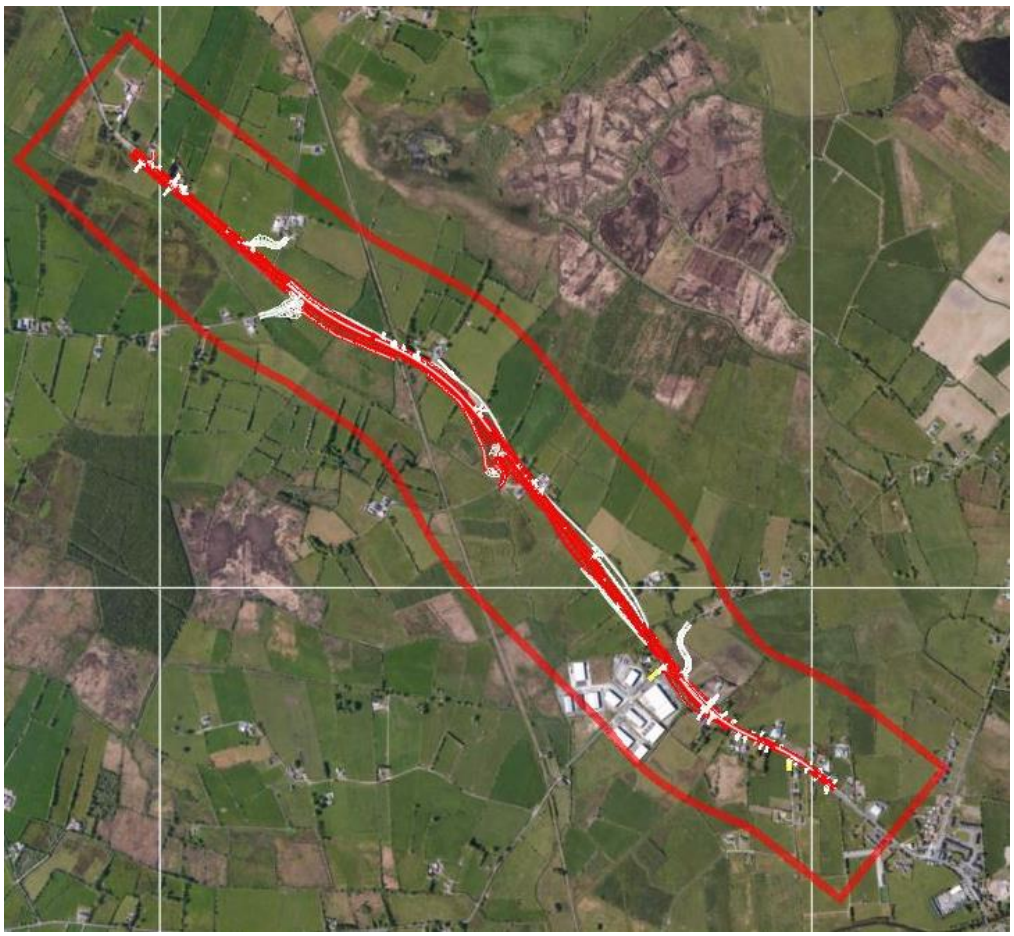
Galway County Council

N17 Milltown to Gortnagunned Road Realignment Scheme

Design Report



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N17 Milltown to Gortnagunned Realignment Scheme

Preliminary Design Report

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Executive Summary

The N17 national primary route runs between Sligo and Galway and forms part of the Atlantic Corridor linking Letterkenny with Waterford.
The route has been identified in several documents such as Transport 21 and the National Development Plan 2018 – 2027 as one of strategic importance and in need of upgrading.

The scheme is located between the village of Milltown, Co Galway and Ballindine, Co Mayo. The scheme runs for 3km, from the outskirts at the northern end of Milltown village and finishes in the townland of Gortnagunned which ties in with a recently completed road realignment scheme of the N17 Carrownurlaur to Ballindine.

1 Introduction & Description

1.1 Scheme Description

This Design Report has been prepared by Galway County Council for the proposed N17 Milltown to Gortnagunned Road Realignment Scheme. The scheme includes the upgrade of 3km section of the N17, North of Milltown, Co Galway.
This proposed section of the N17 that is to be upgraded, currently has lane widths of approximately 3.0m in each direction with no hard shoulder, little or no hard strip, limited verge space and unforgiving roadsides.

The proposed scheme will tie-in on the Northern end of Milltown village with an existing section of the N17 that has already been upgraded in recent years, which is of high standard of construction and complies with TII Standards.

Figure 1.1: Location of the Scheme

1.2 Existing Road Conditions and Constraints

This section of the N17 falls below the standard of the TII Publications (Standards) in terms of horizontal and vertical alignment, visibility, cross-section, and safety on the route is compromised as a result. A selection of photographs of the existing road is provided below:

Figure 1.2: Tie in at Northern End of Scheme to existing realignment

Figure 1.3: Approach to Milltown Village

Figure 1.4: Existing Alignment

Figure 1.5: Disused rail level crossing

Figure 1.6: Extent of Milltown Village Speed Limit

In terms of the cross-section, the existing road is sub-standard for a 100km/h speed limit. The average lane widths in each direction are approximately 3.0m with no hard shoulder, little or no hard strip, limited verge space and unforgiving roadsides. This makes it unsuitable for use by non-motorised users (pedestrians and cyclists).

1.3 Purpose of the Design Report

This Report sets out to:

- Fulfil the requirements of the TII 2020 Project Management Guidelines;
- Document the scheme development to date;
- Validate the need for the scheme;
- Document the design of the scheme and ensure that appropriate design standards will be applied;
- Ensure that matters affecting the land requirements of the scheme have been clearly identified, investigated and clarified.

The design described in this report represents the final planning phase for a National Road Project. The design includes the proposed horizontal and vertical alignment, drainage and earthworks required to carry out the project. The design outlined in this report will be carried forward to the Construction Phase.

1.4 Purpose of the Scheme

The N17 is a National Primary Route linking Galway to Sligo via the towns of Milltown, Ballindine and Claremorris. The section of N17 between Milltown and Ballindine is approximately 7.0km in length and it is along this stretch that the proposed scheme is located. The scheme commences at the townland of Gortnagunned in the north and extends approximately 3.0km south where it ties in at the existing 50km/h speed limits in Milltown. The purpose of this scheme is to tie in with the improvements that have been already completed on the N17 in recent years.

1.5 Project History

In the past number of years, there have been a number of realignment schemes undertaken within the Study Area, including the 4km stretch immediately North of the proposed scheme which was undertaken in 2014 and 2016. This has left the proposed scheme as the last remaining section of the N17 within County Galway which has not been upgraded to a Type 1 single carriageway.

1.6 Scheme Objectives

The general objectives for national road developments were set out in The National Development Plan 2018 – 2027, is a ten-year plan which sets out the strategic frameworks for public capital investment over the next ten years. The plan focuses on the achievement of two over-arching objectives:

"Meeting Ireland's infrastructure and investment needs"
and
"Reforming how public investment is planned and delivered"

- Provide an upgrade of the N17 in a manner that minimises the impacts on the environment, the iconic landscape and minimises the construction costs;
- Improve the existing N17 Road, to make it fit for, serving the local and visiting community as an access and communications route to and from places of abode, community activity, for work and for visiting;
- Improve the level of safety and comfort for road users by upgrading the existing road to modern design standards, providing a consistent road cross-section;
- Improve safety at road junctions, residential/ commercial and community access locations through improved road width and visibility sightlines;

- To reduce journey times and improve journey time reliability on the N17 for long distance trips between the West and North-West Regions and medium distance trips between Tuam and Sligo;
- To assist in supporting the economic performance of the counties of Galway and Mayo through the provision of improved transport infrastructure which will reduce the cost of travel for business and tourism and assist in reducing the overall cost of production thereby improving competitiveness;
- Provide wide hard shoulders which acts as refuge for any broken-down vehicles safely away from flow of traffic;
- Provide footpath and cycleway for full length of the scheme;
- Improve internal road transport infrastructure between regions and within regions;
- Contribute to sustainable transport policies, facilitating continued economic growth and regional development while ensuring a high level of environmental protection;
- Help achieve the objectives of the Government's Road Safety Strategy in relation to the reduction in fatalities and serious injuries caused by road accidents.

1.7 Proposed Construction Procurement Method

It is anticipated that the detailed Design of the proposed road development will be carried out by the Galway County Council (or its agents) and that Construction will take place as part of an Employer Designed Construction Contact. The successful Contractor will be responsible for constructing the project in accordance with the Employer's Design as described in the Employers prepared Contract Documentation and which will accord with such approvals advanced for this proposed road development.

1.8 Public Information and Consultation

The proposed scheme will be submitted to An Bord Pleanála under section 177AE of the Planning and Development Act 2000 for approval. Galway County Council have made details of the proposed road scheme available for public inspection to make submissions and observations on the preliminary designs to Galway County Council. Public bodies were notified during the preliminary design.

- National Parks & Wildlife Services (NPWS)
- Office of Public Works (OPW)
- Inland Fisheries Ireland (IFI)
- Environmental Protection Agency (EPA)

- Bat Conservation Ireland
- Bird Watch Ireland

1.9 Summary of Constraints and Route Selection Process

This section outlines the constraints encountered and summarises the route selection methodology considered in developing the preferred option.

The identification of alternatives was carried out having regard to the constraints and the principal objectives of the proposed road development including the following:

- Provide an upgrade of the N17 in a manner that minimises the impacts on the environment, the iconic landscape and minimises the construction costs;
- Improve the existing N17 Road, to make it fit for serving the local and visiting community as an access and communications route to and from places of abode, community activity, for work and for visiting;
- Improve the level of safety and comfort for road users by upgrading the existing road to modern design standards, providing a consistent road cross-section and providing adequate road foundations;

The route selection process was undertaken to identify the nature and extent of significant constraints within the defined Study Area. These constraints were identified, mapped and assessed so that feasible route options could be designed to avoid such constraint as below.

- Natura 2000/ European Sites;
- Surface Water Environment;
- Topography;
- Landscape;
- Ground Conditions;
- Settlements and Population;
- Existing Road Network, Traffic and Accesses;
- Land Use.

1.10 Preferred Route

Having considered the principal constraints on the N17 Milltown to Gortnagunned and the objectives for the proposed road development, the preferred route was chosen. Refer to **Appendix A1.1** for Preferred Route from Options Report. The preferred route is shown in **Figure 1.7** below:

Figure 1.7: Preferred Route

2 Identification of Need

2.1 Strategic Fit and Policy

The proposed N17 Scheme is compatible with local and national strategies and is referenced in several policy documents. This section sets out the relevant framework of national and local policy which applies.

- Ireland 2040 Our Plan - National Planning Framework;
- Ireland 2040 Our Plan - National Development Plan 2018 - 2027;
- Our Sustainable Future – A Framework of Sustainable Development for Ireland;
- Smarter Travel, A Sustainable Transport Future;
- Building on Recovery – Infrastructure and Capital Investment;
- National Cycle Policy Framework;
- Strategic Framework on Investment in Land Transport (SFILT)
- Galway County Development Plan 2015 - 2021

Specific references are recited below to demonstrate the context of the proposed scheme.

2.1.1 Ireland 2040 Our Plan – National Planning Framework

Ireland 2040 Our Plan – National Planning Framework (herein referred to as NPF) is a long-term plan, published in 2018, which will shape spatial, social and economic policy in Ireland for the coming decades. NPF sets out a strategy that aims to:

- Promote convergence in living standards between places;
- Improve the quality of places and peoples experience of living in them;
- Anticipate and influence market forces such as agglomeration and migration;
- Encourage scale and concentration of people and economic activity;
- Promote economic integration between different places;
- Address geographical peripherality through accessibility and connectivity.

The proposed N17 scheme will contribute to addressing the peripherality of the western coastal areas, and encourage scale and concentration in the Galway city–region.

The NPF supports the need to promote sustainable transport modes, while also recognising the importance of investment in improving road infrastructure.

The NPF sets out ten National Strategic outcomes:

1. Compact Growth;
2. Enhanced Regional Accessibility;
3. Strengthened Rural Economies and Communities;
4. Sustainable Mobility;
5. A Strong Economy, supported by Enterprise, Innovation and Skills;
6. High-Quality International Connectivity;
7. Enhanced Amenity and Heritage;
8. Transition to a Low-Carbon and Climate-Resilient Society;
9. Sustainable Management of Water and other Environmental Resources;
10. Access to Quality Childcare, Education and Health Services.

Together these present a vision of Ireland that combines accessibility with conservation of heritage and environment.

2.1.2 Ireland 2040 – National Development Plan 2018 - 2027

The NDP details the main investment projects, programmes and priorities envisaged over the decade to drive the implementation of the NPF.

The N17 route is favoured towards a full online/offline realignment as its site extents is outside and doesn't encroach on identified designated areas, such as Lough Corrib SAC and Lough Corrib SPA.

2.1.3 Our Sustainable Future, Framework of Sustainable Development for Ireland

Our Sustainable Future – A Framework for Sustainable Development for Ireland (herein referred to as Our Sustainable Future) sets out overarching national policy pertaining to sustainable development with the vision being "A model of national progress and development that respects the three core pillars of sustainability: the environment, the economic, and the social".

With specific regard to transport Our Sustainable Future states:
"Sustainable transport is central to national efforts to combat climate change, air pollution and other negative environmental and social impacts".

Transport measures in Our Sustainable Future are set out below:

- Implementation of Smarter Travel and the National Cycle Policy Framework;
- Reducing distance travelled by private cars and encouraging smarter travel;
- Ensuring that alternatives to the car are more widely available;
- Improvements to public transport; and
- Examine Feasibility of Retrofitting Gross Polluter Vehicles with NOx Abatement technology.

Sustainable development encompasses environmental, economic and social aspects. The provision of a cycleway as part of the N17 improvement will encourage sustainable alternatives to car travel.

2.1.4 Smarter Travel, A Sustainable Transport Future

Smarter Travel, A Sustainable Transport Future published by the Department of Transport in 2009 sets clear targets for the promotion of sustainable transport modes. Building sustainable communities in which people can access a wide range of services locally and increasing developments in locations with high capacity public transport linkages are key to promoting sustainable transport modes. The vision of the policy document is summarised.

- "Improve quality of life and accessibility to transport for all and, in particular for people with reduced mobility and those who may experience isolation due to lack of transport"

The proposed N17 improvement accords with this overarching goal. It will contribute to reducing rural isolation and the promotion of cycling and walking to access local services.

2.1.5 Building on Recovery: Infrastructure and Capital Investment

Building on Recovery, Infrastructure and Capital Investment (herein referred to as Building on Recovery) outlines the Government's €42 billion framework for infrastructure investment in Ireland over the period 2016 to 2021. Building on Recovery is cognisant of the need for investment in transport infrastructure to support economic growth.

Specific public transport and road projects in addition to sustainable transport measure to be progressed are identified.

2.1.6 National Cycle Policy Framework

The National Cycle Policy Framework has an objective to promote cycling as a normal way to get about, especially for short trips and that a culture of cycling will have developed in Ireland to the extent that 10% of all trips will be used by bike by 2020.

The policy supports "the provision of dedicated signed rural cycling networks building on Fáilte Ireland's Strategy to Develop Irish Cycling Tourism. This will cater for recreational cyclists as well as visitors".

Fáilte Ireland's Strategy includes a long-distance cycle route around the coast.

2.1.7 Strategic Framework on Investment in Land Transport (SFILT)

The SFILT policy framework sets a high-level priority for transport investment as being to:

"Maximise the value of the road network through targeted investment that:

- Enhance the efficiency of the existing network, particularly through the increased use of Intelligent Transportation System (ITS) applications;
- Improve connections to key seaports and airports and poorly served regions and complete missing links;
- Support identified national and regional spatial planning priorities;
- Provide access for large scale employment proposals; and
- Address critical safety issues".

The proposed N17 improvement supports these priorities, by improving connections to Galway Port, supporting local spatial planning priorities and addressing safety issues.

2.1.8 Strategic Framework on Investment in Land Transport (SFILT)

Chapter 5 of the Galway County Development Plan 2015 – 2021 deals specifically with Roads and Transportation. It acknowledges that Galway, due to its peripheral location, relies heavily on its public road network for transportation and places a specific emphasis on the county's "*strategic routes",* which includes the M6, N18 and N17.

Table 5.1 Priority Transportation Infrastructure Objectives 2015 – 2021: lists priority transport infrastructure to be provided and or improvement that has been identified within the Development Plan period;

- N17 Tuam to Claremorris Scheme.

Objective TI 5 – Roads and Transportation Networks Improvements

Facilitate the progression of and implement improvements to the existing National and Regional /Local Road networks including the priority transportation scheme, listed in Table 5.1. Priority Transportation Infrastructure Projects for Co. Galway 2015 – 2021 and those listed within table 5.2: Regional/Local Projects Proposed 2015 – 2021 subject to relevant Irish planning and European environmental legislation including Article 6 of the Habitats Directive.

Policy TI 7 – Protection of National Road Network

Policy TI 7 of the County Development Plan sets out the Councils intentions to "*protect the motorway and national road network"* and "*safeguarding the carrying capacity, operational efficiency and safety"* of the network. Considering the issues with alignment and geometry, current operating capacity and history of accidents attributed to the section of the N17 between Milltown and Gortnagunned, the proposed scheme is consistent with this policy.

2.1.9 Regional Planning Guidelines for the West Region 2010 - 2022

Chapter 5 of the West Regional Planning Guidelines 2010 – 2022 deals with Infrastructure Strategy and sets out the policies and objectives which are considered to be the priority access, travel and transport related infrastructure within the region. One such policy, IP2, states:

"Support the National Roads Authority investment to remedy deficiencies generally in the roads network minimising environmental impact."

Considering the issues with alignment and geometry, current operating capacity and history of accidents attributed to the section of the N17 between Milltown and Gortnagunned, the proposed scheme is consistent with the policy above.

In one of the guidelines objectives, IO5, the Northern and Western Regional Assembly identifies a number schemes which have been assigned a priority completion status in order to promote a balanced regional development. One such scheme is the:

"Atlantic Road Corridor – M18 and M17 and N17 from Gort to Charlestown minimising environmental impact."
Having considered the above policy and objective, it is clear to see that completion of the proposed project would be in line with the Regional Planning Guidelines.

2.2 Analysis of Need, Existing and Potential Problems

2.2.1 Identification of Need

The N17 National Primary Road is a single carriageway route that extends from Tuam in Co. Galway at its southern end to Claremorris and Sligo at the northern end. The road is highly trafficked, providing connectivity along the western corridor serving as the main access route linking Sligo, Mayo and Galway.

The section of the N17 that is to be upgraded currently has a typical width of less than 6m, and verges that are typically less than 0.5m wide. The road has substandard horizontal and vertical alignments and inadequate forward visibility for the 100km/h speed limit that applies.

Along this section of the N17 there is a high number of accesses and junctions that provide access to local roads, houses and farm land.

The need for this improvement scheme is well established and has been identified in various publications on Road Development Policy, including National, Regional and Local publications, which have been discussed in **Section 2.1** Policy Context of this report. These policies all refer to the N17, in various ways, as an important inter-urban link whose performance is key to the development of the West region.

However, when reviewing the existing road network, traffic conditions, journey times, level of service and safety, all of which are examined in greater depth below, it becomes apparently clear that the route is not capable of safely accommodating the current and future traffic needs of the route. For the route to serve its purpose as an important transport link, improved works are required.

2.2.2 Existing Road Network

This section of the N17 falls below the standard of the TII Publications (Standards) in terms of horizontal and vertical alignment, visibility and cross-section, and safety on the route is compromised as a result.

Transport Infrastructure Ireland have carried out a sinuosity analysis on the National Road Network and produced a Sinuosity map showing the results. This analysis is considered to be an appropriate indicator of the standard of the horizontal alignment and indicates that, for the section of the N17 between Milltown and Gortnagunned, two thirds of the section has a moderate or severe sinuosity. This indicates that the existing road has a sub-standard horizontal alignment.

In terms of the cross-section the existing road is sub-standard for a 100km/h speed limit. The average lane widths in each direction are approximately 3.0m with no hard shoulder, little or no hard strip, limited verge space and unforgiving roadsides. This makes it unsuitable for use by non-motorised users (pedestrians and cyclists).

Figure 2.1: Existing Alignment

2.2.3 Walking and Cycling

Pedestrians and cyclists must share the N17 carriageway with buses, cars and commercial vehicles. Currently the number of pedestrians and cyclist along the subject section of the N17 is very low, which reflects the hazardous conditions where there is virtually no hard shoulder or verge and the forward visibility along sections are substandard for the traffic speeds.

2.2.4 National Traffic Demand

The TII maintains a network of traffic counters on the National Road Network. One such traffic counter (Ref. TMU N17 080.0 N) is located on the N17 at Kilcloony townland, approximately 3km south of Milltown.

Analysis of the data from this counter indicates that the Annual Average Daily Traffic (AADT) flow for 2017 on the N17 at this location was 8,385 vehicles per day with 4.5% Heavy Commercial Vehicles (HCV). As this road most closely resembles a Type 3 single carriageway, this AADT far exceeds the capacity for a Level of Service D of 5,000 as per Table 6.1: Recommended Rural Road Layouts of DN-GEO-03031 – Rural Road Link Design.

During the initial consultation with residents within the area, many of them noted a significant increase in the volume of traffic on the road since the opening of the M17 motorway. This observation is confirmed by the tallied 2019 AADT from TMU N17 080.0 N, which indicates an AADT of 9,893 with 4.3% Heavy Commercial Vehicles. This analysis indicates projected design year AADT falls within the Level of Service D capacity of the chosen Type 1 Single Carriageway cross section.

Further information on the national road networks traffic demand can be found in TII's publication National Road Network Indicators, which is published on an annual basis with the latest publication being released for 2020. However due to possible effects of Covid on traffic numbers, the 2019 figures were used. Section C of the report deals with the Volume to Capacity Ratio: National Primary Roads. The Volume to Capacity (V/C) Ratio relates the AADT volume carried on a section of road to its daily operational capacity. This assessment indicates that the N17 between Milltown and Ballindine is operating above 120% of capacity. It's clear that the existing road is operating below Level of Service D and to extend the life of the existing N17, it is necessary for this scheme to progress.

2.3 Project Specific Needs

The objectives of the scheme have been reviewed in accordance with the guidance provided in Project Appraisal Guidelines (PAG) Unit 12.0: Minor Projects (€5m to €20m). This document includes a recommendation that project objectives are established which are independent of each other, and specifically relevant to the current project. These are as follows:

- Economy;
- Environment;
- Accessibility & Social Inclusion;
- Integration; and
- Safety;
- Physical Activity (if applicable).

On the basis, of the deficiencies of the existing route as outlined above, and in responding to the aspirations of national and strategic policy documentation, a series of defined objectives have been developed and are presented here.

2.3.1 Economic Objectives

The N17 is a key national corridor connecting the gateways of Galway and Sligo and delays to traffic have a negative impact upon the economy. It is an objective of the scheme to:

- To reduce journey times and improve journey time reliability on the N17 for long distance trips between the West and North-West Regions and medium distance trips between Tuam and Sligo;
- To improve journey time and reliability;
- To assist in supporting the economic performance of the counties of Galway and Mayo through the provision of improved transport infrastructure which will reduce the cost of travel for business and tourism and assist in reducing the overall cost of production thereby improving competitiveness.

2.3.2 Environmental Objectives

It is an objective of the scheme to:

- To avoid any significant impact on any SAC, SPA or NHA;
- To reduce the level of traffic noise along this section of the N17;
- To improve road drainage system and quality of runoff through application of SUDS.
- Mitigate potential environmental impacts by conducting screening and assessment by incorporating mitigation measures into the design.

2.3.3 Accessibility & Social Inclusion Objectives

The scheme will improve the accessibility between the key urban centres of Tuam and Sligo. The scheme will also improve road based public transport at a local, regional and national level, by improving journey reliability along this section of the corridor.

It is an objective of the scheme to:

- To improve accessibility from relatively-deprived areas in rural North Galway and South Mayo to the facilities such as employment, education, transport and healthcare for all road users;
- To improve bus journey time and journey reliability;
- To improve accessibility and reduce severance particularly within the community of Gortnagunned, Drum and Gortnagunned and in turn support social and economic development within this strategically located village and its hinterland.

2.3.4 Integration Objectives

The following integration objectives have been established:

- To offset the negative effects of peripherality and foster balanced regional development in Ireland by improving the economic functioning of the Galway city region;
- To increase the attractiveness of the region for tourists;
- To support initiatives to bring investment into the West Region; and to support transport integration within the wider region, maximising the benefits of previous investment in the N17 corridor, integrating with regional public transport facilities, and improving access to the main ports and airports;
- To support the integration objectives set out in European, National, Regional and Local planning policy by upgrading the N17 National Primary between Milltown and Gortnagunned.

2.3.5 Safety Objectives

The following safety objectives have been established;

- To reduce the collision rate along the national road network between Milltown and Gortnagunned to below the national average rate;
- To reduce the severity of collisions along the national road network between Milltown and Gortnagunned;
- To improve safety for all road users including pedestrians and cyclists along both the national road network and on the surrounding road network between Milltown and Gortnagunned;
- To support the RSA Road Safety Strategy 2013-2020;
- To improve the security of vulnerable road users by providing for non-motorised users.

3 Traffic Conditions

3.1 Annual Average Daily Traffic (AADT)

Annual Average Daily Traffic (AADT) is the average number of vehicles, calculated over a period of one calendar year, passing a point on a road each day. It is expressed in terms of vehicles per day.

Expansion factors are used to estimate AADT based on counts that cover a period of less than one year. The time period can comprise a 6-hour count (minimum time period) 12-hour count, 24-hour count, 7-day count or a count covering a number of months of traffic flow at a particular point. Based on an analysis of observed data, expansion factors can be formulated to predict the relationship between short period traffic counts and AADT.

In developing a process for expanding short period traffic counts to AADT, a number of variables have been considered which can influence the factors to be used. These include:

- Geographical Location;
- Road Type;
- Day of Week;
- Seasonality.

A total of seven automated traffic counter (ATC) and six junctions turning counts (JTC) was carried out. Junction Turning Counts were taken at intersections with regional road along the N17. Each JCT was carried out over a 12-hour period between 07:00 – 19:00.

3.2 Traffic Flows

To determine the existing capacity (AADT) of the N17, traffic surveys were undertaken on Thursday 9th November 2017 with a daily average flow of 9,300 vehicles per day. **Table 3.1** shows AADT for main line and local roads within the scheme. The results of this survey allow a design year forecast of AADT to be calculated using growth factors which can be found in table 6.1 of TII Publications Project Appraisal Guidelines for National Roads Unit 5.3 - Travel Demand Projections (PE-PAG-02017) which are illustrated below in **Table 3.3**

Table 3.1: Base Year AADT (2017) and % HGVs

Link Road Name/Ref.	AADT	% HGV's
N17 –North of Milltown	9300	4.5%
L-2208-0	800	6.7%
L-2227-11	600	5.0%
L-6413-0	200	3.5%
L-22273-0	700	4.5%

Note: Traffic flows are rounded to the nearest 100 vehicles on the N17 and to the nearest 50 vehicles on local roads.

Table 3.2: Traffic Growth Factors

	Low Sensitivity Growth Rates					
Region	2016 – 2030		2030 – 2040		2040 – 2050	
	LV	HV	LV	HV	LV	HV
Galway	1.0243	1.0430	1.0087	1.0177	1.0088	1.0218

	Central Growth Rates					
Region	2016 – 2030		2030 – 2040		2040 – 2050	
	LV	HV	LV	HV	LV	HV
Galway	1.0259	1.0446	1.0109	1.0198	1.0105	1.0236

	High Sensitivity Growth Rates					
Region	2016 – 2030		2030 – 2040		2040 – 2050	
	LV	HV	LV	HV	LV	HV
Galway	1.0294	1.0480	1.0148	1.0236	1.0181	1.0336

Table 3.3: Traffic Growth Factors

	Low Sensitivity Growth Rates					
Region	2016 – 2030		2030 – 2040		2040 – 2050	
	LV	HV	LV	HV	LV	HV
Mayo	1.0111	1.0314	1.0009	1.0128	1.0005	1.0173

	Central Growth Rates					
Region	2016 – 2030		2030 – 2040		2040 – 2050	
	LV	HV	LV	HV	LV	HV
Mayo	1.0127	1.0330	1.0028	1.0148	1.0026	1.0192

	High Sensitivity Growth Rates					
Region	2016 – 2030		2030 – 2040		2040 – 2050	
	LV	HV	LV	HV	LV	HV
Mayo	1.0161	1.0364	1.0063	1.0186	1.0097	1.0290

The growth factors used to calculate travel demand predictions is taken from **Table 3.3** above and Mayo was the chosen region, due to the proximity and the rural location setting of the proposed site. It was decided the traffic growth factors for Galway region didn't reflect the traffic demand prediction for this rural area.

Table 3.4: Travel Demand Projections

Year	Low Sensitivity Growth AADT		Central Growth AADT		High Sensitivity Growth AADT	
	Light Vehicle	Heavy Vehicle	Light Vehicle	Heavy Vehicle	Light Vehicle	Heavy Vehicle
2039	10,365	679	10,648	684	11,662	766

Note; Light Vehicle (Cars & Light Goods Vehicles), Heavy Vehicles (Ordinary Goods Vehicles 1 & 2)

These flow volumes are within the capacity of a Type 1 single carriageway (11,600 AADT) but exceed the capacity of a Type 2 single carriageway (8,600 AADT) as set out by Table 6.1 of TII Publications Rural Road Link Design (DN-GEO-03031). Therefore, the proposed route should be developed as a Type 1 Single Carriageway.

3.3 Do-Nothing Scenario

The "Do-Nothing" option examines the existing road network, traffic conditions and road safety to determine if the existing road infrastructure has the ability to meet future traffic demands while maintaining safety without any upgrade works. This has been investigated in the following sections.

3.3.1 Existing Road Network

The existing N17 within the study area comprises of a single carriageway with narrow hard strips at the carriageway edge. The average lane widths in each direction are approximately 3.0m with no hard shoulder, limited verge space and unforgiving roadsides. Overall, the cross section of the road within the Study Area is sub-standard for a 100km/h speed limit.
In terms of horizontal and vertical alignment, there are a number of bends that fall below the desirable minimum as set out by TII Publications. An analysis has been carried out on the study area and this shows that 70% of the horizontal curves are substandard and 86% of the vertical curves are substandard.

There are a number of junctions within the study area and a high number of direct accesses. Junctions are laid out as priority junctions with no provision of ghost islands or nearside passing bays. This can lead to tailbacks, when vehicles attempt to turn right during peak flows, as vehicles approaching from behind have no opportunity to safely pass the stationary turning vehicle. In terms of direct access, there are a total of 64 No. split between field access (36

No.) and private access (28 No.). As with the junctions, there is no opportunity for vehicles to safely pass a stationary vehicle awaiting an opportunity to complete a right turning movement.

As previously mentioned, the horizontal and vertical alignment of the carriageway is sub-standard for a 100km/h road. This, in turn, leads to issues with stopping sight distance and overtaking opportunities. The minimum stopping sight distance of 215m is not achieved along approximately 50% of the route. The overtaking value achieved is approximately 15%, which is substantially below the requirement of 30% for Type 1 single

3.3.2 Traffic

The main source of traffic data for the route is the permanent automatic traffic counter located in the townland of Kilcloony, south of Milltown. For the year 2017, the AADT was recorded as 8,385 vehicles, of which 4.5% were heavy goods vehicles. A comprehensive set of traffic surveys was carried out over 14 days in November 2017, throughout the study area, and these counts indicated an AADT equivalent to 9,300. A design speed calculation was carried out for the rural section of the N17 under consideration and the results indicated that the design speed of the existing road is just 85km/h. Overall, in terms of traffic, it is clear that the route operates at a poor level of service.

3.3.3 Road Safety

Historic accident records for the route have been obtained from the Road Safety Authority (RSA). These records show that between 2005 and 2016, there were a total of 10 minor accidents on this section of the N17. The TII collision rates have also been reviewed and these show that the accident rate for one third of the scheme is twice the expected collision rate while the remainder is twice below.

The data highlights that the sub-standard geometry of the route, particularly in terms of horizontal alignment, is the main cause of accidents, with 70% of all accidents occurring on bends.

3.3.4 Conclusion

Given the sub-standard layout and the poor level of service in terms of traffic and road safety the Do-nothing scenario is not capable of achieving the scheme objectives either now or in the future, as described in the above sections.

3.4 Do-Minimum Scenario

Sections of the existing route have been examined d to see if a Do-minimum scenario could be identified that comprises upgraded sections that would be “capable of delivering the required levels of service in accordance with appropriate design standards”. However, given the extensive sections of sub-standard geometry, those with limited overtaking

opportunity, the urban sections and generally with the high frequency of junctions, no feasible "low-cost" solution was identified as a do- minimum. It was therefore decided that a full upgrade within the existing corridor should be considered as an option and directly appraised against other off-line scenarios.

For assessment purposes, all options are therefore compared against the Do-nothing, with the Do-minimum being equivalent to the Do-nothing.

3.5 Road Type

Based on the recommendations of TII Standards DN-GEO-03031, the existing single carriageway width is not sufficient to cater for its current volume of traffic or predicted future traffic flows. At the medium level of growth in the design year the current capacity of the road is far exceeded.

It is proposed that a Type 1 single carriageway is to be constructed which also provides continuity with the previous sections, that have been improved along the N17 in recent years. Therefore, without the upgrading of this section of the N17, it will have insufficient capacity for future increases in traffic which will result in increased delays to journey times, decreases in level of service and further decreases in safety.

