as a result of combined extreme tidal & fluvial events;
- December 1999 - Flooding occurred in Limerick City over the Christmas period;
- February 1997 – City street flooding caused by combination of tidal surge & wave action;
- January 1995 - City street flooding caused by high tides;
- February 1990 – Flooding Parteen Weir to Limerick City.

15.3.5 Assessment of Route Corridors

Section 1

Route Corridor Option A1

Route corridor option A1 is located in a low lying area which is a flood plain of the River Shannon and its tributaries. Further evidence of historic flooding at this location is the large deposit of Estuarine Sediments as outlined in Section 15.2.3. The flood plain in this location is classified as within the coastal 100yr flood event. The flood plain covers 40% of the route corridor footprint. This route also crosses 2 minor streams, 5 drainage ditches and the tail race canal.

Route Corridor Option A2.1

Route corridor option A2.1 is located near the edge of a low lying area which is a flood plain of the River Shannon and its tributaries. The flood plain in this location is classified as a coastal 100yr flood event. The flood plain covers 20% of the route corridor footprint as the route corridor is located slightly further north than route corridor option A1 and avoids a significant amount of the River Shannon flood plain. This route crosses 2 minor streams, 5 drainage ditches and the tail race canal.

Route Corridor Option A4

Route Corridor Option A4 is the furthest north of the corridor options and avoids the flood plains of the River Shannon and its tributaries. It does cross 5 minor streams, 3 drainage ditches and the tail race canal.

Section 2

Route Corridor Option B1

Route corridor option B1 starts after the Tailrace Canal crossing and passes through relative high ground which has no significant history of flooding as outlined in **Drawing RCSR-1505 & 1506 in Volume 2.** Route corridor option B1 passes through the flood plain of the River Shannon further south where it crosses the River Shannon and ties into the R445. The floodplain covers 59.3% of the route corridor footprint. This route involves 12 drainage ditch crossings and a crossing of the River Shannon

Route Corridor Option D1

Route corridor option D1 starts after the Tailrace Canal crossing and crosses the River Blackwater, Errina Canal and the River Shannon. There are recorded flooding events at all of these crossings which are detailed in **Drawing RCSR-1505 & 1506 in Volume 2.** The floodplain covers 14.8% of the route corridor footprint. This route crosses 8 drainage ditches and the River Shannon.

Route Corridor Option E1

Route corridor option E1 is the most eastern of the three routes and passes adjacent to where the River Blackwater and the Errina Canal flood plains merge near the townland of Cappavilla North. The corridor is also located in the flood plain of the River Shannon as outlined in **Drawing RCSR-1505 & 1506 in Volume 2.** The floodplain covers 37.3% of the route corridor footprint. This route has 2 drainage ditch crossings and a crossing of the River Shannon.

Table 15.9 Watercourse Summary

Node	On Route	Total Length (Km)	Floodplain (Km)	% Route in Floodplain	No. Ditches	No. Streams	No. Rivers	No. Canals
A-F	A1	2.14	1.312	61.3%	4	1	0	0
F-X	A1	0.968	0.411	42.5%	1	1	0	1
A-X	A2.1	2.45	1.32	53.9%	5	2	0	1
A-G	A4	2.214	0.088	4.0%	3	1	0	0
G-H	A4	1.744	0.336	19.3%	0	3	0	0
G-H	A4.1	1.634	0.217	13.3%	0	2	0	0
H-X	A4	0.823	0.173	21.0%	0	1	0	1
X-J	B1	1.462	0	0.0%	1	0	0	0
J-B	B1	3.364	2.863	85.1%	11	0	1	0
J-L	D1	1.588	0.275	17.3%	6	0	0	0
L-N	D1	1.168	0.221	18.9%	1	0	0	1
M-N	D1	1.751	0.171	9.8%	1	0	0	0
N-O	E1	0.984	0.907	92.2%	1	0	1	0
O-E	E1	1.497	0.797	53.2%	1	0	0	0
Route B1 (X – J – B)		4.826	2.863	59.3%	12	0	1	0
Route B1/D1/E1 (X – J – L – M – N – O – E)		8.45	2.371	28.1%	11	0	1	1

Table 15.10 Route Corridor Option Ranking

SECTION 1	Marks	Marks	Marks
Route Corridor Option	**A1**	**A2.1**	**A4**
Length in floodplain	1273m	675m	597m
No. of watercourse crossings (not including River Shannon and Tailrace)	8	7	9
Ranking	**3**	**1**	**1**

SECTION 2	Marks	Marks
Route Corridor Option	**B1**	**B1/D1/E1**
Length in floodplain	2863m	2371m
No. of watercourse crossings (not including River Shannon and Tailrace)	13	13
Ranking	**2**	**1**

15.4 Hydrogeology

Introduction

The hydrogeology of the area is reflective of the synclinal structure that surrounds Limerick City. As a result of the sequence and folding that features in the bedrock geological history, each bedrock unit traces a spoon-shaped ring around the city. The movement of water through the ground is governed by the permeability and connectivity of each bedrock unit. These properties now determine the area of contribution into as well as the yield available from the aquifers.

Methodology

Review of the available GSI soil, aquifer and bedrock mapping and other records held in GIS database format, is the primary source of hydrogeological information. Interim vulnerability mapping has been prepared by GSI based on depths to rock, soil cover and bedrock characteristics.

General cross sections of the Study Area have also been assessed to identify connectivity and interaction between units. This information has been reviewed with a view to the potential road construction in each area along the route.

15.4.1 Aquifer Types and Classification

The following bedrock aquifer classifications occur in the Study Area.

Table 15.8: Bedrock Aquifers occurring within the Study Area

AQUIFER CLASSIFICATION	CODE	BEDROCK FORMATION
Regionally Important Aquifer – Bedrock which is Karstified (Diffuse)	**Rkd**	Waulsortian Limestone
Locally Important Aquifer – Bedrock which is Moderately Productile only in Local Zones	**Ll**	Waulsortian Limestone
Locally Important Aquifer – Bedrock which is Moderately Productive	**Lm**	Lough Gur Limestone
Locally Important Aquifer – Bedrock which is Moderately Productive	**Lm**	Visean Limestone
Locally Important Aquifer – Bedrock which is Moderately Productile only in Local Zones	**Ll**	Volcaniclastic
Poor Aquifer – Bedrock which is Generally Unproductive	**Pl**	Lower Limestone Shales
Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones	**Ll**	Old Red Sandstone

Code: Rkd : regionally important karstified (diffuse) aquifers
Lk: locally important karstified aquifers Lm: locally important aquifers that are generally moderately productive
Lm: locally important aquifers that are moderately productive
Ll: locally important aquifers that are moderately productive only in local zones
Pl: poor aquifer that is generally unproductive except for local zones

The Geological Survey of Ireland's bedrock mapping for the area illustrates that the Study Area is underlain by seven distinct geological formations / members as discussed above.

One formation is classified as a regionally important karstified (diffuse) aquifer (Rkd), the Waulsortian Limestone. Karst landforms include surface features such as swallow holes, dolines, dry valleys or subsurface features like solution enlarged cavities, and caves, depending on their development with time. Some features may have been previously active when levels and conditions of both sea and land were historically different. Many have since been infilled by the most recent glacial cover and are now essentially dormant. Detailed investigation of these features is required, wherever they are found to be close to a proposed route.

It is noted that all karstified aquifers have limited attenuation capacity once a contaminant enters the aquifer. This is due to its solution enlarged fissures / conduits and fast through-flow velocities to discharge points (springs, wells, rivers, lakes etc). Further searches of aerial photographs (surface) or by geophysical survey results and preliminary site investigations (subsurface) should explore this further if the route is chosen in this aquifer where features are thought to be present. It would be advisable to avoid or minimise the length of the route through known karstified areas, as there may be implications for road foundations, structures foundations and road drainage design.

As the study area is located near a number of high to extremely vulnerable aquifers, which the majority are classified as either locally or regionally important some of the routes pass through such areas as they are unavoidable. The majority of the routes avoid the extremely vulnerable aquifers in the study area so the risk of contamination of these aquifers is kept to a minimum.

Two bedrock formations have been classified as locally important aquifers that are generally moderately productive (Lm). Groundwater flow in such aquifers is generally through a network of fractures, fissures and joints that are reasonably well connected and dispersed throughout the rock, giving a moderate permeability and groundwater throughput. Aquifer storage is moderate and groundwater flow paths can be up to several kilometres in length. There is likely to be a substantial groundwater contribution to surface waters ('baseflow') and large (>2,000 m^3/day), dependable springs may be associated with these aquifers.

Three bedrock formations have been classified as locally important aquifers that are moderately productive only in local zones (Ll). Such aquifers are characterised by a limited and relatively poorly connected network of fractures, fissures and joints, giving a low fissure permeability which tends to decrease further with depth. A shallow zone of higher permeability may exist within the top few metres of more fractured / weathered rock, and higher permeability may also occur along fault zones. These zones may be able to provide larger 'locally important' supplies of water. In general, the lack of connection between the limited fissures results in relatively poor aquifer storage and flow paths that may only extend a few hundred metres.

One bedrock formation has been classified as a poor aquifer that is generally unproductive except for local zones (Pl). Well yields in this type of aquifer will be <40 m^3/day, and is characterised by a few poorly connected fractures, fissures and joints. This low fissure permeability tends to decrease further with depth. A shallow zone of slightly higher permeability may exist within the top few metres of more fractured/weathered rock, and higher permeability may rarely occur along large fault zones. In general, the poor fissure network results in poor aquifer storage, short flow paths (tens of metres) and low 'recharge acceptance'. Groundwater discharge to streams ('baseflow') is very limited.

Consultation with the Geological Survey of Ireland (GSI) indicates that there are no quaternary sand and gravel aquifers within the Study Area.

15.4.2 Aquifer Vulnerability

The following is an overview of the aquifer characteristics along each of the route corridor options:

Section 1

Route Corridor Option A1

Route Corridor Option A1 (nodes A-F-X) leaves the tie in with the proposed Coonagh to Knockalisheen Road. The local topography is low lying and is makes up part of the River Shannon flood plain. The route passes over marine estuarine sediments which are classified as a soft soil deposit. Subsoils between nodes A and X are predominately limestone till. The bedrock and aquifer classification along the entire length of the routes is designated as highly vulnerable.

Route Corridor Option A2.1

Route corridor option A2.1 (nodes A-X) begins at node A in the townland of Gortgarraun and is located in similar soil types as route corridor option A1 which includes marine estuarine sediments but the corridor predominately lies on limestone till. The bedrock and aquifer classification along the entire length of the routes is designated as highly vulnerable.

Route Corridor Option A4

Route corridor option A4 (nodes A-G-H-X) leaves the tie in with the proposed Coonagh to Knockalisheen Road and heads northeast towards node X near Parteen. The route corridor passes predominately over on limestone till and shale till. The corridor for the most part passes over aquifers which can be classified as to have a low to medium vulnerability; the route corridor option does pass over a highly vulnerable aquifer at the start and end of the corridor.

Section 2

Route Corridor Option B1

Route corridor option B1 (nodes X-J-B) leaves node X near Parteen after the Tailrace Canal crossing and encounters both deposits of marine estuarine sediments and limestone till. Sections of the route corridor option B1 passes over sections of the River Shannon flood plain near the proposed crossing of the river. The corridor passes over an aquifer which is predominately classified as highly vulnerable.

Route Corridor Option D1

Route corridor option D1 (nodes X-J-L-M-N-P-D) leaves node X near Parteen after the Tailrace Canal crossing and encounters deposits of marine estuarine sediments but principally limestone till. A small area of peat is located in the townland Derryfadda where the route turns south towards the River Shannon crossing. The River Shannon flood plain extends north towards the townland of Gilloge where there are extensive marine estuarine sediments deposits. The corridor passes over an aquifer which is predominately classified as highly vulnerable, but there is some areas of aquifer which are classified as extremely vulnerable.

Route Corridor Option E1

Route corridor option D1 (nodes X-G-N-O-E) leaves the Tailrace Canal crossing and heads east towards the townland of Rosmadda West where it turns south towards the River Shannon crossing and the eventual tie in with the R445. The corridor passes through areas of alluvium deposits, marine estuarine sediments but the limestone till makes up the majority of the geology conditions with which the corridor passes over. The aquifer is for the most part classified as highly vulnerable but the route corridor option also passes over some areas where the aquifer is classified as extremely vulnerable.

15.4.3 Groundwater Resources

Groundwater resources include the aquifers themselves, particularly close to any feature which can be used for abstraction. This includes wells, boreholes, springs, spas and other surface water features that are either fed by or contribute to groundwater.

Group Water Schemes commonly abstract from boreholes drilled into rock for supply. Cuttings into rock for road construction may lead to local permanent drawdown.

Water supply and quality may need supplemental measures to maintain the resource for continued use.

Springs and holy wells noted on historic 25" and 6" mapping include:

- Knockballynameath;
- Castlebank;
- Ballycannan North;
- Knockalisheen;
- Cottage;
- Prospect;
- Newgarden;
- Ballyvollane;
- Rosmadda West.

To the north of the Study Area in upland areas, the following springs are mapped:

- Ballycar South;
- Coolnalira;
- North of Roo East beside River Blackwater.

To the south of the Study Area in lowland areas, there are also springs and wells mapped, predominantly in areas of Visean limestone. The frequency and concentration of these wells in an aquifer of local importance would suggest that in this area the rock is faulted/fractured resulting in increased productivity.

GSI mapping of groundwater wells indicates that there are many in the Study Area. Refer **Drawing RCSR-1504 in Volume 2.** The yield, depth and use of each should be checked based on existing records. A more detailed audit of baseline water supply and quality may be necessary for assessment of environmental impact when proposed route alignments are known.

Section 1

Route Corridor Option A1 and A2.1

These route corridors are located in the vicinity of some groundwater wells but the accuracy of the location of these wells is not precise. Further investigations will be required to determine the exact location of any wells in the vicinity.

Route Corridor Option A4

Route corridor option A4 is located adjacent to a cluster of groundwater well locations in the townland of Ballyfinneen but the accuracy of this information states that there is a number of wells within 500 – 1000m of this location so further investigation will be required.

