BusConnects Galway: Dublin Road

January 2025

Preliminary Design Report

BUS CONNECTS

SUSTAINABLE TRANSPORT FOR A BETTER CITY.

Table of Contents

Appendices

Table of Figures:

Table of Tables:

LIST OF ABBREVIATIONS

ATU	Atlantic Technological University
BCPDG	BusConnects Preliminary Design Guidance Booklet
CAF	Common Appraisal Framework
DTTAS	Department of Transport, Tourism & Sport
EPA	Environmental Protection Agency
EU	European Union
GCC	Galway City Council
GTS	Galway Transport Strategy 2016
NIFTI	National Investment Framework for Transport in Ireland
NPF	National Transport Authority
OS	Ordinance Survey
PMP	Project Management Plan
RMP	Recorded Monuments and Protected Structures
RSA	Road Safety Audit
RSES	Regional Spatial and Economic Strategy
SAR	Strategic Assessment Report
SDG	Sustainable Development Goal
SDZ	Strategic Development Zone
TFI	Transport for Ireland
TII	Transport Infrastructure Ireland
UN	United Nations

EXECUTIVE SUMMARY

This Preliminary Design Report has been prepared for the BusConnects Galway: Dublin Road Development and builds on the Options Assessment Report.

This report summarises the project background and the need for the development in the context of National and Local Planning Policy, summarises the existing physical conditions and documents the surveys undertaken in developing the design.

The report also details the preliminary design, sets out traffic management proposals and outlines the traffic modelling undertaken.

The land use and acquisition requirements are summarised in this report, along with proposed accommodation works.

The report concludes that the design of the Bus Connects Galway: Dublin Road wholly achieves the development objectives. In doing so, it fulfils the aim of providing enhanced walking, cycling and bus infrastructure on the primary public transport corridor into and out of Galway city centre, enabling the delivery of efficient, safe, and integrated sustainable transport movement along the corridor.

SECTION 1: INTRODUCTION

1.1 Report Structure

This report is structured as follows:

- **Section 1** – This section outlines the general background information to the project and the proposed multi-modal corridor. It summarises the 2nd Non-Statutory Public Consultation that took place in January 2023 and describes the purpose of this report.
- **Section 2** – Outlines the planning policies and context in which this project was developed and presents the concept of BusConnects Galway: Dublin Road as outlined in the Galway Transport Strategy. The objectives for the development are set out and any other transport policies relevant to this corridor are presented.
- **Section 3** – The study area is detailed and divided into two distinct sections, where the existing layout of the development is analysed and discussed. Development specific constraints of the project and how the project will integrate with the existing public transport and active travel network in Galway city is also explained in this section.
- **Section 4** – The Preliminary Design and the process undertook to complete it is explained in this section. Road Geometry is explored along the length of the project, and design parameters such as Design Speed, Forward Visibility and the Horizontal & Vertical alignments of the development are given. The provision for cycling included in the project is covered, along with the provision for busses and the bus network. Any deviation from these specifications is included at the end of this section.
- **Section 5** – This section describes the junction design along the route and gives examples of different junctions that have been utilised and designed into this project. The methods of selecting these junctions is explained, and the junction modelling procedure is laid out.
- **Section 6** – The details of the Ground Investigation undertaken around the project site area, and existing Ground Conditions of the area are presented here. A summary of the studies into the soils, geology, groundwater and hydrogeology are included.
- **Section 7** – This section contains the selected design for the Pavement, Kerbs, Footways & Paved Areas and the methodology of obtaining a finalised design.
- **Section 8** – In this chapter an overview of the structures strategy is provided, along with a summary of structures and retaining walls.
- **Section 9** – Drainage, Hydrology & Flood Risk is the title of this section, and all the details the attribute to these disciplines are incorporated into this portion of the report. The proposed preliminary drainage design which was agreed upon is detailed here.
- **Section 10** – In this section the Services & Utilities that are included in this development are defined. The existing network survey and its results are compiled here, and any diversions that were required to facilitate the proposed design are displayed.
- **Section 11** – The waste quantities that are expected to be produced during the demolition, excavation and construction of this project are compiled in this section.
- **Section 12** – This section contains the summary of the Traffic Signs, Lighting and Communications services that will be required along the length of the proposed development. To facilitate the new bus lanes and network in this project, a large amount of road markings and real-time passenger information will need be installed, and these are explored in this section. New traffic signals and public lighting will be constructed, and the locations of these is collated in this section.
- **Section 13** – Land use and Accommodation is the title of the next section, and it details the extent of land use that is required for this project. The areas of land to be acquired by GCC are noted here, along with the guidelines followed for existing accommodation works.
- **Section 14** – This section describes the landscaping surveys that were carried out for this project, surveying existing trees, landscaped areas and heritage sites. The hardscape and

softscape of the area that is existing and proposed is displayed here and the proposals are tabulated to summarise.

- **Section 15** – In this chapter benefits provided by the development are summarised against the development objectives.

1.2 Project Background

BusConnects is the National Transport Authority's (NTA) programme to improve bus and sustainable transport services. It is a key part of the Government's policies to improve public transport and address climate change. BusConnects Galway: Dublin Road arises from the Galway Transport Strategy (GTS) and Project Ireland 2040.

Barry Transportation (Egis) have been commissioned by Galway City Council to undertake an assessment of potential options for implementation of elements of the Galway BusConnects programme along the R338 (Dublin Road). The route runs from the western end of the development at the Moneenageisha Junction where it is to tie into the Galway BusConnects: Cross City Link project, towards the Doughiska Junction in the east, where the development will terminate. The route will pass through junctions for Renmore Park, Renmore Road and then will continue through the Michael Collins/ Hospice Access Road junction. It will then continue through a realigned junction to Belmont/Ballyloughane Road, which will lead to the Skerritt Roundabout which is to be upgraded from its current roundabout design into a cyclops style junction, providing access to Ballybane and Murrough Avenue.

It will then traverse the Merlin Park Hospital Access Road Junction, Merlin Park Lane Junction, Rosshill Road Junction, Coast Road Junction and finally, terminate at the Doughiska Junction. The proposed development will include new cycle tracks, bus lanes and upgraded junctions which are to be facilitated by a widened alignment across the development. These elements will allow for more active travel options for the residents and visitors that are attempting to travel centrally/west into and out of the city centre.

This proposed route can be viewed in Figure 1-1 below.

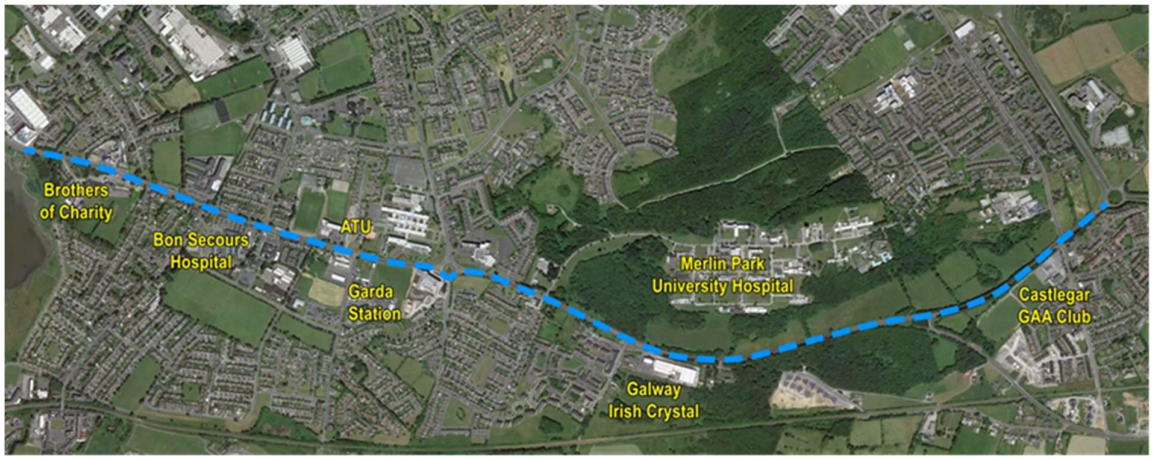

Figure 1-1: Proposed Route for Galway BusConnects: Dublin Road

The Galway Transport Strategy (GTS) established a transport hierarchy that seeks to support those living, studying, working and visiting Galway to move around the city more easily on foot, by bicycle and on public transport. Those seeking to travel by private car will continue to be facilitated; however, the priority will be to cater for greater numbers of people travelling by sustainable means.

The GTS examined a number of options for each project identified and undertook a Multi-Criteria Analysis of each option utilising the Common Appraisal Framework (CAF) for Transport Projects and

Programmes appraisal categories. The CAF was subsequently superseded by the Transport Appraisal Framework (TAF).

This project has been undertaken to facilitate these commuters that do not rely on a car as a mode of transport, and to encourage more people to move away from using cars and instead, to use public transport to and from Galway City and the surrounding area.

1.3 Development Aims & Objectives

The proposed development aims to improve access along the which will enable and deliver efficient, safe, and integrated sustainable transport movement to meet travel demand. The objectives of the overall BusConnects programme are to:

- **Economy** – To enhance and support sustainable growth of Galway City through the provision of a continuous high-quality multi-modal corridor which will improve bus journey times and journey time reliability along the R338 (Dublin Road).
- **Safety** – To enhance pedestrian and cyclist safety through the provision of improved and segregated walking and cycling facilities along the R338, which will help increase active travel.
- **Integration** – To improve connectivity between:
    A. Galway City Centre and its neighbourhoods such as Renmore, Ballybane, Doughiska, Parkmore and Ardaun
    B. Galway City and regional towns such as Oranmore, Athenry and Gort
    C. Galway City and the inter-urban motorway network
- **Environment** – To increase public transport and active travel usage through the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets.
- **Accessibility and Social Inclusion** – To improve access to services and outdoor areas, for example, Merlin Park Woods, Ballyloughane Beach, along the Dublin Road (R338) by improving transport options for everyone, including people with disabilities, mobility issues and people travelling with children.
- **Physical Activity** – To enable local opportunities for walking and cycling activity in communities as a result of improved and segregated walking and cycling facilities which will help increase physical activity.

The planning and design of the proposed development has been guided by these aims and objectives.

The outcomes achieved from delivering the proposed development will be:

- An attractive, resilient, equitable public transport network better connecting communities and improving access to work, education and social activity.
- Facilitate a transport infrastructure network that prioritises walking and cycling and a mode shift to public transport resulting in better air quality and reduced carbon emissions.
- Support increased economic and social potential through integrated land-use and transport planning to reduce the time burden of travel.

Galway City Council's strategic objectives for transport as outlined in the Galway Transport Strategy (GTS, 2016) are:

- To promote and encourage sustainable transport.
- To manage the traffic in a way which maximises mobility and safe movement.
- To maintain and develop/upgrade infrastructure.

1.4 Stakeholder Consultation

This project was originally managed by TII and their Consultant. They progressed the project through to the Emerging Preferred Route (EPR). The EPR was subject to a Non-Statutory Public Consultation (NSPC). This 1st Non statutory public consultation ran for a period of 12 weeks (8th October 2020 to 7th January 2021). This consultation was held fully online as were all meetings due to COVID restrictions in place at the time.

Due to changes in the Public Spending Code, revised NTA Project Approval Guidelines and proposed revised layouts along Bus Corridors (NTA Preliminary Design Guidance Booklet for BusConnects Core Bus Corridor_2021-05-05), the Strategic Assessment Report was redrafted and the development was subject to a revised Concept Development and Option Selection phase including a 2nd Non-Statutory Public Consultation.

A second Non-Statutory Public Consultation (NSPC) for BusConnects Galway: Dublin Road took place between Friday the 13th of January 2023 to the 10th of February 2023. The Emerging Preferred Route proposals between the Moneenageisha Junction and the Doughiska Road junction were displayed.

The consultation process gave an opportunity to all stakeholders to provide feedback on the current general arrangement proposals. The consultation process was carried out online using a dedicated website and virtual room. The development was also advertised in the Galway Advertiser newspaper and was displayed at bus shelters. A registered letter with accompanying brochure was posted to all landowners directly impacted by the development. Brochure drops were also carried out to approximately 400 properties in close proximity of the development. Briefings were held for elected representatives, and online meetings were held with stakeholders and interested parties.

A total of 91 submissions were received from the various platforms of which 13 no. submissions were received via email, 66 no. submissions were received via the online submission form and 12. no were received through phone calls/voicemails using the dedicated phone line for the project.

The majority of feedback was positive with 86% expressing their overall support for the development. The positive feedback concentrated on the merits of the segregation of the cyclists/pedestrians from the live traffic, and there was a good response to the proposed junction improvements.

Respondents raised 177 distinct issues relating to the proposals displayed. 69% of these were related to the engineering aspects of the development of which the most of these were regarding the lane widths and the junction/signalling arrangements. 17% of the issues raised were in relation to safety and 14% were in relation to the environmental elements of the development.

1.5 Audit of the Existing Situation

The following audits, surveys and assessments have been carried out:

- Baseline Tree Survey;
- Traffic Survey (JTC, pedestrian and cyclists counts);
- Bus Journey Time;
- GPR Survey; and
- Road User and Road Safety Audit.

These surveys have been supplemented with secondary record data to include utility information, OPW CFRAM Flood Models, Uisce Eireann drainage details and existing traffic signal data from GCC.

Several environmental surveys have also been carried out by the Environmental Impact Assessment (EIA) team. Refer to the Environmental Impact Assessment Report for further information.

1.6 Purpose of the Preliminary Design Report

The purpose of the Preliminary Design Report is to develop the design of the development following the selection of a preferred route to a stage where sufficient level of detail exists to enable the establishment of land-take requirements and progress the development through statutory processes. The design is to be completed to sufficient detail to enable the identification of development extents, drainage, accommodation works etc. and to assist in the scoping of environmental assessments required to develop the proposals to go forward to statutory processes.

SECTION 2: PLANNING POLICY AND CONTEXT

2.1 Overview

The need for BusConnects Galway: Dublin Road aligns with the following National, Regional and Local policy documents.

International Policy Context:

- United Nations Sustainable Development Goals (United Nations 2030 Agenda)

European Policy Context:

- Sustainable and Smart Mobility Strategy 2020
- European Green Deal

National Policy Context:

- Project Ireland 2040 – National Development Plan 2021- 2030 (NDP)
- Project Ireland 2040 - National Planning Framework (NPF)
- National Investment Framework for Transport of Ireland
- Department of Transport: Statement of Strategy 2021 – 2023
- National Sustainable Mobility Policy 2022-2030
- National Sustainable Mobility Policy 2022-2025
- Road Safety Authority Road Safety Strategy 2021-2030;
- Climate Action Plan 2021, 2023 & 2024; and
- Smarter Travel – A Sustainable Transport Future (A new Transport Policy for Ireland 2009-2020)

Regional Policy Context:

- Regional Spatial and Economic Strategy for the Northern and Western Regional Assembly 2020-2032

Local Policy Context:

- Galway Transport Strategy 2016
- Galway County Development Plan 2022-2028
- Galway City Development Plan 2023 – 2029
- Galway Cycle Network/Cycle Connects
- Bus Connects Galway Network 2023
- GCC Climate Adaptation Strategy 2019-2024
- Galway City Climate Action Plan
- Galway Public Realm Strategy

2.2 International Policy Context:

2.2.1 United Nations Sustainable Development Goals

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by both developed and developing countries - in a global partnership.

Figure 2-1: Relevant UN (United Nations) Sustainable Development Goals

The BusConnects Galway: Dublin Road project, as a multi-modal transport corridor, is aligned with the overarching goal of sustainable development and will directly contribute to 6 of the 17 SDGs. The development will align with these goals by promoting a modal shift to active travel and public transport (SDG 3), improve access to quality employment for commuters from the suburbs with reduced journey times and improved journey time reliability (SDG 8), improving the public realm by upgrading and improving public infrastructure with new and improved quality bus corridors and active travel facilities (SDG 9), promoting a modal shift to sustainable modes of public transport for a cleaner and more environmentally conscious city (SDG 11), reducing harmful greenhouse gas emissions by reducing private vehicle numbers and with the transition of the bus fleet to hybrid and zero emission vehicles (SDG 13), and improvements to the visual and social amenities of the city by providing quality and timely public transport links from the surrounding areas to Galway city centre and the regional transport hubs of Ceannt Train Station and Galway Bus station (SDG 15).

2.3 European Policy Context:

2.3.1 EU Transport White Paper 6

The European Union Transport White Paper 6 (2011) focused on the reduction of emissions from transport and established a series of target actions for Member States, including supporting increasing demand for mobility whilst meeting the 60% emission reduction target.

In Ireland, between 1990 and 2016, transport emissions increased by 139% with road transport increasing by 145%. Nearly 20% of Ireland's greenhouse gas emissions come from transport and it accounts for the largest share of energy use. Transport emissions have been the fastest growing source of Ireland's greenhouse gas emissions in recent years.

The Environmental Protection Agency (EPA) projects that without intervention transport sector emissions will increase by 11.3% over the period 2020 to 2035.

Therefore, essential interventions are needed to shift Ireland onto a low carbon ethos as it manages an

increasing population and increased demand for housing, employment, and transport infrastructure.

Investing in high quality multi-modal transport corridors will promote a modal shift to lower carbon forms of transport (public transport, cycling and walking) from private car use reducing private vehicle numbers on our country's national and regional road networks in both urban and rural settings. By encouraging this modal shift transportation emissions will be reduced an addition to journey times and journey time reliability improvements due to reduced traffic on our road network.

Reductions in private vehicle numbers on the network reduces potential conflicts with pedestrians and cyclists on the network improving safety and aligning with the emission reduction targets in the European Union Transport White Paper.

2.3.2 European Union Green Deal

The EU aims to be climate neutral in 2050. The European Green Deal (2019) provides an action plan to achieve this by boosting the efficient use of resources by moving to a clean, circular economy, restoring biodiversity, and cutting pollution.

The plan outlines investments needed and financing tools available and explains how to ensure a just and inclusive transition. For the transport sector, the EU Green Deal targets the roll out of "cleaner, cheaper and healthier forms of private and public transport"

The BusConnects Galway: Dublin Road project will contribute to achieving this by increasing the availability of buses on the network with cheaper fares for customers using Leap Card compared to traditional cash fares. The implementation of next generation ticketing technology will streamline the process and align with the cheaper forms of public transport objective of this EU policy. The transition to hybrid and zero emissions bus fleets currently underway by Transport for Ireland TFI will align with the cleaner forms of public transport objective of this EU policy, this combined with the increased shift towards public transport as a result of this project, will contribute to lowering Irelands transport related carbon emissions.

2.4 National Policy Context:

2.4.1 National Planning Framework - Project Ireland 2040

The National Planning Framework (NPF) was published in 2018 and provides a framework to guide public and private investment, and to create and promote opportunities, while protecting and enhancing the environment. The NPF sets out the Government's high-level strategic plan for shaping the future growth and development of Ireland out to the year 2040. Its overarching visions are to:

- Develop a new region-focused strategy for managing growth.
- Linking this to a new 10-year investment plan, the Project Ireland 2040 National Development Plan 2021 - 2030
- Using state lands for certain strategic purposes
- Supporting this with strengthened, more environmentally focused planning at local level; and
- Backing the framework up in law with an Independent Office of the Planning Regulator.

The purpose of the NPF is to enable all parts of Ireland, whether rural or urban, to successfully accommodate growth and change, by facilitating a shift towards Ireland's regions and cities other than Dublin, while also recognising Dublin's ongoing key role. Under the framework three regional assemblies have been identified: Eastern & Midland, Northern & Western and Southern. Each of the assemblies is illustrated in Figure 2-2 below.

Figure 2-2: NPF Configuration of the Regional Assemblies in Ireland

The NPF identifies 10 National Strategic Outcomes, as illustrated in, Figure 2-3 which are the shared goals and benefits for every community across the country.

Figure 2-3: National Strategic Outcomes

Improved road infrastructure for vulnerable road users will support the National Strategic Outcomes as follows:

Compact Growth – NS01

This involves managing the sustainable growth of cities, towns and villages to create more attractive places in which people can live and work. Provision of an improved bus corridor and active travel facilities on the R338 (Dublin Road) will enhance the attractiveness, viability and vibrancy of settlements as a means of achieving more sustainable patterns and forms of development.

Enhanced Regional Accessibility – NS02

Linked to compact growth is enhanced accessibility between centres of population which will enable these population centres to activate unrealised potential. Galway City is located on the Atlantic Economic Corridor which seeks to lead the transformation of the Atlantic economy. The provision of an improved bus corridor and active travel facilities on the R338 (Dublin Road) will improve bus journey times and hence accessibility as well as making for a safer journey with reduction in mix of heavy traffic and pedestrians/cyclists.

Strengthened Rural Economics and Communities – NS03

This involves retaining and strengthening rural economies and communities and ensures that the countryside remains as a living and working community. The provision of an improved bus corridor and active travel facilities on the R338 (Dublin Road) will ensure access to critical services such as education, healthcare and employment for the rural communities located to the east of Galway City.

Sustainable Mobility – NS04

This is the provision of safe active travel infrastructure such as segregated cycling and walking facilities which will encourage walking and cycling within the area. It will improve the infrastructure for leisure, recreational and commuter users by providing a safe and comfortable route. As well as meet climate action objectives by providing viable alternatives to using motorised modes and particularly reducing private car travel.

A Strong Economy, supported by Enterprise, Innovation and Skills – NS05

This involves creating places that can foster innovation and enterprise, thereby attracting talent and investment. It also calls for high quality digital connectivity. The construction of an improved bus corridor and active travel facilities on the R338 (Dublin Road) enables increased connectivity which can attract and retain talent and investment. It would also increase economic activity within the local areas along the route.

Enhanced Amenity and Heritage – NS07

This will ensure the city can offer a good quality of life through a well-designed public realm which includes public spaces, parks and streets, as well as recreational infrastructure. It also includes activity-based tourism such as blueways, greenways and peatways.

Access to Quality Childcare, Education and Health Services – NS10

Compact smart growth in urban areas combined with strong and stable rural communities will enable the provision of a range of childcare, education and health services. The provision of an improved bus corridor and active travel facilities on the R338 (Dublin Road) will improve access to childcare, education and health services along the route corridor and the wider community.

The National Planning Framework also identifies several key growth enablers for Galway City. These include:

- Provision of a Citywide public transport network, with enhanced accessibility between existing and proposed residential areas and the City Centre, third level institutions and the employment areas to the east of the city.
- Improving access and sustainable transport links to, and integration with, the existing employment areas to the east of the City at Parkmore, Ballybrit and Mervue.
- Development of a strategic cycleway network with several high-capacity flagship routes

2.4.2 National Development Plan – 2021 – 2030

The National Development Plan 2021 - 2030 was published in 2021 as an early update to the 2018 National Development Plan. The 2018 National Development Plan was published along with the National Planning Framework as part of Project Ireland 2040. The 2018 National Development Plan was developed to drive Irelands long term economic, environmental, and social progress across all parts of the country over the next two decades and underpins the successful implementation of the new National Planning Framework. The updated National Development Plan 2021 – 2030 extends the funding available to support all sectors and regions in Ireland. It will guide national, regional and local planning investment decisions over the coming decade. It also illustrates the commitment to reforming how public investment is planned and delivered. This will be done through a decisive shift to integrated regional investment plans and stronger co-ordination of sectoral strategies.

The National Development Plan provides €156 billion, which will underpin the National Planning Framework and drive its implementation over the next ten years. This will ensure accessibility between key urban centres of population and their regions which will include the Northern and Western Regions. It will also ensure rural areas are strengthened and rural contribution is harnessed as a major part of Ireland's strategic development. This funding will allow for the development and upgrading of existing and new public transport infrastructure. The BusConnects Galway: Dublin Road development will deliver quality bus corridors along the length of the development to provide the area with a dedicated, reliable and efficient bus service, connecting the surrounding areas to the city centre. This will improve the accessibility and social inclusion of the suburban region through which this development will run, in accordance with sustainable urban development best practices.

In terms of active travel, €360 million is being committed to the development of walking and cycling infrastructure all over Ireland over the next 10 years. Active travel facilities will be improved where required and installed as new in areas along the development route where they are lacking. This will improve the opportunities for users to walk or cycle for work, education of leisure within the development area and beyond as it ties into existing and proposed developments in the immediate and wider areas.

2.4.3 National Investment Framework for Transport in Ireland (NIFTI)

The National Investment Framework for Transport in Ireland (NIFTI) is the Department of Transports contribution to Project Ireland 2040. This document provides the framework to prioritise future investment in the land transport network to support the delivery of the National Strategic Outcomes identified in the NPF. The following four priorities are noted in terms of investment:

Figure 2-4: NIFTI Investment Priorities

NIFTI states that the use of the most sustainable travel modes should be utilised to facilitate Mobility of People and Goods in Urban Areas. It states that measures must be designed with the needs of a diverse range of users in mind so that sustainable mobility alternatives are accessible to all residents of urban areas

In terms of Enhanced Regional and Rural Connectivity, the NIFTI states that measures should be implemented to ensure access to jobs, leisure, and public services and in particular for people living in rural areas.

According to NIFTI, investment in sustainable modes so that transport users have safe, accessible, reliable and efficient alternatives to the private car will result in decarbonisation of the transport sector whilst also catering for growing populations.

NIFTI acknowledges that Protection and Renewal of assets includes both steady state maintenance of existing infrastructure as well as improvements to ensure safety or increase accessibility.

BusConnects Galway: Dublin Road will support the objectives of the NIFTI providing access to critical services such as education, healthcare and employment for the community within the Galway City area. As well as, providing safe, comfortable and reliable public transport infrastructure that will encourage public transport use within the area.

Under the NIFTI Modal Hierarchy, sustainable modes, starting with active travel (walking, wheeling and cycling) and then public transport, should be considered first before less sustainable modes such as the private car. The modal hierarchy is illustrated in Figure 2-5 following:

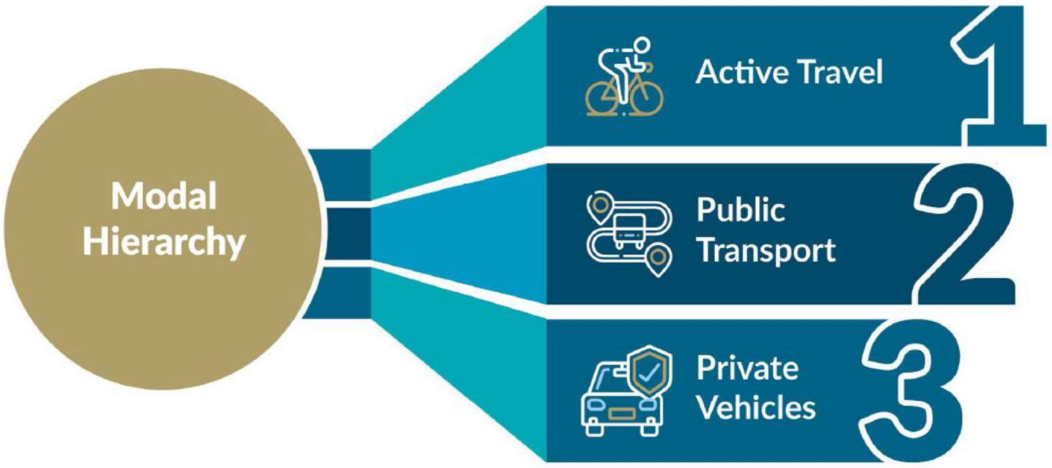

Figure 2-5: NIFTI Modal Hierarchy

BusConnects Galway: Dublin Road will support the modal hierarchy of the NIFTI. The provision of active travel and public transport facilities would ensure that active travel and public transport modes become viable alternatives to private vehicles.

Under the NIFTI Intervention Hierarchy, illustrated in Figure 2-6 following, protecting and renewing the existing transport network through maintenance should, where possible, be the first solution considered when assessing potential project options, followed by maximising the value of the network through optimising its use. Interventions to improve existing infrastructure will then be considered after these two categories have been assessed as inappropriate given the identified project objectives, and before the final possibility of outright new infrastructure.

Figure 2-6: NIFTI Intervention Hierarchy

It is anticipated that BusConnects Galway: Dublin Road will align with the “optimise and improve” tiers of the intervention hierarchy of the NIFTI.

2.4.4 National Sustainable Mobility Policy

The policy sets out a strategic framework to 2030 for active travel and public transport to support Ireland's overall requirement to achieve a 51% reduction in carbon emissions by the end of this decade.

The policy sets a target to deliver at least 500,000 additional daily active travel and public transport trips which will be supported through expanding public transport availability and infrastructure across the country, including quality bus corridors and ensuring that these new sustainable mobility infrastructure meets the highest safety standards.

This policy is underpinned by three main principles, supported by ten core goals as set out in the policy:

Table 2-1: National Sustainable Mobility Policy (NSMP) Principles and Goals

Principles	Goals
Safe and Green Mobility	1. Improve mobility safety
	2. Decarbonise public transport
	3. Expand availability of sustainable mobility in metropolitan areas
	4. Expand availability of sustainable mobility in regional and rural areas
	5. Encourage people to choose sustainable mobility over the private car
People Focused Mobility	6. Take a whole of journey approach to mobility, promoting inclusive access for all
	7. Design infrastructure according to Universal Design Principles and the Hierarchy of Road Users model
	8. Promote sustainable mobility through research and citizen engagement
Better Integrated Mobility	9. Better integrate land use and transport planning at all levels
	10. Promote smart and integrated mobility through innovative technologies and development of appropriate regulation

BusConnects Galway: Dublin Road will directly align with goals 1,2, 3, 5, 6, 7, 9 and 10 of the NSMP. This will be done by reducing safety risks for vulnerable road users, pedestrians and cyclists, particularly at junctions, increase the availability of buses and improve journey time reliability and make public transport and active travel more inclusive and safer for all road users. The objectives of this development, particularly Integration, Environment and Safety run directly parallel to the goals of the NSMP.

2.4.5 RSA Road Safety Strategy 2021 – 2030

The Road Safety Authority (RSA) Road Safety Strategy 2021 - 2030, sets out targets to be achieved in terms of road safety in Ireland as well as policy to achieve these targets. At the core of the 2021–2030 strategy is the aim to achieve Vision Zero in Ireland by 2050.The primary target of the 2021 – 2030 strategy is:

"*To reduce road deaths and serious injuries by 50% by 2030."*

The plan sets out strategies for engineering and infrastructure in terms of the benefits that they can have in reducing collisions. The plan acknowledges that there is a substantial difference in fatal and serious injury risks across different modes of travel and are higher for pedestrians and cyclists and recognises the importance of providing safe and healthy modes of travel from societal, environmental and health perspectives.

By improving public transport provision along the R338 (Dublin Road) and improving junction safety and that of pedestrians and cyclists along the route, this development would support and complement this RSA strategy.

2.4.6 Climate Action Plan 2021, 2023 & 2024

The Climate Action Plan 2021 and subsequent versions of it sets out a major programme for change in response to reducing Ireland's greenhouse gas emissions. The plan aims to achieve a 51% reduction in overall greenhouse gas emissions by 2030 and to reach net-zero emissions by no later than 2050. It is envisaged that these proposals will also have associated positive economic and societal benefits, including cleaner air, warmer homes and a more sustainable economy in the longer term.

The Climate Action Plan makes a commitment to delivering an additional 500,000 public transport and active travel journeys daily by 2035. BusConnects Galway: Dublin Road will support this objective by increasing the number of active travel and public transport users along the entirety of the route. The implementation of this development will increase the speed and reliability of buses along the route and improve the safety and level of priority for pedestrians and cyclists. This will help create a modal shift to public transport and active travel from private vehicles, thus delivering on the target of an additional 500,000 daily public transport and active travel trips. By capitalising upon the ongoing bus fleet transition from traditional diesel-powered buses to hybrid and zero emission buses now and into the future, the harmful greenhouse emissions of the transport fleet will be reduced. This is in line with the target set out in the Climate Action Plan which sets an emissions reduction target from the transport sector of at least 51% by 2030.

2.4.7 Smarter Travel – A Sustainable Transport Future (A new Transport Policy for Ireland 2009-2020)

The actions to encourage smarter travel are addressed in chapter 4 of the Smarter Travel Policy. The challenge is to structure the major elements of population growth into the future around the spatial policy framework outlined in the National Spatial Strategy. The following actions are encouraged for implementation:

Action1

Ensure Government investment in new public facilities such as schools, community/health centres and sports/amenity facilities as far as is practicable takes account, within the framework of relevant policy objectives, of the need to give priority to walking, cycling and public transport as the primary means of accessing these facilities.

Action 2

Ensure better integration of land use planning and transport policies in the relevant planning guidelines as part of their ongoing review and we will avail of policy directives to give effect to specific measures needed to meet the vision for sustainable travel. The general requirement that significant housing development in all cities and towns must have good public transport connections and safe routes for walking and cycling to access such connections and local amenities ties into the objectives of BusConnects in Galway.

Action 3

Land Use and Transportation Strategies (LUTS) also play a vital role in supporting better coordination and integration of development planning between local authorities across Gateways and Hubs. The Cork Area Strategic Plan (CASP) provides a good example of a LUTS approach and similar strategies are in place or are planned for Galway, Limerick and Waterford.

Action 4

The delivery of public transport, cycling and promotion of more sustainable travel patterns generally in many existing urban centres can only be achieved through retrofitting. The Active Travel facilities incorporated into the Bus Connect project is a good example of a plan to retrofit areas towards creating sustainable neighbourhoods so that walking and cycling can be the best options for local trips.

BusConnects Galway meets at least 4 of the 11 Action plans in the Smarter Travel Policy.

2.5 Regional Planning Context

2.5.1 Regional Spatial and Economic Strategy - Northern and Western Region

The Regional Spatial and Economic Strategy (RSES) for the Northern and Western Region came into effect on 24th January 2020. The document is positioned as an implementing strategy for the NPF, supporting the programme for change set out in Project Ireland 2040. The primary focus of the plan is on the Metropolitan Area Strategic Plan for Galway, prepared as part of this plan, which provides a framework for development plans and investment prioritisation over the plan period. As part of this development plan and investment prioritisation, optimising the bus network and fleet to deliver a quality, efficient and reliable bus service to serve the needs of the community for leisure, education and employment related travel.

The plan acknowledges the need to significantly improve the integration of Land-use and Transport Planning across the region in order to facilitate compact growth. To achieve this, the implementation of the Galway Transport Strategy is identified as an objective of the Galway Metropolitan Area Strategic Plan. The implementation of a city-wide bus strategy and by improving the level of infrastructure along the network for current and future population levels will facilitate compact growth of Galway City in a sustainable and managed manner.

BusConnects Galway: Dublin Road aligns with Growth Ambitions 3, and 4 as well as aligning with the All-Island Cohesion aim. This will be achieved by investing in quality bus corridors along the development length to create a vibrant and connected city in alignment with the development objectives, in particular Integration.

2.6 Local Planning Context

2.6.1 Galway Transport Strategy

The Galway Transport Strategy, published in 2016, sets out a series of proposed actions and measures for implementation. These measures cover infrastructural, operational, and transport policy requirements.

The Galway Transport Strategy is a key part of facilitating Galway's growth as a city both physically and economically, whilst creating the potential for improvements of the urban environment. Walking, cycling, bus, rail, road, and traffic management measures are included in the Galway Transport Strategy, as well as mobility management proposals to reduce reliance on private motorised transport and hence increase the use of sustainable travel modes.

The Galway Transport Strategy identified proposals for Public Transport Infrastructure and Cycle Infrastructure within Galway City. Specific proposals for the R338 (Dublin Road) in relation to public transport, cycling, and pedestrian infrastructure include the provision of bus lanes along the full length of the road, provision of cycling facilities, and improvements and upgrades to footpaths and pedestrian crossings.

The implementation of the proposals set out in the Galway Transport Strategy will result in positive outcomes for Galway. The benefits highlighted in the Galway Transport Strategy are listed as follows:

- Future-proofing the city to ensure that Galway can continue to grow as an economic and cultural centre in the West of Ireland
- Facilitating new transport infrastructure including BusConnects and walking and cycling routes
- Improved efficiency of the overall transport network, facilitating a greater degree of access to the city
- Improve environment, urban realm, and ambience – enhancing the streetscape, reducing noise and air pollution (including CO2 emissions), and freeing up more space where people can walk, shop, socialise, and enjoy the city
- Tourism, commercial, and retail benefits – additional transport capacity for shoppers and visitors accessing the city centre and tourist locations such as the Galway Racecourse

2.6.2 Galway City Council Draft City Development Plan 2023-2029

The Galway City Development Plan 2023-2029 sets out Galway City Council's policies and objectives to guide the sustainable development of the City over the lifetime of the Plan to 2029. It provides an integrated, coherent spatial framework which has been prepared following extensive consultation with members of the public, statutory bodies and relevant stakeholders.

The Plan includes specific transport objectives for cycling, public transport, and traffic and road network. These objectives are:

Sustainable Mobility

- To develop a framework that better supports sustainable mobility.
- Facilitate cycling on the proposed BusConnects Routes where appropriate.
- Give priority to cyclists, both for commuting and as a leisure activity.

Public Transport

- Support the implementation of Bus Connects Galway and the overall bus transport network which will include for a high frequency cross-city network of services and all associated infrastructural requirements, traffic management and priority arrangements.
- Promote the availability of the city bus network including the priority measures for use by the national, regional and tour bus services.
- Facilitate public transport interchanges and associated proposals for transfer ticketing and flexible payment methods.
- Prioritise the provision of park and ride facilities at appropriate locations so that they align with the bus network and cross- city link route to create the necessary modal shift to reduce car dependency.
- Promote access to public transport services for those attending primary and post primary schools in consultation with the Department of Education and Skills
- Ensure ease of access to all bus termini in the city centre and facilitate tourist coach drop-off /pick up locations convenient to the city centre that accommodates bus layover areas.

- Support measures which aim to improve the service capacity of the Galway City inter-urban rail transport network including for the development of commuter rail services, with a preference for a twin track approach from the city to Athenry.
- Support measures to develop Ceannt Station as an integrated multi-modal transport hub which facilitates easy interchange between national, regional and local transport services.
- Continue to support taxi services at appropriate locations including proximate to public transport corridors and where feasible permit use of bus priority infrastructure.
- Support the modal change to public transport under the Galway Transport Strategy (GTS) through modal change targets for walking, cycling, and public transport within the lifetime of the City Development Plan.

Traffic and Road Network

- Support the proposals in the Galway Transport Strategy for design interventions, revised traffic management arrangements and priority arrangements for walking, cycling and public transport on the road network.
- Implement improvements on the general road network, including new links and junction revisions where needed in the interest of safety and convenience.
- Implement best practice in road and street design as set out in the Design Manual for Urban Roads and Streets (2013) as updated (2019).

2.6.3 CycleConnects 2022

CycleConnects identifies a cycle network for the whole of Ireland, from a national to a regional and local level. The CycleConnects project finished its public consultation phase on 18th November 2022 and may be subject to change as a result of that. There are four levels of route classifications identified as shown in Figure 2-7 below:

Name	Function
Urban Primary	High quality cycle route that can accommodate a high volume of cyclists typical in most urban areas. These will look to feature on major desire lines in town centres and form distinctive radial and orbital cycle routes in the major towns and cities. These primary routes should also form a cohesive and connected network within the urban area that will be simple for all types of cyclists to navigate.
Urban Secondary	Second tier cycle route in major urban areas to link with urban primary network to add greater route density and options on the network. These will typically be passing through residential areas, school and employment areas
Interurban	On-road cycle route to link all key settlements and destinations outside urban areas. These may have potential to provide off-road/segregated routes parallel to the existing road in later years.
Greenway	Off-road cycle route with no adjacent traffic for the majority of its route. These are typically located on old rail trails or Blueways (routes along rivers, lakes and canals) with cyclists sharing the route with pedestrians.

Figure 2-7: CycleConnects Route Classifications (Source CycleConnects)

In the CycleConnects Plan, Bus Connects Galway: Dublin Road is identified as an urban primary cycle route for the whole length of the R338 (Dublin Road). There are also four other urban primary routes, two urban secondary routes, three feeder routes and one greenway that connect to R338 (Dublin Road).

Figure 2-8: BusConnects integration with CycleConnects Plan

This identifies The Dublin Road (R338) as a key part of the overall cycling network for Galway City.

2.7 Project Objectives

The overall objective of BusConnects Galway: Dublin Road is to provide enhanced walking, cycling and bus infrastructure which will deliver efficient, safe, and integrated sustainable transport from east of Moneenageisha Junction to Doughiska Road Junction which aligns with the strategic aim of the Galway Transport Strategy.

The development specific objectives, against which the development was assessed, are defined in terms of the Common Appraisal Framework (CAF) criteria of:

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

It should be noted that the options selection process on which the consultation was based was undertaken using the CAF, as the Transport Appraisal Framework was not yet released.

2.8 Key Project Objectives

Six key development specific objectives have been identified for the proposed development under the six criteria outlined in the following paragraphs.