4 Design Standards & Geometry

4.1 General

The provision of a safe and efficient network of national roads is a key function of TII and local authorities. Under the Road Safety Strategy 2013 – 2020, published by the Road Safety Authority (RSA), it is a primary objective to save lives and prevent injuries by reducing the number and severity of collisions and accidents across the road network.

To facilitate safety measures, the scheme design has adhered strictly to the TII's Publications standards, guidelines and DMURS. Under TII policy it is also mandatory for an independent Safety Audit to be carried out on all new or improved National Road Schemes. The principal factors affecting the safety of the road schemes include:

- Type and volume of traffic;
- Design speed and overtaking opportunities;
- Horizontal and vertical alignments;
- Visibility, sight and stopping distances;
- Junctions including their type and consistency as well as their proximity;
- Road surfacing and road furniture;
- Road signage, road marking, route and street lighting;
- Private access control;
- Facilities for pedestrians, cyclists and equestrians;
- Impacts from landscaping and other surroundings;
- Construction traffic management; and
- Any combination of the above.

4.2 Principal Geometric Parameters

The geometric design of the scheme is in accordance with TII publication standards, guidelines and DMURS. The principal standards concerning road geometry used in this scheme are outlined in **Table 4.1** below:

Table 4.1: Principal Design Standards

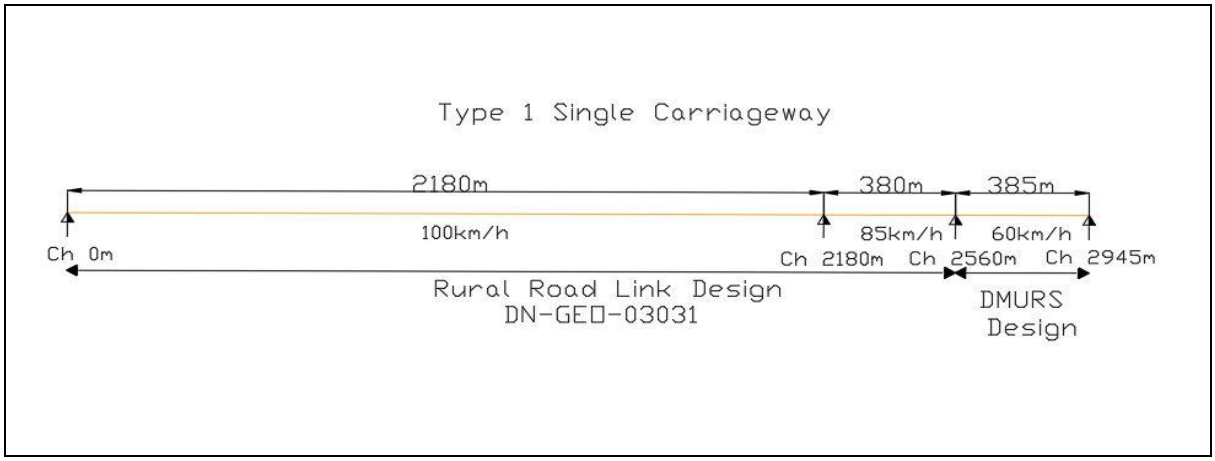
Standard	Standard Title
DN-GEO-03031	Road Link Design
DN-GEO-03036	Cross Section and Headroom
DN-GEO-03060	Geometric Design of Junctions (priority junctions, direct accesses, roundabouts, grade separated and compact grade separated junctions)
DN-GEO-03084	The Treatment of Transition Zones to Towns and Villages on National Roads
DMURS	Design Manual for Urban Roads and Streets

The Type 1 Single Carriageway is designed using three design speed parameters as outlined in **Figure 4.1**. Chainage 0m to 2+180m is designed using a 100km/h design speed, with a sign posted speed limit of 100km/h which complies with TII Publications for Rural Road Link Design, DN-GEO-03031. Chainage 2+180m to 2+560m is designed using an 85km/h design speed, with a sign posted speed limit of 80km/h which complies with TII Publications for Rural Road Link Design, DN-GEO-03031. Chainage 2+560m to 2+945m is designed using a 60km/h design speed, with a sign posted speed limit of 50km/h which complies Design Manual for Urban Roads and Streets (DMURS).

Table 4.2: Speed Limits

Chainage (m)	Design Speed Limit	Sign Posted Speed Limit
+0 to 2+180	100km/h	100km/h
2+180 to 2+560	85km/h	80km/h
2+560 to 2+945	60km/h	50km/h

Figure 4.1: Single Carriageway Design Speeds for proposed scheme



The proposed 3km realignment scheme is designed using a combined Type 1 single carriageway with an Urban single carriageway, as illustrated in **Figure 4.1** above. Geometric parameters are outlined in the tables below for the various design speeds which is critical in the design process for new single carriageways.

Table 4.3: Design Speed Related Parameters 1

Design Heading	Design Element	Design Requirement	Design Requirement	Design Requirement	Standards
Road Type	Main Carriageway	All Purpose Road Type 1 Single Carriageway	All Purpose Road Type 1 Single Carriageway	All Purpose Road Type 1 Single Carriageway	Table 6.1 Rural Road Link Design DN-GEO-03031
Design Heading	**Design Element**	**Design Requirement**	**Design Requirement**	**Design Requirement**	**Standards**
Design Speed	Main Carriageway	100km/h	85km/h	60km/h	Table 1.3 Rural Road Link Design DN-GEO-03031
Sight Distance	Desirable Minimum Stopping Sight Distance (SSD) Full Overtaking Sight Distance (FOSD)	215m 580m	160m 490m	90m 345m	Table 1.3 Rural Road Link Design DN-GEO-03031
Horizontal Alignment	Road Camber Super elevation Range Desirable Minimum R with (Superelevation of 5%)	2.5% 2.5% < S < 7% 720m	2.5% 2.5% < S < 7% 510m	2.5% 2.5% < S < 7% 255m	Table 1.3 Rural Road Link Design DN-GEO-03031
Vertical Alignment	FOSD Overtaking Crest K Value Desirable Min Crest K Value Desirable Max Gradient Minimum Gradient	400 100 5% 0.5%	285 55 5% 0.5%	200 17 5% 0.5%	Table 1.3 Rural Road Link Design DN-GEO-03031 Table 4.1 DN-GEO-03031 Para.4.1.3 DN-GEO-03031
Over-taking Value	Overtaking Value	30%	30%	30%	Table 7.3 DN-GEO-03031

Table 4.4: Design Speed Related Parameter 2

Design Heading	Design Element	Design Requirement	Design Requirement	Design Requirement	Standards
Cross Section	Cross Section	Type 1 Single Carriageway	Type 1 Single Carriageway	Single Carriageway Urban Relief Road	Table 6.1 DN-GEO-03031
Horizontal Curve Bands	Band A, Radius greater than; (Overtaking both Directions)	8160m	5760m	2880m	Figure 7.6 & Para .7.7 DN-GEO-03031
	Band B, Radius Boundaries (RH Curve Overtaking, verge widening may be necessary may be)	8160m -2880m	5760m - 2040m	2880m – 1020m	
	Band C; Radius Boundaries (Not Recommended, dubious overtaking conditions)	2880m – 1020m	2040m – 720m	1020m – 360m	
	Band D; Radius Boundaries (No Overtaking Sections)	1020m – 510m	720m – 360m	360m – 180m	

4.3 Proposed Cross Section

The route consists of a Type 1 single carriageway and is designed in accordance with TII Rural Road Link Design, DN-GEO-03031. The road will consist of two lanes of 3.65m, a hard shoulder 2.5m wide for each carriageway and a verge of 3m on the right-hand side with a verge of 5m on the left-hand side incorporating a shared footpath/cycle track, this cross section shall extend from Ch 0m to Ch 2+560m of the scheme. The footpath/cycle track will move off line to utilise the old road corridor where possible. The design speed of 100km/h will be adopted for the Type 1 section of the scheme from chainage Ch 0m to Ch 2+180m and a design speed of 85km/h from chainage Ch 2+180m to Ch 2+560m, which is consistent with National Roads. The Urban section of the scheme is designed in accordance with DMURS and TII Publications and drawing CC-SCD-00013 with a design speed of 60km/h to be adopted. The Urban single carriageway with footway and cycleway on each side of the carriageway commences at chainage Ch 2+560m to Ch 2+945m. The road will consist of two lanes of 3.5m, a footway of 2.5m and cycleway of 2.0m on each side of the carriageway.

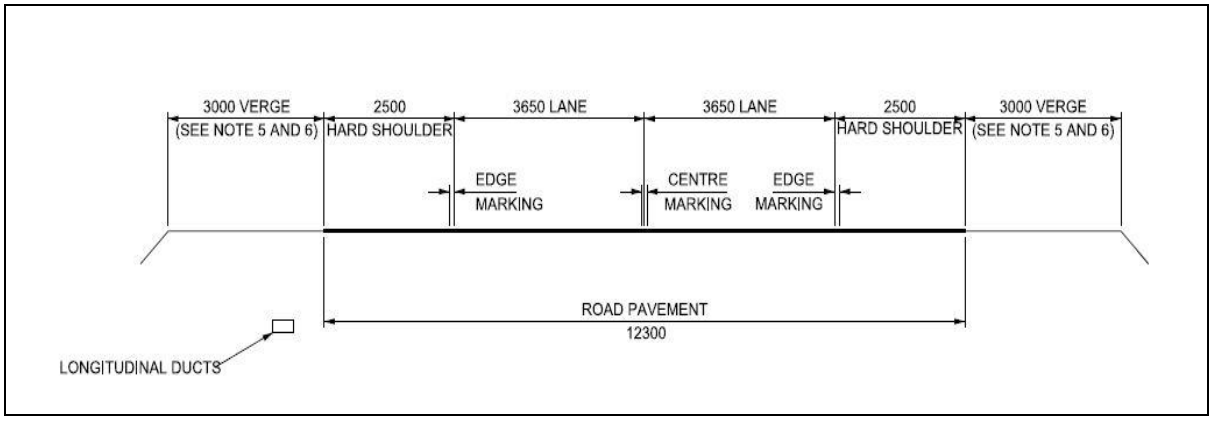
Table 4.3 of TII Publications Cross Sections and Headroom DN-GEO-03036, provides details of road cross section and dimensional requirements for a standard single carriageway cross section. The mainline alignment has been developed utilising these requirements. The standard single carriageway cross section comprises of the following elements:

Table 4.5: Realignment Carriageway Type

Chainage	Road Type
0.000m – 2560.000m	Type 1 Single Carriageway comprising 2 x 3.65m lane, 2 x 2.5m Hard Shoulder and 2 x 3.0m Verge with 3m Cycle/Walking facility on LHS of proposed carriageway.
2560.000m – 2945.000m	Single Carriageway Urban Relief Road comprising 2 x 3.25m lane, with 2.0m cycle track and 2.5m footpath on either side of carriageway.

The Type 1 single carriageway has an overall pavement width of 12.3m with verge widths varying from 3m to 7.5m to facilitate shared 3m wide footway/cycleway track. The Type 1 single carriageway cross section is detailed in **Figure 4.2** below.

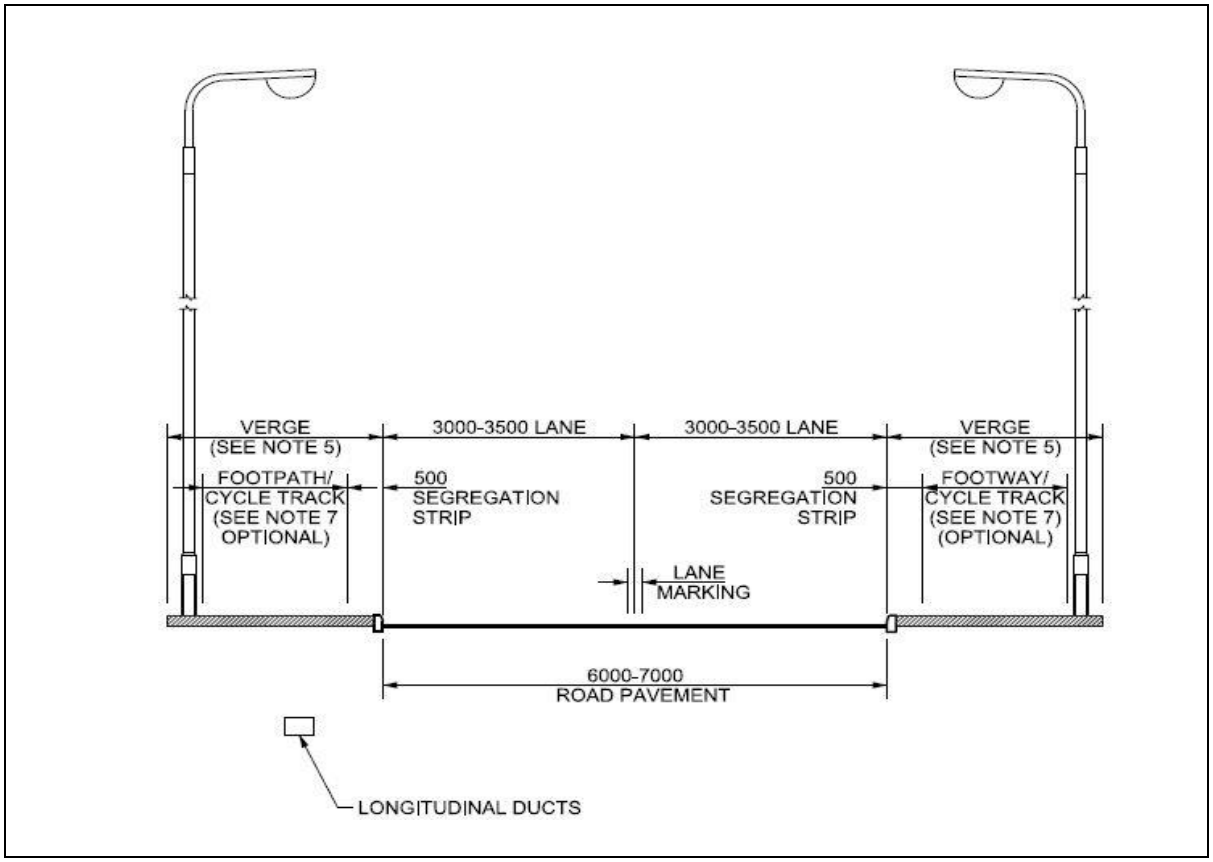
Figure 4.2: TII CC/SCD/00001 Type 1 Single Carriageway



The Urban Alignment section of the carriageway from Ch 2+560m to Ch 2+945m has been designed with cross section dimensional requirements for a standard single urban carriageway cross section, in accordance with DMURS and TII Publications as per **Figure 4.3** below. The standard single urban carriageway cross section comprises of the following elements.

- 2 x 3.25m Carriageway
- 2 x 4.5m Verges which incorporates 2.5m footpath and a 2.0m cycle path

Figure 4.3: TII CC/SCD/00013 Single Carriageway Urban Relief Road



4.4 Geometric Design

The mainline horizontal and vertical alignment has been designed to meet the desirable minimum standards as set out in TII Publications DN-GEO-03031 (TD9). The alignment was designed using Nova point design package for a 100km/h and 85km/h design speed on the Type 1 single carriageway. A design speed of 60km/h was used on the Urban carriageway ensuring the related design speed parameters given in table 1.3 TII Publications DN-GEO-03031 (TD9) were satisfied and compliance was achieved for the desirable minimum requirements where possible. See in **Table 4.6** below the proposed horizontal alignment design and **Table 4.7** below for the proposed vertical alignment design.

Table 4.6: Horizontal Alignment

Chainage		Horizontal Element	Radius	Length (m)	Desirable Minimum	Comment
Start (m)	Finish (m)					
0+000.000	0+620.471	Line	-	620.471		
0+620.471	0+720.471	Transition	-	100.000	100	
0+720.471	0+822.821	Arc	(720)	102.350	720	
0+822.821	0+922.821	Transition	-	100.000	100	
0+922.821	0+943.771	Line	-	20.950		
0+943.771	1+043.771	Transition	-	100.000	100	
1+043.771	1+296.140	Arc	720	252.368	720	
1+296.140	1+396.140	Transition	-	100.000	100	
1+396.140	2+357.564	Line	-	961.425		
2+357.564	2+405.564	Transition	-	48.000	43	
2+405.564	2+610.432	Arc	(510)	63.361	510	
2+610.432	2+658.432	Transition	-	48.000	30	
2+658.432	2+721.793	Line	-	63.361		
2+721.793	2+854.779	Arc	510	132.986	510	
2+854.779	2+945.344	Line	-	90.579		

4.4.1 Horizonal Alignment Constraints

The tie-in at the northern end of the scheme is the end of the recently completed N17 Carrownurlaur to Ballindine realignment, at chainage 0m. The tie-in on the southern end is at the start of the traffic calming at the Milltown village. The horizontal alignment will have to tie -in tangentially at these points.

There is an existing railway crossing at Ch. 1+030m. It was agreed to retain the position and level of the existing railway crossing at this location and not to move east or west. This railway crossing determines the horizontal and vertical alignment at this location. The railway is not in use at present, but may change in the future. This would have resulted in construction of a modern railway crossing at considerable expense.

There is a retained farmhouse at Ch. 1+640m, with a new house at Ch. 1+600m on the right-hand side. It is required to bring the centreline in between these properties. To bring this to the west would bring the road closer to the stream at Ch. 1+550m which is part of an SAC. To bring this to the east would have involved considerably more land take and dividing lands
It is intended to demolish a house at Ch. 1+700m left hand side as the impact on the house would have been considerable.

There is considerable housing on the existing road from Ch. 2+224m to the end. It is considered that the existing road alignment be retained as much as possible. Two properties at Ch. 2+460m and Ch. 2+510m are to be demolished to allow an increase of the radius of the existing bend.

4.4.2 Vertical Alignment Constraints

Vertical Alignment constraints involve tie in at four locations, the northern end at Ch. 0m, the existing railway crossing at Ch. 1+030m, existing ground at Ch 1+600m because of adjacent properties and the southern end at Ch. 2+945m. As there is a potential flat spot at Ch. 2+700m the longitudinal gradient is kept at 2%. Accordingly, a crest curve is used at Ch. 0+800m and a sag curve at Ch. 1+100m. To have reversed this would have involved difficulties in tying in at Ch. 1+600m and there is a side road at Ch. 0+460m which is very steep coming onto the N17. Consequently, the vertical alignment was selected to satisfy the constraints, resulting in considerable fill been required at Ch. 0+800m. It is also required to tie in from Ch. 2+260m to the end of the scheme because of adjacent properties.

Table 4.7: Vertical Alignment Design 1

Chainage		Vertical Align-ment	Radius	K Value	Grade	Desirable Minimum	Comment
Start (m)	End (m)						
0+000.000	0+314.061	Line	-		-0.279	0.5% - 5%	
0+314.061	0+381.797	Sag	4000.105	(40.001)		37	
0+381.797	0+627.970	Line	-		1.414	0.5% - 5%	
0+627.970	0+972.012	Crest	10001.62	100.016		100	
0+972.012	1+067.876	Line	-		-2.026	0.5% - 5%	
1+067.876	1+232.899	Sag	4000.675	(40.007)		37	
1+232.899	1+325.467	Line	-		2.099	0.5% - 5%	
1+325.467	1+594.551	Crest	10001.35	100.014		100	
1+594.551	1+968.925	Line	-		-0.592	0.5% - 5%	
1+968.925	2+059.827	Sag	15000.25	(150.00)		37	
2+059.827	2+149.661	Line	-		0.015	0.5% - 5%	
2+149.661	2+385.786	Crest	10000.19	100.002		100	
2+385.786	2+404.539	Line	-		-2.347	0.5% - 5%	
2+404.539	2+487.743	Sag	2600.551	(26.006)		26	
2+487.743	2+574.511	Line	-		0.853	0.5% - 5%	
2+574.511	2+612.900	Crest	2000.161	20.002		8.2	
2+612.900	2+665.352	Line	-		-1.067	0.5% - 5%	
2+665.352	2+684.312	Sag	1000.015	(10.000)		9.2	
2+684.312	2+762.114	Line	-		0.830	0.5% - 5%	

Table 4.8: Vertical Alignment Design 2

Chainage		Vertical Align-ment	Radius	K Value	Gradient	Desirable Minimum	Comment
Start(m)	End (m)						
2+762.114	2+776.391	Crest	1000.018	10.000		8.2	
2+776.391	2+781.930	Line	-		-0.598	0.5% - 5%	
2+781.930	2+794.059	Sag	1000.018	(10.000)		9.2	
2+794.059	2+816.862	Line	-		0.615	0.5% - 5%	
2+816.862	2+817.322	Crest	1000.053	10.001		8.2	
2+817.322	2+840.889	Line	-		0.569	0.5% - 5%	
2+840.889	2+841.708	Crest	1000.042	10.000		8.2	
2+841.708	2+870.052	Line	-		0.487	0.5% - 5%	
2+870.052	2+881.065	Crest	1000.016	10.000		8.2	
2+881.065	2+886.089	Line	-		-0.614	0.5% - 5%	
2+897.381	2+909.418	Line	-		0.515	0.5% - 5%	
2+909.418	2+920.016	Crest	1000.014	10.000		8.2	
2+920.016	2+926.398	Line	-		-0.545	0.5% - 5%	
2+926.398	2+926.556	Crest	1000.046	10.000		8.2	
2+926.556	2+945.344	Line	-		-0.561	0.5% - 5%	

The road will have a minimum horizontal radius of 720m with a 5% super-elevation within the 100km/h design speed and minimum horizontal radius of 510m with a 5% super-elevation within the 85km/h design speed. Full Overtaking Sight Distance (FOSD) will be provided at all junctions with the carriageway. A maximum vertical grade of 2.34% has been provided in the design which is below the maximum 5% desirable for National and Regional Roads. The lowest K Value sag curve used to transition between sections of the road is 40 which is above the minimum value of 37 allowable for a road with a design speed of 100km/h.

A cross fall of 2.5% has been adopted for the carriageway with a cross fall of 5% on grassed verges. The carriageway cross fall has been increased to 3% on flat areas to improve carriageway drainage. A minimum of 215m Stopping Sight Distance (SSD) has been adopted with verges widened to achieve the SSD where required. The requirement for safety barrier has been considered under TII, DN-REQ-03034(TD19), with hazards designed out where possible.

4.5 Hidden Dips

Also known as blind spots, these occur when the road disappears, from view over a crest or around a bend and reappear in view again further on. Vertical blind spots or hidden dips, occur where there is a sag between two crests on a straight road. The vertical profile is examined and cross referencing to the plan, whereby hidden dips are identified or discounted. The single carriageway design has eliminated horizontal and vertical hidden dips in the proposed 3km scheme.

Table 4.9: Hidden Dips Direction of Travel North to South

Direction of Travel (North to South)	
Chainage	**Description**
Ch 0m – Ch 590m	No hidden dips identified at this chainage as the horizontal alignment is relatively straight, with gradual slope in the vertical alignment.
Ch 590m – Ch 1500m	This chainage is not a straight line of vision for the driver due to the horizontal alignment. A driver at chainage 540m will see the top of road at chainage 590m but will not see road behind at chainage 1500m. There are no hidden dips identified for this section.
Ch 1430m – Ch 1560m – Ch 2160m	This is a straight line with a hidden dip, however the dip is only 0.5m deep which is less than the maximum allowable of 1.05m
Ch 2030m – Ch 2380m – Ch 2600m	The vertical alignment does not coincide with horizontal alignment at these chainages. The driver will not see the car in the dip, however the driver will also not see the pavement behind the crest at Ch. 2380m to give the illusion of a continuous pavement, hence this is at a hidden dip.
Ch 2500m – Ch 2610m - Ch 2760m	This section contains a hidden dip of 0.730m which is less than maximum allowable of 1.05m, hence the hidden dip is satisfactory.

Table 4.10: Hidden Dips Direction of Travel South to North

Direction of Travel (South to North)	
Chainage	**Description**
Ch 2860m – Ch 2600m – Ch 2430m	This section contains a hidden dip of 0.700m which is less than maximum allowable of 1.05m, hence the hidden dip is satisfactory.
Ch 2340m – Ch 2060m – Ch 1520m	This section contains a hidden dip of 0.655m which is less than maximum allowable of 1.05m, hence the hidden dip is satisfactory.
Ch 1520 – Ch 860m	These lines do not coincide horizontally, i.e. where a car is out of line of sight, there is no paved area in the background. There is a lack of overtaking sight distance but no hidden dip.
Ch 860m – Ch 730m - Ch 0m	The line of sight passes over verge at Ch. 710m (crest), hence not a continuous pavement as a result no hidden dip.

4.6 Surface Drainage of Carriageway

Aquaplaning occurs when the vehicles tyres are partially or fully separated from the road surface by a film of water which results in loss of control of the vehicle. If the combination of water depth on the road surface, vehicle speed and tyre condition exceeds the point where water can be dispersed, the thickness of the water film in front of the tyre builds up and begins to penetrate the tyre contact patch.
The degree of which water is displaced is largely governed by the speed of the vehicle, and the capacity of the pavement macrotexture and tyre tread grooves to provide the necessary drainage paths. The provision of appropriate road drainage in conjunction with suitable transverse super elevations and longitudinal pavement gradients ensures that there is a minimal depth of surface water on the carriageway to be displaced.
Aquaplaning potential can be assessed at design stage by determining the expected water film depth for a given drainage path across the carriageway and checking estimated water depths against acceptable design limits.

The design has allowed for areas that have kerbs, to be provided with a minimum longitudinal gradient of 0.5%. The cross fall is increased to 3% as a relaxation as per 11.5.1 DN-GEO-03031.

Six locations have been identified as potential flat spots and the drainage path assessed to determine that the overall minimum gradient of 1% or greater is achieved in accordance with section 4.1.3 DN-GEO-03031 in determining the water film depth. A maximum water film depth of 3.3mm was assumed in accordance with section 11.4 of DN-GEO-03031. The six locations are:

- Ch. 650 RHs;
- Ch. 850 RHs;
- Ch. 970 LHs;
- Ch. 1370 LHs;
- Ch. 2370 RHs;
- Ch. 2670 RHs.

A triangulated surface of the main line was prepared at each location with a calculation based on spreadsheets to determine the maximum water film depth for each location. The water film depth was determined to be less than 3mm. Calculations of water film depth and drainage paths for the proposed design are shown in **Appendix A4.1**

4.7 Side Slopes

Earthworks side slope have been designed with 1:3 side slopes in fill and 1:2.5 side slopes in cut. Side slopes steeper than 1:5 are not recommended in the clear zone. They should be kept as shallow as possible to avoid vehicle rollover.

4.8 Clear Zones

The Clear Zone is defined as the total width of transversable land on the nearside or offside which is to be kept clear of unprotected hazards. This width is available for use by errant vehicles. The zone is measured from the nearest edge of the trafficked lane: i.e. hard shoulder, hard strip, and verge forms part of the clear zone. The design refers to table 4.1 of TII Standards DN-REQ-03034 for required width of clear zone for various design speeds. The required clear zone for the proposed scheme is shown in **Table 4.11** below.

Table 4.11: Required Clear Zone Width for the Scheme

Horizontal Radius (m)	**Design Speed (km/h)**		
	60	**85**	100
	Required Width of Clear Zone (m)		
Inside of Bend or Straight	4.5m	6.5	8.0m
Outside of Bend ≥ 700m	5.0m	8.3	10.4m

4.9 Sound Barrier

A designed noise barrier will reduce noise propagating from source to receiver through diffraction over the top of the barrier or around its edges. Some noise may also be transmitted through the barrier. The level of noise transmitted through the barrier depends on the material properties of the barrier, while the level of noise diffracted is dependent on the location and size of the barrier. For a barrier to be fully effective, the amount of sound passing through it must be significantly less than that diffracting over or around it.

To function well the barrier should obscure the direct line of sight between the source and the receiver. The region behind the barrier is known as the shadow region. Noise barriers attenuate high frequencies more effectively compared with lower frequencies. This is since higher frequencies are diffracted to a lesser degree. At chainage 1+600m right hand side, due to proximity of existing garage and house to the proposed realignment and the height difference between road level and ground level of the house and garage, it is proposed to install a sound barrier at this location. The detailed design stage will determine the sound barrier type, material, height and length to be chosen.

4.10 Safety Barrier

Safety Barriers should be considered an integral part of the road alignment design since there position may affect the stopping sight distance and clearance to structures. It's necessary to ensure that the visibility requirements are not compromised by the presence of the safety barriers. The introduction of safety barriers adjacent to carriageways should only be considered where the elimination of all hazards within the clear zone is not reasonable practicable. A preliminary design of vehicle restraint system has been completed in accordance with DN-REQ-03034 Safety Barriers. All potential hazards located within the clear zone have been identified and categorised as per hazards definitions, classifications, and rankings referred to in DN-REQ-03034. A preliminary safety barrier schedule has been compiled, refer to **Appendix A4.2**. Drawings VRS-01 to VRS-04 in Volume 2 of this report presents the plan layout of the preliminary design of safety barriers.

A safety barrier is a hazard within itself. An effort to reduce provisions of safety barriers across the proposed road development was completed. This exercise was prompted following recommendations from a road safety audit, therefore an effort to achieve a more 'forgiving roadside' design was completed. Embankments side slopes were designed to 1:3 and 1:2.5 across the entire single carriageway section except for one location on the right-hand side. Safety Barriers are required on the main line on the right-hand side at chainage Ch. 1+480m to Ch. 1+680m. The side slopes along the local side roads in certain areas do exceed the recommended slope, hence it is proposed to install safety barriers at these identified locations.

The proposed safety barrier design has been checked against mainline forward visibility to ensure no obstructions to road users sightlines. All side roads and access roads have been checked against proposed safety barrier design and re-alignment.

Each barrier has been assigned a containment level, impact severity level, working class, and set back (taken from the edge of the carriageway under consideration). The preliminary design took cognisance of a 'reasonable compromise between a large working width and a generous set-back' (clause 5.21 of DN-REQ-03034). Where possible, more economical choices between working width classes were made whilst ensuring safety of the design (maximum working width class has been set at W4 which means that the safety barrier in the event of an impact with a vehicle can, in theory deform up to 1.3m). A summary of safety barrier types to be provided along the proposed road development is listed in **Table 4.12** below.

Table 4.12: Summary of Safety Barrier

Location	Containment Level	Barrier Type	Length (m)
L-2227	N2	N2/A/W5	95
L-2227	N2	N2/A/W5	75
L-2227	N2	N2/A/W5	90
L-22087	N2	N2/A/W5	110
L-22087	N2	N2/A/W5	105
L-22087	N2	N2/A/W5	60
N17	N2	N2/A/W5	200

4.11 Relaxations & Departures

TII allows for a flexible approach to be applied to a range of design standards, including Rural Road Link Design DN-GEO-03031 (TD9), for situations where strict application of the desirable minimum standards would lead to disproportionately high construction costs or severe environmental impacts upon people, property and the landscape. The flexibility is applied as a tiered hierarchy through the application of relaxations or departures. Relaxations can be applied at the discretion of the designer. However, if departures are to be incorporated into the design then prior approval of the TII Standards Unit is required. Having regard to the fact that the scheme consists primarily of online upgrade, and is located within a particularly sensitive environment, it has been necessary to incorporate relaxations in the geometric design in-order to avoid excessive impacts.

In addition, there's a significant number of departures from standards required for the scheme. Departures application has been submitted to the TII Standards Unit for approval to incorporate these into the design, which has achieved full approval by TII under Departure Application Number 20859 in accordance with TII Publications GE-GEN-01005 from Standards.

Full details of all Departures from Standard and Relaxations for the scheme are included in the tables below.

Table 4.13: Schedule of Relaxations 1

Ref	Category	Location	Type	Standard Required	Standard Provided	Justification
1	Geometric Design of Junctions DN-GEO-03060 5.6.4	Ch. 186	Entrance 24 Dwell Area @ 3m Approach	+/- 2.5% +/- 10%	-4.0% -10.4%	Tie in with Existing Ground Levels
2	Geometric Design of Junctions DN-GEO-03060 5.6.4	Ch. 198	Entrance 25 Dwell Area @ 3m	+/- 2.5%	-4.0%	Tie in with Existing Ground Levels
3	Geometric Design of Junctions DN-GEO-03060 5.6.4	Ch. 1079	Entrance 6 Dwell Area @ 3m	+/- 2.5%	-4.0%	Tie in with Existing Ground Levels
4	Road Design, DN-GEO-03031	Ch. 2460	Transition Length	Transition Length Short		Problems with Drainage, Flat spots
5	Geometric Design of Junctions DN-GEO-03060 5.6.4	Ch. 2604	Entrance 11 Dwell Area @ 3m	+/- 4%	4.0%	Tie in with Existing Ground Levels

Table 4.14: Schedule of Relaxations 2

Ref	Category	Location	Type	Standard Required	Standard Provided	Justification
6	Geometric Design of Junctions DN-GEO-03060 5.6.4	Ch. 2641	Field Access Dwell Area @ 3 m Approach	+/- 2.5% +/- 10%	-4.0% -10.8%	Tie in with Existing Ground Levels
7	Rural Road Link Design DN-GEO-03031 Table 10.3	Ch. 458 LHS, Ch. 1464 RHS, Ch. 2778 RHS	Horizontal Alignment on side roads for design speed 42km/h	127m	34m	Approach road to the junction and tie in with existing road
8	Rural Road Link Design DN-GEO-03031 Table 10.3	Ch. 675 RHS,	Horizontal Alignment on side road for design speed 42km/h	127m	100m	Approach road to the junction and tie in with existing road
9	Rural Road Link Design DN-GEO-03031 Table 10.3	Ch. 2357 LHS	Horizontal Alignment on side road for design speed 42km/h	127m	50m	Approach road to the skewed junction and tie in with existing road
10	Rural Road Link Design DN-GEO-03031 Table 10.3	Ch. 458 & Ch. 2357	Stopping Sight Distance (SSD) on side roads for design speed 42km/h	50m	30m	50m will be achieved once the verge is widened
11	Rural Road Link Design DN-GEO-03031 Table 10.3	Ch 1330 Side road LHS	Desirable minimum Crest K value	6.5	5	Length of alignment is short.