Section 2

Route Corridor Option B1

A groundwater well is located near the town of Parteen following the Tailrace Canal crossing and is within 300m of a well as shown on **Drawing RCSR-1504 in Volume 2.** The remaining route corridor option does not encounter any other groundwater wells as it is located in a predominately urban area where the population is served with mains water.

Route Corridor Option D1

There are a number of groundwater well is located next to the townlands of Derryfadda and Srawickeen. The accuracy of these well location is between 500-1000m so further investigation will be required.

Route Corridor Option E1

This route corridor option is the most affected of the route corridor options in Section 2 with a significant cluster of well located in the townland of Rosmadda West. The accuracy of the location of these wells are within 50-100m of where they are shown on **Drawing RCSR-1504 in Volume 2.**

15.4.4 Comparison of Alternative Route Corridors

The route corridors were compared on hydro geological criteria for the length of the Route that passed through or impacted a) aquifer vulnerability and b) groundwater resources. The Route Corridor with the worst conditions was given the highest marks on a scale of 1 to 3 i.e. 3 being the worst Route and 1 being the best. The comparison and ranking of the alternative route corridors was divided into two parts.

Section 1

Route corridor options A1 and A2.1 are quite similar in relation to Hydrogeology as they are located in the same general vicinity. Both routes are located above a highly vulnerable aquifer. Route corridor option A4 passes over aquifers which can be classified as to have a low to medium vulnerability but does come into contact with a section of the aquifer which is classified as highly vulnerable.

Route Corridor A1, A2.1 and A4 do not come into close contact with any groundwater wells. It is the conclusion that all three routes have the same possible affect on the groundwater and are in turn ranked the same.

Section 2

Route corridor option B1 passes over an aquifer which is classified as highly vulnerable, the route also passes over an aquifer located over the proposed River Shannon crossing with a classification of high to low vulnerability. Route corridors D1 and E1 similarly pass over a highly vulnerable aquifer, but the route corridors also passes over areas aquifer of extreme vulnerability.

Route corridor option B1 has limited exposure to groundwater wells, with the exception of a well located in Parteen. Route corridor option D1 has a number of groundwater wells located in the vicinity but according to mapping available the exact location of these wells are not know to any great degree. Route corridor option E1 has the greatest amount of groundwater wells which could be affected and is therefore the least favourable of the three routes when it comes to groundwater resources.

SECTION 1	Marks	Marks	Marks
Route Corridor Option	**A1**	**A2.1**	**A4**
Aquifer Vulnerability	2	2	1
Groundwater Resources	1	1	1
Total	**3**	**3**	**2**
Ranking	**2nd**	**2nd**	**1st**

SECTION 2	Marks	Marks	Marks
Route Corridor Option	**B1**	**D1**	**E1**
Aquifer Vulnerability	1	2	2
Groundwater Resources	1	1	3
Total	**2**	**3**	**5**
Ranking	**1st**	**2nd**	**3rd**

15.4.5 Glossary

Aquifer: Any stratum or combination of strata that stores or transmits groundwater (Local Government (Water Pollution) Act, 1990). *More commonly:* A permeable geological stratum or formation that can both store and transmit water in significant quantities.rock that stores and transmits water in significant quantities.

Confined Aquifer: An aquifer in which the groundwater is overlain by impermeable geological strata; confined groundwater is generally subject to pressure greater than atmosphere.

Unconfined Aquifer: An aquifer where the water table is exposed to the atmosphere through openings in the overlying material.

Granular Aquifer: An aquifer composed of discrete grains of material (usually sand and/or gravel) in which groundwater flows through the spaces (pores) between the grains (intergranular flow). Such an aquifer is said to have a *primary* porosity and permeability, as contrasted with secondary porosity and permeability which results from fracturing, etc. Flow through a granular aquifer is said to be *intergranular flow.*

Poor Aquifer: An aquifer which is normally capable of yielding only sufficient water from wells or springs to supply single houses, small farms or small group water schemes. These can be sub divided into: Bedrock aquifers which are generally unproductive except for local zones (Pl) and Bedrock aquifers which are generally unproductive (Pu).

Locally Important Aquifer: An aquifer which is moderately productive, i.e. capable of yielding enough water to boreholes or springs to supply villages, small towns or factories. These are divided into: Sand/gravel aquifers (Lg); Bedrock aquifers which are generally moderately productive (Lm); and Bedrock aquifers which are moderately productive only in local zones (Ll).

Regionally Important Aquifer: An aquifer which is sufficiently productive to be able to yield enough water to boreholes or springs to supply major regional water schemes. These are divided into: extensive sand/gravel aquifers (Rg); karst aquifers (Rk); and fissured aquifers (Rf).

Attenuation: The process of diminishing contaminant concentrations in groundwater, due to filtration, biodegradation, dilution, sorption, volatilisation and other processes. The breakdown or dilution of a contaminant in water.

Base Flow (Hydrogeology): That part of the flow in a stream which is not attributable to direct runoff from precipitation or snowmelt, usually sustained by groundwater discharge. That part of a stream discharge derived from groundwater seeping into the stream.

Base Flow (Hydrology) The groundwater contribution to a surface water course is referred to as base flow. It is the component of the surface water flow not derived directly from run-off. The base flow component of a stream or river volume depends on the hydraulic properties of the contributing aquifer.

Calcareous: Composed of, or containing, calcium carbonate.

Catchment: That area determined by topographic features within which falling rain will contribute to run-off at a particular point under consideration.

Cave: A naturally occurring cavity large enough for human access.

Conduit Flow: A characterisation of some types of Karst aquifers, in which flow is concentrated in conduits created by the dissolution of the limestone bedrock.

Contaminant Loading: The amount (volume and concentration) of a contaminant discharged to soil or groundwater.

Contaminant Transport: The transport of a contaminant through topsoil, subsoil or bedrock.

Carboniferous: The geological time period from 355 to 290 million years ago when most limestones were deposited.

Diffuse Flow: A characterisation of some types of Karst aquifers, in which flow is distributed relatively evenly throughout the rock.

Dissolution: A form of chemical weathering in which water molecules, sometimes in combination with acid or another compound in the environment dissolve parts of a mineral or rock.

Doline / Enclosed Depression: A small to medium sized closed depression, a few metres to a few hundred metres in diameter and depth. Dolines are formed by slow, concentrated solutional removal of rock in an area, from the surface downwards, or by the collapse of overlying rock into a cave or chamber beneath (collapse doline). Dolines function as funnels, allowing point recharge of the karstic aquifer.

Downgradient: The direction in which groundwater or surface water flows (also referred to as down-slope). Opposite of upgradient.

Drumlin: A long, egg-shaped hill that develops when pressure from an overriding glacier reshapes a moraine. Drumlins range in height from 5 to 50 meters and in length from 400 to 2000 meters. They slope down in the direction of the ice flow.

Estevelle: A karst feature that can function as a spring or as a swallow hole depending on underground water levels.

Fault: A fracture in rock along which there has been relative displacement of the two sides.

Fissure: Natural crack in rock which allows rapid water movement.

Groundwater: That part of the subsurface water that is in the saturated zone, i.e. below the water table.

Groundwater Protection Response: Control measures, conditions or precautions recommended as a response to the acceptability of an activity within a groundwater protection zone.

Groundwater Protection Scheme: A scheme comprising two main components: a land surface zoning map which encompass the hydrogeological elements of risk and a groundwater protection response for different activities.

Groundwater Protection Zone: Zones delineated by integrating aquifer categories or source protection areas and associated vulnerability ratings. The zones are shown on a map, each zone being identified by a code e.g. SO/H (outer source area with a high vulnerability) or Rk/E (regionally important aquifer with an extreme vulnerability). Groundwater protection responses are assigned to these zones for different potentially polluting activities.

Groundwater Source: A source of water supply which depends on groundwater, usually a well (dug well or borehole) or a spring, occasionally an infiltration gallery.

Groundwater Table: The uppermost level of saturation in an aquifer at which the pressure is atmospheric.

Karst: An area of limestone or other highly soluble rock, in which the landforms are of dominantly solutional origin, and in which the drainage is usually underground in solutionally enlarged fissures and conduits.

Karst Feature: Landscape feature which results from karstification (solution of limestone) such as a turlough, swallow hole, cave, etc.

Limestone: A sedimentary rock composed primarily of calcium carbonate. Some 10% to 15% of all sedimentary rocks are limestones. Limestone is usually organic, but it may also be inorganic.

Mudstone: Argillaceous or clay-bearing sedimentary rock which is non-plastic and has a massive non-foliated appearance.

Permeability: The ability of a medium to transmit fluids under a potential gradient (units = $L^3/t/L^2$ or L/t). Measure of a soil or rock's capacity to transmit water.

Piezometric Surface: (Potentiometric Surface) The surface representative of the level to which water will rise in a well cased to the impermeable layer above a confined aquifer. In unconfined aquifers, this surface corresponds with the groundwater table.

Recharge: The addition of water to the zone of saturation; also, the amount of water added.

Return Period The frequency with which a certain event would be expected to occur on average over a long period of record.

Sandstone: A clastic rock composed of particles that range in diameter from 1/16 millimetre to 2 millimetres in diameter. Sandstones make up about 25% of all sedimentary rocks.

Shale: A rock formed from fine-grained clay-size sediment.

Siltstone: A typically layered and flaggy rock composed of two thirds silt-sized particles.

Source Protection Area (SPA): The catchment area around a groundwater source which contributes water to that source (Zone of Contribution), divided into two areas; the Inner Protection Area (SI) and the Outer Protection Area (SO).

The **SI** is designed to protect the source against the effects of human activities that may have an immediate effect on the source, in particular in relation to microbiological pollution. It is defined by a 100-day time of travel (TOT) from any point below the water table to the source.

The **SO** covers the remainder of the zone of contribution of the groundwater source.

Spring: A flow of water that occurs where the groundwater table intercepts the ground surface.

Storage: The volume of water held within a certain volume of saturated aquifer.

Subsoil: The material between the topsoil and the bedrock.

Swallow Hole: A small steep depression caused in karst topography by the dissolution and collapse of subterranean caverns in carbonate formations.

Till: A glacial sediment composed of rounded rock fragments in a clay rich matrix.

Vulnerability: A term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities.

Chapter 17 Traffic Assessment, Economic Assessment & Road Safety

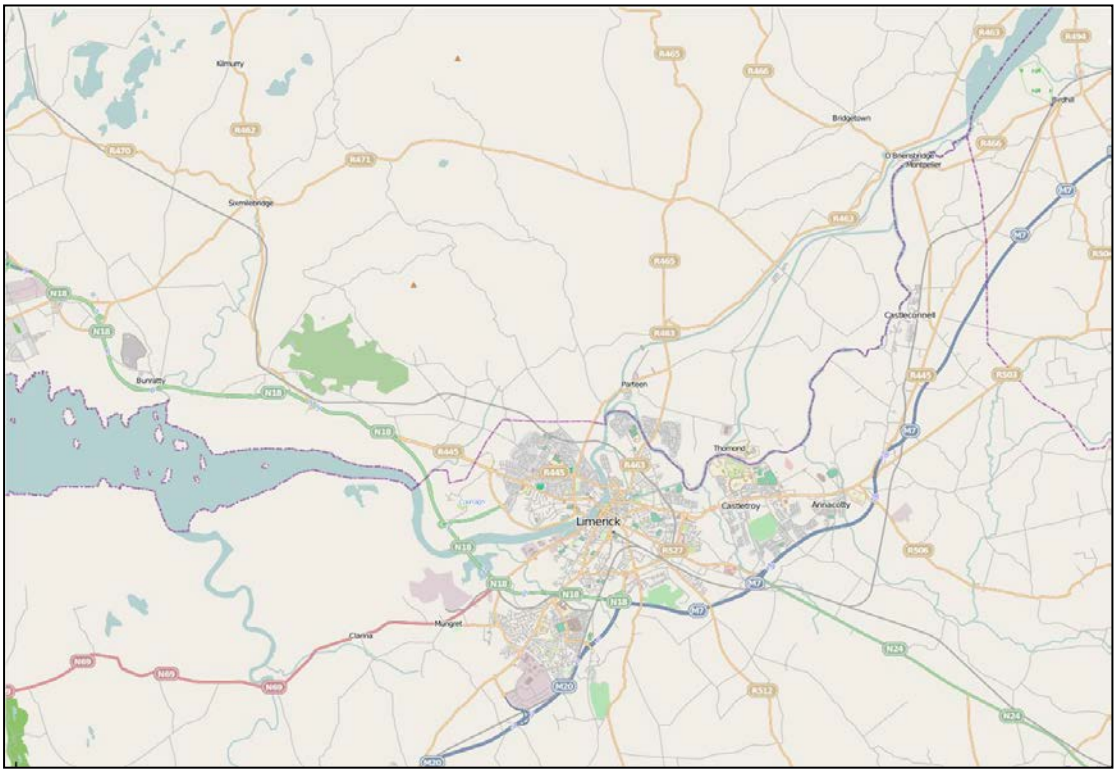
17.1 Traffic Assessment

17.1.1 Introduction

Overview

This report outlines the development of a traffic model built as part of the Route Selection process to assess the impact of potential route options for the proposed Limerick Northern Distributor Road (LNDR). The traffic model study area is illustrated in Figure 17.1.

Figure 17.1: Traffic Model Study Area



Although not a national road scheme, the various route options for the LNDR are appraised in line with the NRA Project Management Guidelines (PMG) 2010 and NRA Project Appraisal Guidelines (PAG) 2011. These guidelines are in compliance with the Department of Transport's Common Appraisal Framework for Transport Projects and Programmes (2009).

Methodology

The traffic study consists of three parts:

- An examination of the existing traffic patterns;
- A prediction of future traffic flow levels; and
- An assessment of the impact of the proposed scheme options on traffic patterns in the proposed opening and design years.

Morning peak and Inter-peak period traffic models have been developed using the traffic modeling software VISUM.