2.8.1 Economy

The large volumes of existing traffic and discontinuous nature of existing bus facilities results in an economically inefficient route with long and unreliable journey times for buses. The following economy objectives have been defined:

To enhance and support sustainable growth of Galway City through the provision of a continuous high-quality multi-modal corridor which will improve bus journey times and journey time reliability along the R338 (Dublin Road).

2.8.2 Safety

The lack of continuous appropriate public transport and active travel facilities can result in conflict points between private cars and pedestrians/cyclists at several locations, particularly at junctions within the study area, increasing the risk of a collision. The following economy objectives have been defined:

Enhance pedestrian and cyclist safety through the provision of improved and segregated walking and cycling facilities along the R338 (Dublin Road).

2.8.3 Integration

The proposed development is required to integrate with Transport, Land-Use, Geographical and Government policies. The following integration objectives have been defined:

Improve multi-modal network connectivity between (a) Galway City Centre and its neighbourhoods such as Renmore, Ballybane, Doughiska, Parkmore and Ardaun; (b) Galway City and regional towns such as Oranmore, Athenry and Gort; and (c) Galway City and the inter-urban motorway network through the provision of a high-quality multi-modal corridor.

2.8.4 Environment

The use of private cars to travel from west of the Moneenageisha Junction to the Doughiska Junction results in the emission of CO2 and particulate emissions which are contributing factors to health issues such as asthma, emphysema, and other respiratory issues, as well as potential noise issues and negative impacts on the environment resulting in climate change. The key environment objectives are therefore:

Increase modal share for public transport and active travel modes through the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets.

2.8.5 Accessibility and Social Inclusion

In order to provide additional transport benefit for those who may be socially excluded, the following objectives are defined:

Improve access to all services and outdoor areas, e.g., Merlin Park Woods, Ballyloughane Beach, ATU (GMIT), along R338 (Dublin Road) by improving transport options for everyone especially for people with disabilities, mobility issues and people travelling with children.

2.8.6 Physical Activity

Private car users are the predominant users within the study area, and the network in its current configuration is set up to facilitate this. Therefore, there is little scope to promote non-motorised travel and encourage increased physical activity with current road layout and traffic movement. The key physical activity objectives are therefore:

To enable local opportunities for walking and cycling activity in communities as a result of improved and segregated walking and cycling facilities which will help increase physical activity.

2.9 Sub-Objectives

Eight development specific sub-objectives have been identified for the proposed development under four of the CAF criteria and are outlined in the following paragraphs.

2.9.1 Economy

To provide an economically efficient development.

2.9.2 Safety

To ensure that the development aligns with the hierarchy of users wherein the safety of pedestrians and cyclists are considered first.

Enhance pedestrian and cyclist safety through the provision of improved and segregated walking and cycling facilities along the R338 (Dublin Road).

To complement the Governments Road Safety Strategy.

2.9.3 Integration

To be compatible with land use objectives as set out in regional and local land use plans.

2.9.4 Environment

To improve the environment in the context of noise and air quality along the R338 (Dublin Road).

Minimise the environmental impact including minimising the private land take required for the development.

To support the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets.

SECTION 3: EXISTING LAYOUT

For the purpose of developing options for assessment, the development was split into 2 sub sections, to the east and to the west of the Skerrit Roundabout. This was chosen as the area to the west of the Skerrit Roundabout generally has a more urban characteristic, with a higher density of accesses, housing and services present along the route. To the east of the Skerrit roundabout the area is more rural, with a lower density of accesses, houses and services present, meaning that different solutions might be preferable in each area.

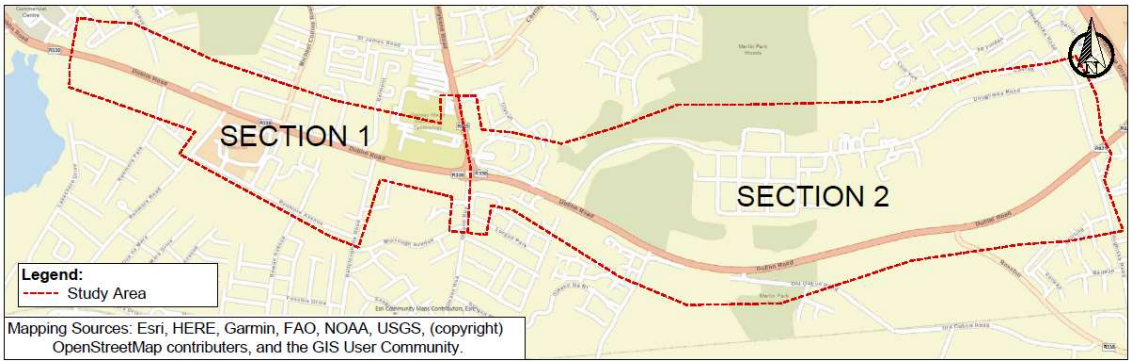

Figure 3-1: Development Sections

3.1 Section 1 – Existing

The general existing cross section from the western tie in consists of an outbound bus lane, outbound traffic lane and inbound traffic lane. To the east of Renmore Road, the bus lane is in the inbound direction. There are footpaths on both sides of the road and right-hand turning lane on the approach to several side roads. The general cross section is 20-21m wide including footpaths. On the southern side the route is generally bounded by public & private greenspace, Bon Secours Hospital Car Park and private front gardens / driveways, on the northern side it is bounded by a mix of public and private greenspace. Currently there are no cycle facilities present along the route. Pedestrian footpaths are provided both sides of the road for the full length of the route, and signalised crossings are provided across the Dublin Road (R338) at the junction with Renmore Road, at Michael Collins Road, and east of the entrance to Belmont. The side roads of Renmore, Michael Collins and the entrance to Galway Hospice Foundation also have signalised crossings, all other side road crossings are uncontrolled.

3.2 Skerrit Roundabout – Existing

This junction lies between Section 1 and Section 2 of the study area. It is currently an uncontrolled roundabout with 4 arms, there are 2 approach lanes on each arm. There are wide turning radii and clear sight lines which allow traffic to go round the roundabout at relatively high speeds. There is no cycle provision or signalised pedestrian crossings provided, although uncontrolled pedestrian crossing points are present at each arm.

3.3 Section 2 – Existing

The general existing cross section of this section of the route consists of a single inbound bus lane and traffic lanes in both directions. There is a footpath on the southern side of the road, a hard shoulder on the northern side of the carriageway, and grass verges both sides. The general cross section is 20-21m boundary to boundary including the footpath. The route is generally bounded by greenspace and a stone wall on both sides. The route is lined by trees on both sides, particularly between Coast Road and Doughiska Road. Currently there are no cycle facilities present along the route. Pedestrian footpaths are

provided for the full length of the route on the south side of the road carriageway, on the north of the road carriageway the footpath is dropped between Galway Crystal and Doughiska. Signalised crossings are provided across the R338 at the junction with Murrough Road, Coast Road and Doughiska, signalised crossings are also provided across the side roads of those junctions.

3.4 Physical Constraints and Opportunities

There are a number of features in the natural and built environment which constrain development options or provide opportunities for enhanced integration. These were considered within the development assessment process and include the following:

- Planned and committed developments including at Atlantic Technological University, Ardaun, Doughiska and the new development adjacent to the junction with Coast Road.
- Public transport & public transport infrastructure including existing bus stop locations, and Galway City Bus Services.
- Trees and other natural and ecological features.
- Architectural, archaeological and heritage sites and features, including Lynch's Stone
- Boundary walls
- Existing urban and sub-urban roads, street networks and accesses to private properties & estates.
- Limited availability of land in urban and suburban areas.

3.5 Integration with Existing and Proposed Public Transport Network

City, Regional and National buses will play a crucial role in the connectivity and mobility of Galway in the future. The Galway Transport Strategy proposes a revised bus network for Galway City comprising of five cross-city bus services, with two of the services (the Green and the Brown service) travelling along Dublin Road. The BusConnects Galway: Dublin Road development would help transform the operation of Galway City's bus services, which include the following features:

- Buses would travel into and out of the city without being delayed in traffic, improving journey times and reliability;
- Buses that spend less time stuck in traffic are available to run more frequent services;
- As more people use the bus, private bus operators would become more confident to invest in their business and fleet; and
- Provision of bus priority measures in and out of the city is an important support for future Park & Ride proposals identified in the GTS; and
- Tourist buses would be more willing to travel to Galway on day trips due to the reliability of journey times and reduced risk of encountering delays due to traffic congestion.

For the purposes of this report, it has been assumed that these bus routes will all be put in place before ,or in tandem, with the implementation of this development.

3.6 Integrating with Existing and Proposed Active Travel Network

Galway is well suited to cycling as a means of transport due to its relatively flat topography and a compact city centre, but the existing cycling facilities are limited and discontinuous.

SECTION 4: PRELIMINARY DESIGN

4.1 Principal Geometric Parameters

As a safety improvement, junction improvement and traffic management within an urban area, the proposed development has generally been designed to urban standards in accordance with the Design Manual for Urban Roads and Streets (DMURS), published by the Department of Transport, Tourism and Sport and the Department of Environment, Community and Local Government in 2019.

DMURS provides guidance in the design of urban roads and streets. DMURS recognises the challenges of fully applying its standards on developments that involve the retrofitting of new facilities to existing roads and streets, as is the case for this development.

The design philosophy adopted for the development has applied a balanced and integrated approach to road and street design by applying as far as possible the four design principles of DMURS, i.e. with respect to connected networks; multi-functional streets; pedestrian focus; and multidisciplinary approach.

In addition to DMURS, criteria from other documents have been considered to provide the most appropriate design application including the National Cycle Manual (NCM) and the Cycle Design Manual (CDM), the Transport Infrastructure Ireland (TII) Publications, Building for Everyone: A Universal Design Approach and the BusConnects Preliminary Design Guidance Booklet (BCPDGB).

A number of published design standards and guides have been utilised to inform the road geometry design of the proposed development, as listed below:

- TII Publications (Standards)
- DMURS
- NCM (NTA 2011)
- CDM (NTA 2023)
- Traffic Sign Manual (TSM)
- Traffic Management Guidelines (TMG)
- National Disability Authority (NDA) Building for Everyone: A Universal Design Approach
- Department for Transport Guidance on the Use of Tactile Paving Surfaces; and
- BCPDGB

Table 4-1 details the key design parameters which have been generally adopted to inform the proposed development design layout. The table describes the relevant geometric features set out in order of functional geometrical requirements for each road user including pedestrians (footpaths), cyclists (cycle tracks), bus lanes, general traffic lanes, junctions and parking/loading areas. In designing the geometrical elements of the proposed development, a balanced approach to the requirements for each of the road functions from a people movement perspective is needed, noting that the aim of the proposed development is to provide enhanced walking, cycling and bus infrastructure.

Table 4-1: BusConnects Key Design Parameters

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
All	Road Type	The proposed development and adjoining street network function in line with DMURS		Link Street/Local Streets	DMURS (Figure 3.3)
Footpath	Footway Widths	Nominal footway widths in low pedestrian activity areas and pinch point areas.		• 2m desirable minimum width • 1.8m minimum nominal width (low pedestrian activity area or localised restrictions) • 1.2m absolute minimum width at pinch points (e.g. trees over 2m length)	NDA[1] (Section 1.5.1) DMURS (Figure 4.34)
		Nominal footway widths in moderate – high pedestrian activity areas		• 2.5m-3m desirable width (moderate to high pedestrian activity area) • 3m-4m desirable width (high pedestrian activity area)	NDA[1] (Section 1.5.1) DMURS (Figure 4.34)
	Footway Longitudinal Gradient	New road sections or new offline footpaths		• 0.5% (1 in 200) absolute minimum • 3% (1 in 33) desirable maximum • 5% (1 in 20) absolute maximum (where constrained by road geometry and other factors)	DMURS (Section 4.4.6)
		Existing footpaths with localised adjustments		• Generally in line with existing site constraints to a maximum of 5% (1 in 20) gradient with no less than 0.5% (1 in 200)	DMURS (Section 4.4.6)
		Ramp gradients – Urban Realm		• Nominal gradient of 1 in 25 with landings at maximum 19m intervals and routes with a gradient of 1 in 33 should have landings at no more than 25m intervals with linear interpolation between gradients as required • Desirable max gradient 1 in 20 with 0.45m max rise over 9m length between landings	NDA[1] (Section 1.5.2) DN-STR-03005 (Section 6.9, 6.14, 6.15)
		Ramp gradients – Bridge Structures		• Desirable max gradient 1 in 20 with 2.5m max rise between landings • Absolute max 1 in 15 – 1 in 12 with 0.65m max rise between landings where 1 in 20 is not practical)	

[1] National Disability Authority: *Building for Everyone: A Universal Design Approach – External environment and approach*

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
	Footway Crossfall Gradient	Fully reconstructed road sections or new offline footpaths		• 1 in 50 nominal gradient	NDA[1] (Section 1.5.1.1)
		Existing footpaths with localised adjustments		• Generally in line with existing site constraints to a maximum of 3.3% (1 in 33) gradient with no less than 1.5% (1 in 65)	DN-PAV-03026 (Table 2.3)
Cycle Track	Cycle Track Width	Optimum cycle track width (two abreast cycling): single-direction, with-flow, raised-adjacent cycle track		• 2m desirable minimum width	BCPDGB (Section 5)
		Minimum cycle track (single file cycling): single direction, with-flow, raised-adjacent cycle		• 1.5m minimum width • 1m absolute minimum width at constrained island bus stop locations	BCPDGB (Section 5.3, 11.2)
		Two-way cycle track (single file cycling)		• 3.25m desirable minimum cycle track with additional desirable minimum 0.5m buffer & absolute minimum 0.3m buffer	BCPDGB (Section 5.3)
		Pedestrian priority zone areas (pedestrian and cyclist) for constrained locations		• 3m minimum width	NCM 1.9.3
	Horizontal Curvature	Minimum horizontal radius (General Alignment)	20 km/h	• 10m radius (urban areas)	NCM 4.10.3
			30 km/h	• 20m	NCM 4.10.3
			40 km/h	• 25m	NCM 4.10.3
		Minimum horizontal radius (Island Bus Stops)		• 4m radius (Entry deflection radius) • 6m radius (Exit deflection radius)	BCPDGB (Figure 34)
		Nominal deflection – Parking & Loading Bays		• 1 in 3 horizontal taper at cycle protected parking	BCPDGB (Figure 12)
		Nominal deflection – Island Bus Stops		• 1 in 1.5 horizontal taper at Island Bus Stops	BCPDGB (Figure 34)
	Longitudinal Gradient	Acceptable gradient range		• 0.5% to 5.0% (1:200 to 1:20)	NCM 5.2.3.4
	Ramps	Transition to cycle track to carriageway		• 60mm drop at 1:20 gradient (2.4m long)	NCM 4.10

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
		Transition from carriageway to Pedestrian Priority Zone		• 120mm at 1:20 gradient (4.8m long)	NCM 4.10
Bus Lane	Crossfall Gradient	Transition from cycle track to Pedestrian Priority Zone	50 km/h	• 60mm rise at 1:20 gradient (2.4m long)	NCM 4.10
		Acceptable gradient range		• 1.25% to 2.5% (1:80 to 1:40)	NCM 5.2.3.4
	Shared Bus/Cycle Lane	Lane widths (collector/link roads – low speed) in constrained environments		• 3m max width (consideration for cycle and bus (including taxis + other permitted vehicles) volumes required in addition to bus lane operation hours)	NCM 4.3.3
Bus Lane Traffic Lane	Nominal with flow Bus Lane Widths	Nominal lane widths adjacent to cycle track/footpath		• 3m min width & lane widening as required by vehicle tracking assessment on tight bends	BCPDGB (Section 5.1)
	Nominal with flow Bus Lane Widths Design Speed	Bus lanes adjacent to on street parking (no cycle track/footpath)	50 km/h	• 3m min width with consideration for designated buffer zones and delineated parking areas	BCPDGB (Figure 12)
		Design speed for vehicles in bus lane along the proposed development		• 50 km/h	DMURS (Section 4.1.1 & Table 4.1)
	Visibility	Forward Visibility Stopping Sight Distance (SSD) (Buses & HGV vehicles).		• 49m	DMURS (Table 4.2 – 50km/h)
	Headroom	Headroom vertical clearance for different structures		• Overbridges – 5.3m(new construction), 5.03m (maintained headroom) Footbridges and sign/signal gantries – 5.7m (new construction), 5.41m (maintained headroom)	DN-GEO-03036 (Table 5.1)
	Design Speed	Design speed for vehicles in general traffic lanes along the proposed development	50 km/h	• • 50 km/h	DMURS (Section 4.1.1 & Table 4.1)
Traffic Lane	Traffic Lane Width	Min carriageway lane width		• 3m min width & lane widening as required by vehicle tracking assessment on tight bends	BCPDGB (Section 5.1)
	Traffic Lane Width Visibility	Min carriageway lane width Forward Visibility Stopping Sight Distance (SSD) (cars & smaller vehicles).	60 km/h	• 3.25m min width	BCPDGB (Section 5.1) DMURS (Table 4.2 – 50 km/h)
			50 km/h	• 45 m	

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
	Visibility	Forward Visibility Stopping Sight Distance (SSD) (Buses & HGV vehicles).	50 km/h	• 49m	DMURS (Table 4.2 – 50km/h)
		Visibility to regulatory signage	Up to 50 km/h	• 60m recommended clear	TSM (Table 5.1)
	Horizontal Curvature	Minimum radius with adverse camber of 2.5%	50 km/h	• 104m	DMURS (Table 4.3)
	Vertical Curvature	Crest curve K value	50 km/h	• 4.7	DMURS (Table 4.3)
		Sag curve K value	50 km/h	• 6.4	DMURS (Table 4.3)
	Longitudinal Gradient	Longitudinal gradient		• 0.5% minimum grade • 5% desirable maximum grade • 8.3% absolute maximum grade	DMURS (Section 4.4.6)
	Cross Fall	Cross-fall		• 2.5% nominal	DMURS (Section 4.4.6)
All - Junctions	Visibility	Intra-junction visibility envelope		• 2.5m behind stop lines, inclusive of all signal heads	DN-GEO-03044 (TII DMRB TD50/04) Section 2.10 & 2.14. Figs 2/2 and 2/3.
		Priority junction side road visibility distance (safe gap stopping distance)		• X Value = 2.4m • 45m SSD (cars & smaller vehicles) • 49m SSD (HGV/Buses)	DMURS (Figure 4.63) DMURS (Figure 4.63 / Para 4.4.5)
		Visibility to primary traffic signals	50 km/h	• 70m desirable min • 50m absolute min	TSM (Table 9.1)
	Corner Radii	Few larger vehicles (local streets)		• 1m -3m radius (subject to vehicle tracking assessment & balance of junction form/function)	DMURS (Section 4.4.3)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
		Occasional larger vehicles including buses and rigid body trucks (between arterial and or link streets)		• 6m maximum radius (subject to vehicle tracking assessment & balance of junction form/function)	DMURS (Section 4.4.3)
		Occasional larger vehicles including buses and rigid body trucks (Arterial/Link to local streets)		• 4.5m – 6m radius (subject to vehicle tracking assessment & balance of junction form/function)	DMURS (Section 4.4.3)
		Frequent larger vehicles (industrial estates)		• 9m radius (subject to vehicle tracking assessment)	DMURS (Section 4.4.3)
	Pedestrian Crossings	Signalised crossing type/length *(subject to confirmation by traffic modelling and site constraints)*		• Preferred for all locations: Single stage direct crossing up to 19m length • Alternative for primary/distributor/dual carriageway roads: Two stage staggered crossings with ideally min 3m staggered offset refuge island (ideally stagger to face oncoming traffic) and ideally min 3m (2m absolute min) wide refuge island. • Alternative for primary/distributor/dual carriageway: Two stage crossing in straight crossing with 4m wide refuge island. • Alternative: Single stage direct crossing greater than 19m length (urban centres)	BCPDGB (Section 5) TMG (Section 10.7, Diagram 10.15) DMURS (Section 4.3.2)
		Signalised pedestrian/toucan crossing width		• Absolute minimum width 2m • Desirable minimum width 2.4m (4m to be considered for urban centres) • Toucan crossing width minimum 4m	TMG (Section 10.7) DMURS (Section 4.3.2)
Parking/Loading	On-street parking Dimensions	Accessible parking and child/parent parking		• 7m x 3.6m with appropriate drop kerb and tactile paving. • Cycle buffer zone (0.75m preferred)	NDA[1] (Figure 1.4)
		Parallel parking (Preferred Arrangement)		• 6m x 2.1m desirable minimum. • 6m x 2.4m preferred • Cycle buffer zone (0.75m preferred)	BCPDGB (Section 6) DMURS (Section 4.4.9)
		Angled parking		• 60 degree parking: 4.8m-5m x 2.4m @ 4.2m depth. • 45 degree parking: 4.8m-5m x 2.4m @ 3.6m depth	DMURS (Section 4.4.9)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
		Perpendicular parking		• 4.8m – 5m x 2.4m desirable minimum. • Buffer zone (0.3m minimum)	DMURS (Section 4.4.9)
		Loading Bay (Parallel)		• 6m x 2.8m (large vans) • Cycle buffer zone (0.75m preferred)	DMURS (Section 4.4.9)

4.2 Mainline Cross-section

Utilising Section 4.4.1 of DMURS and in consultation the NTA, a design strategy was implemented to determine the appropriate cross-section for the development, taking account of the design speed and nature of the locations.

Traffic lane widths have been considered in line with the guidance outlined in DMURS, with the adoption of 3.0m generally as the preferred width of traffic lanes for the proposed development.

Traffic lane widths of 2.75m are permissible but not desirable and only on roads with very low HGV percentage. In some locations these lane widths have been considered for auxiliary turning lanes where appropriate.

The desirable minimum width for a single direction, with flow, raised adjacent cycle track is 2.0m. Based on the NCM this allows for overtaking within the cycle track. The minimum width is 1.5m. The desirable width for a two-way cycle track is 3.0m with a 0.5m buffer between the cycle track and the carriageway. 2m is a desirable minimum width for footpaths with 1.2m being an absolute minimum width at pinch points. A typical CBC cross section is shown on Figure 4-1.

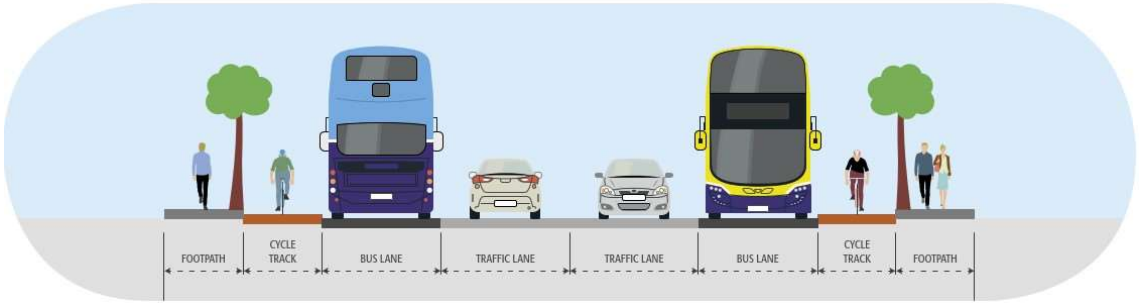

Figure 4-1: Typical CBC Cross Section

A detailed development breakdown of existing and proposed cross section elements is provided in Table 4-2. These tables provide information on the existing facilities for pedestrians, cyclists, bus lanes and general traffic lanes between junctions along the route. A detailed description of the existing and proposed junction arrangements are provided in Chapter 5.

Table 4-2: Proposed Development vs Existing Nominal Cross Section Widths

Chainage Reference	Existing Inbound Carriageway / Proposed Inbound Carriageway				Existing Outbound Carriageway / Proposed Outbound Carriageway				Existing Conditions Notes / Proposed Development Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
Moneenageisha Road Junction to Renmore Park									
CH. 0+000 to CH. 0+370	1.45m – 1.6m	N/A	N/A	3.2m	2.5m – 2.7m	N/A	3.0m	4.2m	No inbound bus lane in the existing conditions. No designated cycle facilities inbound or outbound. Existing footpaths vary in width.
	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	Road widening towards grassed area to facilitate new inbound and outbound cycle tracks and bus lanes. Existing traffic lanes narrowed to standard widths on both sides. Existing wall inbound to be removed to facilitate inbound lane widening. Existing inbound and outbound bus stops to be revised to an inline layout with an island bypass for cyclists. Land take required both inbound (~2m) and outbound (varies up to 4.6m) along this section. Existing priority control junction at Renmore Park to remain as priority control.
Renmore Park to Renmore Road									
CH 0+370 to CH. 0+590	2.0m -2.8m	N/A	N/A	3.2m	1.8m – 2.7m	N/A	3.2m	3.4m	No inbound bus lane in the existing conditions. No designated cycle facilities inbound or outbound. Existing footpaths vary in width.
	1.8m – 2.0m	2.0m fully segregated cycle track	3.0m	3.0m	1.8m – 2.0m	2.0m fully segregated cycle track	3.0m	3.0m	Road widening on both sides to facilitate segregated cycle tracks and bus lanes. Two outbound locations for land take required (varies up to 9.5m and 2.2m) in Council lands along this section to facilitate new widened footpath & cycle infrastructure. Existing outbound landscaped area to facilitate the inclusion of cycle tracks and footpath. Renmore Road signalised junction redesigned as a protected signalised junction with associated segregated crossing facilities for pedestrians and cyclists.

Chainage Reference	Existing Inbound Carriageway / Proposed Inbound Carriageway				Existing Outbound Carriageway / Proposed Outbound Carriageway				Existing Conditions Notes / Proposed Development Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
Renmore Road to Michael Collins Road / Hospice Access Road									
Chainage Reference	Existing Inbound Carriageway / Proposed Inbound Carriageway				Existing Outbound Carriageway / Proposed Outbound Carriageway				Existing Conditions Notes / Proposed Development Notes
	Footway Width (m)	**Cycle Lane/ Track Width (m)**	**Bus Lane Width (m)**	**Traffic Lane Width (m)**	**Footway Width (m)**	**Cycle Lane/ Track Width (m)**	**Bus Lane Width (m)**	**Traffic Lane Width (m)**	
CH. 0+590 to CH. 0+800	3.0m	N/A	3.2m	3.2m	2.0m	N/A	N/A	3.2m. Increases to 4.4m at left turn lane	No inbound bus lane in the existing conditions. No designated cycle facilities inbound or outbound. Existing footpaths vary in width. Large landscaped area along the outside length of this zone.
	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	Road widening to facilitate a new inbound and outbound cycle tracks and bus lanes. Existing traffic lanes narrowed to standard widths on both sides. New island style bus stops proposed outbound and inbound. Existing landscaping to be retained on north side of road, with a proposed segregated footway and cycle track running through it. Land take required both inbound (~3.0m) and outbound (varies up to 9.4m) along this section. Michael Collins Road signalised junction redesigned as a protected signalised junction which will include segregated facilities for pedestrians and cyclists using the junction.
Michael Collins Road to Ballyloughane Road / Belmont Junction									
CH 0+800 to CH 1+150	1.7m – 3.4m	N/A	3.2m	3.2m	1.8m – 2.7m	N/A	N/A	4.2m	No outbound bus lane in the existing conditions. No designated cycle facilities inbound or outbound. Existing footpaths vary in width. Sections of inbound footpath below standard width.

Chainage Reference	Existing Inbound Carriageway / Proposed Inbound Carriageway				Existing Outbound Carriageway / Proposed Outbound Carriageway				Existing Conditions Notes / Proposed Development Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	Road widening on both sides to facilitate segregated cycle tracks and bus lanes. Existing stone wall removed to facilitate widened road alignment. Existing inbound and outbound bus stop to be revised to island bus stop layouts. Land take required in both directions (up to 5.6m outbound, 2.0m inbound) Existing Belmont priority junction redesigned to rationalise the number of junctions along the bus route and encourage greater traffic flow. New junction incorporating Belmont and Ballyloughane Road to be a protected signalised junction for improved user safety, particularly for vulnerable road users. Existing junction paved zone to be converted into a landscaped area.
Ballyloughane Road / Belmont Junction to Skerrit Roundabout									
Chainage Reference	Existing Inbound Carriageway / Proposed Inbound Carriageway				Existing Outbound Carriageway / Proposed Outbound Carriageway				Existing Conditions Notes / Proposed Development Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
CH 1+150 to CH. 1+550	3.0m	N/A	3.2m	3.2m	2.0m	N/A	N/A	3.4m	No inbound bus lane in the existing conditions. No designated cycle facilities inbound or outbound. Existing footpaths vary in width. Large landscaped area along the outbound length of this zone.
	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	The Skerrit roundabout is proposed to be upgraded to a signalised protected junction in the form of a cyclops type junction to offer greater provision for cyclists and to accommodate new bus lanes. Road widening to facilitate a new inbound and outbound cycle tracks and bus lanes. Existing traffic lanes narrowed to standard widths on both sides. Existing outbound inline bus stop to be revised to double island bus stop. Existing inbound bus stop to be incorporated into an island bus stop, which is proposed to feed into a new double bay inline island bus stop. New landscaped areas are proposed on the Inbound and outbound directions, with new trees planted on the outbound direction.

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				
	Footway Width (m)	**Cycle Lane/ Track Width (m)**	**Bus Lane Width (m)**	**Traffic Lane Width (m)**	**Footway Width (m)**	**Cycle Lane/ Track Width (m)**	**Bus Lane Width (m)**	**Traffic Lane Width (m)**	**Existing Conditions Notes** **Proposed Development Notes**
									Significant land take required both inbound (~9m) and outbound (varies up to 9.4m) along this section. A cumulative area of 3330m2.
Skerrit Roundabout to Merlin Park Hospital Access Road									
CH 1+550 to CH 1+860	1.4m – 1.6m	N/A	3.4m	3.2m	1.5m – 2.0m	N/A	N/A	3.4m	No outbound bus lane in the existing conditions. No designated cycle facilities inbound or outbound. Existing footpaths vary in width. Sections of inbound footpath below standard width.
	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	Road widening on both sides to facilitate segregated cycle tracks and bus lanes. Existing inbound bus stop to be revised to an island bus stop layout. New island bus stop proposed outbound. Land take required in both directions (up to 7.8m outbound, 1.7m inbound) Existing Merlin Park Hospital priority junction layout proposed to be upgraded to a signalised junction which will offer greater provision for pedestrians & cyclists. Existing trees on outbound stretch to be removed from CH 0+1740 to CH 0+1795.
Merlin Park Hospital Access Road to Merlin Park									
	Footway Width (m)	**Cycle Lane/ Track Width (m)**	**Bus Lane Width (m)**	**Traffic Lane Width (m)**	**Footway Width (m)**	**Cycle Lane/ Track Width (m)**	**Bus Lane Width (m)**	**Traffic Lane Width (m)**	Existing Conditions Notes Proposed Development Notes

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Development Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
CH 1+860 to CH. 2+190	3.0m	N/A	3.2m	3.2m	2.0m	N/A	N/A	3.4m	No inbound bus lane in the existing conditions. No designated cycle facilities inbound or outbound. Existing footpaths vary in width. Sections of inbound footpath below standard width.
	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	Road widening to facilitate a new inbound and outbound cycle tracks and bus lanes. Existing traffic lanes narrowed to standard widths on both sides. Existing inbound bus stop to be revised to an island bus stop layout. New island bus stop proposed outbound. Land take required in both directions (up to 6.3m outbound, 1.8m inbound). Merlin Park signalised junction layout proposed to be amended to provide a protected signalised junction which will offer greater provision for pedestrians & cyclists negotiating the junction.
Merlin Park to Rosshill Road									
CH 2+190 to CH 2+530	1.0m – 1.5m	N/A	3.4m	3.2m	N/A	N/A	N/A	3.4m	No outbound bus lane in the existing conditions. No designated cycle facilities inbound or outbound. No designated footpath on outbound stretch. Inbound footpath below standard width along this section.
	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	Road widening on both sides to facilitate segregated cycle tracks and bus lanes. Land take required in both directions (up to 3.8m outbound, 1.9m inbound). Rosehill Road junction layout proposed to be amended from the existing priority layout to signalised protected junction layout which will offer greater provision for pedestrians & cyclists using the junction. Existing trees to be removed along outbound stretch.
Rosshill Road to Coast Road									
Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				

Chainage Reference	Existing Inbound Carriageway / Proposed Inbound Carriageway				Existing Outbound Carriageway / Proposed Outbound Carriageway				Existing Conditions Notes / Proposed Development Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Existing Conditions Notes Proposed Development Notes
CH 2+190 to CH 3+290	N/A	N/A	3.2m	3.2m	2.0m	N/A	N/A	3.4m	No inbound bus lane in the existing conditions. No designated cycle facilities inbound or outbound. No designated footpath on outbound stretch. Inbound footpath below standard width along this section.
	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	Road widening to facilitate a new inbound and outbound cycle tracks and bus lanes. Existing traffic lanes narrowed to standard widths on both sides. Land take required in both directions (average of 3m across entirety of section, increases up to 9m on the inbound stretch). Existing Coast Road signalised junction layout proposed to be amended to a signalised protected junction which will offer greater provision for pedestrians & cyclists using the junction. Existing trees to be removed along outbound stretch.
Coast Road to Doughiska Road / Bothar Deoch Uisce Junction									
CH 3+290 to CH 3+860	N/A	N/A	3.4m	3.2m	N/A	N/A	N/A	3.4m	No outbound bus lane in the existing conditions. No designated cycle facilities inbound or outbound. No designated footpaths in area.

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Existing Conditions Notes Proposed Development Notes
	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	2.0m	2.0m fully segregated cycle track	3.0m	3.0m	Road widening on both sides to facilitate segregated cycle tracks and bus lanes. New island style bus stops proposed outbound and inbound. Proposed two-way off-road cycle track along the northern side of the road, behind the existing retained mature hedgerow. Land take required in both directions (up to 10.0m outbound, 3.0m inbound). Existing Doughiska Road signalised junction layout proposed to be amended to a signalised protected junction which will offer greater provision for pedestrians & cyclists using the junction. Some existing trees to be removed along inbound and outbound stretch.

4.3 Design Speed

The design speed to which the horizontal and vertical alignment of the Proposed has been governed by DMURS and the guidance provided by the DTTAS in the document Guidelines for Setting and Managing Speed Limits in Ireland.

As outlined in DMURS '*Design Speed is the maximum speed at which it is envisaged/intended that the majority of vehicles will travel under normal conditions*' for the urban road sections. DMURS recommends that "*in most cases the posted or intended speed limit should be aligned with the design speed" and* that the design speed of a road or street must not be "*up designed*" so that it is higher than the posted speed limit. DMURS sets out that designers *"must balance speed management, the values of place and reasonable expectations of appropriate speed according to context and function"*.

Consideration for selection of an appropriate design speed is undertaken in light of the "Function and Importance of Movement" and "Context" of the street network, as explained further in DMURS Section 3.2. The "Design Speed Selection Matrix" as shown in below is also used to inform the appropriate design speed, which is extracted from DMURS Chapter 4.

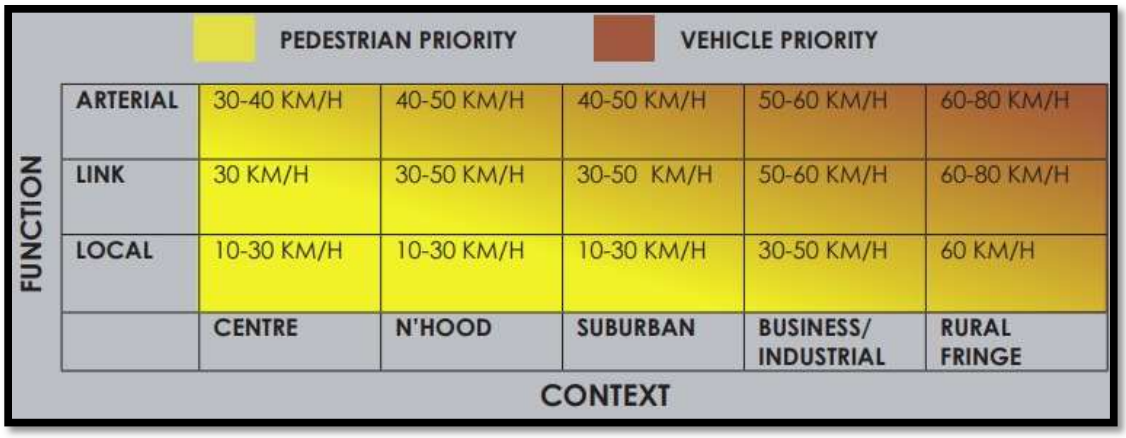

Figure 4-2: DMURS Design Speed Selection Matrix

Table 4-3: Existing and Proposed Design Speed

Chainage Reference	Road/Junction Name	DMURS Road Function	DMURS Place Context	Existing Speed Limit (km/h)	Proposed Design Speed (km/h)	Proposed Posted Speed Limit (km/h)
CH 0+0000 to CH 3+860	Dublin Road (R338) (Entire Development Length)	Arterial/ Link	Business/ Industrial/ Suburban	50	50	50

The design speeds used for the existing and proposed mandatory speed limits on the proposed development are detailed in Table 4-3 below. This has been proposed in light of future developments in the area in addition to the proposed reduction in lane widths, increased frequency of pedestrian crossings and cycle infrastructure. A review of the Road Safety Audit & Road User Audit (RSA) incident data has also indicated that a reduction in speed limit along could be beneficial for reducing the potential for incidents occurring along this section of the route.

4.4 Alignment Modelling Strategy

The 3D model design, including the horizontal and vertical alignments, 3D modelling corridors and the associated design features has been developed using the Autodesk Civil 3D software in accordance with the BCID BIM Execution Plan. The models have been developed for the purposes of informing the development extents and informing the preliminary design for the requirement for any significant earthworks/ retaining structures along the proposed development.

As part of the alignment design process, the horizontal and vertical design has been optimised to minimise impact to the existing road network and adjoining properties where feasible. Horizontal and vertical alignments have been developed to define the road centrelines for the proposed route layout while also taking cognisance of the existing road network. In terms of the horizontal alignments, due consideration has been given to aligning the centrelines as close to existing as practicably possible. However the over-riding determining factor for locating the horizontal alignment is to ensure it is positioned in the centre of the proposed carriageway. This is ideally along a central lane marking on the carriageway, in order to minimise rideability issues for vehicles crossing the crown line.

In the case of developing the vertical alignment along the route, a refinement process has been undertaken to minimise impacts to the existing road network and develop the proposed carriageway levels as close to existing as possible. In most circumstances however, due to a change in cross-section, due consideration is given to the resulting level difference at the outer extents of the carriageway, particularly through urban areas where a difference in existing and proposed footpath levels will require additional temporary land-take to facilitate tie-in.

Existing ground levels have been determined using the existing ground model produced for the proposed development from the topographical survey. This existing ground model informs the differences in levels between proposed and existing along the route, while at junctions it is also used to determine dwell area gradients and lengths to facilitate junction realignment.

The developed alignment design sets parameters for development of other design elements such as drainage, determination of earthworks, utility/services placement etc.

4.5 Summary of Horizontal Alignment

Existing alignments and crossfalls along the proposed development have been generally retained wherever practical. DMURS provides the following guidance in relation to modifications of existing arterial and link road geometry:

Designers should avoid major changes in the alignment of Arterial and Link streets as these routes will generally need to be directional in order to efficiently link destinations.

Major changes in horizontal alignment of Arterial and Link streets should be restricted to where required in response to the topography or constraints of a site.

In some areas, minor adjustments will be required to the horizontal alignment to deliver the requisite width to ensure the provision of the necessary traffic lanes, bus lanes, cyclist and pedestrian facilities which would also allow the drainage of surface water into new/relocated road gullies.

In areas where road widening and minor changes to the horizontal alignment will not be possible due to constraints (environmental, residential, geometrical etc.), new construction has been provided through greenfield areas to ensure the provision of continuity of design throughout the development.

In light of the above and the horizontal and vertical alignment of the mainline are generally as per the existing parameters and surveys. The alignment of the development is generally compatible with the selected design speed and associated safe SSD.

4.6 Summary of Vertical Alignment

Due to the nature of the proposed design i.e. the majority of the design proposals involve widening of the existing roadway in order to accommodate additional facilities, every effort has been made to ensure the vertical alignment adheres as closely as possible to the existing arrangement.

DMURS defines the vertical alignment of a road as follows:

"A vertical alignment consists of a series of straight-line gradients that are connected by curves, usually parabolic curves. Vertical alignment is less of an issue on urban streets that carry traffic at moderate design speeds and changes in vertical alignment should be considered at the network level as a response to the topography of a site."

Visibility concerns associated with adverse vertical crest and sag curves have not been identified on the proposed development due to the nature of the existing urban road network. Notwithstanding, the vertical alignment of the proposed road development has also been assessed to ensure hard standing areas have been designed above the minimum gradient of 0.5% to mitigate localised surface water ponding and facilitate surface run-off drainage measures.

4.7 Forward Visibility

Forward visibility is the distance along the street ahead of which a driver of a vehicle can see. The minimum level of forward visibility required along a street for a driver to stop safely, should an object enter its path, is based on the Stopping Sight distance (SSD).