Table 4.15: Schedule of Departures 1

Ref	Category	Location	Type	Standard Required	Standard Provided	Justification
1	Road Design, DN-GEO-03060 5.6.3.2	Ch. 70 LHS	Field access 1 & Entrance 1 Visibility envelope overlaps with visibility envelope of accesses at Ch. 155 LHS, Ch. 190 LHS	215m	90m to RHS & 85m to LHS	This is an existing residential entrance
2	Road Design, DN-GEO-03060 5.6.3.2	Ch. 155 RHS	Entrance 2 Visibility envelope overlaps with visibility envelope of accesses at Ch. 70 LHS, Ch. 190 LHS	215m	85m to RHS & 35m to LHS	This is an existing entrance. It will not be used very often
3	Road Design, DN-GEO-03060 5.6.3.2	Ch. 190 LHS	Combined Residential & field access 24 and 25 Visibility envelope overlaps with visibility envelope of accesses at Ch. 70 LHS, Ch. 155 LHS	215m	35m to RHS, 215m to LHS	This is an existing Field and residential entrance. It will not be used very often
4	Road Design, DN-GEO-03060 5.6.3.2	Ch. 960 LHS	Field access 4 & Iarnód Éirean access Visibility envelope overlaps with visibility envelope of accesses at Ch. 1028 LHS, Ch. 1078 LHS	215m	215m to RHS, 68m to LHS	This is an existing Field entrance. It will not be used very often

Table 4.16: Schedule of Departures 2

Ref	Category	Location	Type	Standard Required	Standard Provided	Justification
5	Road Design, DN-GEO-03060 5.6.3.2	Ch. 1028 LHS	Field access 5 Visibility envelope overlaps with visibility envelope of accesses at Ch. 960 LHS, Ch. 1078 LHS	215m	68m to RHS & 50m to LHS	This is an existing Field entrance. It will not be used very often
6	Road Design, DN-GEO-03060 5.6.3.2	Ch. 1078 LHS	Entrance 6 Visibility envelope overlaps with visibility envelope of accesses at Ch. 960 LHS, Ch. 1028 LHS	215m	50m to RHS & 150m LHS	This is an existing Residential entrance. It will not be used very often
7	Road Design, DN-GEO-03060 5.6.3.2	Ch. 1330 LHS	Junctions Visibility envelope overlaps with visibility envelope of Main road horizontal alignment.	215m	150m to RHS & 215m LHS	Traffic on these roads will be light. They are serving cul-de-sacs
8	Road Design, DN-GEO-03060 5.6.3.2	Ch. 2345 LHS	Junctions Visibility envelope overlaps with visibility envelope of access at Ch. 2480 LHS	160m	120m to LHS & 160m RHS	This is an existing local road will low AADT recorded
9	Road Design, DN-GEO-03060 5.6.3.2	Ch. 2480 LHS	Field access 10 Visibility envelope overlaps with visibility envelope of Junction at Ch. 2345 LHS	160m	120m to RHS & 55m to LHS	This is an existing Field entrance. It will not be used very often
10	Road Design, DN-GEO-03060 5.6.3.2	Ch. 2480 RHS	Field access 10 Visibility envelope overlaps with visibility envelope of Junction at Ch. 2510 RHS	160m	160m to LHS & 30m to RHS	This is an existing Field entrance. It will not be used very often

Table 4.17: Schedule of Departures 3

Ref	Category	Location	Type	Standard Required	Standard Provided	Justification
11	Road Design, DN-GEO-03060 5.6.3.2	Ch. 2510 RHS	Entrance 23 Visibility envelope overlaps with visibility envelope of Junction at Ch. 2480 RHS & Ch. 2560 RHS	215m	30m to LHS & 50m to RHS	This is an existing Residential entrance
12	Road Design, DN-GEO-03060 5.6.3.2	Ch. 2535 LHS	Field access 11 Visibility envelope overlaps with visibility envelope of field access at Ch. 2480 LHS	160m	55m to RHS & DMURS to LHS	This is an existing Field entrance. It will not be used very often
13	Road Design, DN-GEO-03060 5.6.3.2	Ch. 2560 RHS	Field access 24 Visibility envelope overlaps with visibility envelope entrance at Ch. 2510 LHS	160m	50m to LHS & DMURS to RHS	This is an existing Field entrance. It will not be used very often
14	Road Design, DN-GEO-03060 5.3.5 Staggered Junctions Table 5.2	Ch. 1330 LHS & Ch. 1464 RHS	Distance between Junctions 3 at Ch.1330 & 4 at Ch. 1464 is within the parameters of staggered junction, but it's designed as two separate independent junctions	>200m	134m	Junction at Ch. 1330 is a cul-de-sac, facilitating a number of residential and farm accesses with low volume of traffic
15	Road Design, DN-GEO-03031 Figure 5.3	Ch. 675 RHS & Ch. 1464 RHS	Clearance to minor road at priority junctions 2 & 4	90m 90m	42.5m 68m	Access roads to facilitate agricultural lands
16	Road Design, DN-GEO-03031 Table 10.3	Ch 1330 LHS	Desirable minimum Sag K value	6.5	5	Length of Alignment is short
17	Road Design, DN-GEO-03031 Table 10.3	Ch 1888 LHS	Desirable minimum Sag K value	6.5	4	Length of Alignment is short

4.12 Pedestrians, Cyclists and Non-Motorised User Facilities

It is proposed to provide a shared use two-way cycle and pedestrian facility on the left-hand side (LHS) of the carriageway which will run parallel to the hard shoulder from chainage +0m to 2+560m. The facility is proposed to be 3metres wide with a 2% slope falling towards the carriageway, due to constraints the facility will be reduced to 2 metres in width from chainage 0+120m to 0+200m. The facility will be designed using rural cycleway design (offline) DN-GEO-03047.The shared facility will tie in at chainage 2+560 on the left-hand side of the proposed realignment with the 2.5m footpath and 2m cycle path.

The two-way facility will continue parallel to the proposed single carriageway urban road from chainage of Ch 2+560m to Ch 2+945m along both sides of the re alignment. The footway is proposed to be 2.5m wide and cycle path is proposed to be 2m wide with a 2% slope falling towards the carriageway, which satisfies desirable minimum widths as per table 4.5 of TII Publications DN-GEO-03036. The design is based on providing low volume facilities, which is considered to attract traffic which is less than 1500 users a day, above this threshold is considered High Volume.
This footway/cycleway is then extended as a shared facility on the right-hand side of the alignment and goes offline from Ch 2+560m to Ch 2+310m which utilise the old road corridor, providing access to the N17 Superstore and providing connectivity for pedestrians and cyclist to local road L-2208. The proposed footway/cycleway is designed in accordance with TII Publications for Rural Cycleway Design (Offline) DN-GEO-03047.The footway/cycleway is proposed to be 3.0m wide with a 2% cross fall slope.

4.13 Pedestrian crossings with minor road AADT < 4,000

At priority junctions, where the AADT of the side road is less than 4,000 vehicles, crossing facilities shall be a bend out crossing as illustrated in **Figure 4.4** below. The priority at these junctions should lie with vehicular traffic. Signs should be provided on the road warning motorists of the upcoming crossing facility.

The bend out crossing junction increases the space between cyclist / pedestrian facility crossing point and the main carriageway. This allows space for motorised vehicles turning off the major road before they encounter the cyclist / pedestrian facility. The distance between the edge of the main carriageway and the crossing facility shall be between 10 and 15 metres.

The bend out junction treatment includes a straight approach to ensure cyclists / pedestrians are provided with full visibility on entry to the junction treatment. The horizontal radii of 10 metres on the facility shall be introduced to encourage lower cycle speeds on approach to the junction. A colour contrast treatment should be provided along the cycle / pedestrian route warning cyclists and pedestrians of upcoming conflict with motorised traffic as illustrated in **Figure 4.4**. This configuration is used at junctions at Ch. 460 LHS, Ch. 1530 LHS and Ch. 2350 LHS.

The scheme doesn't have a cyclist / pedestrian facility crossing a priority junction with minor road AADT > 4,000.

Figure 4.4: Bend Out Crossing (minor road AADT < 4,000)

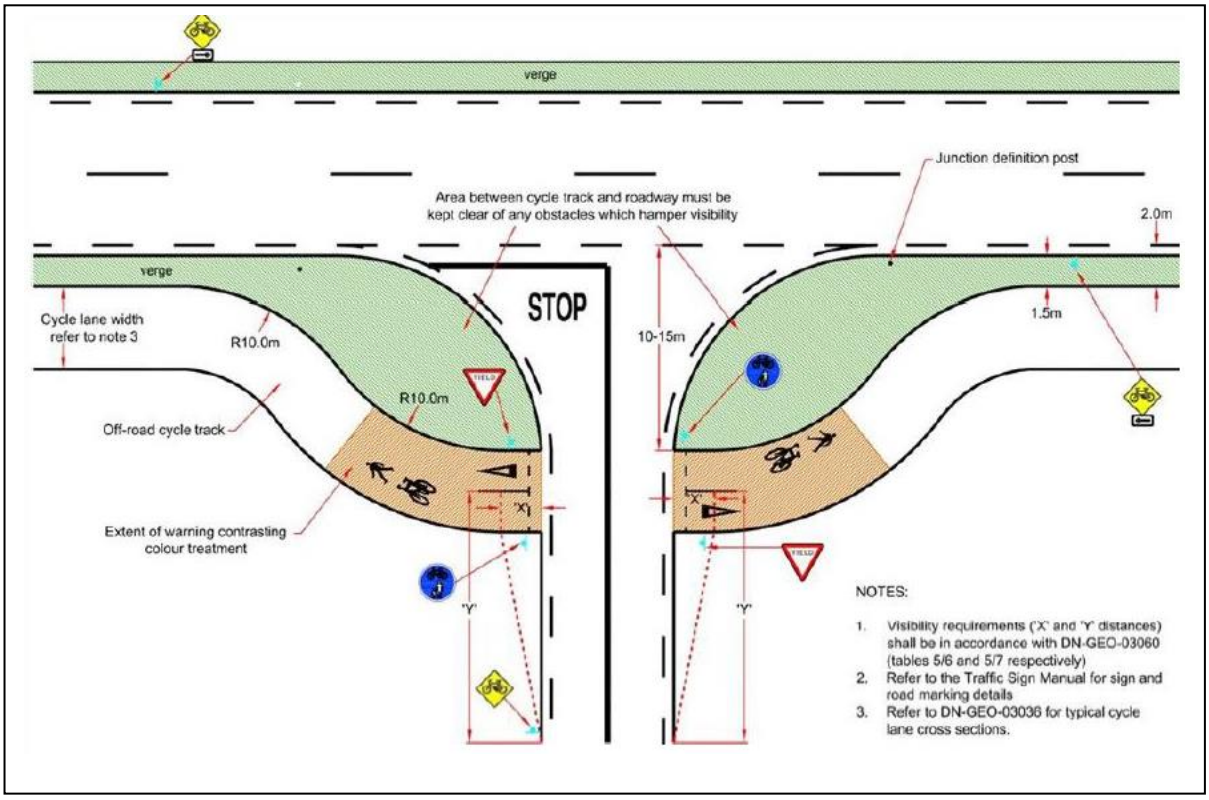
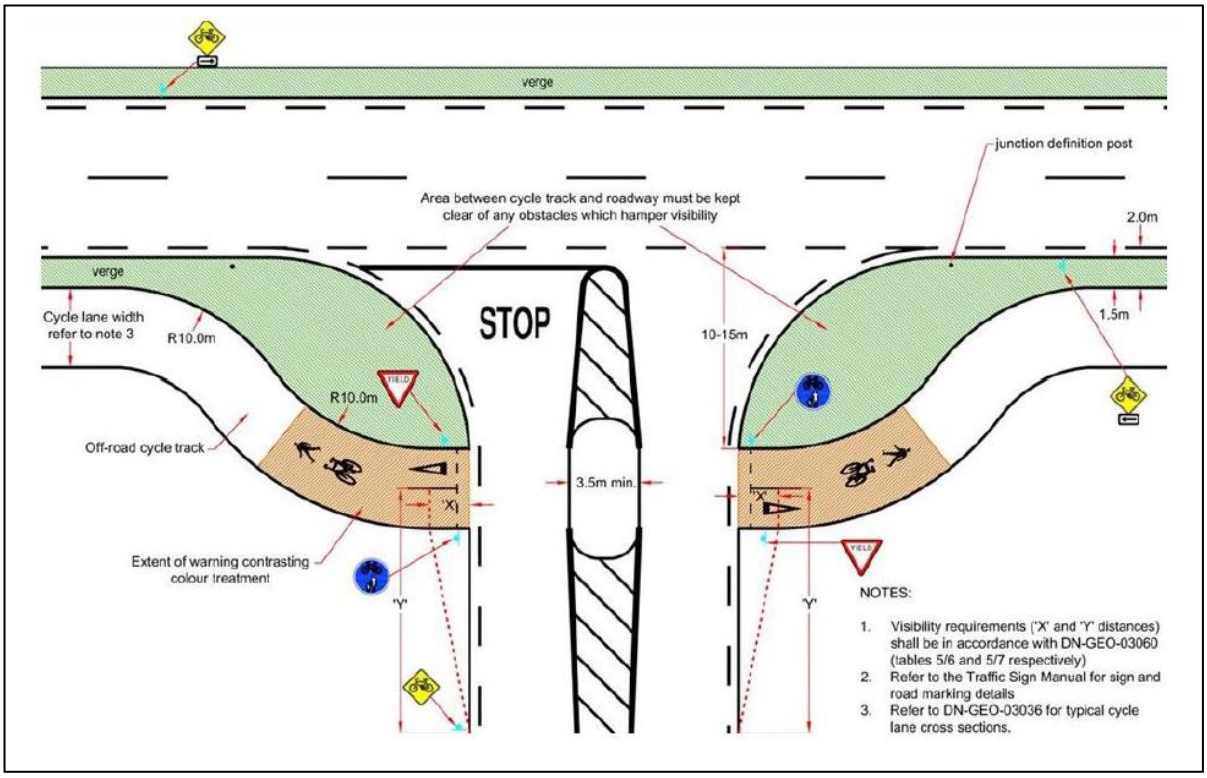


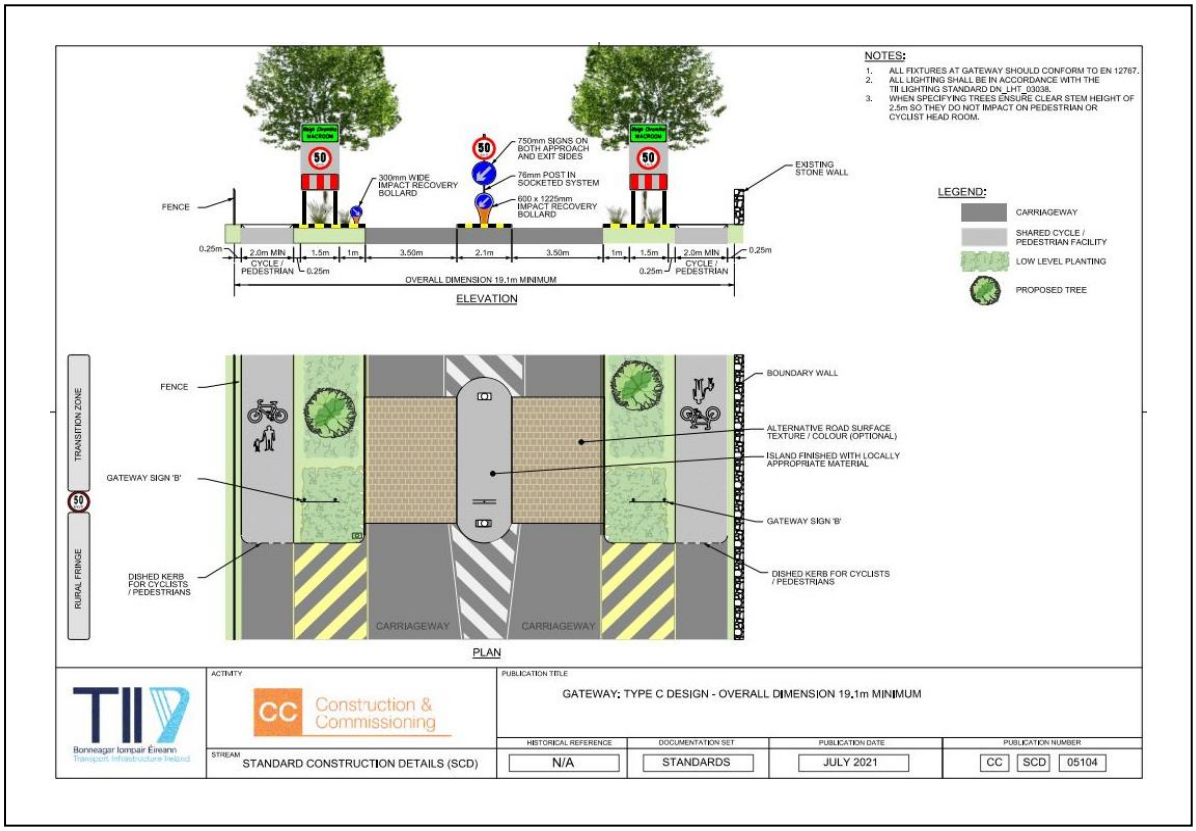
Figure 4.5: Central Island (minor road AADT > 4,000)



4.14 Gateway and Toucan Crossing

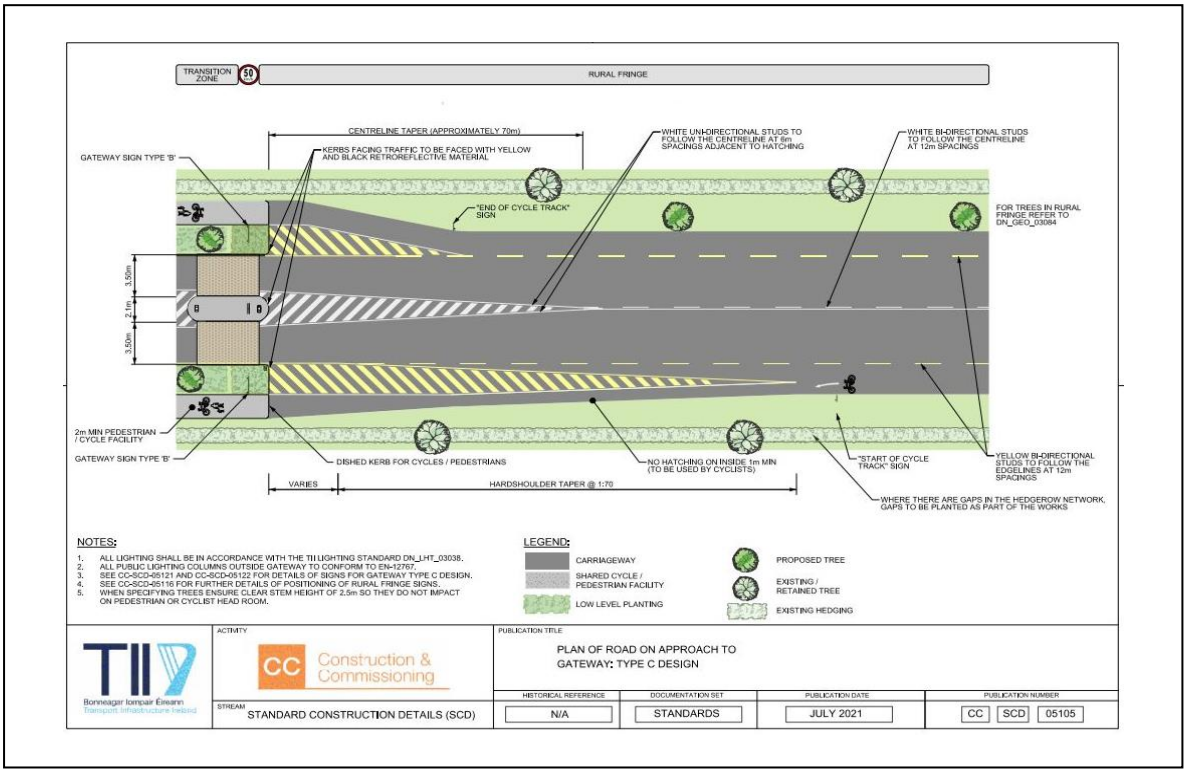
A proposed gateway entrance to Milltown will be located at approximately chainage 2+560m, with a pedestrian crossing located at chainage 2+640m approximately. The design of the Gateway and pedestrian crossing was designed in accordance with TII publication "The Treatment of Transition Zones to Towns and Villages on National Roads" (DN-GEO-03084). The chosen Gateway is a "Type C Gateway Design", with a 2.1m central island and 3.5m kerb to kerb lane on either side of the island. The Gateway design allows kerbed build outs on both sides with cycle/pedestrian lane to the back.

Figure 4.6: Type C Gateway Design



The Gateway Type C is designed in accordance with CC-SCD-05104 as per **Figure 4.6** above. The buildouts contain "Gateway Sign B" (inbound) and (outbound) in accordance with CC-SCD 05121 and CC-SCD-05122, as per **Figures 4.8 and 4.9** below. The location of approach signs is in accordance with CC-SCCD-05116 Position of Rural Fringe Signs as per **Figure 4.10**.

Figure 4.7: Plan Approach to Type C Design



The Approach lining is designed in accordance with CC-SCD-05105 as per **Figure 4.7** above, except the central hatching which is tapered from 2.1m at the central island to 3.5m at chainage 2+430m

Figure 4.8: Gateway Sign B (Inbound)

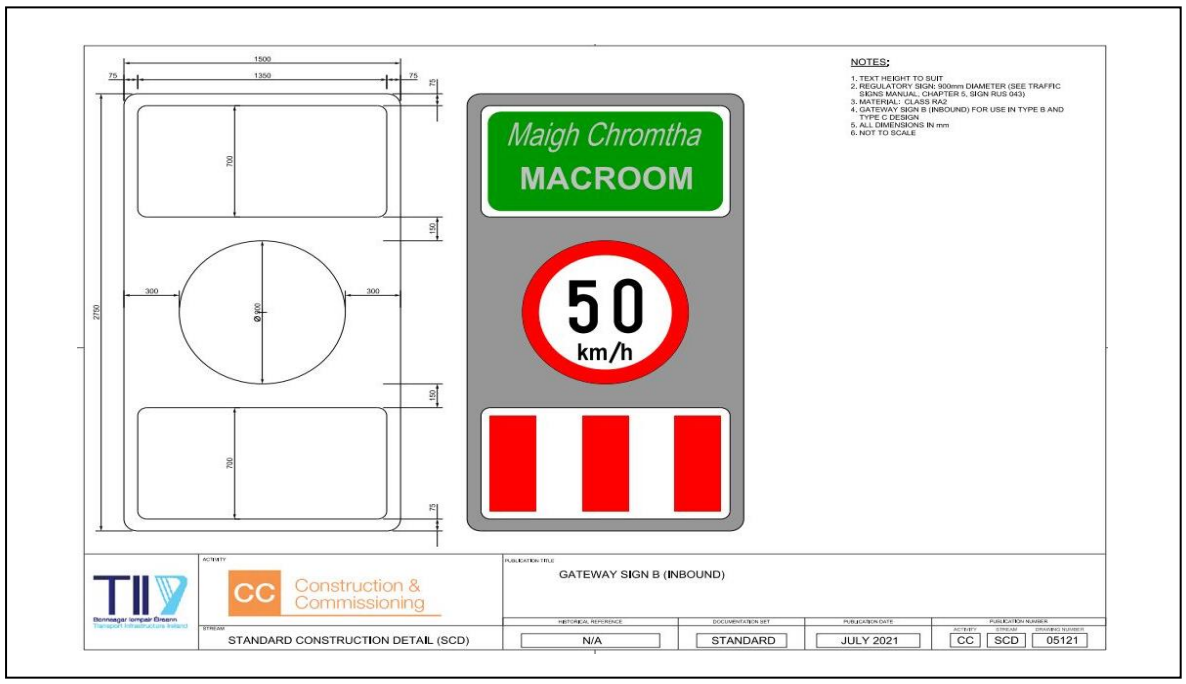


Figure 4.9: Gateway Sign B (Outbound)

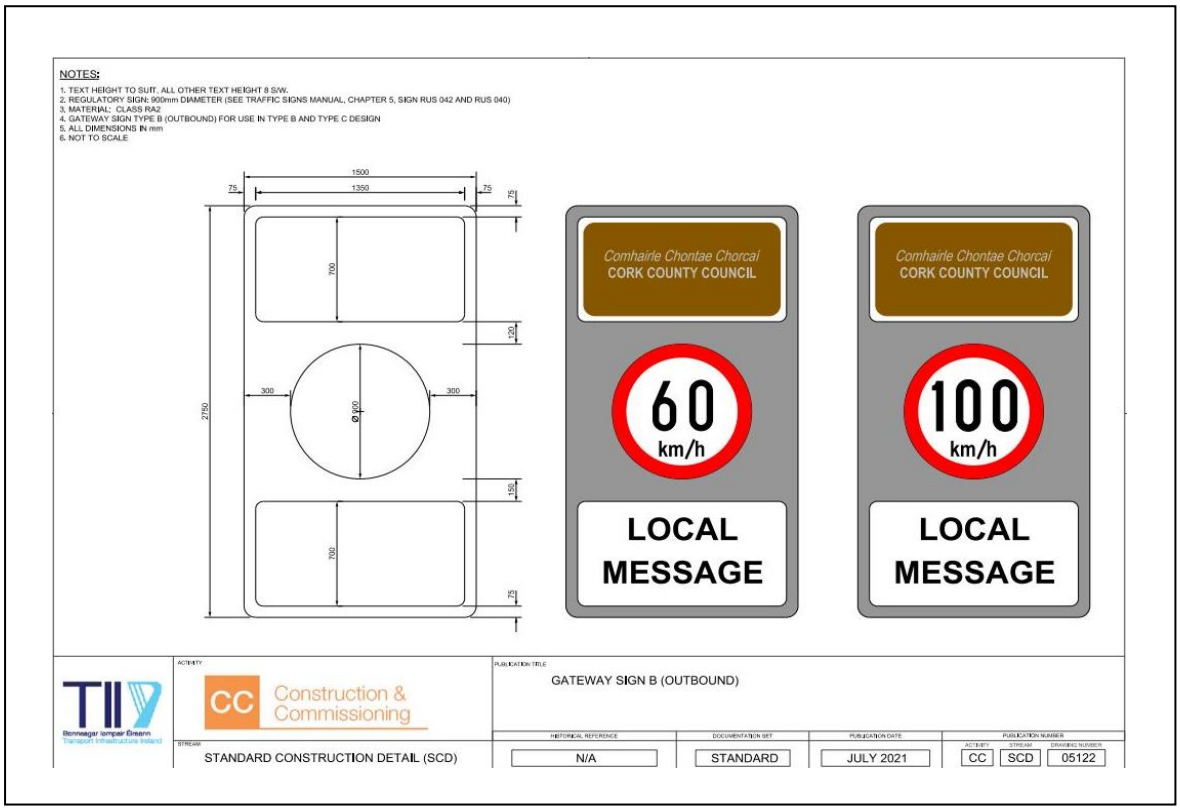


Figure 4.10: Position of Approach Signs

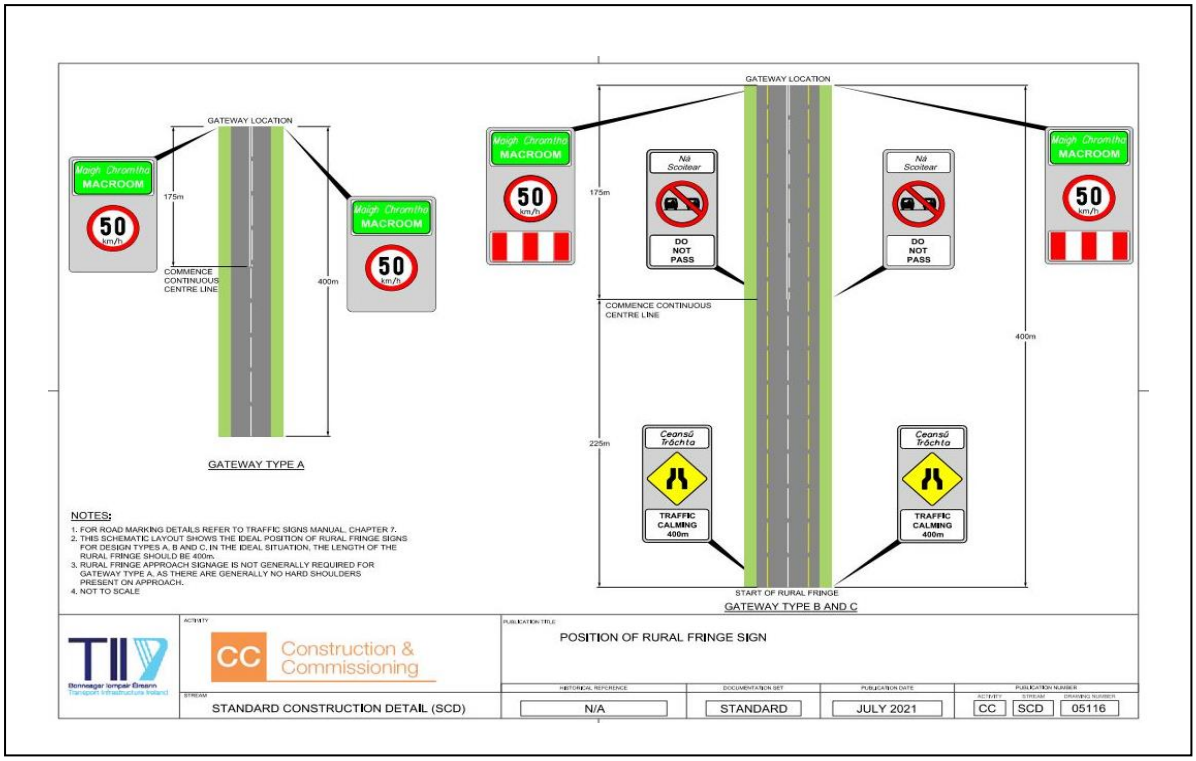
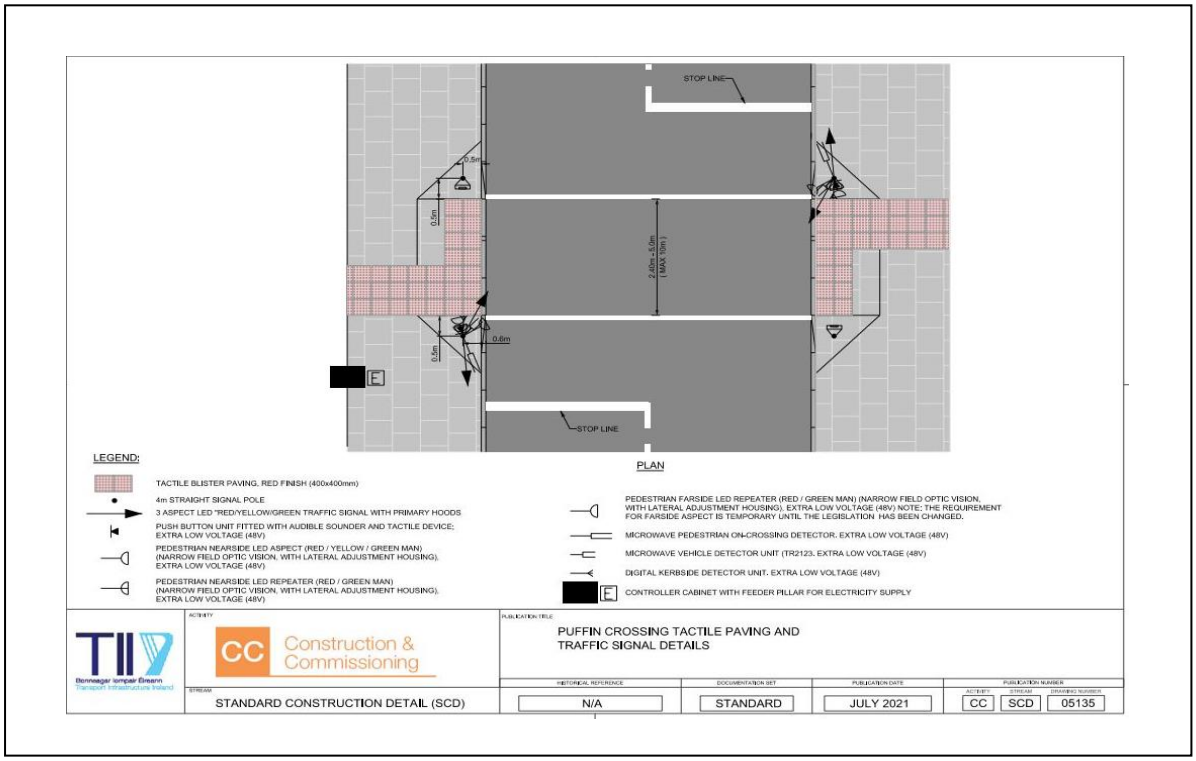


Figure 4.11: Puffin Crossing Road Markings



As shown in **Figure 4.11** above the Puffin crossing road markings is the same road layout markings for a Toucan crossing.
A Toucan crossing is designed for pedestrians and cyclists to use at the same time, without a cyclist having to dismount the bicycle as the area is wider on a Toucan crossing compared to a Puffin or Pelican crossing, leaving plenty room for cyclists to ride across. A Toucan crossing is a controlled traffic lights crossing, where a green bicycle is displayed next to the green man to allow cyclist and pedestrians to cross the carriageway in a safe manner. A red bicycle and red man are shown at other times. The designed Toucan pedestrian / cycle crossing is 5.2m wide and kerb to kerb width is 6.5m, which is located on the Milltown side of Gateway at approximately chainage 2+640m.