In 2009 a strategic multimodal transportation model was developed by Mott MacDonald on behalf of the Mid West Regional Authority. This model encompasses the areas of County Clare, County Limerick and North Tipperary and is known as the Mid West Area Strategic Plan (MWASP). This model was used as a starting point for developing the 2011 Base Year LAM's as it incorporated recent traffic count and RSI information.

The Local Area Model was developed, based on NRA medium growth forecast rates, to provide the following scenarios:

- Base Year (2011)
- Opening Year (2018) Do Minimum;
- Opening Year (2018) Do Something with each route corridor option;
- Future Year (2033) Do Minimum; and
- Future Year (2033) Do Something with each route corridor option.

17.1.2 Data Collection

In order to develop a traffic model, a significant level of traffic data is required to ensure that the model can replicate existing traffic patterns and volumes. This section describes the collation of traffic data for the development of the base year traffic model.

Strategic Traffic

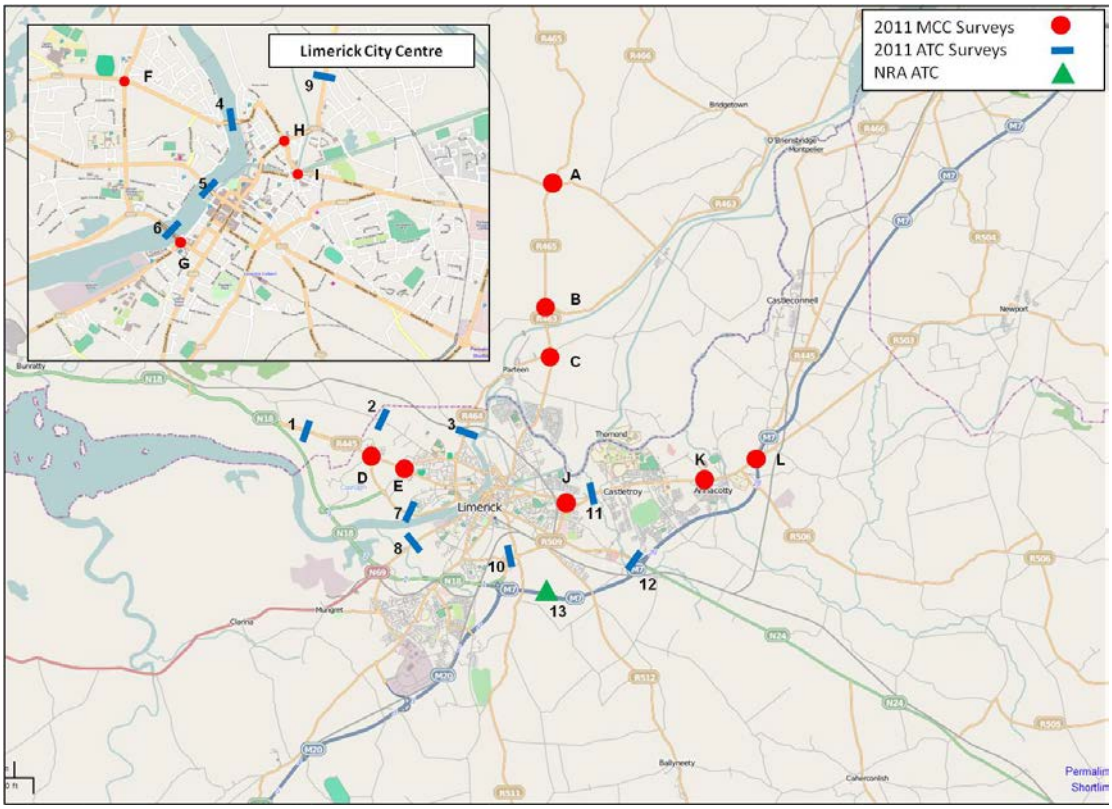
Use of the MWASP Model enabled consideration of the wider strategic traffic impacts of the scheme without need for additional survey data or significantly extending the Local Area Model.

Traffic Surveys

A summary of the traffic survey data that was collated as part of the development of the 2011 LNDR LAM's is outlined below:

- 12 Automatic Traffic Counts (ATC) carried on the 23rd March 2011;
- 1 ATC 'Rossbrien N7-02' (NRA Permanent Traffic Counter on M7);
- 12 12hr Manual Classified Counts (MCC) undertaken between the 23rd – 30th March 2011; and
- Journey time surveys (3 routes).

Figure 17.2: Location of ATC and MCC Surveys



Automatic Traffic Counters (ATC)

Traffic flow data extracted from the permanent NRA ATC and 12 ATC surveys undertaken on the 23rd March 2010 are presented in Table 17.1 below.

Table 17.1: Automatic Traffic Counters (ATC)

ATC	ATC Location	AM Peak (8-9am)	Avg. Inter Peak	PM Peak (5-6pm)	AADT	% HGV
1	R445 Ennis Rd	2079	1296	2167	21551	3.7
2	Old Cratloe Rd.	199	126	222	1997	0.6
3	R464 Long Pave Rd.	750	369	643	5666	2.1
4	R445 Thomand Bridge	975	1173	1365	16802	1.3
5	R857 Sarsfield Bridge	1046	812	996	13443	0.8
6	R527 Shannon Bridge	2323	1739	2235	25586	2.2
7	R527 Condell Rd.	1442	973	1353	14602	2.6
8	R510 Dock Rd.	1765	1276	1668	17676	3.6
9	R463 Corbally Rd.	1100	1100	1194	17593	1.0
10	R509 Childers Rd.	1596	1562	1813	21119	1.6
11	R445 Dublin Rd.	2244	2131	2638	32335	2.3
12	R527 Ballysimon Rd.	1697	1409	1593	19643	2.4
13	NRA Permanent ATC	3651	1903	3428	34675	6.5

Manual Classifed Counts (MCC)

Manual classified count (MCC) surveys were undertaken at 12 junctions on the 23rd March 2011 over a 12 hour period (07:00 – 19:00). The following junctions were surveyed:

- Junction A: R471/R465;
- Junction B: R465/R463;
- Junction C: R463/R464;
- Junction D: R445/R527 Coonagh Roundabout;
- Junction E: R445/R857 Ennis Road Junction;
- Junction F: R464/R445;
- Junction G: R510/R527 Dock Road Roundabout;
- Junction H: R463/R445 Island Road Junction;
- Junction I: R445/R526 Island Road Junction;
- Junction J: R445/R509 parkway Roundabout;
- Junction K: R445 Annacotty Roundabout; and
- Junction L: R445/M7 Newport Roundabout.

Journey Time Surveys

Journey time information has been collected to allow validation of the travel times on the existing road network in the traffic model.

Journey time surveys were undertaken along a number of routes during the AM (08:00 – 09:00), Inter Peak (12:00 – 14:00) and PM Peak (17:00 – 18:00) on 7th, 8th and 16th of March 2011. The surveys were undertaken as follows:

- Route A: Between the M7 at the Newport Roundabout and the N18/R445 Cratloe junction;
- Route B: Between the M7 at the Newport Roundabout and the Coonagh Roundabout on the R445; and
- Route C: Between Birdhill and the N18 / R458 junction to the north of Shannon.

The journey time surveys were undertaken using the moving observer technique. The results are outlined in Table 17.2 with Routes A – C illustrated in Figures 17.3 to 17.5.

Table 17.2: Journey Time Data

Time Period	Direction	Route A (sec)	Route B (sec)	Route C (sec)
AM	Eastbound	1427	1042	2247
	Westbound	1822	1737	2207
Inter	Eastbound	1746	1400	2305
	Westbound	1770	1594	2208
PM	Eastbound	1573	1567	2305
	Westbound	1635	1737	2208

Figure 17.3: Journey Time Survey Route A

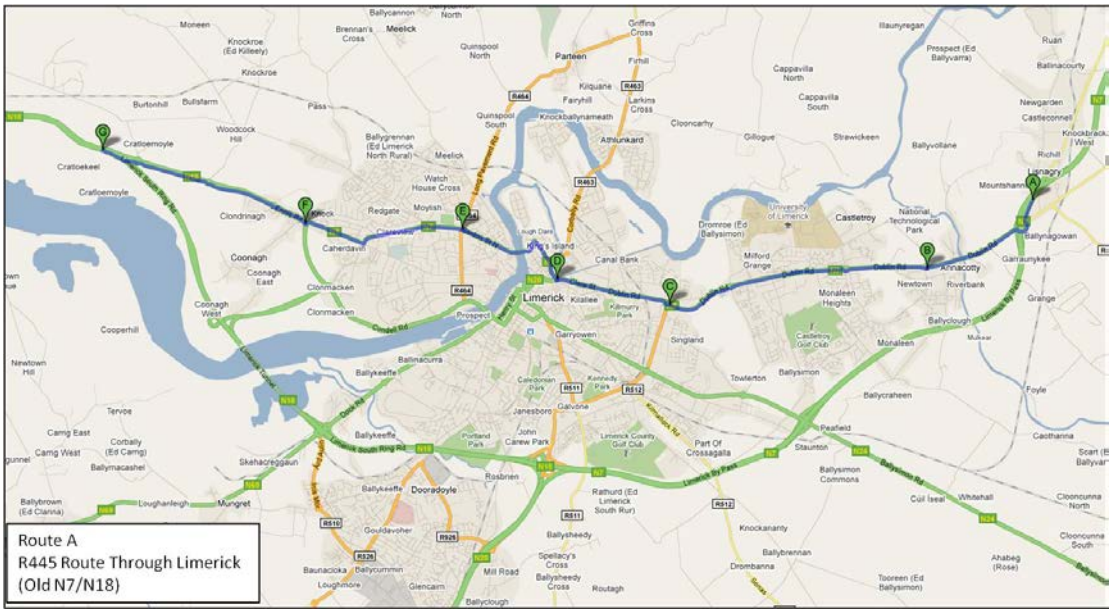


Figure 17.4: Journey Time Survey Route B

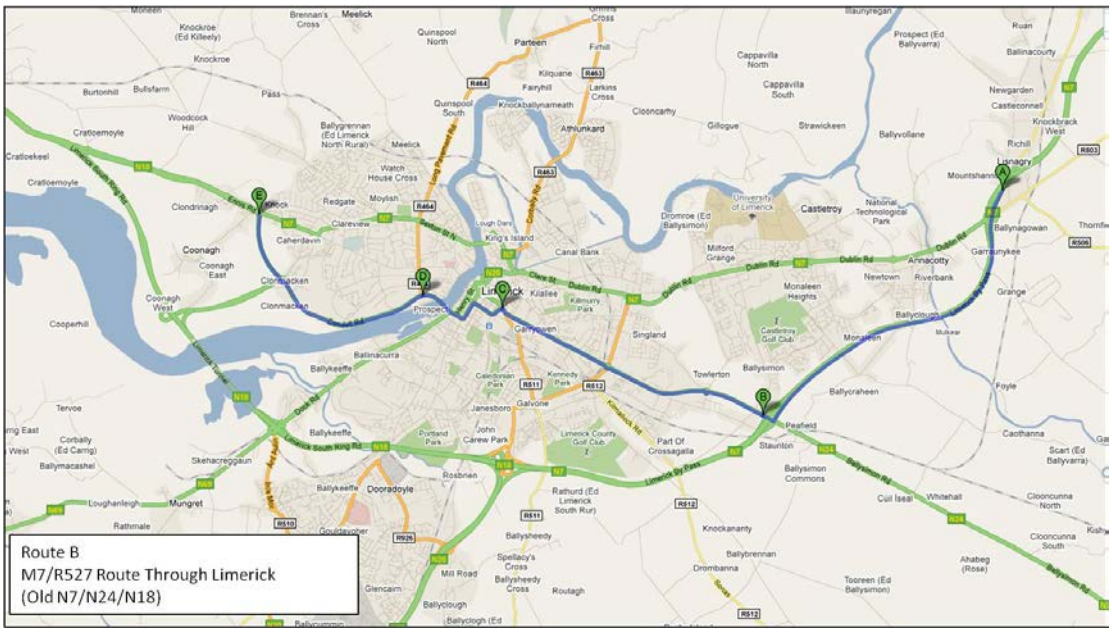
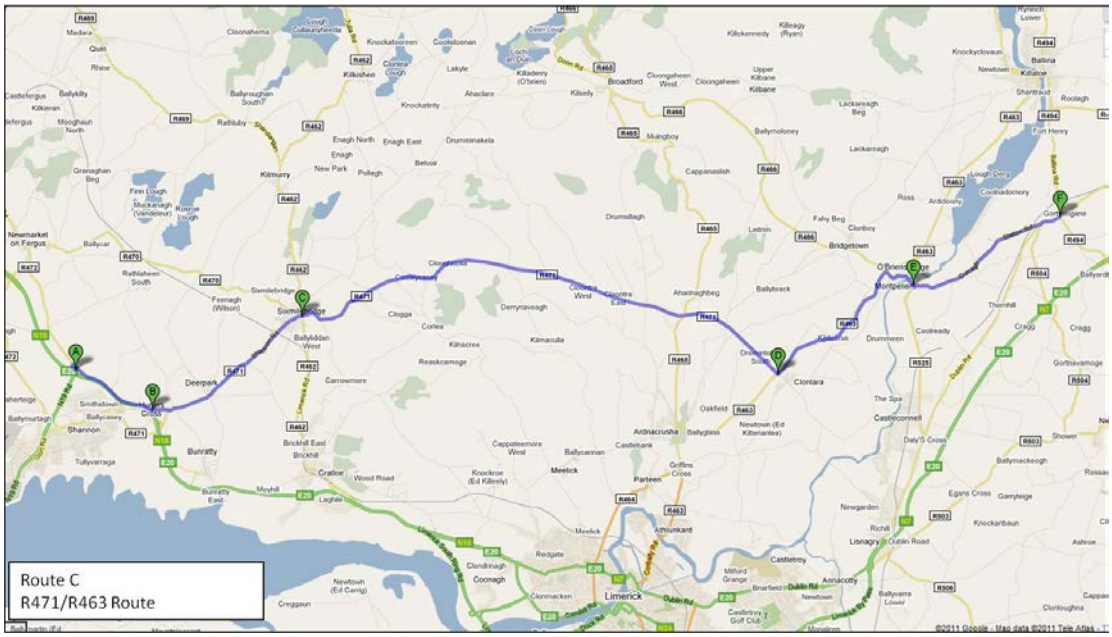


Figure 17.5: Journey Time Survey Route C



17.1.3 Traffic Model

This section of the report describes the development, calibration and validation of the 2011 Base Year LAM's. Base year models have been developed for the following time periods:

- AM Peak Hour (08:00 – 09:00); and
- Average Inter Peak Hour (10:00 – 16:00).

