Bray to City Centre Core Bus Corridor Scheme

July 2023

Preliminary Design Report

BUS CONNECTS

SUSTAINABLE TRANSPORT FOR A BETTER CITY.

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List of Acronyms

Acronym	Definition
AVL	Dublin Bus Automatic Vehicle Location
BCPDGB	BusConnects Preliminary Design Guidance Booklet
BJTR	Bus Journey Time Report
CBC	Central Bus Corridor
CBR	California Bearing Ratio
CPO	Compulsory Purchase Order
DCC	Dublin City Council
DEHLG	Department of Environment, Heritage and Local Government
DfT	Department for Transport (UK)
DLAM	Dublin Local Area Model
DLRCC	Dun Laoghaire-Rathdown County Council
DM	Do Minimum
DMURS	Design Manual for Urban Roads and Streets
DNO	Distribution Network Operator
DRA	Designers Risk Assessment
DS	Do Something
DTTAS	Department of Transport, Tourism and Sport
ED/ED's	Engineering Design/Engineering Designers
EIA	Environmental Impact Assessment
EPR	Emerging Preferred Route
FCC	Fingal County Council
GDA	Greater Dublin Area
GDACNP	Greater Dublin Area Cycle Network Plan
GDRCoP,	Dublin Greater Dublin Regional Code of Practice
GDSDS	Greater Dublin Strategic Drainage Study
GIS	Geographical Information Systems
HGV	Heavy Goods Vehicle
HP	High Pressure
KFPA	Kerbs, Footways and Paved Areas
LED	Light Emitting Diode
LP	Low Pressure
MCA	Multi-Criteria Assessment
NCDWC	National Construction and Demolition Waste Council
NDA	National Disability Authority
NPF	National Planning Framework
NSS	National Spatial Strategy
NTA	National Transport Authority
OPW	Office of Public Works

PDR	Preliminary Design Report
PMG	Project Management Guidelines
PMSC	People Movement Signals Calculator
PRD	Preferred Route Option
RSESs	Regional Spatial and Economic Strategies
SDCC	South Dublin City Council
SDRAs	Strategic Development and Regeneration Areas
SSD	Stopping Sight Distances
STMG	Sustainable Transport Measures Grants
SuDS	Sustainable Drainage Systems
TII	Transport Infrastructure Ireland
WCC	Wicklow County Council

Executive Summary

This Preliminary Design Report has been prepared for the Bray to City Centre Core Bus Corridor Scheme and builds on the previous Options Study Feasibility Report and the Preferred Route Options Report for the Bray to City Centre scheme.

This report summarises the project background and the need for the scheme 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 and the outputs from the junction modelling.

The land use and acquisition requirements are summarised in this report, along with details of affected landowners and property owners, and proposed accommodation works.

The report concludes that the design of the Bray to City Centre Core Bus Corridor Scheme wholly achieves the scheme objectives. In doing so, it fulfils the aim of providing enhanced walking, cycling and bus infrastructure on a key access corridor in the Dublin region, enabling the delivery of efficient, safe, and integrated sustainable transport movement along the corridor.

1. Introduction and Description

1.1 Introduction

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 polices to improve public transport and address climate change. The NTA established a dedicated BusConnects Infrastructure team (the BusConnects Infrastructure team) to advance the planning and construction of the BusConnects Dublin - Core Bus Corridors Infrastructure Works (herein after called the 'CBC Infrastructure Works'). It comprises an inhouse team including technical and communications resources and external service providers procured from time-to-time to assist the internal team in the planning and design of the 12 Proposed Schemes.

The CBC Infrastructure Works involves the development of continuous bus priority infrastructure and improved pedestrian and cycling facilities on twelve radial core corridors in the Greater Dublin Area (GDA), across the local authority jurisdictions of Dublin City Council (DCC), South Dublin County Council (SDCC), Dún Laoghaire-Rathdown County Council (DLRCC), Fingal County Council (FCC), and Wicklow County Council (WCC). Overall, the CBC Infrastructure Works encompasses the delivery of approximately 230 km of dedicated bus lanes and 200 km of cycle tracks along 16 of the busiest corridors in Dublin.

The Bray to City Centre Core Bus Corridor of the CBC Infrastructure Works (herein after called the 'Proposed Scheme') measures approximately 18.5km from end to end. In addition, the section of Stonebridge Road included in the design measures approximately 200m.

The Proposed Scheme commences at the junction of Leeson Street Lower and Earlsfort Terrace on St. Stephen's Green. It runs along Leeson Street Lower and Upper, and Sussex Road. It continues along Morehampton Road and Donnybrook Road, through Donnybrook Village and on to the Stillorgan Road, serving the UCD Interchange via the Stillorgan Road Overbridge at Belfield.

The Proposed Scheme then continues on the Stillorgan Road, which carries on to the Bray Road to Loughlinstown Roundabout. From Loughlinstown Roundabout it runs along the Dublin Road to St. Anne's Church and then continues south through Shankill village. It then passes through Wilford Junction and along the Dublin Road until it terminates on Castle Street in Bray, on the north side of the River Dargle crossing.

Refer to **Figure 1.1** for the overall layout of the Proposed Scheme.

Figure 1.1: Proposed Scheme Route Overview

1.2 Scheme Aims and Objectives

The aim of the Proposed Scheme is to provide enhanced walking, cycling and bus infrastructure along this key access corridor in the southeast Dublin region, which will enable and deliver efficient, safe, and integrated sustainable transport movement along the corridor.

In accordance with the CBC Infrastructure Works the Proposed Scheme objectives are to:

- Enhance the capacity and potential of the public transport system by improving bus speeds, reliability, and punctuality through the provision of bus lanes and other measures to provide priority to bus movement over general traffic movements.
- Enhance the potential for cycling by providing safe infrastructure for cycling, segregated from general traffic wherever practicable.
- Support the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets.
- Enable compact growth, regeneration opportunities and more effective use of land in Dublin, for present and future generations, through the provision of safe and efficient sustainable transport networks.
- Improve accessibility to jobs, education, and other social and economic opportunities through the provision of improved sustainable connectivity and integration with other public transport services.
- 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.

1.3 Project Background

The previous Transport Strategy for the Greater Dublin Area 2016 – 2035 sets out a network of the bus corridors forming the "Core Bus Network" for the Dublin region. Sixteen indicative radial Core Bus Corridors (CBCs) were initially identified for redevelopment. This is shown in **Figure 1.2** below (extract from Transport Strategy for the Greater Dublin Area 2016-2035). It is noted that the current Transport Strategy for the Greater Dublin Area 2022-2042 includes the following objective:

*"**Measure BUS1 – Core Bus Corridor Programme***

Subject to receipt of statutory consents, it is the intention of the NTA to implement the 12 Core Bus Corridors as set out in the BusConnects Dublin programme."

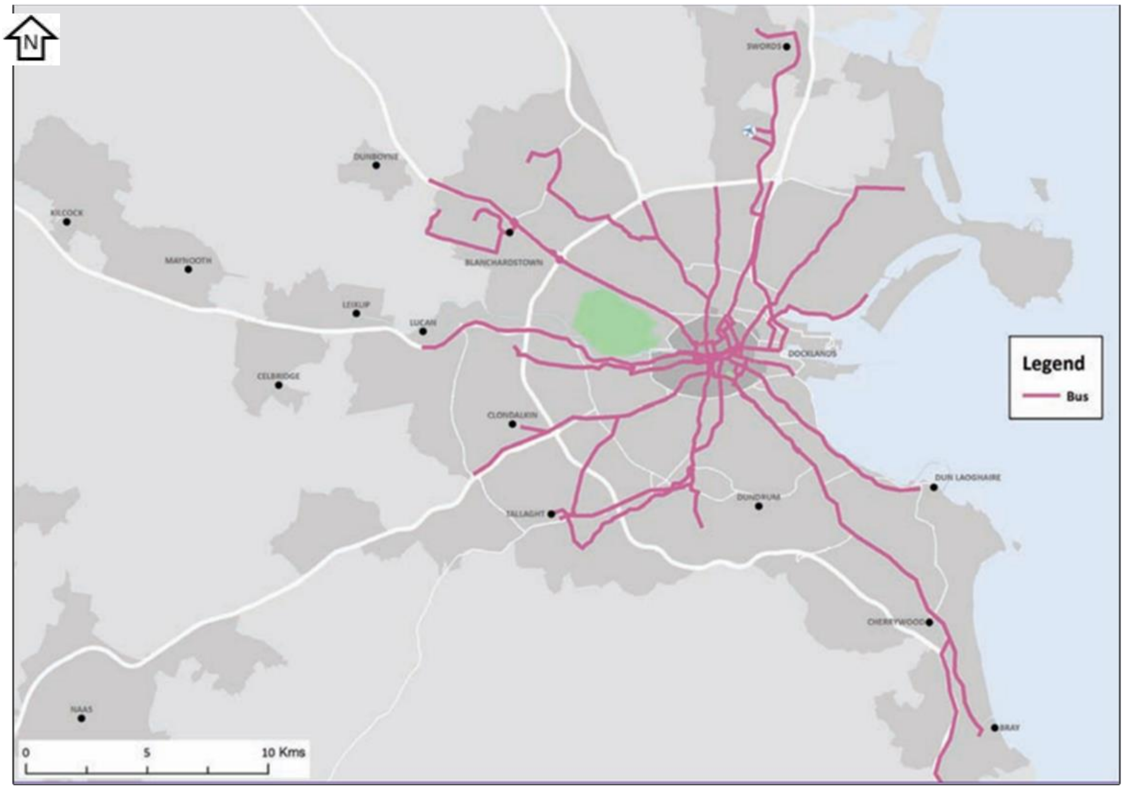

Figure 1.2: BusConnects Core Bus Network – Radial Corridors

Collectively, these corridors currently have dedicated bus lanes along less than one third of their combined lengths which means that for most of the journey, buses as well as cyclists are competing for space with general traffic. This means that bus services are directly impacted by the increasing levels of congestion. This results in delayed buses and unreliable journey times for passengers. Following the completion of the Feasibility and Options studies, sixteen radial corridors were taken forward.

In June 2018, the National Transport Authority (NTA) published the Core Bus Corridors Project Report. The report was a discussion document outlining proposals for the delivery of a CBC network across Dublin. The Proposed Scheme is identified in this document as forming part of the Radial Core Bus Network, designated as Bray to City Centre CBC.

In the context of the proposed planning applications for the CBC Infrastructure Works, the initial sixteen radial CBCs have been grouped as twelve individual Schemes. The twelve Schemes that will be the subject of separate applications to An Bord Pleanála for approval are listed below:

- Clongriffin to City Centre Core Bus Corridor Scheme
- Swords to City Centre Core Bus Corridor Scheme
- Ballymun / Finglas to City Centre Core Bus Corridor Scheme
- Blanchardstown to City Centre Core Bus Corridor Scheme
- Lucan to City Centre Core Bus Corridor Scheme
- Liffey Valley to City Centre Core Bus Corridor Scheme
- Tallaght / Clondalkin to City Centre Core Bus Corridor Scheme
- Kimmage to City Centre Core Bus Corridor Scheme
- Templeogue / Rathfarnham to City Centre Core Bus Corridor Scheme
- **Bray to City Centre Core Bus Corridor Scheme**
- Belfield / Blackrock to City Centre Core Bus Corridor Scheme
- Ringsend to City Centre Core Bus Corridor Scheme

The twelve radial routes that form the CBC Infrastructure works are shown within **Figure 1.3.**

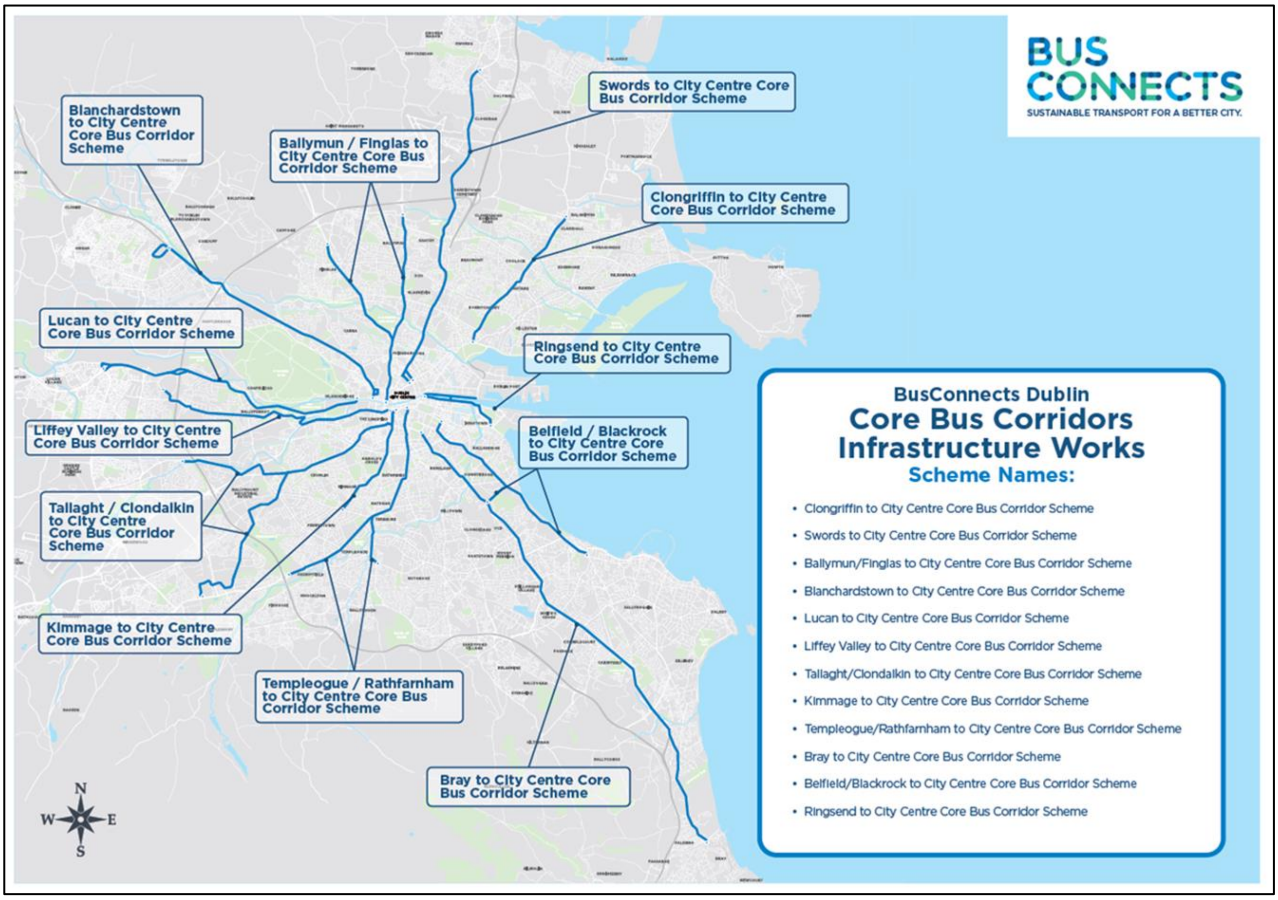

Figure 1.3: BusConnects Radial CBC Network

1.4 Proposed Construction Procurement Method

All of the design-related documentation and background design information should be included with the tender documentation as part of the specification of the Works Requirements. Usually, this includes the definitive Project Brief and all of the documents that have contributed to it, including the Feasibility Studies / Preliminary Reports, Output Specifications, Functional Requirements etc. It also includes any prescriptive drawings and specifications that have been developed in detail sufficient for statutory approval purposes.

Consequently, the design information presented in this report ensures that the objectives of the Proposed Scheme are met, in accordance with current design standards and guidance documents. It further ensures that sufficient land will be acquired during the Compulsory Purchase Order (CPO) process in order to construct the Proposed Scheme and fulfil the design requirements.

Future design stages will be constrained by the requirement to adhere to the design requirements, to incorporate the mitigation specified in the Environmental Impact Assessment Report (EIAR) and to utilise the available land for its construction and any proposed design modifications will require NTA review and acceptance prior to implementation into the Proposed Scheme design.

During preliminary design development, designer's risk assessments were undertaken, details of these are included in **Appendix A**.

1.5 Stakeholder Consultation

Throughout the development of the design there has been extensive stakeholder consultation including three rounds of non statutory public consultation have taken place over the following dates:

- November 2018 to May 2019 - Consultation on Emerging Preferred Route;
- 4th March 2020-17th April 2020 - Consultation on Preferred Route Option; and
- 4th November 2020 - 16th December 2020 - Consultation on Preferred Route Option.

Refer to the Bray to City Centre Core Bus Corridor Preferred Route Option Second and Third Public Consultation Submissions Summary Report for information on the non-statutory consultation.

Consultation with the principal project stakeholders (i.e. Dublin City Council (DCC), Dun Laoghaire-Rathdown County Council (DLRCC, Wicklow County Council (WCC, Transport Infrastructure Ireland (TII), Office of Public Works (OPW), Statutory Undertakers/Utility companies) has taken place to date in order to:

- Inform the scheme development process at particular locations;
- Identify constraints and opportunities within the study area, scheme corridor and route options considered;
- Further refine the scheme objectives;
- Discuss potential mitigation measures and options; and
- Identify planning requirements, conditions, and implications with respect to the Proposed Scheme design measures.

Specific scheme requirements have been discussed and agreed during workshops, with the Local Authorities, and meetings, at Steering Group and Programme level. The BusConnects Infrastructure team has taken cognisance of any specific requirements and recommendations emerging from this process when exploring feasible scheme options and preparing the preliminary design.

In addition to the principal project stakeholders, consultations have taken place with:

- Representative groups;
- Chartered land owners (i.e., owners of lands at any specific locations); and
- Directly impacted landowners.

1.6 Audit of the Existing Situation

The following surveys and desktop studies have been conducted to inform the preliminary design of the Proposed Scheme:

- Problem Identification Audit;
- Accessibility Audit;
- Route Infrastructure Audit;;
- Existing Structures Study;
- Existing Route Collision Analysis;
- Private Landings Study;
- Baseline Tree Survey;
- Cellar Survey;
- Cycle Journey Time Study;
- Phase 1 Utility Survey;

- Bus Stop Study;
- Traffic Surveys (JTC, ATC, pedestrian and cyclists counts);
- Parking Study; and
- Bus Journey Time Study;

These surveys have been supplemented with secondary record data including: utility record information, Office of Public Works (OPW) Catchment Flood Risk Assessment and Management (CFRAM) Flood Models, Irish Water (IW) drainage models and existing traffic signal data from DCC.

1.7 Purpose of the Preliminary Design Report

The purpose of the Preliminary Design Report (PDR) is to outline the design intent of the scheme. In particular, the PDR outlines the following:

- Sets out the context for the Proposed Scheme, the justification for the Proposed Scheme, the basis for selecting the Proposed Scheme improvements, and the design criteria;
- Describes the elements of the Proposed Scheme listed in the preliminary design drawings;
- Summarises the existing physical conditions, addressing, in particular, ground conditions in general and particularly in areas of new construction, existing pavement quality, tree survey information, utility information, road traffic information including existing bus patterns, bus stop usage, traffic signal system, and other relevant information;
- Details and summarises the surveys and studies undertaken in developing the design,
- Sets out traffic management proposals, i.e. permanent changes required as part of the Proposed Scheme (and associated traffic modelling);
- Provides details of the traffic modelling undertaken along the route and the outputs from junction modelling undertaken;
- Summarises the land use and land acquisition requirements, includes details of affected landowners and property owners, and provides details of proposed accommodation works;
- Sets out particular considerations in the context of the urban landscape of the Proposed Scheme, and the criteria influencing the associated design; and
- Sets out the benefits of the Proposed Scheme.

During the preparation of the preliminary design, designers' risk assessments were undertaken, details of these are included in **Appendix A**.

1.8 Preliminary Design Drawings

A comprehensive set of preliminary design drawings have been prepared to convey the scheme design principles for each discipline and should be read in conjunction with this PDR. The following provides a description of the drawings and relevant design content displayed in each of the series as applicable for the scheme. The drawings have been included in **Appendix B** for reference.

Table 1-1 Preliminary Design Drawings

Drawing Series Volume Code	Drawing Series Description/Scale	Design Content
SPW_KP **SPW_ZZ**	Site Location Map (1:12500@A1) and Site Location Plans (1:2500@A1)	Defines the full extent of the works and planning red line boundary. Outlines the scheme chainage structure and provides context for the locality of adjacent Schemes and other notable locations along the route.

Drawing Series Volume Code	Drawing Series Description/Scale	Design Content
SPW_BW	Fencing and Boundary Treatment Plans (1:500@A1)	To be read in conjunction with the GEO_GA General Arrangement series and GEO_CS Typical Cross Section series. Provides an indication of the locations for the proposed boundary modification works along the route.
GEO_GA	General Arrangement Plans (1:500 @ A1)	Displays information for conveying the overarching scheme design intent , providing information on the proposed pedestrian/cycle/ bus/traffic regime, indicative ultimate tree arrangement (existing trees retained and proposed trees), bus stop/shelter locations, key heritage feature locations, parking and loading arrangements, turn bans, side road treatments in addition to identification of specific items of note to the scheme (structures or significant features which may be further described on other drawing series)
GEO_CS	Typical Cross Sections (1:50 @ A1)	To be read in conjunction with the GEO_GA General Arrangement series. Provides an indication of the proposed cross section works in comparison to the existing road geometry. Indicative pavement/kerbing, boundary treatments and key street furniture are also provided for context.
GEO_HV	Mainline Plan and Profile Drawings (1:500@A1)	To be read in conjunction with the GEO_GA General Arrangement series. Provides an indication of the proposed modification works to the mainline vertical alignment with supplementary information on earthworks/retaining walls and other notable structures along the route (as required).
ENV_LA	Landscaping General Arrangement Plans (1:500@A1)	Provides information relating to urban realm and landscaping proposals including: identification of trees to be removed resulting from the arborist assessments, proposed tree/planting regime, proposed footway surface finishes, locations of proposed Sustainable (Urban) Drainage Systems (SuDS) features and proposed boundary treatment and key street furniture notes.
DNG_RD	Proposed Surface Water Drainage Plans and Drainage Catchment Area Plans (1:500@A1)	Displays information for conveying the design intent for the drainage portion of the works including identification of SuDS measures, requirements for allowable discharge rates to the existing networks (attenuation/detention/flow control) where applicable, catchment assessments and proposed notable trunk network modifications and outline design for the proposed drainage discharge strategy along the route.

Drawing Series Volume Code	Drawing Series Description/Scale	Design Content
UTL_UC	Combined Existing Utilities Record Plans (1:500@A1)	Displays information regarding existing statutory undertakers records along the length of the scheme with the Proposed Scheme features shown as background information for context.
UTL_UD	Irish Water Foul Sewer Alteration Plans (1:500@A1)	Provides an indication of the existing foul sewer network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.
UTL_UW	Irish Water Potable Water Alteration Plans (1:500@A1)	Provides an indication of the existing potable water network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.
UTL_UE	ESB Asset Alteration Plans (1:500@A1)	Provides an indication of the existing electrical network (above and below ground) and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.
UTL_UX	Telecommunications Asset Alteration Plans (1:500@A1)	Provides an indication of the existing telecommunications network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.
UTL_UG	Gas Networks Ireland Asset Alteration Plans (1:500@A1)	Provides an indication of the existing gas network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.
LHT_RL	Street Lighting Plans (1:500@A1)	Provides an indication of the proposed modification works to the existing street lighting infrastructure along the route in addition to identification of any key heritage light column features.
TSM_SJ	Junction System Design Plans (1:250@A1)	Provides a more detailed overview of the proposed junction arrangements for pedestrians, cyclists, buses and general traffic with an indication of the proposed junction staging and associated signal head arrangements for key signalised junctions/signalised crossings along the route.
TSM_GA	Traffic Signs and Road Markings Plans (1:500@A1)	Provides an indication of the proposed key signage (information/directional/regulatory) design requirements and the design intent for the proposed lane marking arrangements along the route.

Drawing Series Volume Code	Drawing Series Description/Scale	Design Content
PAV_PV	Pavement Treatment Plans (1:500@A1)	Provides an indication of the proposed pavement treatment works along the length of the route
STR_GA	Bridges and Retaining Structures (Varies)	Whilst part of this series, new Bridges is not applicable to the Bray Scheme, but proposed works at existing bridges/ underpass is applicable and included. Also provides an indication of the proposed retaining structure locations, types and approximate proposed heights along the route.
BLD_ZZ	Bus Interchange (Varies)	UCD Bus Interchange details relating to proposed bus interchange details including architectural layouts and site elevations and sections are provided in **Appendix P** and **Appendix Q**
BLD_ZZ	Building	Woodbrook Side Lodge details related to site layout, architectural layouts and site elevations and sections are provided in **Appendix R**.
SPW_AW	Petrol Station	Circle K details related to site layout, architectural layout, canopy and sections are provided in **Appendix S**.

Drawing information for UCD Interchange, the Woodbrook Side Lodge rebuild and Circle K proposal are included in **Appendix P, Appendix Q, Appendix R** and **Appendix S** of this report respectively. These areas of the scheme are discussed in further detail within the relevant sections herein.

The planning red line boundary has been displayed on the Site Location Plans in drawing series SPW_ZZ as designated by the solid red line 'SITE EXTENTS'. For clarity the various discipline general arrangement drawing series have been displayed with the permanent extent of works boundary line as designated by the solid red line 'SITE BOUNDARY LINE'. Where construction access or accommodation works are required to facilitate the permanent works, this has been displayed by the dashed red line 'TEMPORARY LAND ACQUISITION'. Construction site compounds outside the 'SITE BOUNDARY LINE' are also captured within the dashed red line 'TEMPORARY LAND ACQUISITION'.

Full details of the compulsory land acquisition required to construct the scheme are provided on the various Deposit Maps, Server Maps, and associated CPO schedules/documentation for the Proposed Scheme as part of the statutory application documentation.

1.9 Report Structure

This report is structured as follows:

- **Chapter 2: Policy Context and Design Standards -** This chapter briefly identifies the policies and overview of the approach taken for application of design standards which have been applied to the preliminary design.
- **Chapter 3: The Scheme -** This chapter provides an overview of the design intent at various locations along the Proposed Scheme, providing a description of the route in more detailed subsections. An outline of the key interactions with other infrastructure projects is also provided.

- **Chapter 4: Preliminary Design –** This chapter provides an overview of the key design parameters used for the geometric designs and more detailed descriptions of the design elements for pedestrians, cyclists and buses.
- **Chapter 5 Junction Layout –** The junction design methodology and modelling process is set out for all key junctions along the length of the route in this chapter.
- **Chapter 6: Ground Investigation and Ground Condition –** This chapter provides an overview of the ground investigation process and existing ground conditions.
- **Chapter 7: Pavement, Kerbs, Footways and Paved Areas –** This chapter gives an overview of the existing pavement situation and proposed pavement design for the scheme.
- **Chapter 8: Structures –** In this chapter an overview of the structures strategy is provided, along with a summary of principal and minor structures, retaining walls and embankments, where applicable.
- **Chapter 9: Drainage, Hydrology and Flood Risk –** This chapter is an overview of the drainage strategy includes descriptions of existing watercourses and culverts alongside a summary of the drainage design for each catchment along the scheme, including the consideration of drainage at structures and the maximisation of SuDS features.
- **Chapter 10: Services and Utilities –** This chapter shows the Utilities design strategy documents surveys undertaken to date, identifies conflicts and recommends a number of diversions.
- **Chapter 11: Waste Quantities -** This chapter provides an overview of the waste quantities for the Proposed Scheme.
- **Chapter 12: Traffic Signs, Lighting and Communications –** In this chapter the design strategy for traffic signs, road markings, lighting and communications equipment is outlined, alongside descriptions of how these elements can be maintained and monitored safety and securely.
- **Chapter 13: Land Use and Accommodation Works –** This chapter outlines land use and acquisition requirements, affected land and property owners, and proposed accommodation works.
- **Chapter 14: Landscape and Urban Realm –** This chapter is an overview of the landscape and urban realm design strategy focusing on the existing trees and proposed mitigation.
- **Chapter 15: Scheme Benefits/How are we Achieving the Objectives –** In this chapter benefits provided by the scheme are summarised against the scheme objectives.
- **Appendices –** Various appendices and background information as referenced throughout the report.

2. Policy Context and Design Standards

2.1 Policy Context

The following national, regional, and local policies have been reviewed and considered in the development of the Proposed Scheme:

- Project Ireland 2040 – National Planning Framework;
- Department of Transport: Statement of Strategy 2021 – 2023;
- Smarter Travel – A Sustainable Transport Future: A New Transport Policy for Ireland 2009 – 2020;
- The National Cycle Policy Framework (NCPF) 2009 – 2020;
- Road Safety Strategy 2021 – 2030;
- Building on Recovery: Infrastructure and Capital Investment 2016 – 2021;
- National Implementation Plan for the Sustainable Development Goals 2022 – 2024;
- Climate Action Plan 2023;
- Regional Spatial Economic Strategy for the Eastern and Midland Region 2019 – 2031;
- Greater Dublin Area Cycle Network Plan;
- Transport Strategy for the Greater Dublin Area 2022 – 2042;
- Dublin City Development Plan 2022 – 2028;
- Dun Laoghaire-Rathdown County Council Development Plan (DLRCCDP) 2022 – 2028;
- Wicklow County Development Plan (WCDP) 2022– 2028;
- Bray Municipal District Local Area Plan 2018-2024;
- Stillorgan Local Area Plan 2018 – 2024.

For further information on how the Proposed Scheme meets the policies outlined above refer to the Bray to City Centre Planning Compliance Report in the EIAR.

2.2 Design Standards

Design standards applied on the Proposed Scheme are stated within the applicable chapters of this report. In addition to national design standards the CBC Infrastructure Works has developed the BusConnects Preliminary Design Guidance Booklet (BCPDGB) included in **Appendix O**. Its purpose is to provide guidance for the various design teams involved in CBC Infrastructure Works, to ensure a consistent design approach across the project.

The BCPDGB complements existing guidance documents relating to the design of urban streets, bus facilities, cycle facilities and urban realm. A non-exhaustive list of these guidelines is as follows:

- The Design Manual for Urban Roads and Streets (DMURS);
- The National Cycle Manual (NCM);
- TII Publications;
- The Traffic Signs Manual (TSM);
- Guidance on the use of Tactile Paving;
- Building for Everyone: A Universal Design Approach, and
- Greater Dublin Strategic Drainage Study (GDSDS).

The BCPDGB focuses on the engineering geometry and Proposed Scheme operation. It is recognised that the Proposed Scheme is being planned and designed within the context of an existing city, with known constraints. The BCPDGB provides guidance, however a more flexible approach to the design of the Proposed Scheme, utilising engineering judgement, may be necessary in some locations due to these constraints.

Where it has been necessary to deviate from the parameters set out in the relevant national design standards these relaxations, departures and deviations have been noted within **Section 4.16.**

3. The Scheme

3.1 Scheme Description

The Proposed Scheme commences at the junction of Leeson Street Lower and Earlsfort Terrace on St. Stephen's Green. It runs along Leeson Street Lower and Upper, and Sussex Road. It continues along Morehampton Road and Donnybrook Road, through Donnybrook Village and on to the Stillorgan Road, serving the UCD Interchange via the Stillorgan Road Overbridge at Belfield.

The Proposed Scheme then continues on the Stillorgan Road, which carries on to the Bray Road to Loughlinstown Roundabout. From Loughlinstown Roundabout it runs along the Dublin Road to St. Anne's Church and then continues south through Shankill village. It then passes through Wilford Junction and along the Dublin Road until it terminates on Castle Street in Bray, on the north side of the River Dargle crossing.

The Proposed Scheme, as described below, is split into the following four sections to align with the previous Options and Feasibility Reports and the Preferred Route Options Report.

- Section 1: Leeson St to Donnybrook (Anglesea Road Junction)
- Section 2: Donnybrook (Anglesea Road Junction) to Loughlinstown Roundabout
- Section 3: Loughlinstown Roundabout to Wilford Roundabout
- Section 4: Wilford Roundabout to Bray North (Fran O'Toole Bridge)

3.1.1. Section 1 – Leeson St to Donnybrook (Anglesea Road Junction)

The section runs along Leeson Street Lower and Upper from the junction with St Stephen's Green, providing continuous bus priority and segregated cycle tracks in each direction. A bus gate has been located at the end of Leeson Street Lower before the St. Stephen's Green junction. This is further discussed in **Section 4.12.3**. General Inbound bound traffic is now to be directed from Leeson Street Lower on to Hatch Street Lower, and then on to Earlsfort Terrace in order to reach St Stephen's Green and there will be introduction of two-way general traffic on Earlsfort Terrace between the Hatch Street Lower Junction and St. Stephen's Green. This will require the northbound bus lane on Earlsfort Terrace to be made a general traffic lane. The existing left turning ban at the Earlfort Terrace towards Stephen's Green North has been removed to facilitate the general traffic movement.

The one-way system on Sussex Road and the adjacent section of Leeson St Upper have been retained, with a reduced number of general traffic lanes in each direction to allow for full bus and cycle lane provision and retain existing parking. The proposed junction at Fitzwilliam Place and Leeson Street Lower from the Fitzwilliam Cycle Route (Dublin City Council) has been incorporated into the scheme, while revised junction layouts at Appian Way, Waterloo Road, and Wellington Place have been designed to improve road user throughout and safety.

The full cycle track and bus lane provision continues along Morehampton Road, where in places the cycle tracks are brought behind the tree line. This will impact a number of on-street parking bays between Wellington Place and Belmont Avenue. A 'No Right Turn' restriction has been added from Morehampton Road onto Auburn Avenue to reduce crossing point conflicts.

From Mulberry Lane to Rampart Lane the northbound bus lane has been removed to allow for two reduced width segregated cycle tracks in both direction, while the southbound bus lane has been retained along this narrow section. Signal-controlled priority at the Eglinton Terrace junction on Donnybrook Road will provide northbound bus priority over this length. The perpendicular parking spaces south of Mulberry Lane have been converted to parallel spaces, while the echelon parking spaces on the other side of the road have been retained. From Eglinton Terrace southwards to Eglinton Road a dedicated bus lane, segregated cycle track, and general traffic lane are provided in each direction. The tie in for the proposed Dodder Greenway, designed and built by others, has been included in the design at the Eglinton Road junction on Donnybrook Road.

On Donnybrook Road between Eglinton Road and Anglesea Road in the southbound direction, there is a straight ahead and left-turn lane, a straight ahead general traffic lane, a bus lane, and a cycle track provided. The northbound approach on the Stillorgan Road towards Beaver Row has a cycle track, bus lane, a combined left and ahead general traffic lane, and a right-turn lane to Ailesbury Road. Between Beaver Row and Eglinton Road there is a cycle track, bus lane, and a combined left and ahead traffic lane. South of Anglesea Road, the existing carriageway layout of cycle track, bus lane and two general traffic lanes in each direction is maintained to the end of this section at UCD.

Coach laybys have been proposed at certain locations to reduce instances of loading coaches blocking the bus lane.

It is proposed that, where possible along Section 1 of the scheme, existing kerblines will be retained and the BusConnects Design Guide will be adhered to. Signal-controlled priority shall be employed at certain locations where full segregated bus lane provision has not been possible due to space constraints.

3.1.2. Section 2 - Donnybrook (Anglesea Road Junction) to Loughlinstown Roundabout

The existing lane configuration is maintained on the Stillorgan Road between the Beaver Row / Anglesea Road junction and Foster's Avenue, apart from the southbound on-slip at Belfield, where a continuous bus lane is now provided from the slip road to the Stillorgan Road. To achieve this, the existing southbound bus lane on the Stillorgan Road has been truncated and will require coaches, buses, and taxis using it to merge with the adjacent general traffic lane as they pass under the Belfield flyover. New continuous bus lanes will be provided on the southbound off-slip, and across the Belfield flyover. It is intended to provide segregated cycle tracks on each slip road and a two-way segregated cycle track on the Belfield flyover. A separate cycle link will be provided to the adjacent sideroad to the east of the southbound slip roads.

On the Stillorgan Road between Seafield Road and Foster's Avenue it is intended to provide a bus lane, a one-way segregated cycle track, and two general traffic lanes in each direction. A short length of two-way segregated cycleway will be provided on each side in this area due to the proximity to UCD. This will run from Woodbine Road to Merrion Grove by the southbound carriageway, and from Foster's Avenue to the newly proposed cycle entrance into UCD opposite Seafield Rd by the northbound carriageway. A short new two-way cycle track connection is provided southbound from Merrion Grove which will improve access from Coláiste Eoin / Coláiste Íosagáin to the N11 junction with Merrion Grove.

In addition, new junction layouts have been provided at RTE and Nutley Lane to improve road user throughout and safety. Bus stop locations and layouts have been reviewed, and in certain areas adjusted, to ensure optimum integration with interfacing services. Coach laybys have been proposed at certain locations to reduce instances of loading coaches blocking the bus lane.

The bus interchange proposals at UCD have been developed in collaboration with UCD and are coordinated with the UCD Future Campus masterplan. The drawings in **Appendix Q** can be read in conjunction with the main drawing series for the Proposed Scheme, to provide a more detailed overview of the UCD Interchange proposals. The proposed UCD interchange is located adjacent to the Belfield interchange on the R138 Stillorgan Road (at Chainage A 4000 of the Proposed Scheme) and consists of two main operation zones. The main interchange plaza adjacent to the N11 northbound slip road will accommodate high frequency bus routes. The interchange bus islands located south of the UCD veterinary building, to the northwest of the main plaza and existing woodland, will be used for lower frequency and regional bus routes, as well as to provide overflow for the main plaza services. The interchange proposals also capture upgrade works for a shared pedestrian and cyclist commuter route along a naturally developed route through the existing woodland area. The overall site will provide 20 bus stop locations with 12 standard NTA/ UCD bus shelters and finish to match UCD street furniture. Two landmark bus shelters are proposed with passenger seating area. **Appendix P** provides further details of the landmark shelters, which are designed to provide a cohesive solution adjacent to UCD's proposed Future Campus masterplan development, including the proposed Arrival Plaza.

The existing lane configuration between Foster's Avenue and Wyattville Rd has for the most part been retained. Junction designs along the route have been reviewed in an attempt to remove left turn filter lanes crossing cycle lanes where possible.

Between Merrion Grove and Lower Kilmacud Road it is proposed to provide a bus lane and two general traffic lanes plus a one-way segregated cycle track in each direction. A new dedicated footpath is to be provided between the Lower Kilmacud Road and the Old Dublin Road (Stillorgan), and the Old Dublin Road (Stillorgan) and Trees Road Lower junctions on both sides of the Stillorgan Road. The new southbound footpath at this location will require an extension to the existing St Laurence's Park subway, where a new toucan crossing will also be provided across the Stillorgan Road. The slip road from the Stillorgan Road on to The Hill at Stillorgan is proposed to be closed.

The northbound cycle track north of Brewery Rd has been diverted on to St Brigid's Church Rd, additional traffic calming and footway improvement measures are proposed along the St. Brigid's Church Road to accommodate this. A section of southbound cycle track has also been diverted on to Belmont Terrace at Galloping Green. A new pedestrian link is proposed to South Park from Bray Road in Cornelscourt, and to Shanganagh Vale from the Bray Road.

It is proposed to maintain one bus lane and two general traffic lanes in each direction between Wyattville Road and Loughlinstown Roundabout. Widening of the carriageway and a setback of existing vehicle restraint systems in front of the pedestrian footbridge will be provided on the southbound carriageway to ensure a continuous southbound bus lane through the Loughlinstown Roundabout.

Footpaths are not proposed as per existing infrastructure between the Old Bray Road and Cornelscourt Shopping Centre pedestrian bridge, and between Clonkeen Road and Johnstown Road junctions and between Johnstown Road junction and the new junction at Druid's Glen Road, as alternative walking routes exist on adjacent quieter roads.

A new footpath is proposed on either side of the Stillorgan Road at the new junction on the N11 at Druid's Glen Road which tie-in with the existing footpath towards Wyattville Road. Improvements have been made to cycle track provisions at the Wyattville Road Junction. The existing adjacent northbound Bray Road slip towards Cherrywood Road will be retained in its current two-way layout.

At the Loughlinstown Roundabout it is proposed to signalise the existing roundabout on three arms and to provide a continuous bus lane southbound through the junction towards Shankill.

In addition, new junction layouts have been proposed at all major junctions along this section to remove existing left turn slips and to provide improved cycle movements. The northbound U-turn lane has been removed at the Westminster Road junction in order to facilitate a toucan crossing.

It is proposed that existing kerblines will be retained and that the BusConnects Design Guide will be adhered to where possible along Section 2 of the scheme.

3.1.3. Section 3 - Loughlinstown Roundabout to Wilford Roundabout

Between Loughlinstown Roundabout and Stonebridge Road it is intended to provide a bus lane and general traffic lane in both directions. Where bus lanes are not continuous, Signal Controlled Bus Priority has been provided. South of Stonebridge Road uptill Cricken Lane, where bus lanes are not continuous in both directions due to existing constraints, Signal Controlled Priority has been proposed to ensure bus priority. Signal Controlled Bus Priority has been proposed between the Dublin Road/ Shanganagh Road/ Corbawn Lane Junction and Rathmichael Woods in the northbound direction.

Segregated cycle tracks have not been provided between Loughlinstown Roundabout and Stonebridge Road along the Proposed Scheme. It is intended to provide a two-way cycle track from Stonebridge Road on the Dublin Road as far as the Shanganagh Road junction, and on Stonebridge Road as far as Stonebridge Lane to provide a cycle link to the two schools on Stonebridge Road.

The roundabout between the Dublin Road, Corbawn Lane, and Shanganagh Road is proposed to be upgraded to a signalised junction with new pedestrian crossing facilities and signal-controlled priority for buses. Corbawn Lane is to be an exit only junction on to Shanganagh Road. A dedicated right-turn lane is proposed from Shanganagh Road on to Beechfield Manor. A dedicated left turn lane from Shanganagh Road into Beechfield Manor is also to be provided.

The proposed design between the Shanganagh Road junction and Crinken Lane retains the existing general traffic lanes with no bus or cycle lanes, apart from a section of the northbound carriageway where a bus lane is provided from Crinken Lane to a new junction at the entrance to Olcovar. Signal-controlled priority will be provided along this section. The Quinn's Road roundabout is to be upgraded to a signalised junction, and an upgraded signalised junction is proposed at the entrance to the Olcovar development. Footpaths along the Dublin Road at Cherrington Drive and Beech Road are to be retained at their roadside location.

From Crinken Lane to the Wilford Roundabout it is proposed to provide northbound and southbound bus lanes, segregated cycle tracks and general traffic lanes. Signal-controlled priority will be used northbound from Wilford Junction for a short distance as far as St. Brendan's College. Where appropriate, roadside trees shall be retained by locating the proposed footpaths and cycle tracks behind the tree line. Improved lighting and crowning of trees will be provided to enhance visibility.

New pedestrian crossings are proposed at the new junction outside Olcovar, south of Crinken Lane, south of Allies River Road, and by Crinken Church. The existing pedestrian crossing at St. Brendan's College is to be moved southwards to provide a crossing point close to the relocated southbound bus stop.

At Shanganagh Park and Shanganagh Cemetery, the northbound and southbound cycle track are proposed to be diverted into the park, alongside the southbound footpath, and behind green space and existing trees to the eastern side of the carriageway between two Toucan Crossings, with a newly proposed cemetery boundary wall set back to enable the retention of the roadside tree line. New lighting and crowned trees will be provided to ensure through visibility. Playground areas will be retained in their current existing location as part of BusConnects proposals. Their final future location will be confirmed as part of the Shanganagh Park and Cemetery Masterplan (Dún Laoghaire-Rathdown County Council).

Two new residential developments are planned, with planning approval granted, at Shanganagh Castle and the Woodbrook Estate. The proposed signalised junctions for these developments and bus stops have been co-ordinated with the development proposals and incorporated within the design.

It is proposed that existing kerblines will be retained and that the BusConnects Design Guide will be adhered to where possible along Section 3 of the scheme. Bus stop locations and layouts have been reviewed, and in certain areas adjusted, to ensure optimum spacings. Coach laybys have been proposed at certain locations along the route to reduce instances of loading coaches blocking the bus lane. Coach laybys have been proposed at certain locations to reduce instances of loading coaches blocking the bus lane.

3.1.4. Section 4 - Wilford Roundabout to Bray North (Fran O'Toole Bridge)

From the M11 junction (Wilford Roundabout) to the Lower Dargle Road, it is proposed to continue with a bus lane, general traffic lane and a segregated cycle track in each direction. All junctions have been developed further to provide improved cycle movements. It is proposed to replace the Wilford Roundabout with a new signalised junction. The Corke Abbey Avenue / Old Connaught Avenue junction with the Dublin Road has been designed to cater for the proposed bus and cycle lanes, and to remove the left turn slips in and out of Corke Abbey Avenue. The design for the Upper Dargle Road junction with the Dublin Road has removed the northbound left turn slip from the Dublin Road. The junction with the new road at Chapel Lane has also been upgraded to a signalised junction, including improved cycle and pedestrian movements.