The SSD is the theoretical minimum forward sight distance required by a driver travelling at free speed (i.e. not influenced by other drivers) in order to stop the car when faced with an unexpected hazard on the carriageway. This is calculated as the total distance it takes the driver driving at the design speed to stop safely. It is measured along the centreline of the lane in which the vehicle is travelling, and a rule of thumb is that a driver sitting in a low vehicle (eye height 1.05m) must be able to see an object 0.26m high from the SSD distance.

SSD = perception distance + reaction distance + braking distance.

The SSD standards which have been applied to the proposed design in accordance with the design guidance given within DMURS are shown in Table 4-4. The desirable minimum forward visibility requirements is achieved for the proposed development.

Table 4-4: SSD Design Standards

SSD STANDARDS

Design Speed (km/h)	SSD Standard (metres)
10	7
20	14
30	23
40	33
50	45
60	59

Forward Visibility

Design Speed (km/h)	SSD Standard (metres)
10	8
20	15
30	24
40	36
50	49
60	65

Forward Visibility on Bus Routes

4.8 Corner Radii and Swept Path

In line with the proposed development objectives of improving facilities for walking and cycling, corner radii along the route are to be reduced where appropriate in order to lower the speed at which vehicles can turn corners and increase inter-visibility between all road users.

Junctions are where the actual and perceived risk to both cyclists and pedestrians are highest and usually represent the most uncomfortable parts of their journey. In order to provide a design whereby vehicles navigate through turns at a reduced speed, thereby reducing the risk of and exposure to serious collisions, all junctions are designed to be as compact as possible as per DMURS. Continuous footpaths and cycle tracks (referred to as Raised Table Treatments in the BCPDG) are proposed across all accesses.

The corner radius in urban settings is often determined by swept path analysis. Whilst swept path analysis should be considered, the analysis may overestimate the amount of space needed and / or the speed at which the corner is taken. The design balances the size of the corner radii with user needs, pedestrian and cyclist safety and the promotion of lower operating speeds. In general, on junctions between Arterial and/or Link streets a maximum corner radius of 6m is applied. 6m will generally allow larger vehicles, such as buses and rigid body trucks, to turn corners without crossing the centre line of the intersecting road.

A suite of vehicles was collated for consideration in assessment of alignment/junction designs and entrances to private properties as shown below in Figure 4-3.

Name	Width	Length	W/W Rad
"Standard" Articulated Bus	2.520	18.020	11.400
15m 6WS Luxury Coach	2.500	15.000	12.490
DB32 Fire Appliance	2.180	8.680	8.821
DB32 Private Car	1.715	4.223	6.207
DB32 Refuse Vehicle	2.400	7.900	10.323
Double Decker City Bus	2.520	10.704	10.856
Double Decker Regional Bus	2.550	14.145	12.150
FTA Design Articulated Vehicle (1998)	2.550	16.480	7.314
FTA Design Drawbar Vehicle (1998)	2.550	18.751	10.708
Low Entry Regional Commuter Bus	2.550	13.490	12.200
Rigid Truck	2.500	12.000	12.677
Single Deck City Bus	2.445	11.505	11.948
Single Deck Midi Bus	2.445	10.280	11.577

Figure 4-3: Standard Suite of Vehicles Used for Assessment of the Proposed Development

Vehicle tracking/swept path analysis was carried out using the following vehicles for the length of the development, at all junctions, and at significant accesses:

- DB32 Private Car;
- FTA Design Drawbar Vehicle (1998);
- 11m Rigid Truck;
- FTA Design Articulated Vehicle (1998).

This assessment was used to inform the road design.

4.9 Pedestrian Provision

DMURS defines the footpath cross section by three distinct areas. The 'footway' area is designated as the main throughfare within the footpath designated for pedestrian movement along the street. The 'verge' area provides an area that can be used for street furniture, landscaping, as well as an overflow

area for pedestrian movement. In some circumstances the verge area can also provide a buffer for high speed traffic, however for the majority of the proposed development a cycle track will perform a similar function for separation from motorised traffic.

4.9.1 Footway Widths

The adopted footway design width parameters have been provided in Table 4-1. The desirable minimum footway width for the Proposed Development is 2m and an absolute minimum width of 1.8m has been adopted at constrained sections. This width should be increased in areas catering for significant pedestrian volumes where space permits or in areas where designated additional outdoor functionality has been determined to increase the overall footpath regime.

At specific pinch points, Building for Everyone: A Universal Design Approach (National Disability Authority), defines acceptable minimum footpath widths as being 1.2m wide over a 2m length of path.

In line with the Road User Hierarchy designated within DMURS, at pinch points, the width of the general traffic lane should be reduced first, then the width of the cycle track should be reduced before the width of the pedestrian footpath is reduced. For the majority of the proposed development extents, minimum lane widths have been complied with.

Throughout the development, footway widths of 2m or wider have been proposed, with the exception of a limited number of stretches where a width of 1.8m – 2m is proposed due to the presence of localised space constraints. The existing and proposed development nominal footway widths over the length of the corridor have been provided in Table 4-2.

4.9.2 Footway Crossfall

The adopted footway design crossfall parameters is provided in Table 4-5. The footway crossfall is recommended to be 2% - 3.3% as per DN-PAV-03026.

Table 4-5: DN-PAV-03026, Geometric Parameters for Footways

Parameter	Recommended Limits	Extreme Limits
Longitudinal gradient (normally the same as adjacent highway)	1.25% to 5%	8% maximum*
Width	2m minimum	1.3m minimum
Crossfall	2% to 3.3%	1.5% minimum to 7% maximum at crossings

Note: *In some cases it may be necessary to construct a footway with a gradient of more than 8 per cent. Provision of a handrail is recommended if site constraints necessitate a gradient steeper than 10 per cent.

Building for Everyone: A Universal Design Approach (National Disability Authority) recommends that crossfalls should ideally be limited to 1:50 or 2% gradient as steeper gradients can tend to misdirect prams, pushchairs and wheelchairs. This approach has been generally adopted to within the constraints of the existing footpath extents.

4.9.3 Longitudinal Gradient

The adopted footway design longitudinal grading parameters is provided in Table 4-1. The footway longitudinal gradient follows the gradient of the proposed carriageway. DN-PAV-03026 (Table 2.3) shown in Table 4-5 recommends a longitudinal gradient of 1.25% - 5%.

Similar to cycle tracks throughout the development, longitudinal gradients of footway are likely to be constrained by the longitudinal gradient of the adjacent carriageway with little scope to vary the footway separately. There are no designated ramps for the proposed development with longitudinal grading generally falling within the acceptable range.

4.9.4 Pedestrian Crossings

The adopted pedestrian crossing design parameters is provided in Table 4-1. Where possible, DMURS recommends that designers provide pedestrian crossings that allow pedestrians to cross the street in a single, direct movement. To facilitate road users who cannot cross in a reasonable time, the desirable maximum crossing length without providing a refuge island is 18m. This may be increased to 19m as an absolute maximum. This is applicable at stand-alone pedestrian crossings as well as at junctions.

Refuge islands should be a minimum width of 2m. Larger refuge islands should be considered by designers in locations where the balance of place and movement is weighted towards vehicle movements, such as areas where the speed limit is 60kph or greater, in suburban areas or where there is an increased pedestrian safety risk due to particular traffic movements. Straight crossings can be provided through refuge islands only where the island is 4m wide or more. Islands of less than 4m in width should provide for staggered crossings.

Where space allows, crossing lengths can be minimised by accommodating a suitable landing area for pedestrians between the road carriageway and cycle track, with the cycle track crossing controlled by mini-zebra markings. This reduced pedestrian crossing distance will have the added benefit of improving overall junction performance due to reduced intergreen times.

Along the proposed development, pedestrian crossings varying from 2.4m and 4m in width are incorporated throughout the design. Larger pedestrian crossing widths may be used in areas that are expected to accommodate a high number of non-motorised users.

At signalised junctions and mid-block pedestrian crossings, the footway is to be ramped down to carriageway level to facilitate pedestrians who require an unobstructed crossing. At minor junctions, raised table treatments are provided to raise the road level up to footway level and facilitate unimpeded crossing for pedestrians. Tactile paving is provided at the mouth of each pedestrian in accordance with standards. Audio units are to be provided on each traffic signal push button.

Formal crossing points of the cycle track are to be provided on the upstream side of bus stop islands, consisting of a ramped zebra pedestrian crossing and appropriate tactile paving

4.10 Accessibility for Mobility Impaired Users

The aim of the proposed development is to provide enhanced walking, cycling and bus infrastructure along the corridor. In achieving this aim, the proposed development has generally been developed in accordance with the principles of DMURS and Building for Everyone: A Universal Design Approach.

The following non exhaustive list of relevant standards and guidelines have informed the approach to Universal Design in developing the proposed development:

- Building for Everyone: A Universal Design Approach NDA CEUD;
- How Walkable is Your Town, 2015 NDA CEUD;

- Shared Space, Shared Surfaces and Home Zones from a Universal Design Approach for the Urban Environment in Ireland CEUD;
- Best Practice Guidelines, Designing Accessible Environments. Irish Wheelchair Association;
- DfT Inclusive Mobility;
- UK DfT Guidance on the use of tactile paving surfaces; and
- BS8300:2018 Volume 1 Design of an accessible and inclusive built environment. External Environment- code of practice

The Disability Act 2005 places a statutory obligation on public service providers to consider the needs of disabled people. A specialist consultant was engaged to undertake an Accessibility Audit of the existing environment and proposed draft preliminary design for the corridor. The Audit provided a description of the key accessibility features and potential barriers to disabled people based on the Universal Design standards of good practice listed above. A copy of the Audit has been provided in Appendix C it should be noted that the audit was undertaken in the early design stages with the view to implementing any key measures identified as part of the design development process.

A detailed development breakdown of the relevant existing and proposed footways is provided in Table 4-2. In achieving the enhanced pedestrian facilities there has been a concerted effort made to provide clear segregation of modes at key interaction points along the corridor which was highlighted as a potential mobility constraint in the Audit of the existing situation, particularly for people with vision impairments. In addressing one of the key aspects to segregation, the use of the 60mm upstand kerb between the footway and the cycle track is of particular importance for guide dogs, whereby the otherwise use of white line segregation is not as effective for establishing a clear understanding of the change of pavement use and potential for cyclist/pedestrian conflicts.

One of the other key areas that was focused on was the interaction between pedestrians, cyclists and buses at bus stops. The proposed development has implemented the use of island bus stops to manage the interaction between the various modes with the view to providing a balanced safe solution for all modes. This is further discussed in Section 4.13.

4.11 Cycling Provision

One of the core objectives of the proposed development is to provide segregated cycling facilities along the routes. Physical segregation ensures that cyclists are protected from motorised traffic as well as being independent of vehicular congestion, thus improving cyclist safety and reliability of journey times for cyclists. Physical segregation can be provided in the form of vertical segregation, (e.g. raised kerbs), horizontal segregation, (e.g. verge protected cycle tracks), or both. Segregation also involves providing separation between cycling and walking which is a feature of the development. There are no shared surfaces and very limited Toucan Crossings proposed for the development. Instead cyclists will be provided with dedicated road crossing facilities, separated from pedestrian crossings.

The ‘preferred cross-section template’ developed for the proposed development consists of protected cycle tracks, providing vertical segregation from the carriageway to the cycle track and vertical segregation from the cycle track to the footway.

The principal source for guidance on the design of cycle facilities is the NCM and the CDM, published by the NTA.

The desirable minimum width for a single-direction, with-flow, raised-adjacent cycle track is 2m. This arrangement allows for two-abreast cycling. Based on the NCM width calculator, this allows for overtaking within the cycle track. The minimum width is 1.5m, which based on the NCM width calculator, allows for single file cycling. Localised narrowing of the cycle track below 1.5m may be necessary over very short distances to cater for local constraints (e.g. mature trees).

The desirable minimum width for a two-way cycle track is 3.25m. In addition to this, a buffer of 0.5m should be provided between the two-way cycle track and the carriageway. Using the NCM width calculator, reduction of these desirable minimum widths can be considered on a case-by-case basis, with due cognisance of the volume of cyclists anticipated to use the route as well as the level of service required.

The proposed development is approximately 3.9km long and includes continuous new cycle tracks along the entire length. The preliminary design drawings included within Appendix B show the improved extent of cycle provision, which is summarised below:

- 0% Existing cycle priority (outbound) (0% cycle track, 0% advisory cycle lane,);
- 0% Existing cycle priority (citybound) (0% cycle track, 0% advisory cycle lane);
- 100% Proposed cycle priority (outbound) (98.5% cycle track, 1.5% quiet street); and
- 100% Proposed cycle priority (citybound) (98.5% cycle track, 1.5% quiet street/offline cycle track).

4.11.1 Segregated Cycle Track

A Cycle Track is a segregated cycle lane which is physically segregated from the adjacent traffic lane and/or bus lane horizontally and/or vertically as shown in Figure 4-4 below, taken from the BCPDGB.

The 60mm kerb between cycle track and footpath and between cycle track and road shall be chamfered at 30° to act as a forgiving kerb which permits smooth redirection of a bicycle front wheel and lessens the potential hazard that a vertical upstand kerb would present.

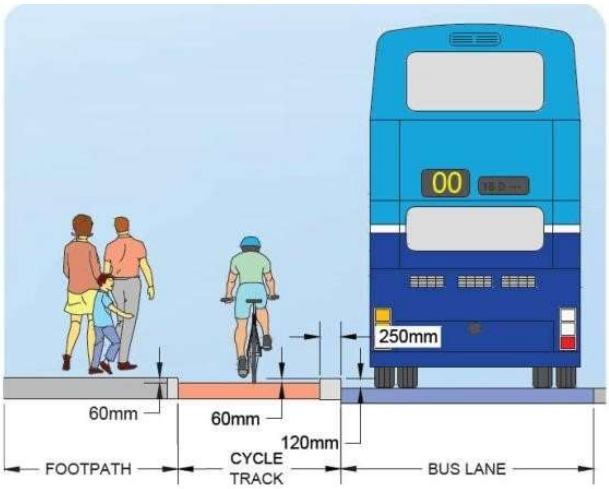

Figure 4-4: Fully Segregated Cycle Track

Wherever possible, the proposed development design has endeavoured to incorporate segregated cycle tracks, and has done so across the full length of the development.

The desirable minimum width for a single-direction, with-flow, raised-adjacent cycle track is 2m. This is based on the NCM width calculator and allows for overtaking or two-abreast cycling within the cycle track. The minimum width for single file cycling is 1.5m, based on the NCM width calculator. Localised narrowing of the cycle track below 1.5m may be necessary over very short distances to cater for local constraints (e.g. mature trees) but will generally be avoided wherever possible.

4.11.2 Cycle Lane

Cycle lanes are designated lanes on the carriageway that are reserved either exclusively or primarily for the passage of cyclists. Standard cycle lanes include mandatory cycle lanes and advisory cycle lanes. Mandatory cycle lanes are marked by a continuous white line which prohibits motorised traffic from entering the lane, except for access. Parking is not permitted on mandatory cycle lanes. Mandatory cycle lanes are 24 hour unless time plated in which case they are no longer cycle lanes. Advisory cycle lanes are marked by a broken white line which allows motorised traffic to enter or cross the lane. they are used where a mandatory cycle lane leaves insufficient residual road space for traffic, and at junctions where traffic needs to turn across the cycle lane. Parking is not permitted on advisory cycle lanes other than for set down and loading. Advisory cycle lanes are 24 hour unless time plated. Advisory Cycle Lanes are not permitted as an option for designers under the CDM.

Cycle tracks are the preferred cycling infrastructure proposed along the length of the development. Where necessary the use of cycle lanes have been limited to the following locations typically along the route:

- Transitions to existing cycle lanes, typically on side roads of the main corridor alignment
- Transitions to existing roadways that do not have cycle facilities

4.11.3 Offline Cycle Track

Offline cycle tracks are fully offset from the road carriageway by a grass verge, providing a greater level of protection and comfort to cycle users. Offline sections of cycle track provided are provided at the following locations:

- CH 0+110 to CH 0+160 at Lynch's Stone inbound cycle track constructed to provide enhanced segregation and mitigate loss of heritage area
- CH 0+620 to CH 0+800 outbound cycle track constructed on the Dublin Road (R338) to provide enhanced segregation and mitigate tree loss in verge area
- CH 1+160 to CH 2+190 outbound cycle track constructed on the Dublin Road (R338) to provide enhanced segregation and mitigate tree loss in verge area
- CH 2+130 to CH 1+420 outbound cycle track constructed on the Dublin Road (R338) to facilitate movement around proposed bus stop & Rosshill Road Junction, provide enhanced segregation and mitigate tree loss in verge area
- CH 3+260 to CH 3+750 outbound two-way cycle track constructed on The Dublin Road (R338) to facilitate movement around proposed bus stop & Coast Road Junction, provide enhanced segregation and mitigate tree loss in verge area

4.11.4 Quiet Street Treatment

Where the proposed development cannot facilitate cyclists without significant impact on bus priority, alternative cycle routes are explored for short distances away from the proposed development bus route. Such offline options may include directing cyclists along streets with minimal general traffic other than car users who live on the street.

The proposed development accommodates cyclists as part of the mainline CBC development. No alternative offline cycle routes were considered necessary or feasible.

4.11.5 Treatment of Constrained Areas

At some locations along the development, the desired cycleway width cannot be achieved, and localised narrowing is required.

Providing a standard width would require additional land take from either surrounding private properties or pedestrian areas. Due to the high foot traffic in this area, it is preferable to provide a reduced cycleway width; This has occurred at between CH 0+620 to CH 0+800 in the outbound direction where the cycleway is reduced to 1.75m.

It is also noted that cycle tracks narrow to minimum 1.5m width at bus stop islands.

4.11.6 Cycle Parking Provision

As noted in Section 4.13 bike racks will generally be provided, where practicable, at island bus stops and key additional locations as noted in the Landscape drawings.

4.12 Bus Provision

The proposed development is approximately 3.9km long from end to end. The updated development design drawings show the improved extent of bus provision:

- 21% Existing bus priority (outbound)
- 76% Existing bus priority (citybound)
- 100% Proposed bus priority (outbound)
- 100% Proposed bus priority (citybound)

The following buses serve Galway City and traverse the proposed BusConnects route

- 402 Shangort Road (Seacrest) – Eyre Square – Merlin Park (Bus Éireann)
- 404 Newcastle – Eyre Square – Oranmore (Bus Éireann)
- 409 Eyre Square – Parkmore Industrial Estate (Bus Éireann)
- 434 Galway - Gort
- 920 Galway – Loughrea
- 251 Galway - Cork Airport
- 251X Galway - Cork Airport
- 706 Galway -Dublin City – Dublin Airport

4.12.1 Bus Priority

Bus priority for the proposed development is based on provision of a dedicated lane within the carriageway for the bus to travel unhindered by the general traffic along the road corridors between junctions. At junctions, bus lane provision can be provided up to the stop line wherein adaptive signalling solutions could request a green signal for buses or similarly a short, generally less than 20m section of shared bus/traffic lane in advance of the junction stop line can be provided and configured in a similar manner using adaptive signalling methods to communicate the arrival of a bus on approach to the junction. Both methods provide a high level of bus priority with the latter solution implemented where left turning traffic volumes are relatively low and/or scenarios where less stages/phases are more desirable for junction capacity and bus priority in a fixed time cycle approach where adaptive bus signalling solutions are not appropriate. This is further discussed in Chapter 5 and Chapter 12.

Over the majority of the route a 3m wide lane is provided for bus and other authorised vehicle use only.

4.12.2 Signal Controlled Priority

Signal Control Priority uses traffic signals to enable buses to get priority ahead of other traffic on single lane road sections, but it is only effective for short distances. This typically arises where the bus lane cannot continue due to obstructions on the roadway. An example might be where a road has pinch points where it narrows due to existing buildings or structures that cannot be demolished to widen the road to make space for a bus lane. It works through the use of traffic signal controls (typically at junctions) where

the bus lane and general traffic lane must merge ahead and share the road space for a short distance until the bus lane recommences downstream. The general traffic will be stopped at the signal to allow the bus pass through the narrow section first and when the bus has passed the general traffic will then be allowed through the lights. In considering signal-controlled priority it is necessary to look at the traffic implications both upstream and downstream of the area under consideration. For the signal-controlled priority to operate successfully, queues or tailbacks on the single (shared bus/traffic) lane portion, cannot be allowed to develop as this will result in delays on the bus service.

There are no sections of signal-controlled priority proposed as part of this development.

4.12.3 Bus Gate

A bus gate is a sign-posted short length of stand-alone bus lane. This short length of road is restricted exclusively to buses, taxis and cyclists plus emergency vehicles. It facilitates bus priority by removing general through traffic along the overall road where the bus gate is located. General traffic will be directed by signage to divert away to other roads before they arrive at the bus gate.

There are no bus gates proposed as part of this development.

4.13 Bus Stops

The below flow chart outlines the process for examining the proposed development and assessing and reporting on the bus stops along the route, as shown in Figure 4-5, below. The Core Bus Network Report concludes that increasing spacing between bus stops is part of the solution to reduce delays along the corridors. For BusConnects it is proposed that bus stops should be spaced approximately 400m apart on typical suburban sections on route, dropping to approximately 250m in urban centres. This spacing should be seen as recommended rather than an absolute minimum spacing.

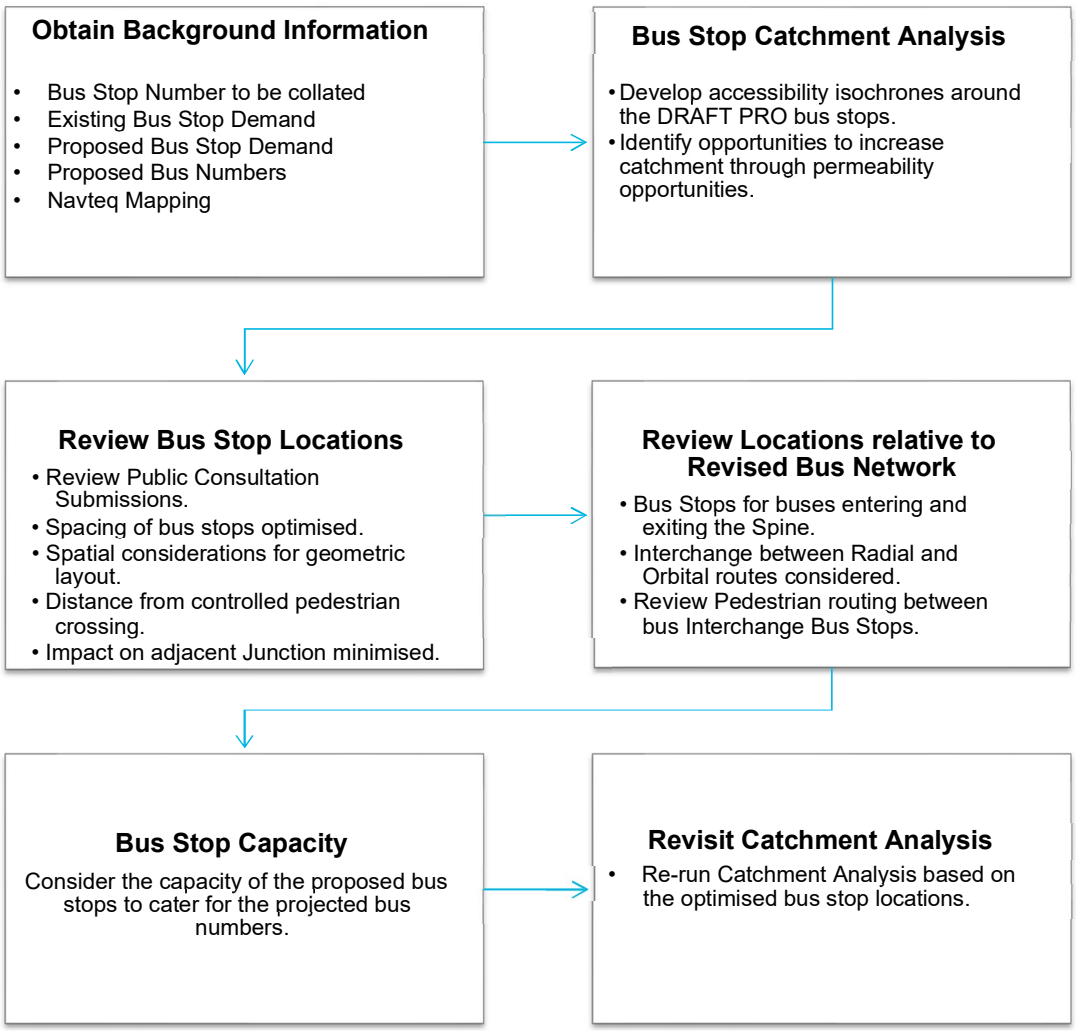

Figure 4-5: Bus Stop Location Assessment Process

The basic criteria for consideration when locating a bus stop are as follows:

- Driver and waiting passengers are clearly visible to each other;
- Located close to key facilities;
- Located close to main junctions without affecting road safety or junction operation;
- Located to minimise walking distance between interchange stops;
- Where there is space for a bus shelter;
- Located in pairs, 'tail to tail' on opposite sides of the road;
- Close to (and on exit side of) pedestrian crossings;
- Away from sites likely to be obstructed; and
- Adequate footway width.

Boarding of passengers, layout of stations is not being examined as they are either not relevant in this case or dealt with elsewhere as part of the overall BusConnects programme.

It is important that bus stops are not located too far from pedestrian crossings as by nature pedestrians will take the quickest route. This may be hazardous and result in jaywalking. Locations with no or indirect

pedestrian crossings should be avoided. Their optimum location is a short distance from a controlled crossing point.

4.13.1 Bus Stop Summary

Table 4-6 below provides an overview of the key changes to the locations for bus stops along the route. Where specific feedback in relation to bus stops from the public consultation process has been provided this has been acknowledged in the assessment.

Table 4-6: Bus Stops along Dublin Road

Inbound						
Existing				Proposed		
No.	Bus Stop No.	Chainage	Distance between Stops (meters)	No.	Chainage	Distance between Stops (meters)
1	522691	CH 0+200	N/A	1	CH 0+190	N/A
2	524351	CH 0+755	555	2	CH 0+760	570
3	524341	CH 1+080	325	3	CH 1+085	325
4	522811	CH 1+340	260	4	CH 1+275	190
5	522831	CH 1+715	375	5	CH 1+710	435
6	524331	CH 2+125	410	6	CH 2+110	400
7	524321	CH 3+760	1635	7	CH 3+355	1245
				8	CH 3+725	370
		Average Distance:	593		Average Distance:	505

Outbound						
Existing				Proposed		
No.	Bus Stop No.	Chainage	Distance between Stops (meters)	No.	Chainage	Distance between Stops (meters)
1	522701	CH 0+350	N/A	1	CH 0+015	N/A
2	524131	CH 0+685	335	2	CH 0+330	315
3	524141	CH 1+060	375	3	CH 0+685	355
4	522811	CH 1+370	310	4	CH 1+040	355
5	524151	CH 2+270	900	5	CH 1+350	310
6	524171	CH 3+180	910	6	CH 1+800	450
7	524181	CH 3+780	600	7	CH 2+150	350
				8	CH 3+355	1205
				9	CH 3+770	415
		Average Distance:	**572**		Average Distance:	469

4.13.2 Island Bus Stops

The preferred bus stop arrangement for the proposed development is the island bus stop arrangement, Figure 34 of the BCPDGB, is shown below in Figure 4-6.

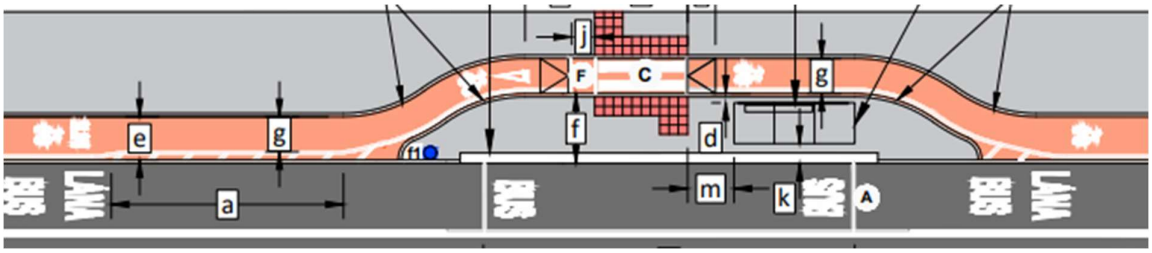

Figure 4-6: Example of an Island Bus Stop

This arrangement will reduce the potential for conflict between pedestrians, cyclists and stopping buses by directing cyclists behind the bus stop, thus creating an island area for boarding and alighting passengers. To address the potential pedestrian/cyclist conflict, a pedestrian priority crossing in the form of a zebra crossing is proposed for pedestrians accessing the bus stop island area.

A 1:20 maximum gradient ramp is provided on the cycle track to raise the cycle track to the level of the footpath/island area onto a 4m wide crossing. Suitable tactile paving is also provided at the crossing point

The desired minimum island width of 3m has been adopted to accommodate the provision of a full end panel shelter and nominal length of 25m to accommodate a 19m typical bus cage arrangement and adjusted to suit the site constraints (e.g. between driveway entrances). The residual bus stop triangular island arrangements can also be used for areas of planting or SuDS as these areas are not intended for pedestrian circulation and will also help promote directing pedestrians towards the designated crossing point in addition to improving the passenger waiting area environment. Bike racks can also be located, where practicable, in the immediate vicinity as shown in Figure 4-7 to promote the use sustainable mode interchange at bus stops for longer distance trips.

Figure 4-7: Example Landscaping Arrangement adjoining Island Bus Stops at Stratford Centre, London (source: Google Street View 2022**)**

The island bus stop design or a variation of it, is used for all of the bus stops where there is a cycle track involved for the proposed development. Table 4-7 below provides a summary of the proposed island bus stop locations.

Table 4-7: List of Island Bus Stops

Inbound / Outbound	Chainage	Bus Stop Type
Inbound	CH 0+190	Island Bus Stop
Inbound	CH 0+760	Island Bus Stop
Inbound	CH 1+085	Island Bus Stop
Inbound	CH 1+275	Island Bus Stop
Inbound	CH 1+710	Island Bus Stop
Inbound	CH 2+110	Island Bus Stop
Inbound	CH 3+355	Island Bus Stop
Inbound	CH 3+725	Island Bus Stop
Outbound	CH 0+015	Island Bus Stop
Outbound	CH 0+330	Island Bus Stop
Outbound	CH 0+685	Island Bus Stop
Outbound	CH 1+040	Island Bus Stop
Outbound	CH 1+350	Island Bus Stop
Outbound	CH 1+800	Island Bus Stop
Outbound	CH 2+150	Island Bus Stop
Outbound	CH 3+355	Island Bus Stop
Outbound	CH 3+770	Island Bus Stop

4.13.3 Inline Bus Stop

Conventional inline bus stops are used on the proposed development where there are no adjacent cycling facilities provided due to the provision of offline cycle facilities elsewhere. Inline bus stops are provided at the following locations listed in Table 4-8.

Table 4-8: List of Inline Bus Stops

Inbound / Outbound	Chainage	Bus Stop Type
Inbound	CH 3+355	Inline Bus Stop
Inbound	CH 3+725	Inline Bus Stop

4.13.4 Bus Shelters

Bus shelters provide an important function in design of bus stops. The shelter will offer protection for people from poor weather, with lighting to help them feel more secure. Seating is provided to assist ambulant disabled and older passengers and accompanied with Real Time Passenger Information (RTPI) signage to provide information on the bus services. The locations of the bus shelters have been presented on the GEO_GA General Arrangement drawing series in Appendix B. The optimum configuration that provides maximum comfort and protection from the elements to the traveling public is the 3-Bay Reliance ‘mark’ configuration with full width roof. This shelter is a relatively new arrangement which has been developed by JCDecaux in conjunction with the NTA. The shelter consists mainly of a stainless-steel structure with toughened safety glass and extruded aluminium roof beams. Figure 4-8 below provides an example image of the preferred full end panel shelter arrangement. The desirable

minimum footpath/island widths required to accommodate the full end panel shelter is 3.3m with an absolute minimum width of 3m to facilitate a min. 1.2m clearance at the end panel for pedestrians. Alternative arrangements for more constrained footpath widths are considered in the following sections.

Figure 4-8: Example of a 3-Bay Reliance Full End Panel Bus Shelter (Source: JCDecaux)

The cantilever shelter using full width roof and half end panel arrangement provides a second alternative solution for bus shelters in constrained footpath locations. Figure 4-9 below provides an example of this type of shelter. Advertising panels in this arrangement are normally located on the back façade of the shelter compared to the full end panel arrangement. The desirable minimum footpath/island widths required to accommodate the full end panel shelter is 2.75m with an absolute minimum width of 2.4m to facilitate a min. 1.2m clearance at the end panels for pedestrians.

Figure 4-9: Example of a 3-Bay Reliance Cantilever Shelter with Full Width Roof and Half End Panels (Source: JCDecaux)

Two alternative narrow roof shelter configurations are also available which offer reduced protection against the elements compared to the full width roof arrangements. These shelter configurations are not preferred but do provide an alternative solution for particularly constrained locations where cycle track narrowing to min 1m width has already been considered and 2.4m widths cannot be achieved to facilitate the full width roof with half end panel shelter or for locations where the surrounding environment may offer protection against the elements. The desirable minimum footpath widths for the narrow roof configuration are 2.75m (with end panel) and 2.1m (no end panel). The absolute minimum footpath

widths for these shelters are 2.4m (with end panel) and 1.8m (no end panel) to requirements for boarding and alighting passengers in consideration of wheelchair, pram, luggage and other such similar spatial requirements.

Figure 4-10: Example of a 3-Bay Reliance Cantilever Shelter with Narrow Roof Configuration with and without Half End Panels (Source: JCDecaux)

The siting of bus shelters also requires due consideration on a case by case basis. Ideally bus shelters should be located on the island bus stop boarding/alighting area where space permits. Where this is not feasible, the shelters should be located parallel to the island to the rear of the footpath. Where bus shelters cannot be located directly on the dedicated island or parallel to the island due to spatial and or other constraints, they should ideally be located downstream of the stop area. This will inherently promote eye to eye contact between boarding passengers and oncoming cyclists and buses when signalling the bus and also improve the courtesy arrangement for segregation of boarding and alighting passengers. Examples from each of these scenarios are shown below.

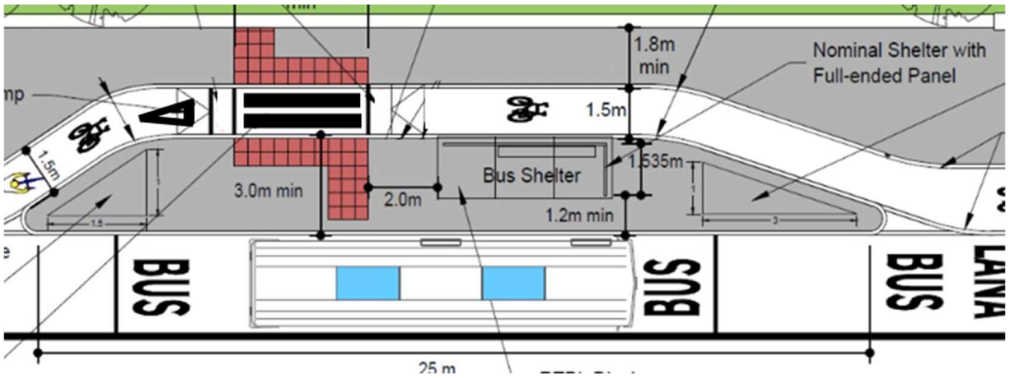

Figure 4-11: Preferred Shelter Location (On Island)

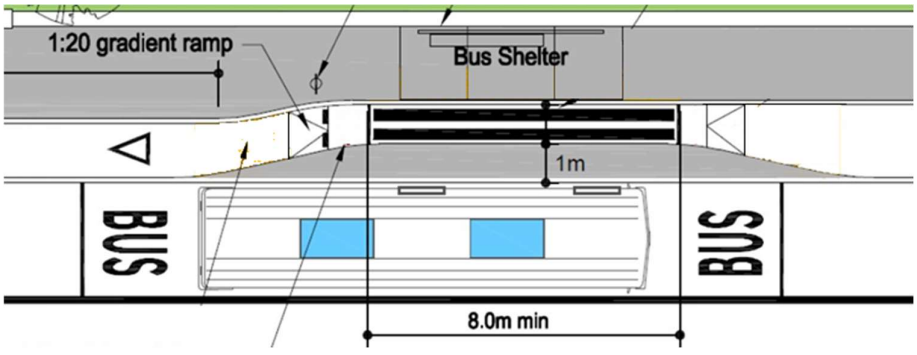

Figure 4-12: Alternative Shelter Location Back of Footpath (Narrow Island with Adequate Footpath Widths)

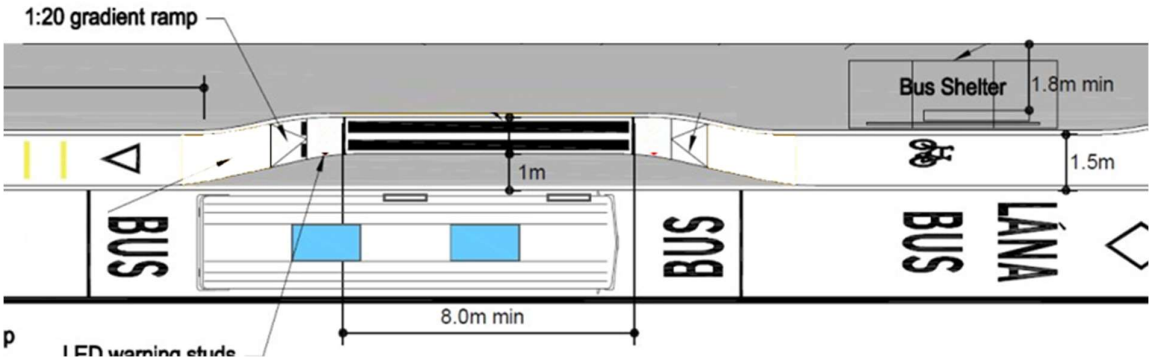

Figure 4-13: Alternative Shelter Location Downstream of Island (Narrow Island with Narrow Footpath Widths at Landing Area)

4.14 Speed Limit Signs

The speed limit will be set at 50kph for the whole development. There is a lack of existing speed limit signs from the Merlin Hospital Access Road along to the western end of the development, and the rural surroundings may currently suggest to the driver that the speed limit is higher than the posted speed. The proposed development aims to provide a consistent message by use of speed limit repeater signs placed at intervals along the development at immediately after junctions to inform drivers who have entered onto Dublin Road.

4.15 Relaxations Departures and Deviations

The terms relaxation and departure are derived from the TII Publications (Standards) requirements for national roads projects. As defined in GE-GEN-01005, a Departure from Standard shall mean any of the following:

- A Departure from any of the mandatory requirements of TII Publications (Standards);
- The use of technical design standards and/or specifications other than those in TII Publications (Standards);
- The use of a set of requirements or additional criteria for any aspect of the Works for which requirements are not defined in the Contract;
- The use of a technical design standard or technical specification in a manner or circumstance which is not permitted or provided for in such directive or specification; and
- A combination of any of the criteria specified above.

The following are variations that are not considered as constituting a Departure from Standard:

- Suggestions/Recommendations within TII Publications (Standards); and
- Relaxations – these need to be recorded in the Departures Report, but a formal application does not need to be completed

For urban renewal developments DN-GEO-03030 provides suitable guidance on the application of DMURS for the design of all urban roads and streets with a 60km/h or less speed limit. A development that is being designed in accordance with DMURS shall require a Design Report. Any deviations from the requirements or guidance set out in DMURS shall be detailed in the Design Report. Notwithstanding, developments that are being designed in accordance with DMURS shall comply with relevant TII Specifications with regards to materials, standard construction details and maintenance requirements.

The Design Report for developments designed in accordance with DMURS shall contain a DMURS Compliance Statement. This statement shall include a table demonstrating compliance with the four Core Design Principles.

- Design Principle 1: To support the creation of integrated street networks which promote higher levels of permeability and legibility for all users, and in particular more sustainable forms of transport;
- Design Principle 2: The promotion of multi-functional, place-based streets that balance the needs of all users within a self-regulating environment;
- Design Principle 3: The quality of the street is measured by the quality of the pedestrian environment; and
- Design Principle 4: Greater communication and co-operation between design professionals through the promotion of a plan-led, multidisciplinary approach to design.

4.15.1 DMURS Design Compliance Statement

The proposed development has been designed in line with the principles and guidance outlined within the DMURS 2019. The development proposals have been developed in direct response to the aims and objectives of the as set out in Section 1.2 which have common synergies with the Core Design Principles of DMURS.