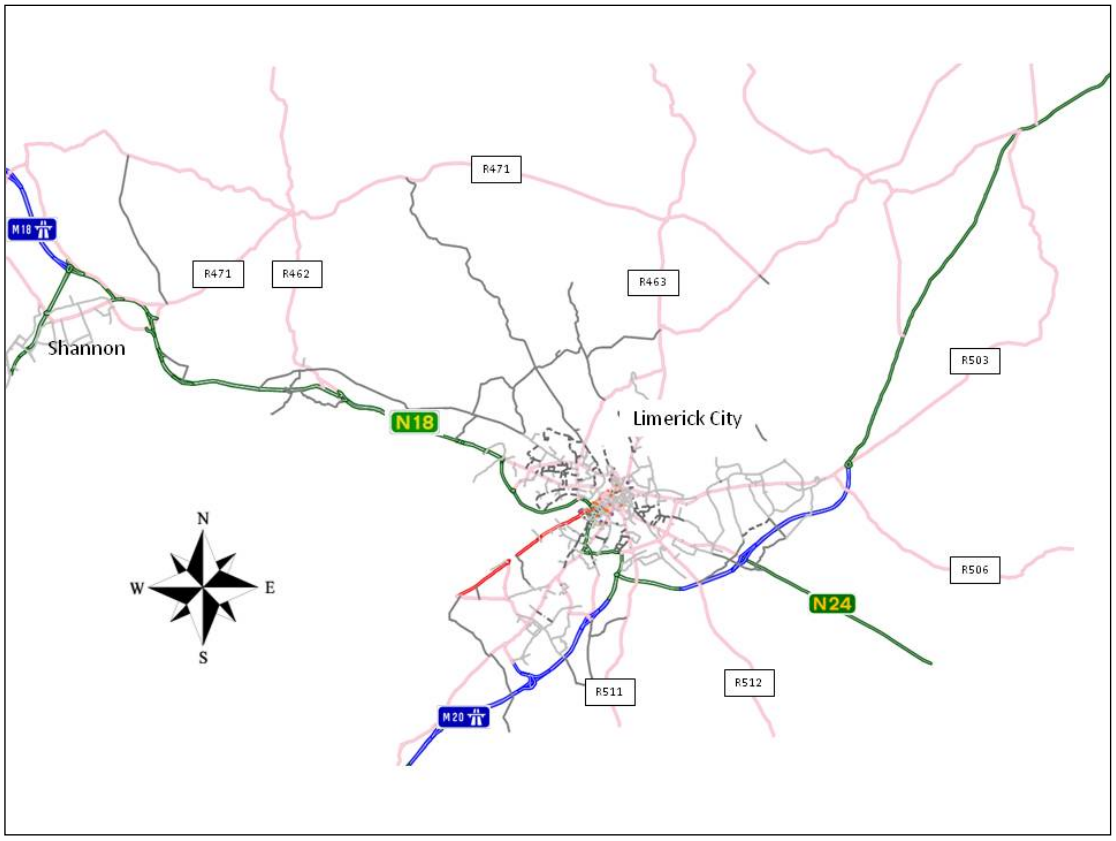
Assignment (fixed demand) models were developed using VISUM (V11.52-02) based on the MWASP model.

Network Development

As outlined above the 2009 MWASP model was used as a starting point for developing the 2011 Base Year LAM's as it incorporated recent traffic count and RSI information. The initial step was to indentify the study area for the LAM. This area was identified by comparing the difference in flows between the 2009 Do Nothing Scenario i.e. without the proposed scheme, and the 2009 Do Something Scenario i.e. with the proposed scheme in place. Any links which show a change in flow as a result of the scheme were included in the LAM network.

Once the study area was identified, it was 'cordoned' out of the 2009 MWASP model. Fig 17.6 illustrates the LAM that was cordoned from the 2009 MWASP.

Figure 17.6: 2009 LNDR LAM Network



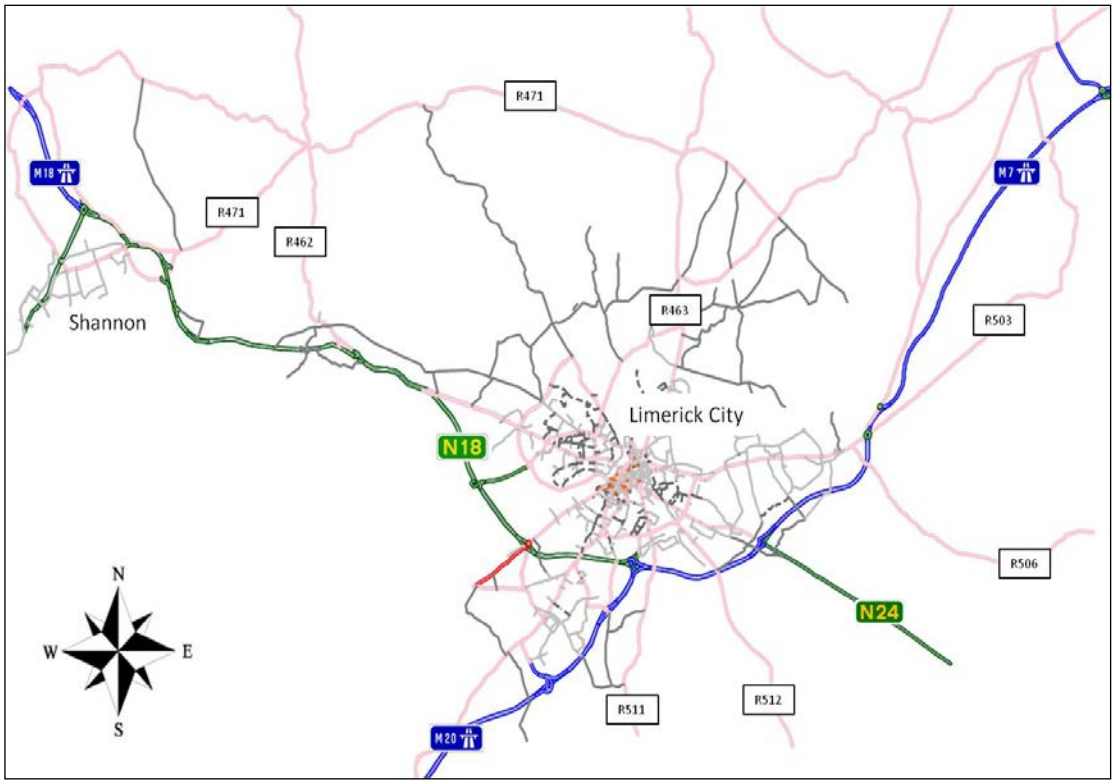
LAM Network Refinement

A significant number of changes to the road network in study area have occurred since the development of the 2009 MWASP. The following changes to the network have been incorporated in the 2011 LAM networks:

- N7 Limerick Tunnel (LSRR Phase 2); and
- M7 Nenagh Limerick Motorway.

A number of additional local roads to the north of Limerick City which were not included in the MWASP model have been included in the 2011 LAM as they are impacted upon by the proposed LNDR scheme. The 2011 LAM network is illustrated in Figure 17.7.

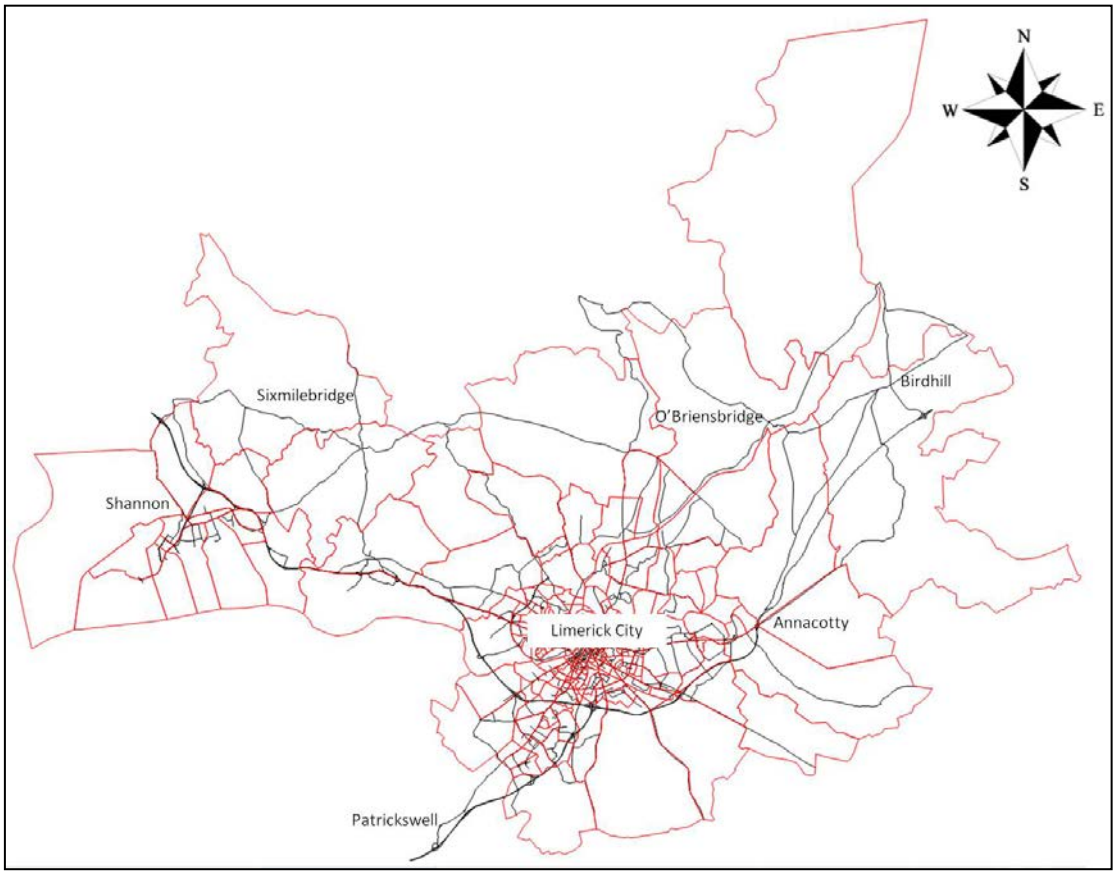
Figure 17.7: 2011 LNDR LAM Network



LAM Zoning System

The zoning system for the LAM is based on the MWASP model zoning system. The zoning system cordoned from the MWASP model is illustrated in Figure 17.8.

Figure 17.8: LAM Cordoned Zoning System (MWASP Model)

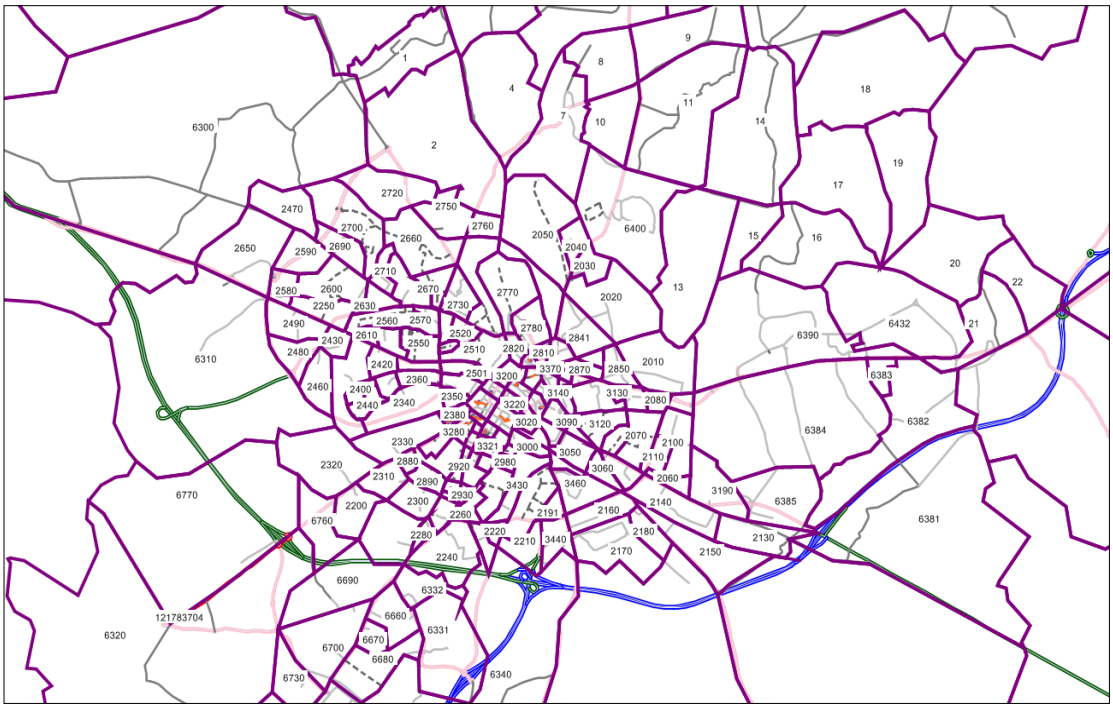


Refinement of Zoning System

In order to obtain greater detail within the LAM, a more detailed zoning system than used in the MWASP was adopted. The MWASP model zones to north of Limerick City through which the proposed LNDR would pass through were further refined in order to improve trip distribution in the area.

Six zones to the north of Limerick City were split into a total of 30 subzones, to produce a LAM with a total of 346 zones. The distribution of demand in these split zones was based on an assessment of the An Post Geo-Coding data which shows the location of all residential and commercial postal address points within each zone. The refined zoning system to the north of Limerick City is illustrated in Figure 17.9.