The proposed works will impact the existing Woodbrook Side Lodge, which is a heritage structure located at the southern end of the Woodbrook Estate in Bray. Proposals to rebuild the impacted Woodbrook Side Lodge residential property, at the southern end of the Woodbrook Estate in Bray, are included within **Appendix R.**

The proposed works will impact the existing Circle K Petrol Station and the proposals to re-instate the remainder of the petrol station site are included within **Appendix S**.

At the end of the scheme at the tie-in to the Fran O'Toole Bridge, the northbound bus lane starts just after the Lower Dargle Road junction so the tie-in at the scheme termination consists of a southbound bus lane and two general traffic lanes and cycle track in both direction, on the immediate Castlestreet approach to the Fran O'Toole Bridge, where the Proposed Scheme will end. This layout has been developed to coordinate with the proposed Bray Bridge Improvement Scheme.

It is proposed to retain the existing kerb lines wherever possible and adhere to the design standards from the Preliminary Design Guidance Booklet along Section 4 of the Scheme. Bus stop locations have been reviewed, and in certain areas adjusted, to ensure optimum spacings. Coach laybys have been proposed at certain locations along the route to reduce instances of loading coaches blocking the bus lane.

3.2 Associated Infrastructure Projects and Developments

A number of infrastructure projects and developments are planned within the vicinity of the Proposed Scheme which will interface with the proposals. These are outlined in the following sections.

3.2.1 Fitzwilliam Place Cycle Scheme

Plans are being developed by Dublin City Council for Fitzwilliam Place Cycle Scheme and the Grand Canal section is of particular relevance to the Proposed Scheme. Co-ordination has been carried out between the BusConnects and DCC on the potential integration opportunities with the Proposed scheme. The Proposed Scheme junction at Fitzwilliam Place and Leeson Street Lower design has been co-ordinated to include for cycle track along Fitzwilliam Place and Adelaide Road.

In the potential interim scenario whereby the proposed Fitzwilliam Place Cycle Scheme infrastructure is not in place ahead of the Proposed Scheme, minor adjustments to kerbline and line marking related to cycle track tie-along along Fitzwilliam Place and Adelaide Road shall be implemented to tie-in to the existing environment.

3.2.2 Dodder Greenway

Plans are being developed by Dublin City Council for the Dodder Greenway and the Ballsbridge section is of particular relevance to the Proposed Scheme. Co-ordination has been carried out between the BusConnects and DCC on the potential integration opportunities with the Proposed scheme, which includes a toucan crossing at the tie-in with the proposed Dodder Greenway at the Eglinton Road junction in Donnybrook Road.

3.2.3 Urban Realm Regeneration at Fitzwilliam Place

The proposed urban realm regeneration at the Fitzwilliam Place square designed by others, has been co-ordinated and incorporated into the Proposed Scheme.

3.2.4 Appian Way and Leeson Street Upper, adjacent to Leeson Village

The development proposals included for the construction of a 10 storey over lower ground floor building to include 44 studio and one-bed apartments. A substation was proposed with access from Leeson Street Upper. All other access was to be for pedestrians, cyclists and emergency access only. The Planning Application has been refused.

3.2.5 75a, Leeson Street Upper and Swan Place (north Morehampton Square)

The development will consist of the demolition of the existing single-storey commercial building, change of use to residential, and the construction of a terrace of three, three-storey, two-bedroom dwelling houses (at around chainage A 1330 of the Proposed Scheme). The Planning Application has been granted.

3.2.6 Development at Kiely's Pub, Donnybrook

The proposed development will consist of the demolition of all existing buildings on site (comprising the former Kiely's public house and outbuildings) and the construction of a mixed-use building of 3 to 7 storeys in height, above basement level. The Planning Application has been granted.

3.2.7 Development at Circle K site, Donnybrook Road and Brookvale Road

Planning proposals have been submitted for the development of a twelve storey over basement building (with retail and cafe/restaurant use at ground floor level and "Build to Rent" residential use at 1st to 11th floor levels.

The proposals include a building overhang detail which would extend over the proposed BusConnects public footway. Following Dublin City Council's refusal of the planning application, an application has been made to An Bord Pleanála.

3.2.8 1, 3, 5, 7, 9 and 11, Eglinton Road

Planning permission for a residential development of 94 no. apartments and a ground floor café (at around chainage A 2500 of the Proposed Scheme), as shown in **Figure 3.1** below. Vehicular access will be provided from Brookvale Road to basement level. The Planning Application has been granted.

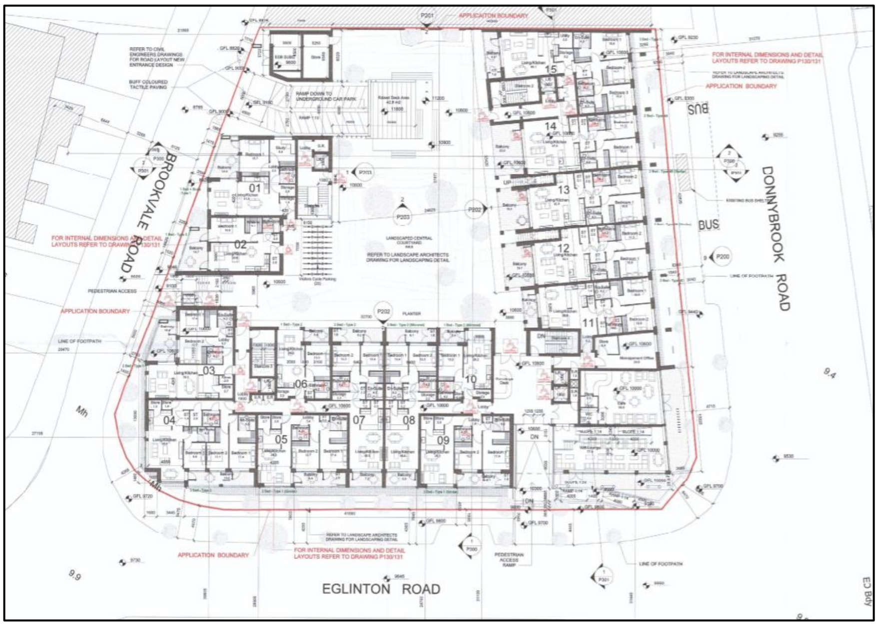

Figure 3.1: Proposed Ground Floor Plan - 1, 3, 5, 7, 9 and 11, Eglinton Road © 2020 Dublin County Council

3.2.9 RTÉ Campus Montrose

Planning proposals have been submitted for this location for the construction of 611 apartments, three town houses, a childcare facility, two cafés, a change of use for the existing Mount Errol building for residents' facilities and a gym (at around chainage A 2900 of the Proposed Scheme), as shown in **Figure 3.2** and **Figure 3.3** below. The development also proposed 2.5 acres of landscaped open space. This planning application was granted by An Bord Pleanála subject to various conditions. However, in March 2021, a High Court order overturned An Bord Pleanála's permission.

The proposed development has been revisited and is currently at pre-planning stage. The proposed development is a mixed development and will consist of 675 housing dwellings, 200 bed hotel, 370sqm crèche, 450 sqm restaurant, 150sqm farm shop and ancillary residential amenity. Liaison has taken place with DCC and the developer ahead of their planning application for the proposed development. The Proposed Scheme design has been co-ordinated with the proposed development at Montrose, the bus top has been moved slightly north and impact on the trees has been minimised. A planning application has not been lodged at the time of writing this report.

Figure 3.2: Ground Floor Layout – RTÉ Campus Montrose, © Dublin City Council 2020

Figure 3.3: Model – RTÉ Campus Montrose, © Dublin City Council 2020

3.2.10 University College Dublin Future Campus Masterplan

The University College Dublin campus at Belfield is located at around chainage A 4075 of the Proposed Scheme. The UCD Future Campus masterplan development consists of significant works within the campus including modifications to the existing entrance arrangement to incorporate a new junction and internal road layout, Arrival Plaza, Centre for Creativity building and Centre for Future Learning. The interfacing elements of the masterplan adjacent to the Proposed Scheme extents are shown in **Figure 3.4** below. The UCD Interchange layout has been coordinated with the UCD masterplan proposals, as discussed in other sections of this report. The planning application for UCD's masterplan proposals has been granted.

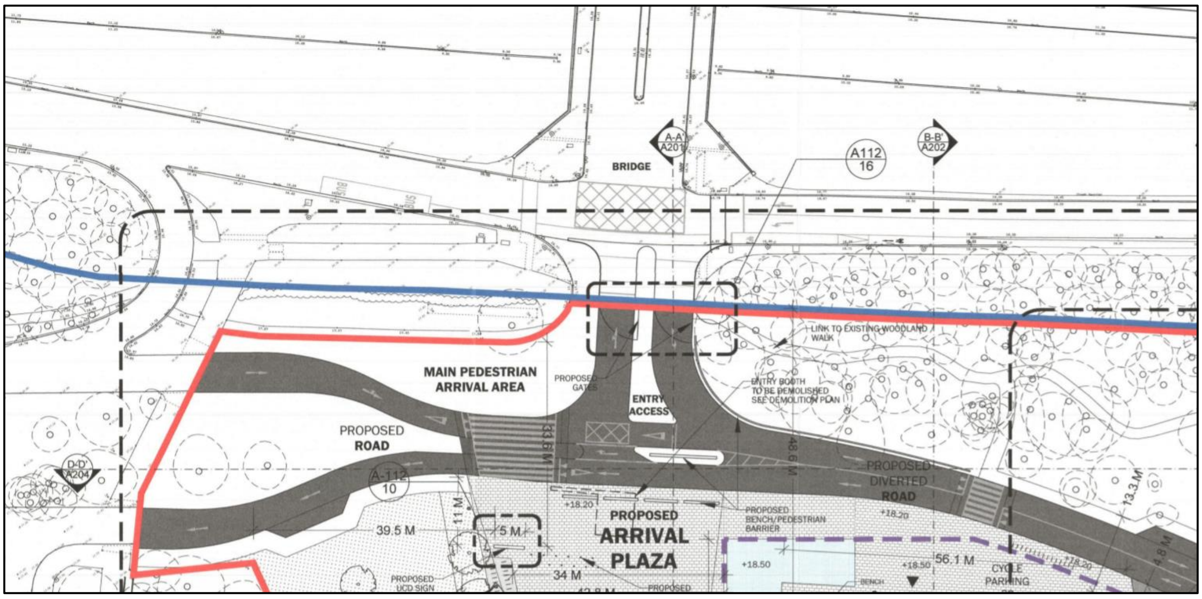

Figure 3.4: Proposed Site Layout Plan, Zone A – University College Dublin © Dun Laoghaire-Rathdown County Council 2020

3.2.11 UCD Nova Cycle Scheme

The UCD Nova Cycle scheme was under construction during the design development of the Proposed Scheme and the scheme is now built as we write this report. The Proposed Scheme design has been co-ordinated with the recently built UCD Nova Cycle scheme keeping BusConnects objectives, between the UCD Nova Entrance near the footbridge and Fosterstown Avenue.

3.2.12 N11 Pavement Renewal Scheme

The Proposed Scheme has been co-ordinated with TII N11 Pavement renewal scheme. N11 Pavement renewal scheme is due for completion in 2023 with 3 years construction 2021-2023 split under 3 Lots. The scheme will upgrade the entire N11 section to bring it to standard, fixing repairs and defects.

3.2.13 Fortwilliam Cottage

Permission is sought for the provision of 4 no. semi-detached houses and an increase in width of existing vehicular entrance to 5.0m, at around chainage A 5800 of the Proposed Scheme. The planning application has been granted.

3.2.14 Talbot Hotel

This development involves the erection of an extension (3555 sq. m in total floor area) consisting of a proposed 4 storeys over a semi-basement extension to the rear of the existing Hotel, comprised of 61 no. bedrooms over the proposed ground floor, first floor, second floor and part set-back third floor. The development at around chainage A 6000 of the Proposed Scheme, as shown in **Figure 3.5** below, includes internal alterations at the rear of the existing building, alterations to the layout of the existing car park, hard and soft landscaping together with all ancillary services and associated site works. The planning application has been granted.

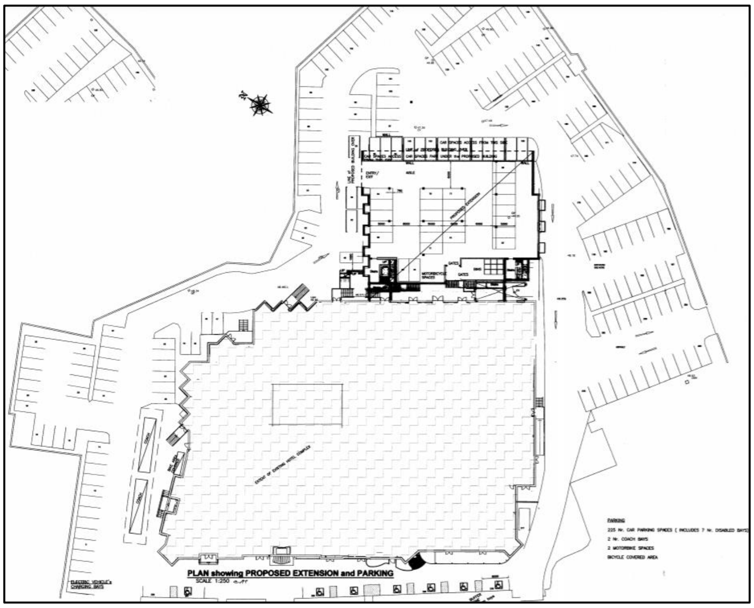

Figure 3.5: Plan Showing Proposed Extension and Parking – Talbot Hotel, Stillorgan © Dun Laoghaire-Rathdown County Council 2020

3.2.15 St Laurence's Park

The proposed works include the demolition of 16 no. Maisonettes, 2 no. semi-detached houses and removal of the existing Library building. Dún Laoghaire-Rathdown County Council proposes to construct a two-storey library building with gross area of 1010 sq. m and 88 apartments. The development at around chainage A 6750 of the Proposed Scheme is shown in **Figure 3.6** below. The planning application has been granted.

Figure 3.6: Proposed Site Layout Plan – St. Laurence Park, Stillorgan, Co. Dublin, © Dun Laoghaire-Rathdown County Council 2020

3.2.16 Stillorgan Leisureplex

The development at around chainage A 6750 of the Proposed Scheme, shown in **Figure 3.7** below, will have a total of 232 Build-To-Rent apartment units. The development will provide for two retail units, four restaurant/café units, provision of a public plaza onto the corner of the Lower Kilmacud Road and the Old Dublin Road, public realm improvements, resident lounge area, communal kitchen and dining, co-working space, cinema, gym, and concierge service. Vehicular access to the basements is from the Lower Kilmacud Road and St. Laurence's Park. The planning application has been granted.

Figure 3.7: Proposed Site Layout Plan – Stillorgan Leisureplex, Old Dublin Road, Stillorgan, Co. Dublin, © Dun Laoghaire-Rathdown County Council 2020

3.2.17 Former Blakes and Esmonde Motors Site

The development will consist of the demolition of existing vacant buildings and the construction of a mixed-use development comprising 179 no. student accommodation units, 103 no. residential apartment units, a sports hall and retail, restaurant, and other facilities. The proposed development will comprise of four buildings ranging in height from three storeys to nine storeys. The proposed development is located at around chainage A 6900 of the Proposed Scheme as shown in **Figure 3.8** below. The development also includes the provision of public, communal, and private open space, and includes improvements to the public realm along the Lower Kilmacud Road and The Hill. The planning application has been granted. Since then the site has been taken over by a new developer and Cairn Homes Properties Ltd., have issued to Notice to ABP with intend to apply to An Bord Pleanála for planning permission for a strategic housing development at this site at the former Blakes and Esmond Motors sites, Lower Kilmacud Road, the Stillorgan Road, (N11) and the Hill, Stillorgan, Co. Dublin all on a site of c. 1.41 hectares. The development will consist of the construction of a mixed use scheme of 377 no. “Built to Rent” BTR apartments, Community Sports Hall (c. 933 sq. m), along with 5 no. restaurant/cafés (c. 841 sq.m), creche (c. 215 sq. m), office (c. 195 sq m) and ancillary residents’ support facilities/services (c. 1,016 sq. m) laid out in 6 no. blocks ranging in height from 3-9 storeys (over basement) comprising 21 no. studio apartments, 189 no. 1 bedroom apartments, 159 no. 2 bedroom apartments & 8 no. 3 bedroom apartments (selected no. with balconies), and public realm upgrades.

Liaison has taken place with DLRCC and the developer ahead of their planning application for the proposed development. The Proposed Scheme design is been co-ordinated with the proposed development at the former Blakes site. A planning application has not been lodged at the time of writing this report.

Figure 3.8: Proposed Site Layout Plan – Former Blakes and Esmonde Motors © Dun Laoghaire-Rathdown County Council 2020

3.2.18 Brewery Road/Stillorgan Road

Planning permission for a `Build to Rent` strategic housing development consisting of a new residential scheme of 287 residential units. Provision is also made for pedestrian connections to the adjoining park to the south west, the N11 Stillorgan Road to the north east and the existing The Grange development to the south east. The development is at chainage A 7650 of the Proposed Scheme and is shown in **Figure 3.9** below. It shall be accessed from Brewery Road. The planning application has been granted.

The Proposed Scheme has also been co-ordinated with the proposed Brewery Road Safety Improvement Scheme at the same location.

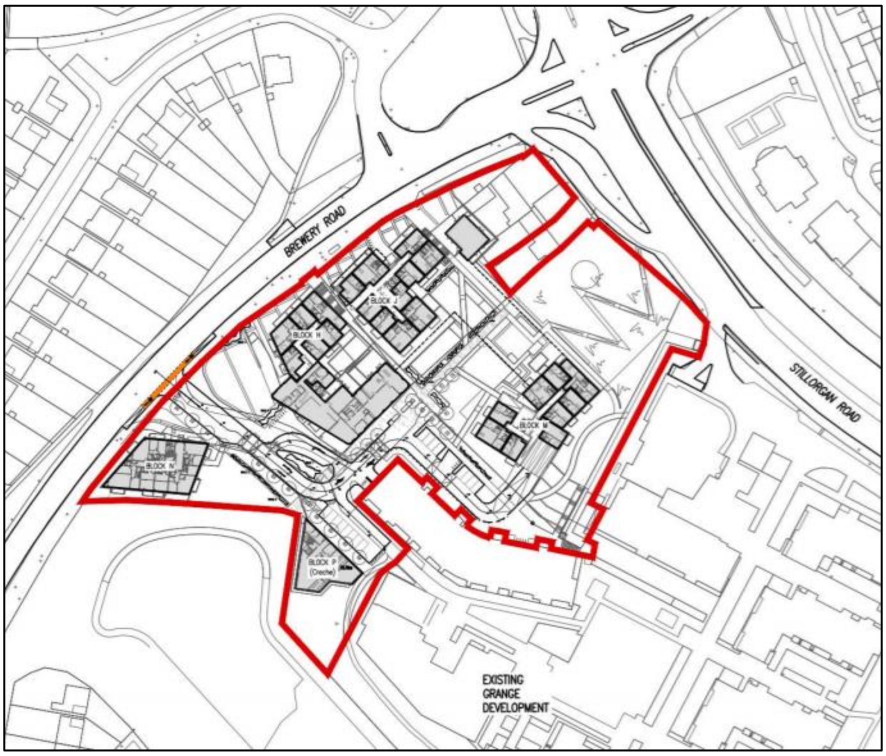

Figure 3.9: Proposed Site Layout Plan - Brewery Road/Stillorgan Road © Dun Laoghaire-Rathdown County Council 2020

3.2.19 Roselawn and Aberdour

A strategic housing development consisting of the demolition of the existing structures on site and the provision of a Build-to-Rent residential development comprising 142 No. apartments, at around chainage A 8550 of the Proposed Scheme as shown in **Figure 3.10** below. The development also proposes a pedestrian link from the N11 to Granville Road via Knocksinna Court, permanent vehicular access off Knocksinna Court via Granville Road, temporary construction access off the N11 and provision of a gate for emergency access towards the south-western corner of the site onto the N11. The planning application has been granted.

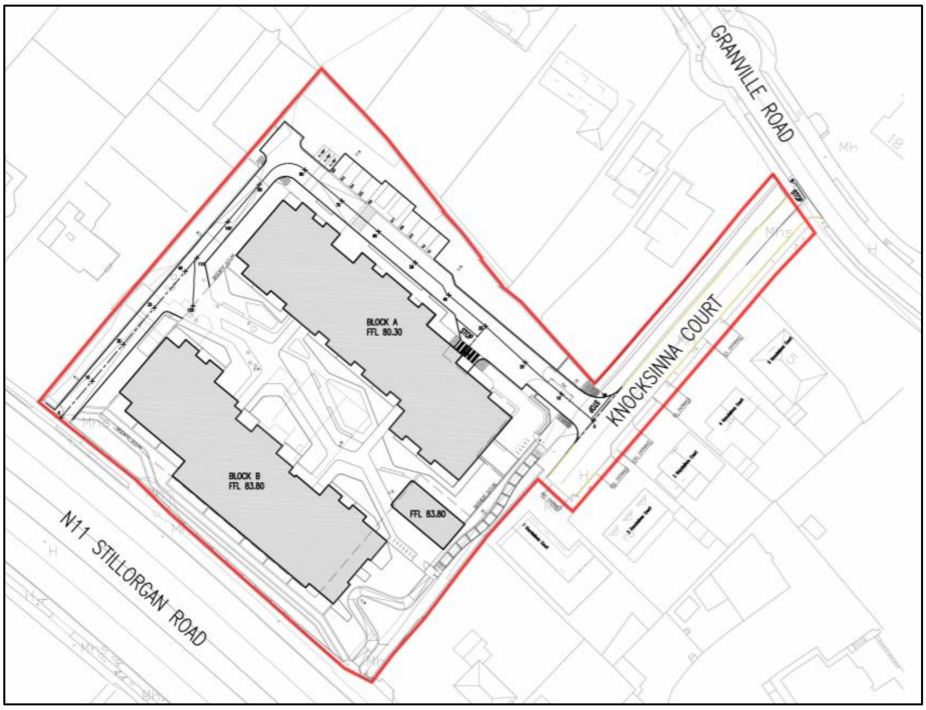

Figure 3.10: Proposed Site Layout Plan – Roselawn and Aberdour © Dun Laoghaire-Rathdown County Council 2020

3.2.20 Springfield House

Permission granted for the demolition of the existing dwelling and the construction of 24 dwelling units at around chainage A 9300 of the Proposed Scheme, as shown in **Figure 3.11** below.

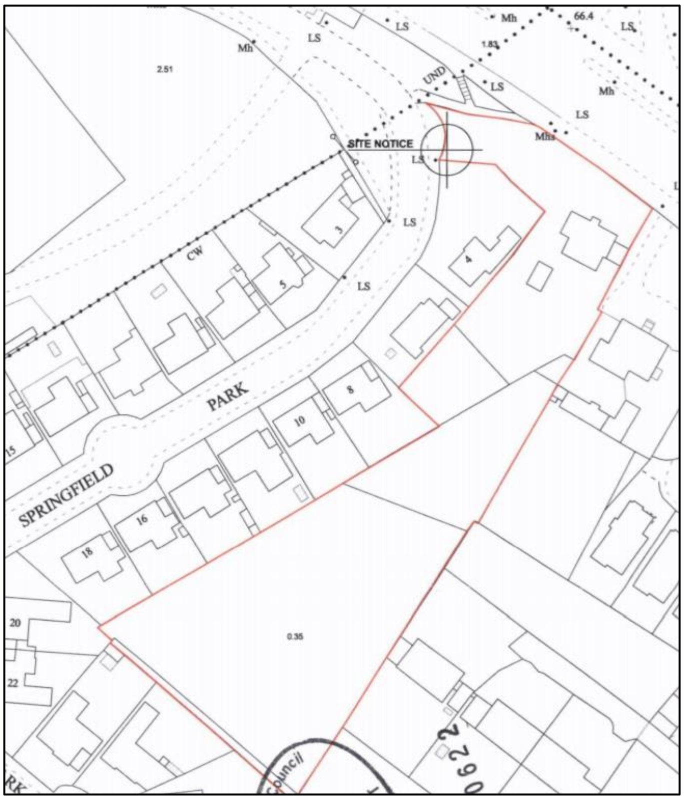

Figure 3.11: Proposed Site Layout Plan – Springfield Park © Dun Laoghaire-Rathdown County Council 2020

3.2.21 51 (Clara House) and 52 (Montrose)

Permission granted for demolition of the two existing dwellings, along with associated outbuildings. Construction of two apartment blocks providing 45 no. apartment units with associated balconies, comprising 17 no. 1 bed units, 25 no. 2 bed units and 3 no. 3-bed units at around chainage A 9340 of the Proposed Scheme as shown in **Figure 3.12** below. The permission includes vehicular access and basement entrance/egress at Kill Lane.

Figure 3.12: Proposed Site Layout Plan – 51 (Clara House) and 52 (Montrose) © Dun Laoghaire-Rathdown County Council 2020

3.2.22 Killart

Permission granted for the construction of 19 no. residential dwellings and new access road off Clonkeen Road (at around chainage A 10700 of the Proposed Scheme), as shown in **Figure 3.13** below.

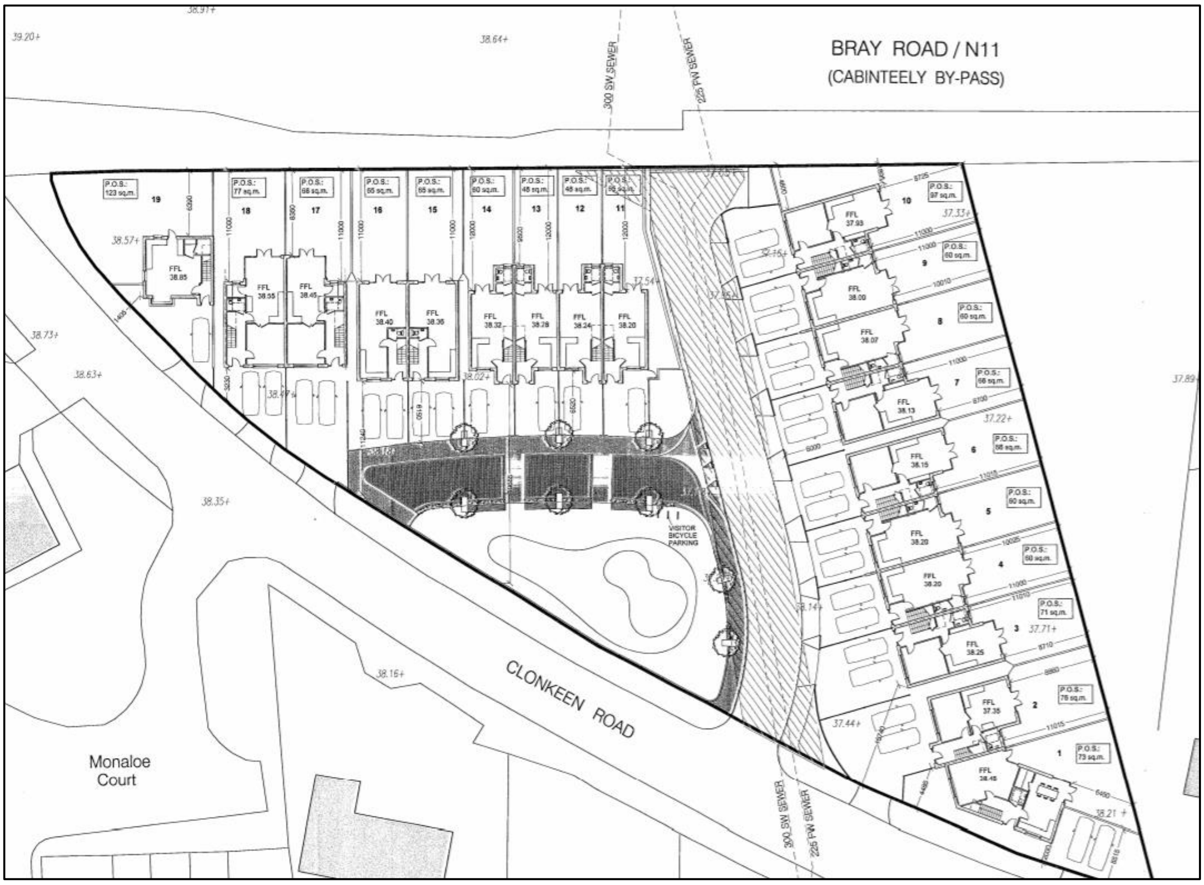

Figure 3.13: Proposed Site Layout Plan – Killart © Dun Laoghaire-Rathdown County Council 2020

3.2.23 Development at the New Junction at Druid Glen Road

The Proposed Scheme design has been co-ordinated with the recently constructed new development along the N11 at the new junction at Druid's Glen Road. The development and the new junction were at construction completion stage during the design development of the Proposed Scheme and is now built as we write this report.

3.2.24 Loughlinstown – Proposed Sign and Railing

Permission has been granted for the replacement of the existing north-facing illuminated advertising display with a digital advertising display and minor alterations to landscape plan. The proposed replacement sign and railing site at around chainage A 13950 of the Proposed Scheme is shown in **Figure 3.14** below.

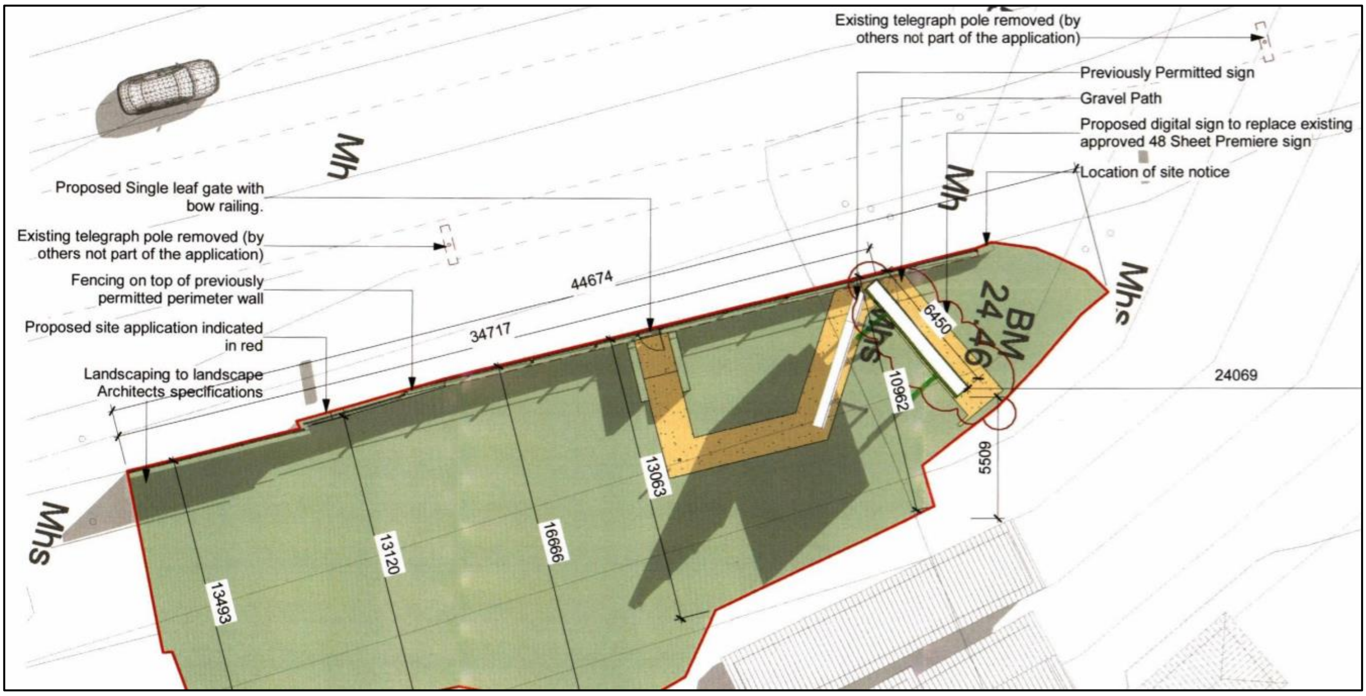

Figure 3.14: Proposed Replacement Sign and Railing Site Layout Plan, Loughlinstown © Dun Laoghaire-Rathdown County Council 2020

3.2.25 Coltsfoot

A planning application has been submitted for the demolition of the existing Coltsfoot single residence and the construction of 53 no. apartments over basement with associated external works and a relocated access point from the Dublin Road. The development location is immediately north of the existing Woodbank development along the R837 Dublin Road, Shankill. Planning permission has been refused.

3.2.26 Rathbeg

Permission has been granted for the demolition of an existing two-storey dwelling house known as 'Rathbeg' and ancillary outbuildings and sheds, and the construction of a residential development of 54 units and main vehicle access off Stonebridge Lane. The proposed site layout at around chainage E 200 of the Proposed Scheme, is shown in **Figure 3.15** below. The Proposed Scheme cycle track proposals in this area have been coordinated with this development to achieve an integrated solution.

Figure 3.15: Proposed Site Layout Plan, Rathbeg, Stonebridge Lane © Dun Laoghaire-Rathdown County Council 2020

3.2.27 Rathbeg Residential Development along Stonebridge Road

Liaison has taken place with DLRCC and the developer ahead of their planning application for a residential development on the site along Stonebridge Road. A planning application has not been lodged at the time of writing this report. The Proposed Scheme design has been co-ordinated with proposed development, which includes routing the two-way cycle track through the proposed development site, which tie-in with the St Anne's School entrance.

3.2.28 Shanganagh Castle Housing Development

Residential development of 597 no. residential units comprising housing, apartment and Build to Rent apartment units with ancillary commercial units at around chainage A 16200 of the Proposed Scheme, as shown in **Figure 3.16** and **Figure 3.17**. The planning application has been granted. The Proposed Scheme design has been co-ordinated with the development.

Figure 3.16: Proposed Site Layout Plan – Shanganagh Castle Residential Development © Dun Laoghaire-Rathdown County Council 2020

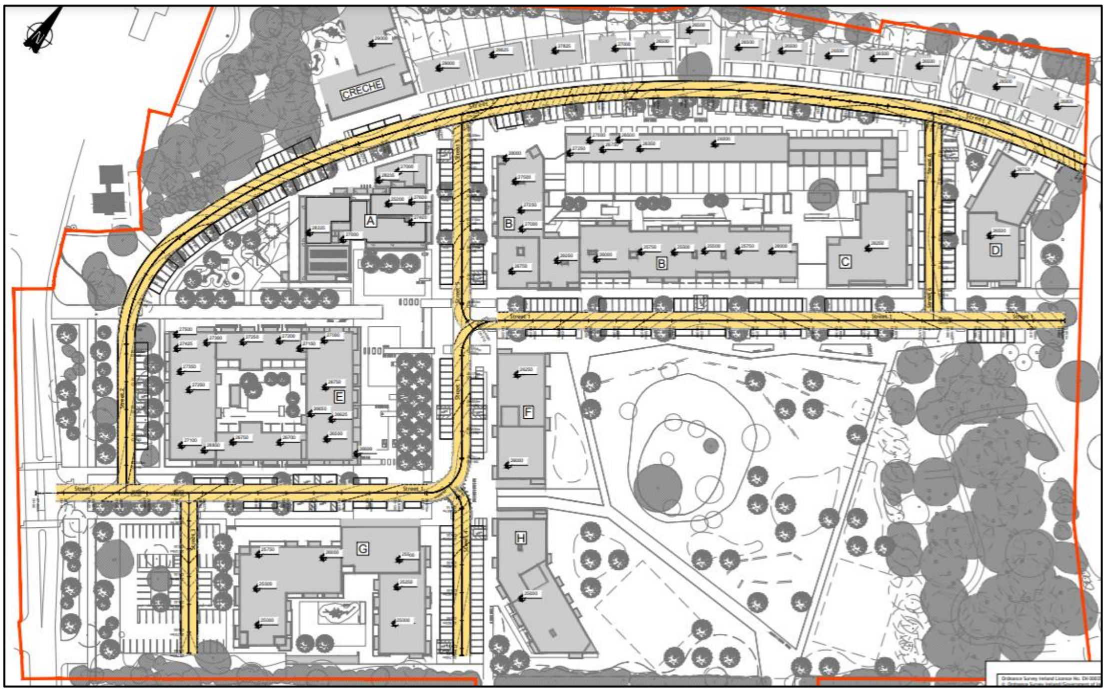

Figure 3.17: Proposed Road Layout Plan – Shanganagh Castle Residential Development © Dun Laoghaire-Rathdown County Council 2020

3.2.29 Shanganagh Park and Cemetery Masterplan

Shanganagh Park and Cemetery is a suburban park surrounded by extensive greenbelt lands at around chainage A 16475 of the Proposed Scheme, as shown in **Figure 3.18** below. The planning application has recently been submitted.

The masterplan includes:

- Upgrading the park from local to regional status,
- Improving functionality in the form of additional recreational use and natural habitat,
- Consolidating the park, the castle and cemetery,
- Improved pedestrian connection between the coastline and the park,
- A sculptural mound, topped by a viewing terrace offering views of Dublin and Wicklow Mountains, Dalkey Island and Bray Head,
- Increased tree cover,
- 3 DART crossing points including a green bridge for wildlife,
- Sports pavilion and facilities,
- Provision for the East Coast Greenway cycling route to traverse,
- An upgraded access to Shanganagh Cemetery,
- An additional carpark on the castle grounds,
- Reopening an entrance to the rear of the castle,
- Relocating the piers from the southwest corner of the park,
- An attenuation pond,
- Relocation of the children’s playground at Old Dublin Road,
- Shared use pedestrian link from proposed Woodbrook DART Station,
- Potential location for renewable energy generation,
- Community gardens and orchards,
- Improved access to Shankill Beach, and
- Other ancillary works.

Figure 3.18: Proposed Masterplan – Shanganagh Park and Cemetery © Dun Laoghaire-Rathdown County Council 2020

3.2.30 Townland of Corke Little, Woodbrook

The Woodbrook Strategic Housing Development is located at around chainage A 16850 of the Proposed Scheme and is shown in **Figure 3.19** below. It consists of a residential-led development comprising 685 no. residential units and 1 no. childcare facility. Included in the planning application is the provision of Woodbrook Distributor Road/ Woodbrook Avenue from the Old Dublin Road (R119) to the future Woodbrook DART Station. Also included in the application is a new vehicular access provided from the Old Dublin Road (R119) opposite Woodbrook Downs entrance including new junction arrangements. Planning permission has been granted and the junction works are under construction as we write this report.

Figure 3.19: Proposed Road Layout Plan – Townland of Corke Little, Woodbrook, Shankill, Co. Dublin © Dun Laoghaire-Rathdown County Council 2020

3.2.31 Aske House

Permission has been granted for the development of a Specialist Hospital for 56 no. in-patients, at around chainage A 16975 of the Proposed Scheme as shown in **Figure 3.20** below. The works include modification/ widening of the existing site entrance at the Dublin Road by setting back and reinstating the old gate piers and railing.

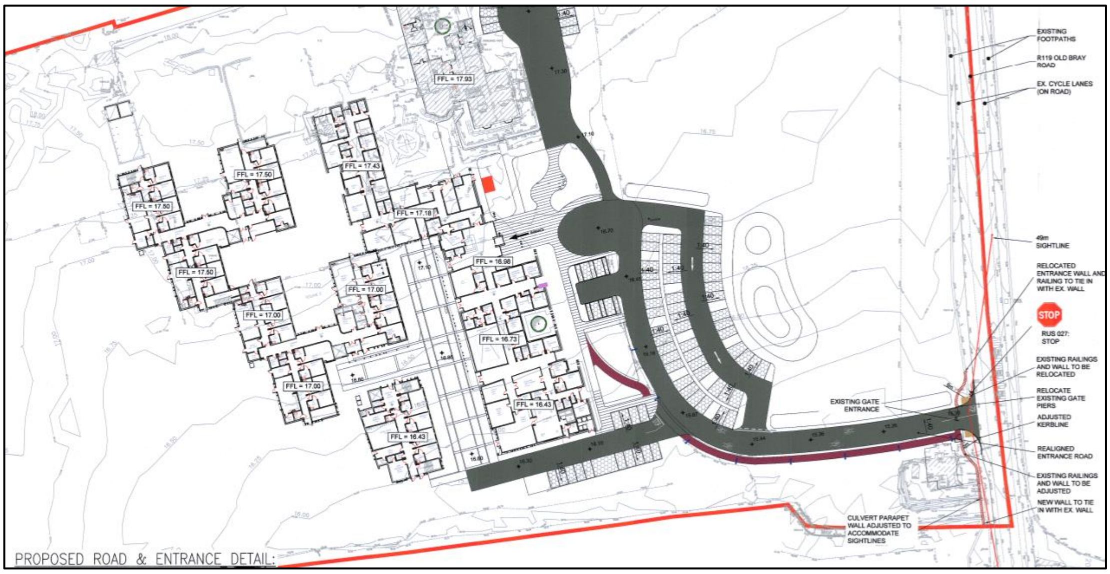

Figure 3.20: Proposed Road and Entrance Detail – The Aske House © Dun Laoghaire-Rathdown County Council 2020

3.2.32 Saint Brendan's College

Planning permission has been granted for a development which will consist of demolition of the existing 1970s two storey school building and ancillary buildings and the construction of a new, part single-storey, part 2-storey school building. Modifications to the existing boundary walls and ancillary site works including new landscaping, playground areas and car parking are also proposed. The site is at around chainage A 17100 of the Proposed Scheme.

Recently the site is undergoing plan for major extension to the Woodbrook College. Discussions have taken place with DLRCC and the Woodbrook College to co-ordinate the design with the Proposed Scheme, in particular the bus stop and access to the college. The new proposed access to the College and the associated relocated bus stop is subject to separate Planning application by Woodbrook College. A planning application has not been lodged at the time of writing this report.

3.2.33 28 Dublin Road Apartment Development

Submitted planning application includes construction of a single storey apartment development consisting of 4 no. one bedroom apartment dwellings including partial site excavation (at around chainage A 17960 of the Proposed Scheme). Planning permission has been refused.

3.2.34 St. John of God Complex

Permission has been granted for revisions to and extension of the existing internal road to provide connection to an associated road proposal on the adjoining Industrial Yarns Complex and removal of existing vehicular access from the Dublin Road. The proposed realignment of the site access is at around chainage A 18100 of the Proposed Scheme, shown in **Figure 3.21** below.

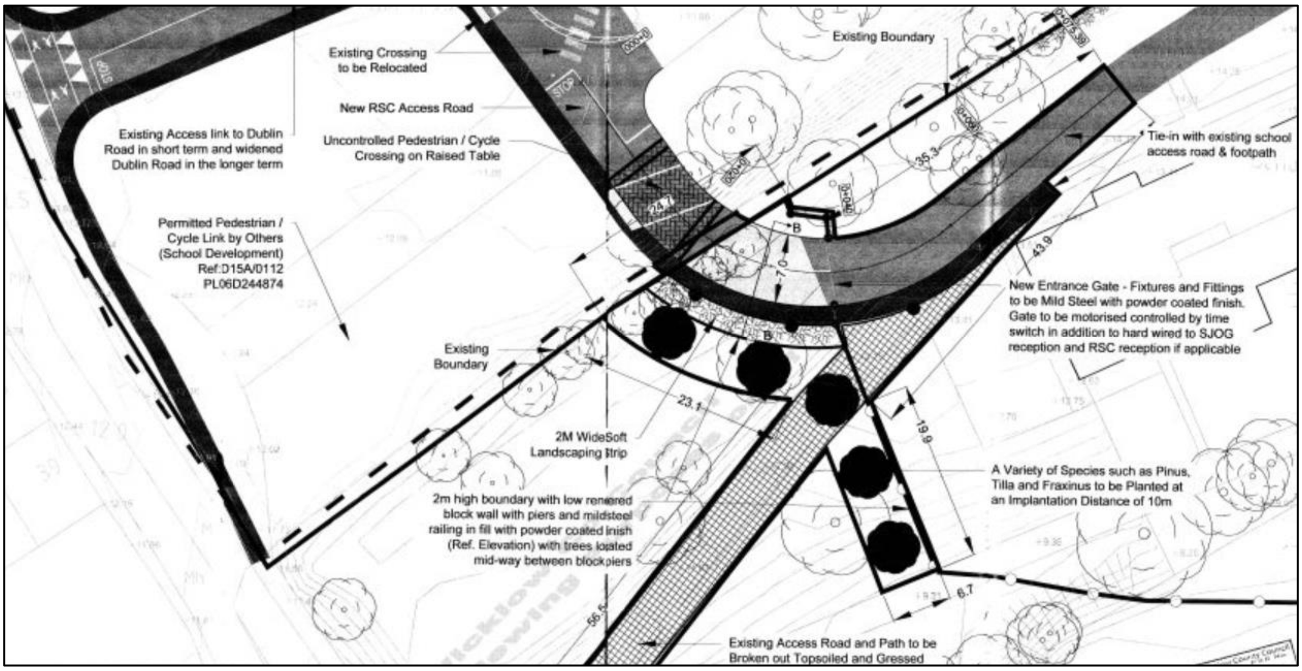

Figure 3.21: Proposed Realignment of Site Access Road, St. John of God Complex © Dun Laoghaire-Rathdown County Council 2020

3.2.35 Bray Golf Club Lands off Ravenswell Road, Bray

Consultation is underway regarding the development of the Bray Golf Club Lands as a Strategic Housing Development. The proposals include for residential units a childcare facility and other associated facilities. The development access is proposed from Ravenswell Road. The proposed works within these lands is subject to further development at the time of writing this report.