4.15 Overtaking Value

The capacity of a single carriageway road is directly linked with the overtaking value for that road. TII Publications DN-GEO-03031 (TD9) sets out the criteria for measuring the overtaking value of the road and sets out minimum overtaking values, which are thought to provide a reasonably safe road in most circumstances.
In accordance with TII Publications DN-GEO-03031 (TD9) an overtaking section commences whenever FOSD is achieved on either a straight or a right-hand curve or the width provision is sufficient to allow overtaking without crossing the dividing line between opposing lanes. An overtaking section terminates either at a point where sight distance reduces to FOSD/2 or at a distance, of FOSD/4 prior to an obstruction to overtaking. Obstructions to overtaking are deemed to be major/minor junctions with physical islands, ghost islands or single lane duelling Simple junctions and accesses with no physical or ghost islands are not considered to provide an obstruction to overtaking. The overtaking value is dependent on junction spacing, horizontal and vertical alignment.

The required length of overtaking provision is dependent upon the road length and the category of the road. This scheme is a Type 1 Standard Single Carriageway on-line improvement, so the corresponding “Overtaking Values” is 30% in accordance with Table 7.3 of TII Publications DN-GEO-03031. The “Overtaking Value” was calculated as the sum of the total length of overtaking sections for each direction of travel, divided by the total length of the proposed scheme.

The overtaking value required for 100km/h speed limit is 580m.The 100km/h speed limits commences at chainage 0m and ends at chainage 2+280m. As part of a traffic calming measure the speed limit is reduced to 80km/h which commences at chainage 2+280m and ends at 2+560m. A 50km/h speed limit commences at chainage 2+560m and continues to chainage 2+945m with this section designed in accordance with DMURS having kerbs and footpaths on either side. For calculating the overtaking values, the section assessed is chainage 0m to chainage 2+560m. Overtaking sections commences at the point where FOSD is achieved and terminated at a point where FOSD is 145m on the left-hand curve and 29m on a right-hand curve. The overtaking values were calculated through the horizontal alignment model

developed for the scheme. See in **Table 4.18** and **Table 4.19** the overtaking metres achieved for the proposed scheme in each direction.

Table 4.18: Overtaking Sight Distance LHS

Increasing Chainage 0 – 2280 (LHS)		
	Chainage (m)	Distance (m)
Overtaking	0 – 0+525	525
Overtaking	0+750 – 1+290	540
Overtaking	1+430 – 2+015	585
Total Overtaking		1650

This scheme provides an overtaking value of 64% going from chainage 0m to 2280m which achieves and satisfies the required standard of 30%

Table 4.19: Overtaking Sight Distance RHS

Decreasing Chainage 2280 – 0 (RHS)		
	Chainage (m)	Distance (m)
Overtaking	2+160 – 2+010	2160
Overtaking	2+160 – 1+491	669
Overtaking	0+870 - 0	870
Total Overtaking		1689

This scheme provides an overtaking value of 64.5% going from chainage 2+280m to 0m which achieves and satisfies the required standard of 30%. This scheme provides an overall average FOSD of 64.5%.

4.16 Junctions & Accesses

Junction types depend on numerous factors but primarily safety and operational performance and will be subjected to the evaluation of design year traffic movements at the junction. A traffic analysis is carried out to assess the capacity based on the projected turning movement at the junction.

Simple priority junctions are the most appropriate junction type for all local accesses on single carriageway roads. Junctions for this scheme were determined based on traffic movements per junction in accordance with Table 4.1 of TII Publications DN-GEO-03060. At Grade Priority Junctions have been provided along the road at the intersections with main road and takes the form of T-Junctions. These access points have been realigned to ensure that they intersect with the main carriageway at right angles 90 degrees. The side-roads, carriageway width is designed at 6m. The Junctions are designed in accordance with TII Publications DN-GEO-03060 (TD41-42). Clear visibility splays have been provided at all junctions.

The proposed scheme directly affects six side roads which are impacted by the proposed N17 road realignment, two side roads of which will form a staggered right/left T-junction with ghost island. An additional two side roads will be added due to the off-line realignment to facilitate local and residential access, see the **Table 4.20** below for full details.

Table 4.20: Direct Access Types

Type Access:	Existing Number	Proposed Number:
Junctions	8	7
Entrances	27	18
Field Accesses	36	18
Access Roads	0	4

4.16.1 Direct Accesses

The overriding principle is that direct vehicular access onto national roads shall be avoided as far as practicable. Where direct vehicular access onto national roads cannot be avoided, it shall be provided such that the visibility envelope from the access does not overlap with the visibility envelope from any other access/junction. Should an overlap occur, a local road connecting both accesses shall be provided with a single direct access onto the national road. This scheme has two geometric layouts for direct accesses, layout 1 field access and layout 2 access to dwellings. Any layout which does not achieve the geometric standards for a new or altered access shall require a Departure from Standard.

Table 4.21: Recommended Standard Access layouts

	Field Access	Access to Dwellings
Direct Access Layout	1	2
Traffic using the access AADT	Less than 10 movements a week.	Less than 150 movements a week.
Layout suitable for carriageway configuration	Single	Single

Figure 4.12: Typical Field Access

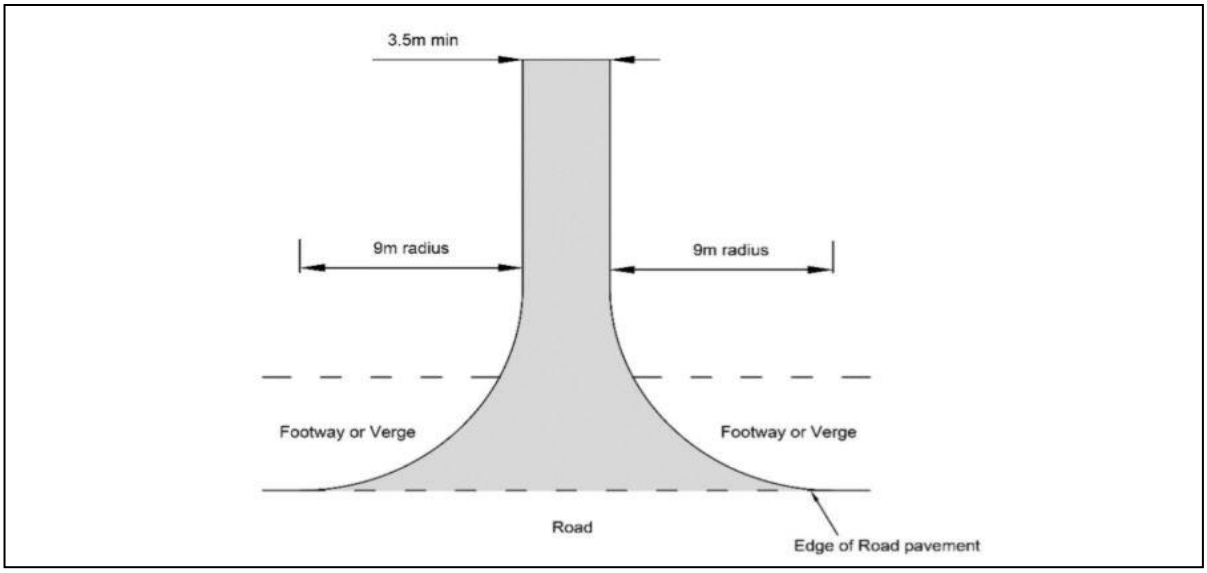


Figure 4.13: Typical Entrance to Dwelling

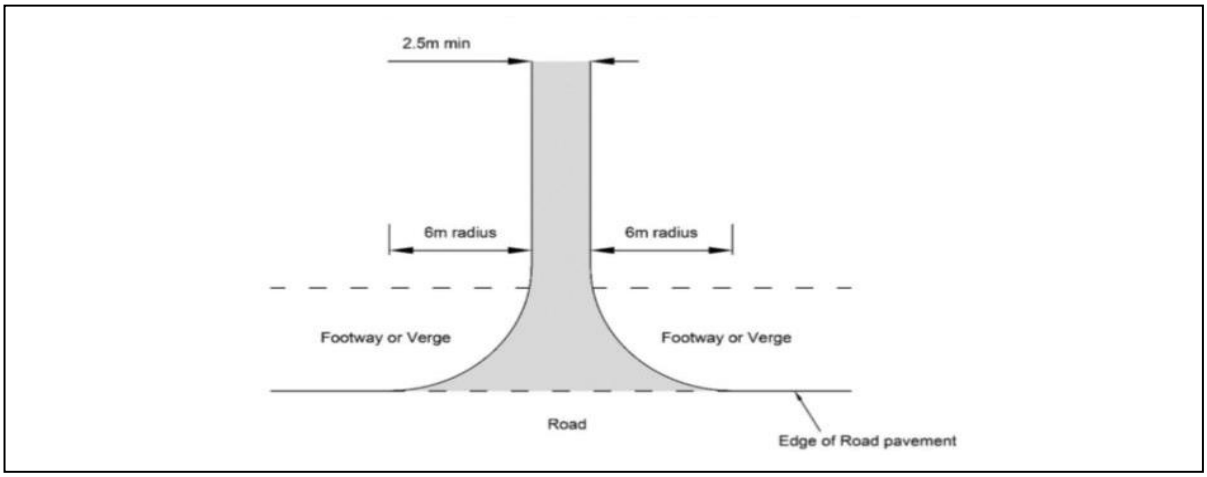


Table 4.22 illustrates the number of junction incorporated into the proposed 3km scheme, showing location, design speed and junction type.

Table 4.22: Junction Strategy

Junction No.	Road No.	Design Speed km/h	Mainline Chainage (m)	Direction from Mainline	Proposed Junction Type	Comments
1	L - 22271	100	0+458	North	Priority Simple T- junction	
2	L - 2227	100	0+675	South	Priority Simple T- junction	
3	Link Road 1	100	1+330	North	Priority Simple T- junction	
4	L - 22087	100	1+464	South	Priority Simple T- junction	
5	Link Road 2	100	1+898	North	Priority Simple T-junction	
6	L - 2208	85	2+300	South	Priority Right/Left Staggered Junction with Ghost Island	
	L - 6413		2+357	North		
7	L - 64131	60	2+778	South	Priority Urban Simple T-junction	

Analysis from traffic count survey carried out on the 9th November 2017 has revealed a highly trafficked minor road L-2208 which forms part of the proposed junction 6, with traffic flow within the threshold for a ghost island junction as per table 4.1 TII Publications DN-GEO-03060, therefore it is proposed to install a right hand turning lane on the N17 with a ghost island on the minor road L-2208. To achieve a Right/Left Staggered junction as per TII guidelines, local road L-6413-0 junction will be required to be re-located to approximately 96m south of its existing location, resulting in realignment of existing junction. A right hand turning lane will also be provided to access local road L-6413-0. All other junction 1, 2, 3, 4, 5 and 7 satisfy the traffic flow requirements to utilise a Priority Simple T- Junction.

Where the new road has been realigned away from the original N17, the number of local access points have been rationalised to provide one access point onto the main carriageway to facilitate

various residential and field access. This includes junction 3 and 5 for the proposed scheme. This will improve the safety of the route by reducing the number of possible conflicts.

Where direct vehicular access to local properties and farmland must be provided to the realigned road and cannot be mitigated, the minimum SSD will be maintained at all access points, particularly those that agricultural machinery will use. Where the minimum distance cannot be achieved a Departure from Standard shall be applied for from the TII.

The local road horizontal and vertical alignment were designed utilising the standards as set out in table 10.3 of TII Publications DN-GEO-03031 which will also tie back into existing road alignment. Vertical and Horizontal curvature values have been used from table 10.3 of TII Publications DN-GEO-03031 for junctions 1 to 6 using a design speed of 42km/h. Junction 7 complying with table 4.3 carriageway geometry parameters for horizontal and vertical curvature (DMURS), as a design speed of 30km/h is considered.

Table 4.23: Junction Approach Gradient

Junction No.	Approach Gradient < 7 %	Corner Radii
1	6.78%	10m
2	5.43%	13m
3	5.6%	10m
4	6.67%	10m
5	2.47%	10m
6	3.359% & 2.951%	13m
7	2.658%	6m

4.16.2 Visibility Envelope

Traffic from either a minor road or direct access must join or cross the major road when there are gaps in the major road traffic stream. It is therefore essential that drivers emerging from minor road or direct access shall have adequate visibility in each direction to see the oncoming major traffic in sufficient traffic to permit them to make their manoeuvres safely. The visibility requirement for drivers emerging from minor road or direct access is to the high object (1.05m) on the major road as defined in DN-GEO-03031. This concept also applies to major road traffic turning right into minor road or direct access.

Figure 4.14: Typical Field Access

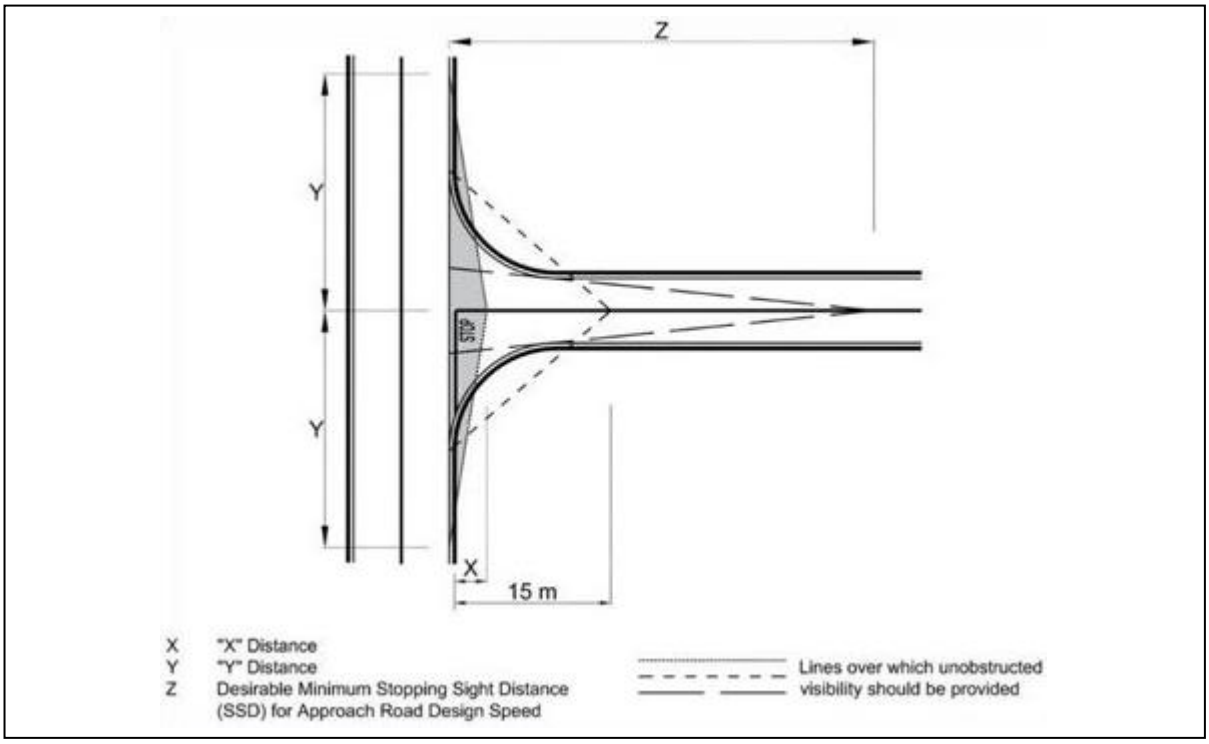


Table 4.24: 'x' Distances on the minor road for visibility measurements

Major road use	Minor road use	Standard	'x' Distance (m)
All roads	All junctions and accesses, Stop control	Desirable Minimum	3.0
All roads	Cycleway	Desirable Minimum	4.0
All roads	Cycleway	Abolute Minimum	2.0
National Roads	Simple Junctions, Stop control	Relaxation	2.4
Regional & Local Roads	All junctions and accesses, Yield control (where there are no relaxations associated with the layout junction)	Desirable Minimum	Max 9.0
Regional & Local Roads	Accesses, Lightly trafficked	Relaxation	2.0
All roads	All junctions and accesses	Desirable Maximum	9.0

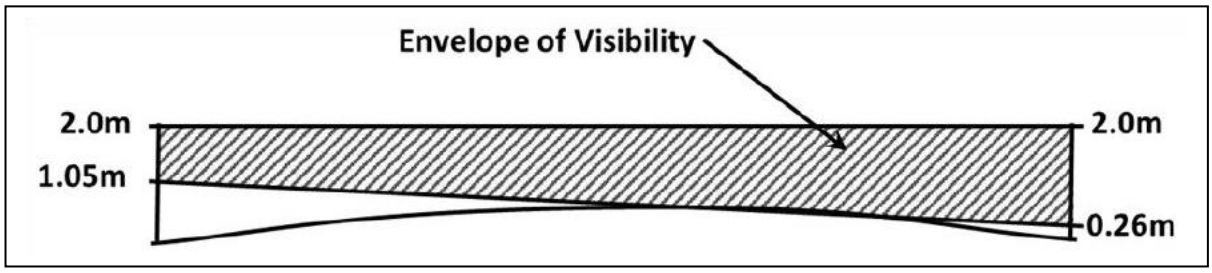
All proposed juctions in the scheme satisfy the desirable minimum 3m 'x' distance on minor roads for visibility. From the point 'x' metres back from the major road a driver approaching the junction along the minor road shall be able to see clearly points to the left and right on the nearer edge of the major road running carriageway at a distance set out in table below, measured from its intersection with the centreline of the minor road. This is called the 'y' distance and is defined in figure above.

Table 4.25: 'y' Visibility distance from the minor road

Design Speed of major road (km/h)	'y' Distance (m)
42	50
50	70
60	90
70	120
85	160
100	215

On national roads, the full 'y' distance must be achieved to the high object 1.05m.
Although the 'y' distance shall always be provided, there is little advantage in increasing it, as this too can induce high approach speeds and take the attention of the minor road or direct access driver away from the immediate junction conditions. Increasing visibility should not be provided to increase the capacities of various turning movements.

Figure 4.15: Measurement of Stopping Sight Distance



Stopping Sight Distance shall be measured from a driver's eye height of between 1.05m and 2.00m, to an object height of between 0.26m and 2.00m above the road surface, as shown in **Figure 4.15** above. It shall be checked in both horizontal and vertical planes, between any two points within the visibility envelope. The check shall be carried out along a line in the centre of the lane. The design shall also comply with dynamic sight distance requirements associated with the provision of cycle facilities. Side roads SSD has been designed in accordance with Table 10.3 Design speed related parameters of DN-GEO-03031 Rural road link design. The desirable minimum stopping sight distance is 50m for 42km/h

Table 4.26: Junction Visibility Envelope

Junction No.	Design Visibility Envelope on Major Road (m)	Achievable Visibility Envelope on Major Road (m)
1	215m	>215m
2	215m	>215m
3	215m	>215m
4	215m	>215m
5	215m	>215m
6	160m	>160m
7	90m	>90m

Table 4.27: Side Road Horizontal & Vertical Alignment

Side Road	Horizontal Curvature		Vertical Curvature K values			
	Min Radius	Design Radius	Min Crest	Design Crest	Min Sag	Design Sag
1	34m	34	N/A	N/A	N/A	N/A
2	34m	100	6.5	10	6.5	6.5
3	N/A	Straight	N/A	N/A	N/A	N/A
4	34m	34	6.5	6.5	6.5	6.5
5	N/A	Straight	N/A	N/A	N/A	N/A
7*	34m	34	N/A	N/A	2.3	6.5

*** *Note see paragraph 4.15.4 for junction 6*

* *Designed to DMURS*

Table 4.28: Junction Alignment at Design Speed of 20km/h

Junction	Vertical Curvature K values			
	Min Crest	Design Crest	Min Sag	Design Sag
1	N/A	N/A	N/A	2.3
2	N/A	10	N/A	6.5
3	N/A	5	N/A	5
4	N/A	6.5	N/A	6.5
5	N/A	N/A	N/A	4
7	N/A	N/A	N/A	6.5

*** *Note see paragraph 4.15.4 for junction 6*

Junction alignment K values are taken from DMURS table 4.3 carriageway geometry parameters for horizontal and vertical curvature at junction intersections. The junction design can accommodate a driver negotiating the junction at a minimum speed of 15km/hr for priority junctions. Also, vehicle tracking software demonstrates junctions complies to the standards set out in DN-GEO-03060, geometric design of junctions. See **Appendix A4.6** for junction report.

4.16.3 Dwell Area

The gradient for the dwell area shall lie between plus and minus 2.5%. In difficult situations, this may be increased to between plus and minus 4% as a relaxation. The intention is to avoid the risk of vehicles stalling on a mild hill start when attempting to accept a gap in the major road traffic or inadvertently rolling out into the major road carriageway. Gradients on minor roads shall be in accordance with DN-GEO-03031. On direct accesses, gradients greater than 10% approaching the major road are a Departure from Standard. The gradient on the minor road immediately next to the major road should be considerably less and a dwell area of at least 15m shall be provided immediately adjacent to the major road carriageway. Where site conditions are particularly difficult this area may be reduced to 10m as a relaxation. In the case

of a direct access to dwellings, it may be reduced to 3m as a relaxation. A combined relaxation in dwell area and approach gradient is not regarded as a departure.

4.16.4 Major Junction at Junction 6

Junction 6 is a Priority Right/Left Staggered Junction with Ghost Island is located at chainage 2300m – 2357m, better known as the N17 Junction. The design speed on the major road at this junction is 85km/h.

The corner radii for local road L-6413-0 has a design radii of 13m on both left and right side. To allow for large commercial vehicles frequent access, the minimum radii shall be 13m followed by a 1:10 taper for 25m.
Road L-2208-0 has a design radii of 13m on the left and right side respectively. To allow for large commercial vehicles frequent access, the minimum radii shall be 13m followed by a 1:6 taper over 30m for ghost island and 13m radius at simple staggered junctions, with taper 1:8 over 32m.

Road L-6413-0 is proposed as a skew junction to the major road, as part of the staggered ghost island junction. The design gradient is max 2.95% which is within the maximum gradient of 7% permitted without been a departure from standard.
Road L-2208-0 is proposed angle of 87 degrees to the major road, as part of the staggered ghost island junction. The design gradient is 3.359% which is within the maximum gradient of 7% permitted without been a departure from standard. Junction 6 chainage 2+300m is within an 85km/h design speed. The speed limit reduces from 100km/h to 85km/h at chainage 2+180m, so considering proximity of speed limit change over in relation to the junction 6 at chainage 2+300m. The right-hand turning lane is designed using a speed limit of 100km/h. See **Table 4.29** below.

Table 4.29: Junction 6 Data 1

Junction 6 Chainage 2300m		
Type	**Design (m)**	**Reference**
Turning Length (+Queuing length if required)	10m +6.5m	Paragraph 5.6.11.1 DN-GEO-03060
Deceleration Length	80m	Table 5.11 DN-GEO-03060
Through Lane Width	3.650m	Paragraph 5.6.7 DN-GEO-03060 & CC-SCD-00001
Turning Lane Width	3.5m	Paragraph 5.6.11.3 DN-GEO-03060)
Direct Taper Length	15m	Table 5.10 DN-GEO-03060
Ghost Island Taper	52.5m	Table 5.9 DN-GEO-03060

Table 4.30: Junction 6 Data 2

Junction 6 Chainage 2357m		
Type	**Design (m)**	**Reference**
Turning Length (+Queuing length if required)	10m	Paragraph 5.6.11.1 DN-GEO-03060
Deceleration Length	55m	Table 5.11 DN-GEO-03060
Through Lane Width	3.650m	Paragraph 5.6.7 DN-GEO-03060 & CC-SCD-00001
Turning Lane Width	3.5m	Paragraph 5.6.11.3 DN-GEO-03060)
Direct Taper Length	15m	Table 5.10 DN-GEO-03060
Ghost Island Taper	43.75m	Table 5.9 DN-GEO-03060

Horizontal Curvature

Horizontal Alignment for **L-6413-0** is a skew junction which forms part of the right / left staggered junction with a radius of 50m. At skew junctions, the centreline of the minor road shall have a minimum radius of 50m that meets the major road nearside channel at right angles. The Skew junction shall be designed in accordance with Figure 5.22 DN-GEO-03060 and link road shall be at an angle of between 50 and 130 degrees to the major road channel. The horizonal alignment does comply with the above parameters, hence the design is satisfactory.
Horizontal alignment for **L-2208-0** is a straight section hence the design is satisfactory.

Vertical Curvature

Desirable maximum gradient outlined in table 4.1 DN-GEO-03031
Approach Road **L-6413-0** is designed with a max gradient of 2.951% < 7% = Gradient Satisfactory.

The Design Crest K value is not applicable to this road.
Design Sag K Value is 8 for design speed of 42km/h
According to table 10.3 DN-GEO-03031, the desirable minimum Sag K value is 6.5, therefore the Sag K Value is satisfactory, as 8 > 6.5

Approach Road **L-2208-0** is designed with a max gradient of 3.359% < 7% = Gradient Satisfactory.

The Design Crest K value is 10 for design speed 42km/h
According to table 10.3 DN-GEO-03031, the desirable minimum Crest K value is 6.5, therefore the Crest K value is satisfactorily, as 10 > 6.5

Design Sag K Value is 10 for design speed of 42km/h
According to table 10.3 DN-GEO-03031, the desirable minimum Sag K value is 6.5, therefore the Sag K Value is satisfactory, as 10 > 6.5

5 Ground Investigation and Earthwork Design

5.1 Ground Investigation

A ground investigation for fieldwork and laboratory testing contract was awarded to Priority Geotechnical in July 2018 and October 2020. The preliminary ground investigation works were carried out to determine the ground conditions along the proposed offline route. The field works for the contract consist of 5 cable percussion boreholes, 5 Trial pit excavations with data recorded. In-situ testing including Standard Penetration Testing (SPT) at regular intervals with disturbed and undisturbed samples being taken from each of the boreholes. Determination of California Bearing Ratio (CBR)were carried out. Refer to **Appendix A5.1** for full report on Ground Investigation.

Table 5.1: Borehole Sampling

Location	Date	Chiselling Depth Base (m bgl)	Duration (hh:mm)
BH 101	09/07/2018	2.0	01:00
BH 102	10/07/2018	3.0	01:00
BH 103	10/07/2018	2.0	01:00
BH 104	11/07/2018	2.0	01:00
BH 105	11/07/2018	3.6	00:30
BH 105	11/07/2018	4.0	01:00

Five (5) number Trial Pits were excavated using a 3-ton tracked excavator. A total of twenty-eight (28) bulk disturbed samples were recorded from the exploratory holes in accordance with Geotechnical Investigation and Sampling Methods and Groundwater Measurements (EN ISO 22475-1:2006). Exploration locations were surveyed using GPS equipment to Ordinance Survey Irish Transverse Mercator system of co-ordinates (ITM) and elevations to Malin Head datum.

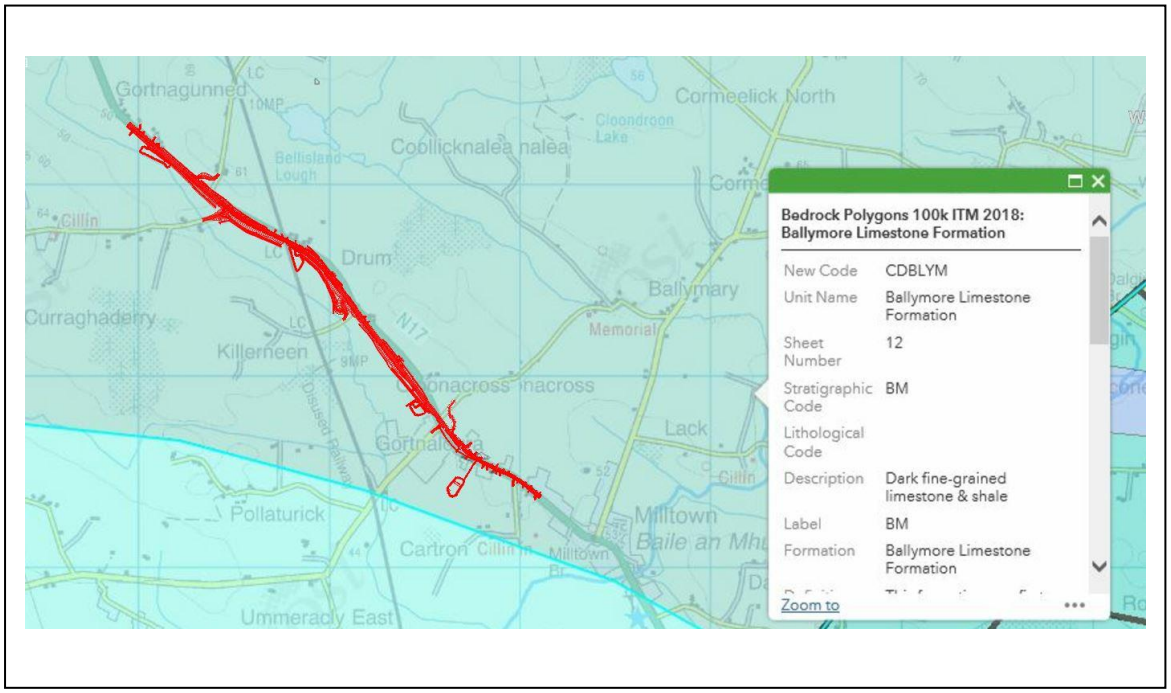
Table 5.2: Trial Pits

Location	Depth (m bgl)	Date
TP 101	3.2	06/07/2018
TP 102	3.5	06/07/2018
TP 103	3.4	06/07/2018
TP 104	3.6	06/07/2018
TP 105	3.3	06/07/2018

5.2 Site Description

The site is in a rural area with much of the area being greenfield/ agricultural land. The new proposed route passes through Limestone till deposits derived from the Limestone bedrock as outlined by the Geological Survey of Ireland maps. Subsoils present in the study area include Glaciofluvial sands and gravels and Limestone till.
The bedrock has been classified by GSI mapping as Ballymore limestone formation but no specific areas of limestone have been found in the location area. National Groundwater Vulnerability mapping has classed majority of the area as an area of low vulnerability with a section closer to Milltown as moderate which could indicate that the bedrock is deeper than 10m.

Figure 5.1: Geological Survey of Ireland, Bedrock Geology (GSI)



Topsoil was encountered at depths from 400mm to 1000mm thick, described as sandy gravelly silt with a content of peaty soil. The topsoil was underlain by mixed glacial deposits; firm becoming stiff grey/brown slightly sandy gravelly clay / very clayey / silty vert sandy gravel with low to medium cobble content. Depths between 2.0m – 4.0m below existing ground level is described as stiff dark grey slightly sandy gravelly silt with medium cobble content. The ground model was not defined below 4.0m below ground level. The borehole was terminated after 1 hour chiselling. Stiff glacial deposits with cobble and boulder content assumed.

Ground investigation data collected from the adjacent N17 Carrownurlaur to Gortnagunned scheme located at the commencement of this proposed scheme, described the topsoil as soft brown silt with frequent rootlets. The subsoil layers consisted of 2m of soft blue/grey slightly sandy gravel clay with many limestone cobbles and occasional boulders. Beneath this layer was a 1.6m deep layer of very soft soil with many limestone cobbles and some boulders. The final layer recorded before the trial pit met an obstruction consisted of stiff to very stiff with some cobbles and boulders at 3.6m below ground level.

5.3 Earthwork Design

Data gained from the ground investigation will be interpreted and utilised during detailed design for the design of the earthworks required in the construction of the scheme. Majority of the materials in cut will consists of a topsoil layer which will be reused on side slopes and other landscaping areas as required. In other areas of cut; the material will be reused as part of the road development. As the proposed development requires a significant volume of fill material, this will be imported as it is expected from that there are low volumes of acceptable material available within the site extents.

5.3.1 In-Situ Testing

Standard Penetration Test, N values were typically carried out in the boreholes using a 60˚ solid cone in place of the standard spilt barrel sampler. The standard Penetration Test was carried out in accordance with Geotechnical Investigation and Testing, Part 3 standard penetration test, BS EN ISO 22476-3:2005+A1:2005.

Six (6) in situ dynamic probes (UK DCP) were undertaken using the Transport Research Laboratory, TRL probe, 60˚ cone, 8kg drop weight over 575mm with the mm per blows recorded to refusal at exploratory locations. The dynamic probing was carried out in accordance with Geotechnical Investigation and Testing, Part 2, Dynamic probing, BS EN ISO 22476-2:2005.

The In-situ results demonstrates bearing capacity of the existing ground is satisfactory to construct the proposed road realignment, as the CBR results are above 2.5% which is the minimum CBR required to carry out road development.