Figure 17.9: 2011 LNDR LAM Zoning System (Limerick City)



Matrix Development

As previously outlined the MWASP model was developed for a total of seven user class. As part of the development of LNDR LAM these matrices were aggregated into two user classes, Light Vehicles (LV) & Heavy Vehicles (HV). The MWASP model user classes were aggregated as follows:

Light Vehicles

- HBW – Home based work;
- HBEB – Home based employers business;
- HBO – Home based other;
- NHBEB – Non Home based employers business;
- NHBO – Non Home based other;
- LGV – Light goods vehicles; and
- HGV – Heavy goods vehicles.

Heavy Vehicles

- HGV – Heavy goods vehicles.

Matrices were then modified during the calibration process using the 2011 traffic survey data ascertained for each peak and the select link analysis tool in VISUM.

Future Year Matrix Development

The development of traffic growth forecasts for the future year LAM's has been based on the requirements set out in PAG Units 5.4: Zone-Based Traffic Growth Forecasting. That guidance sets out separate methodologies for establishing trip end growth for internal and external zones within the LAM.

Demographic Growth (NTM)

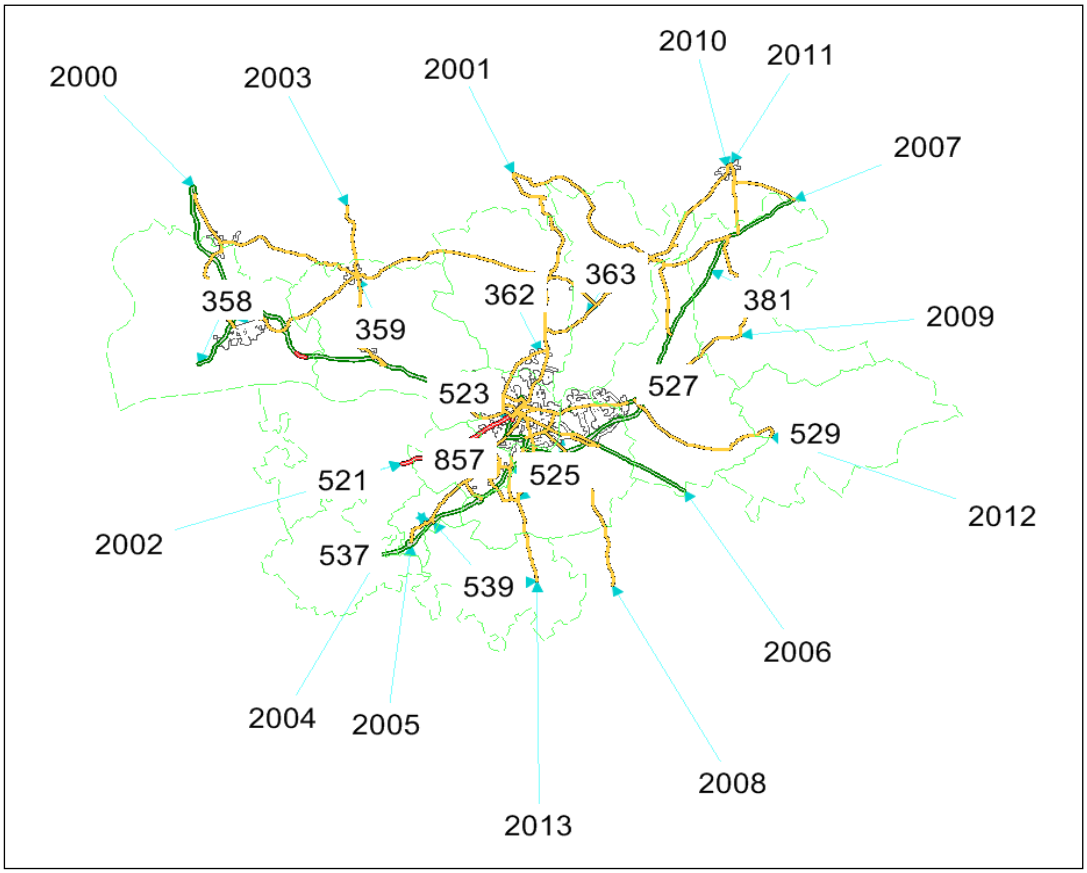
The National Traffic Model (NTM) is made up of 874 zones with each of these zones containing demographic data (population, employment and car ownership) for a base year of 2006 and forecast years of 2025 & 2040. Demographic data is available for three future year growth scenarios namely Low, Medium and High.

As part of the route selection process, only the Medium growth scenario is considered. The future year growth in traffic in the LAM will be based on the forecast growth in population and employment in the LAM. The LAM for the LNDR is made up of the following NTM zones:

- Limerick City: Zones 523 & 841;
- Limerick County: Zones 521, 525, 527, 539 & 857;
- Clare County: Zones 358, 359, 362 & 363; and
- Tipperary County: 381 & 529.

14 external zones (2000-2013) feed traffic into and out of the study area. The NTM zones which cover the LNDR LAM are illustrated below in Figure 17.10.

Figure 17.10: NTM Zones in LAM



Internal Zone Trip End Growth Factors

The relationship between the Limerick LAM zones and the NTM zones was established. Then the origin (O) and destination (D) Trip End Growth (TEG) factors for the zones in the LAM were identified for both the AM and Inter Peak hours from PAG Unit 5.4.

External Zone Trip End Growth Factors

The LAM boundary was cordoned from the both the 2006 Base Year NTM and 2025 and 2040 Do-Nothing NTM, these model where then compared against each other to establish growth factors for each external zone. These growth factors were then annualised to provide annual external TEG factors for the periods 2006–2025 and 2026-2040.

Reallocation of Future Year Growth

NRA PAG Unit 5.3 states that "Within the LAM, there is some flexibility to reallocate growth between different LAM zones within a single NTM zone, although the trip end growth for the collective LAM zones that form the NTM zone should remain consistent with the zone-based trip end growth rates. To account for this, a study of land use zonings in and around Limerick was undertaken using the following documents:

- Limerick City Development Plan 2010 – 2016 (Limerick City Council);
- Draft Southern Environs Local Area Plan 2011 – 2017 (Limerick County Council); and
- South Clare Local Area Plan 2009 – 2015 (Clare County Council).

The review identified a number of key areas surrounding Limerick City where development could potentially occur up to the Design Year horizon of 3033. The following 5 key areas were identified and are also illustrated in Figure 17.11:

- Area A: Mungret/Ballycummin;
- Area B: Coonagh/Moyross;
- Area C: Parteen;
- Area D: Castletroy/University; and
- Area E: Limerick City Centre.

Figure 17.11: Key Growth Areas

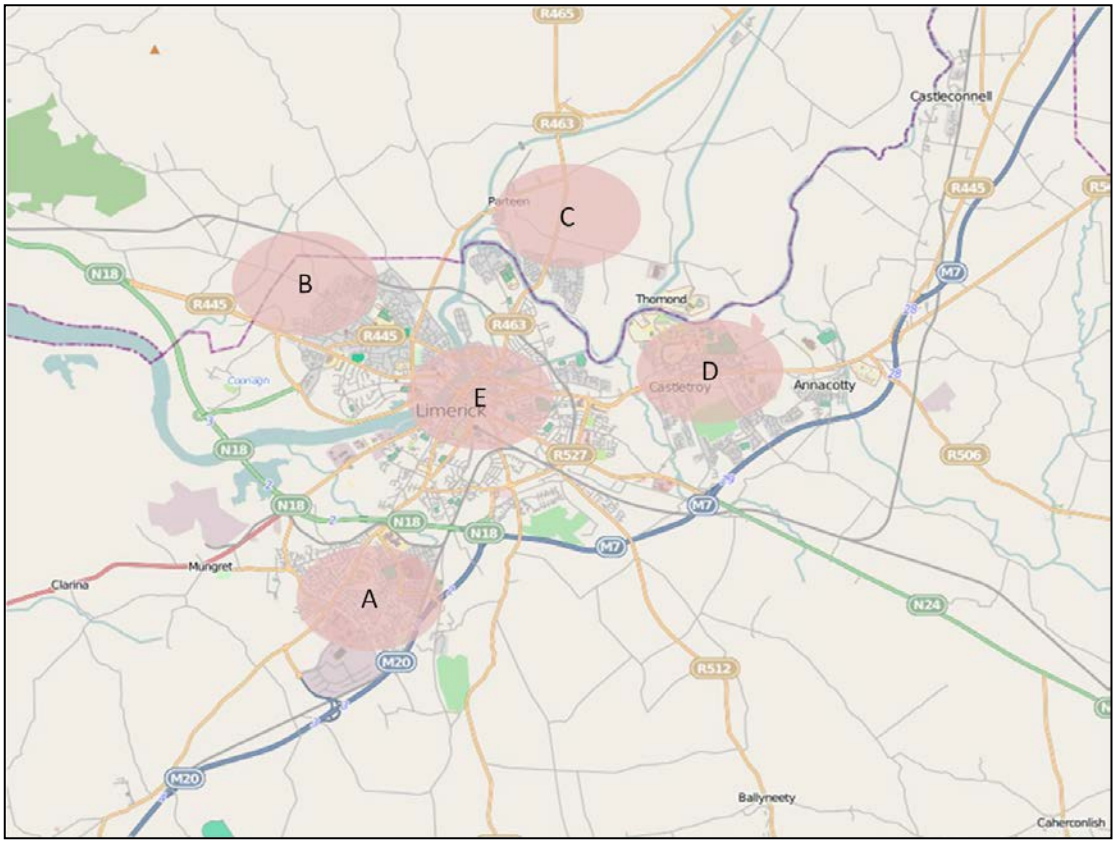


Table 17.11 below outlines the proposed distribution of population and employment for the 5 key growth areas. The actual total growth in trips within the 5 growth areas for Opening Year (2018) and Design Year (2033) during the AM and Inter peak periods is presented in Table 17.3 for Light Vehicles.

Table 17.3: Future Year Growth Distribution (%)

Land Use	A	B	C	D	E	Total
Residential	20%	20%	20%	20%	20%	100%
Employment	20%	20%	20%	20%	20%	100%

The future year target trip ends for the Opening and Design Year scenarios were then adjusted to take into account of the reallocation of growth among the five key growth areas outlined above.

Estimation of Annual Average Daily Traffic (AADT)

To estimate Annual Average Daily Traffic (AADT) a relationship was developed based on regression analysis of local area traffic data to allow the AM Peak hour and average Inter Peak hour flows to be converted into AADT values. The AM and Inter Peak Period flows were converted to AADT values using the following formula:

(2.7* x) + (11.5* y) = AADT

Where:

x = AM Peak Hour Flow

y = Average Inter Peak Hour Flow

The local traffic data that was used to develop this formula was taken from the 13 ATC sites undertaken as part of this study. In order to assess the accuracy of the AM and Inter Peak hour expansion factors to AADT, a comparison of observed and modelled 2011 base year AADT has been undertaken in Table 17.4 below.

Table 17.4: Accuracy of AM & Inter Peak Hour Expansion Factors to AADT

ATC	ATC Location	AM	Inter	Observed AADT	Modelled AADT	Accuracy
1	R445 Ennis Rd	2079	1296	21551	20517	4.8%
2	Old Cratloe Rd.	199	126	1997	1986	0.5%
3	R464 Long Pave Rd.	750	369	5666	6268	-10.6%
4	R445 Thomand Bridge	975	1173	16802	16122	4.0%
5	R857 Sarsfield Bridge	1046	812	13443	12162	9.5%
6	R527 Shannon Bridge	2323	1739	25586	26271	-2.7%
7	R527 Condell Rd.	1442	973	14602	15083	-3.3%
8	R510 Dock Rd.	1765	1276	17676	19440	-10.0%
9	R463 Corbally Rd.	1100	1100	17593	15620	11.2%
10	R509 Childers Rd.	1596	1562	21119	22272	-5.5%
11	R445 Dublin Rd.	2244	2131	32335	30565	5.5%
12	R527 Ballysimon Rd.	1697	1409	19643	20785	-5.8%
13	NRA ATC Rossbrien	3651	1903	34675	31742	-8.4%

The table above shows that the conversion factors used to estimate AADT from the AM and Inter peak hour models leads to accurately modelled AADT forecasts.