The adopted design approach successfully achieves the appropriate balance between the functional requirements of different network users whilst enhancing the sense of place. The implementation of enhanced pedestrian, cycling and bus infrastructure actively manages movement by offering real modal and route choices in a low-speed high-quality mixed-use self-regulating environment. Specific attributes of the proposed development design which contribute to achieving this DMURS objective include;

- Prioritising pedestrians and cyclists through the implementation of designated footpaths, and cycle tracks and limiting vehicles' speed through the use of tight kerb radii on all internal junctions within the development;
- Provision of cycle protected junctions will control speed at which vehicles can travel through the junction and incorporates tight kerb radii to limit vehicles' speed but also allow occasional larger vehicles to manoeuvre safely through the junction, while also reducing pedestrian crossing distances;
- The inclusion of new and enhanced pedestrian crossing facilities will promote increased pedestrian activity along the development, providing safe desire lines for pedestrians to/from all directions. The proposed development also removes the existing lengthy uncontrolled crossings and the associated safety risks that they present to pedestrians at these vehicle dominated locations;
- Introduction of designated cycle protected parking along the development will improve the interaction between parked vehicles, pedestrians and cyclists; and
- The implementation of traffic calming measures and side entry treatments promote pedestrian activity on the junction side arms.

The development proposals are the outcome of an integrated urban design and landscaping strategy to enhance the function and place for the surrounding area and thereby facilitating a safer environment for pedestrians and cyclists.

The design has been progressed in accordance with the design standards within Section 4.1.

4.16 Road Safety and Road User Audit

Road Safety Audits (RSA) have been undertaken at various stages throughout the design development process. The TII GE-STY-01024 document provides an outline of the typical stages for road safety audits and further noted below as follows:

- Stage F: Route selection, prior to route choice;
- Stage 1: Completion of preliminary design prior to land acquisition procedures;
- Stage 2: Completion of detailed design, prior to tender of construction contract. In the case of Design and Build contracts, a Stage 2 audit shall be completed prior to construction taking place;
- Stage 1 & 2: Completion of detailed design, prior to tender of construction contract, for small developments where only one design stage audit is appropriate;
- Stage 3: Completion of construction (prior to opening of the development, or part of the development to traffic wherever possible); and
- Stage 4: Early operation at 2 to 4 months' post road opening with live traffic.

In line with the above a Stage F RSA was undertaken as part of the EPR selection process and a Stage 1 RSA was undertaken as part of the preliminary design development. The RSA is included in Appendix C complete with the proposed designer's responses.

The Stage 1 RSA was reviewed in light of the project development and had identified various elements of the EPR that were subsequentially improved with design development, including the introduction of cycle protected junctions, tie ins for cycle infrastructure on side roads and buffer zones for parking and pedestrian segregation measures.

The Stage 1 RSA represents the response of an independent audit team to various aspects of the development. The recommendations contained within the document are the opinions of the audit team and are intended as a guide to the designers on how the development as constructed can be improved to address issues of road safety.

SECTION 5: JUNCTION DESIGN

5.1 Overview of Transport Modelling Strategy

The design for each junction within the proposed development was devised to meet the objectives of the development and to align with the geometric parameters set out in Section 4.1, in association with the junction operation principles described in the DMURS. Various traffic modelling tools were used to assess the impact of the proposals on a local, corridor and surrounding road network level.

A traffic impact assessment has been undertaken for the proposed development in order to determine the predicted magnitude of impact that the proposed development measures may have against the likely receiving environment. The impact assessment have been carried out using the following scenarios:

- 'Do Nothing' – The 'Do Nothing' scenario represents the current baseline traffic and transport conditions study area without the proposed development and other GTS projects being in place, as outlined in Section 4 above. This scenario forms the reference case by which to compare the proposed development ('Do Something') for the qualitative assessments only.
- 'Do Minimum' – The 'Do Minimum' scenario (Opening Year 2028, Design Year 2043) represents the likely traffic and transport conditions of the study area, including for any transportation developments which have taken place, been approved or are planned for implementation as part of the GTS, without the proposed development in place. This scenario forms the reference case by which to compare the proposed development ('Do Something') for the quantitative assessments.
- 'Do Something' – The 'Do Something' scenario represents the likely traffic and transport conditions of the study area including for any transportation developments which have taken place, been approved or are planned for implementation, with the proposed development in place (i.e. the Do Minimum scenario with the addition of the proposed development). The Do Something scenario has been broken into two phases:

    - Construction Phase (Construction Year 2026) – This phase represents the single worst-case period which will occur during the construction of the proposed development;
    - Operational Phase (Opening Year 2028, Design Year 2043) – This phase represents when the proposed development is fully operational.
    - Opening Year assessment is based on the same network as the base year plus other committed developments;
    - Design year assessment is based in the context of the full implementation of the GTS network re-design (including the Galway City Ring Road) in both the Do Minimum and Do Something scenarios, with the proposed development servicing the new GTS services.

The changes between the Do Minimum and Do Something scenarios have been presented in either a positive, negative or neutral Quality of Impact as a result of the proposed development, depending on the assessment topic. A high, medium, low or negligible rating has been applied to each impact assessment to determine the Magnitude of Impact which is outlined in detail within the EIAR chapter 6 as part the planning submission pack.

5.2 Overview of Junction Design

The purpose of traffic signals is to regulate movements safely with allocation of priority in line with transportation policy. For the proposed development, a key policy is to ensure appropriate capacity and reliability for the bus services so as to maximise the overall throughput of all modes in an efficient manner. The junctions will provide safe and convenient crossing facilities for pedestrians with as little delay as possible. Particular provisions are required for the protection of cyclists from turning traffic at signalised junctions, as well as ensuring suitable capacity for a rapidly increasing demand by this mode.

The design of signalised junctions, or series of junctions, as part of the proposed development has been approached on a case-by-case basis. There have been a number of components of the design development process that have influenced the preliminary junction designs including:

- The junction operational and geometrical principles described in DMURS
- Integration of pedestrian and cycle movements at junctions
- Geometrical junction design for optimal layouts for pedestrians, cyclists and bus priority whilst minimising general traffic dispersion where practical
- Micro-Simulation modelling to assess and refine bus priority designs.

5.2.1 Pedestrians

The junction design approach is to minimise delay for pedestrians at junctions, whilst ensuring high quality infrastructure to ensure pedestrians of all ages including vulnerable users can cross the roadway in a safe and convenient manner. Pedestrian crossings have been placed as close to pedestrian desire lines as safely possible. Where pedestrians are required to cross a cycle track, this is proposed to be controlled by zebra markings to manage potential conflicts as per the NCM.

The preferred arrangement for pedestrians at junctions is to have a wraparound pedestrian signal stage at the start of the cycle. In some instances, this may not be feasible i.e. due to crossing distances and the associated long inter-green times required for pedestrians to safely clear the junction.

To minimise pedestrian delays at junctions, it is important that proposed junction cycle times are kept as short as possible. Adaptive signalling could implement signal cycle times within the range 90-120 seconds to facilitate active travel modes.

5.2.2 Cyclists

The provision for cyclists at junctions is a critical factor in managing conflict and providing safe junctions for all road users. The primary conflict for cyclists is with left turning traffic. Along the majority of the proposed development this conflict has been reduced through provision of protected junctions, reduction in overall traffic volumes and the separation of vehicle and bicycle traffic.

Segregated cycle tracks are proposed along the full length of the development. Toucan crossings are generally not proposed to avoid unnecessary interaction between cyclists and pedestrians. Instead, cyclists are kept separate from pedestrians and provided with dedicated signals at road crossings. A Toucan Crossing is proposed at the pedestrian/cycle access to ATU and at Bon Secours Hospital where there is a particular mid-block demand to cross the R338.

The greater space available at the Skerrit Roundabout has afforded adoption of a Cyclops type protected junction (CDM TL502) with cyclists provided with an orbital cycle track around the junction. Left turning cyclists can effectively bypass the junction, while giving way at pedestrian crossings.

The proposal to use standard protected junctions for all other traffic signals which may or may not include permitting straight-ahead cyclists and left-turning vehicular traffic movements to proceed at the same time in a partial conflict arrangement. Each junction can be assessed on an individual basis as to its suitability as per the CDM. The likely form of protected signalised junctions will be the CDM TL503 and TL505 junction types, however where space permits CDM TL501 and TL504 junction types will be considered as a first preference solution as they afford better free flow of movement for cyclists.

5.2.3 Bus Priority

The development incorporates four different types of bus priority design which is outlined in the BCPDGB and referred to as Junction Types 1-4. Junction Types 1-3 can be implemented using cycling provision as per CDM TL501, 503, 504 or 505 as described in the previous section. BCPDGB Junction Type 4 is

equivalent to CDM TL502, Cyclops junction. The subsections below provide an overview of each junction type design and the principles for applying this junction type.

Junction Type 1

Junction Type 1, as described in Section 7.4.1 of BCPDGB, comprises a dedicated bus lane on both inbound and outbound direction and which continues up to the junction stop line. Due to space constraints, general traffic travelling both straight ahead and turning left is restricted to one lane. Junction Type 1 is typically chosen for the following reasons:

- Volume of left turning vehicles greater than 100 PCUs per hour; and
- Urban setting, no space available for dedicated left turning lane / pocket.

Junction Type 1 has not been adopted in the proposed development.

Junction Type 2

Junction Type 2, as described in Section 7.4.2 of BCPDGB, comprises a signalised junction in a suburban context where there is room for additional lanes. A dedicated bus lane in both inbound and outbound directions continues up to the junction stop line. At approximately 30m back from the stop line there is a yellow box to allow left turners to cross the bus lane to enter a dedicated left turn lane, where space permits. Junction Type 2 is chosen for the following reasons:

- Suburban setting where space is available for a dedicated left turning lane; and
- High volume of left turning traffic which can be controlled separately with exiting traffic from side roads.

A full Junction Type 2 has not been adopted in the proposed development, however a 'hybrid' junction is being used at one location, which comprises of a Junction Type 2 on the south side and a Type 3 junction type on the north side, as shown in Figure 5-1 below.

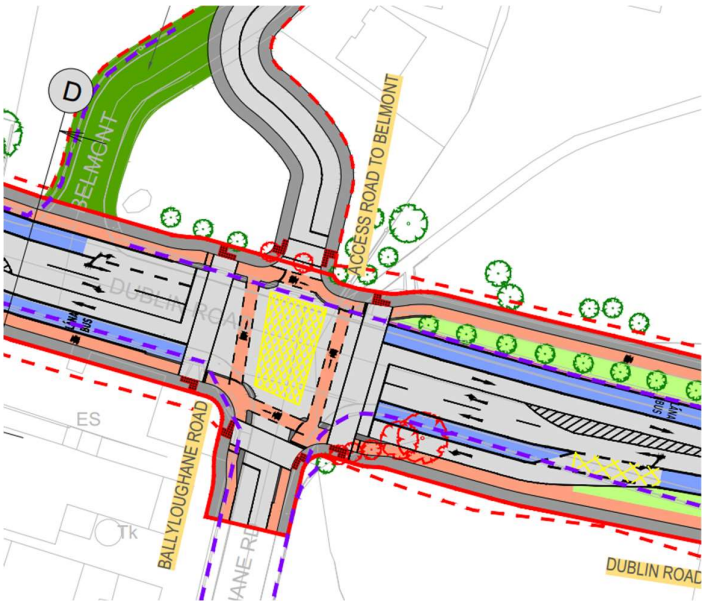

Figure 5-1: Junction Type 2, Proposed Ballyloughane Road / Belmont Access Road

Junction Type 3

Junction Type 3, as described in Section 7.4.3 of BCPDGB, illustrates a signalised junction where the inbound and outbound bus lane terminates just short of the junction to allow left turners to turn left from a short left turn pocket in front of the bus lane. Buses can continue straight ahead from this pocket where a receiving bus lane is proposed. A Junction Type 3 is chosen for the following reasons:

- Volume of left turning vehicles is less than 100 PCUs per hour; and
- Urban setting, no space available for a dedicated left turning lane / pocket.

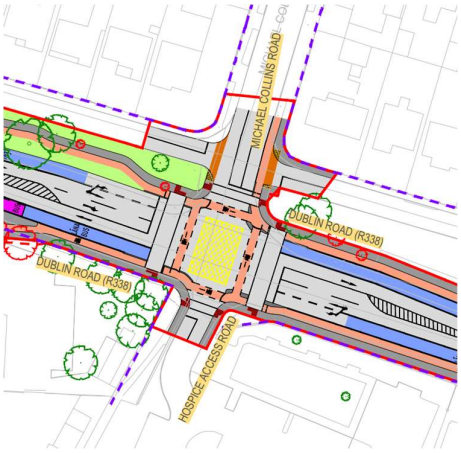

Figure 5-2: Junction Type 3, Proposed Michael Collins Road / Hospice Access Road

Junction Type 4

Junction Type 4, as described in Section 7.4.4 of BCPDGB, illustrates a signalised junction with an inbound and outbound bus lane, but also positions the pedestrian crossings on the inside of the cycle lanes across the arms of the junction. Pedestrian crossing distances are minimised as a result. Zebra pedestrian crossings are proposed across the cycle tracks to allow pedestrians to cross from the footpath to the pedestrian crossing landing areas, thus facilitating left-turning cyclists. The key design features and considerations relating to this junction type are as follows:

- An orbital cycle track is provided, with controlled crossing points to allow pedestrians to cross to large islands within a central signal-controlled area
- Left turning cyclists can effectively bypass the junction, while giving way to pedestrians crossing as well as cyclists already on the orbital cycle track
- Pedestrians and cyclists can cross the road at signalised crossings at the same time due to the segregated and nonconflicting crossings; and
- Pedestrian crossings are close to the pedestrian desire line. However the number of crossings for pedestrians is increased as pedestrians must cross the cycle track to access the central signal controlled area.

Junction Type 4 is chosen for the following reasons:

- High incidence of HGV movements e.g. at industrial estates or where two major regional roads meet; and
- Suburban setting and lower pedestrian volumes.
- Where there is greater existing space available.

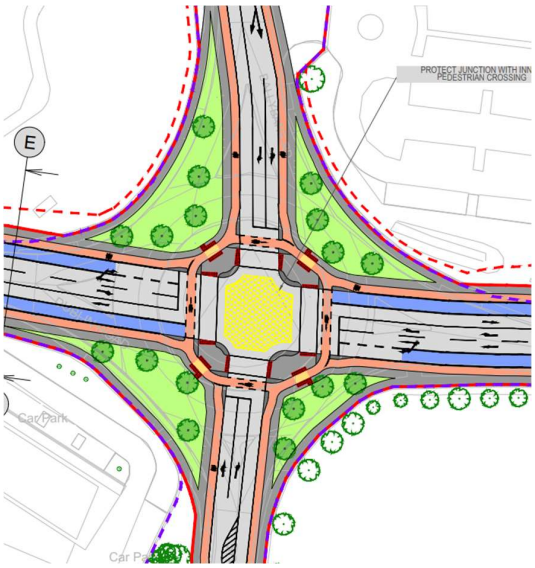

Figure 5-3: Junction Type 4, Proposed Skerritt Junction

5.2.4 Staging and Phasing

The optimum staging for each junction will be determined by the required junction operational parameters and local site conditions. One of the key considerations in the design of signalised junctions is the conflict between left turning and cyclists continuing along the main corridor. The following presents an overview of the design of junction staging:

- Cyclists travelling through the junction across the side road will run with straight ahead and left turning traffic movements in a partial conflict arrangement subject to compliance with CDM 4.4.5.5;
- A short early start will enable cyclists to advance before general traffic. The amount of green given to cyclists is subject to junction dimensions and signal operation. A 5 second early start has been proposed on the main arms of the majority of junctions, with 3 seconds minimum at certain junctions;

5.2.5 Junction Design Summary

A detailed junction assessment has been undertaken in line with the principles described above. The summary tables, Table 5-1 and

Table 5, provide an overview of the key design principles adopted at each junction location.

Table 5-1: Overview of Major Junctions

No.	Junction	Key Design Notes
1	Renmore Road	Existing signalised junction to be converted into Junction Type 3 with the outbound bus lane brought up to the stop line and inbound bus lane shared with a left-turn lane. Existing turning lane provision to be replicated in the proposed junction upgrade. All bicycle movements provided with separate signal control. Pedestrian signals on all 3 arms.
2	Michel Collins Road	Existing signalised junction to be converted into Junction Type 3 with outbound and inbound bus lanes shared with left-turn lanes. Existing turning lane provision to be retained with the proposed junction upgrade and with the addition of a left-turn lane for outbound traffic. All bicycle movements provided with separate signal control. Pedestrian signals on all 4 arms.
3	Belmont/Ballyloughane Road	The existing priority junction for Belmont will be removed and replaced with a new signalised access at a new signalised 4-arm junction serving both Belmont and Ballyloughane Road. The existing mid-block signalised pedestrian crossing on the R338 Dublin Road south of Ballyloughane Road will be removed. The Belmont side of the proposed junction with be Junction Type 3 with the outbound bus lane shared with a left-turn lane. The Ballyloughane side of the junction will be Junction Type 2: inbound left turning traffic cross over the bus lane to access a dedicated left-turn lane. All bicycle movements provided with separate signal control. Pedestrian signals on all 4 arms.
4	Skerritt Junction	The existing 4-arm roundabout junction will be replaced with a Type 4 signalised junction 3 with outbound and inbound bus lanes shared with left-turn lanes and right-turn lanes provided on all 4 arms. The Cyclops layout provides cyclists with dedicated signal control for crossing the road only: pedestrian interactions are handled by yielding. Pedestrian signals on all 4 arms.
5	Merlin Park Hospital	Existing priority junction to be converted into Junction Type 3 with outbound and inbound bus lanes shared with left-turn lanes. Access to the retail outlets on the south side of the junction shall be via the southern arm of the proposed signalised junction. East-west bicycle movements provided with separate signal control. Pedestrian signals on all 4 arms.
6	Murrough Drive	Existing signalised junction to be converted into Junction Type 3 with the outbound bus lane brought up to the stop line and inbound bus lane shared with a left-turn lane. Existing turning lane provision to be replicated in the proposed junction upgrade. All bicycle movements provided with separate signal control. Pedestrian signals on all 3 arms.
7	Rosshill Road	Existing priority junction to be converted into Junction Type 3 with the outbound bus lane brought up to the stop line and inbound bus lane shared with a left-turn lane. Existing turning lane provision to be replicated in the proposed junction upgrade. All bicycle movements provided with separate signal control. Pedestrian signals on all 3 arms.
8	Coast Road	Existing signalised junction to be converted into Junction Type 3 with the outbound bus lane brought up to the stop line and inbound bus lane shared with a left-turn lane.

No.	Junction	Key Design Notes
		Existing turning lane provision to be replicated in the proposed junction upgrade. All bicycle movements provided with separate signal control. Pedestrian signals on all 3 arms.
9	Doughiska Road	Existing signalised junction to be converted into Junction Type 3 with the outbound bus lane shared with left-turn lane. Existing turning lane provision to be retained with the proposed junction upgrade. East arm of junction to tie directly into existing roadway. Inbound bus lane to start west of the junction. Provision of a new 50m length bus lane leading to the Stop line on the north arm of the junction. All bicycle movements provided with separate signal control. Pedestrian signals on all 4 arms.

Table 5-2: Moderate Junctions

No.	Junction	Key Design Notes
1	Renmore Park	Existing priority junction to remain as a priority junction with a continuous footpath/cycle track at the junction to reinforce pedestrian/cyclist priority on the R338 Dublin Road.
2	Connacht Hotel	Existing priority junction to remain as a priority junction with a continuous footpath/cycle track at the junction to reinforce pedestrian/cyclist priority on the R338 Dublin Road.
3	Flannery's Hotel	Existing priority junction to remain as a priority junction with a continuous footpath/cycle track at the junction to reinforce pedestrian/cyclist priority on the R338 Dublin Road.
4	Woodhaven	Existing priority junction to remain as a priority junction with a continuous footpath/cycle track at the junction to reinforce pedestrian/cyclist priority on the R338 Dublin Road.
5	Merlin Gate	Existing priority junction to remain as a priority junction. Existing access restrictions to and from the R338 Dublin Road to be removed. Provision of a continuous footpath/cycle track at the junction to reinforce pedestrian/cyclist priority on the R338 Dublin Road.

5.2.6 Minor and Priority Junctions

There are no minor or priority junctions in the proposed development that are not already listed above.

5.2.7 Roundabouts

No roundabouts are proposed as part of the proposed development.

5.3 Junction Modelling

5.3.1 Overview

Junction modelling was undertaken to enable understanding of the likely impact of the proposed development on the surrounding road networks traffic operations. The focus of the assessment was to ensure bus priority was maximised, whilst ensuring the overall movement of all modes through the junctions was maximised in particular via sustainable modes i.e. walking and cycling, whilst mitigating adverse traffic impacts.

The traffic modelling steps can be summarised as follows and further discussed in the subsequent sections:

- People Movement Calculator Assessment: The draft designs were assessed using a high level central concept of the optimisation of "People Movement" to optimise the available roadway space

and to provide a preliminary understanding of the typical green time proportion for each mode and provided an initial input for the Local Area Model (LAM) which was further refined using the simulation software LinSig and Microsimulation tools. Additionally, it is noted that the NTA's Western Regional Model (WRM) has been used as the primary tool to develop the strategic modelling of the proposed development by providing the multi-modal demand outputs for the assessed years

- Saturn Modelling–- LAM: The proposed development design and traffic signal operation was assessed within the Local Area Model (LAM) which is classified as a subset model of the NTA's Western Regional Model (WRM). The LAM outputs provided projected traffic flows providing a more detailed understanding of traffic clows at a local level in order to provide consistent outputs to inform this assessment;
- Design Optimisation: The proposed junction designs and signal timings were optimised in LinSig, in order to maximise people movement through the corridor and to minimise traffic dispersion off the corridor. Where performance issues such as poor overall capacity, inefficient stage green allocation or specific queues were identified, the junction layout was reviewed and a suitable mitigation or design solution was applied;
- Iterative process: The optimised junction designs and signal timings were fed back into the LAM and the above steps were repeated as part of an iterative process until a suitable level of operation was achieved;
- LinSig and Microsimulation: The optimised LinSig timings were used to inform the microsimulation model developed for the proposed development. The micro simulation assisted to support the junction designs and traffic control strategies and provided journey time information. The junction designs and signal timings were further optimised where necessary as a result of the microsimulation modelling; and
- Final Iterations: As part of the iterative process the optimised junction designs and signal timings were fed back into the LAM and the above steps were repeated to inform the final design and signal timings. The primary role of the micro-simulation model has been to support the ongoing development and optimisation of the junction design, traffic signal control and provides bus journey time information for reporting purposes.

Figure 5-4 illustrates an overview of the traffic modelling process for the proposed development.

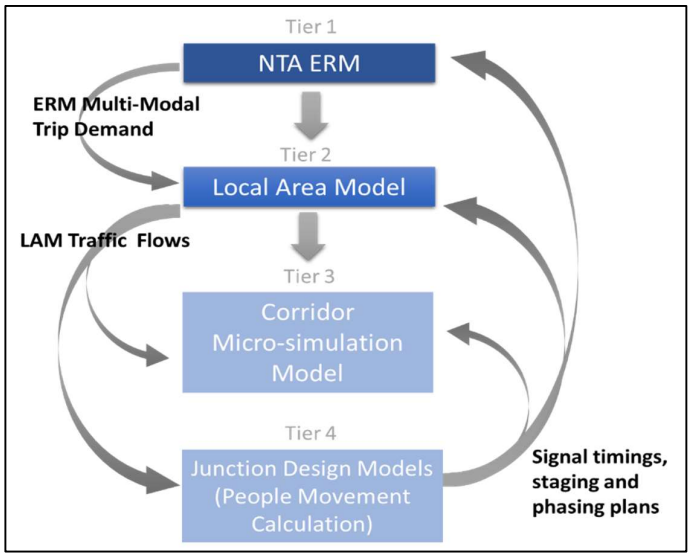

Figure 5-4: Proposed Development Traffic Modelling Hierarchy

5.3.2 People Movement

The design process for junctions has included assessments of the potential people movement throughput along the corridor of the proposed development. In order to understand the benefit of the proposed development with regards to the Movement of People following the implementation of the proposed infrastructure measures, a quantitative People Movement assessment has been undertaken using outputs from the NTA WRM and LAM and comparing the Do Minimum and Do-Nothing options.

People Movement is the concept of the optimisation of roadway space and/or the prioritisation of the movement of people over the movement of vehicles along the route and through the junctions along the proposed development. The aim being the reduction of journey times for higher capacity modes of transport (bus, walking and cycling), which in turn provides significant efficiencies and benefits to users of the transport network and the environment

A typical double-deck bus takes up the same road space as three standard cars but typically carries 50-100 times the number of passengers. On average, a typical double-deck bus carries approximately 60-70 passengers making the bus typically 20 times more efficient in providing people movement capacity within the equivalent spatial area of three cars. These efficiency gains can provide a significant reduction in road network congestion where the equivalent car capacity would require 50 or more vehicles based on average occupancy levels. Consequently, by prioritising the movement of bus over cars, significantly more people can be transported along the limited road space available. Similarly, cyclists and pedestrians require significantly less roadway space than general traffic users to move safely and efficiently along the route. Making space for improved pedestrian infrastructure can significantly benefit this sustainable mode and encourage greater use of this mode.

The traffic and transport chapter of the EIAR report (Chapter 6) and associated appendices presents the findings of the transport modelling and Traffic Impact assessments undertaken for the proposed development.

5.3.3 Assessment of Impacts

The methodologies that have been used to assess the potential traffic and transport impacts of the proposed development during both the Construction and Operational Phases have been carried out as follows:

- Outlining the Assessment Topics;
- Determining the Predicted Magnitude of Impacts;
- Defining the Sensitivity of the Environment; and
- Determining the Significance of Effects.

The above approach has been carried out in accordance with procedures described in the Environmental Protection Agency's (EPA) guidance on the information to be contained in EIARs (EPA 2022) and methodologies outlined in the 'Traffic and Transport Assessment Guidelines (TII 2014), using a Multi-Modal Level of Service (LoS) approach

The traffic and transportation impacts have been broken down into the following assessment topics for both the Construction and Operational Phases:

The qualitative assessments:

- Pedestrian Infrastructure: The changes to the quality of the pedestrian infrastructure as a result of the proposed development;
- Cycling Infrastructure: The changes to the quality of the cycling infrastructure as a result of the proposed development;

- Bus Infrastructure: The changes to the quality of the bus infrastructure as a result of the proposed development; and
- Parking / Loading: The changes to the availability of parking and loading as a result of the proposed development.

The quantitative assessments, which have been undertaken using the proposed development modelling tools described previously:

- People Movement: An assessment has been carried out to determine the potential impact that the proposed development will have on the projected volume of people (by mode – Walking, Cycling, Bus and General Traffic) moving along the proposed development during the Operational Phase only;
- Bus Performance Indicators: The changes to the projected journey times and reliability for buses as a result of the proposed development; and
- General Traffic: The direct and indirect impacts on general traffic using the proposed development and surrounding road network.

Chapter 6 of the EIAR outlines the magnitude and fully details the predicted impacts and methodology of the proposed development.

SECTION 6: GROUND INVESTIGATION AND GROUND CONDITION

6.1 Introduction

Following the selection of a preferred route, a desk study was undertaken along the length of the proposed development, and summarised in Section6.2. Based on the findings of this desk study, a ground investigation (GI) was designed and completed, and the results used to produce a Ground Investigation Report (GIR), which is included in Appendix H.

A summary of factual data, which has been gathered for the development, is provided in this section, with interpretation of design parameters. This report should be read in accordance with the GIR. This document were prepared in accordance with the procedures set out in TII Managing Geotechnical Risk DN-ERW-03083.

6.2 Desktop Review

The desktop study included review of publicly available datasets, current and historical aerial imagery and mapping, results of a site walkover, and existing historical GI.

The sources consulted during the desktop study and the resultant findings are detailed in the GIR in Appendix H. The following section provides a brief summary of the desktop study.

6.2.1 Land Use

The following is a summary of the land use along the proposed development as determined from the desk study:

- Between the production of the earliest mapping reviewed (1829 – 1842) and the current aerial imagery, the land-use has transitioned from a predominantly agricultural use, with isolated buildings scattered throughout, to a predominantly residential use.
- At the eastern end of the corridor, aerial photography from 1995 shows the construction of the current N67 connection carriageway between the R339 and the later removed Martin Roundabout.
- Aerial photography from 1995 onwards shows the progressive development of the urban landscape. Substantial urban development had already taken place west of Skerritt Roundabout by 1995, and ongoing aerial imagery highlighted further development at the eastern end of the proposed development.
- As well as urban fabrics, the area around the proposed development today also includes Merlin Woods, classified as mixed forests, and Merlin Meadows, classified as pastures.
- There are no active quarries identified in the vicinity of the proposed development - the closest known active quarry is Two Mile Ditch Quarry located approx. 3km to NNE from Skerritt Roundabout. The quarry produces aggregates and fill materials.
- There is one (1 no.) historical quarry in the vicinity of the proposed development. The historical limestone quarry is located approximately 850m to the SE from the end of the proposed development.
- The Galway Bay Complex SAC, the Inner Galway Bay SPA, and the Galway Bay Complex pNHA are the closest NPWS designated protected sites, with the westernmost point of the development being 150m away from any of these sites. In addition, the Merlin Meadows are affiliated to the Annex I habitat Lowland Hay Meadows.

6.2.2 Ground Conditions

The following is a summary of the ground conditions underlying the proposed development as determined from the desk study:

- The topography along the proposed development is undulating, varying from approximately 8mOD to 38mOD.
- The geomorphology includes SW-NE oriented streamlined bedrock at the eastern end of the proposed development, and two elongated drumlins, aligned SSW-NNE, where the NNE ends of the drumlins are approaching the proposed development at its western end.
- The proposed development is primarily underlain by till derived from limestone. The western end of the proposed development from Lough Atalia to Bon Secours Hospital is classified as urban. Karstified bedrock outcrops or suboutcrops are located to the north and south of the proposed development along the Merlin Woods.
- The proposed development is underlain by the Burren Formation, a pale grey clean skeletal limestone, formed during the Carboniferous Period.
- Six (6 no.) karst features are identified in the surrounding area, where the closest identified karst feature is 45m from the proposed development.
- Two (2 No.) county geological sites (CGSs), Merlin Park Quarry and Merlin Park Cave, are found along the proposed development. The proposed development borders the northern boundary of Merlin Park Cave CGS. Merlin Park Quarry is situated approx. 92m to the north of the proposed development.
- No legacy landfills are identified along the proposed development. The Merlin Park Quarry is the only identified disused quarry in the vicinity of the proposed development, and is the only potential source of contaminated land identified from the desktop study.
- There are no recorded historical landslide events in the vicinity of the proposed development. Landslide mapping classified the western side of the proposed development as “made”, and the eastern side as having low to moderately low landslide susceptibility, with a localised area of moderately high susceptibility located around a bedrock outcrop at the eastern end.

6.2.3 Hydrological and Hydrogeological Conditions

The following is a summary of the hydrological and hydrogeological conditions along the proposed development as determined from the desk study:

- The only surface water feature identified in proximity to the proposed development corridor is part of the river Corrib estuary called Lough Atalia, which is located approximately 150m to the SW of the western end of the proposed development.
- The proposed development is not identified as being at risk of coastal or fluvial flooding. The nearest identified area of potential flooding is a low probability coastal flooding approximately 200m to NWW from the beginning of the proposed development.
- The proposed development is situated within a Regionally Important Karstified Aquifer characterized by conduit flow, associated with the Burren Formation.
- The Clarinbridge groundwater body (GWB) (IE_WE_G_0008) underlies the proposed development and has a GWB status of ‘Good’ under the Ground Waterbody WFD 2016-2021.
- The groundwater vulnerability classification along the proposed development ranges from “Moderate” to “Extreme”, “High” and “Extreme” vulnerability underly approximately 80% of the route. The central area around Skerritt Roundabout is highly vulnerable. The eastern end is classified as extremely vulnerable. Also, on the eastern side of the proposed development, at Rosshill Park Woods and Merlin Meadows, rock at or near surface or karst is identified as part of the extremely vulnerable area.
- Groundwater recharge for the regionally important aquifer ranges from 151 to 700 mm/yr across the proposed development.
- Two (2 no.) wells are identified in the vicinity of the proposed development. The proposed development does not lie within a Group Scheme or Public Supply Source Protection Area.

6.3 Project Specific Ground Investigation

The following site-specific ground investigations have been completed at the site, and are detailed further in the GIR included in Appendix H:

- Minerex Geophysics Ltd, 2023. A non-intrusive geo-physical survey was carried out over the footprint of the proposed development to determine the ground conditions under the site, to determine the depth to rock and the overburden thickness, to estimate the strength or stiffness or compaction of overburden and the rock quality, and to detect possible karstified rock.
- IGSL, 2023. Intrusive ground investigation carried out over the entire footprint of the proposed development to determine the ground and groundwater conditions to assist the preliminary design of the proposed development.

A site walkover was also carried out by Barry Transportation in advance of ground investigation plant mobilising to site. This informed some on-site repositioning of exploratory holes to better facilitate access for plant and personnel.

6.4 Ground Model

The proposed development is located on the Dublin Road, Galway. Most of the area has been developed and is covered by a layer of made ground varying in thickness from 0.2 to 0.9m. The deposits in Rosshill Park Woods and the deposits in Merlin Meadows, the farmland at the northeast end of the proposed development, and are non-anthropogenic, and are covered by natural topsoil. The made ground is generally underlain by cohesive glacial till such as clays, but silts are also present is smaller quantities.

The entirety of the proposed development is underlain by limestone bedrock belonging to the Burren Formation, which is a Regionally Important Karstified Aquifer characterized by conduit flow. Six (6 no.) karst features have been identified from the GSI database, such as springs, enclosed depressions, and a swallow-hole, with two (2 no.) additional karst features identified from the results of the Minerex Geophysics Ltd 2023 geophysical survey completed along the proposed development.

Five (5 no.) groundwater strikes in the limestone varied from approximately 5.1 to 12.4, and one (1 no.) groundwater strike was recorded at 7.4 mBGL in a clay layer. Data loggers installed in three (3 no.) standpipes have recorded groundwater readings at depths ranging from 4.56 to 6.98 mBGL. Groundwater monitoring for a 12-month period is scheduled to capture seasonal variation. The readings began on 10/04/2024 and will continue until April 2025.

The material types considered significant to proposed development geotechnical design are:

- Topsoil;
- Made ground
- Granular glacial till;
- Cohesive glacial till; and
- Bedrock.

Table 6-1 summarises the interpreted general stratigraphy encountered along the proposed development. It is worth noting that the GI points were carried out adjacent to the alignment of the existing road. Therefore, the ground model does not include the build-up of the existing pavement and foundation layers.

Table 6-1: General Stratigraphy along Proposed Development

Stratum	Description	Depth to Top of Stratum (m BGL)	Thickness of Stratum (m)
Topsoil	-	0	0.1 – 0.6

Stratum	Description	Depth to Top of Stratum (m BGL)	Thickness of Stratum (m)
Made Ground	Firm brown sandy gravelly CLAY with medium cobble content and boulders up to 50cm. Sand is medium. Gravel is subrounded to subangular, fine to course.	0 – 0.8	0.2 – 0.9
Cohesive Glacial Till	Firm grey brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is medium. Gravel is subrounded to subangular, fine to course	0.1 – 8.0	0.1 – 5.7
	Firm to soft grey sandy gravelly SILT with high cobble content and boulders and cobbles up to 60cm. Sand is course. Gravel is subrounded to subangular, fine to course.	0.3 – 3.7	0.2 – 2.3
Granular Glacial Till	Brown grey clayey sandy GRAVEL with high cobble content and boulders up to 80cm. Sand is course. Gravel is subrounded to subangular, fine to course	0.2 – 6.0	0.5 - 3.5
	Grey brown slightly gravelly SAND. Sand is fine. Gravel is subangular to subrounded, fine to course.	0.3 – 1.8	0.3 – 0.9
Bedrock	The Burren Formation – Weak structureless to very locally thinly bedded, pale to dark blueish grey/black, fine-grained LIMESTONE, moderately weathered	1.4 – 6.0	2.0 – 6.6
	The Burren Formation – Strong to very strong, thickly to thinly bedded, pale to dark blueish grey/black. Fine grained, LIMESTONE. Fresh to locally slightly weathered	2.0 – 11.2	Unknown

6.5 Preliminary Geotechnical Design Parameters

This section summarises the geotechnical parameters proposed for the material types anticipated along the proposed development. The GIR (Appendix H) outlines the methodology adopted and the results of laboratory and in-situ tests used to derive the selected geotechnical parameters.

6.5.1 Topsoil

Topsoil was encountered across most of the ground investigation exploratory holes located across all three sections of the development. Topsoil material was typically recorded from ground surface to a depth of 0.3 m. Topsoil can comprise a combination of clay, silt and sand particles and characteristically contains a significant root matter and organic content.

Design parameters for Topsoil have not been determined, as it will not be used in earthwork fill and will be suitable for reuse only as Class 5A Topsoil material in accordance with the TII Specification for Road Works Series 600 – Earthworks (CC-SPW-00600) (TII, 2013).

6.5.2 Made Ground

Made ground is highly present along the proposed development, with thickness varying from 0.2 to 0.9m where present. Made ground often exhibits varying degrees of compaction, heterogeneity and grain size. Made ground is highly variable across the site and has been described as deposits ranging from soft to firm gravelly clay to gravelly cobbles, with brick fragments, metal wires, concrete and building materials present.

During the investigation, no visual or olfactory evidence of contamination was noted. The contractor shall carry out Waste Acceptance Criteria testing on any material that is not suitable for reuse, which will be sent to a suitable disposal facility.

6.5.3 Cohesive Glacial Till

Cohesive glacial till (CGT) is the predominant component of the overburden encountered across the proposed development. Deposits comprise fine soils described as very soft to stiff sandy gravelly CLAY with low to high cobble content. Gravel is subrounded to subangular, fine to coarse. Limited quantities of silt deposits were identified in the proposed development. The thickness of the CGT varies from 0.1 to 5.7m.

6.5.4 Granular Glacial Till

Deposits of granular glacial till (GGT) comprise coarse soils and were found in limited quantities, generally in the eastern half of the site. They are described as brown to grey variably silty and variably clayey SAND, GRAVEL, and COBBLES. The gravel is generally described as fine to course, subrounded to angular. The cobbles are generally described as subangular to angular. Where reported, the GGT is derived from limestone, and varies from 0.3 to 3.5m in thickness.

6.5.5 Bedrock

The proposed development is underlain by the Burren Formation. The Burren Formation is described as pale grey clean skeletal limestone, formed during the Carboniferous Period. Typically, the uppermost metre of the bedrock is weathered and consists of cobbles. Bedrock is described as strong to very strong, thickly to thinly bedded, pale to dark blueish grey/black, fine-grained, LIMESTONE (locally fossiliferous, chert throughout), fresh to locally slightly weathered.

The limestone bedrock of the Burren Formation includes eight (8 no.) karst features, identified both from GSI karst feature mapping, and from the results of the geophysical investigation.

6.5.6 Summary of Geotechnical Parameters

The recommended characteristic values for the encountered geological strata across the site, as detailed in the GIR, are summarised in Table 6-2. It should be noted that a location specific ground model with corresponding geotechnical parameters should be adopted when undertaking any design in accordance with IS EN 1997-1.

Table 6-2: Summary of Characteristic Parameters

Parameter	Unit	Made Ground	Cohesive Glacial Till	Granular Glacial Till	Limestone
Bulk Density	Mg/m³	-	1.9-2.3 (2.1)	1.6–2.3 (2.0)	2.66
Peak angle of shearing resistance	Degrees °	-	24-32 (30)	28-41 (33)	-
Drained Cohesion (c')	kPa	0	0	0	-
Undrained Shear Strength (S_u)	kPa	20	= -18z - 14, where z = depth	-	-
Coefficient of Volume Compressibility (m_v)	MN/m²	-	0.15	-	-
Permeability	m/sec	1×10^{-8}	1×10^{-9}	1×10^{-8}	-
Undrained Elastic Modulus (E_u)	MPa	-	600 *S_u	-	-
Drained Stiffness (E')	MPa	-	E_u * 0.76	46	-
Unconfined Compressive Strength (UCS)	MPa	-	-	-	70

6.5.7 Groundwater

During the 2023 intrusive GI, there were 5 No. groundwater strikes recorded at depths ranging from 5.1 to 12.4 m bgl in the limestone bedrock and 1 No. groundwater strike recorded at 7.4 mBGL in a clay layer.

Four (4 no.) standpipes were installed as part of the 2023 site investigation between 30/10/2023 and 08/11/2023, of which three (3 no.) are monitored with a data logger. Groundwater readings have been recorded in these three standpipes at depths ranging from 4.56 to 6.98 mBGL. Groundwater monitoring for a 12-month period is scheduled to capture seasonal variation. The readings began on 10/04/2024 and will continue until April 2025.

A characteristic groundwater level of 3 mBGL has been chosen for design purposes.

6.6 Geotechnical Engineering Assessment

The following section provides a brief summary of the geotechnical engineering assessment.

6.6.1 Geotechnical Category of the Project

The proposed geotechnical works are categorised as 'Geotechnical Category 2', in accordance with IS EN 1997-1:2005 (NSAI, 2005). Geotechnical category 2 developments include conventional types of structure and foundation with no exceptional risk or difficult soil or loading conditions.