3.2.36 Ravenhall Building (former Everest Centre Site), Castlestreet, Bray

Planning application consists of change of use from retail / commercial to 10 apartment units. Included in the application is the reconfiguration of existing internal and external car parking, alterations to existing services, and a new boundary wall to the north east of the building (at around chainage A 18200 of the Proposed Scheme), as shown in **Figure 3.22** below. The Planning Permission has been refused but currently under appeal (March 2021).

Recently the site has been sold to another developer and the new developer proposal is of residential 58 number apartment complex with underground car park at this site. Discussions are ongoing with WCC and the current developer to co-ordinate the design with the Proposed Scheme. A planning application has been lodged at the time of writing this report.

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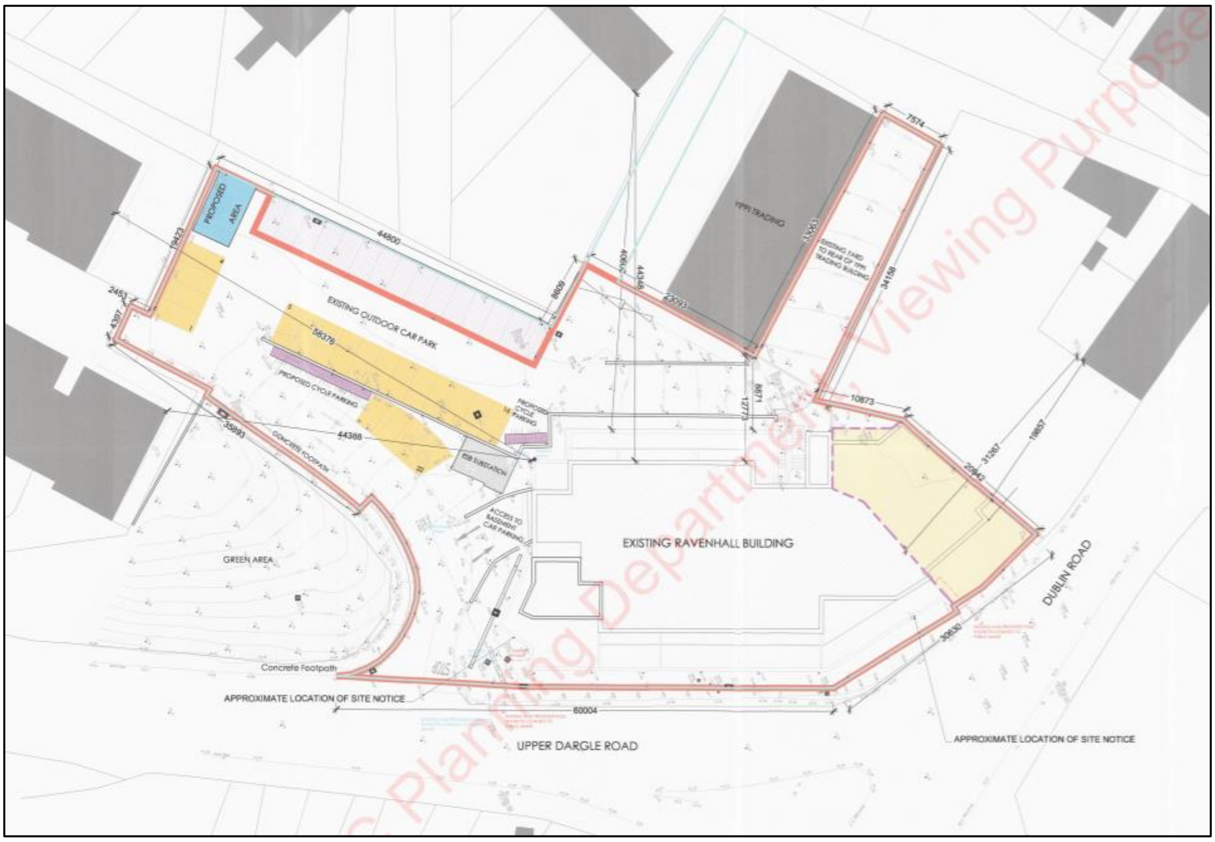

Figure 3.22: Proposed Site Layout Plan – Ravenhall Building © Wicklow County Council 2020

3.2.37 Development of Site on Castle Street adjacent to Dwyer Park, Bray

Liaison has taken place with Wicklow County Council and the developer ahead of their planning application for a residential development and creche on this site. A planning application been lodged at the time of writing this report. The Proposed Scheme design has been co-ordinated with development.

3.2.38 Bray Bridge Improvement Scheme

The Proposed Scheme design terminates at the northern end of the Fran O'Toole bridge and the design has been coordinated to tie in with the Wicklow County Council's Bray Bridge Improvement Scheme proposals, which takes into account bus priority and cyclists and pedestrian infrastructure. The junction design at the tie-in with the proposed Bray Bridge Improvement Scheme designed by WCC has been included as an alternative layout.

Figure 3.23 shows the junction layout as part of the Proposed Scheme where the scheme ties into the existing road cross-section North of the Bray Bridge. **Figure 3.24** shows a coordinated design solution of the overall arrangement of the junction in a scenario in which both schemes have been implemented.

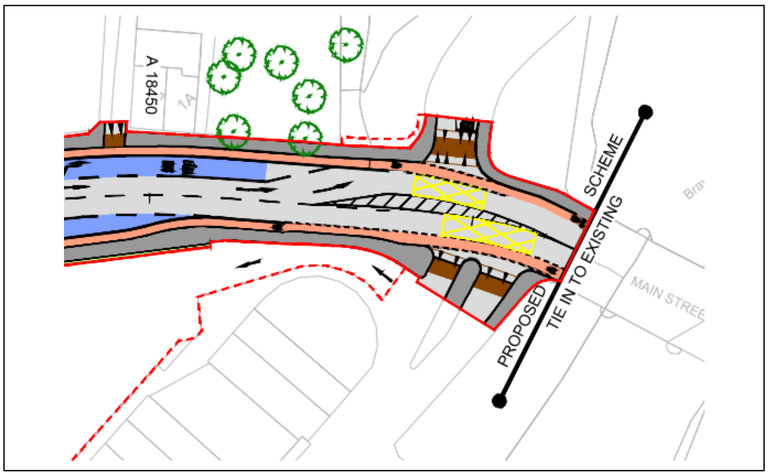

Figure 3.23: BusConnects Design tie-in to the Existing

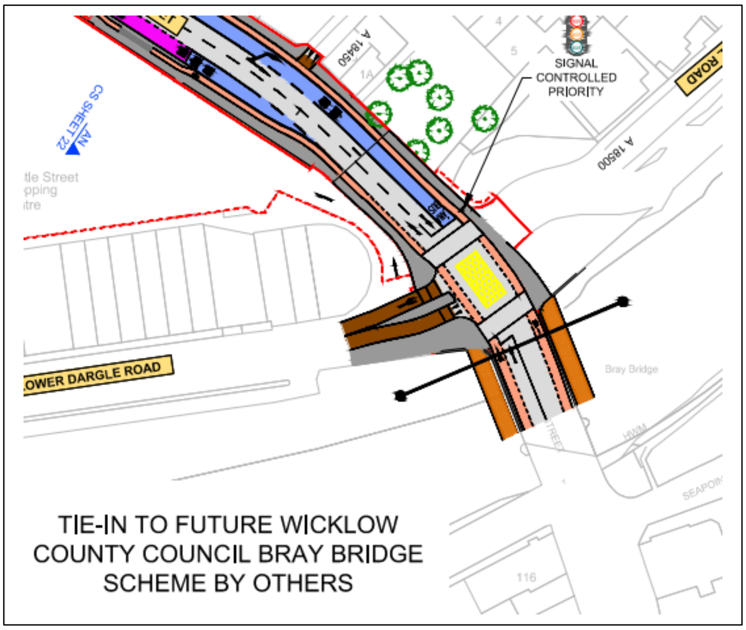

Figure 3.24: BusConnects Design co-ordinated with the proposed WCC Bray Bridge Improvement Scheme

3.3 Integration with Belfield/Blackrock to City Centre Scheme

As part of the scheme proposals, consideration has been given to the potential coordination required in relation to other BusConnects Dublin Infrastructure Works schemes. This section outlines potential interactions of the Proposed Scheme with adjacent schemes.

The Proposed Scheme includes the signalised junction of the R138 Stillorgan Road and Nutley Lane, which is also part of the Belfield/Blackrock to City Centre Scheme.

The BusConnects Infrastructure design team for each scheme have co-ordinated the design at the junction to ensure the design considers:

- Tie-in with the existing;
- Tie-in with the Belfield/ Blackrock to City Centre CBC Scheme.

Works proposed to the Nutley Lane junction include carriageway realignment, cycle track and pedestrian crossing works. The design teams of both schemes have coordinated the respective scheme designs to provide flexibility in the proposals such that construction sequencing and physical works can be coordinated or delivered in sequence should both schemes be implemented. **Figure 3.25** shows the proposed junction layout as part of the Proposed Scheme where the scheme ties into the existing Nutley Lane layout. **Figure 3.27** shows a coordinated design solution of the overall arrangement in a scenario in which both schemes have been implemented.

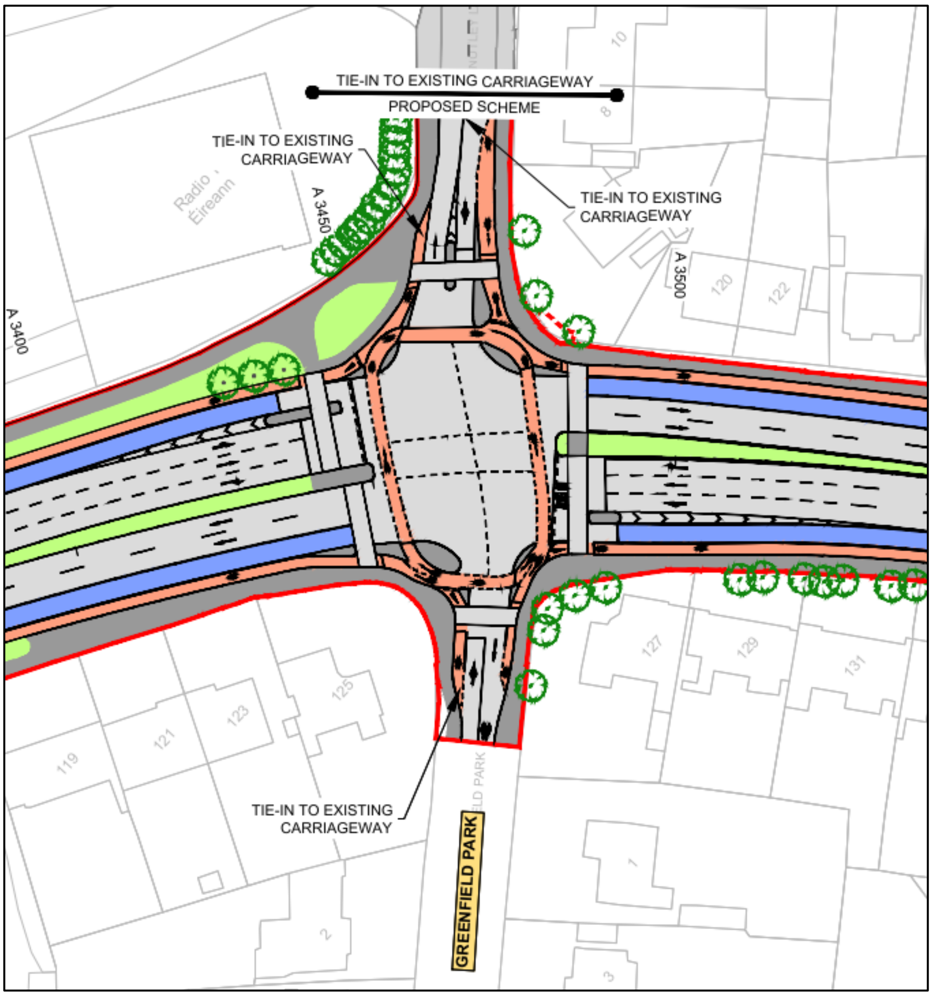

Figure 3.25 Proposed Scheme preliminary design layout at R138 Stillorgan Rd/Nutley Lane junction, tying into the existing Nutley Lane layout

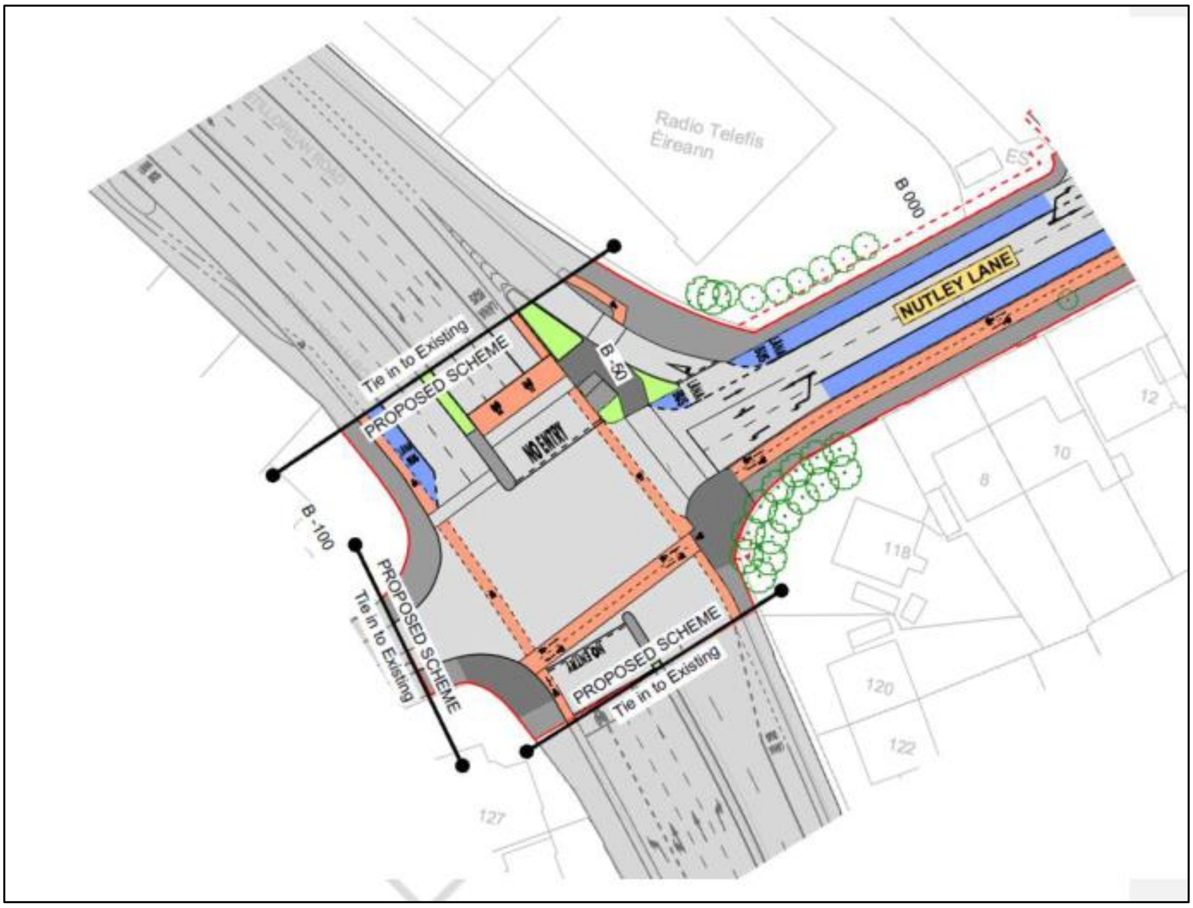

Figure 3.26 Preliminary Design of the Belfield/ Blackrock to City Centre CBC Scheme at Nutley Lane, tying into the existing R138 Stillorgan Rd/Nutley Lane junction layout

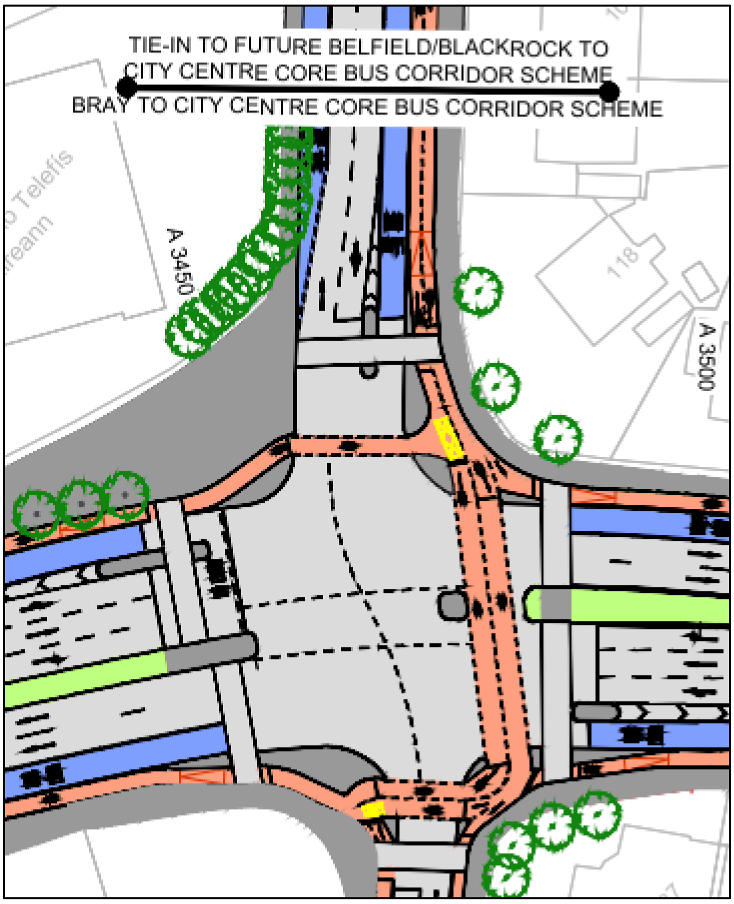

Figure 3.27 Design at R138 Stillorgan Road/Nutley Lane junction of the expected overall arrangement of the Proposed Scheme and Belfield/Blackrock to City Centre Scheme

The Belfield/ Blackrock to City Centre Scheme is subject to a separate planning process, the timing of which is largely independent of that of the Proposed Scheme, and as such no exact sequencing of construction works can be determined at this stage. **Table 3-1** represents a matrix of potential interactions and impacts associated with the various potential sequencing scenarios in relation to construction and operation of both schemes,

It is considered that vehicular access to and egress from the southern of the two existing driveways of the property 118 Stillorgan Road will be retained for pedestrian and cyclists only as part of both the Proposed Scheme and the Belfield/ Blackrock to City Centre CBC Scheme works, and as such shall be included in the CPO process for both.

Table 3-1Matrix of Potential Interactions and Impacts Associated with Different Sequencing Scenarios

	Belfield/ Blackrock Scheme: Not Yet Commenced	Belfield/ Blackrock Scheme: Under Construction	Belfield/ Blackrock Scheme: Completed
Proposed Scheme: Not Yet Commenced	N/A	Construction of the Belfield/ Blackrock to City Centre CBC Scheme shall be carried out in accordance with the Construction Strategy within that scheme's planning application, without any potential interaction with the works associated with the Proposed Scheme. The works shall take place within the Red Line Boundary of the same and tie-in with the existing environment on Nutley Lane. Works to the subject junction will be as per the design in Figure 3.27.	The Belfield/ Blackrock to City Centre CBC Scheme shall be in full operation, designed in accordance with its planning application which will allow for the Proposed Scheme to tie in at a future date. Two-way cycle track will be constructed at Nutley Lane as part of the Belfield/ Blackrock to City Centre CBC Scheme, along with two-way cycle track crossing at the N11 South Eastern arm of the junction. Rest of the physical infrastructure at the R138 Stillorgan Road/ Nutley Lane junction shall remain unchanged, outside of the Belfield/ Blackrock to City Centre CBC Scheme's Red Line Boundary.
Proposed Scheme: Under Construction	Construction of the Proposed Scheme will be carried out in accordance with the Construction Strategy within that scheme's planning application, without any potential interaction with works associated with the Belfield/ Blackrock to City Centre CBC Scheme. The works shall take place within the Red Line Boundary of the same and tie-in with the existing environment on Nutley Lane. Works to the subject junction will be as per the design in Figure 3.26.	It is not envisaged that both schemes will be under construction at the same time at this location. It is considered there is sufficient flexibility in the construction programme to either align (tie-in) construction works here or keep activities staggered to occur at different stages of the programme. The approach taken will need to be determined based on detailed traffic management proposals, which will be co-ordinated between the schemes once the start dates and detailed construction programmes are confirmed.	The Belfield/ Blackrock to City Centre CBC Scheme will be completed, and the Proposed Scheme will make the necessary works at the R138 Stillorgan Road/ Nutley Lane junction for cycle track connectivity to Nutley lane two-way cycle track. The arrangement will reflect the co-ordinated design as per Figure 3.28.
Proposed Scheme: Completed	The Proposed Scheme shall be in full operation, designed in accordance with its planning application. A common point has been determined approximately 40m from the stop line on Nutley Lane arm, upto which the Proposed Scheme will be constructed as per the design shown in Figure 3.26. The subject junction shall remain unchanged in terms of physical infrastructure, outside of the Red Line Boundary.	The Proposed Scheme will have been completed and the Belfield/ Blackrock to City Centre CBC Scheme will tie into the revised existing layout as per the Proposed Scheme shown in Figure 3.26. The Belfield/ Blackrock to City Centre CBC Scheme will construct the two-way cycle track along Nutley Lane as per the co-ordinated design arrangement.	Both schemes will be fully operational in accordance with their planning application and the arrangement will reflect the co-ordinated design as per Figure 3.28.

4. Preliminary Design

4.1 Principal Geometric Parameters

As a safety improvement, junction improvement and traffic management scheme within an urban area, the Proposed Scheme 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 2013.

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

The design philosophy adopted for the scheme 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, the Transport Infrastructure Ireland (TII) Design Manual for Roads and Bridges (DMRB), Building for Everyone: A Universal Design Approach and the BCPDGB.

A number of published design standards and guides have been utilised to inform the geometrical design of the Proposed Scheme, as listed below:

- TII's Design Manual for Roads and Bridges (DMRB)
- Design Manual for Urban Roads and Streets (DMURS)
- National Cycle Manual (NCM)
- Traffic Sign Manual (TSM)
- Traffic Management Guidelines (TMG)
- NDA's Building for Everyone: A Universal Design Approach
- Guidance on the use of Tactile Paving
- Construction Standards for Road and Street Works in DCC; and
- BusConnects Preliminary Design Guidance Booklet (BCPDGB) – See **Appendix O**.

The Proposed Scheme runs through the N11 National Road section between Mount Merrion Avenue/N11 junction and Loughlinstown Roundabout. The N11 section is split into two sub-sections with respect to existing speed limits:

- N11 between Mount Merrion Avenue/N11 junction and Kill Lane/ N11 Junction – 60km/h
- N11 between Kill Lane/ N11 Junction and Loughlinstown Roundabout – 80km/h

For the N11 section of the Proposed Scheme with the proposed speed limit equal to 60km/h between Mount Merrion Avenue/N11 junction and Kill Lane/ N11 Junction in particular, the design seeks to minimise largescale changes to the existing infrastructure where it is deemed to be suitable for use in its existing case, under the DMURS.

For the N11 carriageway section of the Proposed Scheme, with the proposed speed limit greater than 60km/h (80km/hr) between the N11 between Kill Lane/ N11 Junction and Loughlinstown Roundabout, the design seeks to minimise largescale changes to the existing infrastructure where it is deemed to be suitable for use in its existing case, under TII current publications. In particular, adherence to the following standards is the basis of the Design:

- DN-GEO-03031 – Rural Road Link Design
- DN-GEO-03036 – Cross-sections and Headroom
- GN-GEO-03060 – Geometric Design of Junctions (Priority junctions direct access, roundabout, grade separated junction, compact grade separated junction)
- GN-GEO-03044 – Geometric Layout of Signal Controlled Junctions and Signalised Roundabouts
- DN-GEO-03034 - The Design of RSS for roads and bridges
- DN-REQ-03079 - Design of RSS for Constrained Locations Online Improvements, Retrofitting and Urban Setting.
- DN-PAV-03026 – Footway Design
- TII Standards Commission Draft Publication (Literature and Scheme Review Note) - Bus Lanes on Dual Carriageways and Motorways
- DN-GEO-03087 Hard Shoulder Bus Priority Measures on Motorways and Type 2 Dual Carriageway

Where the existing road geometry does not meet the above design standards, this has been highlighted within **Section 4.16** Relaxations, Departures and Deviations from Standard.

Table 4-1 below details the key design parameters which have been generally adopted to inform the Proposed Scheme design layout, including the N11 National Road section. 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 Scheme, 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 Scheme is to provide enhanced walking, cycling and bus infrastructure. It should be noted that the development of the urban realm proposals along the corridor have also informed the key geometrical layouts for the Proposed Scheme which are further discussed in **Chapter 14.**

Table 4-2 below details the key design parameters which have been generally adopted to inform the Proposed Scheme along the National Roads N11 Stillorgan Road.

Table 4-3 below details the key design parameters from the BusConnects Design Guidance document.

Table 4-1: Bus Connects Key Design Parameters

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
All	Road Type	The Proposed Scheme 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) • 1.3m absolute minimum for National Roads 80km/hr section	NDA[1] (Section 1.5.1) DMURS (Figure 4.34) TII DN-PAV-03036 Footway Design (Table 2.3)
		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	NDA[1] (Section 1.5.2)

[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)
				gradient of 1 in 33 should have landings at no more than 25m intervals with linear interpolation between gradients as required • Desirable maximum gradient 1 in 20 with 0.45m maximum rise over 9m length between landings	DN-STR-03005 (Section 6.9, 6.14, 6.15)
		Ramp gradients – bridge structures		• Desirable maximum gradient 1 in 20 with 2.5m maximum rise between landings • Absolute maximum 1 in 15 – 1 in 12 with 0.65m maximum rise between landings where 1 in 20 is not practical)	
	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	BCPDG (Section 5)
		Minimum cycle track (single file cycling): single-direction, with-flow, raised-adjacent cycle track		• 1.5m minimum width • 1m absolute minimum width at constrained island bus stop locations • 1.75m minimum for National Road 80km/hr section	BCPDG (Section 5.3, 11.2) TII DN-GEO-03036 Table 4.5
		Two-way cycle track (single-file cycling)		• 3.25m desirable minimum cycle track with additional desirable minimum 0.5m buffer and absolute minimum 0.3m buffer	BCPDG (Section 5.3)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
		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)	BCPDG (Figure 34)
		Nominal deflection – parking and loading bays		• 1 in 3 horizontal taper at cycle protected parking	BCPDG (Figure 12)
		Nominal deflection – island bus stops		• 1 in 1.5 horizontal taper at Island Bus Stops	BCPDG (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
		Transition from carriageway to pedestrian priority zone		• 120mm at 1:20 gradient (4.8m long)	NCM 4.10
		Transition from cycle track to pedestrian priority zone		• 60mm rise at 1:20 gradient (2.4m long)	NCM 4.10
	Crossfall gradient	Acceptable gradient range		• 1.25% to 2.5% (1:80 to 1:40)	NCM 5.2.3.4
Bus Lane	Shared bus/cycle lane	Lane widths (collector/link roads – low speed) in constrained environments	50 km/h and 60km/h	• 3m maximum width (consideration for cycle and bus (including taxis + other permitted vehicles) volumes required in addition to bus lane operation hours)	NCM 4.3.3
	Shared bus/cycle lane	Lane widths (collector/link roads – low speed) in constrained environments	80km/hr National Road	• 3.5m maximum width (consideration for cycle and bus (including taxis + other permitted vehicles) volumes required in addition to bus lane operation hours)	TII DN-GEO-03087

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
	Nominal with flow bus lane widths	Nominal lane widths adjacent to cycle track/footpath		• 3m minimum width and lane widening as required by vehicle tracking assessment on tight bends (≤60km/h)	BCPDG (Section 5.1)
		Nominal lane widths adjacent to cycle track/footpath		• 3.5m minimum width and lane widening as required by vehicle tracking assessment on tight bends (80km/h) National Road •	TII DN-GEO-03087
		Bus lanes adjacent to on street parking (no cycle track/footpath)		• 3m minimum width with consideration for designated buffer zones and delineated parking areas	BCPDG (Figure 12)
	Design speed	Design speed for vehicles in bus lane along the Proposed Scheme		• 50 km/h (Link Road) • 60 km/h (Arterial Road) • 60 km/h (National Road) • 80kh/hr (National Road) • **Refer to Table 4.6 in the Report for proposed Design Speed and Proposed Speed Limit.**	DMURS (Section 4.1.1 and Table 4.1) National Road as per DN-GEO-03031
	Visibility	Forward visibility stopping sight distance SSD (buses and HGV vehicles).	50 km/h	• 49m	DMURS (Table 4.2 – 50km/h)
			60 km/h and 80kh/h National Road	• Refer to Figure 4.4 in the Report for National Road •	DN-GEO-03031 Table 1.3
	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)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
Traffic Lane	Design speed	Design speed for vehicles in general traffic lanes along the Proposed Scheme		• 50 km/h (Link Road) • 60 km/h (Arterial Road) • 60 km/h (National Road) • 85 km/h (National Road) • Refer to Table 4.6 for proposed Design Speed and Proposed Speed Limit.	DMURS (Section 4.1.1 and Table 4.1) National Road as per DN-GEO-03031
	Traffic lane width	Minimum carriageway lane width	50 km/h	• 3m minimum width and lane widening as required by vehicle tracking assessment on tight bends	BCPDG (Section 5.1)
			60 km/h	• 3m minimum width and lane widening as required by vehicle tracking assessment on tight bends	
			>60 km/h	• 3.25m minimum width	
			60 km/h National Road	• 3.5m minimum width	National Road as per DN-GEO-03036
			80km/ hr National Road	• 3.5m minimum width	
	Visibility	Forward visibility stopping sight distance ssd (cars and smaller vehicles).	50 km/h	• 45m	DMURS (Table 4.2 – 50 km/h)
		Forward visibility stopping sight distance ssd (buses and HGV vehicles).	50 km/h	• 49m	DMURS (Table 4.2 – 50km/h)
		Forward visibility stopping sight distance ssd (buses and HGV vehicles).	60kh/h National Road	• Refer to Figure 4.4 in the Report for National Road	DN-GEO-03031 Table 1.3
		Forward visibility stopping sight distance ssd (buses and HGV vehicles).	80kh/h National Road	• Refer to Figure 4.4 in the Report for National Road	DN-GEO-03031 Table 1.3

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
		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)
	Horizontal curvature	Minimum radius with adverse camber of 2.5%	60 km/h and 80 kh/hr National Road	• Refer to Table 4.2 of the Report	DN-GEO-03031 Table 1.3
	Vertical curvature	Crest curve K value	60 km/h and 80 kh/hr National Road	• Refer to Table 4.2 of the Report	DN-GEO-03031 Table 1.3
	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 and 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 and smaller vehicles) • 49m SSD (HGV/Buses) • Refer to Figure 4.4 in the Report for National Road	DMURS (Figure 4.63) DMURS (Figure 4.63 / Para 4.4.5)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
					N-GEO-03031 Table 1.3
		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 and balance of junction form/function)	DMURS (Section 4.4.3)
		Occasional larger vehicles including buses and rigid body trucks (between arterial and or link streets)		• 6m maximum radius (subject to vehicle tracking assessment and 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 and 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 minimum 3m staggered offset refuge island (ideally stagger to face oncoming traffic) and ideally minimum 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)	BCPDG (Section 5) TMG (Section 10.7, Diagram 10.15) DMURS (Section 4.3.2)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
		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)	BCPDG (Section 6) DMURS (Section 4.4.9)
		Angled parking		• 60 degree parking: 4.8m-5m x 2.4m @ 4.2m depth. • 45degree parking: 4.8m-5m x 2.4m @ 3.6m depth	DMURS (Section 4.4.9)
		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)

Table 4-2 Geometric design Parameters for roads to be designed to TII Publication DN-GEO-03031

Road Type	Design Speed	Min Curvature Radius without superelevation	Min Curvature Radius with 5% superelevation	Min Longitudinal Gradient	Max Longitudinal Gradient	Min Sag K value	Min Crest K value
National Road	85	1440	510	0.5	3.0	26	55
National Road	60	720	255	0.5	6.0	13	17
National Road Diverge/ Merge	60	720	255	0.5	6.0	13	17

Table 4-3 BCPDGB Cross-Section design Parameters

Design Element	Desirable Minimum	Absolute Minimum	Permitted Reductions at Constraints
Footpath	2.0m	1.8m	1.2m over a 2m length of path (2)
Cycle Track (One-way)	2.0m	1.5m	Local narrowing below 1.5m may be necessary over short distances to cater for local constraints
Cycle Track (two-way)	3.25m+ 0.5m (buffer)	Refer National Cycle Manual width calculator. 0.3m (buffer)	
Bus Lane	3.0m	N/A	N/A
Traffic Lane	Preferred Width: 3.0m where speed ≤ 60 km/h 3.25m where speed limit > 60 km/h	2.75m (3)	Matches

1) Deviations from the desirable minimum parameters in the table have been tabulated in **Appendix C**.
2) Building for everyone: A Universal Design Approach
3) Traffic lane widths of 2.75m are permissible but not desirable and should only be permitted on straight road sections with very low HGV percentage and where all desirable minimum widths for footpaths, cycle tracks, parking, bus lanes are not achievable without impacting on third-party lands.

4.2 Mainline Cross-Section

4.2.1 Design Guidance and Requirements

Utilising Section 4.4.1 of DMURS, a design strategy was implemented to determine the appropriate cross-section for the Proposed Scheme, 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. The preferred width of traffic lanes on the Proposed Scheme are:

- 3.0m in areas with a posted speed limit ≤60km/h; and
- 3.25m in areas with a posted speed limit >60km/h

Along a section of the N11 National Road where the Proposed Scheme makes use of the existing bus and general traffic infrastructure, and the posted speed limit of 60km/h for general traffic and 60km/h for bus lane traffic, under the guidance outlined in DN-GEO-03036 and DN-GEO-03087, the preferred width of the traffic lane increases:

- 3.5m in areas with a posted speed limit of 60km/h or as per existing lane width as noted in **Table 4-4**.

Along a section of the N11 National Road where the Proposed Scheme makes use of existing bus and general traffic infrastructure, the posted speed limit increases to 80km/h for general traffic and 60km/h for bus lane traffic, under the guidance outlined in DN-GEO-03036 and DN-GEO-03087 and the preferred width of traffic lanes increases:

- 3.5m in areas with a posted speed limit =80km/h or as per existing lane width as noted in **Table 4-4**.

Along the N11 National Road section, at approaches to junctions, minimum entry lane width considered is 3.0m under the guidance of DN-GEO-03044.

Traffic lane widths of 2.75m are permissible but not desirable and should only be allowed on roads with a 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 NCM this allows for overtaking within the cycle track. The minimum nominal width is 1.5m. The desirable width for a two-way cycle track is 3.25m with a 0.5m buffer between the cycle track and the carriageway. The minimal nominal width of cycle track along the N11 National Road 80km/h section is 1.75m as per TII Publications.

2.0m is a desirable minimum width for footpaths, with 1.2m being a minimum width at pinch points over a 2m length of the path. The minimum nominal width is 1.8m. The minimum nominal width along the N11 National Road 80km/h section is 1.3m as per TII Publications. A typical CBC cross section is shown on **Figure 4.1**.

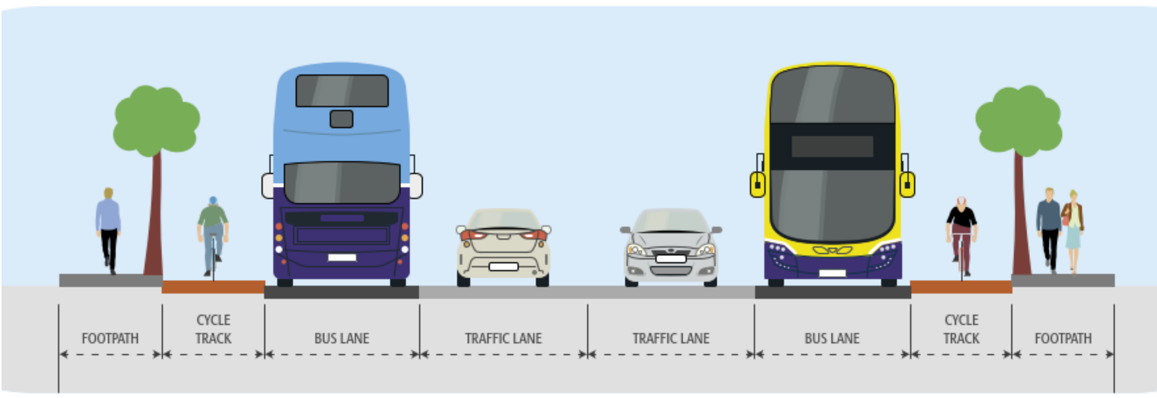

Figure 4.1: Typical CBC Cross Section

A detailed scheme breakdown of the proposed road cross section elements is provided in **Table 4-4**. This table provides 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 is provided in **Chapter 5**. The table is intended to provide supplementary information alongside the information presented on the General Arrangement (GEO_GA), Typical Cross Sections (GEO_CS) and Pavement Treatment Plans (PAV_PV) available in **Appendix B.**

4.2.2 Proposed Scheme Design along the N11 National Road section

Along the N11 section of the Proposed Scheme with the proposed speed limit equal to 60km/h between Mount Merrion Avenue/N11 junction and Kill Lane/ N11 Junction in particular, the design seeks to minimise largescale changes to the existing infrastructure where it is deemed to be suitable for use in its existing case, under the DMURS.

- Along this section of the N11 National Road the Proposed Scheme makes use of the existing pedestrian and cyclists infrastructure, and the footpath and cycle tracks have been improved where practical and designed to DMURS or as per existing as noted in **Table 4-4** . The Proposed Scheme provides for new footpath link along the section of the N11 between the junction with Priority Drive and Hill Road.

- Along this section of the N11 National Road where the Proposed Scheme makes use of the existing bus and general traffic infrastructure, the preferred width of traffic lanes adopted is 3.5m or as per existing lane width as noted in **Table 4-4**.

- Where the existing road geometry does not meet the design standards, this has been highlighted within **Section 4.16** Relaxations, Departures and Deviations from Standard.

For the N11 section of the Proposed Scheme, with the proposed speed limit greater than 60km/h (80km/hr) between the N11 between Kill Lane/ N11 Junction and Loughlinstown Roundabout, the design seeks to minimise largescale changes to the existing infrastructure where it is deemed to be suitable for use in its existing case, under TII publications.

- Along this section N11 National Road where the Proposed Scheme makes use of the existing pedestrian and cyclists infrastructure to minimise large scale changes to the existing infrastructure, the footpath and cycle tracks have been improved at Bus stop locations considering safety or as per existing as noted in **Table 4-4** .

- The Proposed Scheme between N11 between Cornelscourt (junction with old Bray Road) to Kilbogget Junction (ch 9+800 to ch: 12+050) retains the existing pedestrian arrangement and new footpath is not proposed, as it was considered a non-desired pedestrian link based on the pedestrian movement along this stretch and is aligned with the local development plans. Alternative walking routes exist on adjacent quieter roads.

- Along this section N11 National Road where the Proposed Scheme makes use of the existing bus and general traffic infrastructure, the preferred width of traffic lanes adopted is 3.5m or as per existing lane width as noted in **Table 4-4**.

- Where the existing road geometry does not meet the design standards, this has been highlighted within **Section 4.16** Relaxations, Departures and Deviations from Standard.

The existing junctions along the N11 section have been designed to provide safety for pedestrian and cyclists, while giving priority to buses and coaches. The existing left turn slip lanes have been removed and junctions have been design as described in **Chapter 5 Junction Layout**. Junctions have been designed to primarily provide for Two stage crossing in single crossing with 4m refuge island where space allows as noted in Table 4.1. Few existing toucan crossings along the N11 section have been retained to the current two stage staggered crossing, to minimise large scale changes to the existing infrastructure.