Table 5.3: Trial Pit 101

(M) below ground level	Median pen rate mm/blow	Unadjusted CBR %	
		Kleyn pen rate >2mm/blow	TRL
0.103	24	7	4
0.389	9	25	13

Table 5.4: Trial Pit 102

(M) below ground level	Median pen rate mm/blow	Unadjusted CBR %	
		Kleyn pen rate >2mm/blow	TRL
0.302	34	5	3
0.455	9	26	17
0.575	4	75	61

Table 5.5: Trial Pit 103

(M) below ground level	Median pen rate mm/blow	Unadjusted CBR %	
		Kleyn pen rate >2mm/blow	TRL
0.174	28	6	3
0.548	12	17	15
0.688	5	51	26

Table 5.6: Trial Pit 104

(M) below ground level	Median pen rate mm/blow	Unadjusted CBR %	
		Kleyn pen rate >2mm/blow	TRL
0.174	32	5	4

Table 5.7: Trial Pit 104_2

(M) below ground level	Median pen rate mm/blow	Unadjusted CBR %	
		Kleyn pen rate >2mm/blow	TRL
0.184	19	10	3
0.458	3	106	49

Table 5.8: Trial Pit 105

(M) below ground level	Median pen rate mm/blow	Unadjusted CBR %	
		Kleyn pen rate >2mm/blow	TRL
0.172	31	5	4
0.390	14	14	11
0.570	5	58	40

5.3.2 Laboratory Testing

Laboratory testing was carried out in accordance with BS 1377(1990), Methods of test for soils for Civil Engineering purposes and the ISRM suggested methods for rock characterisation, testing and monitoring. A summary of laboratory testing is shown below in **Table 5.9**. The results of CBR samples indicates, as the moisture content is reduced the CBR values increases. A minimum CBR of 2.0% is required. This indicates, that excavated material on site can be reused throughout the project when the correct moisture content is achieved. Refer to **Appendix A5.1** for full report.

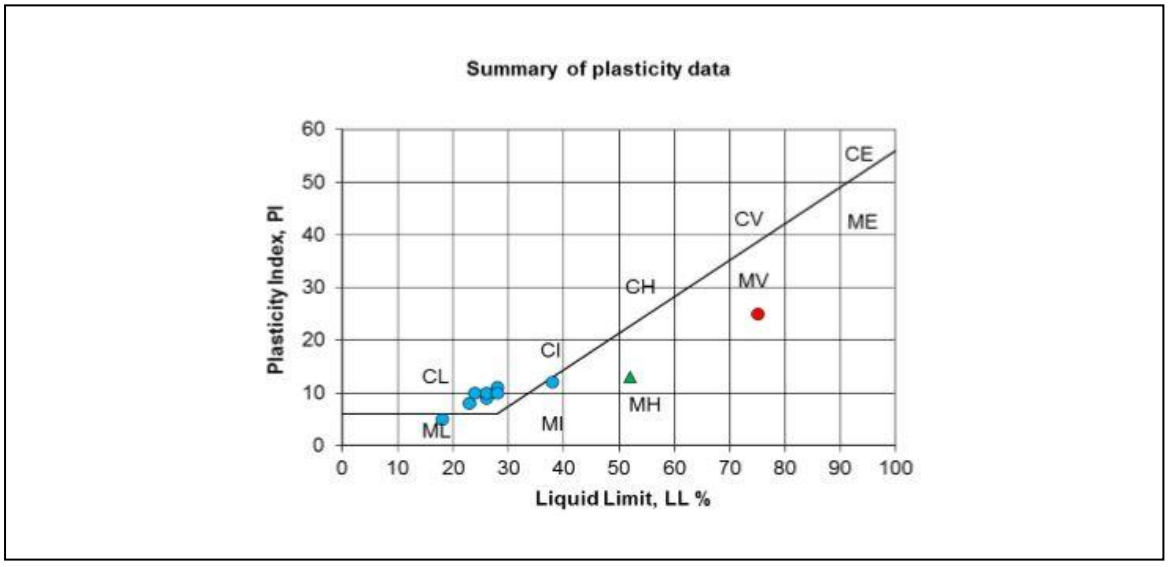
Table 5.9: Summary of Laboratory Testing

Type	Nr.	Remarks
Natural Moisture Content	25	8% to 57%
Atterberg Limits	10	Liquid Limit, LL 18% to 75%
		Plastic Limit, PL 13% to 50%
		Plasticity Index, PI 5 to 25
Particle Size Distribution	10	No hydrometer analysis on fine soils
pH	06	7.8 to 8.8
Sulphate (water soluble) as SO_4	06	<0.010g/l to 0.043g/l
Sulphate (acid soluble)	08	<0.010% to 0.091%
Organic Matter	06	<0.40% to 6.9%
Dry Density/Moisture Content Relationship	04	Maximum dry density, 1.9mg/m^3 – 2.2mg/m^3 Optimum moisture content, 8.5%
California Bearing Ratio (CBR) Spot	08	CBR
Moisture Condition Value (MCV) Spot	06	MCV 1.7 – MCV 8.7

5.3.3 Soil Classification

The plastic and liquid limits for 10 cohesive samples were measured and are plotted on the A-Line Chart in **Figure 6.2** below. Most of the samples can be classified as low plasticity clays with a smaller amount being classified as intermediate and high clays.

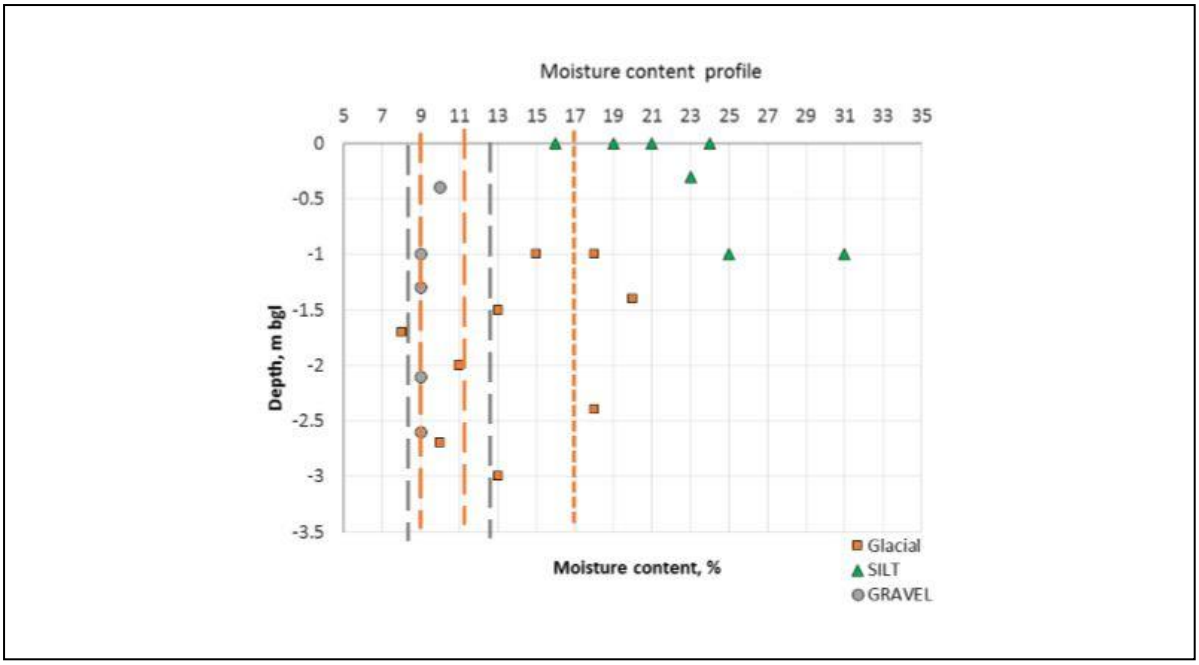
Figure 5.2: Plot of Cohesive Deposits on A-Line Chart



5.3.4 Re-Use Material

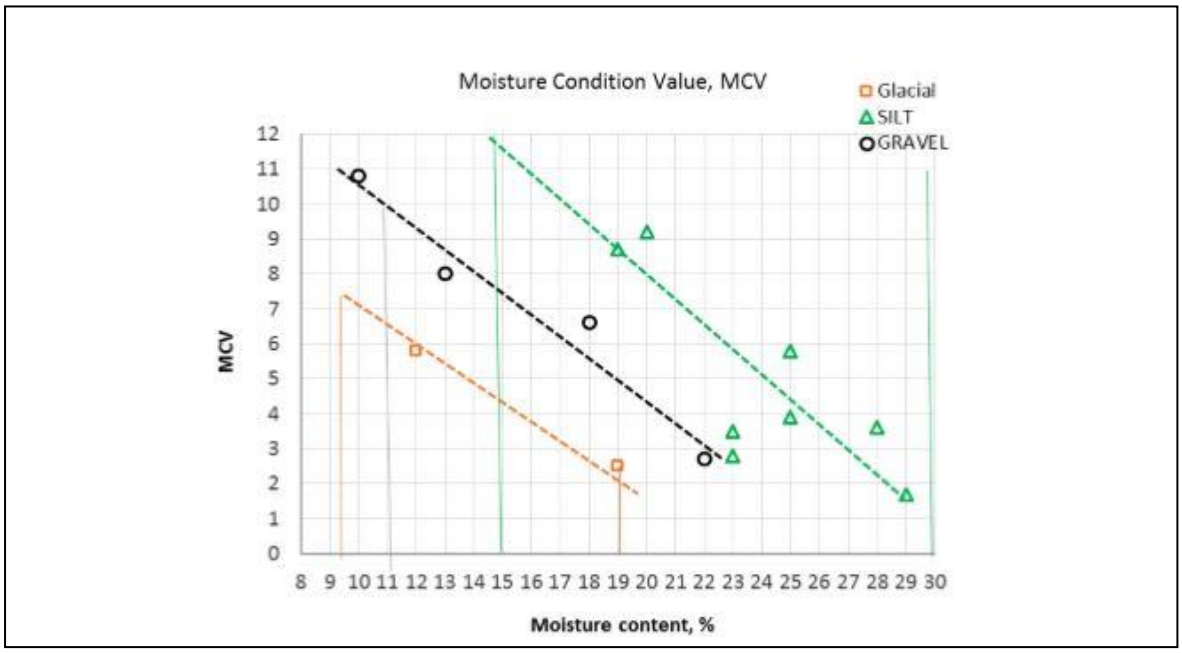
The re-use of excavated material needs to achieve optimum moisture content before it is suitable for reuse. Glacial deposits must lie between 8.5% and 13%. Gravel falls within the range of optimum moisture content and are expected to be suitable for re-use at natural moisture content.

Figure 5.3: Moisture Content of Soil



The Clay with variable moisture content is expected to require some drying; up to -7% moisture. Reviewing a target of 95% maximum dry density the moisture range is extended to between 7% and 17% for the mixed glacial deposits, where drying -3% moisture is required.

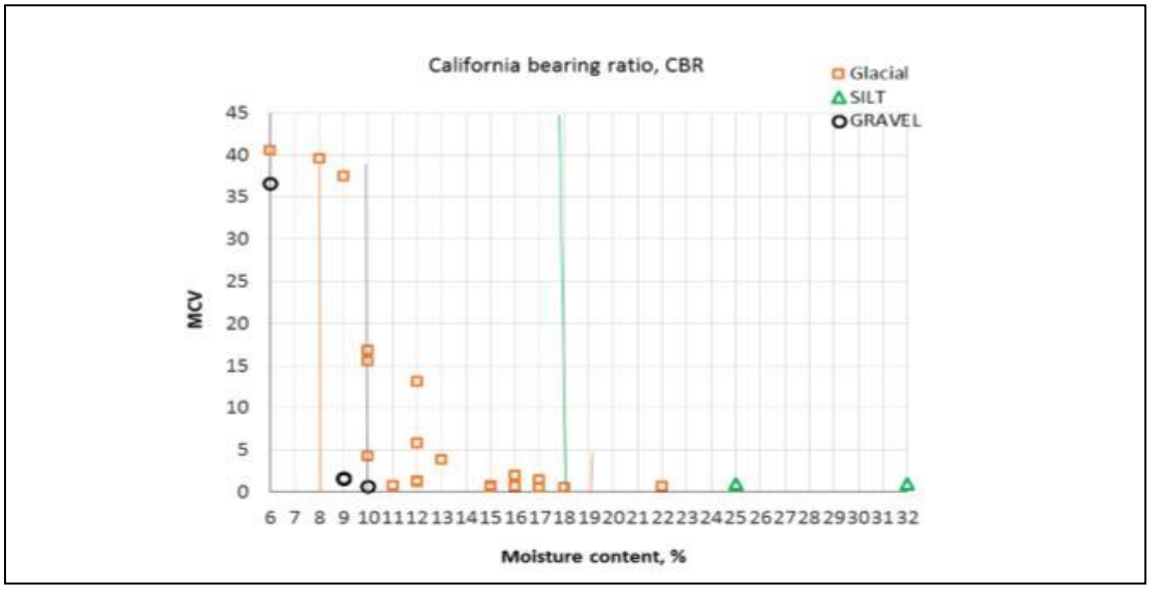
Figure 5.4: Moisture Condition Value / Moisture Content Correlation



A moisture condition value (MCV) of between 1.7 and 8.7 was measured for the Silt sample. A moisture condition value of between 2.7 and 10.8 was recorded for the mixed glacial

deposits. At the range of natural moisture content, of 15% to 31% the Silt is expected to have a moisture condition value between 2 to 12. Drying of -7% is required to achieve a moisture condition value between 8 and 12 for re-use as general earthworks fill. The moisture condition value of between 4 & 8 is expected of the Clay deposit at natural moisture content, drying of -4% is expected typically to achieve MCV greater than 8.

Figure 5.5: CBR / Moisture Content Correlation



5.3.5 Pavement Construction

The w/PL ratio indicated California bearing ratio >CBR2%. Laboratory testing determined CBR values ranged between CBR 0.5% and CBR 2%. The minimum CBR required is 2.5%. Capping layer will be required for the proposed project.

Table 5.10: Summary of Laboratory Testing

Location	Depth, (m) bgl	In Situ California bearing ratio, CBR, %	California bearing ratio, CBR, %	Natural Moisture Content, w %	Capping requirement, mm
BH01	1.0	-	2.0	17	600
BH02	1.0	-	0.8	17	
BH02	2.0	-	0.7	15	
BH03	0.0	-	1.0	28	
BH03	1.0	-	0.5	15	
TP101	1.4	-	0.5	22	
BH04	1.0	-	0.8	11	
TP103	1.3	-	1.6	8	
TP105	1.5	-	0.6	16	

5.3.6 Chemical Composition of Soil

Based on the pH (7.8 to 8.8) and sulphate (<0.010g/l – 0.043g/l; <0.010% - 0.091%) data indicate design sulphate class DS-1in accordance with BRE Digest for concrete in aggressive ground for static groundwater conditions. There are no special requirements with regards to concrete mix design.

Table 5.11: Chemical Data for Soil

Location	BH01	TP103	BH01	TP102	TP104	TP104
Depth, m bgl	1.0	1.30	0.00	1.0	0.40	1.70
Moisture, %	7.2	36	13	8.3	8.2	8.6
pH	8.4	7.8	8.2	8.7	8.8	8.6
Sulphate (2:1 Water Soluble) as SO_4 g/l	0.043	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Sulphate (Acid Soluble), %	0.025	0.091	0.014	< 0.010	0.010	<0.010
Organic Matter, %	< 0.40	6.9	< 0.040	< 0.040	< 0.040	< 0.040

5.4 Hydrology and Hydrogeology

5.4.1 General

A specialist hydrogeologist consultant has been appointed by Galway County Council to advise on the hydrogeological aspects of the scheme. The hydrological Impact Assessment Report will be included as part of the submission. **Refer to Appendix A5.2**. Groundwater ingress was encountered at depths 2.1m to 2.6m during the site investigation works. No groundwater monitoring installation was undertaken as part of the Site Investigation works.

Table 5.12: Summary of Groundwater Levels

Location	Depth Strike (m bgl)	Remarks
BH 101	-	None encountered
BH 102	-	None encountered
BH 103	-	None encountered
BH 104	-	None encountered
BH 105	-	None encountered
TP 101	-	None encountered
TP 102	2.1	2.10m: Slow rate of flow
TP 103	2.6	2.60m: Slow rate of flow
TP 104	-	None encountered
TP 105	-	None encountered

5.4.2 Aquifers

The proposed road development and surrounding area is underlain by Visean undifferentiated Limestones which are clean, pale grey, fossiliferous limestone which are subject to kartification. The aquifer Classification associated with this limestone formation is a Regionally Important Karstic conduit flow aquifer. To the southeast of Milltown Village SW-NE faulting occurs and the bedrock formation is the Oakport and Kilbryan Limestone formation. These are a muddier limestone and their lithology is described as dark nodular calcarenites and shales and is subject to less karstification. The aquifer type associated with this bedrock is classified as LI Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.

5.4.3 Karst Features

There are no mapped karst features in proximity to the proposed road development. This may be associated with the large depth of overburden in the Drum area which is generally of low permeability. There are no significant groundwater supplies within or proximate to the study area. The section of road that may have potential for karstification is in the shallow overburden area towards the southern tie-end of the scheme close to Milltown.

5.4.4 Groundwater Vulnerability

The GSI aquifer vulnerability mapping shows that a large section of the road development to the northwest of the L22208 junction is classified as low vulnerability suggesting overburden depths exceeding 10m throughout. The section of road development to the southeast the L22208 junction increases in vulnerability from medium to extreme vulnerability with bedrock and sub rock close to and at ground level.

5.4.5 Water Resources and Wells

The area is serviced by Milltown group water Scheme with the supply source a treated surface water abstraction from the Clare River approximately 1.5km upstream of the Town. This abstraction is for a P.E. of 1400 households within the group scheme area. The proposed road development is downstream of the is abstraction and therefore will not have the potential to impact the supply source either via groundwater or surface water.
There are a number of historical wells shown on the historical OSI maps in close proximity to the existing road which supplied individual dwellings along the N17. A number of historical wells are mapped but no springs or risings in the vicinity of the proposed road development have been identified, historical or otherwise.

5.4.6 Quaternary

The sub-soils within the study area are obtained from GSI mapping. The road alignment is primarily located on the glacial till defined as till derived from carboniferous sandstones and

cherts. The alignment runs close to boundary between the till on the higher ground to the northeast and the cut-over raised peat to the southwest with the alignment partially cutting through sections of this peat. An Alluvium deposit is present to the north of chainage 2+300m which is associated with lands draining eastward to the Clare river. The soil along the route within the carboniferous tills is described as surface cleys, a mineral soil poorly drained.

5.4.7 Proposed Drainage Layout

The proposed road development provides an opportunity of installing a designed road drainage system for the 3km of road pavement which if suitably designed provides an opportunity of eliminating uncontrolled surface flow discharges towards the Drum Stream which ultimately via Carrownageeha enters the Clare River. The Clare river channel and the lower reaches of the Drum stream channel are within the Lough Corrib SAC and therefore represent highly sensitive receiving waters.

The proposed road drainage will be designed in accordance with guidance from TII guidelines (DN-DNG-03022, DN-DNG-03063 and DN-DNG-03065). The proposed drainage shall be installed along the verge of the carriageway on both right and left-hand side. A filter drain shall be incorporated into the design, except in areas where the road is in fill, a concrete channel is proposed as an alternative to the filter drain. In certain circumstances such as crossing direct access a carrier pipe will be used in these areas. A combined gully and carrier pipes system is proposed from chainage 2+560m to 2+945m on both sides of the carriageway.

Table 5.13: Proposed Drainage Type

Drainage Type	Side
Filter Drain	RHS & LHS
Concrete Channel	RHS & LHS
Gully & Carrier Pipe	RHS & LHS
Gully & Carrier Pipe	LHS

There are four proposed road drainage outfalls as summarised below in **Table 5.8** draining the 2,945m length of Road. All the Outfalls directly or indirectly discharge into the Drum Stream which eventually becomes the Carrownageeha Stream and which outfalls to the Clare River 700m southwest of Milltown.

Table 5.14: Proposed Attenuation Ponds

Outfall Reference	Outfall Chainage	Pavement Chainage (m)	Pavement Width (m)	Paved Area (m2)	Receiving Watercourse
1	180	0 to 770	12.3	9471	Drum Stream Channel
2	1150	770 to 1540	12.3	9471	Toe drain at Rail line
3	2100	1540 to 2120	12.3	7134	Field Drain
4	2300	2120 to 2945	14.6	12118	Field Drain

6 Drainage

6.1 Drainage Overview & Flood Risk

The principal objectives for the proposed road drainage system include:

- To ensure the speedy removal of surface water from the road pavement, to provide safe driving conditions.
- To mimic, in as far as is practical, the existing road drainage regime, particularly in relation to runoff rates and watercourse outfalls, while at the same time providing improved water quality treatment by means of a conveyance channel, linear piping and attenuation ponds prior to discharge.
- To ensure that the impact of the drainage outfalls on the receiving waters is negligible.
- To minimise the impact of runoff on the receiving environment; and
- To provide effective sub-surface drainage to maximise longevity of the road pavement and associated earthworks.

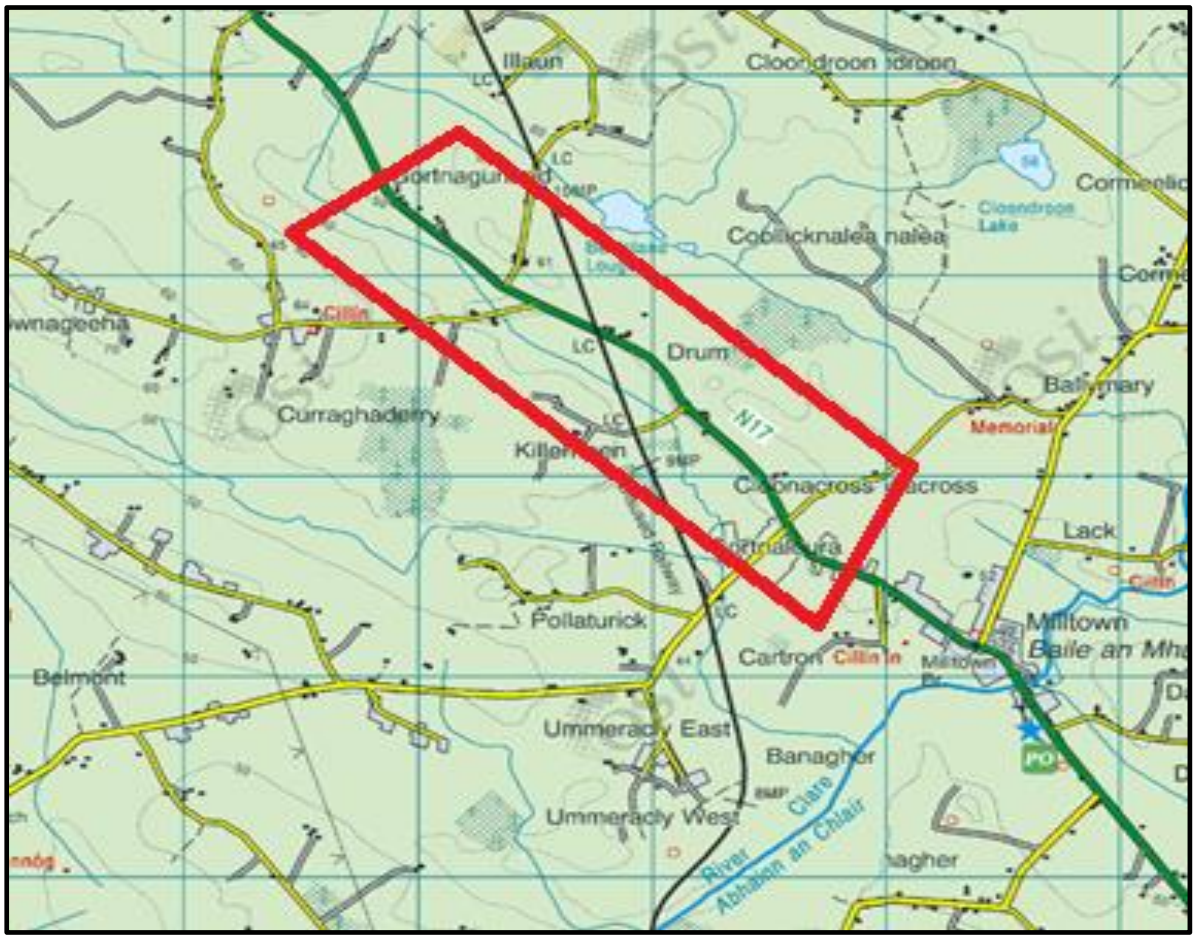
The preliminary drainage proposals have been developed in accordance with the TII Design Manual for Roads and Bridges and in particular in accordance with the TII Drainage systems for National Roads DN-DNG-03022

The existing topography naturally slopes to the south of the scheme with a slight rise in elevation at the centre.

The existing drainage systems in the area can be described as poor both in terms of hydrology and water quality. New land open drainage will be connected to existing land open drainage and kept separate of the road drainage system. Dredging of existing open drainage system will be carried out as required. The existing road network does not provide any form of attenuation or pollution control.

The risk to flooding is minimal with no recorded flooding in this area, as per OPW mapping.

Figure 6.1: OSI map showing scheme location (denoted by red box)



6.2 Design Criteria

The criteria adopted by the Design Team is in accordance with OPW requirements for construction of hydraulic culverts over watercourses. Table 6.1 summarises the design criteria.

Table 6.1: Design Criteria for Culverts.

Parameters	Criteria
Design Flow	1% AEP * 1 in 100-year Return
Climate Change Allowance	20% Increase in Flow to Cater for Climate Change
Minimum Culvert Size	Height Minimum 450mm
Embedment Depths	150mm for circular Culverts 300mm for Rectangular Box Culverts
Freeboard	Min of 300mm above Design Flood Levels

*AEP = Annual Exceedance Probability

Hydrological calculations of design flows for culverts are estimated using statistical flood frequency analysis methods if watercourses are gauged and have a sufficiently long flow record.

All new culverts have been designed for a flood return period of 1 in 100 years with a minimum of 300mm freeboard between the design water levels and the soffit level of the culvert in accordance with OPW requirements.

A minimum culvert diameter of 900mm is adopted on all new culverts conveying watercourses to ensure accessibility for future maintenance and reduce the likelihood of blockages in accordance with OPW requirements. The minimum culvert diameter for ditches and earthwork drainage cross drains should be 450mm as smaller sizes are prone to blockages in accordance with TII publications.

The design of all culverts conveying watercourses provide a minimum embedment depth of 150mm on circular culverts or 300mm on rectangular box culverts below stream bed or to the minimum level as requested by Inland Fisheries Ireland. This is to encourage the re-establishment of stream bed ecology. The bed of the channel both upstream and downstream of the culvert should be reinstated with material similar to that removed during construction. This is similar to a natural bed contiguous with the existing stream bed, upstream and downstream of the proposed culvert. Proposed culverts encroaching on fish habitats shall be designed to ensure that the velocity of flow will be less than the swimming speed to allow passage of migrating fish. Culverts will be designed such that the velocity in the barrel will not be significantly increased from the velocity of the existing watercourse.

Gradients of proposed culverts will aim to recreate the gradient of the existing watercourse where possible. Where relevant, the culvert design shall accommodate invert baffles to facilitate fish passage upstream and downstream. Suitable measures are to be employed to ensure that livestock are prevented from entering the culverts.

Any existing culverts impacted by the proposed road development works will be assessed in relation to their existing capacity and structural stability. These culverts will be extended, up-graded or replaced as necessary. This will also apply to culverts impacted by side roads or access tracks. Section 50 approval will be required for the upgrade or extension of culverts.

6.3 Carriageway Drainage

As the proposed road development incorporates both online upgrade and offline new build, the proposed road drainage system will replace the current one where the road run-off is discharging directly to the receiving water courses and groundwater without any pollution control or attenuation. The proposed system will be designed to ensure the speedy removal of surface water to provide safe driving conditions and to minimise the impact of runoff on the receiving environment. The preliminary drainage proposals are developed in accordance with

the TII Design Manual for Roads and Bridges and the principles of SUDS (Sustainable Drainage Systems) will be applied throughout.
The proposed drainage system includes petrol interceptors and attenuation ponds, all of which ensure that run off is attenuated and treated before being discharged. This system discharges to a local drainage network which flows south before eventually connecting into the River Clare approximately 1.5 km downstream. The River Clare is included within the Lough Corrib SAC.

The proposed drainage system will be installed in the verge of the carriageway and drain to outfalls positioned at low points in the alignment adjacent to existing watercourses. In the interest of pollution control, flows from groundwater and land drainage systems (i.e., culverts, cut off ditches and cross drains), will generally be kept separate from the road drainage network which drains the carriageway.

The proposed drainage system comprises of filter drainage from chainage 0m to 2560m on both the left and right-hand side of the carriageway, except in areas where the road is in fill, a concrete channel is proposed as an alternative to the filter drain. In certain circumstances such as crossing direct access a carrier pipe will be used in these areas. A combined gully and carrier pipes system is proposed from chainage 2560 to 2945m on both sides of the carriageway. The proposed drainage works are outlined in the preliminary design drawings in, Volume 2 of this report.

6.4 Road Drainage Collection Points

The proposed drainage will utilise a number, of different collection points along the upgraded road section, which will feed into the attenuation ponds.
Four collection points and outfalls will be located along the scheme:

Table 6.2: Summary of collection points and outfalls.

Collection Point	Chainage (m)	Outfall	Chainage (m)
1	0+320	1	0+180
2	1+150	2	1+150
3	2+170	3	2+100
4	2+560	4	2+300

The drainage design proposed for the realignment will include petrol interceptors at each outfall, attenuation ponds to ensure that road runoff is treated to a high standard. The result of this treatment, no significant impacts on water quality are expected.

6.5 Pollution Control

The locations chosen for the Attenuation Ponds were selected based on the vertical alignment of the proposed road. See **Table 6.3** below. Attenuation ponds have been designed both for storm water attenuation and first flush water quality detention. Up stream of all outfalls and downstream of the drainage ponds an oil/petrol interceptor is to be provided suitably sized for the drainage pavement area. A shut off penstock at the pond inlet is to be provided, which in

the event of a serious pollution incident the pond can be closed off from the outfall and used to contain the spillage for appropriate removal and treatment. Attenuation Ponds designed using a 1 in 100 storm events plus 20% for climate change.

Table 6.3: Summary of surface water discharges

Attenuation Pond	Chainage (m)	Section Drained
1	0+200	0m to 760m
2	1+100	760m to 1510m
3	2+200	1510m to 2255m
4	2+550	2255m to 2945m

Table 6.4: Summary of Proposed Pond Sizing

Attenuation Pond	Pond Depth (m)	Depth of Water (m)	Free Board (m)	Volume of Pond (m^3) incl of Freeboard
1	0.9	0.4	0.5	1810
2	09	0.4	0.5	1810
3	0.9	0.4	0.5	1363
4	0.9	0.4	0.5	2324

6.6 Culverting of Watercourses

Streams or drainage ditches crossed by the route of the mainline or associated public roads will be culverted by means of piped culverts, box culverts or other culvert sections with a head wall on either end. The culverts will be sized during the detailed design process.

Table 6.5: Summary of Culverts

Culvert	Chainage (m)	Position	Length Culvert (m)	Pipe Diameter (mm)
1	30 - 50	RHS	19	600
2	148 - 162	RHS	14	900
3	419	Across Road	38	300
4	447 - 480	LHS	33	750
5	655	Across Road	83	750
6	905	Across Road	50	900
7	1324 - 1345	LHS	21	600
8	1390	Across Road	59	900
9	1455	Across Access Road	17	750
10	1875	Across Road	59	900
11	1883 - 1911	LHS	28	900
12	2565	Across Road	23	900
13	130	RHS	12	450
14	2110	RHS	12	600
15	2200	RHS	12	300

6.7 Constructional and Operational Mitigation

6.7.1 Constructional Mitigation

A Construction Environmental Management Plan (CEMP) will be developed, and the plan will be finalised by the Contractor in advance of the commencement of construction and the following will be implemented as part of this plan;

- All site-based staff and other relevant staff will receive appropriate training Environmental Operating Plan (EOP).
- An Incident Response Plan detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, logging of non-compliance incidents and any such risks. This will be recorded in the EOP
- A Sediment Erosion and Pollution Control Plan will be implemented.
- Continue to Inform and consult with Inland Fisheries Ireland (IFI)
- Continue to Inform and Consult with National Parks and Wildlife Service (NPWS)

6.7.2 Operational Mitigation

The N17 road pavement runoff water will be collected via filter drainage pipes, concrete channels and gullies at various chainages. Water is discharged to attenuation ponds as per design of drainage system. Upstream of all outfalls, runoff from each rain event is detained and treated in the pond. The retention time promotes pollutant removal through sedimentation and the opportunity for biological uptake mechanisms to reduce nutrient concentrations. Downstream of all outfalls an oil/petrol interceptor will be provided prior to water entering the natural watercourse. To facilitate emergency response to serious spillages all pond and storage systems will be fitted with a manual penstock (or similar provision) so to close off the outfall and contain the spillage water within the pond/storage system for pumping out and appropriate treatment and disposal.

This mitigation proposal will reduce the operational water quality impact on all sensitive water courses to a scale of negligible to minor beneficial impact.