6.6.2 Summary of Proposed Works Requiring Geotechnical Engineering

The majority of the proposed development is at-grade and cuttings will not be required to achieve the required vertical alignment levels. However, embankments shall be required at some chainages, for widening existing roads. In addition, one (1 no.) retaining wall and two (2 no.) attenuation tanks shall be designed for the proposed development.

6.6.3 Fill Classes

Engineering Fill shall be required on this project for the construction of the embankments and backfill to proposed structures. The primary types of fill materials required, which are classified in accordance with Table 6/1 and Table 6/2 of TII Specification for Road Works (CC-SPW-00600 series), include the following:

- General granular fill (Class 1).
- General cohesive fill (Class 2) – consisting of fine–grained glacial till of adequate remoulded undrained shear strength.
- Selected uniformly graded granular material (Class 6B/C) – for use as a starter layer.
- Selected coarse granular material / uniformly graded granular material (Class 6B1/C1) – for use in steepened embankments.
- Selected granular fill (Class 6F1/6F2/6F3) – capping.
- Selected granular fill (Class 6N1) – for use as a fill to structures.
- Selected granular fill (Class 6N2) – for use as a fill below structures.

6.6.4 Reuse of Excavated Materials

The three primary areas where reusable materials may arise is the excavated arising from structures STR_RW_01 (Corrib Great Southern Site Retaining Wall), STR_TK_02 (Attenuation Tank No. 1) and STR_TK_02 (Attenuation Tank No. 2). A review of the GI data from these areas indicate that the material won will comprise primarily topsoil, CGT, and limestone bedrock.

The limestone bedrock is identified as “hard digging” at attenuation tank 1 and 2, though it is only expected to be encountered at attenuation tank 1.

Reusability estimates are summarised in Table 6-3.

Table 6-3: Summary of Material Reusability

Material Type	Earthworks Material Classification	Reusability Estimate (%)	Comment
Topsoil	5A	100	Topsoil stripped from the site is generally expected to be re-usable subject to appropriate handling and storage
Made Ground	2C2 or 6	50-80	Present as reworked CGT, bituminous material, and pavement foundation material
Cohesive Glacial Till	2C2	80	Present generally as a competent stony cohesive material with moderate to low fines content
Granular Glacial Till	1	90	Present as a well graded to coarse granular material
Limestone	1 or 6	100	Weathered limestone bedrock: Limestone that has undergone either

Material Type	Earthworks Material Classification	Reusability Estimate (%)	Comment
			physical or chemical weathering. Encountered in situ with clay infills but anticipated to be clean enough for processing as Class 1. Further testing required to demonstrate compliance for Class 6 Limestone bedrock: Intact rock with strength of moderately to medium strong or better would be suitable for processing as Class 1. Further testing required to demonstrate compliance for Class 6

The contractor shall carry out Waste Acceptance Criteria testing on any material that is not suitable for reuse, which will be sent to the relevant suitable disposal facility.

6.6.5 Areas of Cut

The majority of the proposed development is at-grade and cuttings will not be required to achieve the required vertical alignment levels.

6.6.6 Areas of Fill

The greenfield sites from chainages 2+200m to 3+900m currently sit below the existing road level; in order to widen the road, an embankment will be required. The proposed embankment ranges from 0m to roughly 4.0m in height.

Where possible, excavated material shall be reused on site. Where additional material is to be imported, the fill material shall be in accordance with Transport Infrastructure Ireland Specification for Roadworks Series 600.

6.6.7 Retaining Wall STR_RW_01

The proposed retaining wall is a mass concrete gravity retaining wall with a maximum exposed face height of 2.4m and a length of 83m. The retaining wall shall be backfilled with a Class 6N1 material, with a Class 6H material acting as the drainage layer at the retaining wall interface.

The proposed retaining wall is expected to be founded on a thin layer of GGT, or on firm to stiff CGT. Rock is not likely to be encountered during the excavation. If localised soft spots are encountered during construction works, this material will have to be excavated and replaced with a granular fill material (i.e. 6N2).

Retaining walls shall be assessed for bearing capacity, settlement, sliding and overturning in accordance with IS EN 1997:1.

6.6.8 Attenuation Tank 1 STR_TK_02

The Attenuation Tank is located from Ch 3+480 to Ch 3+555 and comprises of a 75m x 5m x 3m (L x W x H) reinforced concrete tank which will sit on a concrete blinding underlain by a Class 6N2 fill. The excavated area shall then be backfilled to ground level using a Class 6N1 material.

The proposed attenuation tank is expected to be founded on weathered and karstified limestone bedrock. A karst features protocol, shall be applied at this structure.

6.6.9 Attenuation Tank 2 STR_TK_02

The Attenuation Tank is located from Ch 2+700 to Ch 2+785 and comprises of an 85m x 5m x 3m (L x W x H) reinforced concrete tank which will sit on a concrete blinding underlain by a Class 6N2 fill. The excavated area shall then be backfilled to ground level using a Class 6N1 material.

The proposed attenuation tank is expected to be founded on firm CGT. If localised soft spots are encountered during construction works, this material will have to be excavated and replaced with a granular fill material (i.e. 6N2). A karst features protocol, shall be applied at this structure.

6.6.10 Pavement Design

The proposed development includes widening of existing and construction of new pavements as detailed in Chapter 7.

A preliminary design long term stiffness of 35 MPa has been adopted for the sub grade material in the pavement design, based on a sandy clay subgrade material. This is a conservative value using the lowest plasticity index values from the GI and determining a corresponding long term stiffness value. A high water table was conservatively assumed with average construction conditions, and a thin pavement thickness.

Prior to construction, the short-term stiffness of the subgrade shall be determined by a test method specified in DN-PAV-03021.

Where the short-term stiffness of the subgrade at any location is found to be less than the design long-term stiffness, the subgrade will require ground improvement to achieve the design long term stiffness, or the pavement design adjusted to incorporate the short-term stiffness of the subgrade.

A capping thickness of 400mm with a subbase of 150mm would be considered suitable for preliminary design purposes, dependant on the thickness of the overlying pavement layers.

SECTION 7: PAVEMENT, KERBS, FOOTWAYS AND PAVED AREAS

7.1 Pavement

This section identifies the proposed pavement strategy, setting out the design development considerations for the pavement works in current and future design stages. It also outlines the key elements for consideration for future testing requirements, and considerations for the use of recycled aggregates in the detailed design stage.

7.1.1 Overview of Pavement

The road pavement design for the proposed development considers rehabilitation of the existing road pavement and new road pavement construction resulting from road widening or changes in geometry along the development extents. The details of the preliminary pavement design can be found on the PAV_PV Pavement Treatment Plans and GEO_CS Typical Cross Section drawing series. It should be noted that the pavement boxing shown on the typical cross section series has been shown indicatively only for the purposes of demonstrating areas of full depth reconstruction.

The nature of the works associated with the proposed development is to generally widen the existing carriageway or reallocate existing road space to facilitate bus and cycle infrastructure. Existing footpaths and existing traffic lanes will also be impacted by the works. In general, all existing footpaths will be required to be removed and reinstated resulting from the realignment/widening works. Similarly, existing traffic lanes may be required to undergo pavement rehabilitation due to existing defects or pavement reconstruction works due to road realignment works or a pavement inlay/overlay treatment due lane marking reallocation.

The preliminary design of pavement assets is based on the following standards:

- DN-PAV-03021 (Dec. 2010) – Pavement and Foundation Design;
- DN-PAV-03023 (Jun. 2020) – Surfacing Materials for New and Maintenance Construction for use
- in Ireland;
- AM-PAV-06050 (Mar. 2020) – Pavement Assessment, Repair and Renewal Principles;
- PE-SMG-02002 (Dec. 2010) – Traffic Assessment;
- CC-SPW-00600 (Mar. 2013) – Specification for Road Works Series 600 – Earthworks;
- CC-SPW-00700 (Jan. 2016) – Specification for Road Works Series 700 – Road Pavements – General;
- CC-SPW-00800 (Mar. 2013) – Specification for Road Works Series 800 – Road Pavements – Unbound and Cement Bound Mixtures; and
- CC-SPW-00900 (Sep. 2017) – Specification for Road Works Series 900 – Road Pavements – Bituminous Materials.

The different pavement assets are designed taking consideration of:

- Changes in road geometry;
- Existing pavement construction build-up;
- Existing pavement condition;
- Landscape Architect's requirements; and
- The impact of other assets such as drainage, utilities, and structures.

7.1.2 Design Constraints

Geometry Considerations

The proposed development will run on existing pavement assets, within constrained urbanised environments. It is therefore essential for the preliminary pavement design to consider the current road geometry and how it is proposed to be amended for the purpose of the proposed development.

The following road geometry changes expected to have an impact on the preliminary pavement design are:

- Widening;
- Narrowing;
- Horizontal realignment leading to relocation of pavement longitudinal joints
- (in relation to location of wheel tracks);
- Increase in vertical alignment;
- Decrease in vertical alignment;
- Relocation of traffic islands; and
- Any combination of the above.

Widening

Widening is about extending transversely a rehabilitated existing pavement ensuring that the pavement structure shall be consistent from kerb to kerb and drainage paths are being maintained. It is therefore essential to understand what the existing pavement construction and condition is, as well as how it will be rehabilitated, before finalising the design of any widening.

It is proposed that any widening will be the full width of any proposed new lane, be it a cycle lane, a bus lane or a general traffic lane. The widened lane will be tied to the existing pavement as per transverse and longitudinal joint details CCSCD-00704 – Pavement – Longitudinal Joint Between New Construction and Existing Road (Dec. 2010) and CC-SCD-00703 – Pavement – Transverse Joint Between New Construction and Existing Road (Sep. 2010).

Narrowing

Narrowing the pavement is the least disturbing geometrical change. Attention should however be given to the location of longitudinal joints in the existing pavement if the alignment of the traffic lanes is being shifted one way or the other. No longitudinal joint should be located in the wheel tracks.

It is proposed for any narrowing to be limited, in terms of excavation, to the area between the existing and the proposed kerb lines.

Horizontal Realignment

Usually combined with a widening or a narrowing, a change in lanes alignment will result in the relocation of wheel tracks on the transverse profile of the pavement. If it leads to the relocation of the wheel tracks above an existing pavement joint, pavement works are required to prevent accelerated deterioration. Those pavement works could consist of the relocation of longitudinal joints in the binder and surface courses, by renewal of both layers. A geotextile would also be installed on top of the longitudinal joint in the base course to delay reflective cracking.

Increase in Vertical Alignment

Where the vertical alignment is proposed to be increased, the do-minimum treatment will be removal of the existing surface course before overlaying to the new finish level. In some instances, poor condition of the underlying layers may lead to deeper rehabilitation works. The use of regulating layers and materials is likely to be required.

Decrease in Vertical Alignment

Where the vertical alignment is proposed to be decreased, the do-minimum treatment will require the pavement to be cold milled down to the proposed finished level of the binder course, as a minimum.

If the bond between the layer being cold milled into and the underlying layer is weak (i.e. the planer removed the material down to the interface at some locations), cold milling will be extended to this interface. In some instances, poor condition of the underlying layers may lead to deeper rehabilitation works. The use of regulating layers and materials is likely to be required.

Relocation of Traffic Islands

Existing traffic islands to be relocated or removed will be fully excavated, while proposed traffic islands may use the existing pavement as foundation where appropriate.

7.1.3 Existing Pavement Considerations

Construction

As mentioned in the section above on geometrical constraints, as the proposed development is running on existing pavement assets, it is essential to gather intelligence on those existing assets in terms of construction build-up and condition.

Prior to detailed design of the proposed development, an investigation of existing pavement makeup will be completed. It is proposed for a Ground Penetration Radar (GPR) survey to be procured with pavement cores to be taken at regular intervals to allow for the calibration of the GPR. Such survey would generate the following datasets essential for the pavement design:

- Depth of unbound granular materials;
- Depth of rigid materials (concrete);
- Depth of bituminous materials;
- Detailed pavement build-up (number of layers and their associated thicknesses – bound materials only);
- Condition of the bound materials;
- Condition of the interlayer bonds;
- Condition of the foundation layer(s) through the use of Dynamic Cone Penetrometer (DCP) testing; and
- Likely presence of tar contaminated materials.

Required Surveys

Condition data requirements, including surveys, will be required at Detailed Design stage in order to develop and implement Pavement Rehabilitation strategies. Those requirements shall be in line with AM-PAV-06050 (Mar. 2020).

7.1.4 Pavement Design

Pavement Materials

At Detailed Design stage, the selection of appropriate pavement materials should be undertaken with the following considerations:

- Which pavement structure is the most appropriate and compatible with the existing pavement? (i.e. Fully flexible vs. Rigid pavement structure); and

- Which materials are most appropriate from a noise, permeability, colour, texture, etc. perspective?; and
- Which materials, from a lifecycle perspective, provide the best value in terms of environmental impact, durability, maintainability, repairability, recyclability, cost, etc.?

Specific materials should be selected for specific loading areas.

The ambition in terms of pavement materials is to reuse or recycle all of the excavated materials. The specification of materials and processes with a reduced environmental impact will be prioritised.

The Landscape Architect's design will be considered at Detailed Design stage to identify the choice of surfacing materials which will in turn dictate the choice of materials used for the underlying footpath and off-road cycle track structure.

For bituminous footways and off-road cycle tracks, the bituminous layer(s) could make use of as much recycled material as possible. Low Energy Bound Mixtures (LEBM) should be considered as an alternative to the conventional Asphalt Concrete (AC), Hot Rolled Asphalt (HRA) and Stone Mastic Asphalt (SMA) mixtures.

Pavement Structures

The appropriate pavement structures for footpaths and off-road cycle tracks will be defined at Detailed Design stage.

Opportunities for Innovation

Innovative materials and processes delivering enhanced environmental, social and financial benefits are being promoted in the ongoing pavement design process.

Reuse and Recycling Considerations

Opportunities for reuse and recycling of secondary materials have and will continue to be identified and quantified throughout the Specimen Design process.

Current opportunities include but are not limited to:

- Excavated capping layer material to be reused as new capping material if compliant with current standards;
- Excavated subbase layer material to be reused as new subbase material if compliant with current standards;
- Up to 50% of capping and subbase materials can be substituted with Reclaimed Asphalt;
- Concrete base to paved areas to make use of Recycled Aggregate, Recycled
- Concrete Aggregate and more sustainable hydraulic binders (e.g. CEM III/A);
- Concrete footways to also make use of more sustainable hydraulic binders (e.g. GGBS);
- Jointing and bedding mortars used in the construction of paved areas could contain recycled materials;
- Aggregate for base/binder layer for off-road cycle tracks to be 100% Reclaimed Asphalt (Low Energy Bound Material – LEBM).

7.2 Kerbing

The kerbing type selected along the proposed development is primarily dependent upon the presence of a cycle track alongside the carriageway. Where cycle tracks will be present adjacent to the carriageway, the cycle track will be separated by the typical 250mm wide kerb, which will have a 120mm upstand to the carriageway and a 60mm upstand to the cycle track (120mm upstand where cycle track is not raised) as shown in Figure 7-1.

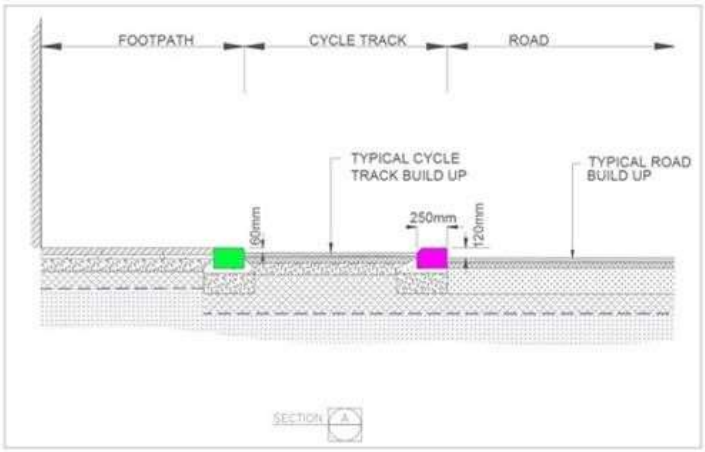

Figure 7-1: Typical Kerb Arrangement for Cycle Tracks

Where this kerb will cross at an uncontrolled junction and at direct accesses, the Raised Table Priority Junction Treatment (Figure 7-2) will be implemented at the majority of locations. At these locations, the kerb will be lowered to a 60mm upstand while the cycle track will be raised throughout.

At controlled and signalised junctions, the cycle track will be ramped down to the carriageway level and the kerb will be transitioned to carriageway level and terminated.

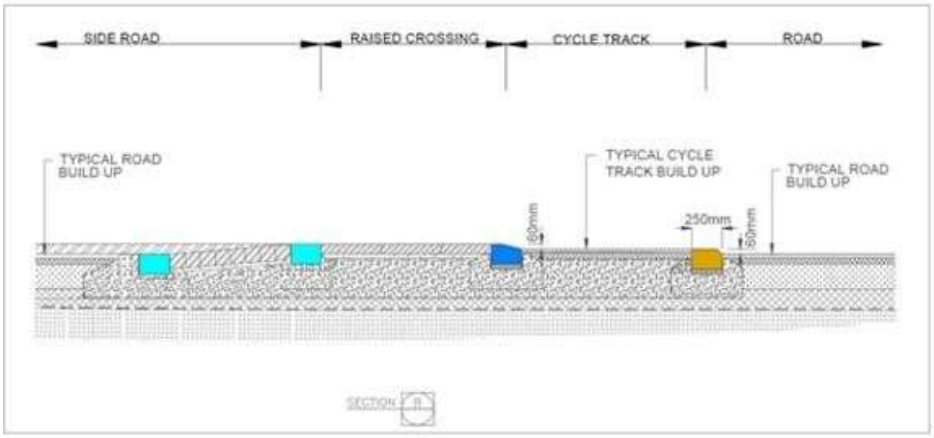

Figure 7-2: Kerb Treatment at Raised Table Priority Junction

At locations where a footpath will be located adjacent to a cycle track, a half battered kerb with a 60mm upstand is proposed. This 60mm high vertical kerb will be required to ensure that the kerb is properly detectable by visually impaired pedestrians using the footpath.

At locations where a cycle track is not present, and the footpath is adjacent to the carriageway, a standard 125mm upstand is proposed. Dropped and transition kerbs will be provided at driveways and pedestrian crossings.

SECTION 8: STRUCTURES

8.1 Overview of Structures Strategy

The proposed development requires a new mass gravity retaining wall which can be classified as a Principal Structure. Principal Structures are defined as those that require technical approval following the processes outlined in TII Publication DN-STR-03001 (Technical Acceptance of Road Structures on Motorways and Other National Roads).

8.1.1 Bridges and Bridge Sized Culverts

There is no impact on existing bridges, nor is there a requirement for new bridges on this development.

8.1.2 Retaining Walls

Retaining walls with a retained height greater than 1.4 m are classified as principal structures. There is a retaining wall with a retained height greater than 1.4m contained within the development. The retaining wall is proposed along Dublin Road. A mass gravity retaining wall of length 82.35m, and of approximate maximum height 3.3m, is proposed on the north side of Dublin Road. The approximate maximum retained height is 2m.

SECTION 9: DRAINAGE, HYDROLOGY & FLOOD RISK

9.1 Overview of Drainage Strategy

The drainage preliminary design was developed following consultation with Galway City Council. The design basis statement was in accordance with the Planning requirements of Galway City Council and those of Transport Infrastructure Ireland (TII).

The principal objectives of the drainage design are as follows:

- To drain surface water from existing and proposed pavement areas throughout the Bus Connects Galway - Dublin Road development.
- To minimise the impact of the runoff from the carriageway on the surrounding environment using techniques such as SuDS features, silt traps, attenuation structures and petrol interceptors amongst others. These measures will reduce the flow volume of the pavement runoff discharging to the receiving environment. They measures will also improve the water quality of the pavement runoff, by reducing suspended particles and contaminants.

9.2 Existing Watercourses and Culverts

There are no existing watercourses and culverts crossing the proposed development.

9.3 Existing Drainage

Prior to commencing the drainage design, the extents of the existing foul and surface water drainage system within the route corridor was determined. This was achieved by reviewing all the available information, including, but not limited to; Topographical survey, Ground Penetrating Radar (GPR), Irish Water and Local Authority GIS databases. Based on the information received from Irish Water and Galway City Council it was found that the study area is serviced by surface water and combined drainage networks (convey foul and surface water flows). The surface water drainage system is managed by Galway City Council, whilst combined sewer systems are managed by Irish Water. Flows are typically collected in standard gully grates and routed via a gravity network to outfall points. There are no formal SuDS/attenuation measures on the existing drainage networks to treat or attenuate run-off from the existing highway. There are some grassed areas and trees adjacent to paved areas which will provide some treatment of surface water runoff, but these have not been designed specifically as SuDS features.

A study based on information supplied by Irish Water and Galway City Council, indicated that the study area is split across seven catchments. The catchment areas, their outfalls and other relevant details are shown on the existing Catchment Area Assessment drawings within Appendix B. The catchments are summarised in Table 9-1 below;

Table 9-1: Summary of Existing Catchments

Existing Catchment Reference	Drainage Catchment Area (km^2)	Existing Network Type	Existing Outfalls
Catchment Area 1	3.250	Surface Water	Network outfalls to the Corrib Estuary via Lough Atalia
Catchment Area 2	0.160	Surface Water	Network outfalls to the Corrib Estuary via Lough Atalia

Existing Catchment Reference	Drainage Catchment Area (km^2)	Existing Network Type	Existing Outfalls
Catchment Area 3	0.180	Combined Sewer	Network outfalls to Mutton Island Wastewater Treatment Plant
Catchment Area 4	0.600	Surface Water	Network outfalls to the Corrib Estuary near Mellows Pitch & Putt
Catchment Area 5	2.820	Surface Water	Network outfalls to the Corrib Estuary near Ballyloughane Strand SAC
Catchment Area 6	2.980	Surface Water	Network outfalls to the Corrib Estuary North of Rabbit Island
Catchment Area 7	1.690	Surface Water	Network outfalls to Oranmore Bay

9.4 Overview of Impacts of Proposed Works on Drainage / Runoff

The proposed route corridor was divided into 9 no. drainage networks. The positioning of the high and low points across the existing road topography formed the basis to determine the extents of each network and the location of suitable outfall points. All 9 drainage networks outfall into an existing storm drainage connection. A list of the network references and the changes in pavement area is provided in Table 9-2 below.

The extents of the proposed surface water drainage networks and their details are provided on drawings BCGDR-BTL-DNG_RD-XX-DR-CD_0001 to 00011_Surface Water Drainage.

Table 9-2: Summary of Increased Permeable and Impermeable Areas

Existing Catchment Reference	Network Reference	Chainage (m)	Road Corridor Area (m^2)	Change in Impermeable areas (m^2)	Change in Permeable areas (m^2)	Net Change in Impermeable areas (m^2)	Percentage Change (%)
Catchment Area 1	Network 1	0+000 to 0+360	8083	1726	322	1404	17
Catchment Area 3	Network 2	0+360 to 0+630	6241	656	38	618	10
Catchment Area 5	Network 3	0+630 to 1+140	12361	1884	686	1198	10
Catchment Area 5	Network 4	1+140 to 1+370	7171	1872	459	1413	20
Catchment Area 5	Network 5	1+370 to 1+650	9973	-958	1503	-2461	-25
Catchment Area 6	Network 6	1+650 to 2+175	12127	2461	0	2461	20
Catchment Area 6	Network 7	2+175 to 3+030	18820	3868	29	3839	20
Catchment Area 7	Network 8	3+030 to 3+800	19463	483	2108	-1625	-8

Existing Catchment Reference	Network Reference	Chainage (m)	Road Corridor Area (m^2)	Change in Impermeable areas (m^2)	Change in Permeable areas (m^2)	Net Change in Impermeable areas (m^2)	Percentage Change (%)
Catchment Area 7	Network 9	3+800 to 3+880	3310	373	0	373	11

9.4.1 Method of Design

The design rational is Outlined in Table 9-3 below.

Table 9-3: Drainage Design Steps

Design Step	Details
Step 1 – Define Drainage Catchments	The proposed development was first split into seven existing catchments as described in Section 9.3. The proposed route corridor was then split into 8 drainage networks. These networks were based on the road topography, the extents of the newly paved areas and the locations of the existing drainage networks.
Step 2 – Define Outfalls	The proposed outfall locations for newly paved areas were identified as either: • An existing drainage network; or • An appropriate watercourse (It was found none of the proposed networks could outfall directly to a watercourse) • Existing topography low points i.e. Networks 7 and 8.
Step 3 – Develop Network	A concept design for each catchment drainage network was developed. Where there was no change in the pavement area within a catchment, the existing drainage network was retained. Where existing drainage networks were reused, the locations of gullies were altered, and kerb drainage units provided as required.
Step 4 – Design SuDS Requirements	Where practicable, SuDS measures were incorporated into the design.
Step 5 – Design Treatment Requirements	Treatment was provided by the use of gully pots, petrol interceptors, and SuDS features.

For the Preliminary Design, the drainage network and SuDS measures for each catchment were determined using hand calculations supported by Preliminary MicroDrainage (WinDes) models.

9.5 Preliminary Drainage Design

9.5.1 Proposed Drainage System

The existing drainage networks are to be maintained and utilised as the main outfalls for the new drainage system. The design aims to replicate the existing situation where possible.

The following drainage measure are to be incorporated into the preliminary design.

- Sealed Drainage Systems collect, convey and discharge runoff via a sealed pipe network. For the purposes of the proposed development, this type of drainage comprises sealed pipes which are connected to gullies and kerb drainage outlets along the kerb line. Precise location of gullies will be determined during detailed design. Sealed systems are provided where there are sensitive aquifers, as is the case for Networks 7 and 8.
- SuDS features: Grassed areas in the form of rain gardens and trees pits, will provide attenuation and treatment to surface water along the development.
- Oversized Storage Pipe: Where it was found there was a net increase in impermeable surface area within a network, a flood compensation pipe was provided within the network. Where there was no net decrease in the impermeable surface area within a network, no form of compensation storage was provided. The flood compensation pipe will provide additional capacity within the drainage system, which will reduce the likelihood of surface water surcharge onto the public road during an intense storm event.
- Gully gratings: Gully pots will be provided at the end of kerb drainage runs and beneath gully gratings. These gully pots incorporate a sump and will act as traps for sediment and grit, which can then be cleaned out as part of maintenance works.
- Attenuation Storage Tanks incorporating flow control: These are provided within drainage Networks 7 and 8 only. They collect surface water from the adjacent network and their outflow rate will be reduced by a flow control mechanism such as a Hydro brake or similar.
- Petrol Interceptors / Petrol interceptors will be provided in areas where surface water is collected from trafficked roads, where a risk of oil entering the drainage network exists. They separate the oil prior to the surface water being discharged from the network.

9.5.2 Summary of Surface Water Drainage

The proposed design strategy for each of the drainage networks are provided in Table 9-4 below.

Table 9-4: Summary of Proposed Surface Water Infrastructure

Network	Chainage (m)	Existing Drainage Regime	Proposed Drainage Measures
Network 1	0+000 to 0+360	Existing drainage network discharges to Lough Atalia at Dublin Road outfall. Existing surface water flows from Network 2 combined sewer to be diverted to Network 1 via a new 300mm Φ surface water connection.	Sealed drainage, 2no. online / oversized storage pipes with penstocks and flow controls, 1no. petrol interceptor. Side entry gullies for all new kerb lines. Existing gullies to be relocated and replaced with cycle friendly gully gratings as required. Rain gardens and/or tree pits to be utilised within permeable green areas where appropriate. Refer to surface water drainage drawings for further details.
Network 2	0+360 to 0+630	As discussed above, surface water flows from existing 500mm Φ combined sewer network adjacent to Connacht Hotel are to be diverted to Network 1 storm system. Existing combined network is accompanied by an existing 300mm Φ overflow pipe that discharges to Lough Atalia.	Sealed drainage, 2no. online / oversized storage pipes with penstocks. Side entry gullies for all new kerblines. Existing gullies to be relocated and replaced with cycle friendly gully gratings as required. Refer to surface water drainage drawings for further details.

Network	Chainage (m)	Existing Drainage Regime	Proposed Drainage Measures
Network 3	0+630 to 1+140	Dublin Road, existing 1200mm Φ surface water sewer outfall with final discharge at Ballyloughane Beach. Additional 450mm Φ overflow pipe connects to outfall near Glenina Heights.	Sealed drainage, 2no. online / oversized storage pipes with penstocks, 1no. petrol interceptor. Side entry gullies for all new kerblines. Existing gullies to be relocated and replaced with cycle friendly gully gratings as required. Rain gardens and/or tree pits to be utilised within permeable green areas where appropriate. Refer to surface water drainage drawings for further details.
Network 4	1+140 to 1+370	Dublin Road, existing 300mm Φ surface water sewer outfall with final discharge at Ballyloughane Beach (see Network 3).	Sealed drainage, 2no. online / oversized storage pipes with penstocks and flow controls, 1no. petrol interceptor. Side entry gullies for all new kerblines. Existing gullies to be relocated and replaced with cycle friendly gully gratings as required. Refer to surface water drainage drawings for further details.
Network 5	1+370 to 1+650	Dublin Road, existing 450mm Φ surface water sewer outfall with final discharge at Ballyloughane Beach. Skerrit Roundabout, existing 225mm Φ surface water sewer outfall with final discharge at Ballyloughane Beach. Reduced impermeable area footprint based on increased greenspace.	Sealed drainage, 2no. online / oversized storage pipes with penstocks, Side entry gullies for all new kerblines. Existing gullies to be relocated and replaced with cycle friendly gully gratings as required. Rain gardens and/or tree pits to be utilised within permeable green areas where appropriate. Refer to surface water drainage drawings for further details.
Network 6	1+650 to 2+175	Dublin Road, existing 1500mm Φ surface water sewer outfall with final discharge at Galway Bay SAC – North of Rabbit Island.	Sealed drainage, 1no. online / oversized storage pipe with penstocks, 1no. petrol interceptor. Existing road edge drainage to be replaced by a sealed combined kerb drainage system. Refer to surface water drainage drawings for further details.
Network 7	2+175 to 3+030	Dublin Road, existing over the edge drainage to be replaced by a sealed combined kerb drainage system merging at alignment low point outfall at Ch 2+680 approx.	Sealed drainage, 1no. online / oversized storage pipe with penstocks, 1no. petrol interceptor. An online attenuation tank system with flow controls shall provide attenuation, where a stormwater rising main pump and proposed 225mm carrier drain shall convey network flows to an existing 1500mm Φ surface water main connection near Gleann Na Ri housing estate. (Refer to Option 7 of Drainage Design Options report of Appendix E and surface water drainage drawings for further details).
Network 8	3+030 to 3+800	R338 (Dublin Road), existing over the edge drainage to be replaced by a sealed combined kerb drainage system merging at alignment low point outfall at Ch 3+475 approx.	Sealed drainage. Rain gardens and/or tree pits to be utilised within permeable green areas where appropriate. Online attenuation tank system with flow controls shall provide attenuation, where a stormwater rising main pump and proposed

Network	Chainage (m)	Existing Drainage Regime	Proposed Drainage Measures
			225mm carrier drain shall convey network flows to an existing 1500mm Φ surface water main connection near Gleann Na Ri housing estate. (Refer to Option 7 of Drainage Design Options report of Appendix E and surface water drainage drawings for further details).
Network 9	3+800 to 3+880	Doughiska Road, outfall, and discharge via existing 225mm Φ surface water sewer at Inner Galway Bay SAC near South Coast Rd.	Sealed drainage, 1no. oversized storage pipe with penstocks.

9.5.3 Summary of Attenuation Features, SuDS and Outfalls

The proposed development will create additional impermeable area through widening of the carriageway to provide designated bus, cycle and running lanes in addition to a footway. Without mitigation, the increased impermeable area would lead to increased run off rates and faster time to peak flow in the existing drainage network.

Where practical, within new areas of public realm gained as part of the design, a sustainable drainage system is considered in the form of rain gardens and tree pits. SuDS are also being considered in existing areas, where practicable and possible.

Networks 7 and 8 consist of two sealed collection networks. These two networks drain to attenuation tanks which both have pumping stations. The pumping station at Network 8 will have a flow rate of 2 l/s, while the pumping station at Network 7 will have a flow rate of 4 l/s. Collected surface waters are pumped from the attenuation tank at Network 7 to the attenuation tank at Network 8 and then on to the existing 1500mm surface water pipe at Chainage 2+170 approx.

As noted in Table 9-5, SuDS measures and oversized pipe systems are provided to mitigate increased runoff rates from paved areas. The newly installed drainage infrastructure will cater for the 1 in 100-year storm with a 20% allowance for future climate change.

The proposed storage/attenuation** measures for each catchment are summarised below in Table 9-7.

** Final details of attenuation measures and controls subject to the detailed design phase.

Table 9-5: Attenuation Tank 1 Details (75m x 5m x 3m deep)

At inlet chamber:	Approx Road Cover Level = 17.350mOD	Tank Invert = 13.450mOD	Tank Cover = 0.6m
At outlet chamber:	Approx. Road Cover Level = 17.600mOD	Tank Invert = 13.075mOD	Tank Cover = 1.225m (1in 200 tank slope)
Pump Station 1	Pump Start, Sump and Alarm levels to be finalised during detailed design. Refer to Plan & Section drawing (SE-00111) for further details		

Table 9-6: Attenuation Tank 2 Details (85m x 5m x 3m deep)

At inlet chamber:	Approx Road Cover Level = 18.930mOD	Tank Invert = 14.430mOD	Tank Cover = 1.2m
At outlet chamber:	Approx. Road Cover Level = 18.940mOD	Tank Invert = 14.005mOD	Tank Cover = 1.635m (1in 200 tank slope)
Pump Station 2	Pump Start, Sump and Alarm levels to be finalised during detailed design. Refer to Plan & Section drawing (SE-00121) or further details		

Table 9-7: Summary of Proposed Storage and Attenuation Features and Outfall Locations

Network / Sub-Catchment	Location	Approx. Impermeable Surface Area		Possible storage/ attenuation measure	Network Outfall(s)	Final Discharge Point
		Existing (m^2)	Net Change (m^2)			
Network 1	0+000 to 0+360	6035	+1404	16.7m3 oversized pipes with flow controls	Outfall 1 - Mainline 0+033	Lough Atalia SAC
Network 2	0+360 to 0+630	5547	+618	11m3 oversized pipes	Outfall 2 – Mainline 0+360	Mutton Island WWTP
Network 3	0+630 to 1+140	9791	+1198	8.8m3 oversized pipes	Outfall 3 – Mainline 0+915	Ballyloughane Beach
Network 4	1+140 to 1+370	4840	+1413	5.8m3 oversized pipes	Outfall 3 – Mainline 1+147	Ballyloughane Beach
Network 5	1+370 to 1+650	9428	-2461	No attenuation required	Outfall 5 – Skerrit Roundabout (south); Outfall 6 – Mainline 1+650	Ballyloughane Beach
Network 6	1+650 to 2+175	9576	+2461	6.4m3 oversized pipes	Outfall 7 – Mainline 2+170 / Existing 1500mm storm sewer tie in	Galway Bay SAC- North of Rabbit Island
Network 7	2+175 to 2+410	4557	+932	4m3 oversized pipe	Outfall 7 – Existing 1500mm storm sewer tie in at Gleann Na Ri via rising main and proposed 225mm carrier drain.	Galway Bay SAC- North of Rabbit Island
Network 7	2+410 to 3+030	10366	+2907	Online attenuation tank – 85m x 5m x 3m deep	Outfall 7 – Existing 1500mm storm sewer tie in at Gleann Na Ri via rising main and proposed 225mm carrier drain	Galway Bay SAC- North of Rabbit Island
Network 8	3+030 to 3+800	16872	-1625	Online attenuation tank – 75m x 5m x 3m deep	Outfall 7 – Existing 1500mm storm sewer tie in at Gleann Na Ri	Galway Bay SAC- North of Rabbit Island

Network / Sub-Catchment	Location	Approx. Impermeable Surface Area		Possible storage/ attenuation measure	Network Outfall(s)	Final Discharge Point
		Existing (m^2)	Net Change (m^2)			
					via rising main and proposed 225mm carrier drain	
Network 9	3+800 to 3+880	2937	+373	3.2m3 oversized pipes	Outfall 9 – Mainline 3+810	Inner Galway Bay SAC – Near South Coast Rd

9.5.4 Pollution Control

One of the principal objectives of the road drainage system is to minimise the impact of the runoff from the roadways on the surrounding environment.

The proposed drainage design incorporates the following pollution control features.

- Stop valves are provided within the networks, so that if a spillage event occurs polluted surface water can be trapped locally.
- Petrol Interceptors are provided (Table 9-8) so that during low intensity storm events pollutants will be removed from the surface water. Final details of all proposed fuel/oil bypass separators are subject to the detailed design phase.
- SuDS features such as tree pits and rain gardens will facilitate the removal of pollutants from surface water.

Table 9-8: Proposed Petrol Interceptors

Receiving Network(s)	PI Location & Outfall	Number of PIs
Network 1 & 2	Mainline Ch 0+033 Outfall 1	1no. bypass separator
Network 3	Mainline Ch 0+910 Outfall 3	2no. bypass separators
Network 4	Mainline Ch 1+150 Outfall 4	1no. bypass separator
Network 5	Mainline Ch 1+650 Outfall 6	1no. bypass separator
Network 6	Mainline Ch 1+927 Outfall 7	1no. bypass separator
Network 7 & 8	Mainline Ch 2+192 Outfall 7	1no. bypass separator
Network 9	Mainline Ch 3+815 Outfall 8	1no. bypass separator

9.6 Drainage at New Bridge Structures

There are no new bridge structures in the proposed development that require special surface water management techniques.

SECTION 10: SERVICES & UTILITIES

10.1 Overview of Utilities Strategy and Survey

Utility records from all providers were sought at an early stage of the development design. These records combined with topographic survey records, walk over inspections and desktop analysis of the proposed development identified areas of risk to existing assets. Where risk was initially identified to high value assets a review was undertaken to ascertain if the risk could be mitigated by amending the development layout design whilst still meeting the objectives of the project. Some areas of conflict were designed out at this stage; however, some remained and had to be accommodated within the overall development design.

10.1.1 Record information

Available utility records were submitted by service providers and reviewed by the project team along the route. These records have assisted with informing the development design. Utility records were received from the following service providers:

- Uisce Éireann
- Gas Networks Ireland (GNI)
- Electricity Supply Bord (ESB)
- Eir
- Virgin Media
- BT
- Enet
- Galway City Council – Fibre network

10.2 Overview of Service Diversions

The construction of the proposed development will result in conflicts with several existing utilities.

These conflicts have been identified, and preliminary consultation has been undertaken with the relevant service providers so that the conflict can be resolved by relocating or diverting the services where necessary and protecting in-situ where appropriate.

The principal statutory and other service providers affected are:

- ESB,
- Uisce Éireann (Watermain & Foul Sewer),
- GNI
- Telecommunication Services – Eir, Virgin Media, Enet & BT.

In addition to the above, it will be necessary to relocate and upgrade some of the existing public lighting and traffic signalling network and equipment along the extents of the development.

The services conflicts and the associated diversions will need to be considered in the detailed design and construction of the development. The design considerations have been considered as much as possible at this stage, but it is likely that design modifications will be required at detailed design stage when further site investigations have taken place.

During construction, it may be necessary to maintain supply to certain services. This will require the retention and protection of existing utility supplies until such time as permanent diversions can be commissioned, or alternatively the construction of temporary diversions to facilitate completion of the works including the permanent diversion of services. The sequence of works must also consider the need to liaise with service providers and, subject to their availability to carry out diversions, staging of the works may be necessary.

The service diversions required for this development are discussed in the following paragraphs and are summarised in Table 10.1 below.

The locations of all known services from records provided from the service providers are shown on Combined Utility Drawings (BCGDR-BTL-UTL_UC-ZZ-DR-CU-00001 to BCGDR-BTL-UTL_UC-ZZ-DR-CU-00011).

10.3 Summary of Potential Diversions

Gas Networks Ireland:

There is one section of the gas network which has been identified to be affected by the development works. Table 10-1 below outlines the potential diversions for the gas services, and these are illustrated on drawing series BCGDR-BTL-UTL_UG-ZZ-DR-CU-00001 to BCGDR-BTL-UTL_UG-ZZ-DR-CU-00011.

Table 10-1: Potential Major Gas Infrastructure Diversions

Reference No.	Asset/Description of Work	Description of Work
G-UG-001	Proposed diversion	Proposed diversion approx. 73m

ESB:

There are multiple sections of ESB networks that require diversions along the route with relocation of poles and mini pillars required. Table 10-2 below outlines several potential diversions for ESB services, and these are illustrated on drawing series BCGDR-BTL-UTL_UE-ZZ-DR-CU-00001 to 00011.