Table 4-4 Proposed Scheme Nominal Cross-Section Widths

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
Leeson Street Lower									
CH. A20 to CH. A50	2.6 min	2.0	3.25	N/A*	N/A*	3.0	2.0	2.6 min	*Bus Lane only.
CH. A50 to CH. A170	2.2 min	2.0	N/A**	3.25	3.25 min	N/A**	1.75 min*	2.3 min***	*Road markings to show cycle lane between CH A55 and CH. A90 . **Combined Bus Lane / Traffic Lane due to bus gate ***CH A60 2m section with 1.5m width
CH. A170 to CH. A230	2.4 min	2.0	N/A*	3.00 min	3.5 min**	N/A*	1.5 min***	2.25 min	*Combined Bus Lane / Traffic Lane due to bus gate **Lane width tapers temporarily to introduce Bus Stop after Hatch Street Lower Junction. ***Cycle track reduced to 1.5m on approach to bus stop.
CH. A250 to CH. A450	2.0 min	1.5 min*	3.0	3.0**	3.0	3.0	1.5 min*	1.8-2.3***	*Cycle Track ties in to existing. **Lane width tapers to introduce Bus Lane after Hatch Street Lower Junction. ***Local narrowing behind bus stops to 1.8m

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A490 to CH 515	3.15	2.0	N/A*	3.4 min	2x 3.0**	3.0	2.0	2.0***	*Combined Bus Lane / Traffic Lane with signal-controlled priority. **Tapers to introduce 3.0m Bus Lane after Adelaide Road. Tapers to provide 3.0m right turn Traffic Lane on approach to Fitzwilliam Place. ***Footpath is part of wider pedestrian island separating inbound and outbound Adelaide Road Traffic Lanes.
CH. A535 to CH. A560	2.0 min	2.0	N/A*	3.4	1x 3.25, 1x3.0	N/A*	2.0	1.5 min**	*Combined Bus Lane / Traffic Lane with signal-controlled priority. **Footpath narrows locally to 1.5m at pinch point on Leeson Street canal bridge. Ties in to existing.
Sussex Road									
CH. B10 to CH. B75	2.0 min	1.5*	3.2 min	3.2 min**	N/A	N/A	N/A	N/A	* Cycle Track narrows over 60m behind combined bus stop and coach stop. ** Lane width tapers to introduce bus lane after Mespil Road Junction. Centre road marking tapers to provide kerbed pedestrian crossing island.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. B75 to CH. B115	2.2 min	2.0	3.65 min*	3.4 min**	N/A	N/A	N/A	3.7 min	*Tapers to provide with-flow lane separation road markings, kerbed traffic signals station. **2m Loading Bay provision between traffic lane and Westbound footpath.
CH. B125 to CH. B280	3.0 min*	2.0	3.0	3.0**	N/A	N/A	N/A	3.25 min	*3.0m taxi rank pick up and drop off between footpath and cycle track. **2.1m on-road parking provided between Traffic Lane and Inbound footpath.
CH. B280 to CH. B400	3.4 min	2.0	3.0*	2x 3.0m**	N/A	N/A	N/A	3.25 min	*Lane width tapers temporarily to provide 2.5m for coach stop area. **Lane width tapers to provide 3m right turn lane. 2.1m on-road parking provided between right turn Traffic Lane and Footpath.
Leeson Street Upper									
CH. A580 to CH. A640	N/A	N/A	N/A	N/A	2x 3.0*	3.0	2.0m	2.9 min	*Centre road marking tapers to provide kerbed pedestrian crossing island. Lane width tapers to provide left turn Traffic Lane on approach to Grand Parade Junction.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A640 to CH. A660	N/A	N/A	N/A	N/A*	3.0*	3.0 min	1.5 min**	3.3 min	*Right turn lane turns onto Sussex Road. Lane separation with kerbed pedestrian crossing island. **Cycle Track narrows locally behind bus stops. Right turn cycle lane markings provided on-road onto Sussex Road.
CH. A660 to CH. A690	2.5*	N/A	N/A	N/A	2x 3.0*	3.0**	1.5m***	3.0	*Lane width tapers to provide right turn lane after Dartmouth Road junction. ** Lane width tapers to introduce Bus Lane after Dartmouth Road. ***Cycle Track narrows locally behind bus stops.
CH. A720 to CH. A925	3.8 min	N/A	N/A	N/A	3.0*	3.0	2.0 min	3.0 min	*2.4m on-road parking provided between right turn traffic lane and footpath.
CH A925 to CH A1015	4.4 min*	N/A	N/A	N/A	3.0	3.0	2.0**	2.25 min	*Tapers around Sussex Road. Pedestrian crossing island between intersection of Sussex Road and Leeson Street Upper. **Includes right turn pocket.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A1015 to CH. A1050	3.0	1.5 min*	3.0	3.0**	3.0	3.0	2.0*	2.3 min	*Cycle track narrows to avoid existing trees and heritage features. **Lane width tapering to introduce bus lane after junction.
CH A1050 to CH. A1115	2.4 min	2.0	3.0	2x 3.0*	3.0	3.0	2.0	2.0 min	*Traffic Lane tapers to introduce right turn lane on approach to Appian Way.
CH. A1140 to CH. A1230	2.0 min	2.0	3.0	3.0*	3.0	3.0	2.0	2.5 min	*Lane width tapering to introduce bus lane after junction.
CH. A1250 to CH. A1300	2.0 min	2.0	3.0	3.0*	2x 3.0**	3.0	2.0	3.3	*Traffic Lane tapers to provide Bus Lane after Appian Way. ** Lane width tapers to introduce right turn lane after Wellington Place junction.
Morehampton Road									
CH. A1320 to CH. A1350	3.0 min	2.0	N/A	4.5*	3.0	3.0	2.0	2.5 min	* Combined Bus Lane / Traffic Lane with signal-controlled priority.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A1350 to CH. A1440	2.0 min	2.0	3.0	3.0*	3.0	3.0	2.0	2.5 min	*Traffic Lane tapers to introduce bus lane after Wellington Place junction.
CH. A1475 to CH. A1525	2.0 min	2.0 min	3.0	3.0	3.0	3.0*	2.0**	2.0 min	*2.1m parking bay provided between Bus Lane and Cycle Track Inbound. **0.75m kerb behind parking bay.
CH. A1525 to CH. A1640	2.0	2.0	3.0	3.0	3.0	3.0	2.0	2.0 min	
CH. A1640 to CH. A1700	2.0	1.5 min*	3.0	3.0	3.0	3.0	1.5 min**	3.75 min	*Cycle Track narrows locally over 30m to tie into existing kerbs. **Cycle Track narrows locally over 40m across Morehampton Terrace junction.
CH. A1730 to CH. A1790	2.5	1.5 min*	3.0	3.0	3.0	3.0**	1.5 min*	1.2 min***	*Cycle track narrows to 1.5m to tie into existing kerbs. **2m loading bay provided within Footpath. ***Footpath narrows temporarily around loading bay

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A1790 to CH. A1840	2.8 min	2.0	3.0	3.0	3.0	3.0	1.5 min*	1.8 min**	* Cycle track narrows to 1.5m to tie into existing kerbs. **Footpath narrows to 1.8m over a length of 50m due to space constraints
CH. A1840 to CH. A1940	2.0 min	1.5 min*	3.0	3.0	3.0	3.0	2.0	2.0 min	*Cycle track narrows to 1.5m to tie into existing kerbs.
CH. A1940 to CH. A2000	2.0 min	1.5 min*	3.0	2x 3.0**	3.0***	3.0	1.5 min****	1.3 min*****	*Cycletrack narrows to 1.5m over a length of 40m outbound to tie into existing kerbs. **Traffic Lane tapers to provide right turn lane on approach to Victoria Avenue Junction. ***Traffic Lane tapers to introduce Bus Lane after Victoria Avenue Junction. ****Cycletrack narrows to 1.5m over a length of 90m Inbound on the approach to bus stop to reduce cyclist speed. *****2.85m loading bay provided within Footpath. Footpath narrows locally at loading bay to 1.3m.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A2020 to CH. A2055	2.25 min	1.5 min*	3.0	3.0**	3.0	3.0***	2.0	2.2 min	*Approach to Bus Stop. **Traffic Lane tapers to introduce bus lane after Victoria Avenue Junction. ***2m loading bay and Angled Parking Bays with, 0.75m kerb separation, provided between Bus Lane and Cycle Track.
CH. A2055 to CH. A2115	2.5 min	1.75 min*	3.0**	3.0	3.0**	3.0***	1.5 min****	2.0 min	*Cycle track reduced locally to avoid existing trees. **2.1m Parallel Parking Bay and 1m kerb separation provided between Cycle Track and Bus Lane. **Traffic Lane tapers to provide Bus Lane after Victoria Avenue Junction. ***Angled Parking Bays and 0.75m kerb separation provided between Parking Bays and Cycle Track. **** Cycle track reduced to 1.5m to reduce speed adjacent to parking bays.
Donnybrook Road									
CH. A2115 to CH. A2310	1.5 min*	1.5 min **	3.0	3.0	3.0***	N/A	1.5 min **	1.5 min*	*Footpath narrows locally at a number of pinch points. ** Cycletrack narrows to 1.5m over a length of 135m SB and 60m NB to tie into existing kerbs. *** Combined Bus Lane / Traffic Lane with signal-controlled priority.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A2310 to CH. A2360	3.25	1.5 min*	3.0	3.0	3.0	3.0**	2.0	2.4 min	*Cycle Track narrows locally to avoid existing tree. ***Bus Lane ends and tapers back into traffic lane at Bus Gate.
CH. A2360 to CH. A2460	2.5 min	2.0	3.0	3.0	3.0	3.0	1.5*	2.0	*Local narrowing to 1.5m to tie in to existing in front of petrol station.
CH. A2460 to CH. A2520	2.5 min	2.0	3.0	3.0	3.0	2x 3.0*	1.5**	2.0 min	*Traffic Lane tapers to provide Bus Lane and offline Bus Stops after Eglington Road. ** Cycle track narrow locally behind combined bus stops.
CH. A2520 to CH. A2580	1.5 min*	2.0	3.0	2x 3.0**	3.0	3.0	1.7 min***	2.8 min	*Footpath narrows locally at pinch point on Anglesea Bridge. **Traffic lane tapers to provide Left Turn/Straight lane on approach to Beaver Row junction. ***Cycle track tapers from reduced with through junction.
Stillorgan Road									
CH. A2630 to CH. A2650	2.0	2.0	3.0	2x 3.0*	2x 3.0	3.0	1.6 min**	1.75 min**	*Traffic Lane tapers to provide Bus Lane after Anglesea Road Junction. **Cycle track and Foopath narrow locally at pinchpoint

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A2650 to CH. A3070	2.0 min	2.0	3.0	2x 3.0**	2x 3.0	3.0	2.0	2.0 min	**Start of grassed median separating contra-flow traffic provided for Stillorgan Road Dual Carriageway.1.35m grassed median to match existing.
CH A.3070 to CH. A3190	2.0 min	2.0	3.0	3x 3.0*	2x 3.25	3.25**	2.0***	2.0 min	*Traffic Lane tapers to provide right turn lane on approach to Airfield Park Junction. Grassed median separating contra-flow traffic provided. ** Bus Lane width as existing ***3m set down area provided between Cycle Track and Footpath alongside The Teresian School.
CH. A3220 to CH. A3315	2.0 min	2.0	3.25*	2x 3.25	2x 3.0**, 1x 3.3	3.25*	2.0	1.2 min***	*Bus lane width as existing. **Traffic Lane tapers to provide right turn on approach to Airfield Junction. ***Local narrowing to 1.8m at existing footbridge crossing, 1.2m at local pinch point to avoid impacting tree, 2.0 minimum otherwise.
CH. A3315 to CH. A3365	2.5 min	2.0	3.5*	2x 3.25**	2x 3.25**	3.25*	2.0	1.8 min***	*Bus lane width as existing **Traffic Lanes as existing ***Local narrowing to 1.8m at pinch point to avoid impacting tree

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH A.3365 to CH. A3450	3.0 min	2.0	3.25*	3x 3.0**	2x 3.25	3.25*	2.0	2.5 min	*Bus Lane width as existing **Traffic Lane tapers to provide right turn lane on approach to Greenfield Park Junction.
CH. A3480 to A3720	2.0 min	2.0	3.0-3.25*	2x 3.0-3.25**	3x 3.0	3.0	1.5-2.0***	1.5 min****	*Bus lane width as existing. **Traffic Lane widths as existing. to provide keep left lane onto Nutley Park. Grassed median narrows to 0.75m over 45m to match existing. ***Local narrowing to 1.5m in front of residential properties to provide adequate Footpath. ****Local pinch point of 1.5m in front of number 141 Stillorgan Road.
Stillorgan Road – Main Road									
CH. A3720 to CH. A4370	N/A*	N/A	3.5**	1x 3.75, 1x 3.5	1x 3.0, 2x 3.0-3.5***	N/A	N/A	N/A	*Pedestrian and Cycle facilities taper off Main Road onto Slip Road. **Tapers to reintroduce Bus Lane between slip road entrance and exit. Bus Lane width as existing. ***3.5m traffic lanes taper to 3.0m in order to provide 3.0m right turn lane.
Stillorgan Road – Eastern/Outbound Slip Road									

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A3720 to CH. A4060	N/A – 2.0*	2.0	3.25**	3.5**	N/A	N/A	N/A	N/A	*Footpath introduced at Bus Stops. **Bus Lane and Traffic Lane widths as existing
CH. A4075 to CH. A4500	2.7 min*	2.0 – 3.25**	3.25****	3.5***	N/A	N/A	N/A	N/A	*Terminates at the end of pedestrian landing zone with pedestrian movements shifted to side road via pedestrian crossings. **Offline section of one-way and two-way cycle track before returning alongside Bus Lane after bus stop. ***Tapers to merge into Stillorgan main road Traffic Lane. ****Bus lane width as existing
Stillorgan Road – Western/Inbound Slip Road									
CH. A3780 to CH. A3940	N/A	N/A	N/A	N/A	3.5*	3.0	2.0	2.0	*Tapers to merge into Stillorgan main road Traffic Lane.
CH. A3940 to CH. A4060	N/A	N/A	N/A	N/A	3.75*	3.5**	2.0***	N/A	*Traffic Lane width as existing. **Bus Lane runs behind Cycle Track. ***0.5m kerb protection on either side of Cycle Track.
CH. A4090 to CH. A4420	N/A	N/A	N/A	N/A	3.0	3.0	2.0	2.0	
UCD Interchange									

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A3880 to CH. A4075	2.0 min*	N/A	3.5***	N/A	N/A	3.25***	N/A	Varies**	*Footpath widens around Interchange to provide for heavy footfall and to tie-in to UCD masterplan proposals. **Paved islands provided at bus and coach stops. ***Bus lane width as existing
Belfield Flyover Junction									
CH. F15 to CH. F70	3.0*	3.0**	3.0	3.0	3.0	3.0	N/A	3.0	*Footpath begins and ends in shared space with Cycle Track on either side of the flyover. **Two-way Cycle Track. 1m kerb protection between Cycle Track and Bus Lane.
Stillorgan Road – Main Road									
CH. A4370 to CH. A4500	N/A	N/A	N/A*	2x 3.5*	2x 3.5**	3.5***	2.0***	2.5 min****	*Stillorgan Eastern Slip Road merging into main line Traffic Lane. **Tapers to provide Traffic Lane onto Stillorgan Western Slip Road. ***Bus lane width as existing **** Pedestrian and Cycle facilities taper off Main Road onto Slip Road
CH. A4500 to CH. A4750	N/A*	2.0	3.5**	2x3.5***	2x3.5	3.5**	2.0	2.0 min	*Footpath facilities on existing side road. ** Bus lane width as existing ***Tapers to provide right turn lane on approach to Fosters Avenue Junction.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A4750 to CH. A4800	N/A	2.0	3.5*	2x 3.5, 1x 3.2***	2x3.5	3.5*	3.6**	2.3	*Bus lane width as existing **Two-way Cycle Track. 0.5m kerb separation provided between Cycle Track and Bus Lane. ***Tapers to provide right turn lane width 3.2m on approach to Fosters Avenue Junction
CH. A4800 to CH. A4930	2.0*	3.25**	3.5*****	2x 3.4, 1x 3.2	2x 3.5***	3.5*****	3.6****	2.3 min	*Tapers from Stillorgan Road side road. **Two-way Cycle Track. ***1.5m Grassed median separating contra-flow traffic provided. Tapers to provide Bus Lane after Foster's Avenue Junction. ****Two-way Cycle Track. 0.5m kerb separation provided between Cycle Track and Bus Lane. ***** Bus lane width as existing
CH. A4975 to CH. A5050	2.0 min	3.25*	3.0	3x 3.0**	3x 3.0***	3.0	1.8****	2.0	*Two-way Cycle Track. Grassed median separating Cycle Track and Bus Lane. **Tapers to provide right turn lane after Fosters Avenue Junction. ***Tapers to provide left turn lane behind Bus Lane. ****Cycletrack narrows to 1.8m to restrict landtake

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A5050 to CH. A5100	3.0 min	3.25*	3.0	3x 3.0	2x3.0	3.0	2.0	2.0	*Two-way Cycle Track. Grassed median separating Cycle Track and Bus Lane.
CH. A5125 to CH. A 5235	1x 1.2 min, 1x 2.0 min*	2.0**	3.0	2x 3.25 min***	3x 3.25****	3.0	2.0*****	2.0	*Existing footpath widths retained around existing footbridge crossing. **Additional 3m two-way cycle track route provided tying into Colaiste Eoin / Íosagáin from Merrion Grove junction. ***Tapers to provide Bus Lane after Merrion Grove Junction. ****Tapers to provide Right Turn lane on approach to Merrion Grove Junction. *****Grassed kerb separation provided between Cycle Track and Bus Lane.
CH. A5245 to CH. A5375	2.0 min*	2.0	3.5 **	2x 3.5	2x 3.5	3.7**	2.0	2.2 min	*2m grassed verge provided between Footpath and Cycle Track. **Bus Lane width as existing.
CH. A5375 to CH. A5465	3.0*	2.0	3.3 **	3x 3.5***	2x 3.6	3.6**	2.0	2.3 min	*2m grassed verge provided between Footpath and Cycle Track **Bus Lane width as existing. ***Tapers to provide U-turn lane on approach to Booterstown Avenue Junction.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A5050 to CH. A5565	2.0 min	2.0	3.65 *	2x 3.25**	3x 3.25***	3	2.0	2.3****	*Bus Lane width as existing. **Tapers to provide Bus Lane after Booterstown Avenue Junction. ***Tapers to provide right turn lane on approach to Booterstown Avenue Junction. ****Grassed verge between driveways provided.
CH. A5565 to CH. A5720	2.0 min	1.5*	3.5**	2x 3.5	2x 3.65	3.0	2.0*	1.6 min***	*Local narrowing to 1.5m to match existing. **Bus Lane width as existing. ***Local narrowing to 1.6m to match existing so as not to impact on residential properties.
CH. A5720 to CH. A5780	2.0	2.0	3.25*	3x 3.25**	2x 3.0	3.0	1.5-2.0***	1.5-2.0***	*Bus Lane width as per existing. **Tapers to provide U-turn lane on approach to Mount Merrion Junction. ***Reduced to 1.5m to match existing at local pinch point.
N11 Stillorgan Road									

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A5810 to CH. A5900	2.0 min	2.0	3.0	2x 3.2-3.5*	3x 3.0***	3.0	2.0	2.0	*Tapers to provide Bus Lane after Mount Merrion Avenue Junction. Traffic Lane width as per existing. **Tapers to provide right turn lane on approach to Mount Merrion Avenue Junction. Traffic lane width reduced to 3.0m min at approach to junction
CH. A5900 to CH. A6000	2.0 min	1.5*	3.0	2x 3.5	2x 3.5	3.0	2.0	2.0	*Narrowing to 1.5m over 150m to match existing.
CH. A6000 to CH. A6100	2	1.5-2.0*	3.0	3x 3.5**	2x 3.5***	3.1	2.0*	2.0	*Narrowing to 1.5m over 50m to match existing. **Tapers to provide 3.25m right turn lane on approach to Trees Road Lower Junction. ***Tapers to provide Bus Lane after Trees Road Lower Junction.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A6120 to CH. A6220	2.1*	2.0	3.25**	3x 3.5***	1x 3.3, 2x 3.0-3.5****	3.25**	2.0	2.0*	*Grassed verge provided with Footpath and Cycle Track. **Bus Lane width as existing. ***Tapers to provide 3.0m right turn lane on approach to Priory Drive Junction. ****Traffic lane widths reduced from 3.5m to 3.0m min on approach to junction to provide right turn lane at Trees Road Lower Junction.
CH. A6275 to CH. A6360	2.0	2.0	3.0	2x 3.65*	1x 3.0, 2x 3.25**	3.0	2.0*	2.0	*Tapers to provide Bus Lane after Priory Drive Junction. Bus Lane width to match existing. **Traffic lane widths reduced to 3.25m and 3.0m min right turn lane on approach to Priory Drive Junction.
CH. A6360 to CH. A6710	2.0	2.0	3.0	2x 3.65*	2x 3.65*	3.0	1.5 min**	1.8 min***	*Traffic Lane widths to match existing. **Narrows to 1.5m over 50m on approach to Bus Stop to retain footpath width. ***Narrows locally behind Bus Stop.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A6710 to CH. A6800	2.0 min	2.0	3.0	1x 3.0, 2x 3.5*	2x 3.65**	3.0	2.0	2.0	*Tapers to provide 3.0m right turn lane on approach to Lower Kilmacud Road Junction. **Traffic Lane width to match existing.
CH. A6830 to CH. A6930	2.0 min	1.7 min*	3.0	2x 3.65	1x 3.0, 2 3.5**	3.0	2.0	2.0	*Narrows to 1.7m from Lower Kilmacud Road Junction to match existing and retain footpath width. **Tapers to provide 3.0m right turn lane on approach to Lower Kilmacud Road Junction.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A6930 to CH. A7480	2.0	1.5 min*	3.0-3.25****	2x 3.5	2x 3.0*****	3.0	1.5 min**	1.8-2.0***	*Cycle track matches existing 1.5m width for length of 120m stretch. Grass verge separation between Cycle Track and Bus Lane provided in front of St John of God Hospital. **Cycle track matches existing 1.5m for length of 50m stretch. Cycle Track tapers behind grassed verge along length of Saint Brigid's Church Road. ***1.8m footpath follows existing. Footpath ends at the introduction of Saint Brigid's Church Road and resumes behind verge at the conclusion of Saint Brigid's Church Road design. ****Bus Lane width as existing. *****Traffic lane widths reduced to 3.0m over 400m as per existing, to maintain footpath and cycle track widths.
Saint Brigid's Church Road									
CH. A7155 to CH. A7172	1.6*	N/A	N/A	3.0	2.5	N/A	N/A	1.6*	*Narrows to 1.4m to tie-in to existing.
CH. A7172 to CH. A7192	2.5 min	N/A	N/A	4.25*	N/A*	N/A	N/A	2	*Narrows to one traffic lane for both directions of traffic.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A7192 to CH. A7320	N/A	N/A*	N/A	3.0	3.0**	N/A	N/A	1.2 min***	*0.5m buffer between traffic lane and contra-flow cycle track on N11. **2.1m parking bays and 3.6m disabled parking bays provided between traffic lane and footpath. ***Footpath narrows locally from 2.0m to 1.2m for a distance of 1.4m due to local pinch point.
N11 Stillorgan Road									
CH. A7480 to CH. A7600	3.25 min	2.0*	3.0 **	3x 3.0-3.5*	2x 3.0**	3.0	2.0*	2.0	*As per existing, traffic lanes taper from 3.5m to 3.0m min to provide 3.0m right turn lane on approach to Farmleigh Avenue Junction. **As per existing, 1m Paved median separating contra-flow traffic provided. Tapers to provide Bus Lane after Farmleigh Avenue Junction. Traffic lane widths as per existing.
CH. A7645 to CH. A7760	1.5 min*	2.0	3.0	2x 4.0**	3x 3.0***	3.0	2.0	2.0 min	*Footpath narrows over 15m due to existing boundary. **Tapers to provide Bus Lane after Farmleigh Avenue Junction. *** Traffic lane width reduced to 3.0m min at approach to junction which includes right turning lane.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A7760 to CH. A7955	2.0 min*	2.0**	3.0	2x 3.6	2x 3.65***	3.0	2.0**	2.0 min	*Tapers behind grassed verge on approach to Beechwood Court. **Includes 0.25m kerb. ***Grassed median separating contra-flow traffic provided.
CH. A7955 to CH. A8145	N/A*	N/A*	3.0	2x 3.65	2x 3.65	3.0	2.0***	2.0 min – N/A**	*Footpath and cycle track carries onto Belmont Terrace. ** Ties into existing offline footpath
Belmont Terrace									
CH. A 7955 to CH. A8145	1.8 min*	2.0	N/A	3.0 min**	N/A	N/A	N/A	N/A	*Narrows locally to avoid impacting properties **Local narrowing in advance of pedestrian crossing. 2.1m Parking and Loading Bays running along the north side of the Traffic Lane between pedestrian crossing and Belmont Green. 2.4m parking running along the south side of the Traffic Lane.
N11 Stillorgan Road – Main Road									
CH. A8145 to CH. A8225	2.0 min	2.0	3.0	2x 3.5	2x 3.65	3.0	2.0	2.0 min*	*Ties into offline footpath/.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A8225 to CH. A8315	2.0 min	2.0	3.0	4x 3.0*	2x 3.5	3.0	1.5-2.0**	2.0 min	*Dedicated left turn lane developed between Bus Lane and Cycle Track. Traffic Lane tapers to right turn lane in advance of Leopardstown Road Junction. Traffic lane width reduced to 3.0m min at approach to junction for all traffic lanes. **Local narrowing to 1.5m after Leopardstown Road Junction and behind adjacent Bus Stops.
CH. A8355 to CH. A8455	2.0 min	1.5 min*	3.0	2x 3.7**	4x 3.0***	3.0*	2.0	2.0 min	* Cycle Track narrows between Bus Stops. **Tapers to provide Bus Lane after Leopardstown Road Junction. ***Dedicated left turn lane developed between Bus Lane and Cycle Track. Carriageway tapers to right turn lane in advance of Leopardstown Road Junction. Traffic lane width reduced to 3.0m min at approach to junction for all traffic lanes.
CH. A8455 to CH. A8965	2.0 min*	2.0	3.0	2x 3.7	2x 3.5	3.0	2.0	2.0 min	*Grassed verge separation provided between driveways.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A8965 to CH. A9075	2.0 min	2.0	3.0	3x 3.25*	2x 3.5	3.0	2.0	2.2 min	*Tapers to right turn lane in advance of Springfield Park. Traffic lane width reduced to 3.25 min at approach to junction for all traffic lanes.
CH. A9110 to CH. A9150	2.0	1.5 min*	3.0	2x 3.65	3x 3.0***	3.0	2.0	2.0	*Narrows to 1.5m to allow for full Footpath width. ** Tapers to provide U-turn lane in advance of Springfield Park. Traffic lane width reduced to 3.0 min at approach to junction for all traffic lanes.
CH. A9150 to CH. A9240	2.0*	1.5 min**	3.25***	2x 3.5	2x 3.5,	3.25***	2.0	2.0	*Footpath ties into existing footbridge. **Narrows to 1.5m to allow for full Footpath width. ***Bus lane width as per existing
CH. A9240 to CH. A9275	4.0 min	2.0	3.0**	3x 3.25*	2x 3.6	3.25**	1.5 min***	2.0	*Traffic Lane tapers to U-turn lane in advance of Kill Lane Junction. Traffic lane width reduced to 3.25 min at approach to junction for all traffic lanes. **Bus lane width as per existing ***Cycle Track narrows locally on approach to Bus Stop.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A9320 to CH. A9390	2.25 min	2.0	3.0	1x 3.5, 1x 3.75	3x 3.3*	3.0	2.0	2.0	*Tapers to right turn in advance of Kill Lane Junction. Traffic lane reduced to 3.3 at approach to junction
CH. A9390 to CH. A9475	3.5-4.0	2.0	3.0	3x3.0*	2x 3.6	3.0	2.0	2.0-3.0	*Traffic Lane tapers to right turn in advance of Westminster Road.
CH. A9510 to CH. A9745	2.0*	2.0	3.25***	2x 3.6	2x 3.6	3.25***	2.0	2.0**	*Footpath tapers offline to Bray Road footpath behind bus stop. **Footpath tapers offline to Old Bray Road in front of tennis court. ***Bus Lane width as per existing

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A9745 to CH. A9840	N/A*	1.65-2.0**	3.25******	2x 3.5, , 1x 3.0***	2x 3.5****	3.25******	1.5-2.25**	1.5 min*****	*Footpath ties in from Bray Road. **Local narrowing of Cycle Track ties in to existing. ***Traffic Lane tapers to right turn in advance of Bray Road N11. Right turn lane reduced to min 3m at approach to junction. **** Tapers to provide Bus Lane after Bray Road N11 Junction. *****Footpath ends behind bus stop. Narrows locally behind Bus Stop shared landing. ******Bus Lane width as per existing
CH. A9880 to CH. A10500	N/A*	2.0	3.5**	2x 3.5	2x 3.5	3.25**	2.0	N/A***	*Footpath ends behind bus stop 35m after Bray Road junction. **Bus Lane width as per existing ***Retained existing road cross section.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A10500 to CH. A10570	N/A	1.6-2.0*	3.5**	2x 3.0, 1x 3.5***	2x3.5 – 4.0****	3.2**	2.0	N/A	*Local narrowing of Cycle Track ties in to existing. ** Bus Lane width as per existing ***Taper to provide right turn Traffic Lane on approach to Clonkeen Road Junction. Traffic Lanes narrow to 3.0m on approach to junction. ****1.5m Paved median separating contra-flow traffic provided on approach to junction.
Bray Road N11									
CH. A10500 to CH. A10570	N/A	1.6-2.0*	3.5**	3x3.5***	2x 3.5	3.2	2	N/A	*Local narrowing of Cycle Track ties in to existing. **Lane width tapers to provide with-flow lane separation between Traffic Lane and Bus Lane on approach to Clonkeen Road Junction. Bus Lane width as per existing. ***Lane width tapers to provide with-flow lane separation between straight ahead Traffic Lane and right turn Traffic Lane on approach to Clonkeen Road Junction.
Bray Road N11									

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A10620 to CH. A10700	2.0	1.5*	3.25*****	2x 3.75	3x 3.3**,*****	3.3*** & 3.3 ****	2.0*	2.0	*Cycle Track narrows locally behind bus stop pedestrian landing zone **Grassed median separating contra-flow traffic provided. Lane width tapers to provide right turn Traffic Lane on approach to Clonkeen Road Junction. ***Lane width tapers to provide with-flow lane separation between Traffic Lane and Bus Lane on approach to Clonkeen Road Junction. ****Bus Lane width as per existing *****Lane width narrows on approach to Clonkeen Road Junction.
CH. A10700 to CH. A11250	N/A	2.0-2.3	3.25**	2x 3.6	2x 3.6*	3.25**	2.0-2.3	N/A	*Grassed median separating contra-flow traffic provided. **Bus Lane width as per existing
CH. A11250 to CH. A11350	2.0 min	2.0-2.3	3.25**	2x 3.6	2x 3.6*	3.25**	2.0-2.2	2.0 min	*Grassed median separating contra-flow traffic provided. **Bus Lane width as per existing

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A11400 to CH. A11550	1.85 min	2.0-2.25	3.25***	1x 3.5, 1x 3.5	2x 3.25, 1x 3.6*	3.0**	2.0	N/A	*Grassed median separating contra-flow traffic provided. Median tapers to right turn in advance of Johnstown Road Junction. Straight through traffic lane reduced to 3.25 at approach to junction to provide 3.25m right hand turn lane onto Johnstown Road **Lane width tapers to provide with-flow lane separation between Traffic Lane and Bus Lane on approach to Johnstown Road Junction. ***Bus Lane width as per existing
CH. A11550 to CH. A11995	N/A	2.0-2.3	3.0-3.25**	2x 3.5 min	2x 3.5*	3.25**	2.0 min	N/A***	*Grassed median separating contra-flow traffic provided. **Bus Lane width as per existing ***Existing road cross section retained.
CH. A11995 to CH. A12080	N/A	2.0	3****	2x 3.65, 2x 3.0*	2x 3.65**	3.25****	2.0	3.0***	*Traffic Lane tapers to two right turns in advance of Orchard Square Junction. Right turning traffic lanes reduced to 3.0m at approach to junction. **Tapers to provide Bus Lane after Orchard Square Junction. ***Footpath to be constructed around the boundary of Circle K and tapers around Orchard Square. ****Bus Lane width as per existing

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A12120 to CH. A12190	2.5 min	2.0	3.25***	1x 3.5, 1x 3.8	4x 3.5*	3.25***	2.0**	2.25 min	*Grassed median separating contra-flow traffic provided. Median tapers to provide U-turn on approach to Orchard Square Junction. Lane width tapers to provide left turn Traffic Lane behind Bus Lane on approach to Orchard Square Junction. **Grassed verge provided between Cycle Track and Footpath. ***Bus Lane width as per existing
CH. A12190 to CH. A12630	2.35-3.0	2.25	3.25***	2x 3.5 min****	2x 3.5 min**,****	3.25***	2.3	2.0 min*	*Footpath tapers behind grassed verge at Shanganagh Vale, Sunnyhill Park. **Grassed median separating contra-flow traffic provided. ***Bus Lane width as per existing ****Traffic lane as existing
Garrison Mews									
CH. A12630 to CH. A12750	N/A	N/A	N/A	N/A	4.5*	N/A	N/A	2	*Grassed verge provided between Traffic Lane and adjacent Bray Road N11 Cycle Track.
Bray Road N11									

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A12630 to CH. A12750	2.0-2.65	2.25	3.25***	2x 3.5 min*,****	2x 3.5 min*,****	3.25***	2.25-2.4	N/A**	*Grassed median separating contra-flow traffic provided. **Footpath tapers along Garrison Mews. ***Bus Lane width as per existing ****Traffic lane as existing
CH. A12750 to CH. A12920	2.0 min	2.0	3.25****	1x 4.0, 1x 3.5, 1x 3.25*	2x 3.5**	3.25****	2.25	2.0***	*Includes 3.5m left slip road developed over length of Traffic Lanes. **Grassed median separating contra-flow traffic provided. ***Grassed verge provided between Cycle Track and Footpath. ****Bus Lane width as per existing
CH. A12920 to CH. A13090	N/A	N/A	N/A	1x 4.0, 1x 3.5	2x 3.6*	3.3	2.0**	2.0***	*Tapers to provide Bus Lane after Wyattville Road Junction. **0.85m grassed median provided between Bus Lane and Cycle Track. ***Cycle Track and Footpath taper around Bray Road N11 onto Wyattville Road.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A13090 to CH. A13650	N/A	N/A	N/A	1x 4.0, 1x 3.5	1x 5.0, 2x 3.65*	3.25	N/A	N/A	*Grassed median separating contra-flow traffic provided. Includes 5.0m left slip road developed over length of Traffic Lanes.
Wyattville East Slip Road									
CH. A12920 to CH. A13145	2.0 min	2.0	3.5*	3.5	N/A	N/A	N/A	N/A	*Bus Lane width as per existing
CH. A13145 to CH. A13195	2.5 min	3.0	N/A*	1x 3.0, 2x 3.5	N/A	N/A	N/A	N/A	*Shared Bus Lane and Traffic Lane.
CH. A13225 to CH. A13650	1.85min	2.0-2.5*	3.0-3.5***	4.0**	N/A	N/A	N/A	N/A	*1m kerb separation provided between Cycle Track and Bus Lane. **Lane width tapers to join Bray Road N11 Traffic Lanes. ***Bus Lane width as per existing
Wyattville West Slip Road									

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A13100 to CH. A13330	N/A	N/A	N/A	N/A	6.0*	N/A	3.0**	1.6 min***	*Lane tapers from Bray Road N11 Traffic Lane. **Two-way Cycle Track with 1.2m minimum grassed verge provided between Cycle Track and Traffic Lane. ***Footpath narrows to a minimum 1.6m for approx. 50m along the Wyattville West Slip Road to match existing.
Wyattville Link Road									
Entire Length	2	2.0*	N/A	3x 3.0	1x 4.0 2x 3.5**	N/A	2.0	2	*0.25m kerb develops into 2m kerb separation between Cycle Track and Traffic Lane. **1m minimum Paved median separating contra-flow traffic provided.
Bray Road									
CH. A13330 to CH. A13450	N/A	N/A	N/A	2.7*	2.7*	N/A	N/A	2	*Quiet street treatment, matching existing.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A13485 to CH. A13755	N/A	N/A	N/A	N/A*	4.75 min*	N/A	N/A	1.6 min**	*Two-way Traffic Lane to one-way Bray Road N11 slip road. Grassed verge provided between Traffic Lane and Bray Road N11 Bus Lane. Quiet street treatment for cyclists in northbound direction. **Footpath narrows to a minimum 1.6m to match existing on approach to the Cherrywood road.
CH. A13755 to CH. A13790	N/A	N/A	N/A	N/A	3.3*	N/A	1.4**	2.0 min	*Verge provided between Traffic Lane and Bray Road N11 Bus Lane. **Cycle track narrows locally over a length of 40m to 1.4m before joining the combined Traffic Lane / Cycle Lane.
Bray Road N11									
CH. A13650 to CH. A13790	2	2.5*	3.25***	2x 3.65	2x 3.65**	3.25***	N/A	N/A	*1m grassed verge provided between Cycle Track and Bus Lane. **Grassed median separating contra-flow traffic provided. ***Bus Lane width as per existing

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A13790 to CH. A13950	2.0 min	2.0-2.5*	3.25****	2x 3.5	2x 3.5**	3.25****	2.0***	2	*Kerb separation provided between Cycle Track and Bus Lane. **Grassed median separating contra-flow traffic provided. ***Grassed separation provided between Cycle Track and Bus lane. ****Bus Lane width as per existing
CH. A13950 to CH. A14025	2	2.5*	3.3****	2x 3.5**	2x 3.7***	N/A	2.0*	2	*Grassed verge separation provided between Cycle Track and Bus Lane. **Lane tapers on approach to roundabout to provide separation between Bus Lane around roundabout. ***Grassed median separating contra-flow traffic provided. ****Bus Lane width as per existing
Dublin Road									
CH. A14115 to CH. A14180	2.0 min	2.5*	3.0-4.0****	3.0-4.0	3.50-4.0**	3.0-4.0***,****	N/A	N/A	*Two-way Cycle Track. Grassed verge separation provided between Cycle Track and Bus Lane. Ends at toucan crossing to join main line. **Grassed median separating contra-flow traffic provided. ***Lane Tapers to provide road marking separation between Traffic Lanes. ****Bus Lane width as per existing

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A14180 to CH. A14640	1.6-3.15*	N/A	3.0	3.0	3.0**	3.0	N/A	2.0***	*Local narrowing to 1.6m to match existing Footpath. **Traffic Lane tapers to provide Bus Lane after Rathmichael Woods Road. ***2m Footpath narrows to 0.6m kerb separation from Bus Lane after Kentfield pedestrian crossing.
CH. A14640 to CH. A14780	1.8 min	N/A	3.0	3.0	3.0*	N/A	N/A	1.8	*Taper to provide contra-flow lane separation between Traffic Lane and Bus Lane on approach to Stonebridge Road Junction.
Stonebridge Road									
CH. E20 to CH. E80	2	3.0*	N/A	2.8-3.2	2.5-3.2***	N/A	N/A	1.2 min**	*Two-way Cycle Track. Includes 0.25m kerb which expands to 1.3m kerb separation after Rathmichael National School entrance. **Footpath matches existing. ***Traffic lane narrows to 2.5 to match existing.
CH. E80 to CH. E205	2.0 min	2.5*	N/A	N/A	N/A	N/A	N/A	N/A	*Two-way Cycle Track. Grassed verge provided with 1.6m footpath at base of verge.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. E205 to CH. E260	3.5*	N/A	N/A	2.5-3.3	3.3	N/A	N/A	1.6-5.4**	*Footpath tapers around Stonebridge Lane. **Footpath contains 2.2m kerbed drop off bay adjacent to school. Footpath tapers to 1.6m on approach to Stonebridge Grove to tie-in to existing.
Dublin Road									
CH. A14810 to CH. A 15075	2	3.0	3.0*	3.0	3.0**	N/A	N/A	1.6***-2.0m	*Lane tapers to provide with-flow lane separation between Traffic Lane and Bus Lane on approach to Corbawn Lane Junction. **Lane tapers to provide contra-flow lane separation between Traffic Lanes on approach to Stonebridge Road Junction. ***Footpath narrows locally to 1.6m in front of Applegreen petrol station to match existing. Grassed verge separation provided between driveways between Station Road and Rivendall House.
Shanganagh Road									

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. G20 to CH. G100	2	N/A	N/A*	3.0*	2x 3.0**	N/A*	N/A	1.8-2.0***	*Combined Bus Lane / Traffic Lane with signal controlled priority. **Lane tapers to left and right turn Traffic Lanes after Beechfield Manor Junction. Combined Bus Lane and Traffic Lane. ***Footpath narrows locally to 1.8m to tie-in to existing back of Footpath.
CH. G100 to CH. G125	2	N/A	N/A*	1x 3.0, 1x 2.5*	3.0**	N/A**	N/A	1.8***	* Combined Bus Lane / Traffic Lane with signal controlled priority. Tapers to provide 2.5m right turn Traffic Lane on approach to Beechfield Manor Junction. ** Combined Bus Lane / Traffic Lane with signal controlled priority. ***Footpath narrows locally to 1.8m to tie-in to existing back of Footpath. Widens and tapers around Beechfield Manor.
CH. G160 to CH. G190	2	N/A	N/A*	3.75*	1x 3.5, 1x 3.3*	N/A*	N/A	2	* Combined Bus Lane / Traffic Lane with signal controlled priority.
Beechfield Manor									

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
Entire Length	1.8 min	N/A	N/A	4.3	1x 3.0, 1x3.5*	N/A*	N/A	2.0 min	* Combined Bus Lane / Traffic Lane with signal controlled priority. Lane Tapers to provide contra-flow lane separation road between Traffic Lanes on approach to Beechfield Manor Junction.
Corbawn Lane									
CH. H5 to CH. H45	2.2 min	N/A	N/A	N/A	3.0 *	N/A	3.0**	2.15 min***	*Road markings taper after Dorney Court pedestrian crossing to provide 3m Garda vehicle stopping bay alongside Traffic Lane. **Two-way Cycle Track. 0.4m kerb provided develops to grassed verge separating Traffic Lane and Cycle Track. ***Splits on approach to Stonebridge Road Junction to tie into pedestrian crossings at Dublin Road and Shanganagh Road.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. H45 to CH. H80	2.15	1.5*	N/A	2.7**	2.7**	N/A	1.2***	3.1-3.4	*Lane tapers to join Traffic Lane after pedestrian crossing. **Traffic Lane develops from one-way Traffic Lane to two-way after Beechfield Manor Estate. ***Cycle Track narrows to 1.2m to tie-in to combined traffic lane. Kerb separation provided between Cycle Track and Traffic Lane between Beechfield Manor Estate entrance and pedestrian crossing.
Dublin Road									

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A15115 to CH. A15160	2.5 min	2.0*	N/A**	2.1-3.0**	1x 3.2, 1x 3.0***	N/A***	N/A	2.8 min	*Cycle track develops from Stonebridge Junction shared space, tapers down from Footpath kerb to join Traffic Lane. **Shared Bus Lane and Traffic Lane. Local narrowing of Traffic Lane to allow for Cycle Track taper onto Dublin Road. ***Shared Bus Lane and Traffic Lane. Tapers to provide right turn lane on approach to Stonebridge Road Junction. Tapers to provide contra-flow lane separation between Traffic Lanes on approach to Stonebridge Road Junction.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A15160 to CH. A15800	1.8 min*	N/A	N/A***	3.0-3.5***	3.0-3.5***	N/A	N/A	1.6 min**	*Footpath narrows locally to 1.8m adjacent to Quinn's Road, tying into existing. **Footpath narrows locally before widening adjacent to Stonebridge Close ***Shared Bus Lane and Traffic Lane. 1.8 – 2.5m parking bays provided alongside Traffic Lanes between Lower Road and Stonebridge Close pedestrian crossings.
CH. A15800 to CH. A15865	1.8 min*	N/A	N/A**	2x 3.0**,***	3.0	N/A**	N/A	1.5-3.7****	*Grassed verge provided between Footpath and Traffic Lane. ** Combined Bus Lane / Traffic Lane with signal controlled priority. ***Tapers to provide contra-flow lane separation between Traffic Lanes to provide right turn lane on approach to Olcovar. ****Footpath narrows to 1.5m at entrance to Sherrington Lodge to tie-in to existing.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A15890 to CH. A15925	2.5 min	N/A	N/A*	3.0*	3.0**	3.0***	N/A	2	* Combined Bus Lane / Traffic Lane with signal controlled priority. **Lane tapers to provide contra-flow lane separation between Traffic Lanes on approach to Olcovar. ***Lane tapers to provide with-flow lane separation between Traffic Lane and Bus Lane on approach to Olcovar.
CH. A15925 to CH. A16035	1.5-2.0*	N/A	N/A**	3.0**	3	3	N/A	1.8-2.0***	*Footpath narrows locally to 1.5m at Crinken College to tie-in to existing. ** Combined Bus Lane / Traffic Lane with signal controlled priority. ***Footpath locally narrows to 1.8m at taper around to Crinken Lane.
CH. A16035 to CH. A16130	1.8 min*	N/A	N/A**	3	3	3	2.0***	2.0 min	*Footpath locally narrows to 1.8m alongside Shanganagh Castle Gate Lodge to tie-in to existing. **Combined Bus Lane / Traffic Lane with signal controlled priority. ***Lane tapers to Join Traffic Lane on approach to Crinken Lane.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A16130 to CH. A16195	2.4 min*	2.0 min	3	2.8-3.0**	2.8-3.0***	3	2.0	2.8 min	*Footpath tapers behind grassed verge. **Tapers to provide Bus Lane and Cycle Track. ***Tapers to provide contra-flow lane separation between Traffic Lanes on approach to Shanganagh Castle Housing Development.
CH. A16220 to CH. A16250	2.4 min*	2.0	3	2.75	2.75**	3	2.0	1.8-2.1***	*Footpath tapers behind grass verge. **Tapers to provide contra-flow lane separation between Traffic Lanes on approach to Shanganagh Castle Housing Development. ***Footpath locally narrows to 1.8m at pedestrian crossing.
CH. A16250 to CH. A16280	2.4 min*	2.0 min**	3	2.75	3.25	3	2.0**	1.8 min***	*Footpath tapers behind grass verge. **Cycle Track tapers behind grass verge after toucan crossing. ***Footpath narrows locally to 1.8m on approach to Allies River Road to provide for dedicated Cycle Track.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A16285 to CH. A16640	1x 2.0*,**	2.5-3.15***	3	3	3	3	N/A	2.0 min	*Footpath adjacent to Bus Lane ends at Shanganagh Cemetery coach stop. **Footpath tapers behind grass verge. ***Two-way Cycle Track. Tapers behind grass verge.
CH. A16645 to CH. A16760	1.65 min*	2.0 min	3	3	3	3	2.0	2.1	*Footpath locally narrows to 1.65m at pinch points at Saint James' Church to tie-in to existing footpath.
CH. A16760 to CH. A16830	2.0 min	2.0	3	2x 3.0*	3	3	2.0	2	*Lane tapers to provide contra-flow lane separation on approach to Woodbrook Downs Junction.
CH. A16870 to CH. A16935	2	2.0*	3	3	1x 3.0, 1x 2.5**	3	2.0*	1.8 min***	*Cycle Track narrows locally behind bus stop **Tapers to provide contra-flow lane separation on approach to Woodbrook Downs Junction. ***Footpath narrows locally to 1.8m adjacent to Beauchamp Lodge to tie-in to existing.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A16935 to CH. A17130	2	2.0	3	3	3.0*	3	1.5-2.0	1.8 min**	*Lane tapers to provide Bus Lane opposite entrance to Woodbrook House. **Footpath narrows locally to 1.8m adjacent to Aske House grounds to tie-in to existing.
CH. 17130 to CH. A17320	1.8 min*	1.65-2.0**	3	3	3.0***	3.0*****	1.5-2.0****	1.8 min	*Footpath locally narrows to 1.8m adjacent to Woodbrook Lodge. **Cycle Track narrows locally adjacent to Woodbrook House grounds. *** Combined Bus Lane / Traffic Lane with signal controlled priority. ****Cycle Track narrows locally adjacent to Aske House. *****Bus lane begins at CH. 17175 and continues inbound
CH. A17320 to CH. A17380	2	2.0	3	3x 3.0*	3.0-6.5**	N/A**	2.0	2.0 min	*Traffic lane tapers to provide two right turn Traffic Lanes on approach to M11 Junction. ** Combined Bus Lane / Traffic Lane with signal controlled priority. Lane tapers to provide contra-flow lane separation between Traffic Lanes on approach to M11 Junction.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A17415 to CH. A17470	2	2.0	3	3.0*	2x 3.0**	3.0***	2.0	2.1	*Lane tapers to provide contra-flow lane separation between Traffic Lanes on approach to M11 Junction. **Lane tapers to provide left turn Traffic lane on approach to M11 Junction. ***Lane tapers to provide with-flow lane separation between Bus Lane and Traffic Lane on approach to M11 Junction.
CH. A17470 to CH. A17660	2	2.0	3	3.0	3	3	2.0	2.2 min	
CH. A17660 to CH. A17720	1.9 min	2.0	3	2x 3.0*	3.0-5.0**	3	2.0	2.2 min	*Lane tapers to provide right turn lane on approach to Old Connaught Avenue. **Traffic Lane tapers to provide Bus Lane after Old Connaught Avenue.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A17770 to CH. A17830	2.0-2.5	1.65-2.0*	3	1x 2.5, 1x 2.8**	2x 3.0***	3	2.0*	2.4 min	*Locally narrows behind Bus Stop. **Traffic Lane tapers to provide Bus Lane after Old Connaught Avenue Junction. Traffic Lane tapers to provide contra- flow lane separation with 2.8m right turn pocket onto Saint Peters Road. ***Traffic Lane tapers to provide right turn onto Corke Abbey Avenue.
CH. A17830 to CH A17890	2	2.0	3	1x 3.0, 1x 2.7*	3	3	2.0	2.0 min	*Traffic Lane tapers to provide 2.7m right turn Traffic Lane onto Chapel Lane.
CH. A17930 to CH. A17960	2	2.0	3	3	1x 2.75, 1x 3.0*	3	2.0	2.2 min	*Traffic Lane tapers to provide right turn Traffic Lane onto Chapel Lane Junction.
CH. A17960 to CH. A18035	2	2.0	3	1x 3.0, 1x 2.3*	3	3	2.0	2.0-2.75	*3.0m Traffic Lane tapers to provide contra- flow lane separation road markings with 2.3m right turn pocket into Roseville Court.