7 Pavement

7.1 General Pavements

The pavement design option for the N17 Milltown to Gortnagunned road have been completed in accordance with TII publications PE-SMG-020002 and DN-PAV-03021.
The pavement is designed for a 40-year design life in accordance with regular recommendations outlined in TII publications

A fully flexible pavement design has been completed for the pavement design options. The final selection for the preferred pavement option for the carriageway will be made in the detailed design phase of the project prior to construction. Refer to Drawings DCS-01 in Volume 2 of this report for typical payment cross section.

Road pavement has two primary functions:

- Provide a good quality surface and appropriate resistance to skidding
- Distribute applied traffic loading to road foundation

Although the actual road pavement layer thicknesses and make-up will be determined at detailed design stage, this chapter outlines the design standards that will be used and indicates the likely road pavement make-up.

7.2 Pavement Design Standards

The pavement for the new Mainline shall be designed to withstand the traffic loading as detailed in the TII Addendum to HD 24/06 of Volume 7 of the TII DMRB. These requirements will be used to assess the options for the pavement at detailed design stage.

The design of capping layer, sub-base and pavement layers shall follow the requirements of 'TII DN-PAV-03021 Pavement and Foundation Design of Volume 7 of the TII DMRB.

The pavement materials to be used and method of construction shall follow the requirements of Series 700 to 1000 inclusive of the TII's 'Specification for Road Works' contained within Volume 1 of the 'Manual of Contract Documents for Road Works'.

7.3 Pavement Foundations

The main purpose of the foundation layers is to distribute the applied vertical loads to the underlying sub-grade providing a firm and uniform support to the pavement layers above. The foundation must be adequate to prevent damage to the subgrade during construction and facilitate compaction of the pavement. The design recommendations for the foundation layers of 'capping' and sub-base are given in the design standard TII DN-PAV-03021 – Pavement

and Foundation Design and are based on the strength of the sub-grade, measured as its 'CBR' value.

The minimum permitted design CBR for Subgrade is 2.5%. Where a subgrade has a lower CBR it is considered unsuitable support for a pavement foundation. Therefore, it must be permanently improved prior to proceeding with the capping layer.
Capping material is used to improve weak sub-grade material. The aim is to increase the stiffness modulus and strength of the formation, on which the subbase will be placed. Capping with laboratory CBR value of at least 15% should be used to provide an adequate platform for construction of the subbase when compacted to appropriate thickness. It is proposed to use a capping layer using granular material which conforms with type 6F1, 6F2 or 6F3 (Series 600 of the Specification for Roadworks) in both embankments and cuttings to the thickness required by the above standard as appropriate to the CBR value of the sub-grade and selected pavement type. The overlying capping is again designed based on a subgrade with a minimum CBR value of 2.5%.

The grading for unbound granular subbase is intended to provide a dense layer of relatively high stiffness modulus, which is reasonably impermeable and will shed rainwater during construction, given adequate fall. It is not necessarily free draining and may exhibit suction, which will result with an increase in moisture content. Unbound granular subbase with laboratory CBR of at least 30% should provide an adequate platform for construction of the pavement when compacted to the appropriate thickness.

The detailed ground investigation will provide information required for the detailed design and as such a detailed analysis of sub-grade strength has not been undertaken at this stage. Typically for a 3% design CBR and a fully flexible pavement a capping depth of 350mm will be required. A thin regulating layer of Clause 804 sub-base is required in lieu of the capping layer where rock is encountered.

7.4 Geotextile

The intended use of these geotextile and geotextile related products is to fulfil one or more of the following functions.

- Reinforcement – Binding the asphaltic layer together to resist crack propagation in either direction, spanning the potential crack.
- Barrier – Sealing and prevention of water penetration into the lower layers and the avoidance of associated problems due to freeze/thaw effects and the need for lower drainage to remove subsurface water resulting in potential reduction of oxidation of lower bitumen layers.
- Stress Relief – Absorb transient stress in all directions.

It is intended that a geotextile membrane will be included in the design for the proposed road realignment scheme. This will be placed on the subgrade prior to the deposition of the capping layer.

7.5 Surface and Binder Course

For this proposed project, the use of a Hot Rolled Asphaltic type surfacing with pre-coated chip is proposed. Therefore, the use of 45mm nominal layer thickness of 30% Hot Rolled Asphalt (nominal size 14mm) has been used, in accordance with clause 4.1.1 of the TII Specification for Roadworks Series 900. This is in conjunction with a binder layer of DBM 40/60 des Asphaltic Concrete complying with clause 3 of the TII Specification for Roadworks Series 900. Alternative pavement materials, compliant with the DMRB, may be considered further at the detailed design stage.

The junctions to the proposed N17 will be designed to the same pavement specification as the mainline alignment for the first 15m adjacent to the Mainline. Beyond this point the junctions will be designed to have a pavement based on the design traffic loading calculated for the junction based on the available traffic data.

Table 7.1: N17 Pavement Design

Pavement Location	Design MSA	Total Thickness of Asphalt Layers
Mainline	18.6	270mm
Side roads	1	200mm

Table 7.2: Preliminary Design Pavement

Location	Wearing Course	Binder	Road Base	Sub - Base
Mainline	45mm HRA 30/14 F Surf 40/60	55mm AC20 dense bin 40/60	170mm AC32 dense base 40/60	150mm Granular Material Type B to Cl.804
Side Road	40mm SMA 14 Surf des	50mm AC20 dense bin 40/60	110mm AC32 dense base 40/60	150mm Granular Material Type B to Cl.804
Access Road & Field Accesses	Double Surface Dressing			150mm Granular Material Type B to Cl.804
Domestic Access	50mm SMA 14 Surf des			150mm Granular Material Type B to Cl.804

7.6 Traffic Signs & Markings

The Road Traffic Signing and Road Markings for the scheme will be designed and implemented primarily in accordance with the Traffic Signs Manual. Where situations not covered by the Traffic Signs Manual arises best appropriate international practice will be followed, amended to suit Irish conditions and provisional on approval by TII. Conceptual proposals for the signage of the scheme have been undertaken during the preliminary design of the scheme. The preliminary proposals cover the following sign types:

- Directional Signs
- Regulatory Signs (e.g. Yield Signs)
- Warning Signs (e.g. Junction Sign)

Other information signs, such as tourist information signs and signs indicating facilities ahead may be required. The proposed signage works are outlined in the scheme Drawings, RS-01 to RS-06 in Volume 2 of this report.

The road marking for the scheme will be generally in accordance with the Traffic Signs Manual. However, where situations arise not covered by the Traffic Signs Manual then appropriate international practice will be followed, amended to suit Irish conditions and subject to approval by TII. The proposed road markings are outlined in the scheme Drawings, RM-01 to RM-04 in Volume 2 of this report.

7.7 Side Roads

Vehicle movements on side roads are predicted to be relatively low (<1.5 Million Standard Axels (MSA)), as such this shall be considered in their design. See above **Table 7.1** and **Table 7.2** for preliminary design of pavement for side roads.

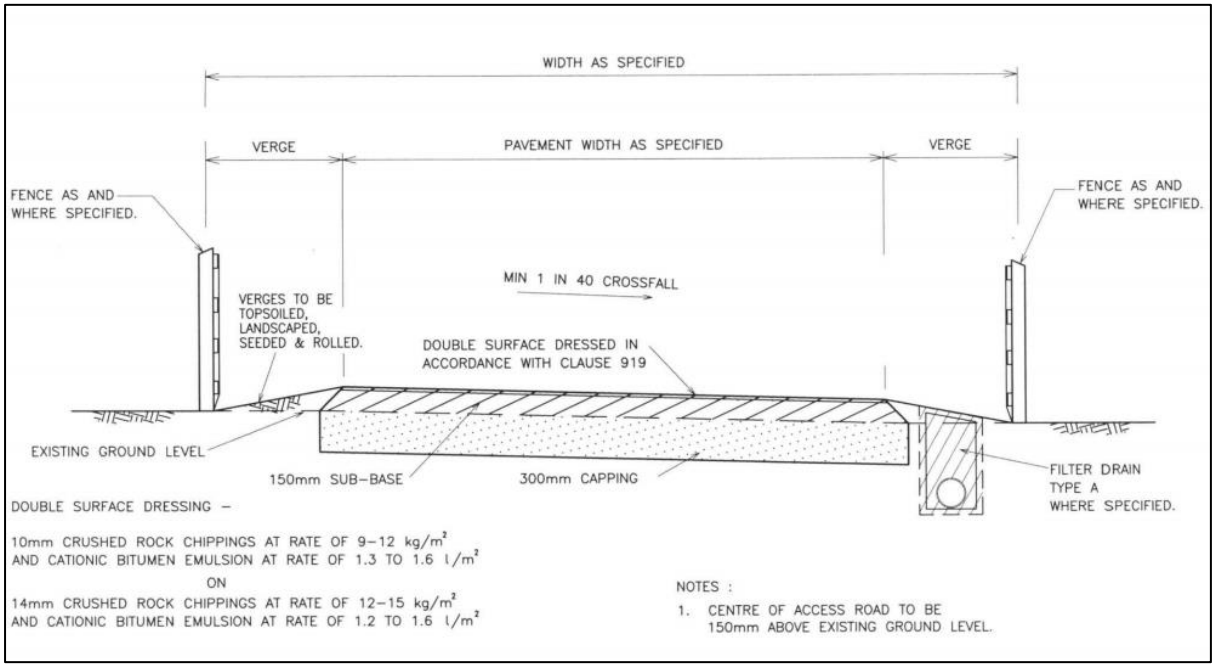
7.8 Domestic Entrances & Field Accesses

Where a recognised domestic vehicle crossing or occasional emergency service vehicle access route crosses a footpath or cycle track, including specified pedestrian areas or precincts, the existing structure may include thicker layers, higher quality materials or other strengthening measures.

7.9 Access Roads

All access road pavements will be in accordance with the TII Specification for Roadworks CC-SCD-00706 which include for a capping and sub-base layer with double surface dressing. CC-SCD-00706 is shown in **Figure 7.1** below.

Figure 7.1 Access Road/Service Road (CC-SCD-00706)

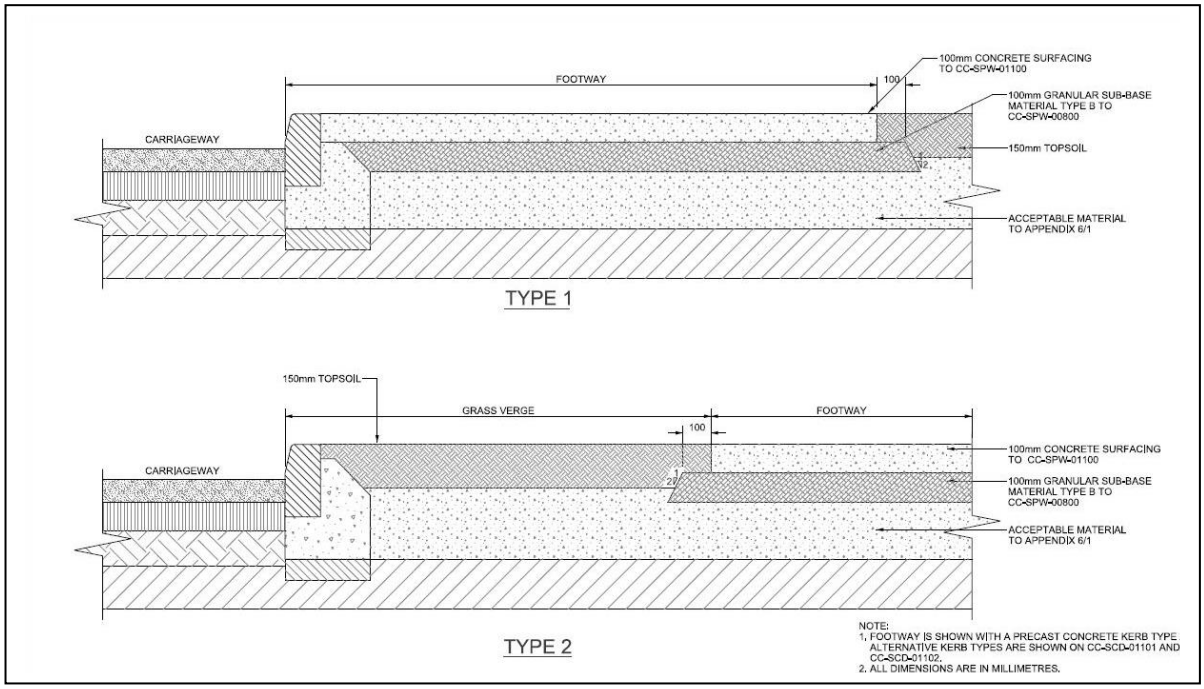


7.10 Footpath Design

The footpath design will be in accordance with TII Specification CC-SCD-01105 as per **Figure 7.2** below, with the more detailed construction make up detailed below.

- 100mm Single Course C28/35 Slab on.
- 150mm SR21 stone blinding with quarry screening on.
- 250mm 6F1 Capping.
- Geosynthetic Layer between sub-grade and sub-base.
- Joints every 3.0m c/c;
- Joints formed with double thickness of Bituminous roofing felt to I.S. 36 (Type 1F);
- All concrete edges and joints shall be bullnosed with a trowel.
- Concrete shall be finished by floating with a wooden trowel and while still green lightly brushed with a bass broom to produce a slight roughness.
- Footpath to be dished at road crossing points.

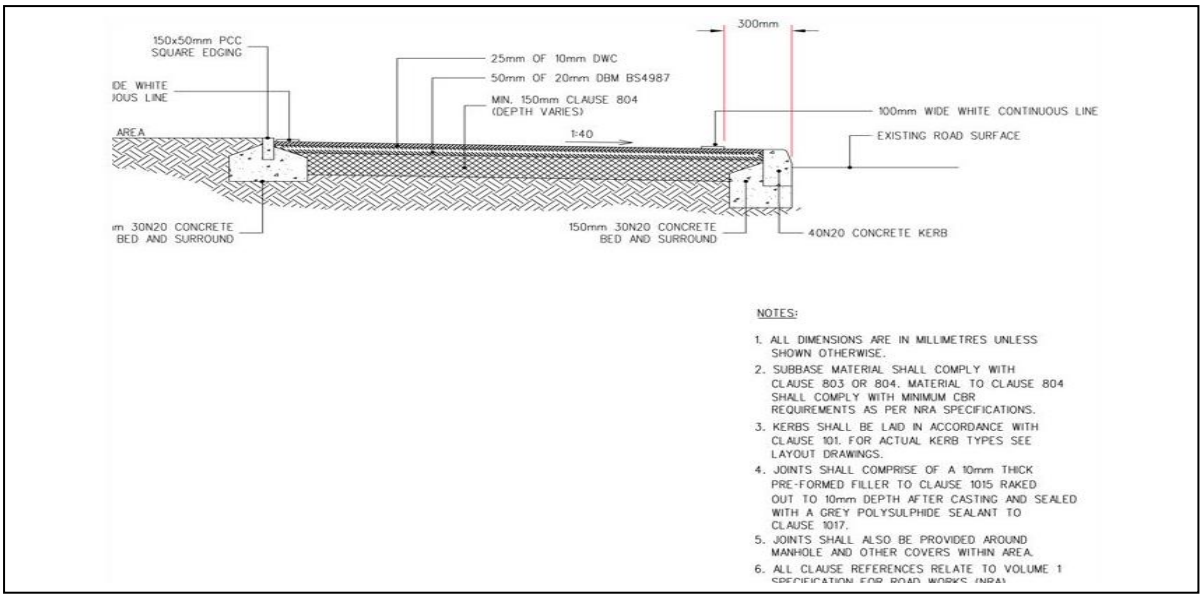
Figure 7.2 Typical Footpath Construction (CC-SCD-01105)



7.11 Cycle track Design

Cycle Tracks are different from Cycle Lanes in that they are physically segregated from motorised traffic. This is achieved through a kerb with a level change. They have limited points of access and egress and therefore they locations are carefully detailed. Cycle tracks have the right of way at residential entrances and field accesses; however, they must yield right of way to road users at road junctions.

Figure 7.3 Typical Cycle Track Construction (National Cycle Manual)



8 Accommodation Works & Land Acquisitions

8.1 Summary Accommodation Works

This section outlines the design of the proposed accommodation works for the proposed road development. Galway Count Council have undertaken a series of meetings with directly affected property owners. The findings from the meetings have been combined with land registry records to produce a comprehensive landownership mosaic for the proposed road development. Refer to Drawing AC-01 to AC-04 in **Appendix A13.1** of this report for further details.

The landownership mosaic was used to establish access requirements and to evaluate side roads and mainline realignments as part of the design phase. Requests made by the property owners and general public were evaluated and included in the design where they were deemed reasonable and possible to provide mitigation measures for the proposed road development. The land use along the proposed road development comprises a mix of agriculture lands and residential properties.

Measures have been considered to facilitate landowners that will be affected by the realignment of the road and are termed as 'Accommodation Works'. These are provided to accommodate the following:

- Re-instatement of access to properties/holdings severed by the scheme
- Provision of re-instatement of boundary walls and boundary fencing at properties affected by the scheme
- Re-instatement of domestic services such as water, sewage, electricity and telecommunications.

Measures to facilitate landowners affected by the Road Project have been included in the design drawings where these have been identified as necessary. The accommodation works that have been identified as necessary to the scheme are scheduled in the sections below.

8.2 Drainage

It is proposed that any field drains severed by the scheme will be reconnected to the existing open drainage system. At the detailed design stage, the new drainage will be designed to ensure that there will be no increased risk of flooding and that the current drainage situation will not be worsened.

Where any existing services are affected by the proposals these will be relocated as necessary and reinstated. These services include, electricity supply, water supply mains and telephone connections.

8.3 Boundary Treatment

At the beginning of the construction phase the land to be acquired as per the proposed boundary will be fenced and access across it restricted where possible. Temporary construction fencing may be required during construction prior to the installation of permanent fencing to secure the site and prevent unauthorised access.

Boundary treatment for the scheme will vary across the proposed road development depending on different circumstances which may require timber post and tension mesh stud fence, mammal proof fencing, masonry walls, steel palisade fencing and noise barriers and may be temporary in nature. Fencing and boundary walls to be constructed in accordance with the TII Standard Construction Details. The scheme will impact upon several individual residential properties and in some cases, it will be necessary to acquire lands which include boundary walls and portions of property frontages and gardens. In these case, accommodations work will be required, and the approach adopted will be to replace a 'like for like' basis. Road boundary fencing will generally be of stock-proof timber post and tension mesh stud fence complying with TII standard detail CC-SCD-00321 as indicated in **Figure 8.1** below, to be provided where specified for the proposed scheme. A mammal resisting fencing complying with TII standard detail CC-SCD-00324 as indicated in **Figure 8.2** will be provided where specified. Note any permanent or temporary fencing that is to be installed outside of the mammal proof fencing shall ensure a 200mm high gap from ground level to the bottom of a tension mesh, to ensure free passage of mammals and direct towards the appropriate mammal underpass. Refer to Drawings MC-01 & AC-01 to AC-04 in **Appendix A13.1** of this report for further information on Fencing and Environmental Barriers.

Figure 8.1: Typical Timber Post and Tension Mesh Stud Fence

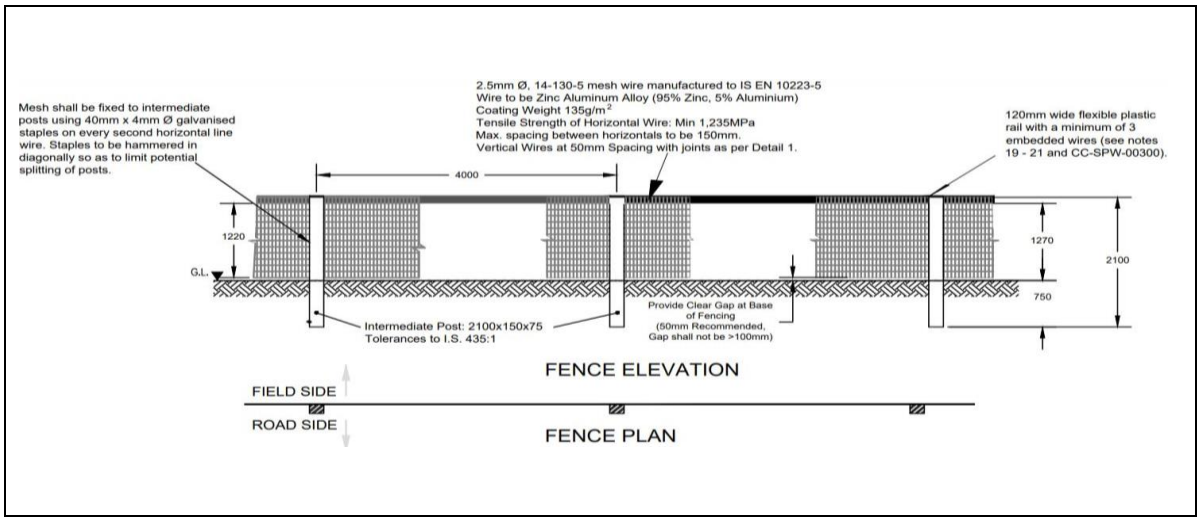
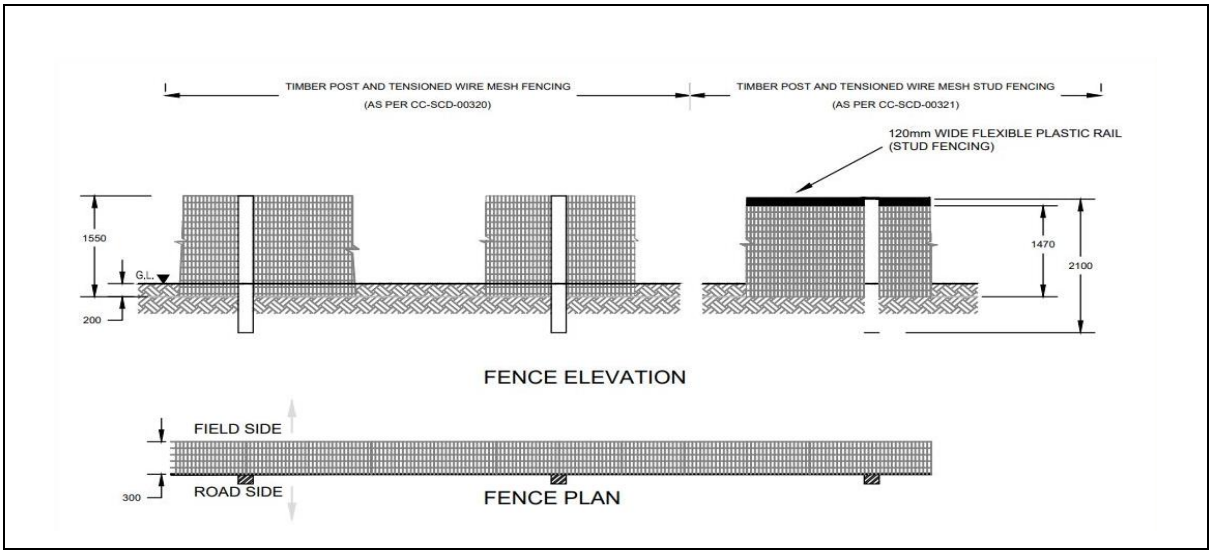


Figure 8.2: Typical Mammal Resistant Fencing (CC-SCD-00324)



8.4 Direct Accesses

Direct access will be permitted however the general objective of the design was to reduce or eliminate the number of access points onto the proposed new N17 alignment. There are 64 No direct accesess to the N17 at present, this will be reduced to 35 No. with this scheme. This will mean that access will only be provided where no other means of access is practicable. **Table 8.1** lists the proposed access.

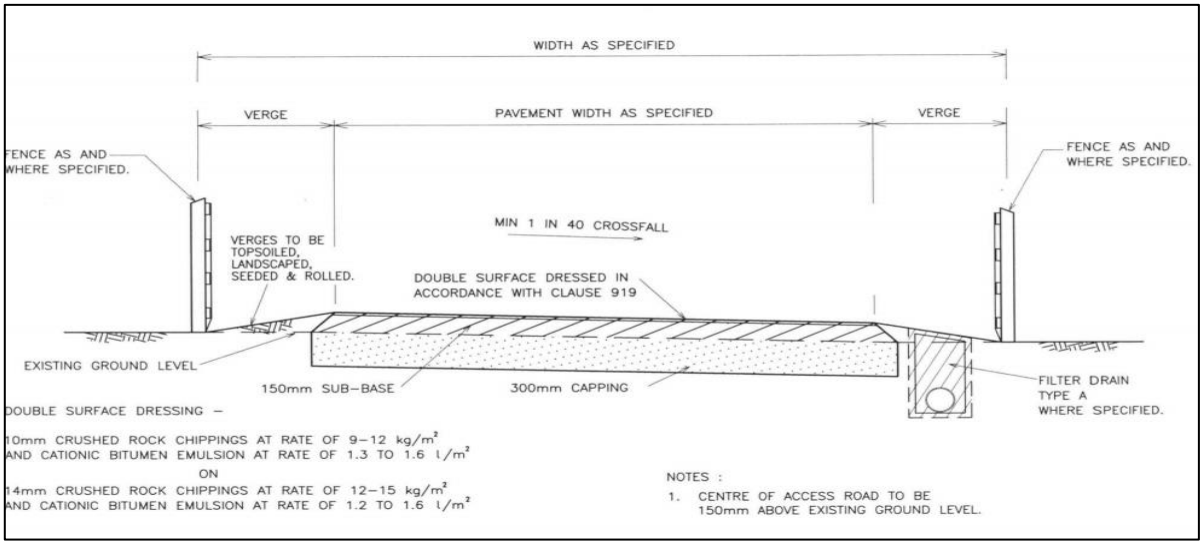
Table 8.1: Direct Accesses

Access	No.	Description
Domestic Entrance	18	Single private house entrance onto proposed N17
Field Entrance	18	Recessed gate directly onto proposed N17
Junction	7	Major/Minor Junctions designed to DN-GEO-03060 along N17 Route
Retention Ponds	4	Entrance via access road
Access Road	4	4.0m wide accommodation access road servicing Field Entrances

8.4.1 Access Roads

Farm access roads will be provided to access severed lands in cases where acquiring the severed lands is generally more expensive than the cost of providing the access. The access roads may be constructed for single landowners, however in many cases the roads will be shared by two or more landowners. Farm access roads shall be a 4.0m wide paved roadway with 1.0m wide verges on each side of the road in accordance with the TII standard detail CC-SCD-00706. The proposed road construction shall be a double surface dressing in accordance with Clause 919 of the TII Specification for Roadworks on 150mm subbase on 300mm capping as indicated on **Figure 8.3**. Farm access roads shall have a 30km/h design speed with a maximum vertical gradient of 10%. The proposed accommodation works are outlined in the scheme drawings, **Appendix A13.1** of this report.

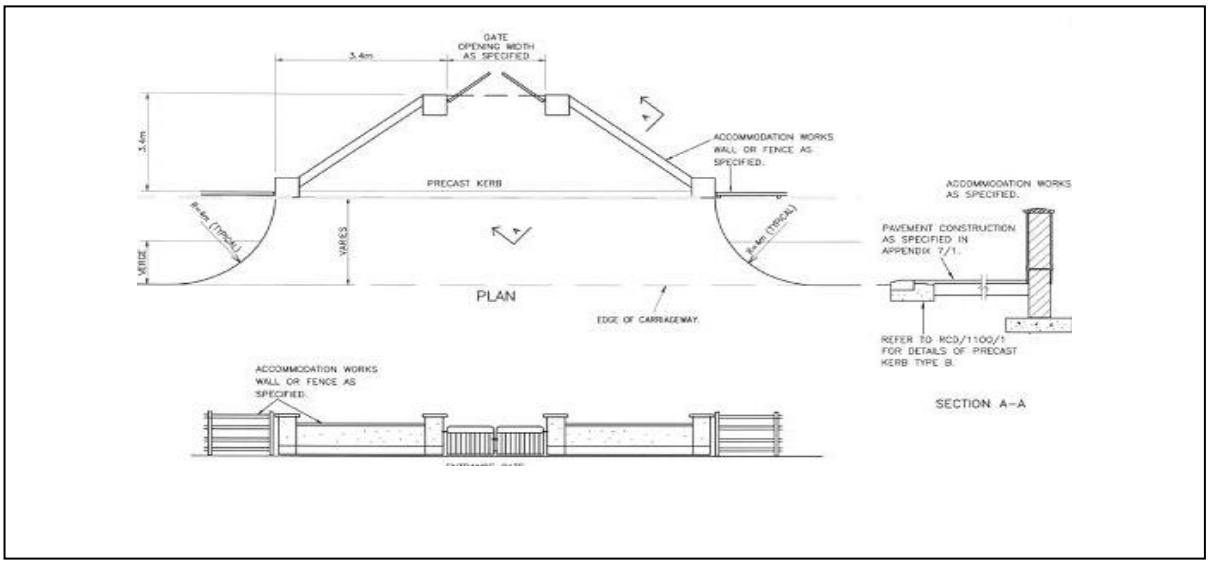
Figure 8.3: Typical Farm Access Road Detail (CC-SCD-00706)



8.4.2 Domestic Entrance

There are several houses that connect to the N17 along the scheme. Where possible the number of access points onto the N17 will be reduced by providing a link road between local access points. In some cases, driveways may be regraded where the levels of the existing road are being elevated or dropped. New house entrances will be constructed in accordance with the TII standard detail CC-SCD-02753 as indicated on **Figure 8.4** or as agreed with the individual landowner.

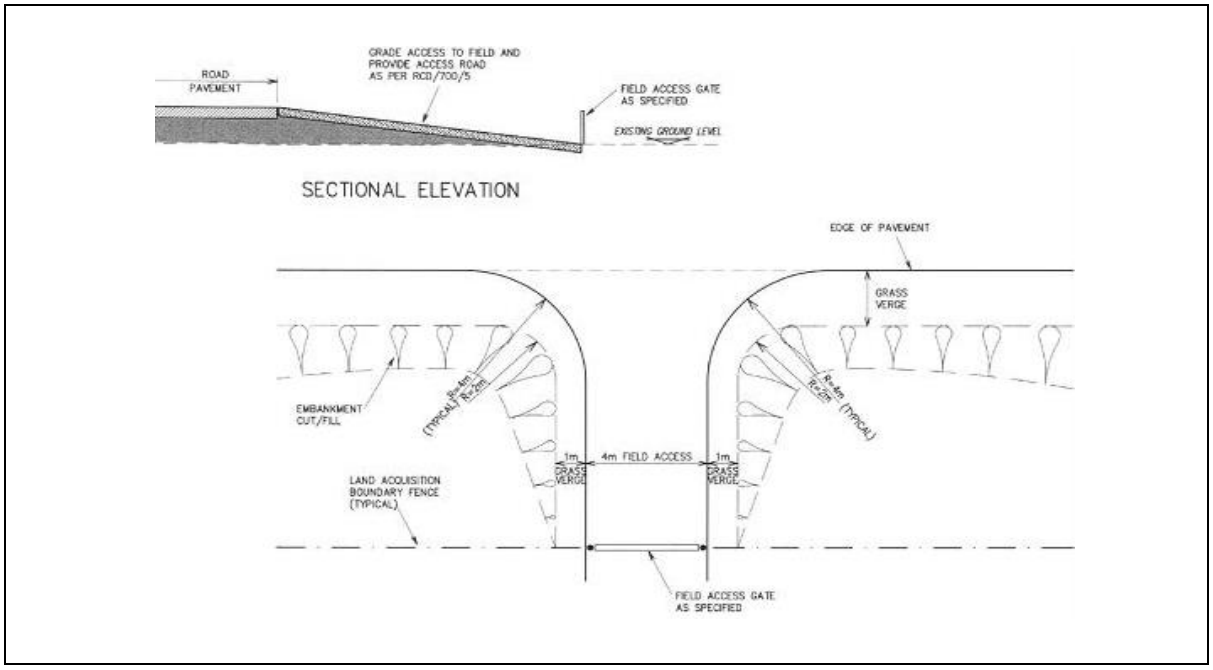
Figure 8.4: Typical Domestic Entrance (CC-SCD-02753)



8.4.3 Field Entrance

Field accesses will generally be constructed as per the detail shown in **Figure 8.5** below with either single or double gate types as per agreement with landowner, as shown in **Figure 8.6 and 8.7 below**.

Figure 8.5: Typical Field Access (CC-SCD-02754)



8.4.4 Field Gates

Gates serving farms will be constructed as per the detail shown in **Figure 8.6 and 8.7**. A total number of 39 single gates and 5 number of double gates will be incorporated into the scheme.