Table 10-2: Potential Major Electricity Infrastructure Diversions

Reference No.	Asset/Description of Work	Description of Work
G-UE-031	Proposed LV UG diversion	12m diversion
G-UE-032	Proposed Mini-Pillar	Proposed Mini-Pillar to be diverted to back of footway
G-UE-001	Proposed overhead diversion	41m overhead diversion
G-UE-002	Relocated pole	Pole to be relocated
G-UE-003	Proposed overhead diversion	48m overhead diversion
G-UE-004	Relocated pole	Pole to be relocated
G-UE-005	Relocated pole	Pole to be relocated
G-UE-006	Relocated Mini-Pillar	To be diverted to back of footway
G-UE-007	Proposed 125mm ducting	Proposed 125mm ducting
G-UE-008	Relocated pole	Pole to be relocated
G-UE-009	Proposed overhead diversion	38m overhead diversion

Reference No.	Asset/Description of Work	Description of Work
G-UE-010	Relocated Mini-Pillar	To be diverted to back of footway
G-UE-011	Proposed 125mm ducting	Proposed 125mm ducting
G-UE-012	Relocated pole	Pole to be relocated
G-UE-013	Proposed overhead diversion	16m overhead diversion
G-UE-014	Relocated pole	Pole to be relocated
G-UE-015	Proposed overhead diversion	20m overhead diversion
G-UE-016	Proposed Mini-Pillar	Proposed Mini-Pillar
G-UE-017	Proposed underground diversion	68m underground diversion
G-UE-018	Pole to be removed	Pole to be removed
G-UE-019	Proposed Mini-Pillar	Proposed Mini-Pillar
G-UE-020	Proposed Steel Pole	Proposed Steel Pole
G-UE-021	Relocated Mini-Pillar	To be diverted to back of footway
G-UE-022	Pole to be removed	Pole to be removed
G-UE-023	Proposed underground diversion (Twinned with G-UE-029)	189m underground diversion
G-UE-024	Pole to be removed	Pole to be removed
G-UE-025	Pole to be removed	Pole to be removed
G-UE-026	Proposed Mini-Pillar	Proposed Mini-Pillar
G-UE-027	Pole to be removed	Pole to be removed
G-UE-028	Pole to be removed	Pole to be removed
G-UE-029	Proposed underground diversion (Twinned with G-UE-023)	189m underground diversion
G-UE-030	Proposed Mini-Pillar	Proposed Mini-Pillar
G-UE-031	Pole to be removed	Pole to be removed
G-UE-032	Relocated Mini-Pillar	To be diverted to back of paved area

Uisce Éireann – Watermains:

There are five sections of watermains requiring diversions along the route. Table 10-3 below outlines several potential diversions for watermain services, and these are illustrated on drawing series BCGDR-BTL-UTL_UW-ZZ-DR-CU-00001 to 00011.

Table 10-3: Potential Major Water Infrastructure Diversions

Reference No.	Asset/Description of Work	Description of Work
G-UW-001	Existing 75mm Cast-Iron pipe	Lower and replace
G-UW-002	Existing 75mm Cast-Iron pipe	Lower and replace
G-UW-003	Existing 150mm Asbestos pipe	Lower and replace approx. 32m
G-UW-004	Existing 150mm Asbestos pipe	Lower and replace approx. 32m
G-UW-005	Existing Chamber	Relocate and replace Cover
G-UW-006	Existing 75mm Cast-Iron pipe	Replace 29m
G-UW-007	Proposed diversion	Proposed diversion approx. length 176m
G-UW-008	Proposed diversion (Twinned with G-UW-025 & G-UW-026)	Proposed diversion approx. 630m
G-UW-009	Existing 75mm Cast-Iron pipe	Lower and replace approx. 29m
G-UW-010	Proposed diversion	Proposed diversion approx. 79m
G-UW-011	Existing chamber cover	To be relocated
G-UW-012	Proposed diversion	Proposed diversion approx. 46m
G-UW-013	Proposed diversion	Proposed diversion approx. 100m
G-UW-014	Proposed diversion	Proposed diversion approx. 44m
G-UW-015	Proposed diversion (Twinned with G-UW-010 & G-UW-026)	Proposed diversion approx. 630m
G-UW-016	Existing 400mm Asbestos pipe	To be replaced. 15m
G-UW-017	Existing 75mm uPVC pipe	Lower and replace approx. 25m
G-UW-018	Existing pipe	To be diverted into footway. Material unknown.

Uisce Éireann– Foul Sewers:

There are no foul sewers requiring diversion along the route. There are potential foul sewer manhole cover adjustments required along the route. Table 10-4 below outlines the potential adjustments for foul sewer manholes, and these are illustrated on drawing series BCG-UT-03-00 to BCG-UT-03-13.

Table 10-4: Potential Foul Sewer Infrastructure Diversions

Reference No.	Asset/Description of Work	Description of Work
G-UF-001	Existing Foul Cover	Replace Cover
G-UF-002	Existing Foul Cover	Replace Cover
G-UF-003	Existing Foul Chamber and Cover	Relocate chamber and replace Cover

Telecommunications:

There are multiple locations along the route where conflicts with telecommunications infrastructure occur, and diversions or chamber relocations are required. Table 10-5 below outlines potential diversions for telecommunication services, and these are illustrated on drawing series BCGDR-BTL-UTL_UL-ZZ-DR-CU-00021-00031.

Table 10-5: Potential Major Telecommunications Infrastructure Diversions

Reference No.	Asset/Description of Work	Description of Work
G-UT-001	EIR - Existing Duct	Proposed Concrete Surround
G-UT-002	EIR - Existing Chamber	Chamber rebuilt and Cover replaced
G-UT-003	EIR - Existing Chamber	Chamber rebuilt and Cover replaced
G-UT-004	EIR - Existing Chamber	Chamber to be relocated
G-UT-005	EIR - Existing Duct	Proposed Concrete Surround
G-UT-006	EIR - Existing Chamber	Chamber to be relocated
G-UT-007	EIR - Existing Chamber	Chamber to be relocated
G-UT-008	EIR - Existing Duct	Proposed Concrete Surround
G-UT-009	EIR - Existing Duct	Proposed Concrete Surround
G-UT-010	EIR - Existing Chamber	Existing cover and chamber to be replaced
G-UT-011	EIR - Existing Chamber	Chamber to be relocated
G-UT-012	EIR - Existing Duct	Proposed Concrete Surround
G-UT-013	EIR - Existing Duct	Proposed Concrete Surround
G-UT-014	EIR - Existing Duct	Proposed Concrete Surround
G-UT-015	EIR - Existing Chamber	Existing cover and chamber to be replaced
G-UT-016	EIR - Existing Chamber	Existing cover and chamber to be replaced
G-UT-017	EIR - Existing Chamber	Existing Chamber to be relocated
G-UT-018	EIR - Existing Duct	Proposed Concrete Surround
G-UT-019	EIR - Existing Duct	Proposed Concrete Surround

Reference No.	Asset/Description of Work	Description of Work
G-UT-020	EIR - Existing Chamber	Proposed Concrete Surround
G-UT-021	Virgin Media - Existing Chamber	Existing cover and chamber to be replaced
G-UT-022	EIR - Existing Duct	Proposed Concrete Surround
G-UT-023	EIR - Existing Chamber	Existing cover and chamber to be replaced
G-UT-024	EIR - Existing Duct	Proposed Concrete Surround
G-UT-026	EIR - Existing Chamber	Existing cover and chamber to be replaced
G-UT-027	EIR - Existing Chamber	Existing cover and chamber to be replaced
G-UT-028	BT - Existing Duct	Steel plate protection
G-UT-029	EIR - Existing Duct	Proposed Concrete Surround
G-UT-030	EIR - Existing Chamber	Existing cover and chamber to be replaced
G-UT-031	BT - Existing Duct	Steel plate protection
G-UT-032	EIR - Existing Duct	Proposed Concrete Surround
G-UT-033	EIR - Existing Chamber	Existing cover and chamber to be replaced
G-UT-034	EIR - Existing Chamber	Existing Chamber to be relocated
G-UT-035	BT - Existing Duct	Steel plate protection
G-UT-036	EIR - Existing Chamber	Existing Chamber & Cover to be rebuilt
G-UT-037	EIR - Existing Chamber	Existing Chamber to be relocated
G-UT-038	EIR - Existing Duct	Proposed Concrete Surround
G-UT-039	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-040	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-041	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-042	EIR - Existing Duct	Proposed Concrete Surround
G-UT-043	BT - Existing Duct	Steel plate protection
G-UT-044	EIR - Existing Duct	Proposed Concrete Surround
G-UT-045	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-046	BT - Existing Duct	Steel plate protection
G-UT-047	EIR - Existing Chamber	Existing Chamber to be relocated
G-UT-048	EIR - Existing Chamber	Existing Chamber to be relocated
G-UT-049	BT - Existing Duct	Steel plate protection
G-UT-050	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-051	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-052	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-053	EIR - Existing Duct	Concrete Surround
G-UT-054	EIR - Existing Duct	Concrete Surround
G-UT-055	EIR - Existing Chamber	Existing Chamber to be relocated

Reference No.	Asset/Description of Work	Description of Work
G-UT-056	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-057	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-058	EIR - Existing Duct	Proposed Concrete Surround
G-UT-059	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-060	EIR - Existing Duct	Proposed Concrete Surround
G-UT-061	EIR - Existing Chamber	Existing Chamber to be relocated
G-UT-062	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-063	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-064	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-065	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-066	EIR - Existing Duct	Proposed Concrete Surround
G-UT-067	EIR - Existing Duct	Proposed Concrete Surround
G-UT-068	EIR - Existing Duct	Existing chamber and cover to be replaced
G-UT-069	EIR - Existing Chamber	Existing chamber and cover to be replaced
G-UT-070	EIR - Existing Chamber	Existing Chamber to be relocated
G-UT-071	EIR - Existing Chamber	Existing Chamber to be relocated
G-UT-072	ENET - Existing Duct	Proposed Concrete Surround
G-UT-073	ENET - Existing Duct	Proposed Concrete Surround
G-UT-074	EIR - Existing Chamber	Existing Chamber to be relocated
G-UT-075	EIR - Existing Chamber	Existing Chamber to be relocated
G-UT-076	ENET - Existing Duct	Proposed Concrete Surround
G-UT-077	ENET - Existing Duct	Proposed Concrete Surround
G-UT-078	ENET - Existing Chamber	Existing chamber and cover to be replaced

SECTION 11: WASTE QUANTITIES

11.1 Introduction

The majority of the waste arisings from the construction of the proposed development will accumulate from demolition, site clearance, excavation and construction related activities due to the proposed public domain street works. A waste calculator was developed for the proposed development to quantify and classify the likely material types in accordance with TII GE-ENV-01101 and the European Waste Catalogue waste codes.

Excavation waste will arise from the following activities:

- Excavation of existing carriageways (e.g. road narrowing, removal of islands);
- Excavation of existing footpaths and cycle tracks and pedestrianised areas (e.g. widening, urban realm improvement;
- Alterations of roundabouts and signalised junctions; and
- Excavation for utility diversions and/or protections.

Waste material resulting from these activities will include concrete (waste code 17 01 01), bitumen/ asphalt (waste code 17 03 02), and soil and stones (waste code 17 05 04). The waste quantities associated with the excavation of soil and stones have been further broken down into the likely TII material specification to establish an understanding of the volume of materials that could potentially be reused/recycled.

Demolition waste will arise from the following activities:

- Removal of street furniture including bus shelters, bins, gates, fences, railings and walls;
- Removal of roadside infrastructure including traffic signals, road signs, safety barriers, street lighting poles and ESB/EIR poles; and
- Removal of trees.

Waste materials resulting from these activities will include masonry brick/blocks (waste code 17 01 02), metal (waste code 17 04 07), plastic (waste code 17 02 03), wood (waste code 17 02 01), glass (waste code 17 02 02), and mixed construction and demolition (waste code 17 09 04).

In developing the waste estimate quantities, a number of assumptions were required to undertake the assessment which are outlined in Section 11.2.

11.2 Waste Estimate Summary

The majority of the waste arisings from the construction of the proposed development accumulates from excavation related activities and demolition works due to proposed public domain street works. The waste produced as a result of the proposed development has been summarised below along with an outline of how this waste will be managed.

In line with current practice in Ireland, surplus materials and wastes from the proposed development will be managed as follows:

- Where feasible, naturally occurring excavated material will be reused within construction in the proposed development in accordance with Article 27 of the Waste Framework Directive and Section 3 of the Waste Management Act 1996, as amended;
- Where practicable, excavation material will be used as engineering and landscaping material within the proposed development and on other projects requiring the types of materials generated through Article 27. Reuse of topsoil and excavated material within the proposed development is proposed

where practicable. The material will also be subject to testing to ensure it is suitable for its proposed end use;

- Article 28 (End-of-Waste) (EPA 2020) criteria may be met by the excavation material, should such facilities become available by the time of commencement of construction of the proposed development, ensuring that the material will meet the acceptance criteria set out in Article 28 of the Waste Directive Regulations;
- All excavation wastes requiring removal from site for recycling or recovery will be delivered to facilities which are authorised under the Waste Management Act 1996, as amended (i.e. which hold a Certificate of Registration, Waste Facility Permit or EPA Licence). Examples of recycling / recovery activities for excavation material may include:
  - Processing of stone to produce construction aggregate;
  - Backfilling of quarries; and
  - Raising land for site improvement or development.
- Any hazardous waste arising will be managed by the appointed contractor in accordance with the applicable legislation; and

- All wastes removed from site will be transported by the holder of the appropriate waste collection permit, granted in accordance with S.I. No. 820/2007 - Waste Management (Collection Permit) Regulations 2007, as amended.

It will be the responsibility of the appointed contractor to secure agreements for acceptance of surplus excavation materials from the proposed development in authorised and regulated facilities, in accordance with the Waste Management Act 1996, as amended, and associated regulations.

11.2.1 Demolition

Table 11-1 shows the estimated quantity and type of waste that will be generated by demolition activities in connection with the proposed development along with how much of this material could potentially be reused or recovered.

Table 11-1: Estimated Demolition Waste Types and Quantities

Waste Type	Approximate Waste and Material Quantity (Tonnes)
Concrete, bricks, tiles and similar	1620
Metals	20
Segregated wood, glass and plastic	6
Total	**1646**

Potentially 100% of material generated from the demolition phase of the proposed development could be considered for reuse for construction within the proposed development or in other construction projects in accordance with Article 27 of the Waste Directive Regulations. It will be the responsibility of the appointed contractor to review feasibility of reuse of materials and ensure that the necessary testing is undertaken to demonstrate compliance with Article 27, as appropriate. Where practicable and appropriate, and if in reusable condition, street and roadside infrastructure such as bus stops, lighting poles, traffic signals, manhole access covers and signs will be reused within the proposed development. If not reused, they will be delivered to appropriately authorised recycling or recovery facilities. The appointed contractor will be responsible for ensuring compliance with all relevant legislation.

Materials will require on-site segregation by waste classification and if not suitable for onsite or offsite reuse, will be delivered to an authorised recycling or recovery facility. Where street furniture is a waste, it may be

necessary to separate elements at source such as lightbulbs from luminaires and metals from other components and deliver these separately to suitable authorised recycling or recovery facilities.

Where metal railings and gates are removed, typically these have inherent value due to their metal content. These will be source-segregated and delivered for metal recycling to an authorised waste facility where not reused.

The least preferable option is disposal to an authorised facility which will only take place when all viable opportunities for reuse and recycling have been investigated by the appointed contractor for feasibility and ruled out.

Prior to commencing construction, the appointed contractor will undertake vegetation clearance and street furniture removal. Limited demolition will be undertaken as part of the construction works for the proposed development.

11.2.2 Excavation

Table 11-2 shows the estimated quantity and type of waste that will be generated by the excavation activities of the proposed development along with how much of this material could potentially be reused or recovered.

Table 11-2: Summary of Excavation Material Type and Quantities

Materials from C&D Sources	Approximate Waste and Material Quantity (Tonnes)
Soil and stone	4,458
Concrete, bricks, tiles and similar	1,770
Bituminous mixtures	6,935
Total	**13,161**

It is estimated that a total of 13,161 tonnes of material will be excavated as part of the construction works. Due to the nature of the works in an urban environment there are limited opportunities to achieve a cut/fill balance of materials that could be more readily accommodated on a greenfield project where earthworks embankments/ bunds are more common. Material from the existing pavement layers will be temporarily stockpiled at the proposed construction compound and sent to a suitable recovery facility for recycling or reuse as recycled aggregate material in the industry

Where material is excavated, it is envisaged that the contractor will seek to reuse or recycle it, where practicable, within the proposed development. Material for excavation will need to be tested by the appointed contractor for quality, contamination and could potentially be reused as general fill or general landscape fill material in construction under the provisions of Article 27. To further establish an understanding of how soil and stone waste materials could potentially be reused/recovered, they have been further broken down into the likely TII material specification and class.

Excavated materials such as capping, subbase, bituminous and concrete materials could be reused or recycled in line with TII specifications:

- Capping, subbase, bituminous and concrete materials could be reused or recycled in fill and capping materials (e.g. 6A, 6B, 6C, 6F, 6G, 6H ,6I, 6M, 6N) providing they comply with the Earthworks Specification for National Roads (CC-SPW-00600) (TII 2024);
- Subbase, bituminous and concrete materials could be reused or recycled in subbase or base materials (e.g. Granular Material Type A to Clause 803) providing they comply with the Road Pavements – Unbound and Cement Bound Mixtures (CC-SPW-00800) (TII 2023a) and

- Subbase and bituminous materials could be recycled in base or binder materials (e.g. Asphalt Concrete base and binder products to Clause 3 or Low Energy Bound Mixtures to Clause 8.1) providing they comply with Specification for Road Works Series 900 Road Pavements – Bituminous Materials (CC-SPW-00900) (TII 2023b).

It is assumed that some of the granular subbase and capping materials will contain excessive cohesive material due to the excavation process and therefore unsuitable for direct reuse. This excess material could be sent to a suitable recovery facility and reused as Class 2 general fill or Class 4 landscape fill material, depending on excavation methods employed by the contractor and existing ground conditions.

Excavated cohesive subgrade material is likely to be unacceptable for direct reuse for pavement construction, however, this material can be tested for quality and contamination and could potentially be reused as Class 2 general fill or Class 4 landscape fill under the provisions of Article 27.

Material which meets the necessary acceptance criteria may be delivered to an authorised soil recovery facility. Material which requires recycling will be sent to an authorised waste facility and may be used in accordance with Article 28 of the European Communities (Waste Directive) Regulations 2011. Article 28 sets the criteria which must be complied with, and the EPA must use to determine, when a waste reaches “end of waste” status and becomes a material. Large quantities of this type of material are unlikely to be reused on site due to the nature of the works in an urban environment with limited embankments / earthworks bunds being constructed. Therefore, excavated cohesive subgrade material may be recovered and used on future projects in the industry.

Topsoil material could be reused in new landscaped areas. It is assumed that some of this material will be contaminated with unsuitable material during the excavation process and therefore will be sent to a suitable recovery facility and reused as Class 2 general fill or Class 4 landscape fill, along with the excavated cohesive subgrade material.

Future design stages will undertake additional site investigations to inform the detailed pavement design and associated excavation quantity assessment.

11.2.3 Municipal Waste

It is anticipated that there will be approximately 50, possibly up to 70 at peak, construction staff employed over the Construction Phase of the proposed development. Small volumes of general municipal wastes will be generated by construction staff during the Construction Phase (e.g. from offices and welfare facilities). Segregation facilities will be provided on the construction site to ensure that recovery and recycling of such wastes is maximised.

11.2.4 Operational Phase

Operational waste may arise as a result of carriageway maintenance which will be undertaken at regular intervals, or as necessary. This will primarily consist of bitumen containing material due to maintenance of carriageway pavement. Only waste generated from the areas where road widening and narrowing, have taken place as part of the proposed development, will be considered in this assessment, as routine maintenance, and associated waste generated, would be carried out on the existing road irrespective of the proposed development.

It is envisaged that bituminous material will be reused within new carriageway construction as far as practicable and in accordance with all applicable legislation. Bituminous mixtures which are not incorporated into the proposed development are likely to be reused where feasible off-site as a byproduct in accordance with Article 27, of the Waste Framework Directive. Bituminous mixtures may be recycled in accordance with the provisions of an Article 28 (End of Waste) decision by the EPA (EPA 2020).

SECTION 12: TRAFFIC SIGNS, LIGHTING AND COMMUNICATIONS

12.1 Introduction

The existing signage and road markings along the extents of the proposed development will be modified or replaced to clearly communicate information, regulatory and safety messages to the corridor users. In addition, the existing lighting and communication equipment along the proposed development will be upgraded where necessary.

12.2 Traffic Signs

A preliminary traffic sign assessment has been undertaken to identify the requirements of the proposed development for directional signs. The requirement for standard regulatory and warning signs has not been assessed due to their small size and general ability to be accommodated within the proposed road corridor and is considered a detailed design task. In general the obstruction caused by posts located in footways will be minimised. Therefore, where practicable, signs are to be placed on single poles, or larger signs will be cantilevered from a post at the back of the footway using H-frames where necessary.

A review of the existing directional signs in the vicinity of the proposed development was carried out to identify existing directional signs that could be retained or would require replacement.

The conclusion of this assessment was the following:

- Renmore Park junction has no existing directional signing and this arrangement is satisfactory for the proposed road upgrade.
- Renmore Road junction has an advance direction sign on the westbound arm only. This sign can be retained for the proposed road upgrade with no other directional signs proposed.
- Michael Collins Road junction has no existing directional signing and this arrangement is satisfactory for the proposed road upgrade.
- Ballyloughane Road junction has no existing directional signing and this arrangement is satisfactory for the proposed road upgrade.
- Murrough Avenue / Ballybane Road junction has a flag-type direction sign for the eastbound exit off the roundabout and an advance direction sign for westbound approach only. The existing direction sign could be re-used for the proposed development but moved to a new location. The advance direction sign would need to be replaced and two new follow-through flag-type direction signs provided at the junction.
- Merlin Hospital junction has no existing directional signing and this arrangement is satisfactory for the proposed road upgrade.
- Merlin Park junction has no existing directional signing and this arrangement is satisfactory for the proposed road upgrade.
- Coast Road junction is currently fully signed with advance directional signs and flag-type directional signs. These signs can be retained for the proposed upgrade and moved if necessary.
- Doughiska junction has no existing directional signing and this arrangement is satisfactory for the proposed road upgrade.

12.3 Road Markings

A preliminary design of road markings has been undertaken in accordance with TSM Chapter 7 and are included in the General Arrangement Drawings in Appendix B.

12.4 Public Lighting

A preliminary design for street lighting has been carried out for the full extents of the development. Refer to drawings BCGDR-BTL-LHT_RL-XX-DR-EO-00001 to 11.

12.4.1 Existing Lighting

Light Emitting Diode (LED) lanterns should be the light source for any new or relocated public lighting provided.

In locations where road widening is required, it is proposed that the Public Lighting columns shall be replaced and relocated to the rear of the footpath, where possible, and the existing removed once the new facility is operational.

Where significant alterations are proposed to the existing carriageways; the existing public lighting arrangement shall be reviewed in association with the Public Lighting Department of Galway City Council to ensure that the current standard of public lighting is maintained or improved.

To determine whether existing public lighting is to be improved / relocated or where new public lighting is required, an inspection shall be carried out in association with Galway City Council, to identify any new column locations required for particular sections of the development.

12.4.2 Proposed Lighting

All new public lighting will be designed and installed in accordance with the specific lighting and electrical items set out the following National Standards and guides, including but not limited to:

- Local Authority Guidance Specifications
- EN 13201: 2014 Road Lighting (all sections);
- ET211:2003 ‘Code of Practice for Public Lighting Installations in Residential Areas’
- BS 5489-1 ‘Code of practice for the design of road lighting’
- Volume 1 - NRA Specification for Road Works, Series 1300 & 1400;
- Volume 4 - NRA Road Construction Details, Series 1300 & 1400;
- IS EN 40 – Lighting Columns;
- Institution of Lighting Professionals “GN01 Guidance Notes for Reduction of Obtrusive Light”

All new lighting should aim to minimise the effects of obtrusive light at night and reduce visual impact during daylight. Lighting shall comply with the ‘Guidance notes for the Reduction of Light Pollution’ issued by the Institution of Lighting Professionals (ILP).

12.4.3 Proposed Lighting at Bus Stops

The design shall include for the provision of lighting in covered areas, open areas and the passenger waiting areas at bus stops.

The location of the lighting column shall be dictated by light spread of fittings to give the necessary level of illumination (the columns at stations provide clearance for buses).

12.5 Traffic Signals

12.5.1 Above Ground Infrastructure

At new and existing traffic signal controlled junctions, above ground infrastructure will include:

Traffic Signal Poles

All traffic signal equipment will be designed in accordance with Chapter 9 of the Department of Transport Traffic Signs Manual. Traffic signal modelling, including LinSig models, will determine the phasing and staging of the traffic signals which determines the design and positioning of the traffic signal heads.

The Traffic Signs Manual clearly defines the requirements and positioning of traffic signal heads, detection equipment, and associated traffic signal poles.

Where existing traffic signal poles do not provide for a sufficient field of view for above ground detection devices, additional traffic signal poles will be erected to mount that detection equipment.

High Mast and Cantilever Traffic Signal Poles

High Mast or Cantilever poles will be considered for multi-lane approaches where there is a potential for a high sided vehicle, including buses, to block the clear visibility of the primary traffic signal of vehicles in the outer lanes. They will also be considered for locations where a median island is not available to mount a second primary, required to control separate streams on a particular arm of a junction.

Cantilever poles may also be used to provide a mounting structure for secondary signals, where a median is not available and a position on opposing primary pole is outside the required line of sight.

Roadside Cabinets

Most equipment locations will require a roadside cabinet to house and protect electronic, electrical and communications equipment. Due to health and safety, design, space, operational and maintenance constraints, it is often necessary to separate these cabinets in accordance with their function. Typically, a junction will have cabinets for:

- Traffic Signal Control Cabinets housing a Spot Utopia system signal controller;
- Fibre Breakout Cabinets; and
- Electricity supply Metering, Mini and Micro pillars.

Cabinets will be positioned to allow for ease of access by maintenance personnel and to minimise their impact on the receiving environment. When accessing cabinets, maintenance personnel will require a clear view of the associated equipment and of approaching vehicles, pedestrians, and cyclists. Cabinets are often positioned at the back of footpaths, to minimise the impact on the effective width of the footpath. They are often clustered together at a junction to minimise the amount of cabling between cabinets and to allow maintenance personnel to quickly shift operations from one cabinet to another.

12.5.2 Underground Infrastructure

The proposed development will require underground ducting network to provide the necessary communications for devices including traffic signals.

Where practicable the proposed development shall utilise existing ducting and chambers to. Below ground infrastructure will include:

Ducts

Each device, mounting structure, and cabinet will have associated underground infrastructure including ducts for:

- **Power Cables** – installed equipment will require a power supply to function, this is facilitated by a ducting connection between the electricity supply point and equipment location. This connection is normally a single power supply duct.
- **Communication Cables** – to facilitate the provision of fibre optic cable as necessary within the proposed development it will be necessary to provide a telecommunication ducting network consisting of two communication ducts, with chambers at appropriate distance or at a change in direction, along the carriageway. This ducting will be provided to connect new signal controlled sites to the existing communication networks. Where existing GCC fibre network micro-ducting is currently in-situ, this shall be retained insofar as practicable.
- **Device Cables** – devices will require cabling between field equipment and control equipment. For example, a ring of four ducts will be provided at each new signalised junction to allow for cabling between the traffic signal controller and the traffic signal poles. It is necessary when designing the ducting provision that sufficient spare capacity is provided to allow for changes to the field equipment, deployment of additional equipment, or damage to the ducting provision.

Chambers

Chambers will be required at the termination points of ducts, at regular intervals along ducts, at changes in direction, and at breakout points for devices.

The position of chambers will be designed to be away from carriageways, cycle tracks, and tactile paving. It is important when positioning chambers that they can be accessed in a safe manner, without the need for extensive traffic, bicycle and pedestrian management.

Individual chambers will be designed and sized with consideration given to the number of ducts and cables that will be routed through the chamber, and the need to provide maintenance loops of cables within the chambers.

Unless prior agreement is in place, chambers will not be shared between users.

Foundations

All cabinets, poles and mounting structures will require a foundation or mounting frame to be constructed to allow for their installation. It is envisaged that for traffic signal poles and other lightweight mounting structures that retention sockets will be installed to allow for the easy installation, maintenance and replacement of equipment.

For larger features, such as high mast and cantilever posts, mass concrete foundation will be provided as per the suppliers details.

Cabinet mountings will be provided as per the manufacturer's and local authorities' standard details, including the incorporation of required vaults, chambers, earthing rods and mats.

12.5.3 Traffic Signal Priority

Public transport priority will be provided through a number of passive and active means. The means of passive priority are based on the design of the geometry, signing and road markings of the junctions. Active priority will be facilitated through the detection of the public transport vehicle and communicating their presence to the Traffic Signal Controller for the implementation of measures on site.

Galway City Council utilises an adaptive Urban Traffic Control system called Spot Utopia. The system can operate in several modes including adaptive, linked, vehicle actuated, scheduled plans and fixed time modes. It can specifically provide public transport priority at intersections.

Detection will be based on the use of several different technologies, working in concert to provide comprehensive detection solutions. The detection types may include:

- Embedded Inductive loop detectors – induction detectors will be cut into the road surface at discrete positions around the junction to detect vehicles approaching, or departing from, the junction. The position and number of detectors will be dependent on the lane configuration and the type of traffic signal controller at the junctions. These embedded induction detectors will require ducting, chambers, and carriageway loop pots, to route the cables associated with the detector to the traffic signal controller.
- Specialised induction detectors – these can be utilised to detect cyclists on particular approaches to junctions. These detectors use a concentrated induction pattern to detect the passage of cyclists.

Above ground detection, including:

- Optical Detection – where it is impractical to install embedded inductive loop detectors into the carriageway, optical detection may be installed. Using these devices, a virtual detector is set up in the field of view that trigger alerts to the traffic signal controller. Optical detectors are generally installed on existing traffic signal poles, or cantilever traffic signal masts, to provide a clear view of the approach. Additional poles may need to be installed to provide the optimum field of view for particular approaches.
- Microwave/Radar Detection – Radar detection is used for pedestrian crossings, pedestrian wait areas, and cycle detection. Similar to the optical detection, virtual detection zones are set up in the radar field of view that trigger alerts to the traffic signal controller.
- Radar detectors are generally installed on existing traffic signal poles, or cantilever traffic signal masts, to provide a clear view of the approach. Additional poles may need to be installed to provide the optimum field of view for particular approaches.
- Push Button Units will be installed on traffic signal poles at pedestrian and cycle crossing points to allow the user to manually alert the traffic signal controller of their presence.

Additional inputs from an Automatic Vehicle Location System (AVLS) and Dedicated Short Range Communications (DSRC) devices can be provided to notify the Traffic Signal Controller of the presence of particular vehicles.

The Traffic Signal Controllers will detect the presence of vehicles, including identification of particular vehicles classes, and use this data to determine the timing to be applied to the junction in the current and upcoming cycles, including the provision of priority to particular traffic signal phases as programmed into the traffic signal plans.

12.6 Communications

Communications will be used to connect on-street devices with the Galway City Council traffic control room. The communications will take the form of:

- Fibre Optic Cable network. Galway City Council operates a fibre optic cable network. It is envisaged that this network will be extended along the length of the proposed development to provide high bandwidth/low latency communication to Traffic
- Signal Controllers, and other apparatus deployed on the proposed development.
- Microtrench ducting, matching the GCC fibre network infrastructure will be utilised as required.
- Fibre breakout cabinets will be provided at each Traffic Signal Controller.
- Microwave Wireless Point-to-Point Links - Where it is not practicable to install ducting for fibre optic cable, or there is a need to provide a high bandwidth/low latency communication to a remote site or cell, point-to-point microwave communications will be provided to facilitate the communications link.

- Cellular Subscriber Networks (3G/4G/5G) - Cellular communications will be provided to low bandwidth devices such as Real Time Passenger Information (RTPI) and Variable Messages Signs (VMS).

12.7 Real-Time Passenger Information

Real-Time Passenger Information (RTPI) capability is expected to be provided at all of the proposed bus stops. This capability will comprise a “live” display identifying the estimated arrival time of each bus at the stop.

12.7.1 RTPI Display Positioning and Mounting

The RTPI display, where present, is typically located adjacent to the shelter on the same side as approaching buses so that people waiting at the stop can simultaneously view both the display and the oncoming buses. Figure 12-1 below illustrates this.

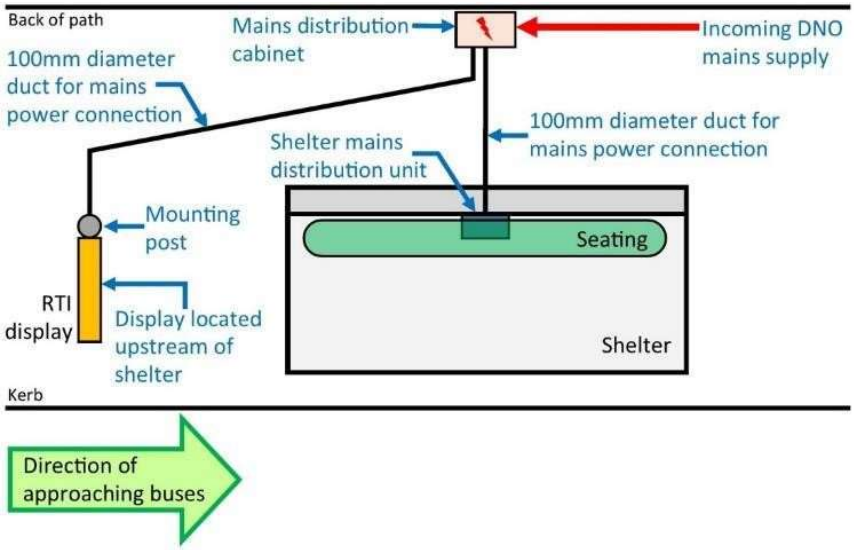

Figure 12-1: Typical layout for bus stop with RTPI display

The display is often placed around 4-5m from the shelter to maintain pedestrian access to the shelter while also enabling a clear view of the display from within the shelter. However, although this is considered the optimum position for a display, the precise location of it will be dictated by other site-based factors such as pedestrian and cyclist access (both to/from the stop and for those passing by) as well as requirements for other bus stop facilities such as waste bins, cycle storage and signage. Other physical restrictions (e.g. narrow footway, other street furniture, walls, and buildings) may also influence the exact location of the display at each stop.

12.7.2 Power Supply for RTPI Display and Bus Shelter

The stand-alone design of the proposed RTPI display means that a physical link between the display and the bus shelter is not required. However, the display will nonetheless require a connection to a mains power supply. This can be shared with the supply to the bus shelter, as shown in Figure 12.1, from a mains distribution cabinet or feeder pillar located at the bus stop, where the mains service provider (DNO) will terminate its incoming connection. This cabinet /pillar will provide mains power to both the RTPI display and the shelter, assuming the bus shelter needs a mains power supply.

The bus shelter will commonly include a mains power distribution unit for all of the equipment in the shelter that requires mains power - usually lighting and/or advertising. Most often this distribution unit is located under the seating although it can vary according to the shelter design.

The shelter installer will provide a connection from this unit to the cabinet/pillar containing the mains power supply for the bus stop, as shown in Figure 12.1.

12.7.3 Data Communications for RTPI Display

The majority of RTPI systems currently in operation now use the mobile phone (GPRS/3G/4G/5G) network as the method of data communication between each display and the central ("back office") bus location/passenger information system. This comprises a small mobile network comms device (including the SIM card) installed within the RTPI display housing. It is assumed for the purpose of this design that such connectivity will be used for provision of RTPI on the proposed development with the mains power for the display - as described above – also providing power for this comms device. In this case no ducting will be required for data comms at the bus stop and the only physical connection to the display (i.e. ducting and cabling) will therefore be as described above for mains power.

12.8 Safety and Security

The requirement for a pleasant, safe and secure environment for passengers waiting at Bus Stops and undertaking their journeys is a key component of the proposed public transport service. This is facilitated by the provision of:

- RTPI – Each stop will be provided with Real Time Passenger Information showing the estimated time of arrival of subsequent buses; and
- Public Lighting – each stop will have public lighting designed to ensure the safe operation of the stops in all lighting conditions and to enhance the sense of security at the stops.

12.9 Maintenance

All traffic signal and communications equipment will be designed and located to be accessed and maintained frequently. All equipment will be accessible without disrupting pedestrian, bicycle, or vehicle traffic and without the use of special equipment.

Apparatus will be designed and located to allow for easy access and the safe maintenance of the proposed development into the future. This will include:

- Use of retention sockets, where applicable, for the erection of Traffic Signals, Above Ground Detection, and other equipment mounting poles to allow for the ease of installation, maintenance and replacement;
- The use of lightweight equipment poles, where appropriate, such as cantilever signal poles. Consideration will be given to the selection of products that allow for maintenance activities to be undertaken from ground level, such as tilt down poles or poles with wind-down mechanisms;
- Placement of poles and retention sockets within 7m of chambers to provide ease of installation and replacement of cables;
- Locating chambers away from pedestrian desire lines, and areas of tactile paving. This is to provide for a reduced impact of Traffic Management;
- On longitudinal duct runs, chambers to be placed at appropriate centres to allow for the ease of installation and replacement of cables;
- Safe areas to be provided for the access and parking of maintenance vehicles; and
- Locating controller, and other, cabinets in positions that allow for safe access and clear visibility of the operation of the junction.

SECTION 13: LAND USE AND ACCOMMODATION

13.1 Summary of Land Use

The land use along the proposed development comprises a mix of residential, commercial properties, community, cultural and institutional and city centre uses. The various land uses are described in the sections below. The extent of the impact due to the proposed development on a landowner's holding is shown on the Compulsory Purchase Order maps.

The following is a description of the land use along the proposed development within the development sections.

13.1.1 Moneenageisha Road Junction to Renmore Park

This section of the development includes residential lands along Dublin Road, recreational, cultural and amenity lands at Lynch's Stone, and commercial zones containing various retail outlets such as the KIA dealership.

In order to construct the proposed development, permanent land take is required within this section at the following locations:

Inbound from the start of the proposed development to the entry to Lakeview School Access Road to facilitate space for proposed cycle track, footpath, and portion of bus lane.

- Inbound from the Lakeview School Access Road to Renmore Park to facilitate space for proposed portion of bus lane, raised table and off-road cycle track & footpath.
- Outbound from the start of the proposed development to 30m east to create space for proposed works at the access junctions.
- Outbound across from the Renmore Park Junction, to facilitate space for proposed footpath, landscaped area, and cycle track.

Temporary land take is required through this section to accommodate the contractor during the construction period of the development. The majority of the temporary land take is allocated to the construction of the access roads and junctions on to the Dublin Road.

Figure 13-1: Moneenageisha Road Junction to Renmore Park Proposal

13.1.2 Renmore Park to Renmore Road

The proposed development continues along the Dublin Road (R338) from Renmore Park to Renmore Road. This section of the development contains commercial zones compromising of a number of retail outlets on the inbound stretch. Outbound the lands are zoned for tourism.

In order to construct the proposed development, permanent land take is required within this section at the following locations:

- Outbound across from the Renmore Road Junction permanent land take is required to create space for the proposed cycle track, footpath, and a portion of bus lane construction works.
- Outbound from opposite the Renmore Park junction to create sufficient space for the proposed footpath, cycle track and bus lane.
- Inbound at the Renmore Road Junction to facilitate space for the proposed footpath and tightening of the junction (on the western edge).

Temporary Land take is required along this section to accommodate the contractor during construction works due to the widening of the carriageway and horizontal alignment and to accommodate the site compound throughout the construction period.