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A18035 to CH. A18080	2	2.0	3	3	1x 3.0, 1x 2.75*	3	2.0	2.0-3.0	*3.0m Traffic Lane tapers to provide contra- flow lane separation with 2.75m right turn pocket into Lidl. Traffic Lane tapers to provide Bus Lane after Upper Dargle Road Junction.
CH. A18080 to CH. A18130	2	2.0-3.5	3	3	3.0-4*	3.0**	2.0	2.0-3.4	*Combined Bus Lane and Traffic Lane. **Bus lane begins at CH. 18100 and continues inbound
Castle Street									
CH. A18165 to CH. A18290	1.8-2.0	2.0	3	3.0*	3	3	2.0	1.75**,***	*Lane tapers to provide Bus Lane after Upper Dargle Road Junction. **2m loading bay provided between Footpath and Cycle Track opposite the Dargle Centre. ***Footpath narrows to 1.75 at the tie-in to St Patrick's square

Location	Eastbound/Outbound Carriageway				Westbound/Inbound Carriageway				Notes
	Nominal Footpath Width (m)	Nominal Cycle Track Width (m)	Nominal Bus Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Traffic Lane Width (m)	Nominal Bus Lane Width (m)	Nominal Cycle Track Width (m)	Nominal Footpath Width (m)	
CH. A18290 to CH. A18375	2.0 min	2.0	3	1x 3.0, 1x 2.4*	3	3	1.5-2.0**	1.8 min***	*3.0m Traffic Lane tapers to provide contra- flow lane separation with 2.4m right turn pocket into Castle Street Shopping Centre. **Cycle Track narrows locally to 1.5m along length of Castle Street Shopping Centre Parking Lot. ***Footpath narrows locally to 1.8m along length of Castle Street Shopping Centre Parking Lot.
CH. A18380 to CH. A18460	2.0 min	1.5*	3	3	3.0**	3	1.5*	1.8-2.2	*Cycle Track narrows locally to 1.5m along either side of Castle Street Shopping Centre Parking Lot. **Lane tapers to provide Bus Lane after Lower Dargle Road.

4.3 Design Speed and Speed Limit

The design speed to which the horizontal and vertical alignment of the Proposed Scheme has been developed has been governed by DMURS and the guidance provided by the Department of Transport, Tourism and Sport (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 **Figure 4.2** below is also used to inform the appropriate design speed, extracted from DMURS Chapter 4.

The above does not include the national road section along the N11 from Kill Lane to Loughlinstown Roundabout, where the speed limit for the general traffic is 80kph (the bus lane speed limit along this section is 60kph), which is governed by the standard in the TII Publications (DN-GEO-03031 (NRA TD 9) – "Rural Road Link Design").

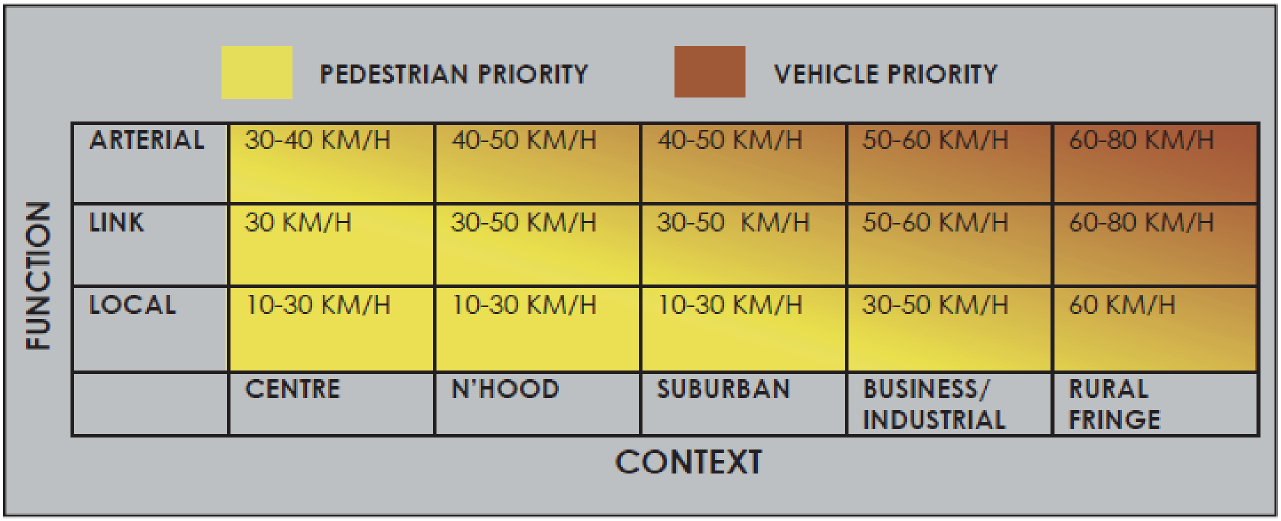

Figure 4.2: DMURS Design Speed Selection Matrix

The Proposed Scheme's design speeds and speed limits are detailed below in **Table 4-5.**

Table 4-5 Existing and Proposed Speed Limits and Design Speeds

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)
A0 to A450	Leeson Street Lower (from Earlsfort Terrace) to Leeson Street Lower (north of junction with Fitzwilliam Place)	Link	City Centre	30	30	30
A450 to A2770.	Leeson Street Lower (north of junction with Fitzwilliam Place) to Stillorgan	Link	City Centre, Neighbourhood	50	50	50

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)
	Road (Outside Donnybrook Parish - Church of the Sacred Heart)					
A2770 to A9400.	Stillorgan Road (Outside Donnybrook Parish - Church of the Sacred Heart) to Stillorgan Road (at N31 Mount Merrion Avenue)	Arterial	Neighbourhood	60	60	60
A5600 to A9400	Stillorgan Road (at N31 Mount Merrion Avenue) to N11 Stillorgan (north of junction with Westminster Road)	National	National Road	60	70	60
A9400 to A14110.	N11 Stillorgan (north of junction with Westminster Road) to South of Loughlinstown Roundabout	National	National Road	60 (bus lane), 80 (general traffic lane)	85	60 (bus lane), 80 (general traffic lane)
A14110 to A14750.	South of Loughlinstown Roundabout to Dublin Road (north of junction with Stonebridge Road)	Link	Suburb	50	50	50
A14750 to A15710.	Dublin Road (north of junction with Stonebridge Road) to Olcovar Junction	Link	Suburb / Neighbourhood	50	30	30
A15710 to A18500.	Dublin Road, Olcovar Junction to Lower Dargle Road (Bray)	Link	City Centre	50	50	50
A3900	UCD Bus Interchange	Local	Centre	30	30	30
A4000	Belfiled Interchange	Slip Road	Neighbourhood	50	50	50
A13150	Wytville Interchange	Slip Road	National Road	50 (Diverge) 60 (Merge)	50 (Diverge) 60 (Merge)	50 (Diverge) 60 (Merge)

4.4 Alignment Modelling Strategy

The 3D model design, including the horizontal and vertical alignments, 3D modelling corridors and the associated design features have been developed using the Autodesk Civil 3D software. The models have been developed for the purposes of informing the scheme extents and informing the preliminary design for the requirement for any significant earthworks/ retaining structures along the Proposed Scheme.

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, 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 Scheme 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 Scheme 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. Localised adjustments to the horizontal alignment have been done at few junctions along the N11, Wilford roundabout and through Shankhill around the Shanghanagh Park and Cemetery.

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 scheme.

In light of the above the horizontal and vertical alignments of the mainline are generally similar to the existing parameters. The alignment of the scheme is generally compatible with the selected design speed and associated safe Stopping Sight Distance. There are eight significant side roads along the extents of the scheme: Sussex Road, Brookvale Road, Eglinton Road, southbound Merge/Diverge at UCD, northbound Merge/Diverge at Belfield (UCD), UCD Overbridge, southbound Merge and Diverge for Wyattville Rd junction, northbound Merge and Diverge for Wyattville Rd junction, Wyattville Overbridge where the horizontal alignments for those roads will remain largely unchanged.

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 along the have not been identified on the Proposed Scheme 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 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 Distances (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 and TII Publications DN-GEO-03031 are shown in **Figure 4.3** and **Figure 4.4.**

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

Figure 4.3: DMURS SSD Design Standards

REGIONAL AND LOCAL ROAD DESIGN SPEED (km/h)	85	70	60	50	42	V2/R
STOPPING SIGHT DISTANCE m						
Desirable Minimum Stopping Sight Distance	160	120	90	70	50	
One Step below Desirable Minimum	120	90	70	50	40	
Two Steps below Desirable Minimum	90	70	50	40	30	

Figure 4.4: TII Publication SSD Design Standards

The desirable minimum forward visibility requirements are being achieved across the majority of the Proposed Scheme. Where the desirable minimum forward visibility requirements are not being achieved, details are provided in the Relaxation, Departures and Deviation Table in **Appendix C**. A summary of the location experiencing a reduction in forward visibility is noted in **Table 4-6** below.

Table 4-6: Locations where Reduced Forward Visibility is Provided

Road Name	Direction	Chainage	Desirable min. SSD	Achieved SSD
Morehampton Road	Bray-bound	Ch A2089 to Ch. A2098	49m	36m
Leeson Street Upper	Bray-bound	Ch. A2195 to Ch. A2213	49m	36m
N11 Stillorgan Road	Bray-bound	Ch. A11485 to Ch. A11672	160m	120m
Dublin Road	Bray-bound	Ch. A14185 to Ch. A14196	49m	36m

4.7.1 Junction Visibility

An assessment of visibility at major and minor junctions has been completed along the route. In accordance with DMURS, the SSD parameters for relevant design speeds has been adopted as the Y-Distance visibility to be achieved while an X-Distance of 2.4m (reduced to 2.0m as a relaxation) has been implemented.

An assessment of the junction visibility at accesses serving individual properties and single dwellings has been undertaken, ensuring that the existing visibility splay “X” and “Y” are maintained or improved.

4.7.2 Junction Intervisibility

In the absence of DMURS guidance with respect to visibility at signalised junctions, the principles and parameters of ‘Junction Intervisibility’ from DNGEO-03044 (The Geometric Layout of Signal-Controlled Junctions and Signalised Roundabouts) has been adopted as a benchmark to assess the intervisibility at all signalised junctions.

As many of the junctions along the Proposed Scheme will involve retrofitting of the existing layout in an urban environment to provide additional NMU provisions in addition to the requirements to facilitate vehicle swept-paths, junction intervisibility will be impacted.

4.8 Corner Radii and Swept Path

In line with the Proposed Scheme 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 intervisibility between users.

Junctions are where the actual and perceived risk to both cyclists and pedestrians are highest and usually represent the most uncomfortable parts of any journey. In order to provide a design whereby vehicles navigate through turns at a reduced speed, thereby reducing the risk of serious collisions, kerb and footway buildouts have been included on the majority of the designed junctions along the route thus adhering to design guidance given within the DMURS document where it is stated:

> *‘Build-outs should be used on approaches to junctions and pedestrian crossings in order to tighten corner radii, reinforce visibility splays and reduce crossing distances.’*

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 balanced 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 was applied which 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 4.5**

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 4.5: Standard Suite of vehicles used for Assessment of the Proposed Scheme

In general vehicle tracking/ swept path analysis was carried out using the following principles:

- **DB32 Private Car –** Analysis undertaken at private residential properties, to ensure that the length of driveways remains sufficient to accommodate a private car.
- **DB32 Refuse Vehicle –** Analysis undertaken to ensure refuse vehicles can make all turns in/out of all side roads and entries concerning residential/commercial properties.
- **14.1m Double Decker Regional Bus –** Analysis undertaken along the main alignment of the route to ensure that buses can make all turns at junctions and as set out by bus lanes.
- **Rigid Truck –** Analysis undertaken in the areas at the start of the scheme around the shopping centre and industrial estate.
- **FTA Design Articulated Vehicle (1998) –** Analysis undertaken in the areas at the start of the scheme around the shopping centre and industrial estate.

Section 4.17 of this report details areas of turning bans along the Proposed Scheme.

The below issues were found when carrying out the swept path analysis:

- Sussex Road – Outbound traffic from Dublin City Centre must negotiate two reverse right-angled turns (near Canal Bank Café / M. O'Brien's) on Sussex Road just before merging onto Leeson Street Upper. Larger vehicles like Single Deck City Bus, Rigid Truck or FTA design Articulated Vehicle were shown to have swept path issues negotiating the turn during the initial design with standard lane widths. To mitigate this issue, the bus lane has been widened locally at the turning locations.

- Loughlinstown Roundabout **–** At the southern end of Loughlinstown Roundabout the southbound buses need to negotiate a left turn before merging onto Dublin Road. Due to space constraints the curve radius is too small for buses to negotiate the turn in a standard 3m wide bus lane. To mitigate this, the bus lane has been widened to provide for an acceptable swept path for buses to successfully negotiate the curve.

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' provides an area that can be used for street furniture 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 Scheme a cycle track will perform a similar function for separation from motorised traffic. The 'strip' area is designated as a specific location for which retail/commercial/private premises may undertake certain outdoor activities including dining, stalls, or outdoor seating etc. These areas often have specific licences or agreements in place with the Council or have dedicated legal interests (private landings) over this area of the footpath. The assessment of these areas is further discussed in **Chapter 13**.

Figure 4.6 below provides an extract from DMURS demonstrating the relevant components of the footpath.

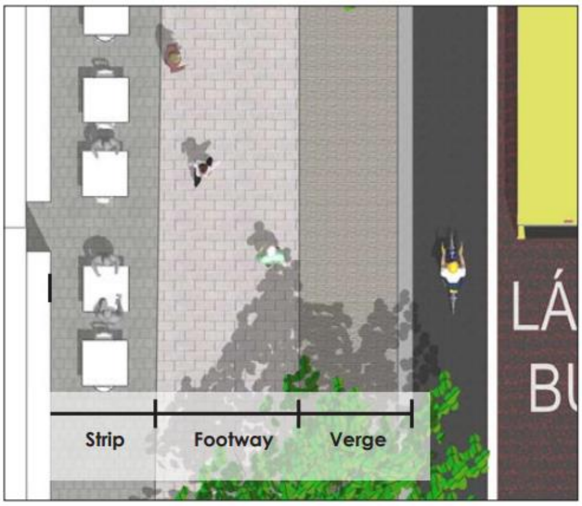

Figure 4.6: Key Components of the Footpath

4.9.1 Footway Widths

The adopted footway design width parameters have been provided in **Table 4-4**. The desirable minimum footway width for the Proposed Scheme is 2m and an absolute minimum width of 1.8m has been adopted at constrained sections.

At specific pinch points, Building for Everyone: A Universal Design Approach, 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 Scheme extents, desirable minimum lane widths have been adopted throughout.

Throughout the scheme, footway widths of 2.0m or wider have been proposed, with the exception of a limited number of stretches where a width of 1.8m or greater is proposed due to the presence of localised space constraints. At specific pinch points the footway has been reduced below 1.8m width over a short length to match the existing kerbline or tie-in to the existing footpath and/or to avoid landtake. Deviation and relaxation for the desirable minimum has been documented in the Departure/ Deviation/ Relaxation schedule in **Appendix C.** The Proposed Scheme nominal footway widths over the length of the corridor have been provided in **Table 4-4**. The Proposed Scheme will provide significant improvements to the footway width provisions for the most part of the length of the Proposed Scheme.

The pinch points with reduced footpath widths are summarised below:

- At chainage A530 to A560 the footpath is reduced to 1.5m locally as the alignment matches existing kerb line and boundary wall to avoid land take in front of residential properties;
- At chainage A2115 to A2310 the footpath is reduced to 1.5m locally at short pinch points along the Donnybrook Road;
- At chainage A3480 to A3780 the footpath is reduced to 1.5m locally as the alignment matches existing kerb line and boundary wall to avoid land take in front of residential properties;
- At chainage A5720 to A5780 the footpath is reduced to 1.5m locally due to pinch point to match existing;
- At chainage A7155 to A7172 the footpath is reduced to 1.5m locally due to pinch point to match existing and constrint due to boundary wall;
- At chainage A7645 to A7760 the footpath is reduced to 1.5m locally due to pinch point to match existing;
- At chainage A9745 to A9840 the footpath is reduced to 1.5m locally due to pinch point to match existing;

- At chainage A13,100 to A13,330 the footpath is reduced to 1.6m locally due to pinch point to match existing at the Wytville slip road;
- At chainage A13485 to A13755 the footpath is reduced to 1.6m locally due to pinch point to match existing at the Bray Road;
- At chainage A 14180 to A14640 the footpath is reduced to 1.5m locally due to footpath narrows to a to match existing;
- At chainage A 15160 to A15800 the footpath is reduced to 1.6m locally due to footpath narrows to a to match existing;
- At chainage E 20 to E 80 the footpath is reduced to 1.5m locally and narrows to a pinch point of 1.2m as alignment matches existing kerb line and boundary wall to avoid land take;
- At chainage E 205 to E 260 the footpath is reduced to 1.5m locally to match existing kerbline and boundary wall to avoid land take;
- At chainage A14810 to A 15075 the footpath is reduced to 1.5m locally as the existing footpath narrows to a pinch point of 1.6m in front of Applegreen petrol station to match existing;
- At chainage A 15800 to A 15865 the footpath is reduced to 1.5m locally as the existing footpath narrows to a pinch point of 1.6m due to alignment of existing boundary wall at Sherington Lodge;
- At chainage A 15925 to A 16035 the footpath is reduced to 1.5m locally as the existing footpath narrows to a pinch point of 1.5m due to alignment of existing boundary wall at Crinken College;
- At chainage A 16645 to A 16710 the footpath is reduced to 1.5m locally as the existing footpath narrows to a pinch point of 1.65m matching existing kerbline and to minimise landtake and tree loss at Saint James' Lodge.

4.9.2 Footway Crossfall

The adopted footway design crossfall parameters have been provided in **Table 4-7**. The footpath crossfall is recommended to be 2% - 3.3% as per DN-PAV-03026 Footway Design.

Table 4-7: DN-PAV-03026, Figure 2.3 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 recommends that cross falls 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 have been provided in **Table 4-1**. The footpath longitudinal gradient follows the gradient of the proposed carriageway. DN-PAV-03026, *Table 2.3* shown in **Table 4-7** recommends a longitudinal gradient of 1.25%-5%.

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

4.9.4 Pedestrian Crossings

The adopted pedestrian crossing design parameters have been provided in **Table 4-1**. Where practicable, 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 19mThis is applicable at stand-alone pedestrian crossings as well as at junctions.

Refuge islands should be a minimum width of 3m. 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 Scheme, pedestrian crossings varying from 2.4m and 4m in width have been incorporated throughout the design. Larger pedestrian crossing widths have been allocated in areas that are expected to accommodate a high number of non-motorised users.

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

Formal crossing points are to be provided on the upstream side of bus stop islands, consisting of an on-demand signalised pedestrian crossing with appropriate tactile paving, push buttons and LED warning studs. A secondary informal crossing should be provided on the desire line on the downstream side of the island.

4.10 Accessibility for Mobility Impaired Users

The aim of the Proposed Scheme is to provide enhanced walking, cycling and bus infrastructure along the corridor. In achieving this aim, the Proposed Scheme 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 been informed the approach to Universal Design in developing the Proposed Scheme:

- Building for Everyone: A Universal Design Approach; Centre for Excellence in Universal Design at the National Disability Authority (NDA CEUD);
- How Walkable is Your Town, (NDA CEUD, 2015);
- 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. An Accessibility Audit of the existing environment was undertaken to help inform the 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 I.**

The audit provided a description of the key accessibility features and potential barriers to mobility impaired people based on good practice, and identified the following issues to be addressed in the design process:

- Accessible Parking - On-street Disabled Parking Space layout should be to the appropriate standard, with dropped kerb access between the parking space and footpath;
- Access Routes on Footpaths - Width of footpaths should be clear of clutter, such as street furniture, and allow unimpeded access for the mobility impaired, and in doing so, meet the minimum standards for widths;
- Drainage - All footpaths should have sufficient cross-fall for drainage purposes but without affecting the ability of mobility-impaired people to move safely along the corridor;
- Guardrails - Guardrails should be located only where needed for safety purposes – and care should be taken not to create narrow spaces which create difficulties for movement;
- Pedestrian Crossing Points - Pedestrian crossing points should be laid out in accordance with standards and make it convenient and safe for mobility impaired users to negotiate crossing of carriageways;
- Controlled and Uncontrolled Crossings - Controlled and Uncontrolled Crossings should have tactile paving laid out correctly to provide tactile and visual assistance to mobility-impaired users approaching crossing points;
- Changes in Level - Any changes in level should be addressed in the design process to ensure that all changes in level, where practicable, comply with standards;
- Shared pedestrian/cyclist areas - Shared pedestrian/cyclist areas should be well laid out, with clear visual and tactile elements included, to ensure that these areas are safe for mobility-impaired users, pedestrians and cyclists;
- Surface Material - Footpath materials should be selected to ensure surfaces are free of undulations, with no trip hazards where there is a transition between surface materials – or where the Proposed Scheme ties into the existing infrastructure; and
- Street Furniture - All poles for signs and street lighting should be carefully located to minimise the effect on the safe and convenient passage of pedestrians and cyclists, with due cognisance to the safe movement of mobility impaired users.

A detailed scheme breakdown of the proposed footways has been provided in **Table 4-4**. 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 set down kerb between the footway and the cycle track is of particular importance for guide dogs, whereby the 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 interactions.

One of the other key areas that was focused on was the interaction between pedestrians, cyclists, and buses at bus stops. The Proposed Scheme 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.**

4.10.1 UCD Interchange Accessibility

The UCD interchange main plaza shelter facilities will be delivered in accordance with the applicable sections of the Building Control (Amendment) Regulations 2014. Accessibility has been considered in the design and a Disability Access Certificate will be obtained prior to commencement of operation.

The main interchange shelters on the plaza incorporate provision for priority seating and wheelchair users. The wider facility aims to prioritise pedestrian permeability. Two Signalised raised crossings are provided from the main plaza and to the proposed UCD Arrivals Plaza, with the interchange located immediately adjacent to the Arrivals Plaza to achieve minimum distances between the bus stops and the main campus area. Existing stepped access to the campus has also been removed and replaced with an accessible ramp. Pedestrian circulation space and zebra crossing widths have been maximised, with driving aisle widths and crossing distances minimised.

The design process has optimised the layout for pedestrian safety and located crossings as close as possible to desire lines. The interchange wayfinding strategy will be developed at the next design stage to incorporate elements such as clarity of signage and colour contrasts within the design, to ensure that accessibility measures are fully incorporated.

4.11 Cycling Provision

One of the core objectives of the Proposed Scheme is to enhance the potential for cycling by providing safe infrastructure for cycling, segregated from general traffic wherever practicable. 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. parking/verge protected cycle tracks), or both.

The 'preferred cross-section template' developed for the Proposed Scheme consists of protected cycle tracks, providing vertical segregation from the carriageway to the cycle track and vertical segregation from the cycle track to the footpath.

The principal source for guidance on the design of cycle facilities is the National Cycle Manual (NCM), published by the National Transport Authority.

The desirable minimum width for a single-direction, with-flow, raised-adjacent cycle track is 2.0m. 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 Scheme is approximately 18.5km long from end to end. The General Arrangement drawings included within **Appendix B** show the improved extent of cycle provision, which is summarised below:

- 91% Existing cycle priority outbound (51% segregated cycle track and 40% advisory cycle lane)
- 84% Existing cycle priority inbound (43% segregated cycle track and 41% advisory cycle lane)
- 91% Proposed cycle priority outbound (91% segregated cycle track)
- 91% Proposed cycle priority inbound (89% segregated cycle track and 2% Quiet Street)

4.11.1 Segregated Cycle Tracks

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 4.7** below, taken from the BCPDGB.

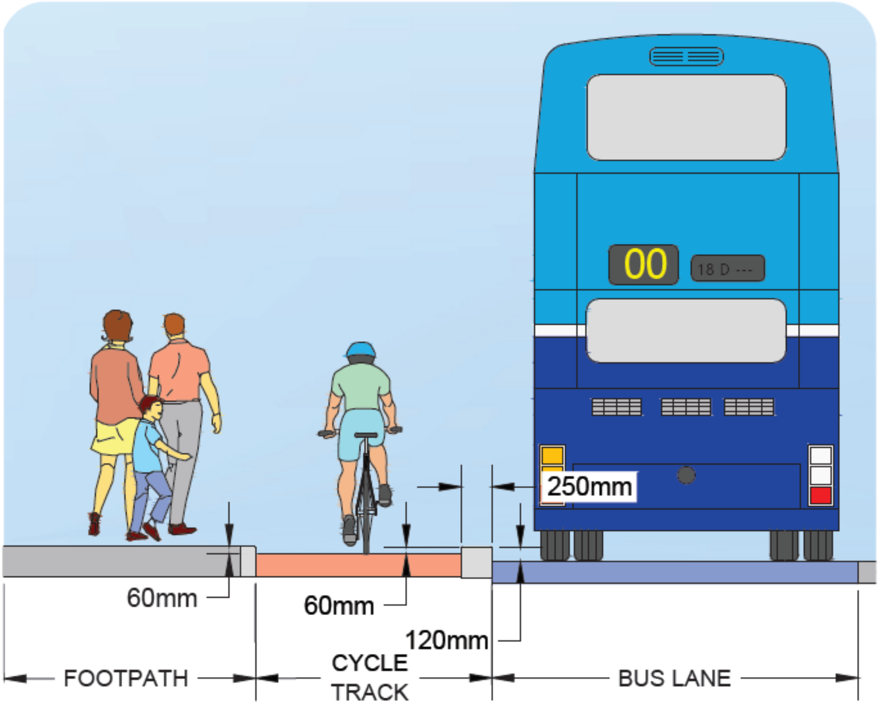

Figure 4.7:Fully Segregated Cycle Track

Wherever possible, the Proposed Scheme design has endeavored to incorporate segregated cycle tracks, and has done so in the following locations:

- From Leeson Street Lower to R138 at Donnybrook Church (approx. 4km):
  - Segregated cycle track provided in each direction running adjacent to the direction of vehicle travel, which in some locations passes behind the roadside tree line.
  - Signal-controlled crossings provided at all junctions through a combination of parallel pedestrian/cycle crossings and shared toucan crossings.
- R138 at Donnybrook Church to Loughlinstown Roundabout on the N11 (approx. 11km)
  - Segregated cycle track provided in each direction running adjacent to the direction of vehicle travel.
  - A section of northbound cycle track between Brewery Road to The Hill is diverted to the adjacent side road, St. Brigid's Church Road, due to space constraints on the N11. A similar approach is taken for the southbound cycle track at Belmont Terrace slightly further south at Galloping Green.
  - To facilitate local access, this cycle route is supplemented in places with bi-directional cycle track sections on one or both sides of the N11 which includes two-way cycle track from UCD to Merrion Grove and from Wyatville junction to Loughlingstown Roundabout.
  - Signal-controlled crossings provided at all junctions through a combination of dedicated cycle crossings and shared toucan crossings.
- Dublin Road - Stonebridge Road to Corbawn Lane (approx. 0.5km)

- Bi-directional cycle track on the eastern side of Dublin Road and northern side of Stonebridge Road, offset from the carriageway.
- Signal-controlled crossings provided at all junction through a combination of parallel pedestrian/cycle crossing and shared toucan crossings.

- Dublin Road – Shanganagh Park to Bray (approx. 2.5km)
  - Segregated cycle track provided in each direction running immediately adjacent to the direction of vehicle travel, offset from the carriageway where possible.
  - A two-way cycle track has been provided through Shanganagh Park and past the adjacent Shanganagh Cemetery, with northbound cyclists accessing this side of the Dublin Road at two toucan crossing points.
  - Signal-controlled crossings provided at all junctions through a combination of dedicated cycle crossings and shared toucan crossings.
  - Toucan crossings are not provided at the M11 Wilford junction as there is no cycle provision on the M11 approach road.

The desirable minimum width for a single-direction, with-flow, raised-adjacent cycle track is 2.0m. This is based on the NCM width calculator and allows for overtaking within the cycle track. The minimum width is 1.5m, 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).

At the following locations segregated cycling facilities have not been provided as a result of specific site constraints:

- Dublin Road – Loughlinstown Roundabout to Stonebridge Road (approx. 700m)
  - Impacts including land take to residential properties were not considered appropriate. The proposed bus lanes along this section will be shared with cyclists.
- Dublin Road – St. Anne's junction to Crinken Lane (approx. 930m)
  - Local resident group engagement and the potential impacts on the Shankill village area were considered when determining cycle and bus infrastructure in this area. In addition, existing advisory lanes that exist in places are considered too narrow to be retained alongside the new cross section proposals. Cyclists will use the general traffic lanes alongside general traffic and buses, with a speed limit reduction proposed over this section.

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 them. 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.

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

- Transitions to existing cycle lanes, typically on side roads of the main corridor alignment;

- At grade junction crossings; and
- For side road crossings where the cycle track is locally reduced to road level.

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:

- Two-way cycle track to the east of Dublin Road as it passes Shanganagh Park;
- Inbound between St Columcille's Hospital and Loughlinstown Roundabout as existing;
- Alongside the R138/N11 as it approaches UCD in both direction as existing Two-way cycle track along Stonebridge Road connecting to Shanghanagh Road;
- Along St. Brigid's Church Road for a short section where insufficient space was available along the R138 inbound; and
- Along Belmont Terrace for a short section to improve cycle track widths and interactions with general traffic outbound.

Local connections are also provided to offline cycle routes in the vicinity of Grand Canal, at Coláiste Eoin, the proposed Dodder Greenway and adjacent to the Dublin Road/Upper Dargle Road junction.

The UCD Interchange proposals also include offline cycle routes, which become shared spaces with pedestrians once within the campus and interchange area. This is in keeping with the cycling strategy for the campus and recognises that the campus is a different environment to that of the main Proposed Scheme.

4.11.4 Quiet Street Treatment

Where the Proposed Scheme cannot facilitate cyclists without significant impact on bus priority, alternative cycle routes are explored for short distances away from the Proposed Scheme bus route. Such offline options may include directing cyclists along streets with minimal general traffic other than car users who live on the street. Guidance in this regard has been provided within the BCPDGB which states:

'*Diversions of proposed cycle facilities on to quieter parallel routes, to avoid localised narrowing of cycle tracks on the main CBC route, is to be considered in the context of the CBC route being listed as a primary cycle route as per the Greater Dublin Area Cycle Network Plan. These diversions, however, may also be considered where appropriate cycle facilities cannot be provided along the CBC route without significant impact.'*

So-called quiet streets (due to the low amount of general traffic) are deemed suitable for cyclists sharing the roadway with the general traffic without the need to construct segregated cycle tracks or painted cycle lanes. The Quiet Street Treatment would involve appropriate advisory signage and lane marking for both the general road users and cyclists.

A quiet street cycle route is proposed on the west side of the N11 commencing north of Loughlinstown roundabout (chainage A13780), the route passes residential and commercial premises along a local road with low traffic and low vehicle speeds before joining up with a dedicated section of cycle path approximately 100m south of the Wyattville Road Bridge (chainage A13310). In addition to this, local connections are provided from the scheme corridor's main cycle track to existing quiet streets at certain locations, where appropriate.

4.11.5 Treatment of Constrained Areas

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

All locations where widths are less than desirable minimum are recorded and presented in **Table 4-4** and Schedule of Departures/ Deviations/ Relaxations in **Appendix C** and summarized below:

It is also noted that cycleways narrow to slow the flow of cyclists to a minimum 1.5m width when approaching an island bus stop and 1m at a shared landing bus stop.

- At chainage A 9745 to A 9840 the cycle track is reduced to 1.4m locally due to cycle track locally narrowed over length of 100m to approximately 1.65m southbound and 1.5m northbound at pinch points to tie-in to existing at the Old Bray Road junction along N11;
- At chainage A13755 to A 13790 the cycle track is reduced to 1.4m locally due to cycle track locally narrows over a length of 40m to 1.4m before joining the side road off-N11 mainline along Bray Road;
- At chainage H45 to H80 the cycle track is reduced to 1.4m locally due to cycle track narrows to 1.2m to tie-in to combined traffic lane;
- At chainage A 18460 to A 18512 the cycle track is reduced to 1.4m locally, along Bray Road Northbound at Castle Street Shopping Centre due to boundary constraints at entrance off Lower Dargle Road. This is to avoid land take at Belton Terrace.

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 Scheme is approximately 18.5km long from end to end. The Preliminary Design drawings show the extent of the improved extent of bus provision:

- 69% existing bus priority outbound (69% Physical)
- 68% existing bus priority inbound (68% Physical)
- 100% proposed bus priority outbound (92% Physical – 8% Virtual)
- 99.6% proposed bus priority inbound (87% Physical – 12.5% Virtual)

4.12.1 Bus Priority

Bus priority for the Proposed Scheme 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 can request a green signal for buses. 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. The latter solution may be implemented where left-turning traffic volumes are relatively low and/or in scenarios where fewer 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 11.

Over the majority of the route a minimum 3m-wide lane is provided for bus and other authorised vehicle use only. Larger lane widths are needed in some instances where the swept path of the bus needs more space. Along the N11 section with bus lane speed limit of 60km/hr, bus lane width of 3.0m or as existing (>3.0m, approx. 3.25m) has been provided to largely retain the existing infrastructure.

4.12.2 Signal Controlled Priority

Signal controlled 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 pinch-points in a road 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 bus priority it is necessary to look at the traffic implications both upstream and downstream of the area under consideration. For the signal-controlled bus 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.

Locations where signal controlled bus priority has been provided on the Proposed Scheme are highlighted in **Table 4-8.**

Table 4-8: Signal Controlled Bus Priority Locations

Location	Reason for Mitigation
Leeson Street Lower / Hatch Street Lower Junction	Traffic in the southbound direction is already a bus and local access only route. Northbound straight-ahead traffic will be limited to buses and local access only, with Signal Controlled Priority provided for buses at the junction. Northbound general traffic will be diverted along Hatch Street Lower and Earlsfort Terrace. *Approx. Chainage A20 to A230 both-directions.*
Leeson St Lower / Fitzwilliam Place Junction	Signal Controlled Priority is provided here where the cross section is constrained at the existing canal bridge and on approach, to provide dedicated cycle tracks and maximise footpath widths in a high-volume pedestrian area. *Approx. Chainage A460 to A570 Southbound.*
Leeson St Lower / Grand Parade Junction	Signal Controlled Priority is provided here where the cross section is constrained at the existing canal bridge, to provide dedicated cycle tracks and retain existing footpath widths in a high-volume pedestrian area. *Approx. Chainage A530 to A570 Northbound.*
Leeson Street Upper / Wellington Place Junction	The provision of 2.0m cycle tracks northbound on Morehampton Road has shifted the contra-flow road markings and paved traffic-signal island alignment. Available carriageway width alongside these contra-flow road provisions is locally narrowed. Signal Controlled Priority is adopted locally here to avoid reductions in footpath and cycle track widths. *Approx. A1300 to A1370 Southbound.*
Donnybrook Road / Belmont Avenue Junction	Signal Controlled Priority has been provided in the northbound direction at this junction to maximise available footway space for pedestrians and a time-plated loading bay in this busy location. Southbound traffic lanes have also been widened to provide

Location	Reason for Mitigation
	minimum desired lane width, and to provide a dedicated right turn lane onto Belmont Avenue. *Approx. A1950 to A2000 Northbound.*
Donnybrook Road from Eglinton Terrace to the Crescent	Bus priority by provision of Signal Controlled Priority in the northbound direction has been adopted over this section of the corridor to minimise impacts to existing property, noting the constrained cross section of the existing corridor at this location. *Approx. A2100 to A2320 Northbound.*
Dublin Road / Shanganagh Road Junction to Shanganagh Park	Bus priority by provision of Signal Controlled Priority has been adopted over this section of the corridor to minimise impacts to existing property, mature tree and other topography constraints. *Approx. A15075 to A16130 Southbound.*
Dublin Road / Olcovar Junction to Woodbank	Bus priority by provision of Signal Controlled Priority has been adopted over this section of the corridor to minimise impacts to existing property, mature tree and other topography constraints. *Approx. A14630 to A15900 Northbound.*
Dublin Road / M11 Junction	Two dedicated right turn lanes have been identified as required for southbound traffic from the Dublin Road onto the M11. Impacts to the existing building line on the northbound side of the road and to the Woodbrook Estate retaining wall and adjacent mature trees running along the southbound side of the road also need to be minimised. To facilitate this, Signal Controlled Priority is provided instead of a dedicated northbound bus lane at this location. *Approx. A17140 to A17380 Northbound.*
Dublin Road / Upper Dargle Road Junction	There are local pinch points at Raven Hall shopping centre and other nearby properties. In addition, a two-way cycle track tie-in must be accommodated on the southbound side at this location. Bus priority takes place over a small distance of approximately 30m in the northbound direction and 20m in the southbound direction to avoid further land take and associated impacts.

Location	Reason for Mitigation
	Approx. A18100 to A18130 Northbound *Approx. A18150 to A18170 Southbound*

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.

Locations where Bus Gates have been provided on the Proposed Scheme have been summarised within **Table 4-9**.

Table 4-9: Bus Gate Locations

Location	Reason for Mitigation
Leeson Street Lower - Between Hatch Street Lower and Earlsfort Terrace	Reduces traffic through this section to buses and local access only. The existing building lines on both sides of the road do not allow for more than two lanes while providing suitable footway and cycle track widths through this section. *Approx. Chainage A0 to A250*

One bus gate is provided at the northern end of the scheme on Leeson Street Lower, between the junction with Earlsfort Terrace (St Stephen's Green) and Leeson Lane. Between these points, only buses, taxis, cycles, emergency vehicle access will be permitted on the Leeson Street Lower carriageway for the duration of the bus gate operational hours. Traffic approaching Leeson St Lower from the Hatch St Lower junction will be restricted to buses and local access only at all times of day.

The purpose of the bus gate at this location is to limit the carriageway traffic between St Stephen's Green and Hatch St Lower to buses and local access only. Southbound general traffic is already not presently permitted on this section of Leeson St Lower. The diversion of northbound general traffic allows a reduction in carriageway cross section to accommodate suitable footway and cycle track widths while maintaining bus priority.

Northbound general traffic will be diverted via Hatch Street Lower and Earlsfort Terrace. This requires the conversion of the northbound bus lane on Earlsfort Terrace to a general traffic lane. Earlsfort Terrace is on an orbital route and carries up to six bus services per hour in each direction, whereas Leeson Street Lower is on a spine route and carries up to 16 buses per hour in each direction. The existing left turning ban at the Earlfort Terrace towards Stephen's Green North has been removed to facilitate the general traffic movement.

General traffic will be restricted from proceeding north at the Leeson Street Lower / Hatch Street junction by traffic restrictions, supporting traffic signs and (if deemed necessary) by bus lane enforcement cameras. Local access from the south will be maintained at this junction for those vehicles wishing to access Leeson Lane and other accesses off Leeson Street Lower, which may be controlled by permit if necessary.

4.13 Bus Stops

The below flow chart outlines the process for examining the Proposed Scheme and assessing and reporting on the bus stops along the route, as shown in **Figure 4.8**, below. The Core Bus Network Report concluded that increasing spacing between bus stops was 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.

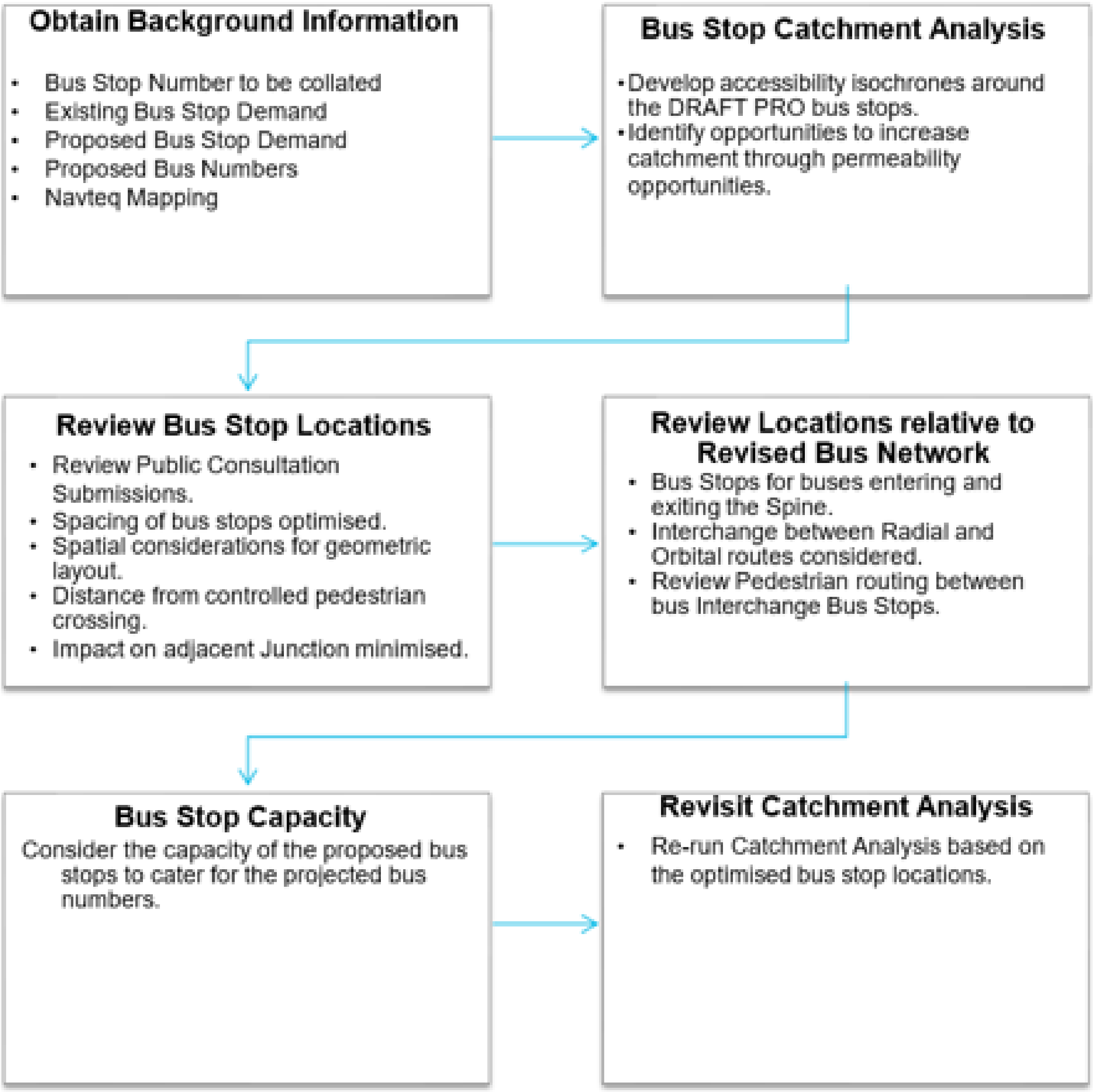

Figure 4.8: Bus Stop Location Assessment Process

The procedure for the assessment undertaken was set out in the Bus Stop Review Methodology document provided in **Appendix H1.**

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

- Driver 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 and 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 4-10 and Table 4-11provide an overview of the key changes to the locations for bus stops along the route. A more detailed breakdown of the bus stop review in addition to the catchment analysis outputs is provided in **0.2.** Where specific feedback in relation to bus stops from the public consultation process has been provided this has been acknowledged in the assessment also.