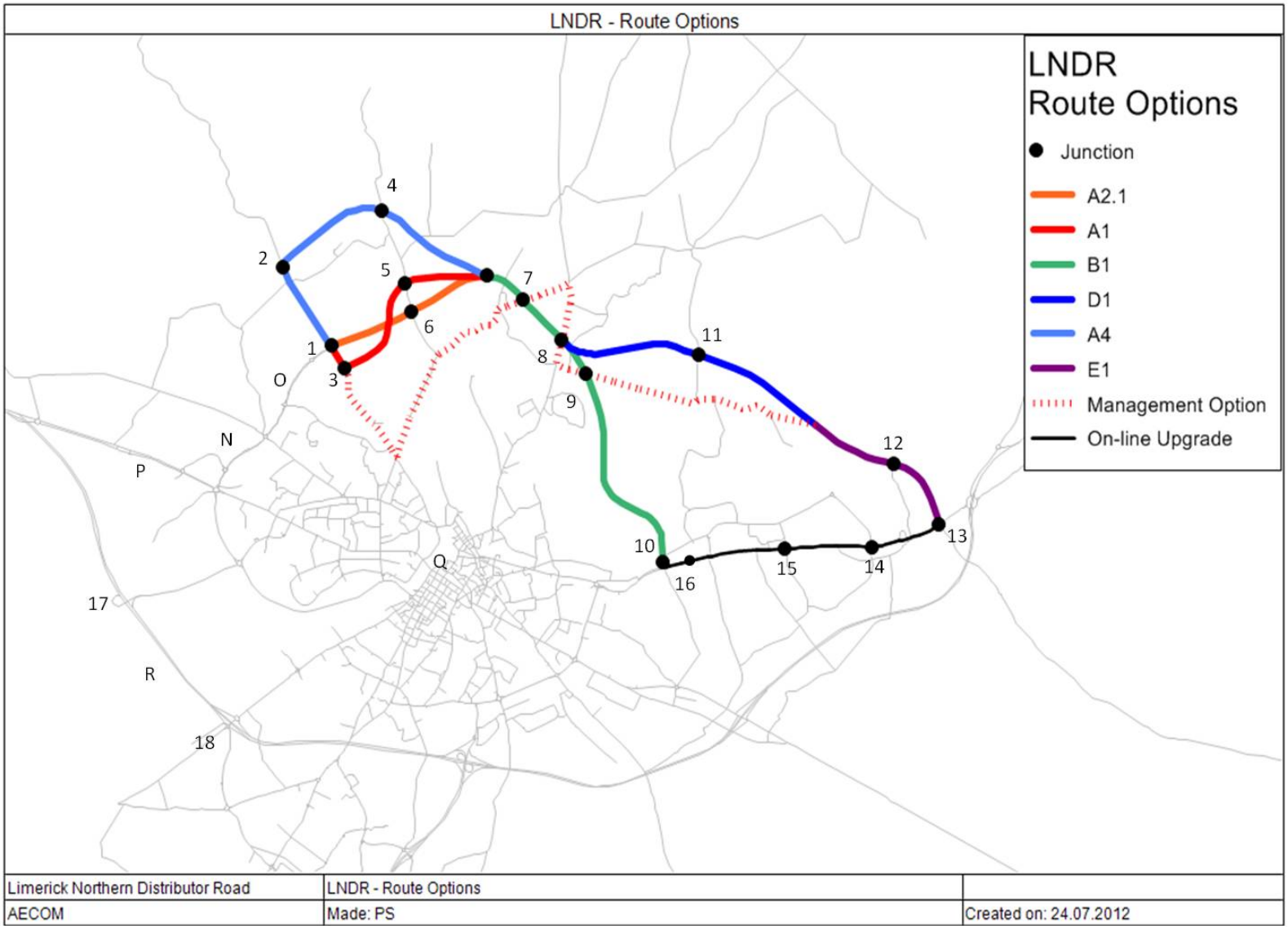
Forecast AADT

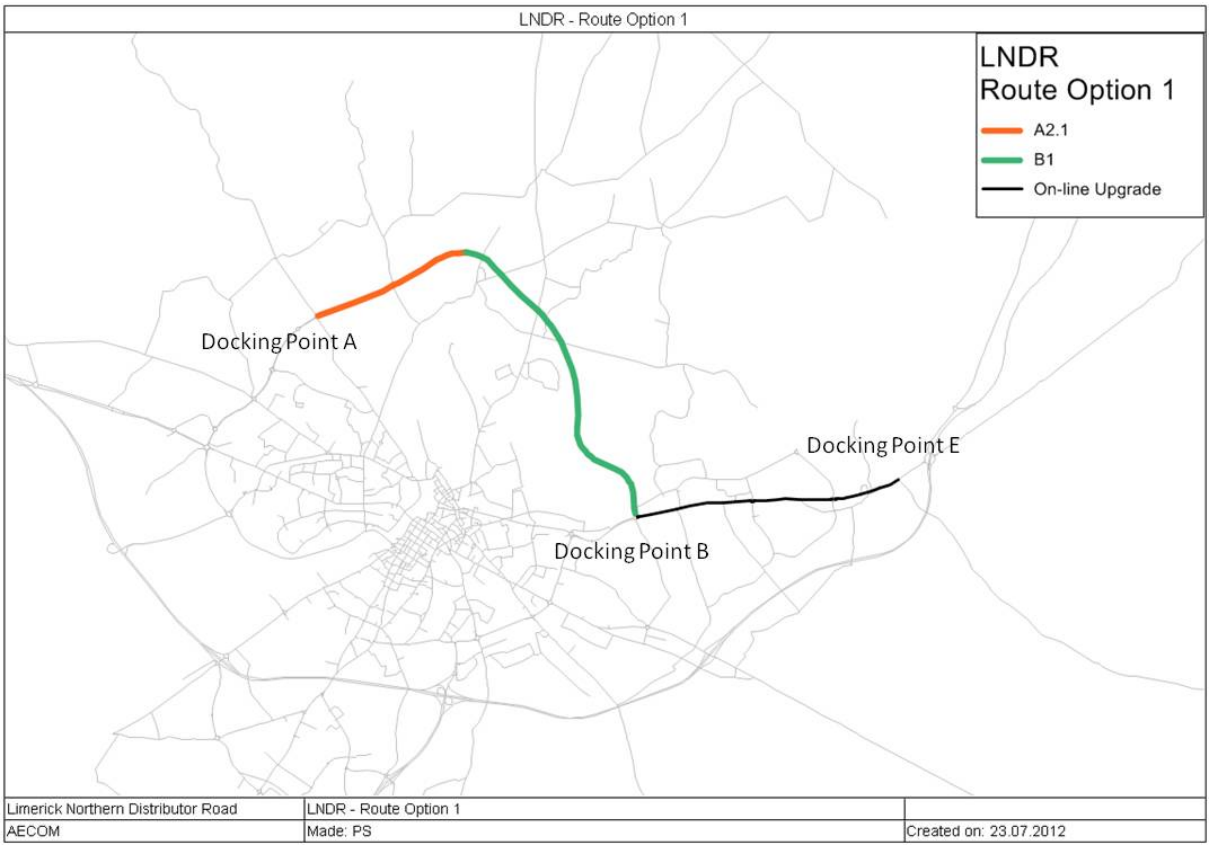
The forecast AADT flows on the road network in the study area extracted from the models are outlined in Tables 17.5 for the following scenarios:

- 2033 Do-Minimum; and
- 2033 Do-Something.

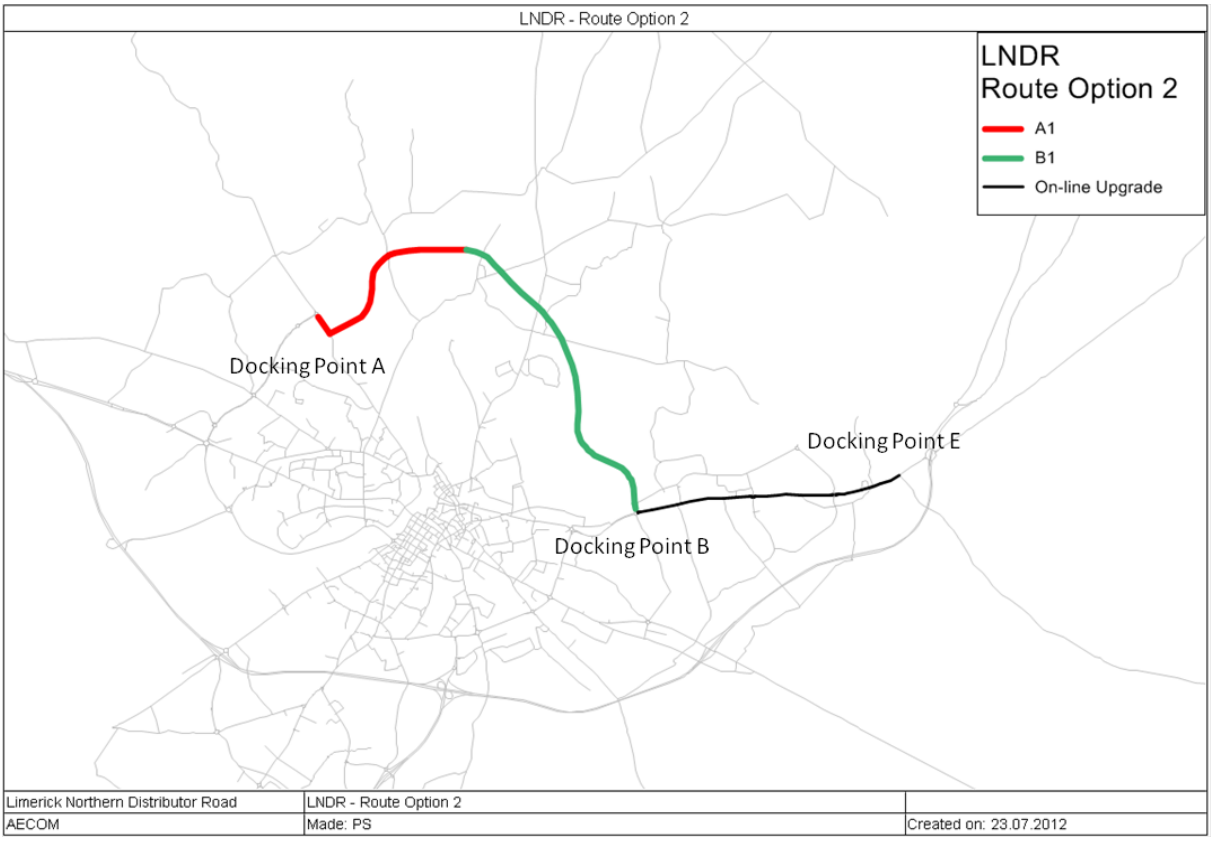
Figure 17.12 overleaf highlights the road network and locations where the AADT traffic flows were taken in the model. Table 17.5 outlines the forecast AADT for the NRA medium growth scenario.

Figure 17.12: 2033 AADT Locations

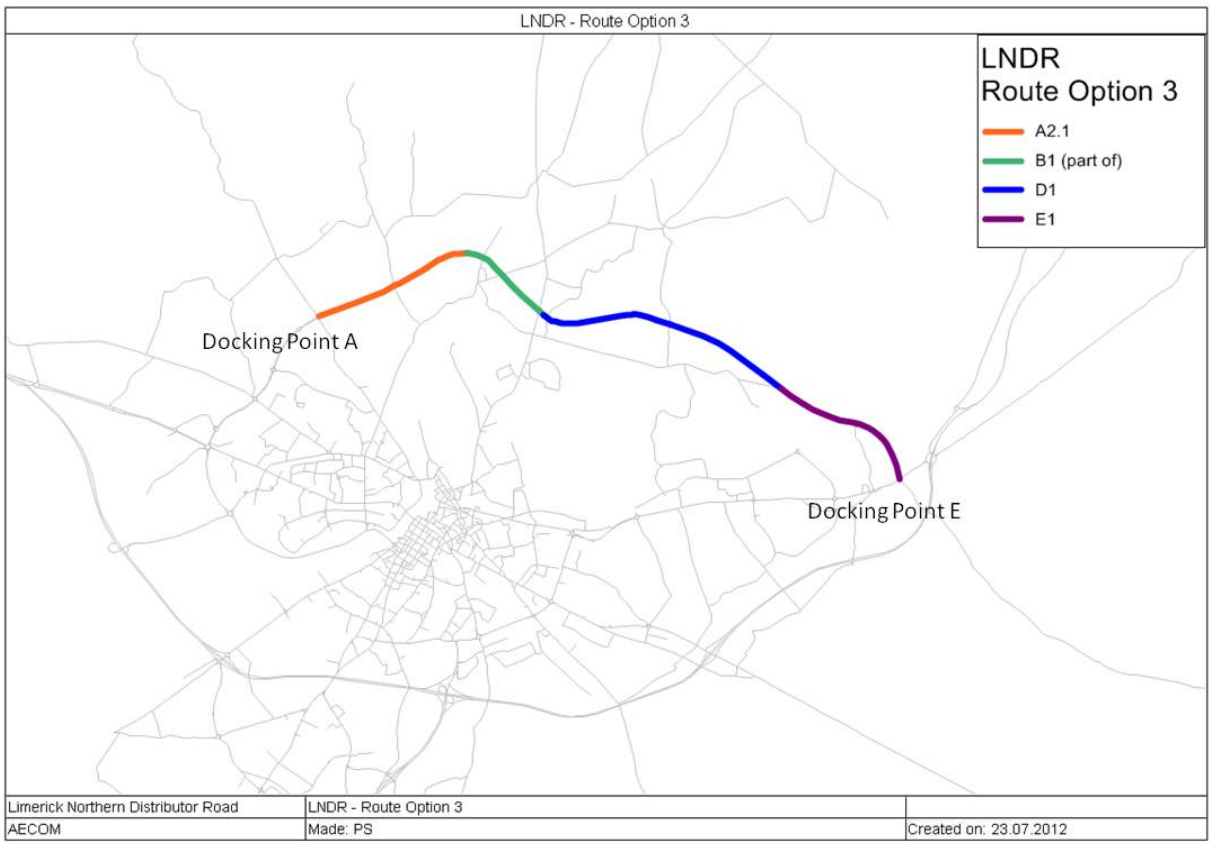




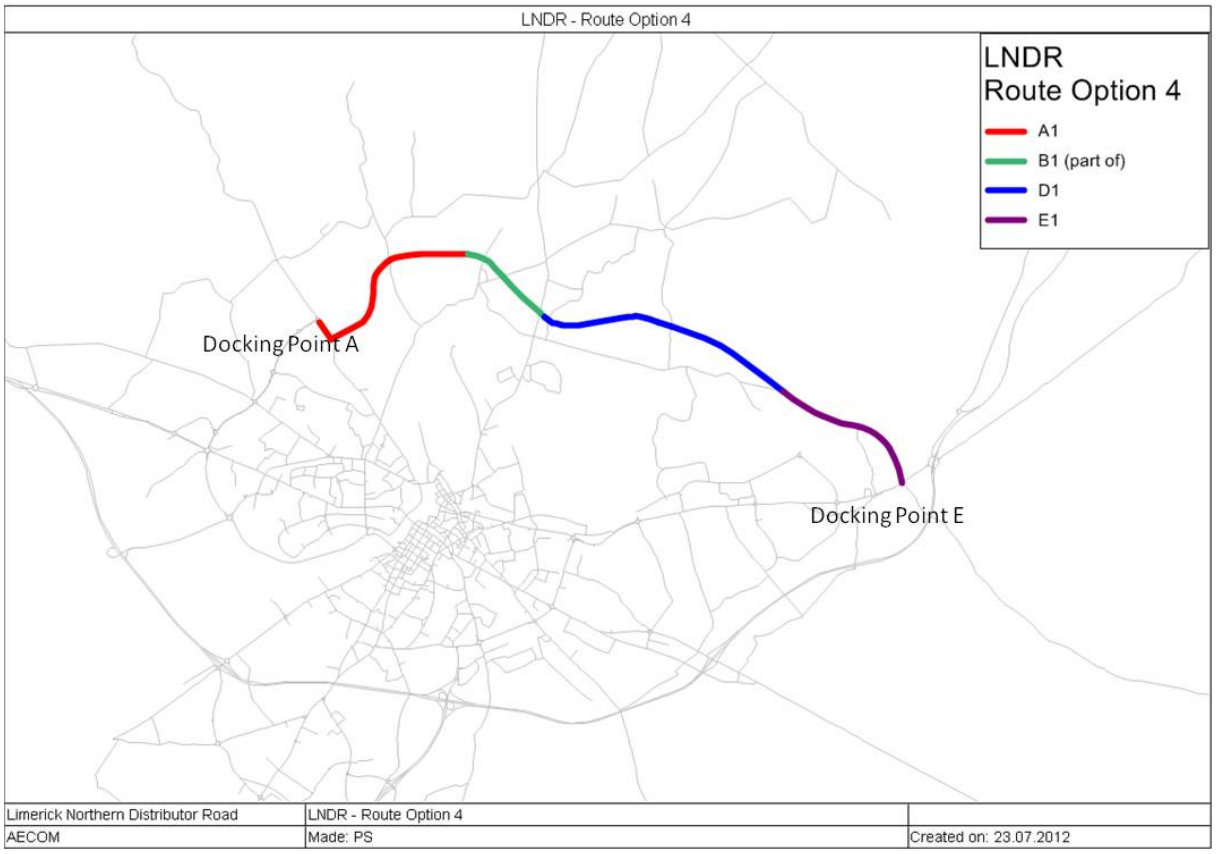
Do-Something Route Option 1 (Docking Points A-B-E)