Figure 8.6: Typical Single Steel Gate Detail (CC-SCD-00309)

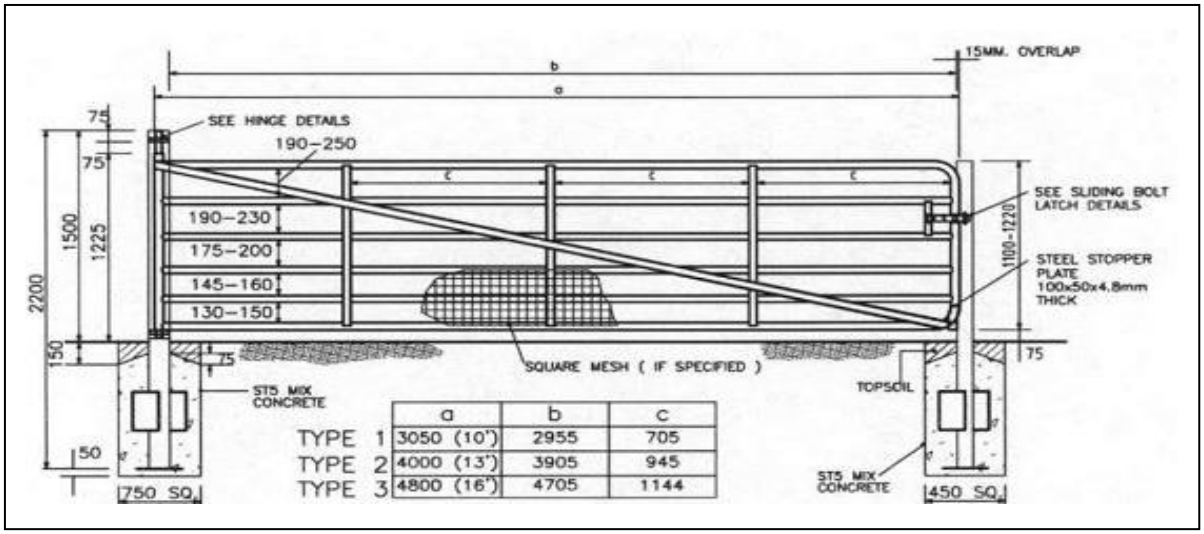
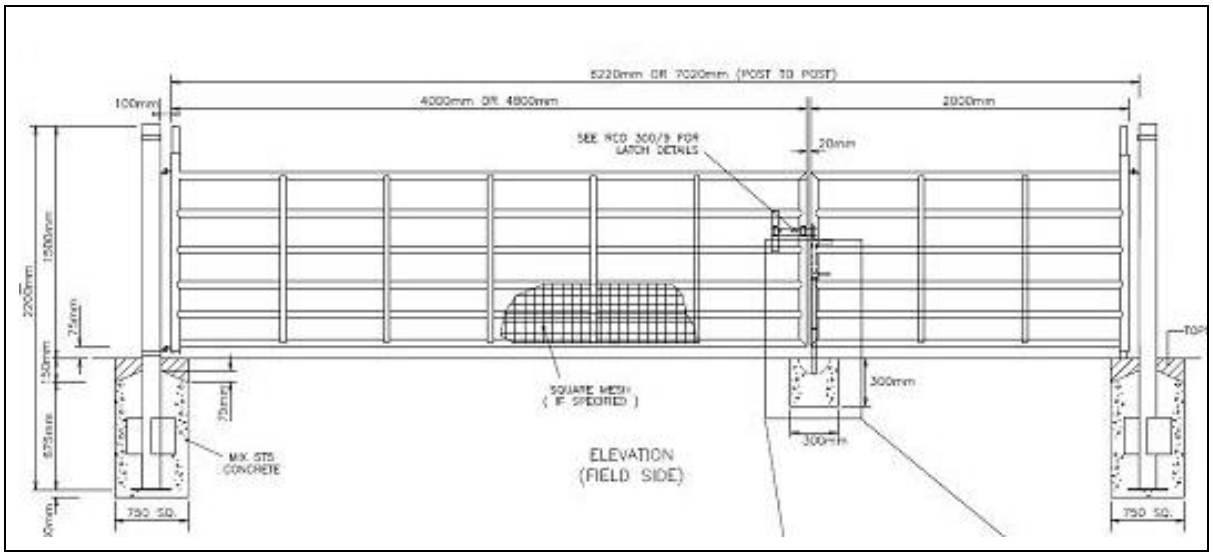


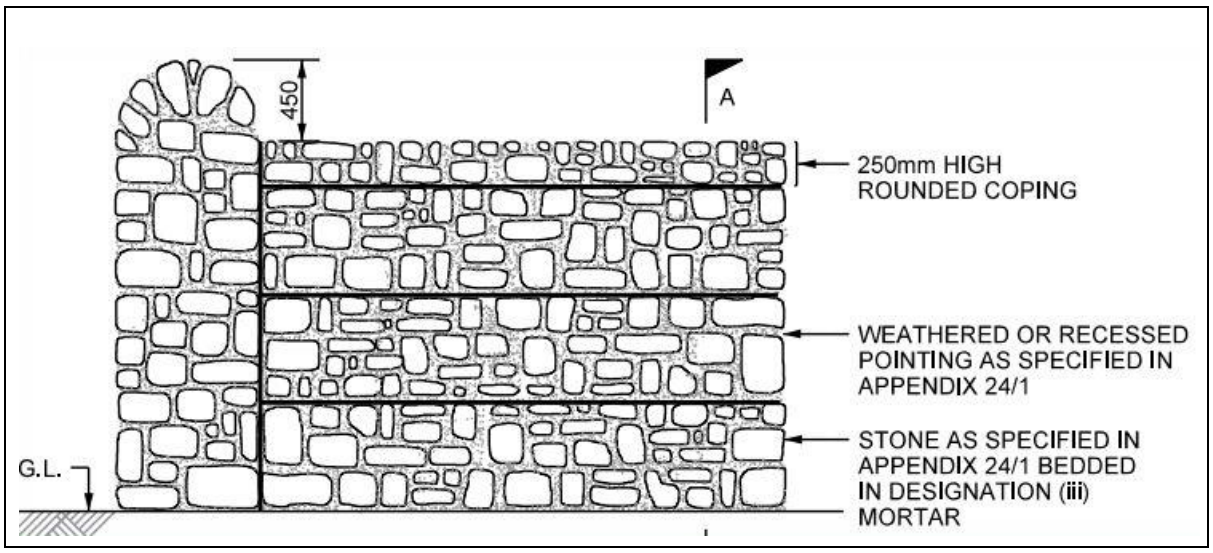
Figure 8.7: Typical Double Steel Gate Detail (CC-SCD-00310)



8.5 Walls

Stone Walls will be constructed outside existing houses on left and right-hand side of the proposed realignment, which will consist of a double-sided stone wall finish, complying with TII SCD/02404 standard construction detail, as indicated in **Figure 8.8** below. It is proposed to construct a 1.1m high retaining block wall above existing ground level due to increase elevation change in the vertical alignment of the proposed road at chainage 2+500m to 2+610m on the right-hand side of the proposed realignment. It is proposed to build a stone wall 900mm above ground level adjacent to footpath on both right and left-hand side from chainage 2+560m to 2+945m. These walls will also act as retaining walls along this chainage.

Figure 8.8: Typical Stonework Wall (CC-SCD-02404)



8.6 Summary of Land Acquisitions Requirements

Land take due to construction of the scheme will be required for various reasons including:

- Road and cycleway/footpath construction.
- Grass verges.
- Embankments and cuttings.
- Side road upgrades and realignment.
- Accommodation works for entrances and accesses to houses and properties.
- Maintenance strips and working space.
- Construction staging and traffic management.
- Drainage and Environmental facilities; and
- Buffer zones, and landscaping.

Land and property owners will be among those most affected by the construction of this scheme. Impacts will range from encroachments onto property lines, loss of lands through acquisition, alterations to or loss of direct accesses to the new scheme and in some instances a degree of severance. It is possible to maintain these impacts to a minimum by,

- Agreeing and providing accommodation works in an efficient manner.
- Maintaining regular communication between land/property owners and Local Authority.
- Keeping land acquisition to a minimum, at property interfaces.
- As far as practicable, maintaining access or provision of alternatives during the construction phase, and land acquisition phase.
- As far as practicable, maintain all existing utilities or provision of alternatives during the construction phase.
- Employing best practice construction methods and efficient traffic management.

8.6.1 Affected Property Owners

The proposed scheme will impact on approximately 43 landowners, including Galway County Council, summary detail is shown in **Table 8.2**, **Table 8.3 and Table 8.4** below. The holdings of land and property owners affected by the N17 Milltown to Gortnagunned realignment scheme was determined through Land Registry searches using www.landdirect.ie on-line interactive database and by reference to local knowledge and landowner consultation conducted by Galway County Council NRPO office. This information has been used to establish the landownership database for the scheme.

Table 8.2: Impacted Property Owners

Folio	Plot Ref No.	Owner	Land Type	Road Bed (Ha)	Land Take (Ha)
GY50865N	001	Alan Hernon	Agri	0.000	0.065
GY10539N	002	James Hernon	Agri	0.000	0.309
GY10539N	002A	James Hernon	Agri	0.000	0.076
GY61262F	003	Ivan & Josephine Hernon	Res	0.000	0.018
GY10542N	004, 004A, 004B	Mary Heneghan & Bridget Greene	Agri +Res	0.080	0.652
GY106000F	005, 005A	John & Bridget Greene	Agri +Res	0.018	0.033
GY10541N	006	Mary Kelly	Agri	0.000	0.213
GY10541N	006A, 006B	Mary Kelly	Agri	0.047	0.367
GY10543N	007	Patrick Rhatigan	Agri +Res	0.000	1.086
GY10543N	007A,007C, 007D	Patrick Rhatigan	Agri	0.055	1.444
GY10543N	007E,007F, 007G,007H, 007I	Patrick Rhatigan	Agri	0.266	0.485
GY1616N	008	John Malin	Agri	0.000	0.997
GY122897F	009	Martin Varley	Agri	0.000	0.714
GY122897F	010	Martin Varley	Agri	0.000	0.629
GY122897F	011, 011A	Martin Varley	Agri	0.103	0.460
GY329F	012, 012A	Jarlath & Ann Connolly	Agri +Res	0.140	1.841
GY80151F	013, 013A	James Harley	Agri	0.96	0.891
GY2791N	014, 014A, 014B	John Kirrane	Agri	0.070	0.532
GY2790N	015, 015A, 015B, 015C	John Kirrane	Agri +Res	0.099	0.386
GY2791N	016, 016A, 016B	John Kirrane	Agri	0.013	0.012
GY110106	017, 017A	Cathal & Elaine Mchugh	Agri +Res	0.019	0.085
GY110106	018, 018A	Cathal & Elaine Mchugh	Agri +Res	0.062	0.189
GY767N	019,019A,019B, 019C, 020, 021	Michael & Cathal McHugh	Agri	0.131	1.148
GY87376F	022A, 022	John & Martina Fahy	Res	0.020	0.1710
GY6146F	023A, 023	Michael Joseph Mc Hugh	Agri +Res	0.087	0.029
GY329F	024A, 024	Jarlath & Ann Connolly	Agri	0.002	0.169

Table 8.3: Impacted Property Owners

Folio	Plot Ref No.	Owner	Land Type	Road Bed (Ha)	Land Take (Ha)
GY768N	025A, 025	Helen & Val Flattery	Agri	0.119	1.323
GY30693N	026A, 026	Marquerite Slattery	Agri	0.025	0.234
GY792N	027A, 027	Valentine Flattery	Agri +Res	0.359	0.989
GY56290N	028A, 028, 0	Marie Murphy	Agri	0.130	0.085
GY45274N	030A, 030	Miltown Development Company	Agri	0.018	0.016
GY47436N	031, 031A, 031B, 031C	Pat McGarry	Agri	0.007	1.010
GY47436N	032A, 032	Pat McGarry	Agri	0.015	0.006
GY21790F	034A, 034	James & Bernadette Greene	Res	0.032	0.038
GY61301F	035, 035A	Bernie & Kevin Naughton, Karen O'Byrne	Commercial	0.177	0.000
GY47434N	036A, 036	Patrick McGarry	Agri	0.016	0.141
GY15270F	037A, 037	Patrick McGarry	Agri	0.045	0.237
GY46066N	038A, 038	Pat McGarry	Agri +Res	0.050	0.207
GY45273N	039, 039A	Ann Mullarkey	Agri +Res	0.033	0.864
GY28706F	040A, 040	William & Bernadette Costello	Res	0.025	0.188
GY47433N	041	Mary Keaveney	Agri	0.000	0.035
Unknown	042A, 042	Not Registered (Mary Keaveney)	Agri	0.009	0.094
GY27145N	043, 043A, 043B, 043C, 044	John O' Donnell	Agri	0.092	0.088
GY91741F	045A, 045	John O' Donnell	Res	0.003	0.004
GY26391F	046	Paul Burke & Sheila Canney Burke	Res	0.041	0.000
Unknown	047, 047A, 048, 049	Not Registered, (Ann Molloy)	Agri +Res	0.063	0.023
GY27145N	050A, 050	John O' Donnell	Agri +Res	0.040	0.016
GY72492F	051, 051A, 051B	Padraic O'Donnell	Agri	0.081	0.029

Table 8.4: Impacted Property Owners

Folio	Plot Ref No.	Owner	Land Type	Road Bed (Ha)	Land Take (Ha)
GY47598F	052A, 052	Michael Kelly & Jacqueline Chivers	Res	0.030	0.028
GY42009N	053A, 053	William & Mary Francis Aherne	Agri	0.033	0.013
GY72488F	054A, 054	Michael & Margaret O'Malley	Res	0.019	0.009
GY9354F	055A, 055	Mary & Paul Heaney	Res	0.033	0.003
GY47624F	056A, 056	Eamon O' Donnell & Marie Mc Dermott	Res	0.016	0.007
GY17174F	057A, 057	Eamon Callaghan	Res	0.014	0.008
GY7905F	058	Padraic & June Flannery	Res	0.016	0.000
GY125356F	059A, 059	Padraic Flannery	Agri	0.037	0.009
GY15381F	060A, 060	Mary Mc Daid	Agri	0.053	0.007
GY44669F	061, 061A, 061B, 062	Padraic Flannery	Agri	0.011	0.005
Unknown	064A, 064, 065, 065A	Irish Rail	Unused Railway Line	0.075	0.157
GY116017F	066A, 066	Sean Murphy	Agri	0.018	0.099
GY116239F	067	Galway County Council	Road	0.108	0.000
GY115905F	068	Galway County Council	Road	0.173	0.000
GY115903F	069	Galway County Council	Road	0.131	0.000
GY115954F	070	Galway County Council	Road	0.112	0.000

Table 8.4: Impacted Property Owners

GY115876F	071	Galway County Council	Road	0.823	0.000
GY115889F	072	Galway County Council	Road	0.142	0.000
GY115896F	073	Galway County Council	Road	0.192	0.000
GY329F	074	Jarlath & Anne Connolly	Road	0.076	0.000
GY116017F	075, 075A	Sean Murphy	Agri	0.041	0.184
GY47436N	076, 076A	Patrick McGarry	Agri	0.050	0.093
GY127810F	077, 077A	Shane Jarlath O'Connor	Agri	0.085	0.238
GY1618N	078	Thomas Varley	Res	0.000	0.037
GY1616N	079	John Malin	Agri	0.000	0.015
GY122897F	080	Martin Varley	Agri	0.000	0.002
GY46440F	081	Gerard & Mary O'Neill	Road	0.080	0.000
GY114294F	082	Galway County Council	Road	0.023	0.000
GY116239F	083	Galway County Council	Road	0.037	0.000
GY114341F	084	Galway County Council	Road	0.070	0.000
GY115998F	085	Galway County Council	Road	0.096	0.000
GY114797F	086	Galway County Council	Agri	0.000	0.347
GY329F	087	Jarlath & Anne Connolly	Agri	0.000	0.130
GY329F	088	Jarlath & Anne Connolly	Agri	0.000	0.003

The property land take has been developed to ensure that sufficient land is included to allow for construction and future maintenance of the scheme. In addition to the construction of the scheme the proposed land take includes the following.

- 3m maintenance strip from top cuttings/bottom of embankment along mainline,
- 2-3m (depending on location) maintenance strip along side roads,
- Environmental mitigation measures,
- Drainage, attenuation measures and watercourse realignment,
- Accommodation access roads,
- Landscaping and planting requirements,
- Acquisition of severed land parcels,
- Temporary site compound and working space,
- Temporary traffic management.
- Stockpile Areas

8.7 Demolition and Acquisition

8.7.1 General

From the outset of the design of the proposed road development every effort was made to avoid property demolitions where possible. However, there are still unfortunately and unavoidably number of property demolitions that are necessary for the construction of the proposed road development. Demolition of dwelling houses/derelict houses, garages, farm sheds is a major constraint within the proposed scheme to achieve the satisfactory horizontal alignment for the proposed road development. A detailed list of buildings to be demolished is illustrated in **Table 8.5** below.

Table 8.5: Buildings to be Demolished

Chainage	Side	Description
Ch 1+620m	LHS	Shed
Ch 1+700m	RHS	House & Garage
Ch 2+230m	RHS	Shed
Ch 2+275m	LHS	Derelict House
Ch 2+475m	LHS	House & 2 Sheds
Ch 2+510m	LHS	House & Garage

8.7.2 Demolition Methodology

The demolition work will be carried out by a specialist demolition contractor who will operate in accordance with the method statement and Health and Safety legislation. The method statement will outline how the contractor proposes to undertake the demolition works in accordance with the Construction Environmental Management Plan (CEMP) to demonstrate that the work will be carried out safely and to ensure that significant environmental impacts will not arise. The Contractor will ensure to put in place a Quality Assurance Plan to ensure the correct structures are demolished. This method statement will be approved by the Employer in advance of any works. Refer to **Appendix 10.8** for full details on Construction Environmental Management Plan (CEMP).

The Contractor will put in place a Public Communication Strategy which will provide a two-way mechanism for members of the public to communicate with designated members of the Contractor's staff and for the Contractor to communicate important information on various aspects of the of the proposed road development to the public/ This will include a communications strategy for notifying neighbouring residence of proposed demolition in the area. Warning signs will be erected notifying people of dangers of moving plant/demolition works.

Prior to commencement of demolition works, security fencing will be erected around the area to be demolished and regularly checking to see that it is in a satisfactory condition. Asbestos survey will be carried out on all structures by a competent person to determine if there is any asbestos present. Removal of asbestos by trained personnel and placed into appropriate packaging ready for removal off site if present, in accordance with Health and Safety legislation thereby ensuring significant environmental impact will not arise.

Before commencement of demolition works, all existing services will be identified, located and turned off. This includes ESB, water, gas and telecommunications. The Contractor will ensure all services to properties are off before work commences.

A bat survey is to be completed at all properties prior to being demolished. This will involve the ecologist using a cherry picker to access the roof tiles and removing several tiles. Once the ecologist confirms the roof space is clear the demolition can take place.

The demolition process will include the mechanical demolition of the buildings and removal of materials from site. Demolition will commence from the roof structure working downwards. The Contractor will use large-tracked excavators for the demolition works. Water will be used to suppress dust from the demolition works should it be required. All materials will be sorted and segregated for removal off site to a licenced facility.

Construction waste will vary significantly from site to site but typically would include the following non-hazardous materials:

- Concrete, brick, tiles and ceramics.
- Stone and Soil.
- Metals.
- Wood.
- Other.

The hazardous waste stream which could arise from construction activities may include the following:

- Waste electrical and electronic components.
- Batteries.
- Asbestos.
- Liquid fuels
- Contaminated Soil.

Any material that can be salvaged for recycling will be removed and stored separately. All glass in the property such as windows and doors, will have been removed prior to demolition works to remove the dangers associated with broken glass in the rubble or during demolition works.

In all cases where demolition and site clearance is being undertaken, the relevant archaeological and architectural heritage mitigation measures will be implemented.

9 Services & Utilities

9.1 General

The new scheme intercepts various utility services along its proposed mainline, link roads and side roads. The delivery of the proposed road development shall ensure that there are no permanent disruptions to services provided by these providers and that all temporary disruptions are minimised. Where service diversions are required to facilitate the development, all design works and construction must be carried out in accordance with the relevant statutory bodies and utility and service providers.

The relevant utility companies have been consulted to identify conflict areas between their services and the proposed road scheme. This section of the report identifies likely diversions necessary. The scheme is predominately located within a rural environment, and majority of the scheme will be online road realignment and therefore, the scheme has high impact upon telecommunications lines, watermain and ESB.

The utility companies listed in table 9.1 below have been approached with respect to the N17 realignment scheme. A detailed topographical survey was undertaken on behalf of Galway County Council by Murphy Surveys Ltd during January 2018 to identify the location of utilities within the study area. For the location of all existing known services refer to Drawings EGWS-01, ESB-01 & EE-01 to EE-04, in **Appendix A13.1** of this report.

Table 9.1: Utility Companies Consulted

Company	Service	Affected
Ervia	Gas Supply	No
Electricity Supply Board (ESB)	Electricity Supply up to 38kVA	Yes
Electricity Supply Board International (ESBI)	Electricity Supply above 38kVA	No
Galway County Council	Water Supply, Foul Water and Storm Water drainage	Yes
Milltown Group Water Scheme	Water Supply	Yes
Éir	Telecommunications	Yes

9.2 Service Impacts

This section of the report presents the locations of potential impacts to services and the general measures that have been identified as being necessary to undertake in agreement with the respective parties.

During the detailed design and construction of the scheme the appointed contractor shall re-consult and comply with the requirements of the relevant bodies and service providers listed in **Table 9.1** with respect to service realignments and diversions necessitated by the project.

9.2.1 Electricity Supply Board (ESB)

It has been established that the ESB have various overhead and underground cables running through this study area, including medium voltage (MV) (10kV/20kV) and low voltage (LV) (230V/400V). It will be necessary to liaise closely with ESB personnel throughout the duration of the project, regarding existing facilities and future planning. Refer to **Table 9.2** below for a detailed list of the ESB service conflicts. The design of diversions and alterations to the ESB network will be discussed further at detailed design stage to determine the exact head clearance between the proposed roads and the power lines, and determine whether undergrounding of services will be necessary.

9.2.2 Overhead Transmission Lines

Overhead lines run parallel and across the scheme at the locations detailed in **Table 9.2**, which will require relocation or diversion works to be carried out as part of the scheme works. It is proposed to provide underground ducting for any low voltage/medium voltage ESB service which directly cross the proposed mainline alignment and do not have sufficient clearance to remain overhead. Services outside the “clear zone” of the alignment may remain as overhead services.

Final determination of crossing details will need to be agreed with ESB at detailed design stage. All ESB works will be in accordance with the providers requirements and standard details pertaining to existing service along the scheme. The Contractor appointed to construct the scheme will be required to supply and lay the ducting under the contract.

Some overhead lines on the construction site may need to be raised, diverted or power supply temporarily cut in accordance with Health and Safety and ESB requirements, prior to or during construction of works.

9.2.3 Underground Transmission Lines

There have been several underground ESB transmission lines identified within study area, which are identified in **Table 9.2** below.

Table 9.2: ESB Network affecting the proposed realignment

Chainage	(HV) 38KV + Overhead Lines.	(MV) (10KV/20KV) Overhead Lines	(LV) (400V/230V) Overhead Lines	(HV) 38KV + Underground Cables	MV/LV Underground Cables
0+370m		Crossing Carriageway			
0+868m		Crossing Carriageway			
1+573m to 1+672m			Along the Carriageway		
1+628m					Crossing Carriageway
1+672m to 1+688m					Crossing Carriageway
2+258m			Crossing Carriageway		
2+368m		Crossing Carriageway			
2+428m to 2+493m			Along the Carriageway		
2+493m		Crossing Carriageway	Crossing Carriageway		
2+629m			Crossing Carriageway		
2+765m		Crossing Carriageway			
2+809m to 2+985m			Along the Carriageway		
2+917m			Crossing Carriageway		
Side Road L-22273-0		Crossing Carriageway			
Junction 6 at L-2208-0			Crossing Carriageway		

9.2.4 Lighting

It is proposed to extend the existing lighting line which currently is on the left-hand lane, to cross over the carriageway to the right-hand side at Ch. 2+850m and extend to Ch. 2+560m along the carriageway verge. This area, is designed using DMURS Standards with a design speed of 60km/hr. The proposed lighting will go off line at Ch. 2+560m to Ch. 2+300m following the line of the proposed shared footpath/cycleway. See **Table 9.3** below. Refer to Drawing PL-01 in **Appendix A13.1** of this report for the proposed lighting works.

Table 9.3: Proposed Lighting

Chainage (m)	Side	Surface	Lighting Type	No Lights	Height (m)
2+300 – 2+560	RHS	Footpath/Cycleway	Axia 3.1 5296 Integrated lenses	7	6
2+560 – 2+850	RHS	Footpath/Cycleway	Axia 3.2 5266 Integrated lenses	10	10
2+850 – 2+945	LHS	Footpath/Cycleway	Axia 3.2 5266 Integrated lenses	3	10

9.3 Water Supply

Protection, diversion or relocation of water services will be made in agreement with the water services of Galway County Council and the Milltown Group Water Scheme. Maps of the Milltown Group Water Schemes have been obtained from the GWS Committee. The maps are large scale plans of the entire scheme which indicate that the watermains are located within the existing roads, however there is no indication as to the exact location of the watermains. A new watermain line including ancillary works will be located within the verge of the road for the entire length of the proposed road scheme and will be discussed further at detailed design stage. Temporary diversions to the water supply will be required prior to construction of road scheme. Permanent reconnection of water supply to all dwelling houses, commercial properties and agricultural lands that are affected by the proposed scheme will be the responsibility of the main contractor that's awarded the contract. See **Table 9.4** below. Refer to Drawing PW-01 to PW-04, in **Appendix A13.1** of this report for the proposed watermain layout.

Table 9.4: Proposed Watermains

Chainage (m)	Side	Surface	Pipe Size (mm)	Pipe Type
0+000 – 2+945	RHS	Verge	125	HPPE (PE-100) / HDPE / MDPE(PE-80) or DI

9.4 Telecommunications

9.4.1 Éir

Éir have a number of overhead services that are affected by the proposed road development. The locations at which conflicts occur between Éir services and the proposed road development are shown in **Table 9.5** below and shown in Drawing EE-01 to EE-04, in **Appendix A13.1** of this report. The services are generally underground in the grass verge or the hard shoulder with connections to dwellings running overhead from poles located next to junction boxes. The remainder of the services are overhead and are generally located adjacent to the existing N17 and existing side roads within the Study Area. As illustrated in **Table 9.5** the location at which conflict occurs with Éir services and the proposed N17 realignment are shown.

Table 9.5: Telecommunications affecting the proposed realignment

Chainage (m)	Road	Telecommunications
0+555	N17	Crossing Carriageway
0+700	N17	Crossing Carriageway
1+550	N17	Crossing Carriageway
2+285	N17	Crossing Carriageway
2+770	N17	Crossing Carriageway
0+555	L-22273-0	Crossing Carriageway
0+675	L-2227-0	Crossing Carriageway
1+550	L-22087-0	Crossing Carriageway
2+285	L-6413-0	Crossing Carriageway
2+300	L-2208-0	Crossing Carriageway
2+780	L-64131-0	Crossing Carriageway
0 – 0+550	N17	Along Carriageway
0+640 – 0+700	N17	Along Carriageway
0+825 – 1+000	N17	Along Carriageway
2+260 – 2+290	N17	Along Carriageway
2+520 – 2+945	N17	Along Carriageway

The new proposed telecommunications line is to be installed underground in the verge on the left-hand side of the proposed scheme, consisting of 14 no chambers constructed in accordance with TII CC-SCD-00564. Refer to Drawing PE-01 to PE-04, in **Appendix A13.1** of this report for the proposed watermain layout.

9.5 Wastewater

Irish Water and Galway County Council have recently completed construction of a municipal Waste Water facilities at Milltown. The waste water network is inside the study area from chainage 2300m – 2945m. This waste water pipeline will be maintained and protected during

construction. It is not intended at this stage to provide new connections/access to the existing foul sewer network in Milltown. It is understood that not all existing dwelling houses within the study area, are connected to the existing wastewater network.

9.6 Gas Supply – Ervia (Formerly Board Gáis Éireann)

Ervia owns and operates the gas transmission and distribution system in Ireland. Ervia do not currently have any mains in the vicinity, of the proposed scheme. There is no impact on the Gas Supply as a result of the proposed scheme.

9.7 Irish Rail

The currently abandoned Galway – Sligo railway runs through the scheme with a level crossings located on the existing road. Although the railway is currently not in use, it forms part of the Western Rail Corridor which is referenced in National, Regional and Local Policy documents as an important infrastructural project for the growth of the West Region. It is therefore important to maintain minimal conflicts between the proposed scheme and the existing railway. It has been agreed with Irish Rail that the existing rail crossing be maintained at its original location and its existing elevation, so the proposed road development is designed to tie in at its existing location with existing levels maintained.

10 Construction & Environment

10.1 General

It is estimated that the overall construction period will last approximately 18 months. A variety of construction activities will occur simultaneously at a number of locations along the route of the proposed road realignment but will be in a phased manner. Construction will be undertaken using nationally accepted methods. Construction of the proposed road realignment will include activities such as excavation, embankment and movement of materials within the fenced off work area. This will generate noise, dust and movement of machinery which will potentially have minimal impact on adjoining lands. The duration of these works will vary. A strategy for construction has been developed with the aim of minimising potential environmental impacts at each subsequent phase of the project. Progress to construction construction is dependent on both planning and funding approvals the following descriptions are prepared on the presumption that these approvals would be in place.

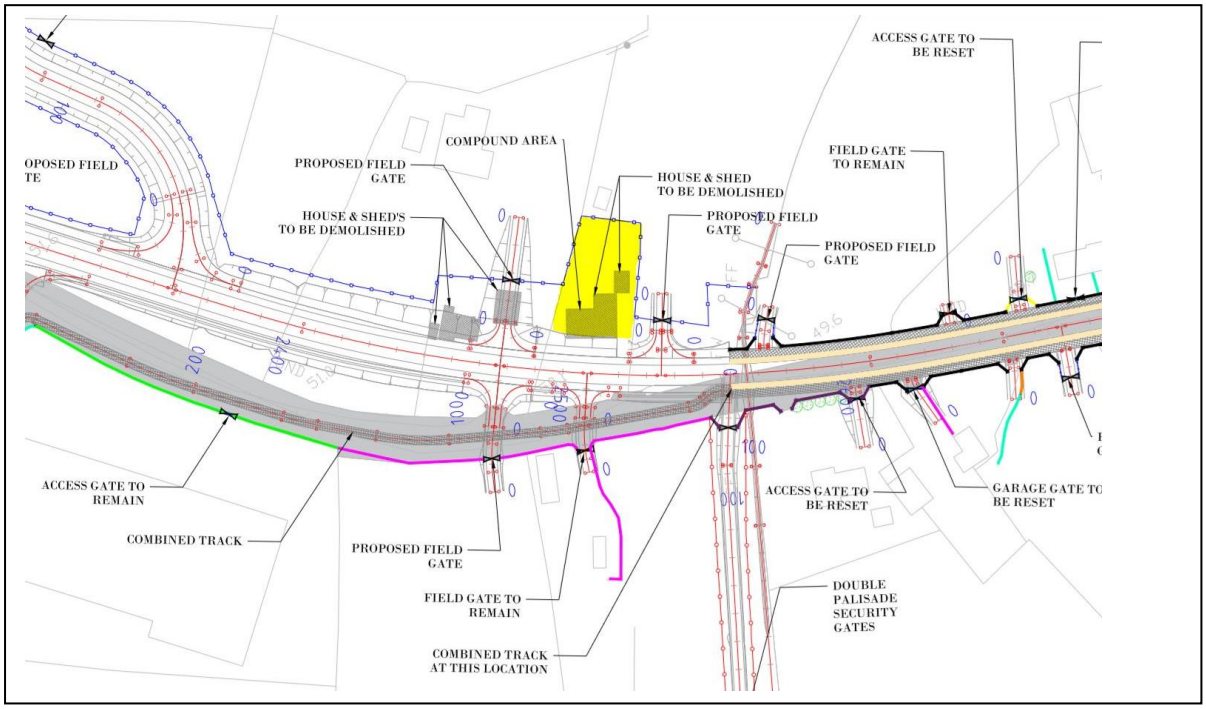
It is likely that works will be carried out under the Public Works Contract for Civil Engineering Works designed by the Employer (PW-CF3). The successful Contractor would be responsible for the construction of the scheme to the detailed design completed by the Employers / Consultant. It is assumed that construction of the proposed scheme will be under taken as a single contract which will last approximately 18 months.

10.2 Construction Compounds

There will be a number, of construction compound sites along the route of the scheme. The location, size and suitability of the sites selected will be at the discretion of the contractor.

The main compound may include, stores, offices, materials storage areas, material processing areas, plant storage and parking for site and staff vehicles. These sites are proposed to remain in place for the duration of the contract but may be scaled up or down during various activities on site. Smaller temporary compounds may be required for the construction of sections of work which will be found at various locations along the length of the scheme. It is however at the contractor's discretion where and how many of these sites are intended to be used of any at all. All construction compounds identified as potential sites will be sited within the development boundary. A proposed Site compound is identified at chainage 2+ 510m on left hand side. See **Figure 10.1** below;

Figure: 10.1: Location of Main Site Compound within the Scheme.



The storage of fuels, other hydrocarbons and other chemicals within the construction compounds will not be permitted within 50m of a watercourse. All fuel storage areas will be bunded to 110% of storage capacity to prevent spills and provide sufficient additional capacity in the event of rainfall occurring simultaneously. The compounds will also have appropriate levels of security to limit potential vandalism, theft and unauthorised access within the compounds.

Following completion of construction these areas will be cleared and re-instated, temporary buildings and containers, parking areas and waste material such as rubble, aggregates and unused construction materials will not be permitted to remain exposed on these sites and will need to be removed and disposed of appropriately.

10.3 Spoil Areas

The design team have identified two plots of land to be used as spoil areas, located east and west of the existing railway line. Plot 1 located at Ch 1+ 020m right hand side consisting of 0.713 ha of which 0.57ha can be utilised, which will be accessible through the proposed Access Road 1. Plot 2 located at Ch 1+ 200m right hand side consisting of 1.840 ha, of which 1.7 ha can be utilised, which will be accessible through the proposed Access Road 2.