Table 4-10: Proposed Scheme Bus Stop Summary

Inbound							
Existing				Proposed			
No.	Bus Stop No.	Station Chainage	Distance from next Stop (m)	No.	Bus Stop No.	Station Chainage	Distance from next Stop (m)
1	4154	A18290	N/A	1	4154	A18410	N/A
2	4416	A18020	270	2	4416	A17960	450
3	4201	A17675	345	3	4201	A17675	285
4	4202	A17120	555	4	4202	A17080	595
5	4203	A16690	430	5	4203	A16800	280
6	5090	A16460	230	6	5090	A16460	340
7	4204	A16225	235	7	4204	A16170	290
8	4205	A16075	150	8	Removed	N/A	N/A
9	4206	A15740	335	9	4206	A15780	390
10	3140	A15485	255	10	3140	A15480	300
11	3141	A14930	555	11	3141	A14930	550
12	3142	A14505	425	12	3142	A14505	425
13	3143	A13910	595	13	3143	A13860	645
14	3144	A13440	470	14	3144	A13440	420
15	3145	A13135	305	15	3145	A13040	400
16	3146	A12720	415	16	3146	A12720	320
17	3147	A12165	555	17	3147	A12195	525
18	3148	A11790	375	18	3148	A11790	405
19	5127	A11320	470	19	5127	A11260	530
20	5128	A10700	620	20	5128	A10685	575

Inbound							
Existing				Proposed			
No.	Bus Stop No.	Station Chainage	Distance from next Stop (m)	No.	Bus Stop No.	Station Chainage	Distance from next Stop (m)
21	2996	A9815	885	21	2996	A9815	870
22	3258	A9450	365	22	3258	A9450	365
23	2060	A9200	250	23	2060	A9265	185
24	2061	A8790	410	24	2061	A8790	475
25	2062	A8240	550	25	2062	A8280	510
26	2063	A7940	300	26	2063	A7970	310
27	2064	A7590	350	27	2064	A7590	380
28	2065	A7330	260	28	2065	A7330	260
29	4727	A6600	730	29	4727	A6600	730
30	4728	A6200	400	30	4728	A6150	450
31	461	A6020	180	31	Removed	N/A	N/A
32	2068	A5640	380	32	2068	A5640	510
33	2069	A5430	210	33	Removed	N/A	N/A
34	2070	A5030	400	34	2070	A5180	460
35	2084	A4640	390	35	2084	A4620	560
36	768	A4020	620	36	768	A4000	620
37	769	A3710	310	37	769	A3710	290
38	770	A3255	455	38	770	A3315	395
39	771	A3050	205	39	771	A3050	265
40	772	A2685	365	40	Removed	N/A	N/A
41	773	A2485	200	41	773	A2475	575
42	774	A2235	250	42	Removed	N/A	N/A
43	775	A1920	315	43	775	A1925	550
44	776	A1630	290	44	776	A1630	295
45	777	A1415	215	45	777	A1415	215
46	906	A1085	330	46	906	A1170	245
47	907	A850	235	47	907	A850	320
48	908	A665	185	48	908	A675	175
49	909	A405	260	49	909	A400	275
50	786	A140	265	50	786	A200	200
		Average Distance (m)	370			Average Distance (m)	414

Outbound							
Existing				Proposed			
No.	Bus Stop No.	Station Chainage	Distance from next Stop (m)	No.	Bus Stop No.	Station Chainage	Distance from next Stop (m)
1	845	A110	N/A	1	845	A130	N/A
2	846	A365	255	2	846	A365	235
3	847	B50	300	3	847	A620	255
4	848	B350	290	4	848	A950	330
5	2795	A1170	260	5	2795	A1265	10
6	756	A1515	345	6	756	A1540	275
7	757	A1850	335	7	757	A1820	280
8	758	A2050	200	8	758	A2050	230
9	759	A2440	390	9	759	A2440	390
10	760	A2710	270	10	760	A2700	260
11	761	A3065	355	11	761	A3075	375
12	762	A3350	285	12	762	A3350	275
13	763	A3660	310	13	763	A3660	310
14	764	A4020	360	14	764	A4020	360
15	2007	A4200	180	15	2007	A4200	180
16	2008	A4685	485	16	2008	A4685	485
17	2009	A5025	340	17	2009	A5250	565
18	2010	A5550	525	18	2010	A5575	325
19	435	A5885	335	19	Removed	N/A	N/A
20	7353	A6190	305	20	7353	A6200	625
21	4571	A6875	685	21	4571	A6740	540
22	2013	A7285	410	22	2013	A7400	660
23	2014	A7670	385	23	2014	A7670	270
24	4636	A7920	250	24	4636	A7880	210
25	2016	A8410	490	25	2016	A8410	530
26	2015	A8860	450	26	2015	A8850	440
27	2017	A9170	310	27	2017	A9180	330
28	3259	A9435	265	28	3259	A9600	420
29	7361	A9905	470	29	7361	A9905	305
30	7362	A10650	745	30	7362	A10650	745
31	3129	A11285	635	31	3129	A11450	800
32	3130	A11800	515	32	3130	A11810	360
33	3131	A12150	350	33	3131	A12150	340
34	3132	A12500	350	34	Removed	N/A	N/A
35	3133	A12810	310	35	3133	A12810	660
36	3134	A13300	490	36	3134	A13300	490
37	3135	A13870	570	37	3135	A13870	570
38	3136	A14540	670	38	3136	A14545	675
39	3138	A14950	410	39	3138	A15010	465

Outbound							
Existing				Proposed			
No.	Bus Stop No.	Station Chainage	Distance from next Stop (m)	No.	Bus Stop No.	Station Chainage	Distance from next Stop (m)
40	3139	A15445	495	40	3139	A15445	435
41	4124	A15700	255	41	4124	A15920	475
42	4125	A16220	520	42	4125	A16310	390
43	4126	A16390	170	43	Removed	N/A	N/A
44	4127	A16800	410	44	4127	A16890	580
45	4128	A17115	315	45	4128	A17225	335
46	4129	A17700	585	46	4129	A17790	565
47	4130	A18190	490	47	4130	A18210	420
48	4131	A18340	150	48	4131	A18390	180
		Average Distance (m)	389			Average Distance (m)	408

Table 4-11: Proposed Scheme Coach Stop Summary

Inbound							
Existing				Proposed			
No.	Coach Stop No. if Shared with Bus Stop	Station Chainage	Distance from next Stop (m)	No.	Coach Stop No. if Shared with Bus Stop	Station Chainage	Distance from next Stop (m)
1	4154	A18290	N/A	1	-	A18290	N/A
2	4202	A17120	1170	2	4202	A17085	1205
3	4206	A15740	1380	3	Removed	N/A	N/A
4	3140	A15485	255	4	-	A16335	750
5	3142	A14505	980	5	3142	A14505	1830
6	3143	A13910	595	6	-	A13900	605
7	3145	A13135	775	7	-	A13120	780
8	5127	A11320	1815	8	-	A11320	1800
9	5128	A10700	620	9	-	A10665	655
10	3258	A9450	1250	10	Removed	N/A	N/A
11	2060	A9205	245	11	-	A9230	1435
12	2061	A8790	415	12	Removed	N/A	N/A
13	2062	A8200	590	13	-	A8245	985
14	2063	A7940	260	14	-	A7930	315
15	4727	A6600	1340	15	4727	A6600	1330
16	461	A6020	580	16	-	A6200	400
17	2070	A5030	990	17	-	A5225	975
18	768	A4020	1010	18	768	A4020	1205

Inbound							
Existing				Proposed			
No.	Coach Stop No. if Shared with Bus Stop	Station Chainage	Distance from next Stop (m)	No.	Coach Stop No. if Shared with Bus Stop	Station Chainage	Distance from next Stop (m)
19	770	A3255	765	19	-	A3010	1010
20	772	A2685	570	20	Removed	N/A	N/A
21	773	A2485	200	21	773	A2485	525
22	775	A1920	565	22	Removed	N/A	N/A
23	776	A1630	290	23	776	A1630	855
24	906	A1085	545	24	Removed	N/A	N/A
25	908	A625	460	25	-	A645	985
26	909	A410	215	26	-	A340	305
27	786	A140	270	27	-	A215	125
		Average Distance (m)	698			Average Distance (m)	904

Outbound							
Existing				Proposed			
No.	Coach Stop No. if Shared with Bus Stop	Station Chainage	Distance from next Stop (m)	No.	Coach Stop No. if Shared with Bus Stop	Station Chainage	Distance from next Stop (m)
1	845	A110	N/A	1	-	A115	N/A
2	846	A365	255	2	-	A415	300
3	847	A610 (B50)	245	3	847	B50	195
4	848	A950 (B350)	340	4	-	B300	340
5	756	A1515	565	5	756	A1540	590
6	759	A2440	925	6	759	A2860	1320
7	760	A2670	230	7	-	A2860	0
8	762	A3350	680	8	-	A3285	425
9	764	A4020	670	9	764	A4020	735
10	2007	A4200	180	10	-	A4200	180
11	2009	A5025	825	11	-	A4870	670
12	435	A5885	860	12	-	A6300	1430
13	4571	A6875	990	13	-	A6875	575
14	4636	A7920	1045	14	-	A7780	905
15	2016	A8410	490	15	-	A8475	695
16	2017	A9170	760	16	-	A9120	645
17	7361	A9905	735	17	Removed	N/A	N/A

Outbound							
Existing				Proposed			
No.	Coach Stop No. if Shared with Bus Stop	Station Chainage	Distance from next Stop (m)	No.	Coach Stop No. if Shared with Bus Stop	Station Chainage	Distance from next Stop (m)
18	7362	A10650	745	18	-	A10700	1580
19	3129	A11285	635	19	-	A11285	585
20	3134	A13300	2015	20	3134	A13300	2015
21	3135	A13875	575	21	-	A13900	600
22	3139	A15445	1570	22	-	A16515	2615
23	4128	A17115	1670	23	4128	A17225	710
24	4131	A18340	1225	24	4131	A18390	1165
		Average Distance (m)	793			Average Distance (m)	831

4.13.2 Island Bus Stops

The preferred bus stop arrangement for the Proposed Scheme is the island bus stop arrangement as shown below in **Figure 4.9.**

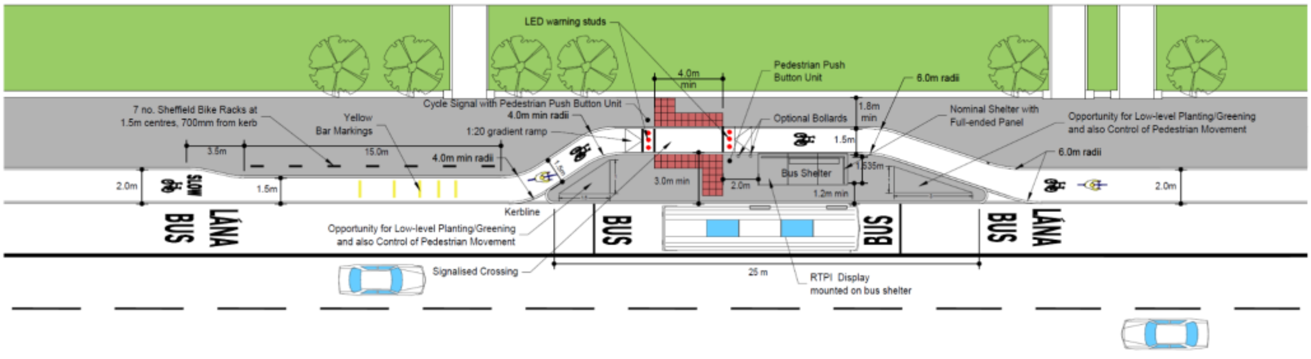

Figure 4.9: Example of an Island Bus Stop

This arrangement will reduce the potential for conflict between pedestrians, cyclists and stopping buses by deflecting cyclists behind the bus stop, thus creating an island area for boarding and alighting passengers. On approach to the bus stop island the cycle track is intentionally narrowed with yellow bar markings also used to promote a low-speed single file cycling arrangement on approach to the bus stop. Similarly, a 1 in 1.5 typical cycle track deflection is implemented on the approach to the island to reduce speeds for cyclists on approach to the controlled pedestrian crossing point on the island. To address the pedestrian/cyclist conflict, a pedestrian priority crossing point is provided for pedestrians accessing the bus stop island area. At these locations a 'nested Pelican' sequence similar to what has been provided on the Grand Canal Cycle Route is introduced so that visually impaired or partially sighted pedestrians may call for a fixed green signal when necessary and the cycle signal will change to red. Where the pedestrian call button has not been actuated the cyclists will be given a flashing amber signal to enforce the requirement to give way to passing pedestrians. A schematic outline of the nested pelican sequence is provided below in **Figure 4.10.** Audible tactile units will also be a featured at the crossing points.

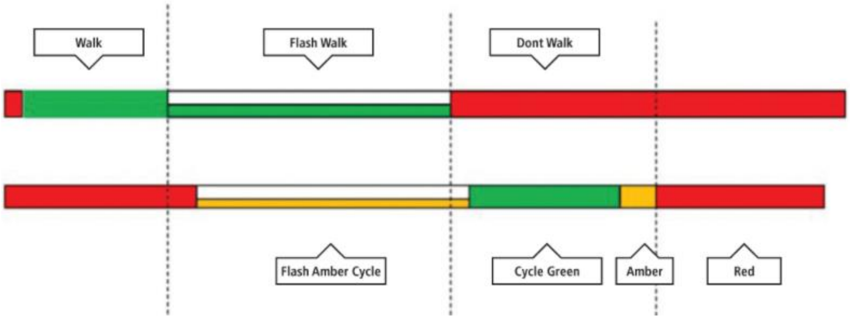

Figure 4.10: Example of a Nested Pelican Sequence

A 1:20 ramp is provided 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 in addition to a series of LED warning studs at the crossing location which are actuated by bus detector loops in the bus lane. The exit taper for the bus stop has been specified at 1 in 3 to provide for the gradual transition to the cycle track.

The desired minimum island width of 3m has been developed 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 should also be located in the immediate vicinity as shown in **Figure 4.11** to promote the use of sustainable mode interchange at bus stops for longer distance trips.

Figure 4.11: Example Landscaping Arrangement at Island Bus Stops on Oxford Road Manchester (source: Google Streetview 2021)

The island bus stop design is used for the majority of the bus stops along the Proposed Scheme. Additional information on the island bus stop design principles can be found in the BCPDG. **Table 4-12** below provides a summary of the proposed island bus stop locations.

Table 4-12: Proposed Island Bus Shelters

Inbound / Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Shelter	Bus Stop Type
Inbound	Woodbrook College	4202	A17080	New bus shelter proposed.	Island

Inbound / Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Shelter	Bus Stop Type
Inbound	St. Columcille's Road	3143	A13860	New bus shelter proposed.	Island
Inbound	Willow Court	3145	A13040	New bus shelter proposed.	Island
Inbound	St. Laurence College	3146	A12720	New bus shelter proposed.	Island
Inbound	Kilbogget Grove	3147	A12195	New bus shelter proposed.	Island
Inbound	Shrewsbury Lawn	3148	A11790	New bus shelter proposed.	Island
Inbound	Cabinteely Bypass	5127	A11260	New bus shelter proposed.	Island
Inbound	Leopardstown Road	2062	A8280	New bus shelter proposed.	Island
Inbound	Galloping Green	2063	A7970	New bus shelter proposed.	Island
Inbound	Brewery Road	2064	A7590	New bus shelter proposed.	Island
Inbound	Merville Road	2065	A7330	New bus shelter proposed.	Island
Inbound	Laurence Park	4727	A6600	New bus shelter proposed.	Island
Inbound	Oatlands College	4728	A6150	New bus shelter proposed.	Island
Inbound	Sycamore Crescent	2068	A5640	New bus shelter proposed.	Island
Inbound	St. Thomas Road	2070	A5180	New bus shelter proposed.	Island
Inbound	Seafield Road	2084	A4620	New bus shelter proposed.	Island
Inbound	UCD Interchange	768	A4000	New bus shelter proposed.	Island (and Plaza)
Inbound	Belfield Road	769	A3710	New bus shelter proposed.	Island
Inbound	RTE	770	A3315	New bus shelter proposed.	Island
Inbound	Mount Eden	775	A1925	New bus shelter proposed.	Island
Inbound	Morehampton Terrace	776	A1630	New bus shelter proposed.	Island
Inbound	Grand Parade	908	A675	No bus shelter proposed.	Island
Inbound (Coach)	Grand Parade	-	A645	No bus shelter proposed.	Island
Outbound	Mespil Road	847	A620	No bus shelter proposed.	Island
Outbound	Burlington Hotel	848	A950	New bus shelter proposed.	Island
Outbound	RTE	762	A3350	New bus shelter proposed.	Island
Outbound	Stillorgan Slip Road (UCD)	764	A4020	New bus shelter proposed.	Island
Outbound (Coach)	Stillorgan Slip Road (UCD)	-	A4200	New bus shelter proposed.	Island

Inbound / Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Shelter	Bus Stop Type
Outbound	Seafield Road	2008	A4685	New bus shelter proposed.	Island
Outbound	Colaiste Eoin	2009	A5250	New bus shelter proposed.	Island
Outbound	Priory Grove	7353	A6200	New bus shelter proposed.	Island
Outbound (Coach)	Priory Grove	-	A6300	New bus shelter proposed.	Island
Outbound	Patrician Villas	4571	A6740	New bus shelter proposed.	Island
Outbound	Farmleigh Avenue	2014	A7670	New bus shelter proposed.	Island
Outbound	Beechwood Court	4636	A7880	New bus shelter proposed.	Island
Outbound	Newtownpark Avenue	2016	A8410	New bus shelter proposed.	Island
Outbound	Cabinteely Way	7362	A10650	New bus shelter proposed.	Island
Outbound	Shrewsbury Lawn	3129	A11450	New bus shelter proposed.	Island
Outbound	Kilbogget Grove	3131	A12150	New bus shelter proposed.	Island
Outbound	St Laurence College	3133	A12810	New bus shelter proposed.	Island
Outbound	Commons Road	3135	A13870	New bus shelter proposed.	Island
Outbound	Woodbrook Strategic Housing Development	4127	A16890	New bus shelter proposed.	Island
Outbound	Woodbrook College	4128	A17225	New bus shelter proposed.	Island

4.13.3 Shared Landing Area Bus Stops

Where space constraints do not allow for an island bus stop, an option consisting of a shared bus stop landing zone will be considered. The principles of this arrangement are similar to those described in **Section 4.13.2**. The use of corduroy tactile paving on the cycle track is additional in this arrangement to help facilitate awareness and reduce speeds in lieu of the 1:1.5 deflection provision for the island bus stop. The cycle track will also be narrowed when level with the footpath and tactile paving provided to prevent pedestrian/cyclist conflict. Shared landing area bus stops were required in a number of locations along the CBC route due to localised space constraints. See **Table 4-13** below, for the locations of bus stops of this type. An example of a shared landing area bus stop is shown in

Figure 4.12.

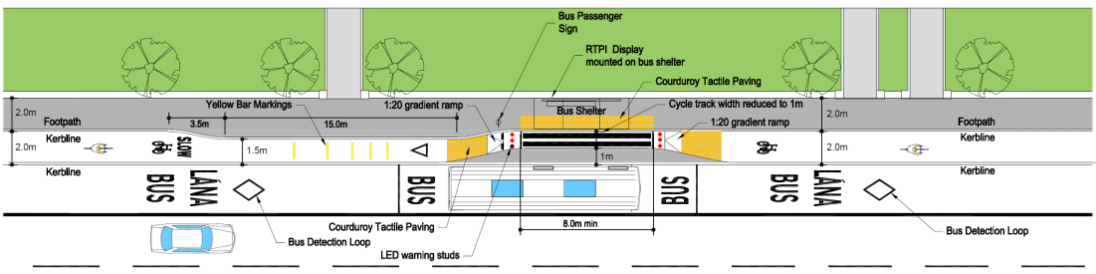

Figure 4.12: Example of a Shared Landing Area Bus Stop

Table 4-13: List of Shared Landing Area Bus Stops

Inbound / Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Shelter	Bus Stop Type
Inbound	St. Cronan's Road	4154	A18410	New bus shelter proposed.	Shared
Inbound	Roseville Court	4416	A17960	New bus shelter proposed.	Shared
Inbound	Old Connaught	4201	A17675	New bus shelter proposed.	Shared
Inbound	St. James Church	4203	A16800	New bus shelter proposed.	Shared
Inbound	Shanganagh Castle	4204	A16170	New bus shelter proposed.	Shared
Inbound	Clonkeen Road	5128	A10685	New bus shelter proposed.	Shared
Inbound	Old Bray Road	2996	A9815	New bus shelter proposed.	Shared
Inbound	Westminster Grove	3258	A9450	New bus shelter proposed.	Shared
Inbound (Coach)	Westminster Grove	-	A9230	New bus shelter proposed.	Shared
Inbound	Foxrock Church	2060	A9265	New bus shelter proposed.	Shared
Inbound	Knocksinna	2061	A8790	New bus shelter proposed.	Shared
Inbound (Coach)	Laurence Park	-	A6600	New bus shelter proposed.	Shared
Inbound	Teresian School	771	A3050	New bus shelter proposed.	Shared
Inbound (Coach)	Teresian School	-	A3010	New bus shelter proposed.	Shared
Inbound	Donnybrook Road	773	A2475	New bus shelter proposed.	Shared
Inbound	Royal Hospital	777	A1415	New bus shelter proposed.	Shared
Inbound	Leeson Street Upper	906	A1170	No bus shelter proposed.	Shared
Inbound	St. Johns Ambulance	907	A850	No bus shelter proposed.	Shared
Inbound	Fitzwilliam Place	909	A400	No bus shelter proposed.	Shared
Inbound (Coach)	Leeson Street Lower	-	A340	No bus shelter proposed.	Shared
Inbound (Coach)	Embassy of Malta	-	A215	No bus shelter proposed.	Shared
Inbound	Embassy of Malta	786	A200	No bus shelter proposed.	Shared
Outbound (Coach)	Leeson Street Lower	-	A115	No bus shelter proposed.	Shared
Outbound	Leeson Street Lower	845	A130	No bus shelter proposed.	Shared
Outbound	Fitzwilliam Place	846	A365	No bus shelter proposed.	Shared

Inbound / Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Shelter	Bus Stop Type
Outbound (Coach)	Leeson Close	-	A415	No bus shelter proposed.	Shared
Outbound	Leeson Village	2795	A1265	No bus shelter proposed.	Shared
Outbound	Morehampton Court	756	A1540	New bus shelter proposed.	Shared
Outbound	Brendan Road	757	A1820	New bus shelter proposed.	Shared
Outbound	Victoria Ave.	758	A2050	No bus shelter proposed.	Shared
Outbound	Donnybrook Stadium	759	A2440	New bus shelter proposed.	Shared
Outbound	Donnybrook Church	760	A2700	New bus shelter proposed.	Shared
Outbound	Teresian School	761	A3075	New bus shelter proposed.	Shared
Outbound	Belfield Road	763	A3660	New bus shelter proposed.	Shared
Outbound	Booterstown Ave.	2010	A5575	New bus shelter proposed.	Shared
Outbound	St. John of Gods	2013	A7400	New bus shelter proposed.	Shared
Outbound (Coach)	Newtownpark Avenue	-	A8475	New bus shelter proposed.	Shared
Outbound	Knocksinna	2015	A8850	New bus shelter proposed.	Shared
Outbound (Coach)	Foxrock Church	-	A9120	New bus shelter proposed.	Shared
Outbound	Foxrock Church	2017	A9180	New bus shelter proposed.	Shared
Outbound	Westminster Grove	3259	A9600	New bus shelter proposed.	Shared
Outbound	Old Bray Road	7361	A9905	New bus shelter proposed.	Shared
Outbound	Shrewsbury Lawn	3130	A11810	New bus shelter proposed.	Shared
Outbound	Cherrywood	3134	A13300	New bus shelter proposed.	Shared
Outbound	St. Anne’s Church	3138	A15010	New bus shelter proposed.	Shared
Outbound	Old Connaught Ave.	4129	A17790	New bus shelter proposed.	Shared
Outbound	Castle Street	4130	A18210	New bus shelter proposed.	Shared
Outbound	Dwyer Park	4131	A18390	New bus shelter proposed.	Shared

4.13.4 Inline Bus Stops

Inline bus stops are used on the Proposed Scheme where there are no adjacent cycling facilities provided due to the presence of offline cycle facilities. Inline bus stops are provided at the following locations listed in **Table 4-14**

Table 4-14: List of Inline Bus Stops

Inbound / Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Shelter	Bus Stop Type
Inbound	Shanganagh Cemetary	5090	A16460	New bus shelter proposed.	Inline
Inbound	Claremount	4206	A15780	New bus shelter proposed.	Inline
Inbound	Stonebridge Close	3140	A15480	New bus shelter proposed.	Inline
Inbound	Station Road	3141	A14930	New bus shelter proposed.	Inline
Inbound	Kentfield	3142	A14505	New bus shelter proposed.	Inline
Inbound	Cherrywood Road	3144	A13440	New bus shelter proposed.	Inline
Outbound	Kentfield	3136	A14545	New bus shelter proposed.	Inline
Outbound	Stonebridge Close	3139	A15445	New bus shelter proposed.	Inline
Outbound	Claremount	4124	A15920	New bus shelter proposed.	Inline
Outbound	Shanganagh Park	4125	A16310	New bus shelter proposed.	Inline

4.13.5 Layby Bus Stops

Layby bus stops can provide an effective solution for coaches with long dwell times at bus stops. However as stated in the BCPDGB; urban area bus stop laybys, when re-entering general traffic lanes, can present significant operational problems and negative impacts for bus users and should only be used where there are compelling safety, road capacity or operational reasons.

An example of a layby landing zone bus stop arrangement is shown below in **Figure 4.13**.

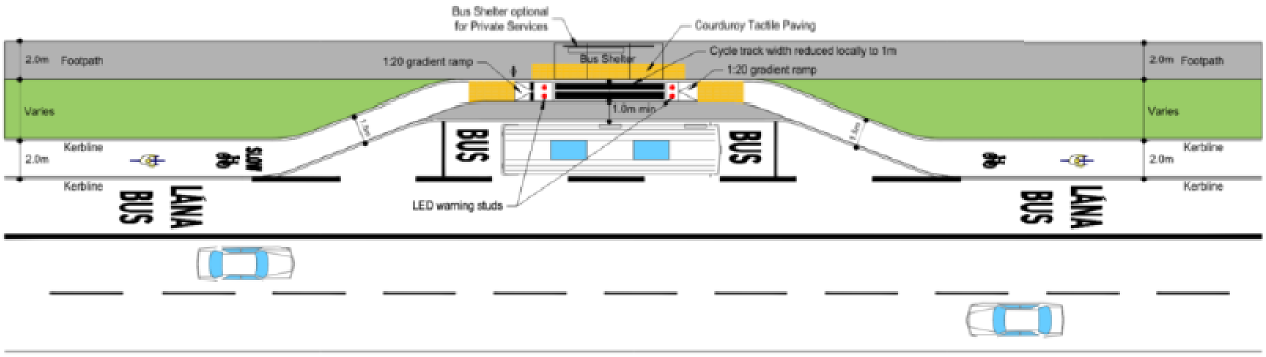

Figure 4.13: Example of a Layby Bus Stop

Table 4-15 below provides a summary of the proposed layby bus stop locations.

Table 4-15: List of proposed Layby Bus Stops

Inbound / Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Shelter	Bus Stop Type
Inbound (Coach)	Castle Street Shopping Centre	New	A18290	New bus shelter proposed.	Layby

Inbound / Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Shelter	Bus Stop Type
Inbound (Coach)	Allies River Road	New	A16335	New bus shelter proposed.	Layby
Inbound (Coach)	Saint Columcille’s Hospital	New	A13900	New bus shelter proposed.	Layby
Inbound (Coach)	Wyatville Slip Road	New	A13120	New bus shelter proposed.	Layby
Inbound (Coach)	Johnstown Road	New	A11320	New bus shelter proposed.	Layby
Inbound (Coach)	Clonkeen Road	New	A10665	New bus shelter proposed.	Layby
Inbound (Coach)	Leopardstown Road	New	A8230	New bus shelter proposed.	Layby
Inbound (Coach)	Galloping Green	New	A7930	New bus shelter proposed.	Layby
Inbound (Coach)	Oatlands College	New	A6200	New bus shelter proposed.	Layby
Inbound (Coach)	Saint Thomas Road	New	A5225	New bus shelter proposed.	Layby
Inbound (Coach)	Eglington Road	New	A2485	New bus shelter proposed.	Layby
Inbound	Eglington Road	773	A2475	New bus shelter proposed.	Layby
Outbound (Coach)	Sussex	New	A910 (B300)	New bus shelter proposed.	Layby
Outbound (Coach)	Donnybrook Church	New	A2860	New bus shelter proposed.	Layby
Outbound (Coach)	RTE	New	A3285	New bus shelter proposed.	Layby
Outbound (Coach)	Fosterbrook	New	A4870	New bus shelter proposed.	Layby
Outbound (Coach)	Stillorgan Park	New	A6875	New bus shelter proposed.	Layby
Outbound (Coach)	Galloping Green	New	A7780	New bus shelter proposed.	Layby
Outbound (Coach)	Cabinteely Way	New	A10700	New bus shelter proposed.	Layby
Outbound (Coach)	Johnstown Road	New	A11285	New bus shelter proposed.	Layby
Outbound (Coach)	St. Columcille's Hospital	New	A13900	New bus shelter proposed.	Layby
Outbound (Coach)	Shanganagh Cemetery	New	A16515	New bus shelter proposed.	Layby

4.13.6 Bus Shelters

Bus shelters provide an important function in the 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 4.14** 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.

For the UCD Interchange islands, standard shelters will be used here. Advertising panels may not be provided for these shelters to ensure cohesiveness with the surrounding campus environment with finish to match UCD street furniture. The UCD Interchange is discussed in more detail in **Appendix P and Appendix Q.**

Bus shelters have not been provided on few bus stops along Lesson Street Lower, Lesson Street Upper and Morehampton Road, as tabulated in **Table 4-13** ; as these shelters will have significant and long term visual impact on the buildings and protected structures and the streetscape during the Operational phase due to their location. There are currently fingerpost bus stops and will be replaced with the latest TFI posts and flags.

Alternative arrangements for more constrained footpath widths are considered in the following sections.

Figure 4.14: 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 4.15** 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 4.15: 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 minimum 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. **Figure 4.16** below provides an example of this type of shelter. 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 allow for boarding and alighting passengers in consideration of wheelchair, pram, luggage, and other such similar spatial requirements.

Figure 4.16: 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. The preferred shelter location is shown below in **Figure 4.17**. 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 in **Figure 4.18** and **Figure 4.19**. At certain locations the shelter positioning has been limited due to existing constraints and therefore final shelter positioning has been considered on a case-by-case basis.

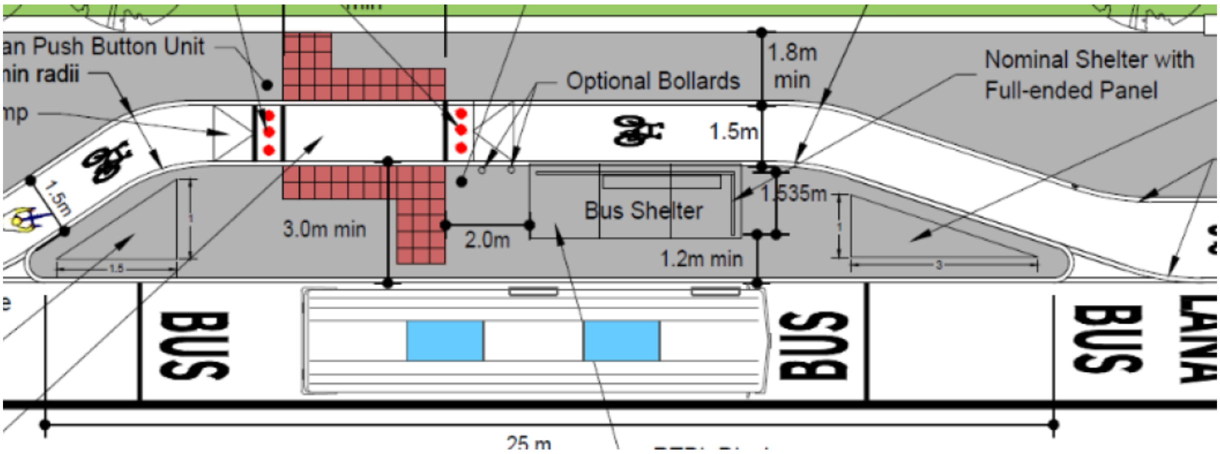

Figure 4.17: Preferred Shelter Location (on Island)

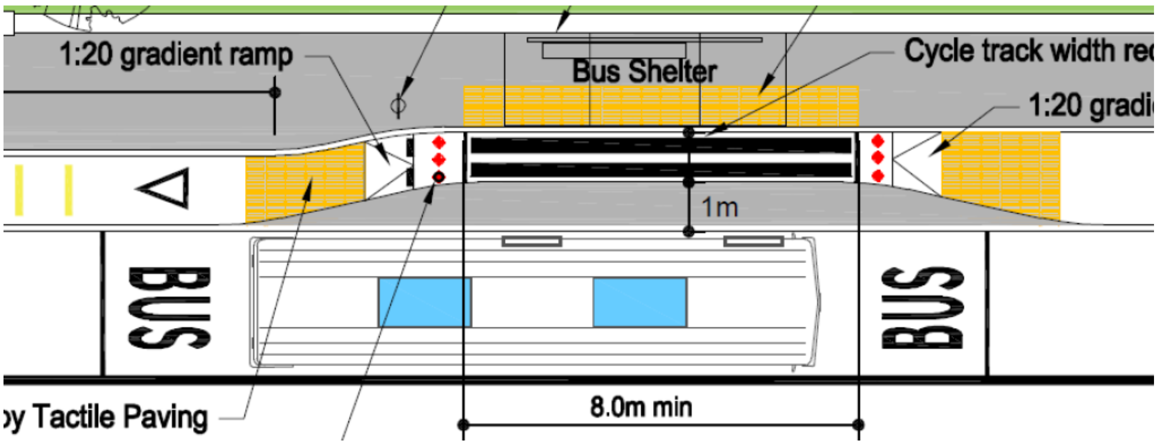

Figure 4.18: Alternative Shelter Location Back of Footpath (Narrow Island with Adequate Footpath Widths)

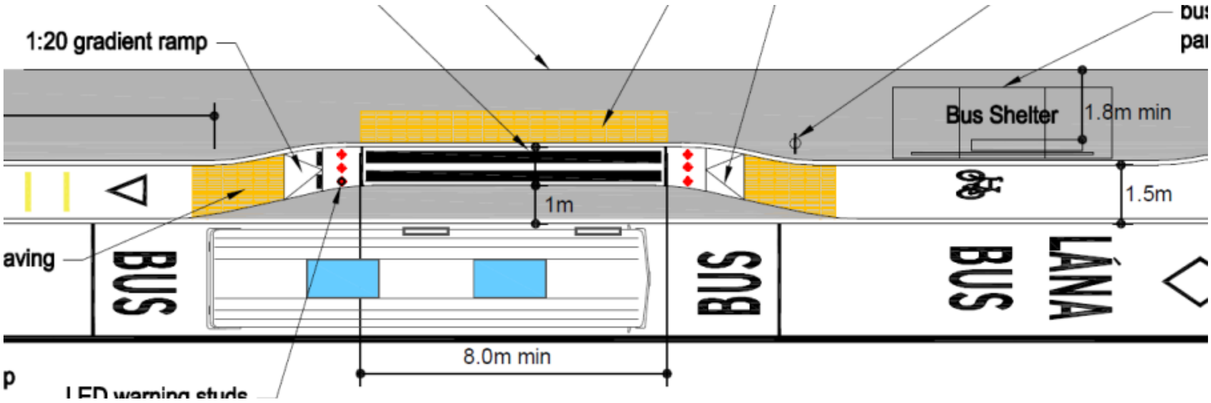

Figure 4.19: Alternative Shelter Location Downstream of Island (Narrow Island with Narrow Footpath Widths at Landing Area)

4.14 Parking and Loading

As part of the ongoing assessment of existing conditions to support the development of the engineering design along the Proposed Scheme, a parking survey assessment was undertaken to assess the existing loading and parking arrangements and potential alternatives along the Proposed Scheme. **Appendix G** provides the details of the Parking and Loading Report.

The report was prepared in the absence of parking survey data, which could not be obtained due to ongoing movement restrictions as a result of the international Covid-19 pandemic, information was obtained by site visits and desktop studies. Quantification of the number of existing parking spaces and their potential removal along the scheme is a critically important task, as removal of parking without provision of viable replacement options may result in a reduction in the cross-sectional width of the design.

Below is an overview of the methodology in assessing the parking impacts along the Proposed Scheme:

- Review the existing parking arrangements on the road network or immediately adjacent to the Proposed Scheme;
- Assess the impacts associated with the current design proposals;
- Identify possible mitigation measures / alternative parking arrangements;
- Analyse mitigation measure to inform the optimum recommendation; and
- Provide recommendations and identify residual parking impacts.

In assessing the Proposed Scheme the following parking/loading classifications were adopted:

- Designated Paid Parking;
- Permit Parking;
- Disabled Permit Parking;
- Loading/Unloading (in designated Loading Bays);
- Loading/Unloading (outside designated Loading Bays);
- Taxi Parking (Taxi Ranks);
- Commercial vehicles parked for display (car sales); and
- Illegal Parking.

In addition to the above consideration for other parking usage/ behaviour has been analysed under the following classifications:

- Informal parking: on-street parking in which spaces may or may not be marked and in which the Local Authority does not charge for use; and
- Adjacent parking: parking which is located in close proximity to the street. This parking includes free and paid parking and highlights car parks which may be affected by future design proposals.

4.14.1 Summary of Parking Amendments

The locations for existing and proposed parking/loading modifications in line with the Proposed Scheme have been identified on the GEO_GA General Arrangement drawings in **Appendix B** and further discussed in detail in **Appendix G**. The proposed changes in parking provision are summarised in **Table 4-16** which provides a summary of the key residual parking/loading impacted areas along the Proposed Scheme.

Table 4-16: Summary of Parking Amendments

Locality	Parking type	Existing Parking Provision	Proposed Parking Provision	Change
Leeson Street Lower and	Designated paid parking	2	0	-2

Locality	Parking type	Existing Parking Provision	Proposed Parking Provision	Change
Upper, Sussex Road	Permit parking	56	59	+3
	Loading bays (designated)	8	2	-6
	Loading bays (Non designated)	1	0	-1
	Taxi rank	30	9	-21
	Illegal parking	7	0	-7
Morehampton Road	Designated paid parking	17	0	-17
	Permit parking	21	3	-18
	Illegal parking	4	0	-4
	Loading bays (designated)	0	2	+2
	Informal parking	4	0	-4
Donnybrook Road	Designated paid parking	38	21	-17
	Permit parking	1	0	-1
	Loading bays	9	4	-5
	Commercial parking (incl. businesses)	15	5	-10
UCD Interchange	Permit parking	82+	0	-82
Belmont Terrace	Informal parking	23	21	-2
	Illegal parking	3	0	-3
St Anne's Church at Shankill	Informal parking	83	83	0
Dublin Road at Old Connaught Ave / Corke Abbey Ave	Disabled parking	0	1	+1
	Commercial vehicles (car sales)	76	62	-14
	Commercial parking (incl. businesses)	19	9	-10
Castle Street	Designated paid parking	132	119	-13
	Loading bays (Designated)	2	6	+4
	Loading bays (Undesignated)	2	0	-2
	Commercial vehicles (car sales)	16	13	-3
	Commercial vehicles (incl. businesses)	15	4	-11

4.14.2 Summary of Parking Changes

With the Proposed Scheme in place, the impacts of the change in on-street parking have been considered and are itemised below (in summary); the associated mitigation effects and other measures are also summarised:

- Leeson Street and Sussex Road, 21 taxi rank spaces along Leeson Street Lower and Sussex Road, 6 designated and 1 non-designated loading bay on Leeson Street and Sussex Road, and 2 paid parking spaces on Leeson Street Upper. An overall parking loss of 30 spaces resulting from the proposed design. 21 alternative time plated taxi ranks are proposed on Hatch Street Lower to mitigate against the impact of the design. Adjacent parking has been investigated and is considered appropriate to mitigate against the Proposed Scheme impacts.

- Morehampton Road, the Proposed Scheme shows a loss of commercial car parking spaces, serving those facilities for Hampton Hotel and shops between Marlborough Road/Herbert Park to Belmont Avenue. Permit parking, designated paid parking, informal parking and disabled permit parking is proposed to be impacted in the context of commercial parking arrangements, and residential parking has also been impacted from those Proposed Schemes in Morehampton Road. An overall parking loss of 39 spaces resulting from the current design proposals (excluding observed illegal parking). An alternative disabled parking space has been identified in the design. Adjacent parking has been investigated and is considered appropriate to mitigate against the Proposed Scheme impacts.

- Donnybrook Road, Proposed Scheme shows a loss of 5 designated loading/unloading bays and impacted residential parking spaces located on the northbound west of the junction with Auburn Avenue. There is also a loss of parking spaces to the front of the First Stop and Fast Fit garages. An overall parking loss of 33 spaces resulting from the current design proposals. Adjacent parking has been investigated and is considered appropriate to mitigate against the Proposed Scheme impacts.

- UCD Interchange construction will result in the loss of 82 spaces. This has been coordinated with the wider UCD Future Campus masterplan.

- Belmont Terrace, the Proposed Scheme shows a minor impact to 2 informal parking spaces. Adjacent parking has been investigated and is considered appropriate to mitigate against the Proposed Scheme impacts.

- St Anne's Church shows an impact to 10 informal parking spaces adjacent to Dublin Road without reconfiguring the parking lot. Subject to agreement with car park owner, the space will be reviewed and optimised to retain parking spaces. Adjacent parking has been investigated and is considered appropriate to mitigate against the Proposed Scheme impacts.

- The Proposed Scheme shows a loss of 24 and 29 car parking spaces in Dublin Road at Old Connaught Ave/Corke Abbey Avenue Junction and along Castle Street respectively which includes the loss of car park spaces at the Dargle Centre and Castlestreet Shopping Centre.