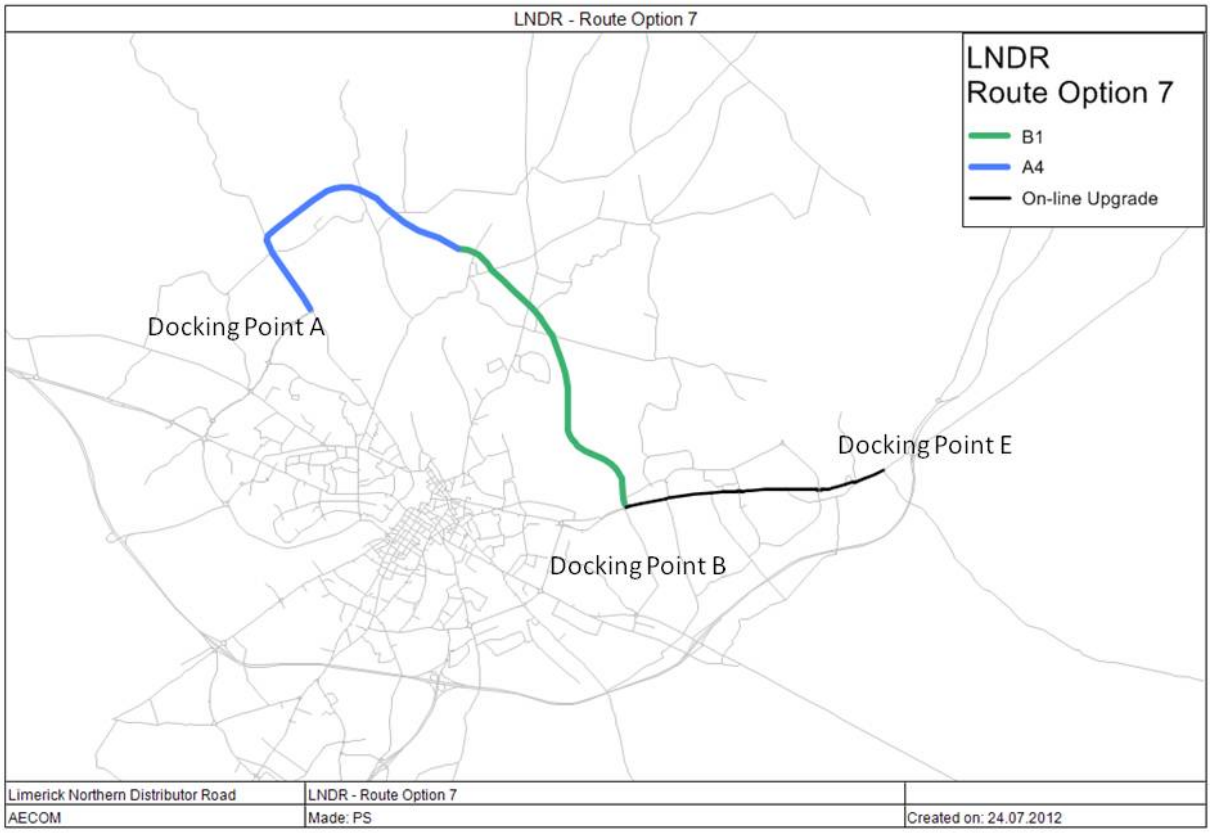
Do-Something Route Option 2 (Docking Points A-B-E)



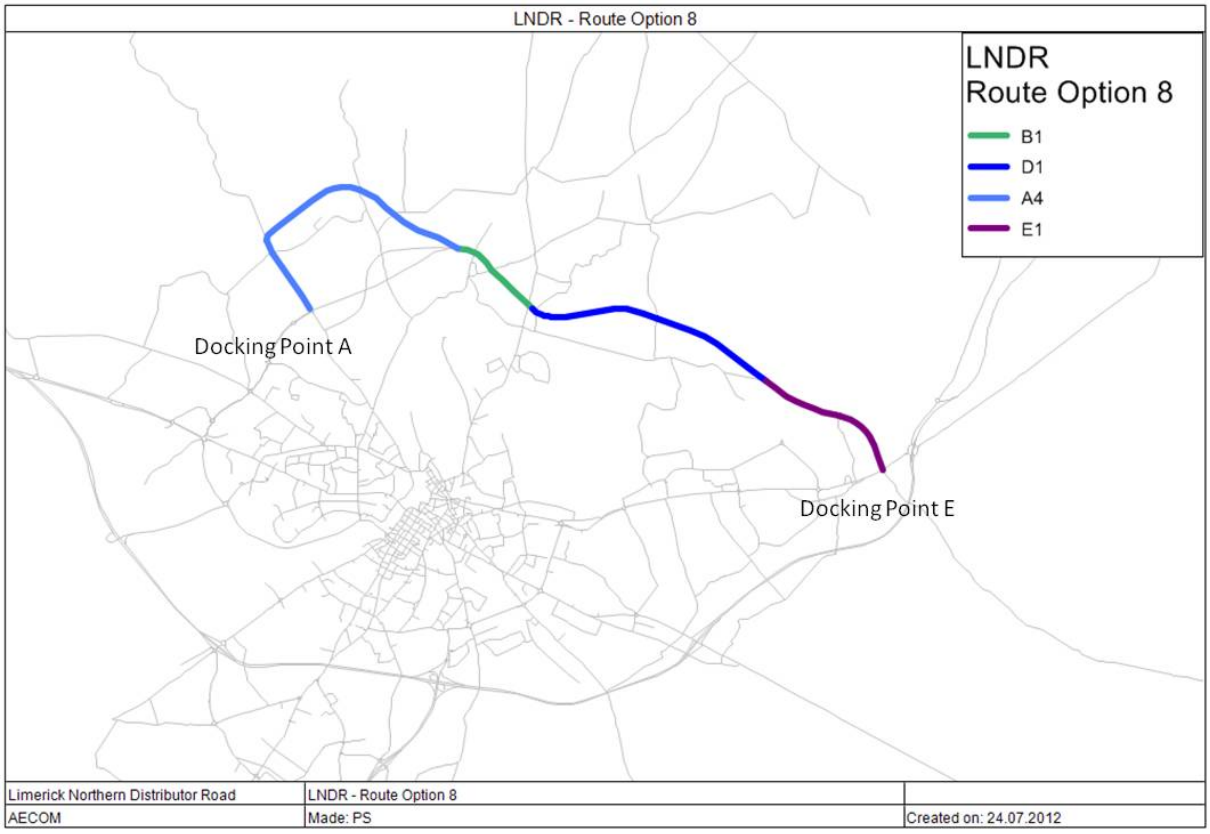
Do-Something Route Option 3 (Docking Points A-E)



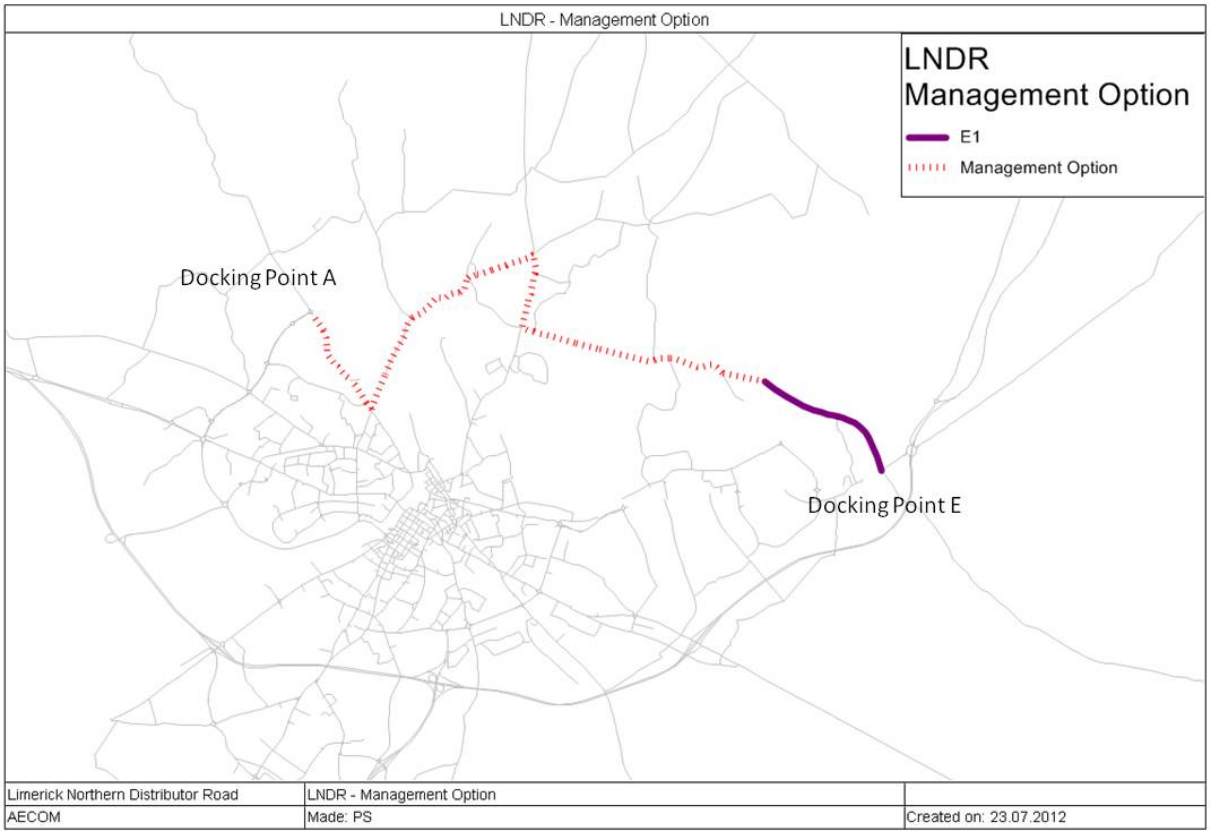
Do-Something Route Option 4 (Docking Points A-E)



Do-Something Route Option 7 (Docking Points A-E)



Do-Something Route Option 8 (Docking Points A-E)



Do-Something Route Option – Management Option (Docking Points A-E)

Table 17.5.1: 2018 Forecast AADT Values (Medium Growth)

Link	Junctions	Do-Min	Mgmt. Option	Route 1	Route 2	Route 3	Route 4	Route 7	Route 8
A2.1	1 - 6	-	-	13586	-	11741	-	-	-
A2.1	6 - 7	-	-	14801	-	12971	-	-	-
A1	1 - 3	3190	3642	-	14234	-	12840	-	-
A1	3 - 5	-	-	-	13185	-	11623	-	-
A1	5 - 7	-	-	-	13670	-	12082	-	-
A4	1 - 2	4547	4054	-	-	-	-	3615	9494
A4	2 - 4	-	-	-	-	-	-	8535	7583
A4	4 - 7	-	-	-	-	-	-	8912	8059
B1	7 - 8	-	-	14171	13817	13390	12934	11575	10942
B1	8 - 9	-	-	15917	15853	-	-	14484	-
B1	9 - 10	-	-	21418	21149	-	-	20024	-
B1	10 - 16	-	-	31371	30353	-	-	29162	-
D1	8 - 11	-	-	-	-	17505	17144	-	16193
D1	11 - 12	-	-			19896	19575	-	18620
E1	12 - 13	-	12671	-	-	19477	19808	-	18300
R445	16 - 15	16753	14256	21573	21119	14003	13803	20579	13761
R445	15 - 14	18920	16791	22950	22766	17535	17172	22280	16980
R445	14 - 13	25523	24185	27556	27587	25797	25720	27697	25273
N	-	11642	11023	19495	18729	18209	17549	15612	14987
O	-	4378	4592	14686	13805	13122	12400	9450	8635
P	-	20140	20520	23323	23154	24487	24351	22168	22778
Q	-	14331	13611	12855	12890	13061	12927	13101	13007
R	17 - 18	15165	14016	12189	12219	11077	10983	12841	12026

Table 17.5.2: 2033 Forecast AADT Values – Medium Growth

Link	Junctions	Do-Min	Mgmt. Option	Route 1	Route 2	Route 3	Route 4	Route 7	Route 8
A2.1	1 - 6	-	-	22400	-	19622	-	-	-
A2.1	6 - 7	-	-	22461	-	19800	-	-	-
A1	1 - 3	7827	9003	-	22450	-	20346	-	-
A1	3 - 5	-	-	-	18883	-	16822	-	-
A1	5 - 7	-	-	-	19464	-	17116	-	-
A4	1 - 2	6418	5635	-	-	-	-	10429	13752
A4	2 - 4	-	-	-	-	-	-	15303	13697
A4	4 - 7	-	-	-	-	-	-	15648	14122
B1	7 - 8	-	-	18608	16986	17916	16298	14829	14768
B1	8 - 9	-	-	21510	20545	-	-	19856	-
B1	9 - 10	-	-	33717	33816	-	-	33370	-
B1	10 - 16	-	-	41218	40603	-	-	40374	-
D1	8 - 11	-	-	-	-	25195	24289	-	23963
D1	11 - 12	-	-	-	-	31399	30720	-	30385
E1	12 - 13	-	25213	-	-	32407	32014	-	31471
R445	16 - 15	20691	17754	26967	26242	17219	17100	26108	17202
R445	15 - 14	23439	21163	28487	28070	21224	21083	28011	21027
R445	14 - 13	32363	31202	35717	35805	34068	34218	35833	33696
N	-	20949	20086	29047	27207	28364	26297	24305	23420
O	-	10250	10663	23555	21469	21545	19335	15452	14219
P	-	21143	21571	25610	25470	26046	25005	23419	23368
Q	-	16281	14908	13574	13833	14169	14092	14227	14229
R	17 - 18	21308	18509	18085	17094	15579	16114	16956	16542

Network Statistics

Network statistics were extracted from the AM and Inter Peak hour traffic models for each route option and a comparison was made against the Do-Minimum option. The key network statistics comprise the following:

- Total Vehicle km;
- Total Network Travel Time (hrs);
- Average Vehicle Speed (kph); and
- Average Trip Length (km).