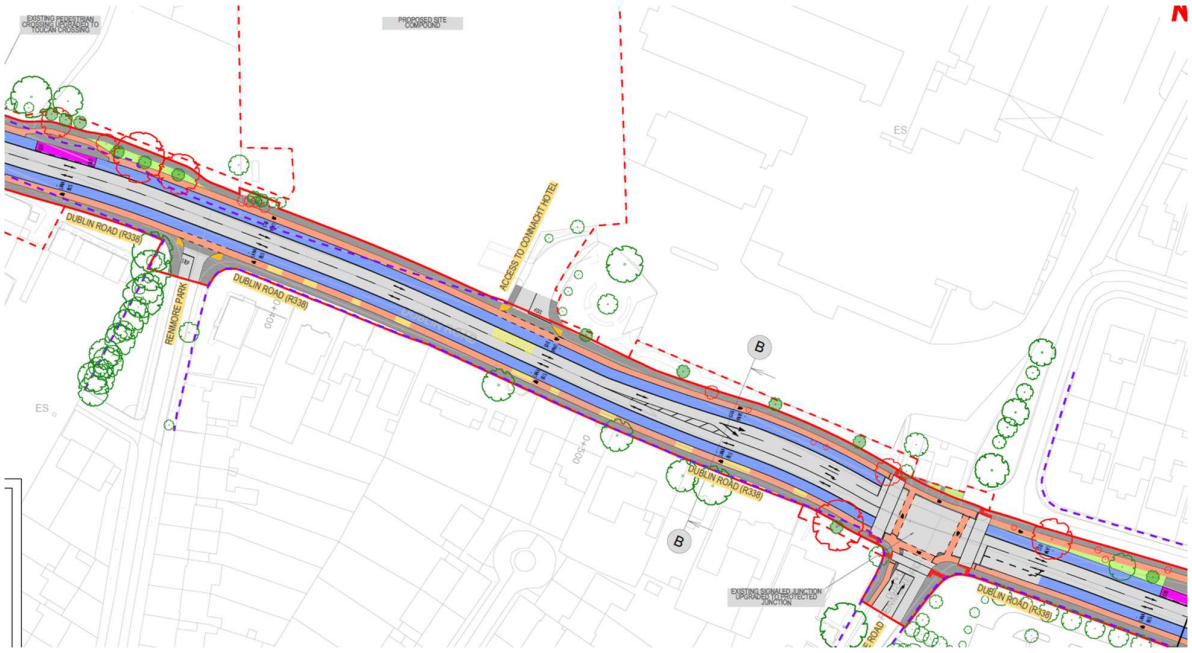

Figure 13-2: Renmore Park to Renmore Road Proposal

13.1.3 Renmore Road to Michael Collins Road / Hospice Access Road

The proposed development continues along the Dublin Road (R338) from Renmore Road to the Michael Collins Road / Hospice Access Road Junction. This section of the development is zoned for health inbound, which contains the Bon Secours Hospital and its surrounding grounds. There are residential areas along the outbound stretch of Glenina Heights.

Minor permanent land take is required inbound just west of the Michael Collins Road junction for the accommodation of the bus set down bay to ensure that consistent width is maintained on the footpath and cycle track.

Temporary land take is required through this section to facilitate the construction of the development, including the proposed bicycle stand and surrounding landscaping on the northern side and bus set down space west of the Michael Collins Road junction.

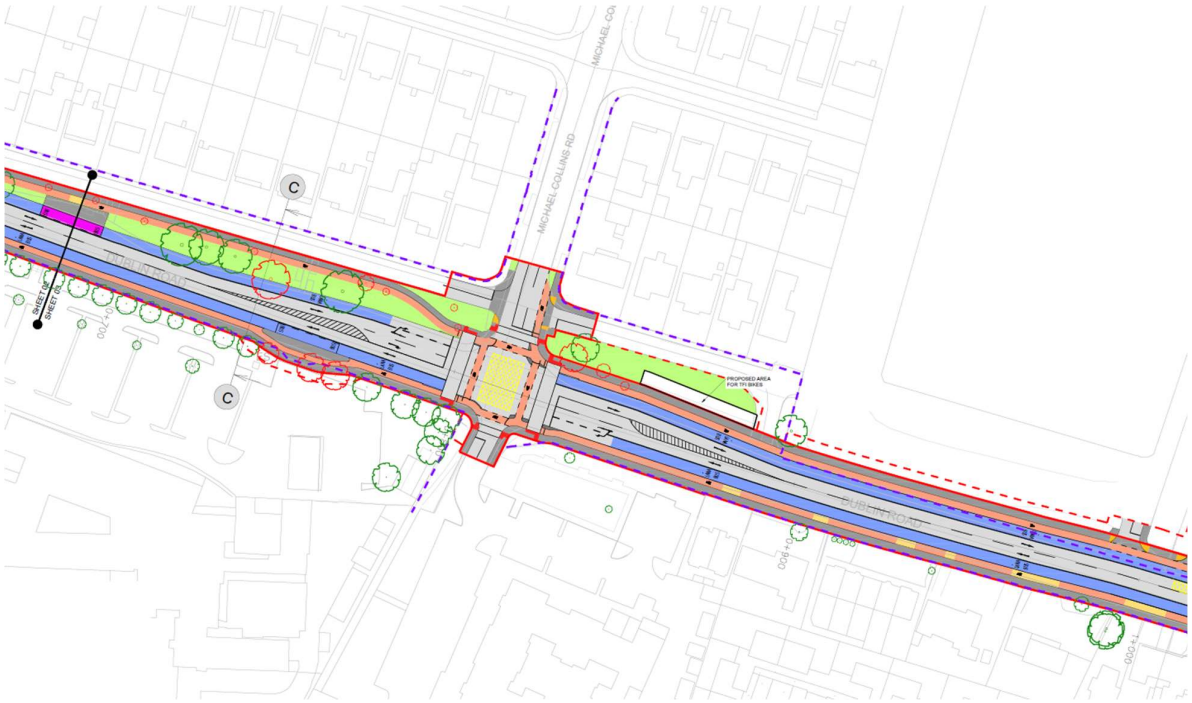

Figure 13-3: Renmore Road to Michael Collins Road Proposal

13.1.4 Michael Collins Road / Hospice Access Road to Ballyloughane / Belmont Access Road

The proposed development continues along Dublin Road, from the Michael Collins Road and Belmont Access Road Junction, to the Ballyloughane and Belmont Access Road. This section of the development includes a portion of residential and tourism zones with Flannery's Hotel along the outbound stretch. Along the inbound stretch there are various residential lots.

Permanent land take is required within this section to facilitate:

- The inbound footpath, cycle track and portions of the bus lane require land take for the majority of this section.
- Proposed island bus stop from between the Connacht Hotel Access Road and proposed Belmont Access Road.
- New Belmont Access Road and footpaths opposite Ballyloughane Road require land take to accommodate the proposed development.
- The Ballyloughane Road Access and junction requires land take to accommodate the footpath and cycle track as well as approximately 45m west of the junction heading inbound accommodating the footpath, cycle track and bus stop island up until the bus stop.

Temporary Land take is required along this section with majority of it being a requirement for the construction of the New Belmont Access Road and its associated footpaths opposite the Ballyloughane

Road as well as the accommodation of the horizontal realignment and carriageway widening to accommodate both inbound and outbound bus set down spaces west of the Belmont Access junction.

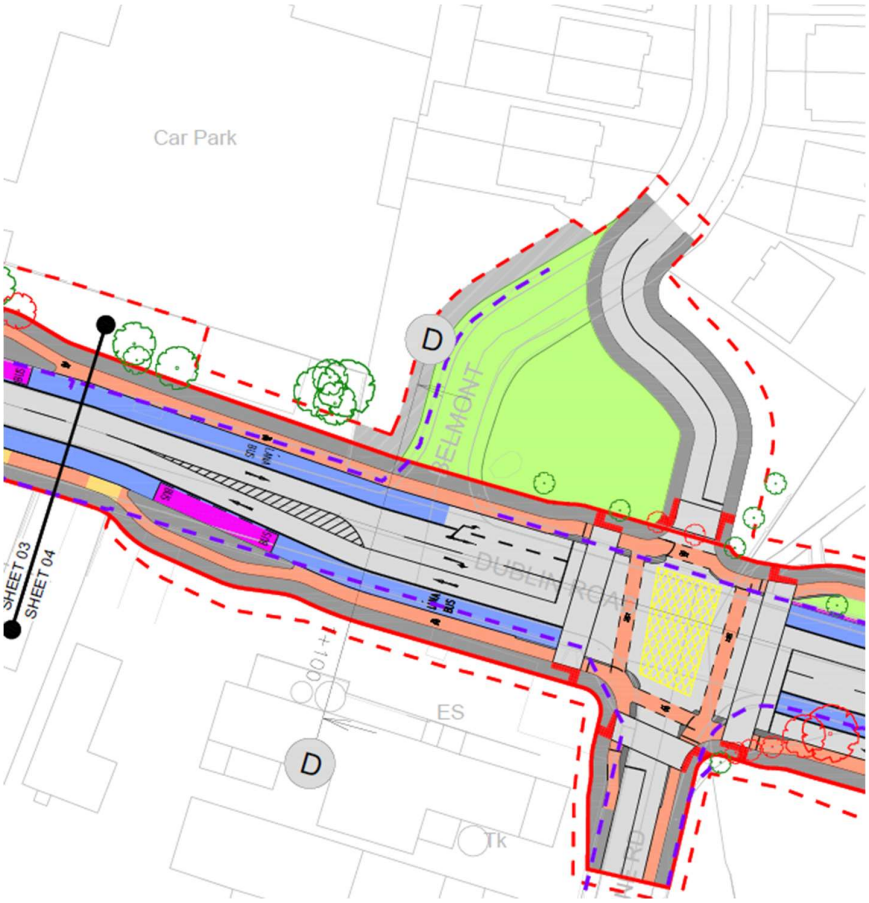

Figure 13-4: Michael Collins Road to Bellmont Road Proposal

13.1.5 Ballyloughane Road / Belmont Access Road to Skerritt Roundabout

This section includes from Ballyloughane Road and Belmont Access Road to the Skerritt Roundabout. This section of the development largely comprises Atlantic Technological University lands.

In order to construct the proposed development, permanent land take is required within this section at the following locations:

- Along the entirety of the outbound stretch there is land take required to facilitate a proposed landscaped area, cycle track, footpath and island bus stop.
- East of Ballyloughane Road there is land take required to construct a new proposed footpath, cycle track, left turning pocket of carriageway and a portion of bus lane.
- West of the Skerritt roundabout land take is required to facilitate the proposed footpath, cycle track, landscaped area, and portion of the proposed double island bus stop.

Temporary Land take is required along the entirety of this section in order to accommodate the contractor and allow for safe working space adjacent to the carriageway.

Figure 13-5: Belmont Access to Skerrit Roundabout Proposal

13.1.6 Skerrit Roundabout to Merlin Park Hospital Access Road

The proposed development passes east, through the Skerritt Roundabout to the Merlin Park Hospital Access Road. This section of the development includes a portion of residential zones of Merlin Gate and Woodhaven, and the grounds of the former Corrib Great Southern Hotel.

Permanent land take is required within this section to facilitate:

- The outbound proposed footpath, cycle lane and portion of bus lane east of the Skerritt Roundabout to Merlin Park Hospital Access Road.
- Along the inbound lane, there is only a minor section of land take accommodating the construction works at the Merlin Gate access.

Temporary Land take is required along the entire outbound direction of this section with additional temporary land take required near the Skerrit Roundabout and the bus set down bay in the inbound direction.

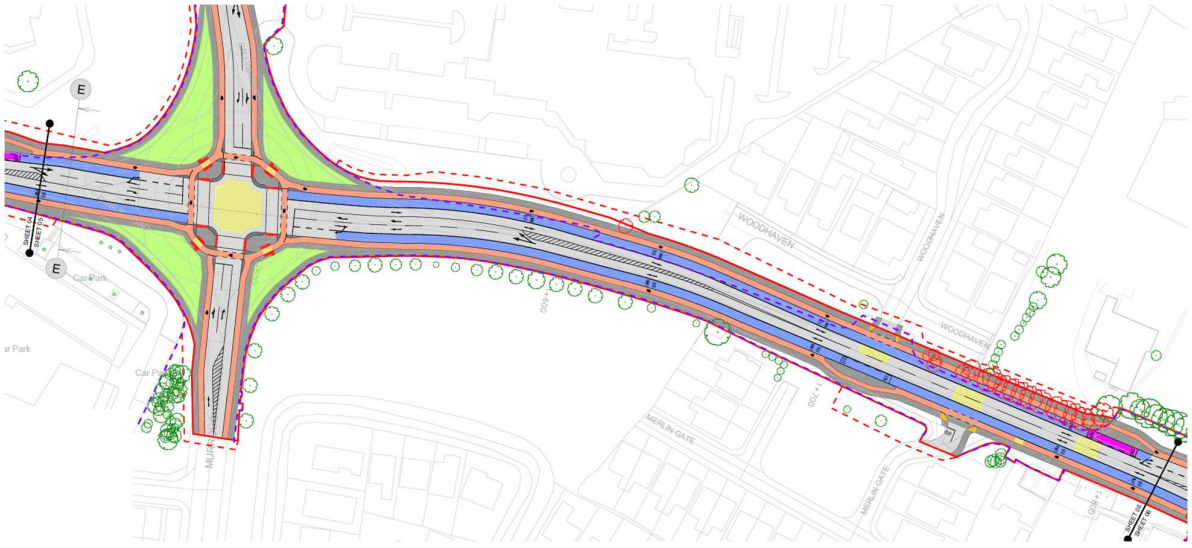

Figure 13-6: Skerrit Roundabout to Merlin Park Hospital Access Proposal

13.1.7 Merlin Park Hospital Access Road to Merlin Park

The proposed development continues along Dublin Road, from the Merlin Park Hospital Access Road to the Merlin Park Junction. This section of the development progresses through rural lands with stone boundary walls along the majority of both sides. Permanent land take is required within this section to facilitate:

- The provision of the footpath, cycle lane and portion of bus lane along the entire outbound stretch.

Temporary Land take is required along the entire outbound direction of this section with additional temporary land take required near the Merlin Park Access junction along the inbound direction.

Figure 13-7: Merlin Park Hospital Access Road to Merlin Park Proposal

13.1.8 Merlin Park to Coast Road

The proposed development continues along Dublin Road, from Merlin Park to the Coast Road Junction. This section of the development progresses through rural lands which contains the Galway Irish Crystal plant on the inbound. The Merlin Park Woods are situated along the south of this section, along the inbound stretch. Permanent land take is required within this section to facilitate:

- The proposed footpath, cycle lane and portions of the bus lane along the entire outbound stretch.

Temporary land take is required along the entire outbound section to accommodate the contractor during the construction works.

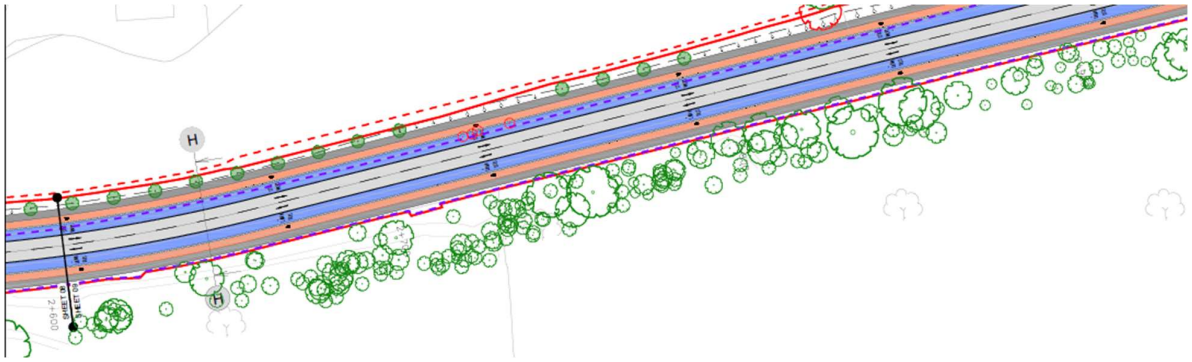

Figure 13-8: Merlin Park to Coast Road Proposal

13.1.9 Coast Road to Doughiska Junction

The proposed development continues from Coast Road to the Doughiska Junction, where the development terminates. This section of the development progresses through rural lands. There is a stone boundary wall along sections of both the inbound and outbound stretches. Permanent land take is required within this section to facilitate:

- The proposed footpath, cycle lane and sections of the bus lane along the entire outbound stretch.
- Minor sections adjacent to the junctions along the inbound stretch to facilitate the footpath.

Temporary Land take is required along the entire outbound direction of this section with additional temporary land take required near the Doughiska Junction and its associate active travel link to the Coast Road.

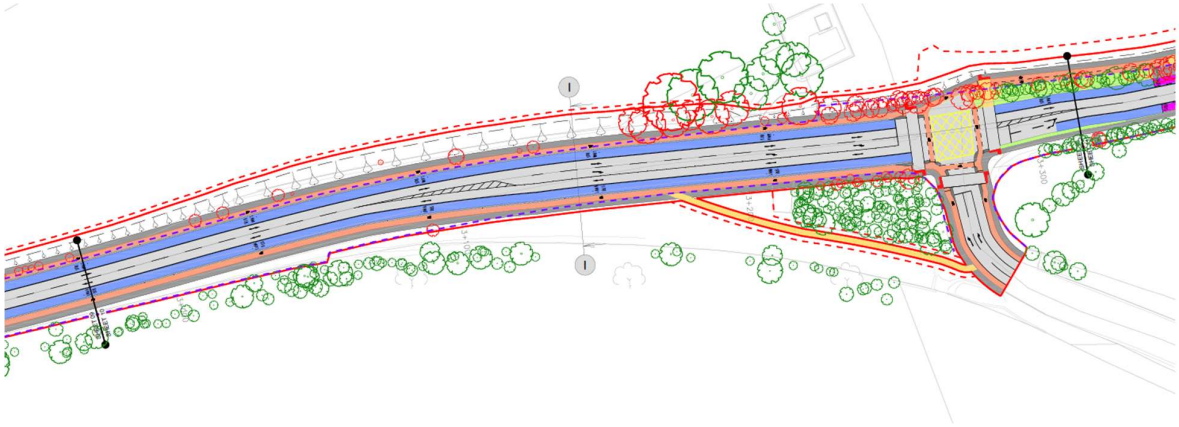

Figure 13-9: Coast Road to Doughiska Junction Proposal

13.1.10 Site Compound

During the construction of the proposed development it is proposed that a construction compound, will be installed at the grounds immediately west of the Connacht Hotel as shown on General Arrangement drawing BCGDR-BTL-GEO_GA-XX-DR-CR-00013.

No land acquisition is compulsorily required within this area to facilitate the development of a temporary construction compound and access to the routes to and from this compound as the necessary lands are in the ownership of Galway City Council.

13.1.11 Summary of Compulsory Land Acquisition

From the commencement of the design of the proposed development, every effort has been made to minimise compulsory land acquisition. However, there are a number of public and private lands that are required to meet the objectives of the proposed development. Reference should be made to the 'Compulsory Purchase Order (CPO) Documents' prepared as part of the planning application.

In total approximately 4.76ha. of land will be required to be permanently acquired to construct the development. There will also be approximately an additional 1.85ha. of temporary land acquisition required to allow for construction of boundary treatment and surface tie in work.

13.2 Summary of Accommodation Works and Boundary Treatment

This section outlines the proposed design of the accommodation works along the proposed development. The proposed accommodation works consist of relocated boundary walls and gates, and the regrading of driveways and adjacent grass areas, where deemed necessary. Where driveways are proposed to be regraded a maximum gradient of 5% in accordance with Recommendations for Site Development Works for Housing Areas, Dept of the Environment and Local Government, 1998 will be adopted, where practicable.

Where cellar and private landings are affected by the proposed development preconstruction and post construction surveys will be performed by the appointed contractor. It will be determined during the detailed design stage if strengthening works are required to these existing structures.

To maintain the character and setting of the proposed development, the approach to undertaking the new boundary treatment works along the development is replacement on a 'like for like' basis in terms of material selection and general aesthetics, unless otherwise noted on the drawings. Final details of boundary walls, gates, driveways and grassed areas where affected, will be agreed between the directly impacted landowners and GCC. Final details of boundary walls, gates and driveways will be agreed between the affected landowners and GCC during the accommodation works negotiations.

SECTION 14: LANDSCAPE AND URBAN REALM

14.1 Introduction

Urban Realm refers to the everyday street spaces that are used by people to shop, socialise, play, and use for activities such as walking, exercise or to commute to and from work. The Urban Realm encompasses all streets, public spaces, junctions and other rights-of-way, whether in residential, commercial or civic use. Well-designed urban realm contributes to the identity of localities and enhances the everyday lives of local communities and those passing through. It typically relates to the space between buildings to which the public has free access and may include seating, trees, planting and other features that enhance the experience for all.

Successful urban realms or public open space tend to have certain characteristics including:

- being welcoming and appealing
- having a distinct identity
- being pleasant and safe
- are easy to move through

Design Principles

Designing Landscape and Urban Realm for public streets and spaces includes adaptation and enhancement of existing spaces as well as establishment of new spaces. Finite public space resources must be optimised to meet the present and future needs of local communities and commuters. The Urban Realm design principles are therefore as follows:

- Making streets and public spaces attractive and appealing to people;
- Recognising and enhancing established local character and identity of places;
- Ensuring inclusive and accessible environments with access for all;
- Provision of seating, trees and landscaping that encourage gathering and dwell time;
- Re-balancing the needs of pedestrians and cyclists over private vehicular transport; and
- Provision of directly accessible high-quality public transport services.

Relevant Policy and Guidelines

In addition to the overarching aims and objectives for the design of Landscape and Urban Realm, a range of existing policies and objectives have been considered in developing landscape and urban realm proposals for the proposed development, including:

- Galway City Council Development Plan (GCDP), 2023-2029, Galway City Council (2023);
- Galway Transport Strategy, Galway City Council (2016);
- Galway Public Realm Strategy, Galway City Council (2019);
- Design Manual for Urban Roads and Streets (DMURS) (2019); and
- Department of Arts, Heritage and the Gaeltacht, Landscape Strategy for Ireland 2015-2025 (NLS).

14.2 Consultation with Local Authority

Consultation has taken place with Galway City Council throughout the design process. Stakeholders and statutory bodies have been consulted through the process as well as through the Public Consultations and various development presentations.

14.3 Landscape and Character Analysis

The landscape and urban realm proposals are derived from analysis of the existing urban realm, including existing street and public space character, any heritage features, existing boundaries, tree planting and existing vegetation, and the range of contemporary and heritage materials in use that inform the quality and character of different parts of the overall route.

The design team identified the range of character areas along different parts of the route informed by adjacent land uses fronting onto the route; the character and heritage of buildings including any protected structures and private gardens or grounds; the nature and presentation of any boundary walls, railings or hedgerows; existing street trees or vegetation and the nature and quality of streetscape materials.

This analysis provided an understanding of the existing character areas along the route and facilitated detailed and iterative consideration as to the integration of the proposed development. This analysis informed design changes to the initial proposals so as to avoid adverse impacts of existing streetscape character, and also identified opportunities for enhancement and creation of new spaces along the route. Character analysis also informed the development of mitigation proposals where public or private property would be directly impacted by the preferred development.

14.4 Arboricultural Survey

14.4.1 Scope of Assessment

An Arboricultural Impact Assessment Report (AIAR) included in Appendix G was prepared based on a detailed tree survey along the proposed development corridor and following the requirements of BS5837:2012 *Trees in relation to design demolition and construction – Recommendations.*

The AIAR documents the nature, quality and condition of existing trees along and adjacent to the route and identifies the likely direct and indirect impacts of the proposed development on such trees. It then makes recommendations as to trees that should and/or will need to be removed and identifies trees in relative proximity to the proposed works and construction wayleaves that should be protected during construction, with suitable mitigation measures, as appropriate. The AIAR identifies trees to be removed, and the Arboricultural Method Statement sets out how retained trees are to be successfully protected.

The AIAR includes the following:

- Description of the site and summary of the trees survey findings;
- Description of the survey methodology;
- A brief summary of trees to be removed;
- Outline guidance for the design team and any key considerations, or issues which need to be addressed;
- The principles for the tree protection on development sites;
- Schedule and corresponding drawings of surveyed trees;
- Tree Protection and Removal Plans; and
- Tree survey tabular report (survey schedules).

14.5 Hardscape

The proposed development has been developed in a manner which employs best practice in urban design and having regard to the Street Material typology described in Chapter 4 Streetscape Materials of Galway Public Realm Strategy (GPRS), Galway City Council (2019).

14.5.1 Design Principals

In the development of the preliminary design proposal, the following elements were analysed and considered:

- The character of each section including building typologies, uses, scale, pedestrian environment, landmarks, landscape character and any other relevant place attributes;
- Assessment of the development proposals and any impacts to the local setting that may need mitigation; and
- Preparation of conceptual public realm design responses for each section that are in keeping with the local character and in line with the objectives, in particular, ensure that the public realm is carefully considered in the design and development of the transport infrastructure and seek to enhance key urban focal points where appropriate and feasible.

14.5.2 Material Typologies

The GPRS sets out the typical streetscape arrangements for the public realm typologies for Galway. It showcases how the design approach and application of the material palette and streetscape elements differ in each typology. The materials palette accounts for different typologies and different conditions within those typologies. A hierarchy of streets and spaces ensures that the proposals are cost-efficient while setting apart special places in the city. The proposed materials are based on the existing landscape character, existing materials, historical materials and treatments along the route to match existing material treatments, while also identifying areas of opportunity for enhancement through the use of higher quality materials.

The proposed material typologies employed in the preliminary design are described as:

- **Poured in situ concrete pavement.** Used extensively on existing footpaths. Concrete pavements can be laid with or without a kerb, can have neatly trowelled edges and textured surface for a clean, durable, slip resistant surface.
- **Asphalt footpath**. Used locally on existing footpaths and will tie in with other sections of urban realm. Laid with a road kerb, can have a smooth finish or textured aggregate surface, provides a strong flexible slip resistant surface.
- **Precast concrete unit paving.** Concrete paving slabs and bricks available in a wide variety of sizes, colours and finishes to provide an enhanced urban realm. Can be used with matching concrete kerbs or with salvaged natural stone kerbs as appropriate.
- **Natural stone paving**. Employed for high quality urban realm areas, mostly in city centre locations. This typology represents new or re-used natural stone paving and kerbs surface and is used to create enhanced public spaces for major urban realm interventions.
- **Stone or concrete setts.** Proposed for distinguishing features such as pedestrian crossing points, raised tables and parking/set-down areas.
- **Self-binding gravel.** Proposed for some pedestrian pathways that are off-road and leading through informal landscaped areas.
- **No change/existing surface retained.** At some locations, the proposed development does not necessitate any alteration to the alignment of the existing footpath or roadway. These include established and more recently constructed sections of streetscape.

Other design responses include:

- Boundary treatments to both commercial and residential properties. Opportunity exists to take the best examples of existing boundary treatment and reinstate them, while improving other sections of the road frontage;
- Tree pit enhancements will be undertaken, using materials such as self-binding gravel. Consideration has also been given to the construction of tree pits to include in-ground root protection systems to improve both the vitality of the trees and the life span of the pavements; and
- Street furniture is mostly confined to replacing or relocating existing furniture, at locations where there is potential development opportunities there is the prospect to provide additional street furniture where it would most enhance the communal spaces.

Public Realm Upgrades/General Upgrade

The proposed treatment of the space surrounding the Lynch's/Mile Stone will follow the palette of Galway Public Realm Strategy (Galway City Council 2019). The strategy provides a palette for general upgrades across the city. Here the focus is on lifting the quality of streetscape and achieving a level of consistency in the design approach. Refer to Figure 14-1.

The proposed materials palette is described as:

- Concrete paving and concrete setts paving with granite kerb.

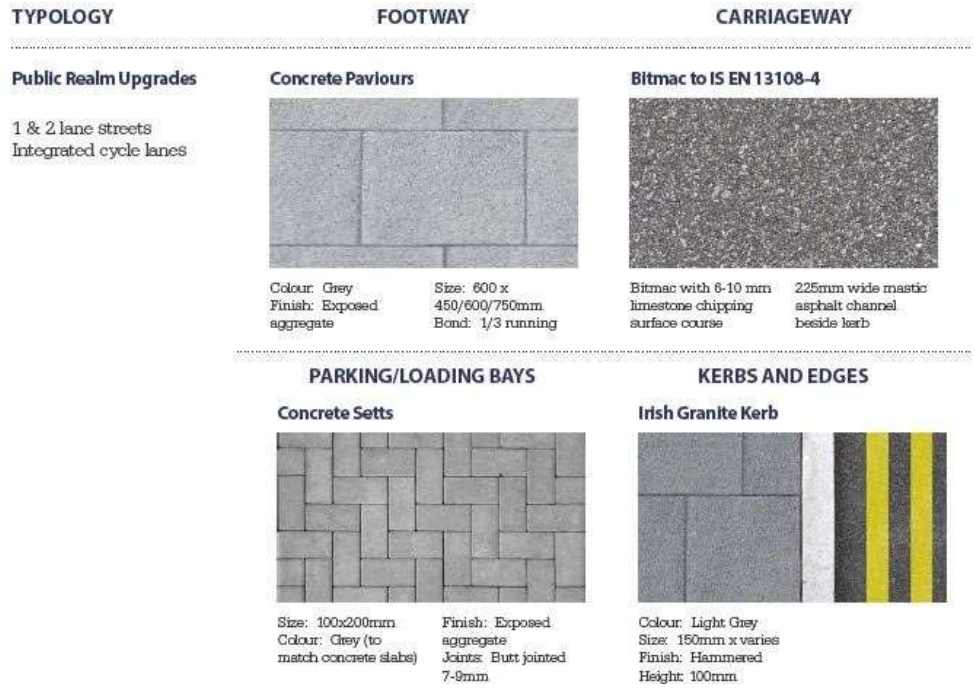

Figure 14-1: Public Realm Upgrade materials palette (extract from GPRS)

Detailing

The design considers re-use of existing high-quality and natural stone kerbs so as to maintain streetscape character, reduce construction costs and maximise sustainability.

Pedestrian crossings at side streets will be raised where practicable and will be distinguished using stone or concrete setts as appropriate to the locality.

In some locations, existing street trees have disturbed or broken footpath surfaces. The footpath around such trees will be replaced where appropriate with self-binding gravel so as improve the vitality of the trees and ensure accessible pedestrian facilities.

Sustainable Drainage Systems (SuDS) will be incorporated, in accordance with Galway City Development Plan, within hardscape areas to locally manage surface water run-off and reduce demand for piped surface water drainage infrastructure.

Informal footpaths through landscaped areas that are set back from the main carriageway will be formed using self-binding gravel as an alternative to asphalt or concrete.

Where private or commercial property boundaries are realigned, boundary walls and railings will be reinstated to match the existing and may be extended to other properties along the same street to enhance streetscape character.

Existing street furniture such as seating will be relocated within the revised streetscape and new street furniture will be provided at locations where opportunity sites have been identified to establish or enhance public spaces.

Hardscape works will be complemented by soft landscaping including trees, hedgerows, native planting, ornamental planting, amenity grass areas and species rich grasslands as appropriate. Soft landscaping will enhance the amenity value and visual character of streets and spaces, mitigate the loss of existing trees, and enhance ecological value along the route.

14.6 Softscape

Softscape refers to existing trees including street trees and groups of trees, new tree planting, hedgerows, ornamental planting and amenity grasslands. Softscape plays an important role in ensuring that streets and public spaces are attractive and healthy spaces for the local community, but also in providing better air quality, managing surface water run-off and in maintaining and creating habitats.

14.6.1 Planting Strategy

The planting strategy has been developed in response to the objectives set out in both the Galway City Council Development Plan (GCDP) 2023-2029 and in response to landscape and urban realm opportunities arising from the proposed development to integrate new infrastructure within the existing local context and to enhance the visual and amenity value of streets and spaces.

The overarching planting strategy is to retain established trees and vegetation wherever possible for their arboricultural, amenity and biodiversity value.

The Arboricultural Survey described in Section 14.4 above identified trees and groups of trees along the project route and provided a detailed schedule of the characteristics, vitality and quality of trees. The AIAR was prepared by overlaying the proposed development General Arrangement with the tree survey so as to identify trees or groups of trees that might be impacted by the development. The AIAR includes recommendations for the retention, removal or management of trees and identifies trees that will be impacted by virtue of the proposed development. It also sets out tree protection measures for trees adjacent to the proposed development that might otherwise risk damage during construction.

The planting strategy includes replacement of street trees and groups of trees that may be impacted by the proposed development, but also the introduction of new tree planting and street trees within other spaces and along streets. Reinforcement of green infrastructure along the route will improve the overall amenity, character and appeal of the route corridor and localities along it, as well as enhancing biodiversity.

In addition to trees and street trees, other vegetation is also proposed along the route including hedgerows, ornamental planting and amenity grassland, shrub and meadow grass areas. These will, in part, be utilised to reinstate property boundaries altered by the proposed development, but also to create new landscape spaces along the route where existing junctions are to be rationalised yield increases in pedestrian and amenity space.

Throughout the design process, collaboration between the Landscape and Urban Realm designers and the Drainage Engineers has sought to adopt Sustainable Drainage Solutions (SuDS) to manage storm water run-off. SuDS features have been considered along the route and incorporated within suitable landscape areas in the form of rain gardens, bioretention areas, filter drains, swales, tree pits and permeable paving.

14.6.2 Typical Planting Typologies

A range of general planting typologies are incorporated into the proposed development as appropriate to localities and character areas along the route. In some instances, planting is focussed on reinstatement and repair of existing tree group areas that will be impacted to facilitate construction of new footpaths, cycle tracks and road infrastructure. In other cases, planting is focussed on enhancing the amenity, green

infrastructure and biodiversity along the route and in providing distinctive and attractive places for people to gather and relax.

New Street Trees and Tree Groups

A range of urban street tree species have been incorporated into the overall route planting design depending on location and whether trees are to be planted in grass verges or in tree pits within paved urban environments as appropriate, and also to ensure diversity of species and provide habitats for urban wildlife. Typically, proposed trees will be semi-mature, minimum 18/20cm girth standards with 2m clear stem height to facilitate visual permeability. The full range of proposed street trees are included in Table 14.1 at the end of this Chapter.

The proposed planting has allowed for native species similar to those on site and to those removed and is specified to be planted at an advanced heavy-standard size (min. 4.5m height) specifically along Merlin Park boundary.

Elsewhere along the route of the proposed development there are a range of existing mature and immature street trees. While it is proposed to retain and protect existing trees wherever possible, some will be impacted. The proposed development includes replacement and additional planting of semi-mature street trees to mitigate the loss of existing trees and to maintain the long-term tree-lined character of streets.

The proposed development incorporates additional landscaping arising from junction reconfiguration, reinforcement of existing vegetation areas, and the establishment of new urban realm and landscape opportunity areas. Tree species will be determined by location and will comprise either native trees species as set out above, or selected non-native street trees suitable for coastal areas, tolerant to salt-laden wind and tolerant to drought. as set out in Table 14.1.

Landscaping proposals respond to the different localities and may include grass planting, hedgerows, trees, grasses, ornamental planting and swathes of spring bulbs. The full range of proposed ornamental planting, shrub and hedging species are included in Table 14.2 at the end of this Chapter.

Boundary Planting

The proposed development corridor is bounded by a wide range of established private, institutional, commercial and public land boundaries. While the design development has sought to avoid impacts on such boundaries, the proposed development will nonetheless require both temporary and permanent acquisition of lands.

Impacted property boundaries will be reinstated following construction. In some instances, boundaries will be re-built along their original alignments. In other cases, boundaries will be re-built on a new setback alignment. In general, property boundaries will be reinstated on a ‘like for like’ basis, including any walls, piers, fences, railings, gates, driveway finishes and private landscaping. Private grounds that are utilised in part for construction access will be reinstated following completion of the works to match the existing landscaping of the property where possible. Where private grounds are reduced by permanent land take required for the proposed development, the remaining grounds will be reinstated to match the landscape and character of the existing grounds in consultation with the property owner.

14.7 Proposed Landscape and Urban Realm Design

This section outlines the landscape and urban realm proposals along the proposed development. The landscape design is presented on a series of 1:500 scale drawings *Landscaping Design Drawings* in Appendix B that include the combined hard and soft landscaping proposals for the entire route. These drawings include the general arrangement of the proposed layout and identify in particular:

- Existing trees and tree group areas;
- Tree and tree group felling;

- The location and extent of existing hard landscaping surfaces to be retained;
- The location and extent of new hard landscaping surfaces to be formed using different materials;
- Proposed trees and tree groups;
- Proposed grass verges, amenity areas and species rich grass land;
- Proposed ornamental planting, native planting and hedgerows; and,
- Sustainable Urban Drainage (SuDS) infrastructure.

Additionally, along the development corridor, a number of Public Space Opportunity Sites have been identified where existing spaces can be enhanced or new spaces created. These are included and further illustrated in the descriptions below as appropriate.

Codes of Practice and Recommendations

All tree planting works will be undertaken in accordance with the following British Standard Codes of Practice:

- BS 3998:2010 Tree work;
- BS 5837:2012 Trees in Relation to Design, Demolition and Construction; and
- BS 8545:2014 Trees: from nursery to independence in the landscape – Recommendations.

All hard landscaping and paving works will be undertaken in accordance with:

- Engineer's drawings and details;
- Galway Public Realm Strategy (2019);
- All relevant TII Construction Management Guidelines;
- CC-SPW-01100 (Feb. 2012) - TII Specification for Road Works Series 1100 – Kerbs, Footways and Paved Areas;
- TII Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub;
- TII Guidelines for Treatment of Noise and Vibration and Air Quality;
- DMURS Advice Note 2;
- BS 7533-101:2021 Code of practice for the structural design of pavements using modular paving units

Mitigation Measures

Mitigation measures are an inherent part of the multi-disciplinary design proposals and have been considered iteratively throughout the design process. Mitigation measures are informed by understanding existing conditions including the range of land uses, the nature and quality of existing built and landscape features and dimensional constraints and other opportunities. That information is used to identify the optimum integration of initial and evolving design proposals for carriageways, streetscapes, infrastructure including pedestrian and cycle facilities.

Mitigation includes minimising adverse impacts on private and public property and landscapes through avoidance and reduction; identifying opportunities to create improvements along streets and at other public spaces; and seeking opportunities to mitigate unavoidable impacts of trees, landscapes and property through reinstatement and new planting. Underlying landscape and urban realm design and mitigation is the concept of Placemaking that seeks to ensure that streets, public spaces and amenities are developed to create attractive and safe places of people to use as destinations and for commuting. Mitigation, as an integral part of the design process, includes:

- Reinstatement of impacted built or other features on a 'like for like' basis so as to restore established streetscape and spatial character;
- Upgrading the condition and/or quality of built elements to retore or enhance overall character and amenity;
- Introduction of new and reconfigured public spaces and streetscapes to provide more coherent, attractive and useable urban realm;
- Planting new street trees, woodland/parkland tree groups and other landscaping to offset any unavoidable impacts on existing landscape features along the development; and

- Enhancing the sustainability of public spaces through improving biodiversity and introduction of Sustainable Drainage Systems (SuDS) wherever possible.

Table 14-1: Proposed Tree Planting Species

Species Name Common Name	Criteria for use	Girth / Form / Height	Comments
Proposed trees			
Alnus glutinosa Common Alder	Irish native tree. Planter beds. Native, deciduous. Tolerant of exposed coastal areas.	18-20cm (Advanced Heavy Standard), RB/min 4.5m in height	
aesculus hippocastanum European horse-chestnut	Large deciduous tree. Tolerant of exposed coastal areas. Low maintenance	20-25cm (Advanced Heavy Standard), RB/min 5m in height	
Acer platanoides ‘Culumnare’, Norway Maple	Good street tree. Tolerant of exposed coastal areas. Low maintenance architectural tree. Attractive to pollinating insects.	18-20cm (Advanced Heavy Standard), RB/min 4.5m in height	
Acer platanoides ‘Globosum’ Norway maple 'Globosum'	A small to medium-sized tree, up to 8m tall, with a dense, rounded crown. Good street tree.	16-18cm (Advanced Heavy Standard), RB/min 4m in height	

Species Name Common Name	Criteria for use	Girth / Form / Height	Comments
Acer pseudoplantanus Sycamore maple	Good street tree. Tolerant of exposed coastal areas. Tolerates air pollution and resists drought. Low maintenance architectural tree. Attractive to pollinating insects	20-25cm (Advanced Heavy Standard), RB/min 5m in height	
Betula pendula Silver Birch	Irish native tree. Planter beds. Good in groups. Tolerant of exposed coastal areas. An invaluable part of the native ecosystem, host to many insect species and birds.	18-20cm (Advanced Heavy Standard), RB/min 4.5m in height	
fagus sylvatica European Beech	Irish Native Tree. Large, vigorous deciduous tree reaching 30m in height, with a broad, spreading crown. Leaves broadly elliptic, yellow-green in spring, rich golden copper to russet-brown in autumn.	20-25cm (Advanced Heavy Standard), RB/min 5m in height	
Prunus avium Double flowering cherry	Irish native tree. Planter beds. Tolerant in sheltered coastal areas. Feature accent element on urban squares, parks and avenues.	18-20cm (Advanced Heavy Standard), RB/min 4.5m in height	

Species Name Common Name	Criteria for use	Girth / Form / Height	Comments
Quercus petraea Sessile Oak	Irish native tree. Feature tree in planter beds. Tall narrow pyramidal version of the Common Oak 'Fastigiata Koster' is ideal for growing along an avenue or where space is at a premium. Great for attracting native wildlife.	18-20cm (Advanced Heavy Standard), RB/min 4.5m in height	
Sorbus aria Whitebeam	Irish Native Tree. Tolerates coastal exposure	18-20cm (Advanced Heavy Standard), RB/min 4.5m in height	
Tilia cordata 'Greenspire' small-leaved lime	Street tree. Tolerant in sheltered coastal areas. Tolerates air pollution and resists heavy pruning. Wildlife friendly, attractive to pollinating insects. Good avenue tree	18-20cm (Advanced Heavy Standard), RB/min 4.5m in height	
Ulmus glabra Wych Elm	Good street tree. Tolerant of exposed coastal areas. Tolerant of urban conditions. High resistance to Dutch elm disease (DED).	18-20cm (Advanced Heavy Standard), RB/min 4.5m in height	
Proposed Multi-stem Trees			

Species Name Common Name	Criteria for use	Girth / Form / Height	Comments
Betula pendula Silver Birch	Irish native tree. Planter beds. Good in groups. Tolerant of exposed coastal areas. An invaluable part of the native ecosystem, host to many insect species and birds.	2.5-3m height/RB/ Multistem (3 no. stem)	
Syringa Vulgaris	It is a deciduous shrub which grows into a bushy thicket. The light blue-purple flowers are very sweet-smelling in early summer. Feature accent element on urban squares, parks and avenues.	2.0-2.5m height/RB /Multistem (3 no. stem)	

Table 14-2: Proposed ornamental planting, shrub and hedging species

Scientific name	Reference image
Proposed Native Hedge/Hedgerow Planting *Fagus sylvatica* *Euonymus europaeus* *Corylus avellana* *Crataegus monogyna* *Ile aquifolium* *Lonicera periclymenum* *Prunus spinosa* *Viburnum opulus*	
Proposed Ornamental Shrub & Herbaceous *Achillea millefolium 'Cerise Queen'* *Calamagrotis x acutiflora 'Karl Foerster'* *Echinacea pallida* *Lavandula angustifolia 'Hidcote'* *Phlomis tuberosa 'Amazone'* *Rosmarinus officinalis* *Geranium macrorrhizum 'Spessart'* *Scabiosa columbaria* *Rudbeckia fulgida 'Golgstrum'* *Salvia nemorosa 'Ostfriesland'* *Sarcococca hookeriana var. humilis* *Stipa tenuissima 'Pony Tails'* *Symphotrichum ' Little Carlow'* *Viburnum opulus*	
Proposed Groundcover planting *Anemone hupehensis var. japonica ' Prinz Heinrich'* *Astrantia major 'Claret'* *Carex elata 'Aurea'* *Digitalis grandiflora* *Heuchera villosa 'Palace Purple'* *Knautia arvensis* *Knautia macedonia* *Nepeta x faassenii 'Walker's Low'* *Perovskia atriplicifolia 'Blue Spire'* *Rudbeckia fulgida 'Golgstrum'* *Salvia nemorosa 'Caradonna'* *Scabiosa columbaria* *Stachys bysantina* *Tulbaghia violacea* *Verbena bunarensis* *Viburnum davidii* *Persicaria affinis 'Superba'* *Vinca Minor*	  

14.8 Proposed Design

This section outlines the landscape and urban realm proposals along the various sections of the route. Further detail on these design proposals is available in the Landscaping Design Drawings in Appendix B.