4.15 Turning Bans

Turning bans and restricted movements along the route are shown on the General Arrangement Drawings within **Appendix B.**

A summary of the turning bans along the Proposed Scheme are shown in **Table 4-17.**

Table 4-17: Summary of Turning Bans

Chainage	Minor Road	Major Road	Existing or Proposed	TM Measure Implemented	Reason for Mitigation	Impact of Mitigation
A0	St Stephen's Green East	Leeson Street Lower	Existing	No right turn, onto major road		
A0	St Stephen's Green West	Leeson Street Lower	Proposed	No right turn, onto major road	Traffic is rerouted away from Leeson	Improved reliability for bus journey

Chainage	Minor Road	Major Road	Existing or Proposed	TM Measure Implemented	Reason for Mitigation	Impact of Mitigation
					Street Lower to prioritize public transport	times along the corridor
A0	Earlsfort Terrnace	St Stephen's Green East	Existing turning ban removed	No left turn, onto major road	Northbound traffic from Lesson Street Lower is routed through Hatch Street and Earlsfort Terrance for the Bus Gate.	Improved reliability for bus journey times along the corridor
A55	Leeson Lane	Leeson Street Lower	Proposed	No right turn, onto major road	Traffic is rerouted away from Leeson Street Lower between Earlsfort Terrace and Hatch Street Lower to prioritize public transport, cycling and walking at this location.	Improved reliability for bus journey times along the corridor
A55	-	Leeson Street Lower	Proposed	No straight on, except buses and bicycles, onto major road	Required to direct traffic down Leeson Lane and away from St Stephen's Green junction at posted hours. This will maximise the efficiency of the bus network in this area. The shared traffic lane transitions to a bus lane after this sign.	Improved reliability for bus journey times along the corridor
A235	Pembroke Street Upper	Leeson Street Lower	Proposed	No right turn except for access onto major road	Traffic is rerouted away from Leeson Street Lower between Earlsfort Terrace and Hatch Street Lower to prioritize public transport, cycling and walking at this location.	Improved reliability for bus journey times along the corridor
A235	Hatch Street Lower	Leeson Street Lower	Proposed	No left turn except for buses and access onto major road	Traffic is rerouted away from Leeson Street Lower between Earlsfort Terrace and Hatch Street Lower to prioritize public transport, cycling and walking at this location.	Improved reliability for bus journey times along the corridor

Chainage	Minor Road	Major Road	Existing or Proposed	TM Measure Implemented	Reason for Mitigation	Impact of Mitigation
A255	-	Leeson Street Lower	Proposed	No straight on except for buses and access	Traffic is rerouted away from Leeson Street Lower between Earlsfort Terrace and Hatch Street Lower to prioritize public transport, cycling and walking at this location.	Improved reliability for bus journey times along the corridor
A450 and 490	Adelaide Road	Leeson Street Lower	Existing	No left turn, onto minor road		
A535	Wilton Terrace	Leeson Street Lower	Existing	No right turn onto minor road		
A555	Grand Parade	Leeson Street Lower	Existing	No right turn onto major road		
A560	Grand Parade	Leeson Street Upper	Existing	No right turn onto minor road		
B5	Mespil Road	Leeson Street Upper	Existing	No left turn onto major road		
B5	Mespil Road	Leeson Street Upper	Existing	No right turn onto minor road		
B120	Sussex Terrace	Lesson Street Upper	Existing	No left turn onto major road		
B400	-	Leeson Street Upper	Existing	No right turn onto major road		
A990	-	Leeson Street Upper	Existing	No right turn onto major road		
A1015	Burlington Road	Leeson Street Upper	Existing	No right turn onto major road.		
A1150	Waterloo Lane	Leeson Street Upper	Existing	No right turn onto major road		
A1325	Wellington Place	Morehampton Road	Proposed	No right turn onto minor road	Existing junction layout already precludes right turn from Morehampton Road onto Wellington Place. The addition of Proposed Signage will make traversing the junction clearer for drivers.	Clarifying existing arrangements
A1705	Marlborough Road	Morehampton Road	Existing	No right turn onto minor road		
A1715	Herert Park	Morehampton Road	Existing	No right turn onto minor road		
A1875	Brendan Road	Morehampton Road	Existing	No right turn onto minor road		
A1950	Auburn Avenue	Morehampton Road	Proposed	No right turn onto minor road	Proposed design at this location requires the removal of contra-flow road	Improved reliability for bus journey times along the corridor

Chainage	Minor Road	Major Road	Existing or Proposed	TM Measure Implemented	Reason for Mitigation	Impact of Mitigation
					markings and kerbed lane separation guidance islands that are preferred for turning right across oncoming traffic. Introducing a turn ban at this location brings it in line with the rest of Morehampton Road, where northbound right turns are currently banned onto adjacent roads. Queuing vehicles turning onto Auburn Avenue will block the development of the Bus Lane along Morehampton Lane. Queueing vehicles to turn onto Auburn Avenue may overlap central white line, preventing right turn lane from developing on approach to Belmont Avenue. Right turn is provided for vehicles 50m to the south at Victoria Avenue / Belmont Avenue Junction.	
A2525	Eglinton Road	Donnybrook Road	Existing	No right turn onto minor road		
A2570	Beaver Row	Stillorgan Road	Existing	No right run onto minor road		
A2600	Beaver Row	Stillorgan Road	Existing	No right turn, except buses onto major road		
A2640	Anglesea Road	Stillorgan Road	Existing	No right turn onto minor road		
A8120	Belmount Grove	Stillorgan Road	Existing	No left turn into minor road		
A11215	Johnstown Road	N11 Bray Road	Existing	No right turn onto minor road		
A12740	-	Beech Grove Cottages	Existing	No straight on		
A11400	Johnstown Road	N11 Bray Road	Existing	No right turn onto minor road		

Chainage	Minor Road	Major Road	Existing or Proposed	TM Measure Implemented	Reason for Mitigation	Impact of Mitigation
A13490	-	Bray Road	Existing	No straight on N11		
A13740	-	Bray Road	Existing	No straight on		

4.16 Relaxations, Departures and Deviations from Standard

The design has been developed in accordance with the standards and guidance listed within **Section 4.1**. However, in some circumstances it has been necessary to digress from the desirable minimum geometric parameters identified.

4.16.1 DMURS Design Compliance Statement

The Proposed Scheme has been designed in line with the principles and guidance outlined within the Design Manual for Urban Roads and Streets (DMURS) 2019. The scheme proposals have been developed in direct response to the aims and objectives of the Proposed Scheme 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 Scheme 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.
- Providing of cycle-protected junctions to control the speed at which vehicles can travel through the junction and incorporating tight kerb radii to limit vehicles' speed, but also allowing occasional larger vehicles to manoeuvre safely through the junction, while also reducing pedestrian crossing distances.
- The inclusion of new and enhanced pedestrian crossing facilities to promote increased pedestrian activity along the scheme, providing safe desire lines for pedestrians to and from all directions. The Proposed Scheme 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 scheme to improve the interaction between parked vehicles, pedestrians and cyclists.
- The implementation of traffic calming measures and side entry treatments to promote pedestrian activity on the junction side-arms.

The scheme 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** as far as practicable, but in some instances, it has been necessary to deviate away from these. A schedule of identified departures and deviations relating to the road geometry, alongside those identified for other technical design elements, is included within **Appendix C.**

In addition, for the N11 section of the Proposed Scheme between Kill/N11 junction and Loughlinstown Roundabout in particular with 80kh/h speed limit, the design seeks to minimise largescale changes to the existing infrastructure where it is deemed to be suitable for use in its existing case, under TII standards. The design parameters stated in the following TII standards were adopted, and any departures or relaxations from those standards are recorded in **Appendix C.**

- DN-GEO-03031
- DN-GEO-03044
- DN-GEO-03036

4.17 Road Safety and Road User Audit

Road Safety Audits 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:

DMURS recommends that a Quality Audit should be undertaken to demonstrate that appropriate consideration has been given to all of the relevant aspects of the design of any scheme which involves works on public roads. Furthermore, NGS Circular 3 of 2022, issued by the Department of Transport on the 7th June 2022 notes that Quality Audits are required for all works carried out on public roads which involve new infrastructure or reconfiguration of existing infrastructure.

NGS Circular 3 of 2022 outlines the following stages in the Audit process:

- **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 and 2:** Completion of detailed design, prior to tender of construction contract, for small schemes where only one design stage audit is appropriate.
- **Stage 3:** Completion of construction (prior to opening of the scheme, or part of the scheme to traffic wherever possible).
- **Stage 4:** Early operation at 2 to 4 months' post road opening with live traffic.

In line with the above, a Stage 1 Quality Audit has been carried out on the Proposed Scheme. Refer to the Quality Audit Report in **Appendix M.**

The Quality Audit considers the following elements, and has been undertaken in general accordance with DMURS:

- Visual Quality Audit;
- Street Use Audit;
- Road Safety Audit;
- Access Audit;
- Walking Audit;
- Cycle Audit;
- Non-Motorised User Audit;
- Community Audit; and
- Place Check Audit.

The Stage 1 Road Safety Audit has been carried out in accordance with TII Publication 'GE-STY-01024 Road Safety Audit' document and includes designer responses with changes made the design as appropriate. Refer to the RSA report in **Appendix M**. Stage F Road Safety Audit (RSA) was undertaken as part of the Emerging Preferred Route Selection process.

The Stage 1 RSA represents the response of an independent audit team to various aspects of the scheme at preliminary design stage. 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 scheme as constructed can be improved to address issues of road safety.

5. Junction Layout

5.1 Overview of Transport Modelling Strategy

The design and modelling of junctions has been an iterative process to optimise the number of people that can pass through each junction, with priority given to pedestrian, cycle and bus movements.

The design for each junction within the Proposed Scheme was developed to meet the underlying objectives of the project and to align with the geometric parameters set out in **Section 4.1** in conjunction with the junction operation principles described in the BCPDG. Various traffic modelling tools were used to assess the impact of the proposals on a local, corridor and surrounding road network level which is further described in **Section 5.3.5.**

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

- **Do Minimum (DM) –** This scenario represents the likely conditions of the road network with all major committed transportation schemes in place that will impact on the use of public transport and private car, without the Proposed Scheme; and
- **Do Something (DS) –** This scenario represents the likely conditions of the road network with all major committed transportation schemes in place that will impact on the use of public transport and private car, with the Proposed Scheme (i.e. the 'DM' scenario with the addition of the Proposed Scheme).

Both scenarios above comprised of an assessment at opening year (2028) and opening year +15 years (2043). In developing the design proposals for the Proposed Scheme, the 2028-year flows were determined to provide the higher volume of traffic flows for the most part and as such has been generally adopted as the design case scenario for junction development. Where design flows from the 2028 DoSomething model were not deemed appropriate for a specific location the flows associated with the DM and or base 2019 survey flows have been considered. Similarly, the final junction designs have been supplemented with additional cycle volumes to try and ensure a minimum 10% cycle mode share in terms of people movement at each junction can be achieved in line with the National Cycle Policy Framework.

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 Scheme, a key policy is to ensure appropriate capacity and reliability for the bus services so as to maximise the overall throughout of people 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, 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 Scheme has been approached on a case-by-case basis. There have been a number components of the design development process that have influenced the preliminary junction designs including:

- The junction operational and geometrical principles described in the BCPDG;
- 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;
- PMSC to inform junction staging and design development;
- LINSIG junction modelling to assess junction design performance and refinement;
- Micro-Simulation modelling to assess and refine bus priority designs; and
- Cyclist quantification.

5.3 Junction Geometry Design

5.3.1 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 in a safe and convenient manner. Pedestrian crossings have been placed as close to pedestrian desire lines as possible. Where pedestrians are required to cross a cycle track, this is proposed to be controlled by traffic signals to manage potential conflicts.

The preferred arrangement for pedestrians at junctions is to have a wrap-around pedestrian signal stage at the start of the cycle. In many instances, this hasn't been feasible i.e., due to crossing distances and the associated intergreen time for pedestrians to safely clear the junction. A "walk with traffic" system is therefore proposed at certain junctions, in particular where refuge islands have been introduced for a two-stage pedestrian crossing. At these locations, controlled crossing for pedestrians is provided across part of the junction, whilst some of the traffic movements that are now in conflict with the pedestrian movement, are allowed to run at the same time. This facility has the advantage of allowing pedestrians to cross during the cycle whilst having less effect on traffic capacity.

To minimise pedestrian delays at junctions, it was important that proposed junction cycle times are kept as short as possible. The cycle times at all signalised junctions in the DS scenarios for 2028 and 2043 are proposed to be reduced in comparison to the DM cycle times, as shown in the summary **Table 5-1**.

Table 5-1: Junction Cycle Times

Junction	Do Minimum Cycle Time (seconds))	DoSomething Cycle Time (seconds)
St Stephen's Green / Earlsfort Terrace	120	120
Leeson Street Lower / Hatch Street	120	120
Leeson Street Lower / Fitzwilliam Place / Wilton Terrace	120	120
Leeson Street Upper / Grand Parade	120	120
Leeson Street Upper / Dartmouth Road	120	120
Sussex Road / Sussex Terrace	n/a	120
Leeson Street Upper / Burlington Road	120	120
Leeson Street Upper / Appian Way	120	120
Leeson Street Upper / Waterloo Road	120	120
Leeson Street Upper / Wellington Place	120	120
Morehampton Road / Bloomfield Avenue	120	120
Morehampton Road / Herbert Park / Marlborough Road	120	120
Donnybrook Road / Belmont Avenue / Victoria Avenue	n/a	120
Donnybrook Road / Eglinton Terrace Bus Pre-Signal	n/a	Demand Dependent
Donnybrook Road / Eglinton Road	120	120
Donnybrook Road / Anglesea Road / Beaver Row	120	120
Stillorgan Road / Airfield Park / RTE	120	120
Stillorgan Road / Greenfield Park / Nutley Lane	120	120
UCD Grade Separated Junction	120	120
Stillorgan Road / Fosters Avenue	120	120
Stillorgan Road / Belfield Park / The Rise	120	120
N11 Stillorgan Road / Booterstown Avenue	120	120
N11 Stillorgan Road / Mount Merrion Avenue	120	120
N11 Stillorgan Road / Treesdale / Trees Road Lower	120	120
N11 Stillorgan Road / Priory Drive / Old Dublin Road	120	120

Junction	Do Minimum Cycle Time (seconds))	DoSomething Cycle Time (seconds)
N11 Stillorgan Road / Lower Kilmacud / Stillorgan Park Road	120	120
N11 Stillorgan Road / Farmleigh Avenue / N31 Brewery Road	120	140
N11 Stillorgan Road / Belmont Terrace	Demand Dependent	Demand Dependent
N11 Stillorgan Road / Leopardstown Road / Newtownpark Avenue	120	140
N11 Stillorgan Road / Springfield Park	120	120
N11 Stillorgan Road / Kill Lane	120	120
N11 Stillorgan Road / Westminster Road	120	120
N11 Stillorgan Road / Bray Road	120	120
N11 Bray Road / Clonkeen Road	120	120
N11 Bray Road / Johnstown Road	120	120
N11 Bray Road / Cherrywood	120	120
N11 Bray Road / Wyattville Northbound Slip Roads	60	60
N11 Bray Road Southbound Slip Roads / Wyattville Road	120	120
N11 Bray Road / Cherrywood Road / Silver Tassie	120	120
Loughlinstown Roundabout	n/a	60
Dublin Road / Stonebridge Road	120	80
Dublin Road / Shanganagh Road / Corbawn Lane	n/a	120
Shanganagh Road / Beechfield Manor	120	120
Dublin Road / Quinns Road / Cherrington Road	n/a	60
Dublin Road / Olcovar	n/a	80
Dublin Road / Shanganagh Park	90	80
Dublin Road / Woodbrook	90	92
Dublin Road / M11	n/a	120
Dublin Road / Corke Abbey Avenue / Old Connaught Avenue	120	120
Dublin Road / Chapel Lane	n/a	120
Dublin Road / Upper Dargle Road	120	120

5.3.2 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.

Based on international best practice, the preferred layout for signalised junctions is the “Protected Junction”, which provides physical kerb build outs to protect cyclists at junctions. The key design features and considerations relating to this junction type are listed below:

- The traffic signal arrangement removes any uncontrolled conflict between pedestrians and cyclists, assigning clear priority to all users at different stages within a traffic cycle;
- Kerbed corner islands should be provided to force turning vehicles into a wide turn and remove the risk of vehicles cutting into the cycle route at the corner, which is a cause of serious accidents at junctions. The raised islands create a protective ring for cyclists navigating the junction, improving safety for right turning cyclists

- Cycle tracks that are protected behind parking or loading bays return to run along the edge of the carriageway approaching the junction. Consideration has been given to remove any parking or loading located immediately at junctions to enhance visibility between motorists and cyclists;

- The cycle track is typically ramped down to carriageway level on approach to the junction and proceeds to a forward stop line. A secondary cycle stop line is also proposed at an advanced location to the vehicular stop line at a number of junctions to cater for right turning cyclists, while also placing the cyclists within viewing of traffic waiting at the junction. Cycle signals will control the movement of cyclists including the second stage movement i.e. right turners.

- Cyclist and pedestrian crossings have been kept as close as possible to the mainline desire line. However pedestrian and cyclist crossings are to be separated where feasible. This is to ensure motorists infer a clear differentiation between cycle lane crossing through the junction and the pedestrian crossing across the same arm.

In some instances, protected junctions have not been incorporated into the design of a signalised junction. In these instances, this has been limited to minor signalised junctions where left turning movements by general traffic is projected to be low and cyclists desire line is projected to be straight through the junction.

5.3.3 Bus Priority

The scheme incorporates four different types of bus priority design which have been outlined in the BCPDG and referred to as Junction Types 1 to 4. The subsections below provide an overview of each junction type design and the principles for applying this junction type.

5.3.3.1 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 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.

In this instance, mainline cyclists proceed with the bus phase. The bus lane gets red, allowing the general traffic lane to proceed. If the volume of turning vehicles is greater than 150 PCUs, then the cyclists should also be held on red. If the volume of left turners is approx. 100 – 150 PCUs, left turners will be controlled by a flashing amber arrow and cyclists should receive an early start.

Junction Type 1 as shown in **Figure 5.1** below, has been applied to the majority of junctions along the Proposed Scheme.

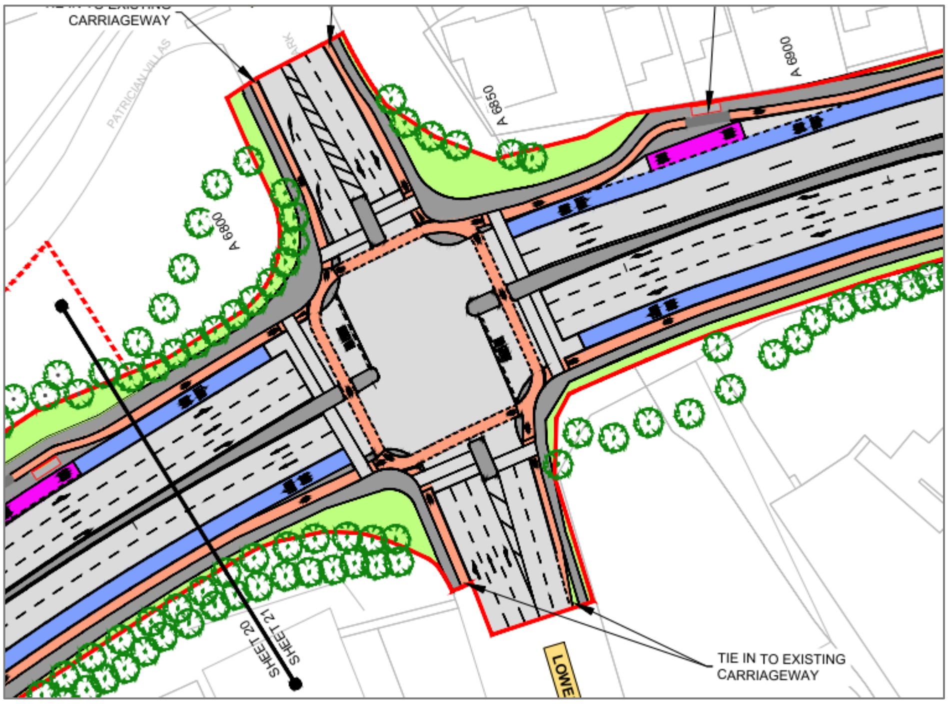

Figure 5.1: Junction Type 1

5.3.3.2 Junction Type 2

Junction Type 2 as shown in **Figure 5.2**, 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 continue up to the junction stop line. At least 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 pocket, where space permits. Junction Type 2 has been chosen for the following reasons:

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

In this instance, left turners are held and mainline cyclists proceed with the bus phases. Mainline cyclists can proceed also with the straight ahead general traffic if left turners are held. If the volume of left tuners traffic is less than 150 PCUs per hour, then mainline cyclists could still proceed with left turnings from the left turning pocket on a flashing amber arrow.

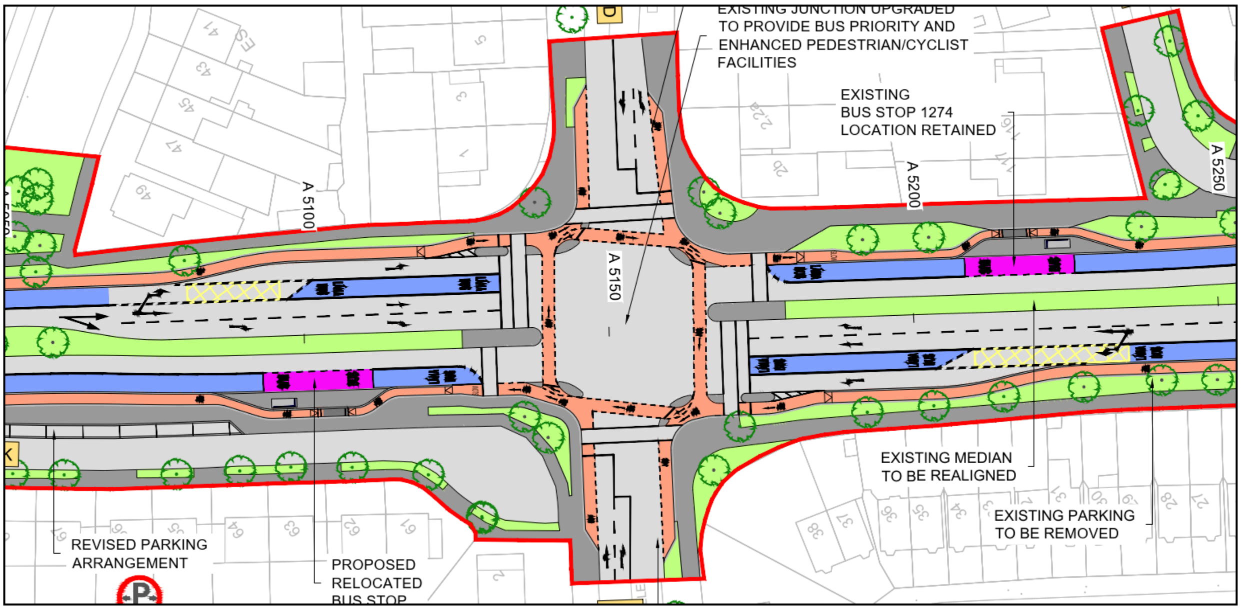

Figure 5.2: Junction Type 2

5.3.3.3 Junction Type 3

Junction Type 3 as shown in **Figure 5.3**, 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;
- Urban setting, no space available for a dedicated left turning lane / pocket.

In this instance, mainline buses and general traffic (including left turners) proceed together, but before they do, mainline cyclists are given an early start of approxiately 5 seconds to assist with cyclist priority and to minimise potential conflicts. When this early start is complete, the mainline cyclists can still proceed (this is permitted where turning volumes are less than 150 PCUs per hour, which for Type 3 junctions they will be). Left turning from the left turn pocket are given a flashing amber.

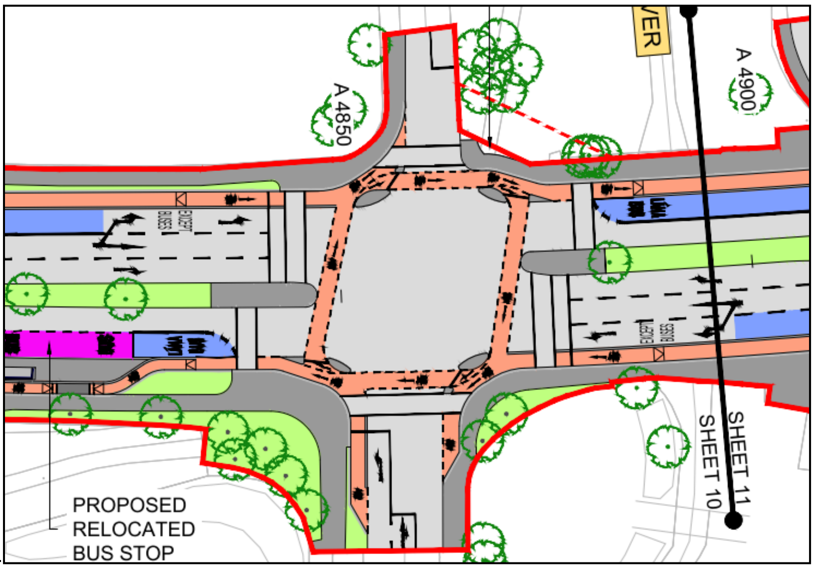

Figure 5.3: Junction Type 3

5.3.3.4 Junction Type 4

Junction Type 4 as shown in **Figure 5.4**, 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. Signalised pedestrian crossings are proposed across the cycle tracks to allow pedestrians to cross from the footpath to the pedestrian crossing landing areas, thus avoiding uncontrolled pedestrian – cyclist conflict. 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 at the same time due to the segregated and nonconflicting crossings; and
- Signal controlled pedestrian crossing distances are reduced when compared to traditional junction layouts, due to the face that pedestrians cross the cycle track in a separate signalised movement. Pedestrian crossings are also 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.

In this instance, mainline buses and left turning from the mainline proceed together.

There are no Type 4 junctions on the Proposed Scheme.

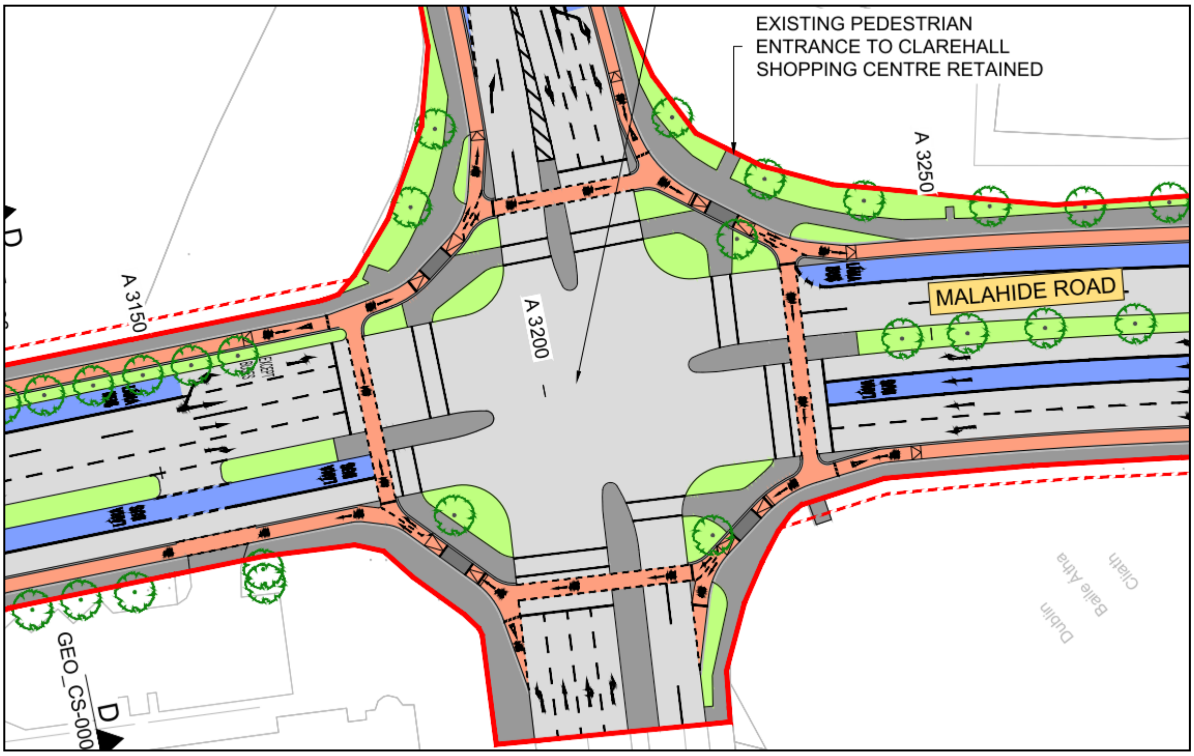

Figure 5.4: Junction Type 4

5.3.4 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 traffic and buses, cyclists and pedestrians continuing along the main corridor. The following presents an overview of the design of junction staging. A junction specific assessment can be found in the Junction Design Report in **Appendix L.**

- Cyclists travelling through the junction across the side road will run with straight ahead traffic movements, including buses in a dedicated bus lane;
- 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 seconds early start has been proposed on the main arms of the majority of junctions, with 3 seconds minimum at certain junctions;
- Cycle movements crossing a side road can run simultaneously with the bus stage in the same direction, so long as it is not permitted to turn left from the bus lane in this scenario; and
- Cycle movements at junctions are to be controlled by cycle signal aspects where there is an advance stop line ahead of the traffic signals including for hook turns at the far side of the side street crossing. Additional cycle signals have been provided for right turning cyclists.

5.3.5 Junction Design Summary

A detailed junction assessment has been undertaken in line with the principles described previously. The following summary tables, **Table 5-2** and **Table 5-3** provide an overview of the key design principles adopted at each junction location. More detailed information for each junction location can be found in the Junction Design Report in **Appendix L.**

Table 5-2: Overview of Major Junctions

No.	Junction Location	Description
1	Airfield Park RTE Stillorgan Road	Modified 4-arm signal-controlled junction with bus priority on dual carriageway
2	Greenfield Park Nutley Lane Stillorgan Road	Modified 4-arm signal-controlled junction with bus priority on dual carriageway
3	N11 UCD junction	Modified grade separated
4	Fosters Avenue Stillorgan Road	Modified 3-arm signal-controlled junction with bus priority on dual carriageway
5	Belfield Park The Rise Stillorgan Road	Modified 4-arm signal-controlled junction with bus priority on dual carriageway
6	Booterstown Avenue Stillorgan Road	Modified 3-arm signal-controlled junction with bus priority on dual carriageway
7	Mount Merrion Avenue Stillorgan Road	Modified 3-arm signal-controlled junction with bus priority on dual carriageway
8	Treesdale Trees Road Lower Stillorgan Road	Modified 4-arm signal-controlled junction with bus priority on dual carriageway

No.	Junction Location	Description
9	Priory Drive Old Dublin Road Stillorgan Road	Modified 4-arm signal-controlled junction with bus priority on dual carriageway
10	Lower Kilmacud Road Stillorgan Grove Stillorgan Road	Modified 4-arm signal-controlled junction with bus priority on dual carriageway
11	Farmleigh Avenue Brewster Road Stillorgan Road	Modified 4-arm signal-controlled junction with bus priority on dual carriageway
12	Leopardstown Newtownpark Avenue Stillorgan Road	Modified 4-arm signal-controlled junction with bus priority on dual carriageway
13	Springfield Park Stillorgan Road	Modified 3-arm signal-controlled junction with bus priority on dual carriageway
14	Kill Lane Stillorgan Road	Modified 3-arm signal-controlled junction with bus priority on dual carriageway
15	Westminster Road Stillorgan Road	Modified 3-arm signal-controlled junction with bus priority on dual carriageway
16	Bray Road Stillorgan Road	Modified 3-arm signal-controlled junction with bus priority on dual carriageway
17	Clonkeen Rd Bray Road	Modified 4-arm signal-controlled junction with bus priority on dual carriageway
18	Johnstown Rd Bray Road	Modified 4-arm signal-controlled junction with bus priority on dual carriageway
19	New Development (Cherrywood) Bray Road	Modified 3-arm signal-controlled junction with bus priority on dual carriageway
20	Wyattville Road N11 northbound slip roads	Modified grade separated slip road junction, northbound only
21	Wyattville Link Road slip road N11 Bray Road	Modified grade separated 4-arm junction
22	N11 Silver Tassie	Modified 3-arm signal-controlled junction with bus priority on dual carriageway (northbound only)
23	M11 slips (Wilford Roundabout) Dublin Road	New 3 arm signal-controlled junction

Table 5-3: Overview of Moderate Junctions

No.	Junction Location	Description
1	Leeson Street Lower St Stephen's Green	Modified 4 arm signal-controlled junction with bus priority
2	Hatch Street Earlsfort Terrace	Modified 4 arm signal-controlled junction
3	Hatch Street Lower Pembroke Street Upper Leeson Street Lower	Modified 4 arm signal-controlled junction with bus priority
4	Fitzwilliam Place Wilton Terrace Adelaide Street Leeson Street Lower	Modified 4 arm signal-controlled junction with bus priority
5	Grand Parade Mespil Road Leeson Street Upper	Modified 4 arm signal-controlled junction with bus priority
6	Dartmouth Road Leeson Street Upper	Modified 3 arm signal-controlled junction with bus priority, northbound only
7	Sussex Road Sussex Terrace	New 3 arm signal-controlled junction with bus priority, southbound only
8	Burlington Road Leeson Street Upper	Modified 3 arm signal-controlled junction with bus priority, southbound only
9	Appian Way Leeson Street Upper	Modified 3 arm signal-controlled junction with bus priority
10	Waterloo Road Leeson Street Upper	Modified 3 arm signal-controlled junction with bus priority
11	Wellington Place Leeson Street Upper	Modified 3 arm signal-controlled junction with bus priority
12	Bloomfield Avenue Morehampton Road	Modified 3 arm signal-controlled junction with bus priority
13	Herbert Park Morehampton Road	Modified 4 arm signal-controlled junction with bus priority
14	Belmont Avenue Victoria Avenue Morehampton Road Donnybrook Road	New 4 arm signal-controlled junction with bus priority
15	Eglinton Terrace Donnybrook Road	New pre-signal for northbound bus priority
16	Eglinton Road Donnybrook Road	Modified 3 arm signal-controlled junction with bus priority
17	Anglesea Road Beaver Row Donnybrook Road Stillorgan Road	Modified 4 arm signal-controlled junction with bus priority

No.	Junction Location	Description
18	Stillorgan Road Bellmont Terrace	Modified 2 arm signal-controlled junction
19	Stonebridge Road Dublin Road	Modified 3 arm signal-controlled junction with bus priority
20	Corbawn Lane Shanganagh Road Dublin Road	New 3 arm signal-controlled junction with bus priority
21	Shanganagh Road Beechfield Manor	Modified 3 arm signal-controlled junction
22	Quinn's Road Cherrington Road Dublin Road	New 4 arm signal-controlled junction
23	Dublin Road Olcovar	New 3 arm signal-controlled junction with bus priority
24	Dublin Road Shanganagh Castle	New 3 arm signal-controlled junction with bus priority
25	Dublin Road Woodbrook Downs	New 4 arm signal-controlled junction with bus priority
26	Dublin Road Corke Abbey Avenue	Modified 4 arm signal-controlled junction with bus priority
27	Chapel Lane Dublin Road	New 4 arm signal-controlled junction with bus priority
28	Upper Dargle Road Dublin Road	Modified 4 arm signal-controlled junction with bus priority

5.3.5.1 Minor and Priority Junctions

A total of 64 minor junctions (not including minor access points for properties) are without signal control across the Proposed Scheme. These are shown on the General Arrangement Drawings contained within **Appendix B.**

5.3.5.2 Roundabouts

The existing Loughlinstown roundabout at N11/M11/Dublin Road will be retained, with traffic signals added to improve its performance and with a southbound bus bypass from N11 to Dublin Road, as shown in **Table 5-4** below. Spiral lane markings and improved lane markings will also be introduced to improve lane discipline at this junction.

The existing roundabouts at Dublin Road / Shanganagh Road, Dublin Road / Quinn's Road and at the M11 slip at Dublin Road (Wilford) will be converted to traffic signal-controlled junctions, as set out in the tables above.

Table 5-4: Roundabouts

No.	Junction Location	Description
1	Loughlinstown Roundabout Dublin Road / N11 Bray Road /M11	Signal-controlled roundabout

5.4 Junction Modelling

5.4.1 Overview

Junction modelling was undertaken to enable understanding of the likely impact of the proposed route design on traffic operation on the surrounding road network. The focus of the assessment was to ensure bus priority was maximised, whilst ensuring the overall movement of people through the junctions was maximised in particular via sustainable modes i.e. walking and cycling, whilst mitigating and resulting 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 people movement calculator to provide a preliminary understanding of the typical green time proportion for each mode and provided an initial input for the LAM modelling which was further refined using LinSig and Microsimulation tools.
- **Saturn Modelling - LAM:** The proposed scheme design and traffic signal operation was assessed within the LAM which is a subset model of the NTA's Eastern Regional Model (ERM). The LAM outputs provided projected traffic flows for the DS Operational Year for the peak periods. In addition, traffic dispersion plots were provided, comparing the DS vs the DM to identify where any traffic dispersion is likely to occur off the Proposed Scheme;
- **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 dispersion was achieved;
- **LinSig and Microsimulation:** The optimised LinSig timings were used to inform the microsimulation model developed for the Proposed Scheme. 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. Final LinSig junction models were undertaken using the final flows and supplemented with projected cycle flows to accommodate a 10% cycle mode share where possible in terms of people movement at each junction.

Figure 5.5 illustrates an overview of the traffic modelling process for the Proposed Scheme.

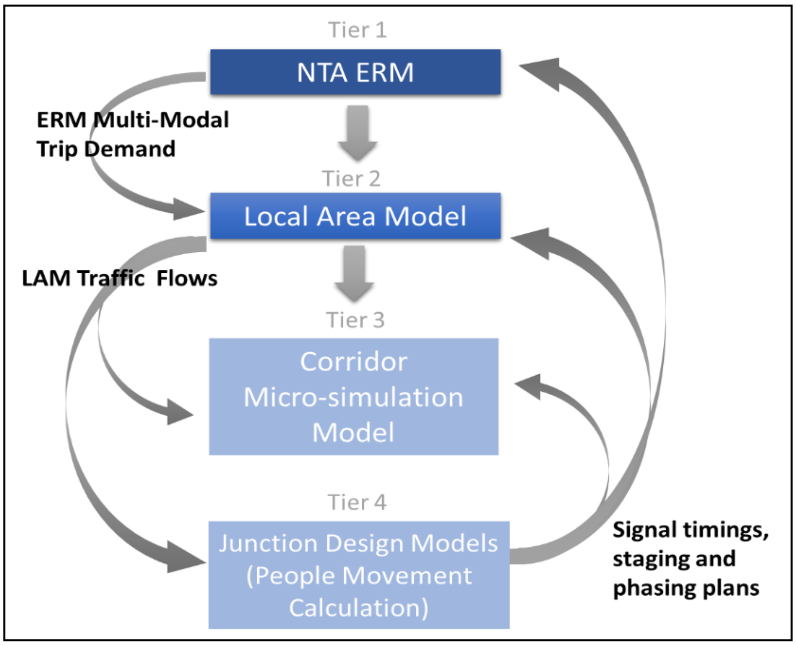

Figure 5.5: Proposed Scheme Traffic Modelling Hierarchy

5.4.2 People Movement

An assessment has been carried out to determine the potential people movement the Proposed Scheme will generate. This adopts a policy led approach to the design of junctions, which prioritises the people movement and maximisation of sustainable modes i.e., walking, cycling and bus in advance of the consideration and management of general traffic movements at junctions. The outputs of the calculator provide an estimate of people movement per mode per junction and the respective percentage mode share. **Figure 5.6** illustrates the People Movement Formulae.

People Movement Formulae	
Cyclists	$\sum(\frac{Green\ Time}{headway})(\frac{3600}{Cycle\ Time})(\frac{CT\ Width}{1.5})$
Buses	$\sum(No.of\ Buses)(Occupancy)(Direction)$
General Traffic	$\sum LinSig\ PCU\ Capacity\ Outputs$
Pedestrians	$\sum(Green\ Time)(\frac{Walking\ Speed}{Ped.Walking\ Buffer})(\frac{Crossing\ Width}{2})(\frac{3600}{Cycle\ Time})(No.Crossing\ Points)$

Figure 5.6: People Movement Formulae

The emerging proposed designs were inputted to the PMSC tool, which produced initial people movement outputs and indicative green times per mode. The results provided an initial starting point to facilitate a review of the junction designs, where necessary pedestrian, cyclist and bus infrastructure was optimised accordingly to facilitate additional capacity. The revised designs were then added into the LAM to facilitate traffic modelling.

The LAM outputs provided traffic flows for the operational year (2028) and operational year +15 (2043). The traffic flows were fed into the LinSig models to facilitate a detailed analysis of the proposed junction operation. The LinSig and Dublin Local Area Model (DLAM) analysis required multiple traffic modelling iterations to arrive at a balanced solution for prioritising sustainable modes and minimising traffic dispersion. The people movement results were also re-evaluated during the iteration process, and the results were also used to inform the projected number of cyclists in the operational year, as discussed in the following section.

5.4.3 Local Area Model (LAM)

As noted previously, the Proposed Scheme design and traffic signal operation was assessed within the LAM. The LAM outputs provided projected traffic flows for the DS Operational Year 2028 and Future Year 2043 for the respective AM and PM peak periods. In addition, traffic dispersion plots were produced, comparing the DS vs the DM to identify where any occurred onto the adjoining road network, and where necessary to review and apply traffic management, to retain traffic on the corridor and to minimise dispersion at inappropriate locations.

The results of the LAM were used to inform the proposed junction designs and optimise signal timings, 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.

To demonstrate the benefits of this iterative process, **Figure 5.7** illustrates an initial 2028 AM distribution plot, whilst **Figure 5.8** illustrates a final iterated distribution plot. **Figure 5.7** illustrates more significant traffic dispersion onto the surrounding road network, whilst the refined **Figure 5.8** demonstrates a more optimised Proposed Scheme, where traffic dispersion has been minimised without compromising the sustainable modes.

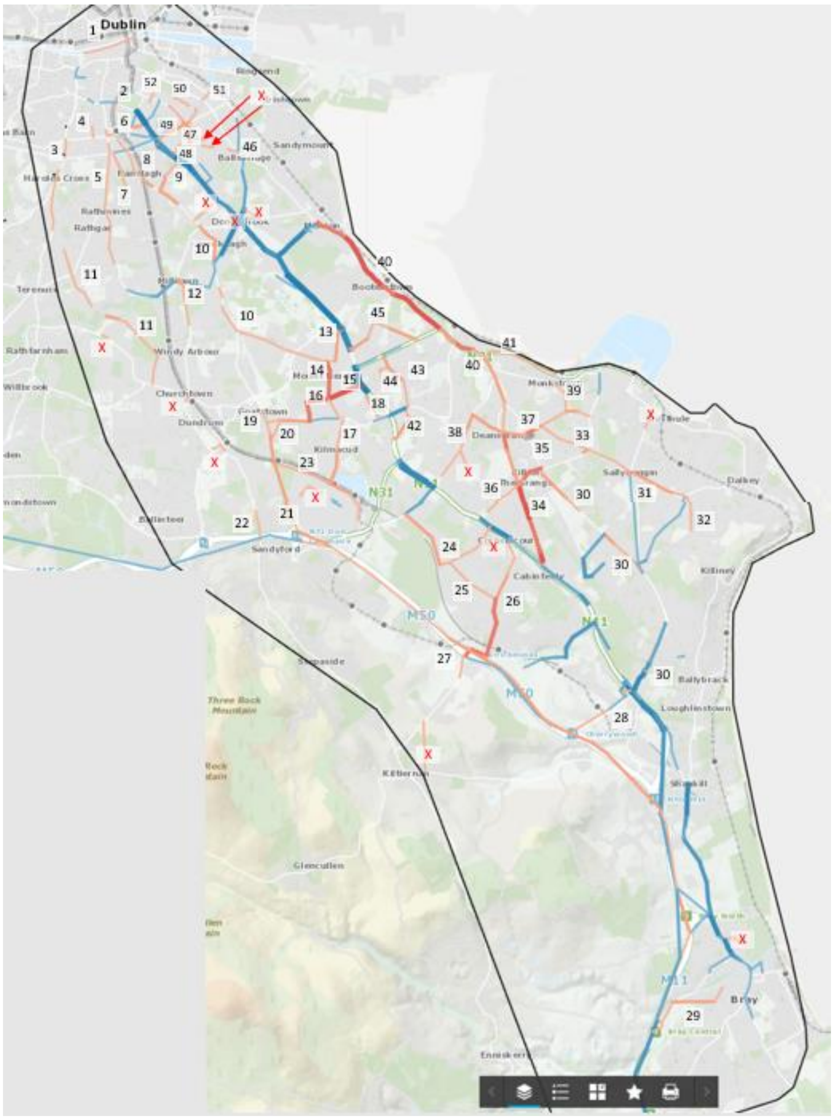

Figure 5.7: Flow Difference on Road links (Do Minimum vs Do Something), AM Peak Hour, 2028 Opening Year

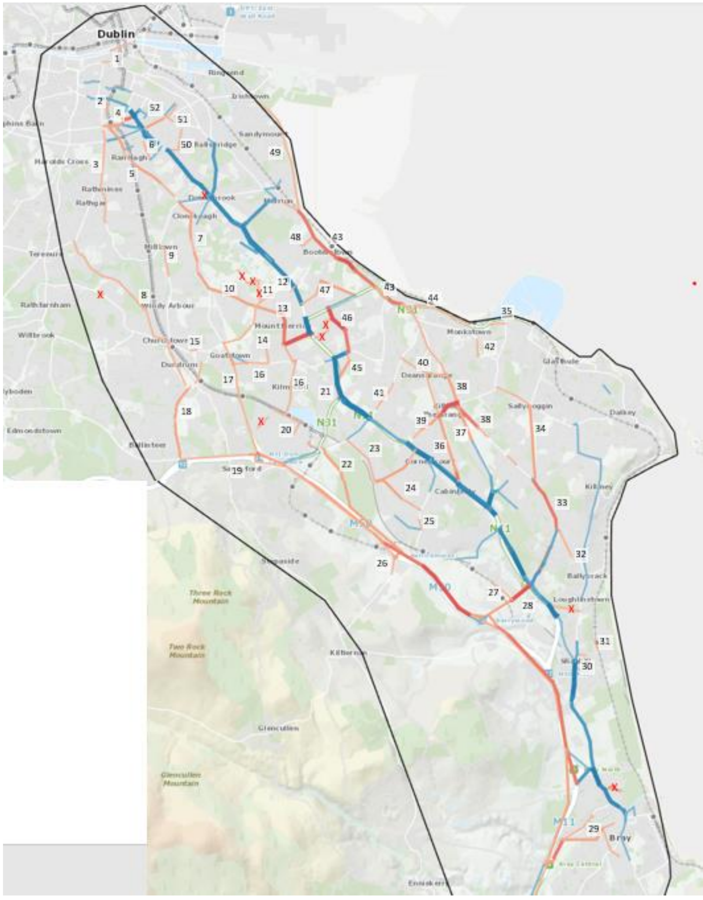

Figure 5.8: Flow Difference on Road links (Do Minimum vs Do Something), PM Peak Hour, 2028 Opening Year

5.4.4 LinSig Modelling

Detailed junction modelling analysis using LinSig 3.2.40 was undertaken on the emerging design proposals at each signalised junction until the LAM model iterations had been concluded and a final preliminary design was achieved. The LinSig modelling adopted the future year traffic flows from the Saturn LAM model runs for the DS scenario for the Opening Year 2028.