The total soil cut for the proposed project is estimated at 35,000 m^2, of which its estimated that 70% will be reused within the proposed road development. To facilitate the deposition of this material the capacity required needs to exceed this volume. The design has allowed a 5m buffer zone around the perimeter of the selected land to contain no material and a 25m buffer zone on the southern end of Plot 1 & 2 due to the stream location which has connectivity to the Clare

River. Plot 1 has the potential to facilitate 8,200m3 and Plot 2 with potential to facilitate 34,420m3, the combined volume total between Plot 1 & 2 is 42,620m3, which clearly exceeds the required 10,528m3 and satisfies the volume required to carry out the works. Works will be carried in accordance with the Outline Erosion and Sediment Control Plan. Refer to **Appendix A10.1** for full details of Erosion and Sediment Plan. In **Figure 10.2** below shows location of proposed Spoil Area.

Figure: 10.2: Location of Spoil Areas within the Scheme.

10.4 Pre - Construction Works

Pre-construction works may be undertaken and may also include certain diversion works of services and utilities including electricity, telecommunications and watermains. Advanced tree clearance, hedgerow clearance and fencing contracts may also be undertaken and are dependent on the anticipated seasonal timing of the award of the main contract. If appropriate, these advance works contracts would be used as a means, to clear the site of vegetation during permitted seasonal periods to enable the main construction contract to proceed with reduced impediment on the main works.

The establishment of the works compounds and connection of services for their operation will be undertaken at the start of the works on site after the issuing of the notice to enter and award of the main construction contract. This will then be followed by site clearance and topsoil stripping of the site in stages. It is likely that this will be phased to keep just ahead of the major earthworks movements in order, to maintain the protection of existing vegetation for as long

as possible. Initial works on permanent and temporary boundary fences may also be undertaken as a preliminary operation, with further boundary works required on completion of the main construction works. Accommodation works where required for access, as well as temporary access routes and main haul routes for the transportation of material around the site will also be constructed as part of the preliminary operations.

The main construction consists predominantly of the earthworks and road pavement construction. The earthworks construction will involve the excavation and placement of materials for the construction of cuttings and embankments as well as the hauling of materials and importation of materials to complete the road formation. Materials for the road construction will include materials that will be brought to site including gravels and bituminous pavement and surfacing materials. In addition to the earthworks and pavement construction the main activities will involve the following:

- Drainage – the installation of open drainage, pipe culverts, filter drains, carrier pipes and concrete channels
- The diversion and construction of utilities and services
- Environmental mitigation
- Ancillary roadwork's including the installation of safety barriers, signage and road marking
- Accommodation works for affected landowners such as access roads, entrances, fences, gates, walls, ducting and reconnection of severed services.

10.5 Construction Phasing & Traffic Management

The scheme has sections of work that are both on-line and offline and as such the Contractor shall be responsible to undertake the Works in a manner that will cause the least amount of traffic disruption. Appropriate phasing of the works along with temporary traffic management measures and temporary road diversions will be required to minimise disruption to the traffic. A preliminary constructability report has been developed. Refer to **Appendix 10.2**

The haulage of materials to and from the site will create a significant temporary impact to both road users and to residents living on this section of the N17. To minimise these impacts it is important that only authorised site access roads, as directed by the Local Authority, are used by construction vehicles.

The construction process will be planned to accommodate existing traffic flows and the daily construction operations adjacent to the scheme. The overall traffic management strategy for the scheme will be developed further during the detailed design stage through development of the preliminary Traffic Management Plan.

The actual traffic management plan and potential construction diversions required will be the contractor's responsibility. The Contractor will be also responsible for acquiring all the necessary licensing and permissions for the use of roads with regards to any temporary closures and traffic management. The Contractor will then further develop the Preliminary Traffic Management Plan into a Construction Stage Traffic Management Plan (CSTMP) with detailed traffic management drawings and phasing proposals. The CSTMP will need to be approved by Galway County Council and the relevant emergency services in order that potential road closures, restrictions, delays, and diversions are carried out safely and efficiently.

The Contractor's CSTMP shall comply with the Preliminary Traffic Management Plan as well as all TII, Galway County Council and relevant standards and guidelines. The plan shall be designed in accordance with the Traffic Signs Manual Chapter 8 – Temporary Traffic Measures and Signs for Roadworks, Department of Transport (DOT), 2010.

Other standards, specifications and guidelines recommended for implementation by road authorities, contractors and persons undertaking works on public roads include:

- Guidance for the Control and Management of Traffic at Road Works, October 2007, Local Government Management Services Board (LGMSB), for the DOT and TII;
- TS4: Guidelines, Certification Scheme and Specification for Construction of Traffic Signs (DOELG).

As part of the Contractor's CSTMP a detailed programme/schedule of the planned works must be prepared by the Contractor in charge of the works, prior to commencement of the project. This will be reviewed for approval by Galway County Council. The programme /schedule will need to state:

- The overall programme of construction.
- Programming of key and specific elements of construction.
- The duration of each element and phase of construction.
- Temporary traffic management measures during each phase of construction.
- Methods of construction; and
- Daily timing for undertaking each task.

10.6 Construction Material

The main materials that will be hauled in bulk to and from the site including within the site boundaries are:

- Earthworks, including topsoil, general cut and fill material, and capping materials.

- Pavement Materials, including granular sub-base material and bituminous pavement materials.
- Concrete, both in-situ and precast units such as pipes and culverts.
- Other materials will be required including fencing material, attenuation pond material and environmentally friendly plants.
- A draft traffic management plan has been developed by Galway County Council and is included in the preliminary design drawings.

It is envisioned that, at least 70% of material in cut will be reused within the road construction. The fill material required exceeds the cut material which requires material to be imported to construct the proposed road development.

10.7 Environmental Assessment

McCarthy Keville O Sullivan Ltd (MKO) have been employed to undertake an Ecological Impact Assessment Report (including bat survey), a Natura Impact Statement and an Environmental Impact Assessment Screening Report (EIA).

10.7.1 Appropriate Assessment

An Appropriate Assessment Screening Report has been completed, where it couldn't be concluded beyond reasonable scientific doubt, in view of best scientific knowledge, on the basis of objective information and in light of the conservation objectives of the relevant European sites, that the proposed development, individually or in combination with other plans and projects, would not be likely to have a significant effect on Lough Corrib SAC and Lough Corrib SPA. As a result, it is recommended to the competent authority that an Appropriate Assessment is required and that a Natura Impact Statement be prepared in respect of the proposed development.

As the proposed road alignment runs parallel to the boundary of Lough Corrib SAC and there is hydrological connectivity between the proposed works and the SAC via existing drains and streams.

In the absence of mitigation (e.g. Sediment Control Plan/silt fencing) there is potential for construction related runoff to enter adjacent watercourses. The runoff of contaminated/silt laden material could affect the conservation objectives and qualifying interests of the SAC via a deterioration in surface water quality.

In order, to ensure that the integrity of the SAC is maintained, it was deemed necessary to include robust best practice/mitigation measures in the development proposal.
In light, of recent European Case Law. The guidance provides the following clarification in relation to the screening process.

"*In determining the likelihood of significant impacts, and hence the need for an Appropriate Assessment, mitigation measures (i.e. measures to avoid or reduce negative effects) cannot be taken, into account. This was confirmed by the Court in its ruling in case C-323/17."*

It was therefore recommended that a full Appropriate Assessment and a Natura Impact Statement be prepared for the proposed road development. Refer to **Appendix A10.3** for full details of the Appropriate Assessment Screening Report.

10.7.2 Natura Impact Statement

The Natura Impact Statement (NIS) was prepared for the project by McCarthy Keville and O'Sullivan (MKO) Planning and Environmental Consultants provided the following determinations and conclusions in terms of potential impacts to European Sites (SACs and SPAs). The NIS has provided an assessment of all potential direct or indirect adverse effects on European Sites.

The detailed assessment provided in the Natura Impact Assessment (NIS), it is concluded that, the proposed development will not result in any residual adverse effects on any of the European Sites, their integrity or their conservation objective when considered on its own. Therefore, no potential for the proposed development to contribute to any cumulative adverse effects on any European Site when considered in-combination with other plans and projects.

In the review of the projects that was undertaken, no connection, that could potentially result in additional or cumulative impacts was identified. Neither was any potential for different (new) impacts resulting from the combination of the various projects and plans in association with the proposed development.

The NIS has provided an assessment of all potential direct or indirect adverse effects on European Sites. Where the potential for any adverse effect on any European Site has been identified, the pathway by which any such effect may occur has been robustly blocked using avoidance, appropriate design and mitigation measures as set out. The measures ensure that the construction, and operation of the proposed development does not adversely affect the integrity of European sites.

Therefore, it can be objectively concluded that the proposed development, individually or in combination with other plans or projects, will not adversely affect the integrity of any European Site. Refer to **Appendix A10.5** for full details of the Natura Impact Statement (NIS)

10.7.3 Environment Impact Assessment

The Environmental Impact Assessment Screening (EIA) concluded that, the characteristics of the potential impacts are not considered significant. There are no long-term negative impacts. Whilst temporary noise levels and disturbance are typical of any construction phase, any potential impacts on sensitive receptors will be short term and effectively managed through best practice measures. No impact interactions have been identified and it is considered that any minor impacts will be avoided through the implementation of best working practices. No likely significant long term or permanent negative environmental impacts have been identified during the screening process. The potential for any direct or indirect impact on habitats is low and the likelihood of any significant effects occurring because of the works can be excluded. Refer to **Appendix A10.4** for full details of the Environmental Impact Assessment Screening.

10.7.4 Ecological Impact Assessment

Ecological Impact Assessment (EcIA) concluded that, following consideration of the residual effects (post-mitigation) it is noted that the proposed road development on its own, will not result in any significant effects on any of the identified Key Ecological Receptors (KER's). No significant residual effects on receptors of International, National, County or Local Importance were identified.

No potential for significant on nationally designated sites or any ecological receptor exists given that all identified pathways for impact are robustly blocked by the project design and mitigation contained in the OESC and the hydrology report.

The proposed road development will be constructed and operated in strict accordance with the design, best practice and mitigation that is described within the Ecological Impact Assessment Report and as such, significant effects on ecology are not anticipated at any geographical scale on any of the identified KERs. Refer to **Appendix A10.6** for full details of the Ecological Impact Assessment Report.

10.8 Archaeology and Architectural Heritage

As part of the constraints study, an archaeological assessment was undertaken by a TII Archaeologist. The assessment concluded that the chosen option would have no impact on known archaeological sites or monuments with potential impacts to elements of the architectural heritage. Refer to **Appendix A10.7** for full details of the archaeology and architectural heritage report. Despite this, there is always a risk that artefacts of archaeological or cultural heritage may be encountered during the execution of a project. Therefore, we must take consideration of this and have it included in the risk assessment.

If the scheme is approved a full programme of architectural heritage recording and archaeological test excavations will be organised by the Council in advance of the construction phase of the project. Any archaeological site discovered by test excavations will be fully investigated and recorded, and the results will be publicised for the public benefit. Archaeological investigations will be subject to licences from the National Monuments Service, on behalf of the Minister, in consultation with the National Museum of

Ireland, and will be supervised for the Council by a TII Archaeologist appointed to the scheme as Project Archaeologist per the *Code of Practice for Archaeology* (2017) agreed between TII and the Minister for Arts, Heritage, Regional, Rural and Gaeltacht Affairs.

10.9 Construction Impacts and Mitigation Measures

10.9.1 Noise

As per TII guidance noise levels associated with construction may be calculated in accordance with guidance set out in BS 5228-1:2009+A1:2014, Code of practice for noise and vibration control on construction and open sites. Noise: Part 1. This standard sets out sound power levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels at selected locations. However, it is generally not possible to conduct detailed prediction calculations for the construction phase of a project pre-construction. The programme for construction works has not been established in detail. Under such circumstances, best practice involves the consideration of appropriate mitigation measures.

The TII guidance document specifies noise levels that it typically deems acceptable in terms of construction noise. These limits are set out in **Table 10.1** for noise levels at the façade of dwelling houses during construction. Note that these values are indicative only; it may be appropriate to apply more stringent limits in areas where pre-existing noise levels are low.

Table 10.1: Max Permissible Noise Levels at Dwellings

Days and Times	Noise Levels (dB re. 2x10-5 Pa)	
	LAeq(1hr)	LAmax
Monday to Friday 07:00 to 19:00hrs	70	70
Monday to Friday 19:00 to 22:00hrs	60*	60*
Saturdays 08:00 to 16:30hrs	65	75
Sundays & Bank Holidays 08:00 to 16:30hrs	60*	65*

*Note * Construction activity at these times, other than that required for emergency works, will normally require the explicit permission of the relevant local authority.*
In exception circumstances, there may be a requirement that certain construction works are carried out during night-time periods.

10.9.2 Vibration

Vibration is defined as regularly repeated movement of a physical object about a fixed point. The magnitude of vibration is expressed in terms of peak particle velocity (PPV) expressed in millimetres per second (mm/s).

As, vehicles travels along a road, vibration can be generated in the road and subsequently propagate towards nearby buildings. Such vibrations are generated by the interaction of a vehicle's wheels and the road surface and by direct transmission through the air of low frequency energy waves. Some of these waves rise as a function of the size, shape and speed of the vehicle, and others from pressure fluctuations due to engine, exhaust and other noises generated by the vehicle. **Table 10.2** below demonstrates the allowable vibration during the construction phase taken from TII guidance documents.

Table 10.2: Allowable Vibration during Construction Phase

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 to 50Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

10.9.3 Construction Noise Assessment

A variety of items of plant will be in use, such as excavators, lifting equipment, dumper trucks, compressors and generators. It is also possible that rock breaking may be required on occasions and there will be vehicular movements to and from the site that will make use of existing roads. Due to the nature of the activities undertaken on a large construction site, there is potential for generation of significant levels of noise. The flow of vehicular traffic to and from a construction site is also a potential source of relatively high noise levels. The construction programme has been established in outline form only, it is not possible to calculate the actual magnitude of noise emissions to the local environment. However, the impact due to construction activities will be transient in nature.

10.9.4 Construction Vibration Assessment

The potential for vibration at neighbouring sensitive locations during construction is typically limited to demolition, excavation works, rock-breaking operations and lorry movements on uneven road surfaces. The more significant of these is the vibration from excavation and rock-breaking operations; the method of which will be selected and controlled to ensure there is no likelihood of structural or even cosmetic damage to existing neighbouring dwellings.

10.9.5 Construction Noise Mitigation Measures

The contract documents will clearly specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001.
These measures will ensure that:

- No plant used on site will be permitted to cause an ongoing public nuisance due to noise;

- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations;
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract;
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers;
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use;
- Any plant, such as generators or pumps that is required to operate before 07:00hrs or after 19:00hrs will be surrounded by an acoustic enclosure or portable screen;
- During, the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 9.8 using methods outlined in BS 5228-1:2009+A1:2014, Annex E. It should be noted that BS 5228- 1:2009+A1:2014 does not detail any specific noise limits in relation to construction noise.

10.9.6 Construction Vibration Mitigation Measures

Measures shall be taken to minimise vibration due to plant and machinery on the site and no machine which uses the dropping of heavy weights for demolition shall be permitted.
Ground vibration from the project would be expected to be orders of magnitude less than that required to cause cosmetic or structural damage to buildings or lead to disturbance of occupiers, hence mitigation measures are not required in respect of the operational phase. It may be concluded that the project is not expected to give rise to vibration that is either significantly intrusive or capable of giving rise to structural or even cosmetic damage.

10.10 Construction Management Plan

Prior to any demolition, excavation or construction a Construction Management Plan (CMP) will be produced by the successful contractor. A Construction Management Plan deals with the Contractor's overall management and administration of a construction project. A CMP is prepared by the Contractor during the pre-construction phase, to ensure that the project is completed on-time and within budget. The CMP will include a detailed programme of works and budget. The CMP is also developed to ensure that all construction activities are undertaken in a satisfactory and safe manner, to a delivery program meeting the Clients requirements. The Contractor will be required to include details under the following headings:

- Details of working hours and days;
- Details of construction plant storage, temporary offices and on-site chemical toilet areas;

- Details of chemical/fuel storage areas (including location and bunding to contain runoff of spillages and leakages);
- Details of emergency plan - in the event of fire, chemical spillage, cement spillage, collapse of structures or failure of equipment or road traffic incident within an area of traffic management. The plan must include contact names and telephone numbers for: Local Authority (all sections/departments) Ambulance; Gardaí and Fire Services;
- Traffic management plan (to be developed in conjunction with the Local Authority – Roads Section) including details of routing of network traffic; temporary road closures; temporary signal strategy; routing of construction traffic; programme of vehicular arrivals; on-site parking for vehicles and workers; road cleaning; other traffic management requirements;
- Truck wheel wash details (including measures to reduce and treat runoff);
- Dust management to prevent nuisance (demolition & construction);
- Site run-off management;
- Noise and vibration management to prevent nuisance (demolition & construction);
- Landscape management;
- Management of demolition of all structures and assessment of risks for same;
- Lighting details;
- Signage;
- Stockpiles;
- Project procedures & method statements for;
    - Demolition & removal of services, pipelines (including risk assessment and disposal)
    - Diversion of services
    - Excavation
    - Temporary hoarding & lighting
    - Storage and Treatment of soft soils
    - Exporting of surplus geological material (soils, rock etc)
    - Protection of watercourses from contamination and silting during construction.

The production of the CMP will also detail areas of concern with regard, to Health and Safety and any environmental issues that require attention during the construction phase. Adoption of good management practices on site during the construction and operation phases will also

contribute to reducing environmental impacts. The Contractors must comply in strict accordance with the Construction Environmental Management Plan (CEMP). Refer to **Appendix 10.8**

10.11 Environmental Operating Plans

During the construction phase of the scheme the works will comply with all relevant legislation and guidelines that aim to reduce and minimise environmental impacts. Construction related impacts are generally of short-term duration and localised in nature, these impacts will be reduced as far as possible by complying with the mitigation measures outlined in the EIA for the Scheme, Construction Industry Guidelines, TII Environmental Construction Guidelines, Environmental Operating Plan and Waste Management Plan.

The Contractor will be required to complete an Environmental Operating Plan (EOP) in accordance with the TII Guidelines for the Creation and Maintenance of an Environmental Operating Plan. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the road and provide a documented account to the implementation of the environmental commitments set out in the EIA and measures stipulated in the planning conditions. Details within the plan will include;

- All Environmental commitments and mitigation measures included as part of the planning approval process and any requirements of statutory bodies such as the National Parks and Wildlife Services as well as a method documenting compliance with the measures.
- A list all applicable environmental legislation requirements and a method of documenting compliance with these requirements.
- Outline methods by which construction work will be managed to avoid, reduce or remedy potential adverse impacts on the environment.

To oversee the implementation of the EOP the Contractor will be required to appoint a responsible manager to ensure that the mitigation measures included in the EIA and the EOP are executed in the construction of the works and to monitor that those mitigation measures employed are functioning properly.

10.12 Waste Management Plan

Included within the EOP will be the Waste Management Plan which clearly sets out the Contractor's proposals regarding the treatment, storage and recovery or disposal of waste. The plan itself will contain (but not be limited to) the following measures:

- Details of waste storage (e.g. skips, bins, containers) to be provided for different waste and collection times;

- Details of where and how materials are to be disposed of - landfill or other appropriately licensed waste management facility;
- Details of storage areas for waste materials and containers;
- Details of how unsuitable excess materials will be disposed of where necessary;
- Details of how and where hazardous wastes such as oils, diesel and other hydrocarbon or other chemical waste are to be stored and disposed of in a suitable manner;
- A construction and demolition waste plan.

10.13 TII Environmental Construction Guidelines

The TII Environmental Construction Guidelines provide guidance with regard, to environmental best practice methods to be employed in construction on National Road Schemes for the following;

- Guidelines for the Treatment of Badgers prior to the Construction;
- Guidelines for the Treatment of Bats during the Construction;
- Guidelines for the Crossing of Watercourses during the Construction;
- Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage;
- Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, During and Post-Construction of National Road Schemes;
- Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes;
- Guidelines on the Management of Noxious Weeds on National Roads;
- Guidelines for the Treatment of Noise and Vibration in National Road Schemes;
- Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes;
- Management of Waste from National Road Construction Projects;
- Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan.

This is a non-exhaustive list and relevant guidance current at the time of construction will be followed.

11 Cost Estimate

11.1 General

A Project Appraisal is the process to establish the merits of a proposed intervention in the transport system. It allows the probable impacts of the proposed scheme be compared with other options for addressing the same problem, and relative to other proposals addressing different objectives. All appraisals are carried out relative to a Do-Minimum case – the most likely scenario if the proposed scheme does not proceed.

The Project Appraisal for the N17 Milltown to Gortnagunned Road Project was undertaken by Galway County Council in accordance with the TII Project Appraisal Guidelines.

The project appraisal comprises a multi-criteria appraisal, using six standard criteria as set out in the Common Appraisal Framework, namely, economy, environment, safety, accessibility, integration and physical activity. The six appraisal criteria are sub-divided into 26 sub-criteria and the scheme is assessed against each one of these. The multi-criteria analysis is presented in a Project Appraisal Balance Sheet which provides a summary of the Business Case for the project.

A Cost Benefit Analysis was also undertaken as part of this appraisal using the TII Simple Appraisal Tool. This tool estimates the potential benefits associated with accident savings, travel time and vehicle operating costs and this has indicated that the benefits of the scheme would exceed the costs. The scheme would also provide a safe route for pedestrians and cyclists encouraging a greater mode share, where currently the number of pedestrians and cyclists along the route are very low, reflecting the very unsafe nature of the existing road for vulnerable road users. The cost benefit shows a positive return on the investment with a benefit to cost ratio (BCR) of 1.19.

Refer to **Appendix A.11.1** for full details of the Scheme Cost Estimate.

11.2 Cost Estimation

A preliminary cost estimate for the construction of the scheme has been prepared. The preliminary cost estimate is based on the following considerations and assumptions;

- The estimated scheme costs were calculated using the TII's Schedule of rates, while also paying attention to other recently tendered minor improvement scheme rates in Galway.
- The estimate assumes the road scheme will be tendered as a single construction project and that it will be procured as a traditional construction contract;

Table 11.1 Design Cost Estimate

N17 Milltown to Gortnagunned Road Realignment				
Scheme Estimate				
Base Cost Expenditure Heading	**Base Cost (incl VAT) €**	**Contingency €**		**Estimate €**
Main Contract Construction	11,925,000	1,200,000		13,125,000
Main Contract Supervision	505,000	54,000		559,000
Archaeology	350,000	36,000		386,000
Advance Works & Other Contracts	170,000	44,000		214,000
Public Transport Connectivity/Asset Renewal	100,000			100,000
Land & Property	3,337,000	216,000		3,553,000
Planning & Design (incl GI & Topo)	500,000	90,000		590,000
TOTAL	**€16,887,000**	**€1,640,000**		**€18,527,000**
			Programme Risk	**€926,350**
			SCHEME ESTIMATE	**€19,453,350**

12 Road Safety

12.1 Road Safety

Road Safety is an important issue, particularly on national primary routes, and the safety on this section of the N17 is compromised by a wide range of issues such as horizontal and vertical alignment, sightlines, cross-section, unforgiving roadsides including numerous at-grade junctions and direct accesses.

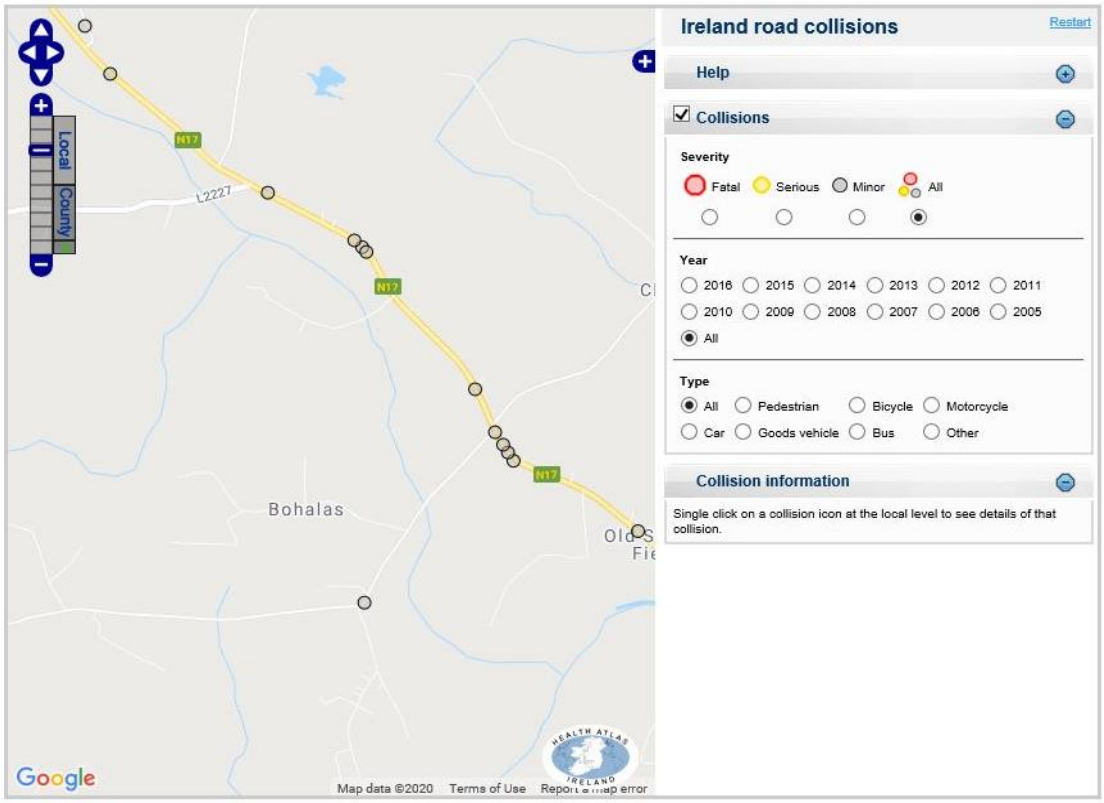
This is recognised by the collision rate analysis which is produced by TII and indicates that the accident rate on the N17 is twice the expected for one third of the scheme and twice below for the remainder. As this data is for the period 2012 – 2014, the situation may have worsened since with the increase in traffic volumes. See **Figure 12.**1 below: Red is twice above the expected collision rate, blue is twice below.

Figure 12.1: TII collision maps 2012

According to the Road Safety Authority website, as seen in **Figure 12.2** below, the collision data along this section of road between 2005 and 2016 has been as follows:

Fatal: 0
Serious Injury: 0
Minor accidents: 10

Figure 12.2: Road Safety Authority Collisions map



Another contributory factor in the compromise of safety on this route is the recently completed realignment and upgrades to the carriageway north of the proposed scheme. A 1km stretch immediately north of the proposed scheme was upgraded in 2014 and this was extended to Ballindine in 2016. This inconsistent road standard is a risk to safety on the route as speeds can be inappropriate for road conditions and the substandard alignment can lead to driver frustration and encourage unsafe manoeuvres.

12.2 Road Safety Audit

The primary purpose of a Road Safety Audit is to identify potential safety hazards within the scheme design or construction that could affect road users, and where issues arise these will be addressed in the design development.

The Road Safety Audit will be carried out in accordance with the TII's Publications Road Safety Audit GE-STY-01024. This document consists of two extracts from the TII's Publications which are:

- Standard: TII's Road Safety Audits; and
- Advice Note: TII's Road Safety Audit Guidelines.

The Road Safety Audit is described in the TII's Publication Road Safety Audit GE-STY-01024 as; *"the evaluation of road schemes during design and construction to identify potential safety hazards which may affect any type of road user, before the scheme is opened to traffic, and to suggest measures to eliminate or mitigate those problems".*

Road Safety Audits are generally completed at three stages for schemes of this nature as listed below:

- Stage 1: Design Stage (prior to land acquisition procedures);
- Stage 2: Detailed Design Stage (prior to tender of construction contract);
- Stage 3: Completion of Construction (prior to opening of the scheme to traffic); and
- Stage 4: Post Completion

12.3 Stage F (Part 2) Road Safety Audit

An independent auditing team from PMCE Consultants Dublin were appointed to conduct Stage F (Part 2) Road Safety Audit on the preferred route corridor of the proposed N17 Milltown to Gortnagunned Road Realignment. The audit was completed on the 15th December 2020 in the PMCE Dublin office and included a site visit on the 31st October 2018. This Stage F audit was carried out in accordance with the relevant sections of GE-STY-01024. The team examined only those issues within the design relating to the road safety implications of the scheme, and has therefore, not examined or verified compliance of the design or any other criteria.

Refer to **Appendix A.12.1** for full details of the Stage F (Part 2) Road Safety Audit and Designers Response form.

12.4 Stage 1 Road Safety Audit Road

An independent auditing team from PMCE Consultants Dublin were appointed to conduct a Stage 1 Road Safety Audit on the proposed road realignment. The Audit was completed on 26th April 2021, with the Stage 1 reply form returned with accepted recommendations.

13 Conclusions & Recommendations

13.1 Conclusions

In conclusion, this report demonstrates;

- There is a clear need for the scheme and the proposals as described will meet the scheme requirements and objectives.
- The scheme is in accordance with the relevant policy documents including the Galway County Development Plan 2015 to 2021, the Regional Planning Guidelines for the West Region, 2010 – 2022 and the National Spatial Strategy;
- The proposed scheme will cater for the design year traffic volumes, providing a good Level of Service, with a reduction in journey time delays and an improvement in reliability.
- The need for the scheme has also been established in terms of existing substandard junctions and accesses, substandard road cross section, limited Full Overtaking Sight Distance (FOSD) and Stopping Sight Distance (SSD), deficient pavement and substandard existing alignment – both in terms of horizontal and vertical layout.
- The proposed scheme will bring the section of road up to an appropriate standard in terms of cross section and alignment to cater for the anticipated traffic volumes and speeds and that will be consistent with the sections of the N17 immediately north and south.
- It is anticipated that the proposed road development will lead to a significant improvement in road safety through the improvement in geometry, provision of sightlines along the road particularly at junctions and access points, provision of improved road cross-section, provision of signing and road markings to modern standards, provision of safety fencing where required, and in general a more predictable and comfortable driving experience.
- An Environmental Impact Statement (EIS) and Natura Impact Statement have been prepared in respect of the scheme and all mitigation measures will be incorporated into the scheme design.
- The road is designed in accordance with TII Standards. The design speed of the main line carriageway consists of 100km/hr from Ch 0 to Ch 2+180, 85km/hr from Ch 2+180 to Ch 2+560 and 60km/hr from Ch 2 +560 to Ch 2+945. The recommended cross section for the scheme is a Type Single Carriageway with footway/cycleway over a section of the scheme. The design of the horizontal and vertical alignment is in accordance with TII Standards,

Rural Road Link Design DN-GEO-03031 and Geometric Design of Junctions DN-GEO-03060.

- The alignment length is approximately 3.0km. The scheme commences in the townland of Gortnagunned. The scheme is located along the line of the existing N17 and ties back to the existing road level at Milltown.
- Seven junctions will be provided on the proposed road as follows.

Table 13.1: Proposed Junctions

Junction	Location	Chainage	Type
Junction 1	Proposed N17/ L-22271	0+458	At Grade Junction
Junction 2	Proposed N17/ L-2227	0+675	At Grade Junction
Junction 3	Proposed N17/ Link Road 1	1+330	At Grade Junction
Junction 4	Proposed N17/ L-22087	1+464	At Grade Junction
Junction 5	Proposed N17/ Link Road 2	1+888	At Grade Junction
Junction 6	Proposed N17/ L-2208 & L-6413	2+300 & 2+357	At Grade Junction
Junction 7	Proposed N17/ L-64131	2+778	At Grade Junction

- The proposed road realignment has been designed in accordance with applicable standards, best practice guidelines and in accordance with policy documents.
- The Cost Benefit Analysis has shown that the scheme is economically viable and a worthwhile project to progress.
- The Design Report is a key deliverable of Phase 3 Design and informs Phase 4 EIA/EAR & The Statutory Process.

13.2 Recommendations

The Design Report documents that all studies and deliverables outlined in the Project Management Guidelines Phase 3 Design and Environmental Evaluation have been undertaken and completed. Therefore, it is recommended that the proposed road realignment, as described in this Design Report be approved by the TII, to inform the basis for the Land Acquisition and Statutory Processes to follow.

14 Appendices

Appendix A1.1 Options Selection Report
Appendix A2.1 Project Appraisal Report
Appendix A3.1 Traffic Survey Report
Appendix A4.1 Drainage Paths & Water Film Depth Report
Appendix A4.2 Preliminary Safety Barrier Schedule
Appendix A4.3 Horizontal Alignment Geometry Report
Appendix A4.4 Vertical Alignment Geometry Report
Appendix A4.5 Departures Application
Appendix A4.6 Junction Report
Appendix A5.1 Ground Investigation Report
Appendix A5.2 Hydrological Impact Assessment Report
Appendix A6.1 Greenfield Runoff Rate N17 Milltown
Appendix A6.2 Interceptor Ditch Design N17 Milltown
Appendix A6.3 Pipe Run Calculations N17 Milltown
Appendix A6.4 Road Side Drainage Catchment N17 Milltown
Appendix A6.5 Retention Pond Design @ CH 180m N17 Milltown
Appendix A6.6 Retention Pond Design @ CH 1100m N17 Milltown
Appendix A6.7 Retention Pond Design @ CH 2200m N17 Milltown
Appendix A6.8 Retention Pond Design @ CH 2550m N17 Milltown
Appendix A7.1 Pavement Design
Appendix A8.1 Property Valuations
Appendix A9.1 Public Lighting Proposal
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