14.8.1 Section 1 – Moneenageisha to Skerrit Junction

Existing Character: This section of the proposed development is characterised by residential and industrial, including other amenities such as schools, hospitals, and hotels. There are footpaths on both sides of the road and right-hand turning lane on the approach to several side roads. Both sides of the route are generally bounded by public & private greenspace.

Currently there are no cycle facilities present along the route. Pedestrian footpaths are provided both sides of the road for the full length of the route, and signalised crossings are provided across the Dublin Road (R338) at the junction with Renmore Road, at Michael Collins Road, and east of the entrance to Belmont. The side roads of Renmore, Michael Collins and the entrance to Galway Hospice Foundation also have signalised crossings, all other side road crossings are uncontrolled.

There are a number of prominent and distinctive features adjoining or close to the proposed development including Lough Atalia (a protected landscape under the Galway Bay Complex SAC (Special Area of Conservation) and the Inner Galway Bay SPA (Special Protection Area)), the Lynch's Stone, Connacht Hotel Galway, St. James' Church and Cemetery, Glenina House and Atlantic Technological University.

Design Proposals: The aim is to provide an upgraded and consistent urban realm quality along this section. It is proposed to maintain the two-way general traffic lanes and introduce continuous bus lanes in both directions in this section. The existing footpaths will be upgraded and extended, and new segregated cycle tracks will be provided in both direction along the entire length of the route. Signal-controlled crossings will be provided at all junctions through a combination of dedicated cycle crossings and shared toucan crossings. The layout for this section can be seen below in Figure 14-2.

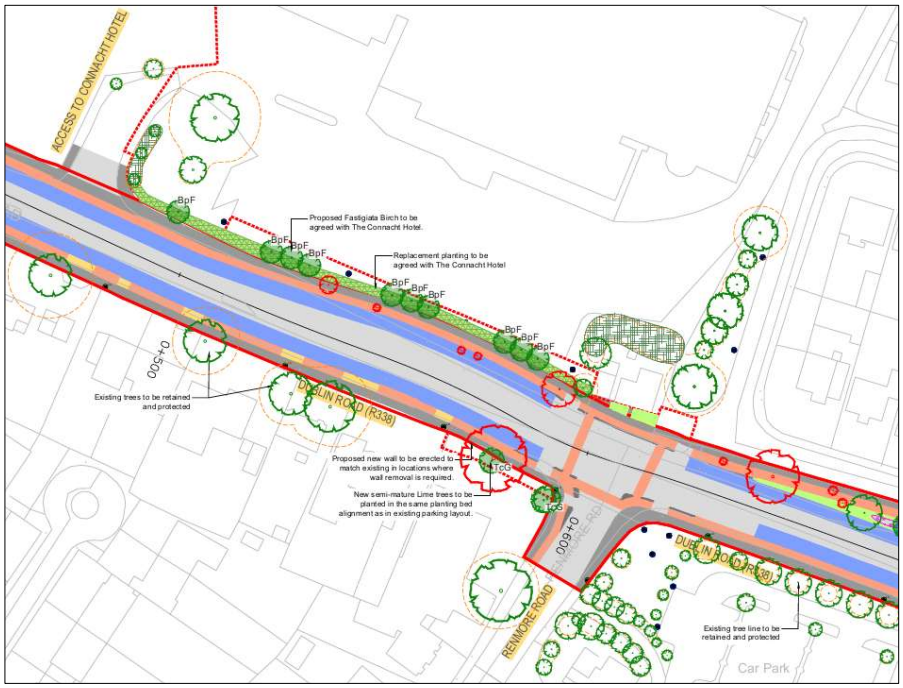

Figure 14-2: Dublin Road to Renmore Road Junction

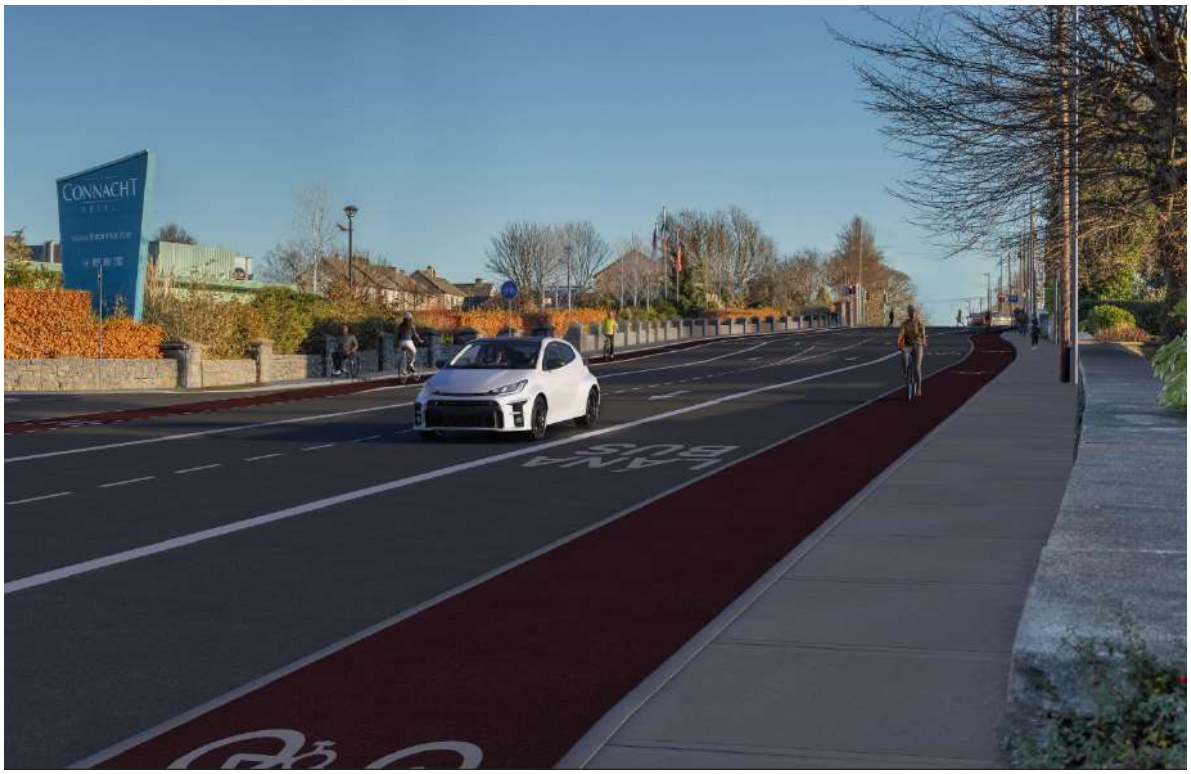

Figure 14-3: Proposed View at the entrance of Connacht Hotel

The existing junctions at Renmore Road and Ballyloughnane Road will be modified to a fully signalised junction with dedicated pedestrian and cyclist facilities.

Designing the public realm with functional delineation will also improve safety for pedestrians and cyclists. The proposed materials include high quality concrete paving and granite kerbs to unify the materials around the junctions. Existing tree surrounds would be widened and surfaced with self-binding gravel.

Proposals for the Michael Collins Junction are shown overleaf in Figures 14-4 and 14-5

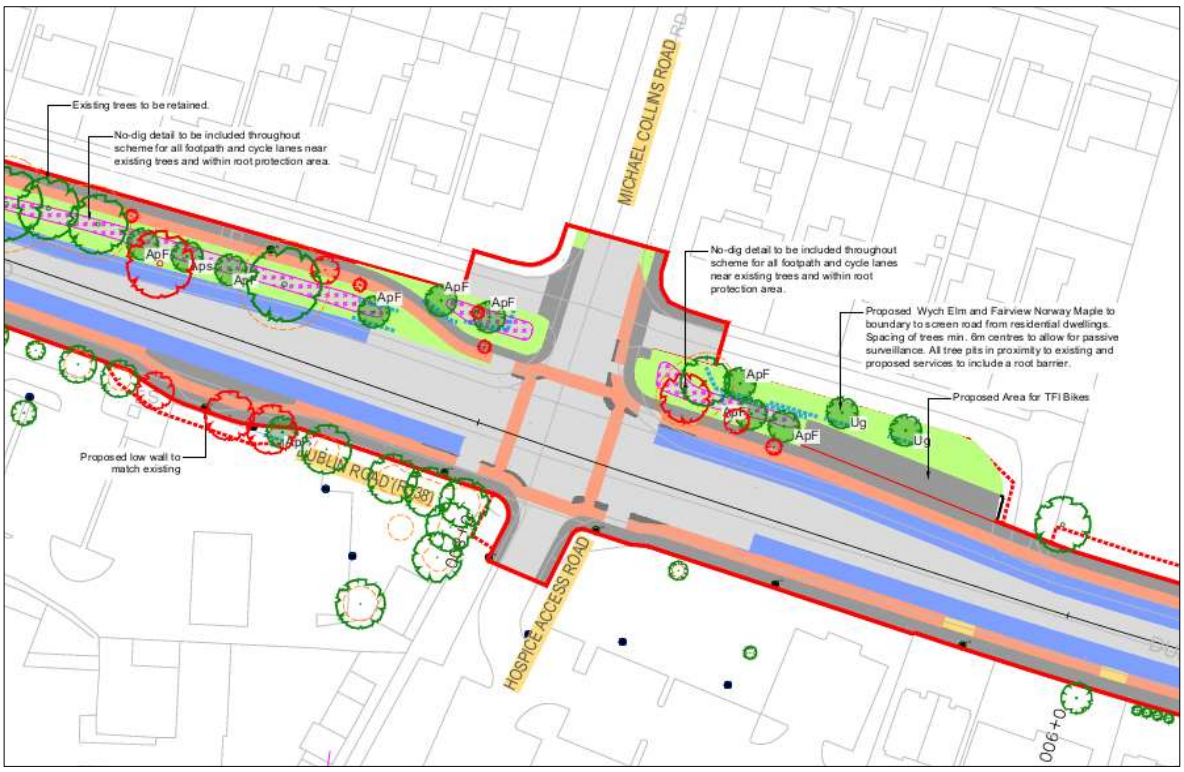

Figure 14-4: The Michael Collins Road Junction

Figure 14-5: Proposed view of the road from Renmore Road junction to Michael Collins Road Junction

Skerrit Junction

It is currently an uncontrolled roundabout with four arms and there are two approach lanes on each arm. There are wide turning radii and clear sight lines which allow traffic to go round the roundabout at relatively high speeds. There is no cycle provision or signalised pedestrian crossings provided, although uncontrolled pedestrian crossing points are present at each arm.

A new "cyclops" (Cycle Optimised Protected Signals) junction is proposed to replace the Skerritt Roundabout which is designed to separate pedestrians and cyclists from traffic at the junction, reducing the possibility of collisions or conflict.

The layout of the proposed Skerritt Junction is shown in Figures 14-6 and 14-7 below.

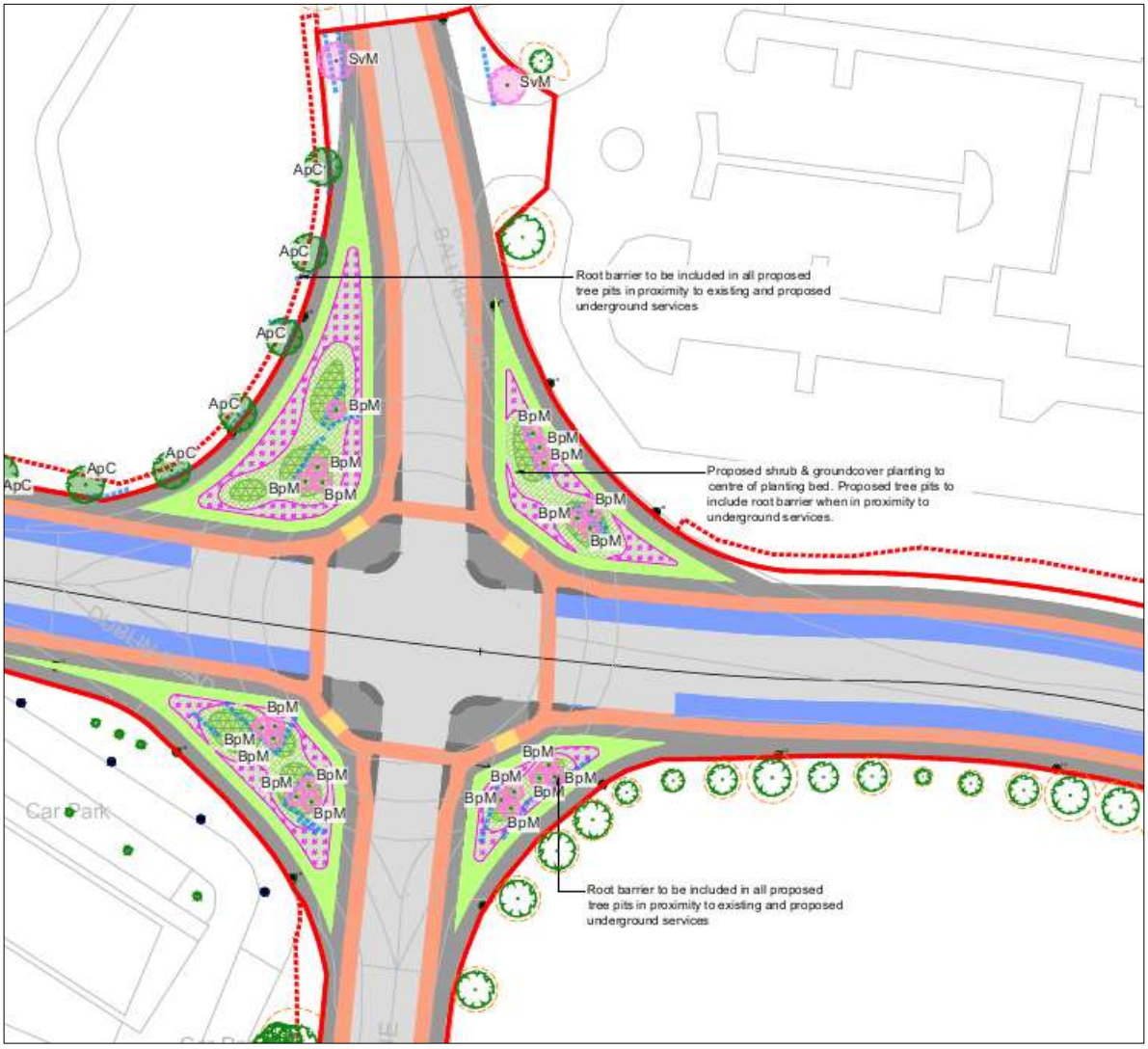

Figure 14-6: Skerritt Junction

Figure 14-7: Proposed view of the Skerritt Junction

14.8.2 Section 2 – Skerritt Junction to Doughiska Road Junction

Existing Character: This section of the route consists of a single inbound bus lane and traffic lanes in both directions. There is a footpath on the southern side of the road, a hard shoulder on the northern side of the carriageway, and grass verges both sides. Currently there are no cycle facilities present along the route. Pedestrian footpaths are provided for the full length of the route. Signalised crossings are provided across the R338 at the junction with Murrough Road, Coast Road and Doughiska.

The route is generally bounded by greenspace and a stone wall on both sides. The route is lined by trees on both sides, particularly between Coast Road and Doughiska Road. This section is characterised by wide areas of open space, with open fields such as the Merlin Meadows, or enclosed areas such as the Rosshill Park Woods. The landscape comprises extensive areas of mature deciduous woodland, with mature tree lines accompanying the existing Dublin Road.

Design Proposals: There are interventions additionally proposed for instance tree removal and construction of retaining wall to allow the proposed development. Raised tables will be provided to the access at the Woodhaven estate and the Merlin Gate estate.

The drainage works for this section includes construction of trenches for short sections of attenuation pipes and surface water chambers. Combined kerbs and drainage systems will also be constructed at discrete locations.

New segregated cycle tracks will be provided in each direction from Skerritt Junction to the Coast Road. A two-way segregated cycle track will be provided on the northern side of the route from the Coast Road to Doughiska Junction which will run behind the roadside tree line. Signal-controlled crossings will be provided at all junctions through a combination of dedicated cycle crossings and shared toucan crossings.

The proposed development will upgrade pedestrian routes and crossing points to improve mobility along the second section also. Footpaths are to be replaced and widened with new high quality paving surface,

and between chainage 2+280 and 3+760, a footpath will be implemented along the outbound carriageway to link the existing ones. A pedestrian crossing is being proposed in all new non-signalized junctions and raised crossings in the minors' junctions and entrances.

Below are shown layouts of locations in this section with proposed views.

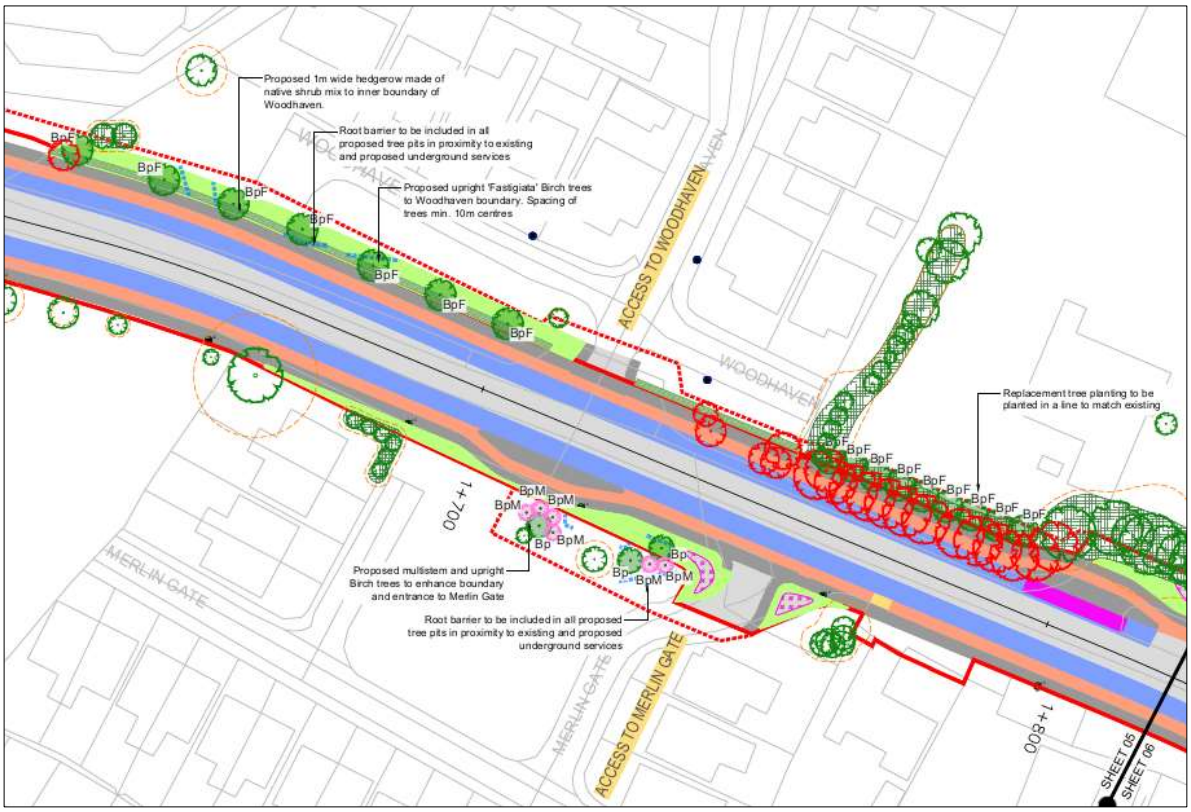

Figure 14-8: Skerritt Junction to Merlin Park section

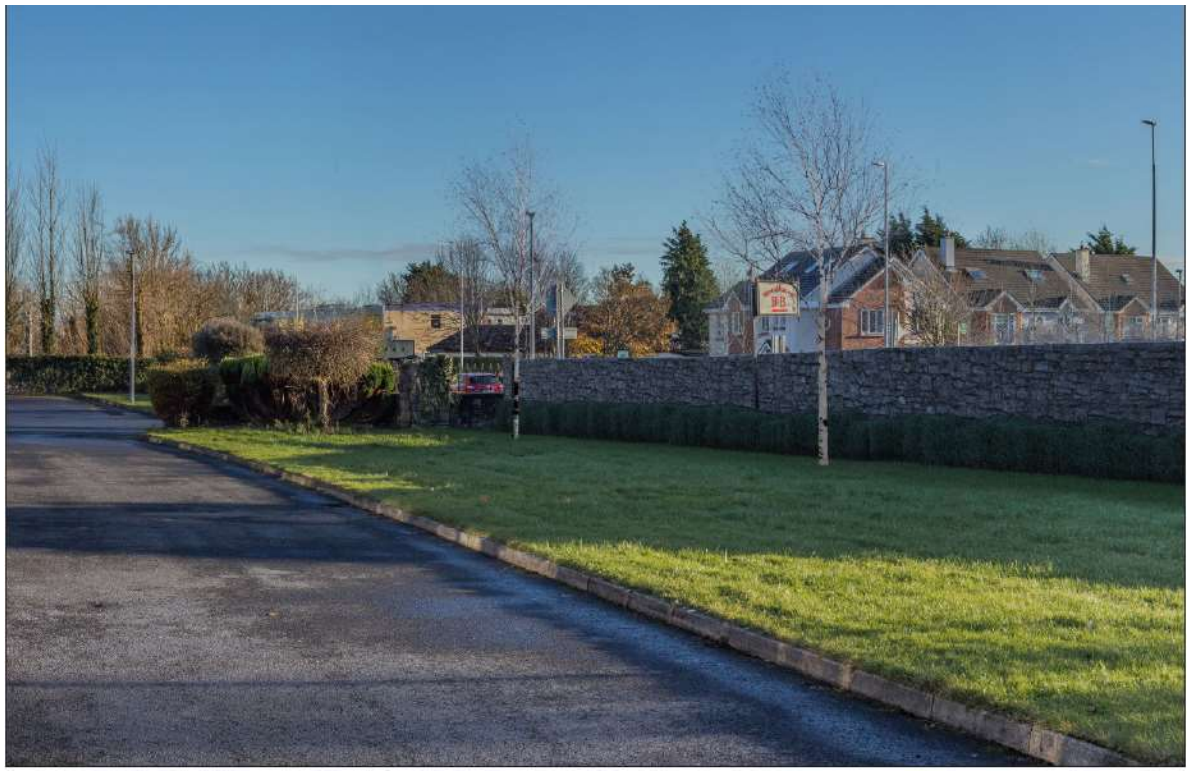

Figure 14-9: Proposed view of the section from Skerritt Junction to Merlin Park

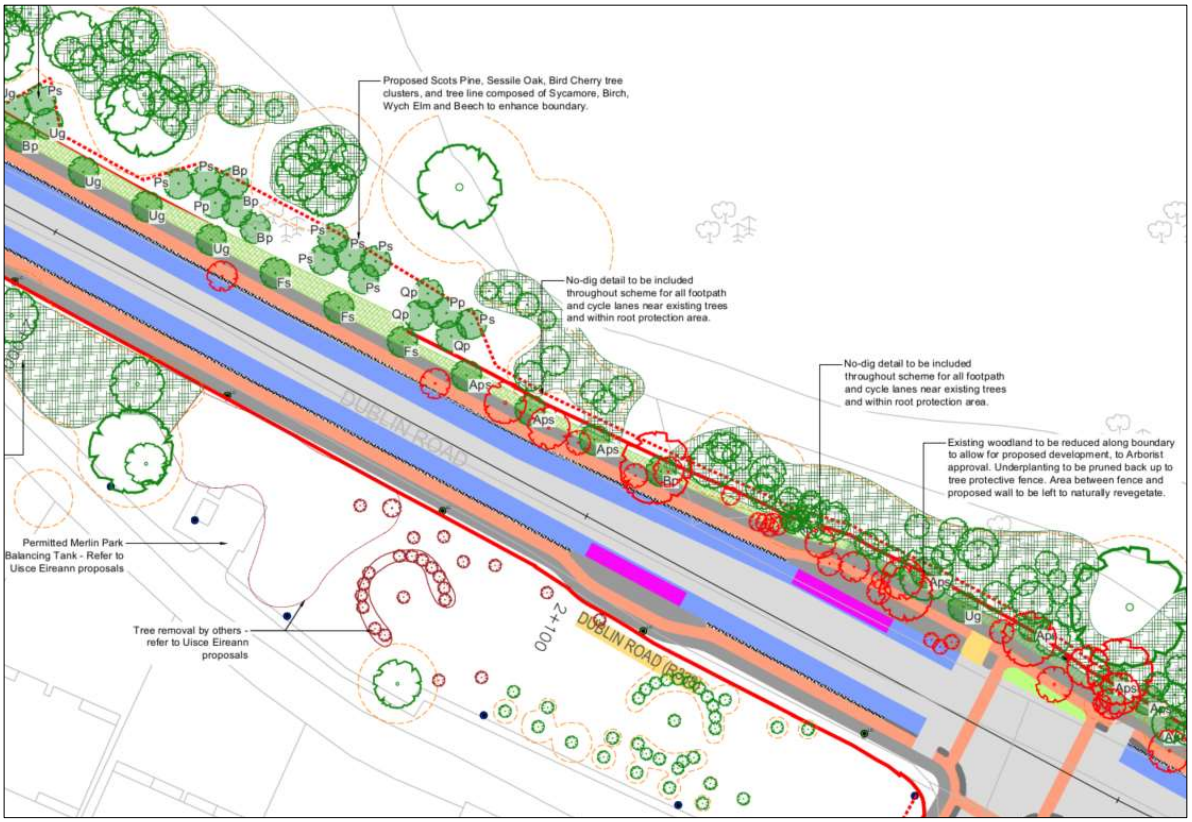

Figure 14-10: Dublin Road along the Merlin Park

Figure 14-11: Proposed view of the section

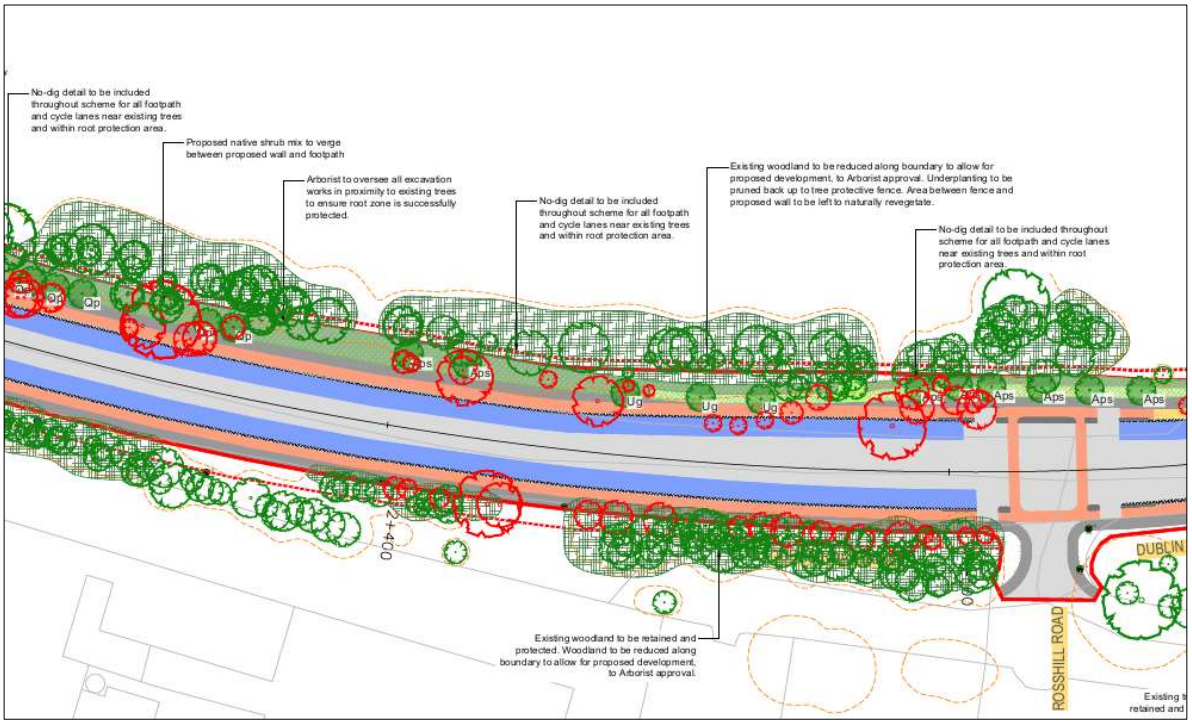

Figure 14-12: Dublin Road towards Rosshill Road

Figure 14-13: Proposed View

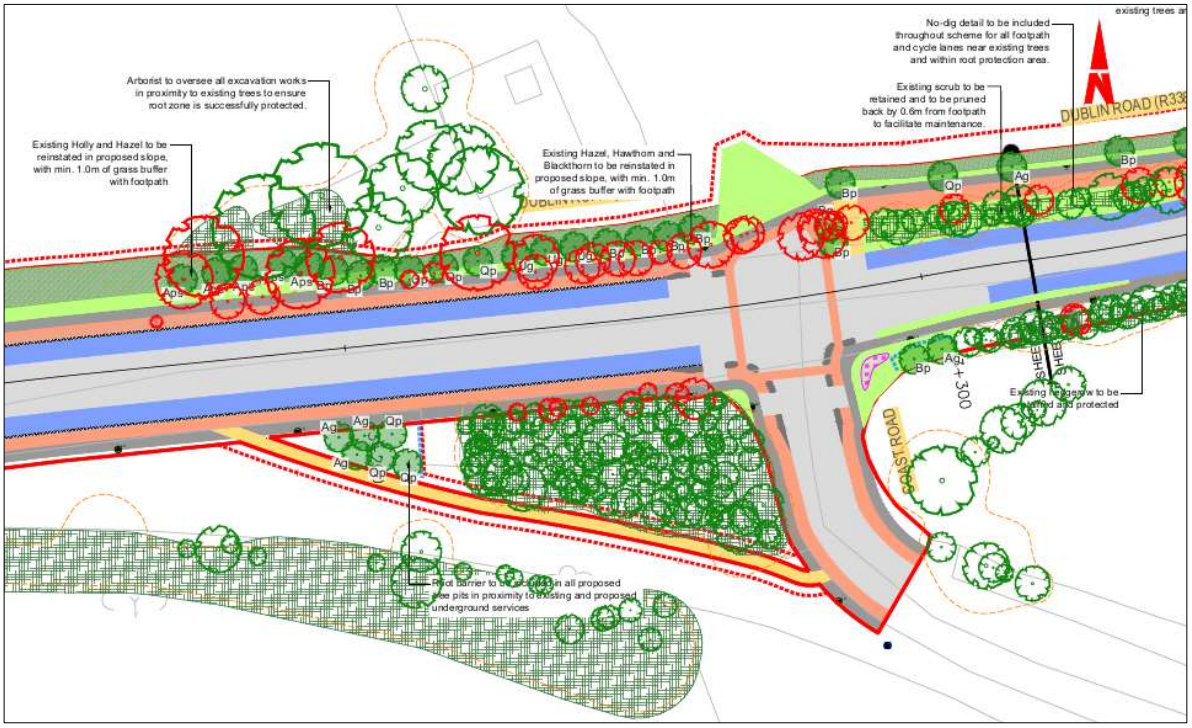

Figure 14-14: Dublin Road toward Coast Road

Figure 14-15: Proposed view of Dublin Road towards Coast Road

SECTION 15: HOW WE ARE ACHIEVING THE OBJECTIVES

This section sets out the manner in which the proposed development described herein will achieve the following Objectives as set out:

- Economy - To enhance and support sustainable growth of Galway City through the provision of a continuous high-quality multi-modal corridor which will improve bus journey times and journey time reliability along the R338 (Dublin Road).
- Safety - Enhance pedestrian and cyclist safety through the provision of improved and segregated walking and cycling facilities along the R338 (Dublin Road).
- Integration - Improve multi-modal network connectivity between (a) Galway City Centre and its neighbourhoods such as Renmore, Ballybane, Doughiska, Parkmore and Ardaun; (b) Galway City and regional towns such as Oranmore, Athenry and Gort; and (c) Galway City and the inter-urban motorway network through the provision of a high-quality multi-modal corridor.
- Environment - Increase modal share for public transport and active travel modes through the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets.
- Accessibility and Social Inclusion - Improve access to all services and outdoor areas, e.g., Merlin Park Woods, Ballyloughane Beach, ATU (GMIT), along R338 (Dublin Road) by improving transport options for everyone especially for people with disabilities, mobility issues and people travelling with children.
- Physical Activity - To enable local opportunities for walking and cycling activity in communities as a result of improved and segregated walking and cycling facilities which will help increase physical activity.

There is a total of approximately 10.4km of dedicated bus lanes in Galway City (GTS, 2016) and suburbs of which, almost 30% are outside the city, near Baile Chláir. Sections of the existing network where there is no designated priority are therefore completely dependent on prevailing traffic conditions, with reliability of public transport services impacted by traffic congestion.

The absence of dedicated bus priority (both physical, e.g., bus lanes and / or supporting traffic management measures) compromises the reliability of the existing public transport service offering, and therefore reduces the appeal of the bus services available (local, regional and inter-city). In addition, congestion and delay on the road and street network quickly propagates and impacts on the bus service where there is no priority and the bus must merge with general traffic, undermining the public transport service further.

The inclusion of new and enhanced pedestrian crossing facilities will promote increased pedestrian activity along the development, providing safe desire lines for pedestrians to/from all directions. The proposed development also removes the existing lengthy uncontrolled crossings and the associated safety risks that they present to pedestrians at these vehicle dominated locations.

Currently, bus priority is characterised by discontinuity. Bus priority is only provided along certain limited sections, and a number of pinch-points cause significant delays which result in a negative impact on the performance of the bus service as a whole.

These services suffer from poor journey time reliability due to a lack of bus priority and buses experiencing the same congestion as private traffic. The proposed development will provide the necessary bus priority to provide reliable and consistent bus journey times, encouraging modal shift away from the private car.

In addition to the level of service improvements the proposed development will facilitate for existing bus services, the proposed Galway City Bus Network identified in the Galway Transport Strategy, will see improved bus services and continued investment in bus services into the future, which will also be afforded similar journey-time reliability and therefore improve their attractiveness as an alternative to private car usage.

Without the interventions of the proposed development there would likely be an exacerbation of the issues which informed the need for the proposed development itself.

The capacity and potential of the public transport system would remain restricted by the existing deficient and inconsistent provision of bus lanes and the resulting sub-standard levels of bus priority and journey-time reliability. Thus, the unreliability of bus services would continue. As such the proposed development is actively enhancing the capacity and potential of the public transport system, and supports the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets.

A key objective of the proposed development is to enhance the potential for cycling along the route. Without the provision of safer cycling routes, intended as part of the proposed development through the reduction of general traffic, there would continue to be an insufficient level of safe provision for cyclists who currently, or in the future would be attracted to use the route of the proposed development.

In terms of the need to improve facilities for cyclists along the route of the proposed development, the design intent is that the removal or reduction of traffic along the Dublin Road corridor and the provision of a segregate cycling facility will provide safer routes.

The proposed development is implementing safe, cycling infrastructure throughout and as such is greatly enhancing the potential for cycling.

Within the extents of the proposed development there are a number of amenities and trip attractors which experience high pedestrian usage including Wellpark and Glenina Heights, Castlepark, Renmore, Merlin Park, Atlantic Technological University, and the Sportsground. In order to improve accessibility to jobs, education and other social and economic opportunities through the provision of an integrated sustainable transport system, there needs to be a high-quality pedestrian environment, including specifically along the route of the proposed development. There are some uncontrolled crossings across priority junctions at side roads along the route of the proposed development that benefit from dropped kerbs and tactile paving.

Along with these interventions, the proposals include significant improvements to the pedestrian environment, both along links and at both signalised and priority junctions and crossings. As such the proposed development will improve accessibility to jobs, education and other social and economic opportunities not only through improvement to the public transport network and cycling infrastructure but through improvements to the pedestrian environment.

The Landscape and Urban Realm proposals for the proposed development are based on an urban context and landscape character analysis of the route. The proposals have been informed through discussions with Galway City Council.

The proposals have been developed amongst the multi-disciplinary Design Team so that the preliminary landscape design is integrated into the overall proposed development design.

The overall landscape and urban realm design strategy for the proposed development was developed to create attractive, consistent, functional and accessible places for people alongside the core public transport facilities. It aims to mitigate any adverse effects that the proposals may have on the streets, spaces, local areas and landscape through the use of appropriate design responses. In addition, opportunities have been sought to enhance the urban realm and landscape design at key locations including Brothers of Charity, Renmore Community Centre, Atlantic Technological University, Merlin Park Hospital, Bon Secours Hospital, Merlin Woods and Rosshill Park Woods. Through a combination of the above benefits, such as the provision of safe and efficient sustainable transport networks, improved infrastructure for walking and cycling, and urban realm strategies, the proposed development specifically facilitates improvements to encourage more journeys generally at a local level by active travel, including connecting to and from bus stops for all pedestrians, and in particular improving facilities for the mobility and visually impaired.

Therefore, it is considered that the proposed development as described enables compact growth, regeneration opportunities and more effective use of land in Galway City, for present and future generations.

It is therefore considered that the design of the proposed development wholly achieves the objectives set out herein. In doing so it fulfils the aim of the proposed development in providing enhanced walking, cycling and bus infrastructure on the BusConnects Galway: Dublin Road corridor, enabling the delivery of efficient, safe, and integrated sustainable transport movement for the city.

APPENDIX A: COMPLIANCE WITH CONSTRUCTION REGULATIONS DESIGNER DUTIES

APPENDIX B: PRELIMINARY DESIGN DRAWINGS

APPENDIX C: STAGE 1 ROAD SAFETY AUDIT & ROAD USER AUDIT

APPENDIX D: DRAINAGE DESIGN BASIS

APPENDIX E: DRAINAGE DESIGN OPTIONS REPORT

APPENDIX F: FLOOD RISK ASSESSMENT

APPENDIX G: ARBORICULTURAL IMPACT ASSESSMENT REPORT

APPENDIX H: GROUND INVESTIGATION REPORT

NTA

Údarás Náisiúnta Iompair
National Transport Authority

National Transport Authority
Dún Scéine
Harcourt Lane
Dublin 2
D02 WT20

Project Ireland 2040
Building Ireland's Future