Tables 17.6 and 17.7 outline the key network statistics for the AM and Inter Peak Periods respectively. Overall the tables show that all route options including the traffic management option provide benefits for the entire network compared to the Do-Minimum option.

Table 17.6: 2033 AM Peak Network Statistics (Light Vehicles)

Route Option	Total Vehicle km	Total Network Travel Time (hrs)	Average Speed (kph)	Average Trip Length (Km)
Do-Minimum	492785	11859	41.2	12.00
Management Option	490406	11285	43.1	11.73
Route Option 1	490333	11288	43.0	11.94
Route Option 2	489957	11202	43.3	11.93
Route Option 3	488629	10916	44.4	11.90
Route Option 4	491535	10898	44.7	11.97
Route Option 5	493102	10931	44.7	12.01
Route Option 6	495183	10918	45.0	12.06
Route Option 7	494517	11193	43.8	12.04
Route Option 8	492705	10891	44.9	12.00

The network statistics outlined above for the AM Peak hour illustrate that Route Options (3 to 6 & 8) which connect directly to the Cappamore Junction provided the most benefit in terms of reduced travel time in the network. The average speeds in the network are also higher for these route options compared to the route options which connect to the Goody Roundabout.

As expected the longer route options practically options 5 to 8, have the total highest vehicle kilometres, with Route Option 3 generating the lowest total vehicle kilometres. The network statistics for the traffic management option are similar to that of route options 1 and 2.

Table 17.7: 2033 Inter Peak Network Statistics (Light Vehicles)

Route Option	Total Vehicle km	Total Network Travel Time (hrs)	Average Speed (kph)	Average Trip Length (Km)
Do-Minimum	303204	6877	43.7	10.37
Management Option	304792	6532	46.3	10.42
Route Option 1	303217	6403	46.9	10.37
Route Option 2	303792	6419	46.9	10.39
Route Option 3	306978	6340	48.0	10.50
Route Option 4	307105	6345	48.0	10.50
Route Option 5	307262	6346	48.0	10.51
Route Option 6	307416	6364	47.9	10.51
Route Option 7	304667	6434	46.9	10.42
Route Option 8	307424	6352	48.0	10.51

The network statistics for the Inter Peak hour are similar to the AM Peak hour statistics, whereby the route options that connect to the Cappamore Junction have lower total network travel times and higher network average speeds than the route options that connect to the Goody Roundabout.

17.2 Economic Assessment of Route Options

17.2.1 Introduction

The Cost Benefit Analysis (CBA) compares the 'Do Minimum' with the 'Do Something' scenarios and determines if and to what extent the benefits resulting from the provision of the scheme will outweigh the cost, and also provides and economic comparison of the alternative route options.

This analysis has been carried out using the TUBA v1.7c cost benefit analysis program in accordance with the National Roads Authority (NRA) Project Appraisal Guidelines (PAG) 2011.

17.2.2 Scheme Costs

At Route Selection stage Option Comparison Cost Estimates (OCCE) were developed for the seven route options and are presented in Table 17.8 below. A breakdown of yearly costs by expenditure type is also presented in Table 17.9. The cost inputs into TUBA are exclusive of VAT as outlined below. The relevant cost estimates are included in Table 17.8 below.

17.2.3 CBA Results

The results of the Cost Benefit Analysis are presented in Table 17.10 for each route option. The results presented in Table 17.10 take account of the potential accident benefits of each scheme and also take into account the residual value of each scheme.

The "Impact on Public Accounts" for all proposed schemes is summarised in Table 17.11 below. This table fulfils the requirement of the exchequer cash flow analysis. The table takes into account the investment costs of each option and the impact upon exchequer revenue in terms of fuel (indirect taxation) and tolling (revenue).

Table 17.8: Scheme Cost Estimates (in 2011 prices exclusive of VAT, millions)

Expenditure	TM Option	Route 1 A2.1/B.1	Route 2 A.1/B.1	Route 3 A2.1/E.1	Route 4 A.1/E.1	Route 7 A4/B.1	Route 8 A.4/E.1
Main Contract Construction	94.23	100.89	104.80	102.54	106.45	109.80	111.65
Main Contract Supervision	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Archaeology	1.32	1.77	1.92	2.40	2.55	2.30	2.93
Advanced Works	1.32	3.50	3.35	5.82	5.67	4.68	7.00
Residual Network	1.02	0.60	0.65	0.82	0.87	0.78	1.00
Land & Property	23.52	10.99	9.62	13.10	11.73	12.37	14.89
Planning & Design	3.20	1.87	2.03	2.53	2.69	2.44	3.10
Total (€m)	**125.11**	**120.12**	**122.87**	**127.71**	**130.46**	**132.87**	**141.07**

Table 17.9: Expenditure Breakdown by Year

Year	Planning & Design	Land & Property	Archaeology	Advanced Works	Main Contract Construction	Main Contract Supervision	Residual Network
2010	5						
2011	50						
2012	45						
2013		100	20				
2014			80	80			
2015				20	30	30	
2016					30	30	
2017					40	40	
2018							100
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Table 17.10: Cost Benefit Analysis Summary (€,000)

Parameter		TM Option	Route 1 A2.1/B.1	Route 2 A.1/B.1	Route 3 A2.1/E.1	Route 4 A.1/E.1	Route 7 A4/B.1	Route 8 A.4/E.1
Consumer User Benefits	30 Year Appraisal + Residual Value*	€204,504	€227,721	€234,602	€303,250	€299,875	€227,120	€294,775
Business User Benefits		€63,670	€75,284	€77,775	€100,098	€99,092	€74,868	€96,951
Carbon Benefits		€790	€870	€874	€1272	€1202	€764	€1115
Accident Benefits		€19,580	€36,150	€33,870	€49,740	€51,860	€28,040	€28,040
Residual Value		€193,158	€216,904	€223,648	€303,760	€302,270	€215,549	€294,667
Present Value of Benefits (PVB)		€481,702	€557,289	€570,769	€758,120	€754,299	€546,341	€715,548
Present Value of Costs (PVC)		€120,899	€121,410	€122,316	€142,860	€142,618	€129,158	€147,655
Net Present Value (NPV)		€360,803	€435,879	€448,453	€615,260	€611,681	€417,183	€567,893
Benefit to Cost Ration (BCR)		**3.98**	**4.59**	**4.67**	**5.31**	**5.29**	**4.23**	**4.85**

Table 17.11: Impact on Public Accounts (€,000)

Impact on Public Accounts		TM Option	Route 1	Route 2	Route 3	Route 4	Route 7	Route 8
Revenue	30 Year Appraisal + Residual Value	€10,084	€14,250	€13,122	€21,639	€20,945	€14,772	€19,504
Investment Costs		€94,243	€89,466	€91,369	€95,342	€97,265	€99,152	€105,540
Indirect Tax Revenues		€16,572	€17,694	€17,825	€25,879	€24,408	€15,234	€22,611
Present Value of Costs (PVC)		€120,899	€121,410	€122,316	€142,860	€142,618	€129,158	€147,655

17.2.4 Conclusions

The Economic Assessment has been undertaken using TUBA in accordance with NRA Project Appraisal Guidelines 2011. The assessment has demonstrated a Benefit Cost Ratio over a 30-year appraisal period based on the NRA Medium growth scenario as follows:

- **Traffic Management Option – 3.98**
- **Route Option A2.1/B.1 – 4.59**
- **Route Option A.1/B.1 – 4.67**
- **Route Option A2.1/E.1 – 5.31**
- **Route Option A.1/E.1 – 5.29**
- **Route Option A4/B.1 – 4.23**
- **Route Option A.4/E.1 – 4.85**

The benefits of each route option are based on the benefits generated during the AM Peak Hour (08:00 – 09:00) and average Inter Peak hour (10:00 – 16:00). These hourly benefits are factored up to annual benefits based on annualisation factors.

It should also be noted that TUBA does not calculate benefits that are due to changes in accident costs. Therefore the accident benefits of each route option were calculated using model outputs and NRA accident parameters in line with the PAG.

In terms of BCR the longer route options which dock at the Cappamore junction on the R445 perform better than the shorter route options. The longer route options which connect to the Cappamore Road Junction generate higher user benefits. The Traffic Management Option performs the least favourable overall.

17.3 Road Safety

A road safety audit has been prepared following an examination of the drawings provided to the audit team and a site visit by the audit team who have not in any way been involved with the design of this scheme.

The audit team confirm this Stage F Road Safety Audit for the Limerick Northern Distributor Road, has been conducted for the sole purpose of identifying any features of the route selection design that could be removed or modified to improve the safety of the scheme. The scheme has been assessed in accordance with NRA HD19 in Volume 5 of the National Road Authorities' Design Manual for Roads and Bridges and does not confirm compliance with any other standard.

The findings and recommendations of the Stage F Road Safety Audit are outlined on the following page.

Table 17.12: Safety Concerns, Findings and Recommendations of Road Safety Audit

Item	Problem	Recommendation
	General	
1.	At the tie in to the Connagh Knockalisheen Distributor Road there are four different alignments with sub options proposed at this location to continue the route east. The following are the audit teams comments on these options: • Option A1 requires an additional junction before continuing east. • Option A2 & A2.1 provide a direct continuation east • Option A3 requires an additional junction before continuing east • Option A4 & A4.1 require a possible four proposed junctions before continuing east.	Option A2 and A2.1 provide a direct continuation from the Coonagh Knockalisheen alignment with minimum impact on the surrounding road network. Option A4 and A4.1 is the least direct continuation and affects four local roads requiring four proposed junctions which increase the risk of possible accidents. The audit team would recommend either options A1, A2 or A2.1 as the options with the least likelihood of risk to the users.
2.	All options cross the Ardnacrusha tributary at the same proposed location and the Shannon River but Options C1, D1, D2 and E1 also cross the Blackwater River introducing a third river crossing and bridge.	Options B1 and B2 have one less river crossing which reduces the risk of vehicles being in conflict with barriers and water.
3.	Options C1, D1, D2 and E1 cross numerous local roads as they head east and connect with the existing R445. Option C1 is the only option which cuts through the residential area between Plassey Park Road and the R445. Options B1 and B2 connect to the existing R445 at an existing roundabout through a rural green area adjacent to the university and residential and commercial area.	Recommend any of options B1, B2, D1 or E1 to connect to the existing R445.
4.	The proposed are for the 5 corridors is within the flood plain of the Shannon river and its tributaries. Realigned sections of local roads could be affected by flooding.	Ensure adequate drainage is provided to all realigned sections of roads.

Item	Problem	Recommendation
5.	There are a number of overhead cables crossing the different corridors, specifically D2, which will affect safety during construction and possibly operation.	Ensure all utilities are considered in the route selection process for both construction and operation.
6.	All five options join the existing R445 at a roundabout junction all of these are existing roundabouts on the R445 except the junction with option C1. This is a proposed roundabout which will be constructed on an existing wide single carriageway already cluttered with roundabouts.	Review Option C1 proposal to provide another roundabout on the existing R445.
7.	At the eastern end of the schemes options B1 and B2 both connect to the existing roundabout closest to the city which will lead to an increase in the volume of traffic along the existing section of the R445 to the tie in at the existing roundabout at the end of option E1. Between these two roundabouts, the R445 has numerous junctions and private and commercial accesses and the proposed scheme will lead to increased conflicts between traffic turning in and out of these premises. This increased traffic could also adversely affect the operation of the existing roundabouts.	Review Option B1 and B2 to ensure existing access and junctions along the R445 will not adversely be affected by the proposed scheme. Notwithstanding the above, Options B1 and B2 will have an increased number of access junctions and thus an increased risk of accidents.
	Option A4 and A4.1	
8.	Both option A4 and A4.1 are just in the foothills and the existing contours could lead to steep gradients for realigned local roads and property entrances	Ensure existing ground contours are considered in final option.
9.	Where option A4 crosses the local road near Ballyfinnan at the western end of the scheme there are properties very close to the proposed corridor and access may be difficult to accommodate	Ensure appropriate access is provided to all properties affected by the scheme and the number of direct accesses, if required, kept to a minimum.
10.	A4.1 crosses two local roads at an angle and the presence of a watermain was noted at this location on site.	