5.4.4.1 LinSig Assumptions

The following LinSig assumptions were applied in the modelling:

Cycle Time

- 120s (max) cycle time permitted.

Pedestrian

- Green Time: 6s minimum green time for pedestrians; and
- Intergreen: based on a walking speed of 1.2m per second plus a 2 second safety buffer using AutoCAD

Cyclist

- Cruise Speed: 15km/h or 4.16m per second.
- Cyclist Early Start: 5s on the majority main CBC arms, with 3s minimum. On the side roads of junctions, 3s cyclist early start; and
- Modelled cyclist flows based on cycle quantification exercise.

5.4.4.2 Cycle Quantification

The vision of the 'National Cycle Policy Framework' (NCPF) is that "10% of all trips will be by bike".

Each junction along the Proposed Scheme has been designed to be consistent with the above objective to accommodate a minimum 10% cycle mode share in terms of people movement at each junction. This will mean that in practice the junctions should be designed to have capacity to provide for at least the existing levels of cycling demand or levels of cycling that provide for a minimum 10% mode share in future years (whichever is the greater).

A Cycle Demand Quantification assessment was undertaken in order to identify projected cycling demand in the Opening Year (2028) to inform the design of cycle facilities at each junction along the Proposed Scheme in line with the NCPF. The level of cycle demand informs the level of priority and the requirements for geometric design for cyclists. This also has implications for the green time allocation to be provided for cycle movements modelled in LinSig and then in turn in VISSIM traffic flow simulation software.

The Cycle demand calculation illustrated in **Figure 5.6** is based on the capacity provided rather than being informed by existing or modelled future year cycling numbers. It was noted that using the maximum pedestrian capacity calculation skewed the mode share calculations therefore the existing pedestrian counts plus an uplift factor of 20% has been applied.

The calculation accounts for the green time provided in a typical signal cycle, the number of cycles within the hour and an assumption on headway between cyclists. The calculation also considers the capacity benefit of wider lane provision, whereby cyclists can overtake each other with greater widths.

Using the Cycle Quantification and People Movement spreadsheet the following checks were undertaken to ensure cycle demand is catered for at an appropriate level and that each of the criteria is satisfied:

- A minimum 10% cycle mode share is provided for when summing people movement across all arms (including side roads);
- The calculated cycle capacity (calculated from above) exceeds existing cycling flow; and
- If the calculated mode share of 10% is less than the existing flow. The minimum target is the existing flow plus design buffer level of 20%.

To quantify the cycle demand numbers for input into LinSig, the following approach was applied:

- Cycle Design Target demand for the junction calculated based on achieving the above criteria (10% of total people movement at junction or existing plus 20% buffer);
- This Design Target total for whole junction is distributed across turning movements based on existing observed 2019 survey data for cycling;
- A minimum turning demand of 10 cyclists per hour to be allowed for;
- Cycle demand turning flows input to LinSig models with green times and phasing and staging plans adjusted as appropriate;
- Resulting LinSig models provided for input to VISSIM models which will model the same cycling flows.

Table 5-5 presents a summary of the projected number of cyclists per junction identified as a design target and a Total Number of Cyclists modelled in LinSig per junction.

Table 5-5: Cyclist People Movement Quantification

Junction Name	Proposed Flashing Amber	Cycle Quantification (Number of Cyclists)			
		2028 AM Peak Hour		2028 PM Peak Hour	
		Design Target	Total Modelled	Design Target	Total Modelled
Leeson Street Lower/ St Stephen's Green	No	600	-	600	-
Hatch Street/ Earlsfort Terrace	No	No Protected Cycle Facilities, works include general traffic diversion only			
Hatch Street Lower/ Pembroke Street Upper/ Leeson Street Lower	No	911	911	911	911
Fitzwilliam Place/ Wilton Terrace/ Adelaide Street/ Leeson Street Lower	No	977	663	1028	749
Grand Parade/ Mespil Road/ Leeson Street Upper	No	1100	1100	1096	1096
Dartmouth Road/ Leeson Street Upper	No	1075	1075	924	924
Sussex Road/ Sussex Terrace	No	419	419	510	510
Burlington Road/ Leeson Street Upper	No	962	962	963	963
Appian Way/ Leeson Street Upper	No	969	969	976	976
Waterloo Road/ Leeson Street Upper	No	967	967	977	977
Wellington Place/ Leeson Street Upper	No	952	952	944	863
Bloomfield Avenue/ Morehampton Road	No	963	756	970	970
Herbert Park/ Morehampton Road	No	611	611	741	741
Belmont Avenue/ Victoria Avenue/ Morehampton Road/ Donnybrook Road	No	774	732	930	930
Eglinton Terrace/ Donnybook Road	No	Cyclists Bypass Signals			
Eglinton Road/ Donnybrook Road	No	850	662	968	968
Anglesea Road/ Beaver Row/ Donnybrook Road/ Stillorgan Road	No	1013	787	1012	860
Airfield Park/ RTE/ Stillorgan Road	Yes	1213	1213	1209	1209
Greenfield Park/ Nutley Lane/ Stillorgan Road	Yes	1553	1065	1547	927
N11/ UCD Junction	No	1051	783	965	965
Fosters Avenue/ Stillorgan Road	No	1326	619	1319	1319
Belfield Park/ The Rise/ Stillorgan Road	No	1193	1193	1206	1206
Booterstown Avenue/ Stillorgan Road	No	871	871	1114	1114
Mount Merrion Avenue/ Stillorgan Road	No	1113	1113	1123	910
Treesdale/ Trees Road Lower/ Stillorgan Road	No	1040	1040	1049	657
Priory Drive/ Old Dublin Road/ Stillorgan Road	Yes	1130	1130	1133	1133
Lower Kilmacud Road/ Stillorgan Grove/ Stillorgan Road	No	1118	829	1111	827
Farmleigh Avenue/ Brewster Road/ Stillorgan Road	Yes	828	615	860	775
Bellmont Terrace/ Stillorgan Road	No	Cyclists Bypass Signals			
Leopardstown/ Newtownpark Avenue/ Stillorgan Road	No	1031	917	1031	821
Springfield Park/ Stillorgan Road	No	1077	887	1077	1077
Kill Lane/ Stillorgan Road	No	851	661	851	822

Junction Name	Proposed Flashing Amber	Cycle Quantification (Number of Cyclists)			
		2028 AM Peak Hour		2028 PM Peak Hour	
		Design Target	Total Modelled	Design Target	Total Modelled
Westminster Road/ Stillorgan Road	No	820	820	297	297
Bray Road/ Stillorgan Road	Yes	830	830	816	816
Clonkeen Rd/ Bray Road	No	819	819	869	869
Johnstown Rd/ Bray Road	No	777	777	842	842
New Development (Cherrywood)/ Bray Road	No	1116	1116	1126	1126
Wyattville Northbound Slip Roads/ N11 Bray Road	No	N/A	1300	N/A	1300
Wyattville Link Road/ Slip Road/ N11 Bray Road	No	510	510	500	500
N11/ Silver Tassie/ Cherrywood Road	No	N/A	1000	N/A	1000
Loughlinstown Roundabout	No	801	801	801	801
Stonebridge Road/ Dublin Road	No	388	388	363	363
Corbawn Lane/ Shanganagh Road/ Dublin Road	No	No Protected Cycle Facilities			
Shanganagh Road/ Beechfield Manor	No	No Protected Cycle Facilities			
Dublin Road/ Quinn's Road	No	No Protected Cycle Facilities			
Dublin Road/ Olcovar	No	No Protected Cycle Facilities			
Dublin Road/ Shanganagh Castle	No	-	-	-	-
Dublin Road/ Woodbrook Downs	No	-	-	-	-
M11 slips (Wilford Roundabout)/ Dublin Road	No	410	410	394	394
Cork Abbey Avenue/ Old Connaught Avenue/ Dublin Road	No	303	303	369	369
Chapel Lane/ Dublin Road		-	-	-	-
Upper Dargle Road/ Dublin Road	No	464	464	439	439

5.4.4.3 LinSig Results

Table 5-6 provides an overview of the junction analysis results.

Table 5-6: Proposed Scheme Signalised Junctions

Junction Name	Cycle Time (Seconds)		2028 Peak Hour Practical Reserve Capacity (PRC)	
	DoMinimum	DoSomething	AM Peak	PM Peak
Leeson Street Lower/ St Stephen's Green	120/125	120	16.2%	30.4%
Hatch Street/ Earlsfort Terrace	-	120	-	-
Hatch Street Lower/ Pembroke Street Upper/ Leeson Street Lower	220/175	120	8.8%	11.3%
Fitzwilliam Place/ Wilton Terrace/ Adelaide Street/ Leeson Street Lower	194/200	120	-0.2%	5.1%
Grand Parade/ Mespil Road/ Leeson Street Upper	120	120	-3.5%	3.1%
Dartmouth Road/ Leeson Street Upper	120	120	5.5%	8.9%
Sussex Road/ Sussex Terrace	Priority	120	14.0%	13.9%
Burlington Road/ Leeson Street Upper	120	120	68.0%	5.2%

Junction Name	Cycle Time (Seconds)		2028 Peak Hour Practical Reserve Capacity (PRC)	
	DoMinimum	DoSomething	AM Peak	PM Peak
Appian Way/ Leeson Street Upper	121/148	120	10.10%	-10.0%
Waterloo Road/ Leeson Street Upper	121/148	120	21.0%	28.6%
Wellington Place/ Leeson Street Upper	121/148	120	14.2%	5.2%
Bloomfield Avenue/ Morehampton Road	128/137	120	8.1%	6.0%
Herbert Park/ Morehampton Road	120	120	0.8%	14.4%
Belmont Avenue/ Victoria Avenue/ Morehampton Road/ Donnybrook Road	Mid-block	120	-8.2%	4.7%
Eglinton Terrace/ Donnybrook Road	No Junction	Demand Dependent	N/A	N/A
Eglinton Road/ Donnybrook Road	160	120	1.3%	9.7%
Anglesea Road/ Beaver Row/ Donnybrook Road/ Stillorgan Road	160	120	1.6%	0.0%
Airfield Park/ RTE/ Stillorgan Road	No Junction	120	16.9%	3.8%
Greenfield Park/ Nutley Lane/ Stillorgan Road	121/151	120	2.4%	2.4%
N11/ UCD Junction	97/87	120	2.3%	13.8%
Fosters Avenue/ Stillorgan Road	132/140	120	8.8%	19.8%
Belfield Park/ The Rise/ Stillorgan Road	121/124	120	-1.3%	12.5%
Booterstown Avenue/ Stillorgan Road	209/223	120	7.1%	6.6%
Mount Merrion Avenue/ Stillorgan Road	145/120	120	6.9%	4.8%
Treesdale/ Trees Road Lower/ Stillorgan Road	120	120	5.7%	2.3%
Priory Drive/ Old Dublin Road/ Stillorgan Road	164/123	120	4.8%	7.2%
Lower Kilmacud Road/ Stillorgan Grove/ Stillorgan Road	120	120	4.6%	4.1%
Farmleigh Avenue/ Brewster Road/ Stillorgan Road	129/144	140	1.1%	3.6%
Belmont Terrace/ Stillorgan Road	Demand Dependent	Demand Dependent	N/A	N/A
Leopardstown/ Newtownpark Avenue/ Stillorgan Road	120/144	140	1.6%	1.4%
Springfield Park/ Stillorgan Road	159/183	120	9.9%	59.3%
Kill Lane/ Stillorgan Road	150/155	120	-4.0%	-8.3%
Westminster Road/ Stillorgan Road	196/192	120	5.5%	31.3%
Bray Road/ Stillorgan Road	168/143	120	4.5%	11.5%
Clonkeen Rd/ Bray Road	121/123	120	7.1%	9.5%
Johnstown Rd/ Bray Road	121/147	120	4.2%	1.4%
New Development (Cherrywood)/ Bray Road	No Junction	120	65.2%	48.8%
Wyattville Northbound Slip Roads/ N11 Bray Road	76/74	60	12.7%	12.7%
Wyattville Link Road/ Slip Road/ N11 Bray Road	158/168	120	0.0%	-11.9%
N11 Silver Tassie/ Cherrywood Road	158/152	120	26.4%	54.7%
Loughlinstown Roundabout	Roundabout	60	15.0%	21.4%
Stonebridge Road/ Dublin Road	115/158	80	7.7%	8.0%
Corbawn Lane/ Shanganagh Road/ Dublin Road	Roundabout	120	-4.3%	-2.7%
Shanganagh Road / Beechfield Manor	83/112	120	91.1%	65.2%
Dublin Road/ Quinn's Road	Roundabout	60	86.1%	71.8%
Dublin Road/ Olcovar	Priority	80	29.5%	1.6%
Dublin Road/ Shanganagh Castle	No Junction	80	21.5%	4.0%

Junction Name	Cycle Time (Seconds)		2028 Peak Hour Practical Reserve Capacity (PRC)	
	DoMinimum	DoSomething	AM Peak	PM Peak
Dublin Road/ Woodbrook Downs	No Junction	92	14.2%	6.9%
M11 slips (Wilford Roundabout)/ Dublin Road	Roundabout	120	12.0%	27.7%
Cork Abbey Avenue/ Old Connaught Avenue/ Dublin Road	132/143	120	24.5%	39.9%
Chapel Lane/ Dublin Road	Priority	120	47.5%	47.5%
Upper Dargle Road/ Dublin Road	140/133	120	36.4%	14.7%

In summary, the Proposed Scheme junctions are expected to operate within capacity and provide sufficient priority for bus movements. There are however a small number of junctions where the proposed layouts will operate close to or slightly above their overall capacity. At these junctions, significant physical and operational constraints mean that this cannot be fully mitigated but the junctions have been designed to ensure that walking, cycling and bus priority operation are optimised, with a resultant impact on general traffic capacity only.

These junctions include the Fitzwilliam Place and Grande Parade junctions on Leeson Street, where the closely spaced nature of the junctions, the tight geometry and the need to accommodate a significant volume of cycle movements mean that traffic capacity is limited and the junctions operate above general capacity during some peak periods of the day. However, in all instances, bus priority has been protected and the total people movement through the junction has been optimised.

A similar situation occurs at the junctions of Appian Way/Leeson Street and Anglesea Road/Donnybrook Road where significant demand is in place for traffic and cycle movements on the side roads as well as the mainline. At these junctions, there is also a requirement to accommodate turning bus movements and to separate cycle turning movements. The operation of the junctions has been optimised and co-ordinated with nearby junctions to ensure a maximum flow of people movement by sustainable modes and to limit the delay impact on general traffic.

Through the modelling iterations of junction operational modelling and wider LAM, the impact of traffic reassignment from the CBC13 corridor to other alternative routes has been limited by optimising the overall performance of these constrained junctions. The best overall balance has therefore been achieved between the optimised performance for sustainable modes of travel on the corridor and a suitable level of capacity for general traffic at each junction.

6. Ground Investigation and Ground Conditions

6.1 Introduction and Desktop Review

A high-level desk study of available information was undertaken for the Proposed Scheme using data from the Geological Survey Ireland (GSI), GeoHive, Environmental Protection Agency, and Flood Information websites, including:

- 1836 – 1842 Historic map 6 inch (Geohive)
- 1888 – 1913 Historic map 25 inch (Geohive)
- 1830 – 1930 Historic map 6 inch – Cassini (Geohive)
- Contour map (EPA)
- Geological Survey of Ireland (GSI)
- Quaternary Sediments and Geomorphology map (GSI)
- Teagasc Soils map (GSI)
- Bedrock, Geology100k map (GSI)
- Karst Features map (GSI)
- Depth to Bedrock map (GSI)
- Groundwater Aquifer map (GSI)
- Groundwater Vulnerability map (GSI)
- Groundwater Wells and Springs map (GSI)
- Groundwater Recharge map (GSI)
- Subsoil Permeability map (GSI)
- Active and Historic Pits and Quarries map (GSI)
- Mineral localities map (GSI)
- Historic Ground Investigations map (GSI)

A detailed overview of all desk study information reviewed is presented within Chapter 14 Land, Soils, Geology and Hydrogeology of the Environmental Impact Assessment Report (EIAR) Volume 2 of 4 Main Report, July 2021.

6.2 Summary of Ground Investigation Contract

The ground investigation (GI) works for the Proposed Scheme are being undertaken in a phased manner. The initial phase entailed investigation at proposed retaining wall RW-003 (the need for RW-003 has since been removed), proposed retaining wall RW-016 and the St Laurence's Park subway. Further phases of ground investigation generally conforming to the guidelines of Eurocode 7 will be required as the design develops.

The Ground Investigation contractor, Causeway Geotechnical Ltd was appointed by the NTA. The ground investigation field works were carried out between September and November 2020. Groundwater monitoring is ongoing.

6.3 Ground Investigation

The investigation comprised:

- three cable percussive boreholes;
- one window sample borehole;
- five slit trenches for utilities identification;
- Geotechnical and environmental sampling;
- Groundwater monitoring; and

- In-situ testing and laboratory testing of samples.

For further details of the works refer to Factual Report – Report No. 20-0399E Bus Connects Route 13 Bray to City Centre – Ground Investigation, Causeway Geotechnical Ltd, December 2020, **Appendix E.**

Further phases of ground investigation generally conforming to the guidelines of Eurocode 7 will be required as the design develops.

6.4 Soils and Geology

A summary of anticipated soils and geology based on desk study information and the results of the ground investigation is presented below. For further details refer to:

- Chapter 14 Land, Soils, Geology and Hydrogeology, Environmental Impact Assessment Report (EIAR) Volume 2 of 4 Main Report, July 2021; and
- Factual Report – Report No. 20-0399E Bus Connects Route 13 Bray to City Centre – Ground Investigation, Causeway Geotechnical Ltd, December 2020.

6.4.1 Quaternary Deposits

The naturally occurring Quaternary deposits along the route consist of the following:

- Alluvium (typically gravelly from Ch A2200-2500 and Ch A3850-4000); and
- Glacial till derived from limestone and granites (across the remainder of the route, expect where Quaternary deposits are absent).

Quaternary deposits are shown to be absent between Ch A8550-A8900, Ch A9250-9350 and Ch A9750-A9850.

Made ground is encountered across the scheme with variable thickness dependent of the historic land use of the area.

6.4.2 Bedrock Geology

The bedrock geology along the route consists of:

- From Dublin City Centre Ch A0 to Mount Merrion Ch A5500: dark limestone and shale (Lucan Formation);
- From Mount Merrion Ch A5500 to Loughlinstown Ch A13600: granite with microcline phenocrysts;
- From Loughlinstown Ch A13600 to Bray River Ch A18541: dark blue-grey slates and phyllites striped with pale siltstone; and
- From Bray River Ch A18541 to Bray: greywacke and quartzite.

6.5 Contaminated Land

The proposed works will be carried out within a predominantly urban environment, therefore there is a high probability of made ground associated with residential and industrial development being encountered across the scheme.

Made ground was recorded at the location of CP03 of Bus Connects Route 13 Bray to City Centre – Ground Investigation to a depth of 3.5m bgl. It is assumed tha tthis made ground is due to raising of the site to level the area within the school grounds. Testing carried out on sample in CP03 P03 of Bus Connects Route 13 Bray to City Centre – Ground Investigation indicates material is "Inert" Waste Classification.

A number of disused gravel pits and historic quarries are on historic mapping and records close to the route alignment but do not cross the route.

6.6 Ground Summary and Material Properties

The ground conditions at the location of retaining wall R13-RW016 are indicated to be soft to firm silt overlying medium dense gravel recorded to a depth of 1.3m bgl in WS01 of Bus Connects Route 13 Bray to City Centre – Ground Investigation. The ground conditions at the location of retaining wall R13-RW017 across the entrance road from R13-RW016 are recorded in cable percussion borehole CP03. This borehole recorded deep made ground deposits to a depth of 3.5m bgl. This made ground was found to be overly stiff slightly sandy, gravelly silt and dense brown sandy sitly gravel.

A cable percussion borehole was carried out at the west side of the St Laurence Subway adjacent to Stillorgan Library. The results of this borehole recorded made ground associated with pavement construction overlying firm to stiff slightly sandy, gravelly clay. Bedrock was recorded at 4.8m bgl within this borehole.

For details of the ground conditions and material properties of the structures investigated in the preliminary GI refer to Factual Report – Report No. 20-0399E Bus Connects Route 13 Bray to City Centre – Ground Investigation, Causeway Geotechnical Ltd, December 2020, **Appendix E**

6.7 Groundwater

Monitoring of groundwater installations was completed in November 2021. A summary of the groundwater monitoring is presented in **Table 6-1** below. Details of the monitoring standpipes can be found in Factual Report – Report No. 20-0399E Bus Connects Route 13 Bray to City Centre – Ground Investigation, Causeway Geotechnical Ltd, December 2020, **Appendix E.**

Table 6-1: Summary of Groundwater Monitoring

Borehole ID	Standpipe Depth (m)			Depth to Groundwater (m)						
		18-Nov	19-Jan	12-Feb	23-Apr	02-Jun	22-Jun	16- Jul	20-Aug	24-Sep
R13-CP01	4.8	2.47	2.12	2.21	3.21	2.39	3.22	3.33	3.28	3.22
R13-CP02	2.67	2.24	2.05	1.99	2.33	2.25	2.42	2.46	2.44	2.44
R13-CP03	6.21	Dry	Dry	6.11	Dry	Dry	Dry	Dry	Dry	Dry

6.8 Preliminary Engineering Assessment

Construction of the Proposed Scheme will require a small number of relatively low height retaining walls and minor structure and earthworks modifications, for example the extension of the St Laurence's Park subway. Further details are provided in **Chapter 8**.

6.8.1 Foundations and Retaining Walls

The underlying geology of dense sands and gravels, stiff Glacial Till or bedrock is expected to have sufficient bearing capacity for normal shallow foundations to be adopted for these structures, with the exception of R13 RW017 where deep made ground was recorded.

Further consideration of the ground conditions is only expected to be required at locations where thick deposits of made ground are present . Significant depths (3.5m) of very soft to soft made ground were recorded in borehole R13-CP03 of Bus Connects Route 13 Bray to City Centre – Ground Investigation, adjacent to R13-RW17. It is anticipated that it will be necessary to excavate and replace poor quality made ground prior to construction of this retaining wall..

Along the alignment, deep made ground is only expected at locations where:

- It is necessary to widen an existing embankment;
- A structure is in an area previously developed and is underlain by demolition rubble;
- Current ground level has been raised in the past for some other reason, most likely to occur near a river but may also have been done to level a hill side; or
- The ground has been previously disturbed to construct a deep sewer, fuel tank or other buried structure.

6.8.2 Earthworks

Re-grading of the existing slope in the locality of the St Laurence's Park subway is required to accommodate the new footway on the N11. Further investigation of the composition of the slope is required. If the slope comprises firm to very stiff Glacial Till as encountered to the west of the N11, maximum gradients of 2 horizontal (H): 1 vertical (V) should be achievable.

6.8.3 Pavement Design

Refer to **Section 7** for pavement design proposals. Limited ground condition information is available at this stage in the design in relation to pavement proposals. Due to the nature of the scheme which largely consists of widening adjacent to existing pavements, and other works to existing pavements, the pavement design is anticipated to align with existing pavement formations.

For the bus station at UCD, where new pavement is proposed, a review of Ground Investigation for UCD Future Campus Project – Factual Report, Priority Geotechnical Ltd, August 2020 was undertaken. A review of laboratory CBR tests and in-situ Plate Load Tests resulted in a CBR value of <2% in 11 tests, with one further test resulting in a CBR value of <2.5%.

7. Pavement, Kerbs, Footways and Paved Areas

7.1 Introduction

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.

7.2 Overview of Pavement

The pavement design for the CBC Infrastructure Works addresses problems identified on previous bus corridor schemes in terms of rutting and on-going maintenance issues. The prevailing principle followed is the provision of a low maintenance 'stiff' pavement construction.

Designs and inputs have been prepared in accordance with the reference codes outlined in the basis of design documents. The designs will comply with TII Publications, the National Cycling Manual and Design Manual for Urban Roads and Streets.

This report presents the preliminary design for the Proposed Scheme and includes the following:

- Design scope and strategy;
- Network asset management and maintenance;
- Pavement survey and condition assessment;
- Preliminary design;
- Rehabilitation of existing road pavements;
- New full depth road pavement construction;
- Future pavement investigation; and
- Recycling and re-use of site-won pavement materials.

7.2.1 Design Scope

The pavement works include new pavement for the offline section and rehabilitation or pavement strengthening works for the online section where the existing pavement will be disturbed by construction works. In the case where no works are required to accommodate a bus lane the local authority will remain responsible for the maintenance and repairs to the existing carriageway.

- Where the existing bus lane pavement is being utilised as part of the scheme, a visual inspection and appropriate testing will be carried out to assess the condition of the pavement.
- Where required, full depth pavement reconstruction will be carried out.
- The refurbishment of existing pavements will be designed for a 20-year life and new full depth construction designed for a 40-year life. Pavements will be constructed in accordance with TII Publications and relevant local authority standards.
- A five-year surface renewal schedule should be established for existing road surfaces currently in good condition. A 10-year renewal and/or treatment schedule for all new road surfaces should be established.
- Road pavements should be constructed of traditional bitumen/asphalt materials or a flexible composite construction comprising asphalt over cement bound granular base.

- Cycle tracks should be constructed in compliance with the National Cycle Manual.
- Pedestrian footways should be constructed in accordance with TII standard details. The surface finish may be asphalt, concrete, concrete flags, concrete blocks or natural stone paving. The choice of surface finish will be dependent on environmental and public realm requirements.
- At all bus stop areas (and in their vicinity) as well as at some key junctions concrete pavement (rigid or rigid composite) may be considered.
- Pavement profile shall be designed and constructed or reconstructed to provide a uniform standard of high-ride quality.
- Where a combination of new and existing pavements is used, joints shall be made in accordance with TII's Publications and relevant local authority road design standards. In particular, longitudinal construction joints should not be located in known wheel paths.
- Where schemes cross under existing road bridge structures that are retained by the scheme proposals, then no increase in pavement levels/vertical design levels will be allowed by the design over the structural footprint of the bridge.
- The pavement design will ensure that the subgrade is adequately compacted, by means of reprofiling or other proposed method, where:
    - The existing pavement is to be widened by the provision of additional new pavement construction; and
    - The new pavement results in the new subgrade being at a lower level than the existing subgrade.
- Locations for site investigations works will be determined (for areas affected by the design), in order to:
    - Ensure a robust design that takes cognisance of ground conditions present within the study area;
    - Determine the existing ground conditions; and
    - Inform the final detailed pavement design (e.g., pavement material types and construction depths will be specified, and a detailed cost estimate of the proposed pavement works will be prepared).
- Cognisance will be taken of:
    - TRL Report 250: Design of long-life flexible pavements for heavy traffic; and
    - TRL Report 615: Development of more versatile approach to flexible and flexible composite pavement design.

7.2.2 Design Standards

The standards and manuals used throughout the pavement evaluation, include, but are not limited to the following:

- TII PE-SMG-02002 Traffic Assessment (HD 24/06);
- TII DN-PAV-03021 Pavement and Foundation Design (NRA HD 25-26);
- TII AM-PAV-06050 Pavement Assessment, Repair and Renewal;
- TRL Report 615, 'Development of a more versatile approach to flexible and flexible composite pavement design', Transport for London, 2004;

- TRL Report LR1132, 'The structural design of bituminous roads', Transport and Road Research Laboratory, 1984;
- TRL 386 'Design guide and specification for structural maintenance of highway pavements by cold in-situ recycling', 1999;
- TRL 611 'A guide to the use and specification of cold recycled materials for the maintenance of road pavements', 2004;
- TII Road Pavement Standards Details;
- TII Footway standard details; and
- Preliminary Design Guidance Booklet for BusConnects Core Bus Corridors.

7.2.3 Design Strategy

Refurbishment of the existing road will be considered during design. Investigation into ground conditions will be required in areas where widening of the existing carriageway or construction off-line is necessary. Design for the refurbishment of existing pavements and new full depth flexible, flexible composite and rigid pavements will be considered. The strategy aims to accomplish the following objectives:

Existing pavements

- Assess the construction and condition of the bound pavement layers;
- Ascertain the underlying foundation performance;
- Assign pavement exhibiting similar properties to homogeneous sections;
- Calculate the predicted design traffic in terms of million standard axles;
- Calculate the residual life of the pavement; and
- Design structural treatments to strengthen the pavement where necessary and ensure the pavement can withstand the future predicted traffic.

New off-line full depth construction

- Trial pits should be located in areas where the road is to be widened;
- Determine in-situ strength of the soils to 1.2m depth below finished pavement level;
- Recover soils samples for classification and determination of in-service strength;
- Determine foundation type and depth; and
- Determine depth of a new pavement.

7.2.4 Geometry

Changes to the horizontal and vertical alignment may be restricted by the threshold constraints. Changes to vertical alignments will require the construction of a new surface course and depending upon the magnitude of change a new binder course may also be required. A change to horizontal alignment may require new full depth construction.

For widened elements of the schemes, a new full depth pavement will be required. Continuity of drainage must be maintained over the profile of the earthworks between the existing carriageway and the proposed widening to prevent moisture/water becoming trapped in the pavement foundation, with the exception of SuDS solutions where stored water in the pavement foundation is managed.

7.2.5 Network Asset Management and Maintenance

The extents of the Proposed Scheme are covered by three local authorities. These are:

- Dublin City Council (DCC);
- Dún Laoghaire-Rathdown County Council (DLRCC); and
- Wicklow County Council (WCC).

In general, the local authorities take a similar approach to pavement management. The local authorities use this information to rank the network condition. Data is used to inform pavement maintenance and prioritisation although a significant proportion of local authority repair work is constrained by budget and is reactive to public complaints. Road Condition Index (RCI) is determined from the machine-driven surveys. RCI is a form of ranking of pavement condition and can be simplified into red, amber and green categories. Typical authority RCI ranking is shown in **Table 7-1** below. The majority of maintenance carried out by the local authorities is limited to repair of the surface course layer only.

Table 7-1: Typical Authority RCI Ranking for Network Asset Management of Pavements

Typical RCI Ranking	
Red	Poor overall condition. Plan maintenance soon
Amber	Some deterioration is apparent. Plan investigation soon
Green	Generally, in good condition.

7.3 Pavement Condition Survey and Assessment

7.3.1 Visual survey

A walked high-level visual survey was carried out along the majority of the route during February 2020. A video survey recorded from the footway / cycleway was used to determine the visual condition of the bus lanes on the multi-lane sections of R138 and N11. Certain areas were inaccessible due to lack of adjacent footpath. Weather conditions at the time of the survey were mainly dry with occasional showers. The location, photograph, type and severity of the observed defects or features was stored in ArcGIS. A brief description and photograph of each observation was recorded in ArcGIS interactive mapping software.

7.3.2 High level ranking of pavements

The condition assessment and ranking of pavement condition is based on a visual survey and supported by Right-of-Way (ROW) condition data.

Each observed defect or feature was assigned a symbol and plotted on a general arrangement plan of the Proposed Scheme. The plotted information was used to identify and assign pavements exhibiting similar properties to homogeneous sections for ranking and treatment. The condition of the pavement was ranked into three categories according to the number and types of defect which occurred in an area of pavement. The three categories are major defect, minor defect and no visual defect. These defects were recorded as major in purple and minor in red for the individual defects. In cases where there were a large number of minor defects they were assigned to the major colour zone along with all major defects, otherwise a minor colour zone was assigned.

Figure 7.1 presents an extract from a typical general arrangement plan which shows the ranking of pavement condition and visual observations. The ranking is identified as a red dash line indicating major defects; in this case deteriorating asphalt over distressed concrete pavement. The plan also shows core locations for a proposed pavement investigation.

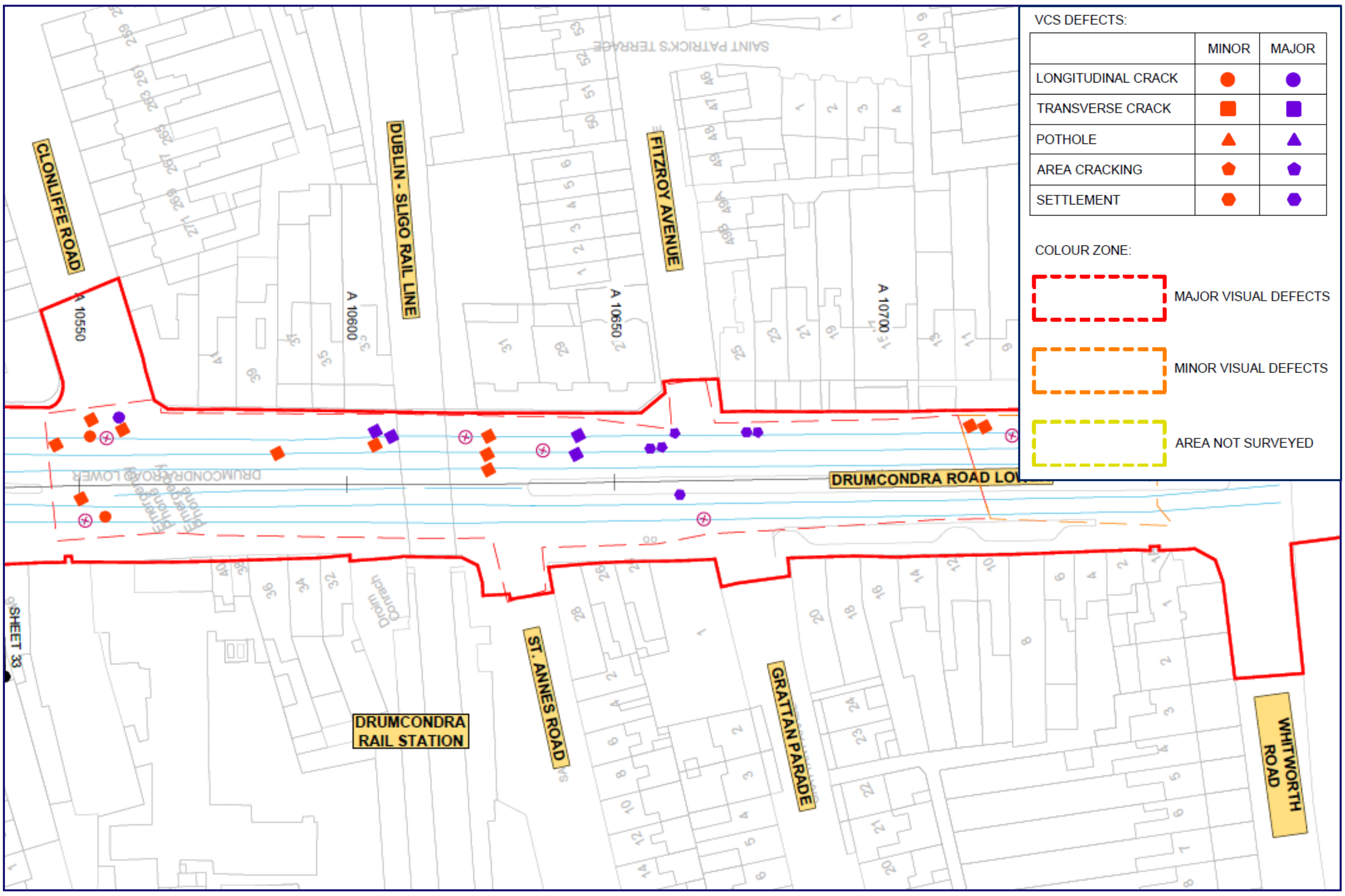

Figure 7.1: Example Ranking of Pavement Condition and the Type and Location of Defects Observed.

Having completed the visual assessment, the maps generated through the ArcGIS mapper were then used to inform the proposed pavement design, in **Appendix B.**

7.4 Pavement Design

7.4.1 Refurbishment of Existing Pavements

The preliminary refurbishment design is based on the information recorded during the visual condition survey supplemented by information received from the Authorities responsible for maintenance and information from drive through videos. The type of defect or combination of defects was assessed as described previously. The type of treatment proposed is dependent on the severity and number of observed defects and overall condition of the pavement.

7.4.1.1 Treatment Options

In the absence of information on the type, thickness and strength of the existing pavements, the types of construction presented in **Table 7-2** is based solely on visual condition information gathered during a visual survey complimented by Street View and limited local authority condition data.

Table 7-2: Typical Treatments for New and Refurbished Pavements

Road Repair/ Maintenance	Depth (mm)	Material Type	Specification Clause
Profile and lay 45mm			
New surface course only	45	HRA 35/14 F surf 40/60 des	SPW 0900 cl. 4.1.2
Profile and lay 130mm			
Surface course (Note 1)	40	HRA 30/14 F surf 40/60 des	SPW 0900 cl. 4.1.1
Binder course	90	AC20 dense bin 40/60 des	SPW 0900 cl. 3.1.4
Profile and lay 200mm			
Surface course (Note 1)	40	HRA 30/14 F surf 40/60 des	SPW 0900 cl. 4.1.1
Binder course	60	AC20 dense bin 40/60 des	SPW 0900 cl. 3.1.4
Base	100	AC32 dense base 40/60 des	SPW 0900 cl. 3.1.1
Note 1: SMA surf PMB 65/105-60 SPW 0900 Clause 5.1.1 may be used in place of HRA surface course			

7.4.1.2 Presence of Tar Bound Materials at Depth

It is probable that tar will be present in the lower layers of the bound pavement of older roads. This should only affect materials recovered from the deeper excavations (200mm) for new binder course and base. In the absence of any factual information an estimate of 1% tar bound materials from the deeper excavation would be reasonable.

7.4.2 Design of New Full Depth Pavement

7.4.2.1 Depth of Asphalt for New Full Depth Pavement

The design pavement thickness for a new full depth pavement comprising asphalt concrete with 40/60 bitumen binder has been determined in accordance with DN-PAV-03021 – Pavement and Foundation Design (NRA HD 25-26) for a 20-year and 40-year design period. The traffic design has been separated into bus/coach and HGV traffic volumes and is applicable for new and refurbished pavement design

Table 7-3 presents the range in asphalt thickness comprising AC 40/60 for new full depth pavement in areas of widening and full depth repair to existing pavements.

Table 7-3: Range in Thickness for a New Full Depth Asphalt Pavement.

Design Life	Vehicle	Traffic Lane	Maximum (mm)	Minimum (mm)	Average (mm)
20 years	Bus/Coach	Bus/Coach only	270	210	240
	HGV	Other traffic lanes	250	200	220
40 years	Bus/coach	Bus/Coach only	310	240	270

Design Life	Vehicle	Traffic Lane	Maximum (mm)	Minimum (mm)	Average (mm)
	HGV	Other traffic lanes	290	200	230

7.4.2.2 Pavement Foundation Design for New Full Depth Pavement

The foundation design is based on an assumed in-service California Baring Ratio (CBR) of 3% at formation level. In accordance with TII DN-PAV-03021 – Pavement and Foundation Design (NRA HD 25-26) the required thickness of Type B Subbase is 300 mm.

7.4.2.3 New Full Depth Construction for Bus Lanes

New pavement design should comply with the requirements of TII DN-PAV-03021 – Pavement and Foundation Design (NRA HD 25-26). The required asphalt pavement depth along the Proposed Scheme ranges between 240mm and 300mm, with an average thickness of 250mm AC 40/60 for a 40-year design life. Pavement depths for bus lanes can be seen below in **Table 7-4**

Table 7-4: New Full Depth Construction for Bus Lanes

Road Repair/ Maintenance	Depth (mm)	Material Type	Specification Clause
Surface course	40	SMA surf PMB 65/105-60	SPW 0900 cl. 5.1.1
Binder course	60	AC20 dense bin 40/60 des	SPW 0900 cl. 3.1.4
Base	140 to 200	AC32 dense base 40/60 des	SPW 0900 cl. 3.1.1
Subbase	300	Type B Subbase	SPW 0800 cl. 804
Total depth	540 to 600	Assumed CBR≥3%	
Alternative Construction with EME2			
Surface course	40	SMA surf PMB 65/105-60	SPW 0900 cl. 5.1.1
Binder course/Base	160 to 200	AC10 EME2 15/25 des	DN-PAV-03021
Subbase	300	Type B Subbase	SPW 0800 cl. 804
Total depth	500 to 540	Assumed CBR≥3%	

7.4.2.4 Long Stay Offline Bus Layby

Although modified asphalts provide good rut resistance, stationary vehicles with their engines running can deform asphalt in a relatively short time period. Two alternative options should be considered:

- A grouted macadam is a proprietary process whereby an open-graded asphalt surface layer is constructed over a competent substrate. A new full depth construction is preferable. A high strength cementitious grout is applied to the surface to completely fill all the voids. The resultant product is a strong and rut resistant surface which is not prone to the plastic deformation associated with conventional asphalt. This process should be considered for both on-line and off-line bus stops.

- Pavement quality concrete continually reinforced with no joints in accordance with HD26, minimum thickness 200mm would provide a robust pavement surface and structure. Concrete pavements should be constructed over a cement bound base.

7.5 Construction of New Cycleways and Footways

The typical standard designs for new cycleways and footways below are extracted from TII standard details.

7.5.1 Cycleway

A typical cycleway construction is shown in **Table 7-5** below.

Table 7-5: Typical Cycleway Construction

New Cycleway	Depth (mm)	Material Type	Specification Clause
Asphalt – no vehicle overrun			
Surface course	30	Red colour, AC10 dense surf 70/100 des	SPW 0900 cl. 3.1.13
Binder course	50	AC20 dense bin 70/100 des	SPW 0900 cl. 3.1.5
Subbase	225	Type B Subbase	SPW 0800 cl. 804

7.5.2 Footpath

Table 7-6 presents a range of typical options for new footway construction. The full range of options are provided in TII standard details.

Heritage paving – design and construction will be to a bespoke design, dependent on the type and dimension of paving modules specified.

Table 7-6: Typical Footway Construction

New Footway	Depth (mm)	Material Type	Specification Clause
Asphalt – light vehicle overrun			
Surface course	20	AC6 dense surf 70/100 des	SPW 0900 cl. 3.1.15
Binder course	50	AC20 dense bin 70/100 des	SPW 0900 cl. 3.1.5
Subbase	225	Type B Subbase	SPW 0800 cl. 804
Concrete – light vehicle overrun			
Surface layer	150	C25/30 unreinforced concrete	SPW 1000 cl. 1001
Subbase	150	Type B Subbase	SPW 0800 cl. 804
Pavers – light vehicle overrun			
Surface layer	60	Concrete block paver	BS 7533

New Footway	Depth (mm)	Material Type	Specification Clause
Bedding sand	30	Bedding sand	BS 7533
Base	70	AC20 dense bin 70/100 des	SPW 0900 cl. 3.1.5
Subbase	150	Type B Subbase	SPW 0800 cl. 804
Flags- light vehicle overrun			
Surface layer	65	Flags	BS 7533
Bedding layer	25	Mortar	BS 7533
Base	70	AC20 dense bin 70/100 des	SPW 0900 cl. 3.1.5
Subbase	150	Type B Subbase	SPW 0800 cl. 804

7.6 UCD Bus Interchange

The interchange will be trafficked by a large volume of buses. Slow moving, stationary and manoeuvring buses are very damaging to the pavement structure and its surface; the choice of pavement type must be carefully considered. Although modified asphalts provide good rut resistance, stationary vehicles with vibration from their engines running can deform asphalt in a relatively short time. Pavement quality concrete surfacing will provide a robust pavement surface and structure and is proposed for the Bus Interchange area. Concrete is highly rut resistant and resistant to oil dropping and is low maintenance. The concrete pavement will be constructed over a cement bound base.

A proportion of the pavement will be constructed over a sustainable drainage system (SuDS). The pavement foundation will provide storage beneath the pavement and will comprise single sized crushed rock.

7.6.1 Traffic Design

The new interchange will be trafficked by a high volume of buses and coaches during the design period. A daily volume of 2,230 buses/coaches over a design period of 40 years has been assumed for the pavement design. Pavement specifications for the UCD Bus Interchange can be found in **Table 7-7 and Table 7-8**

Table 7-7: Pavement Type A - Bus Bay and Pass Lanes – Sustainable Drainage

Depth (mm)	Pavement Type A - SUDS Bus Bay and By-pass lanes	Specification
300	C 35/45 Concrete	SPW 1000 cl 1001 -1005
150	C8/10 Concrete Subbase	SPW 0800 cl. 822
	Waterproof Separation Membrane	SPW 1000 cl. 1007
600	20/40 Crushed Rock/Crushed Gravel EN 13242. 20/40. Gc 80-20. GTNR FNR	SPW 0500 cl. 505
COMPOSITE GEO-GRID TENSAR TRI-AX TX160 + TERRAM 1000		Proprietary
SUBGRADE CBR ≥2%		

Table 7-8: Pavement Type B - Bus Bay and Pass Lanes

Depth (mm)	Pavement Type B Bus Bay and By-pass lanes	Specification
300	C 35/45 Concrete	SPW 1000 cl. 1001 -1005
150	C8/10 Concrete Subbase	SPW 0800 cl. 822
600	Capping	SPW 0600 cl. 613
SUBGRADE CBR ≥2%		

7.6.2 UCD Service Road

A new service road around the perimeter of the proposed interchange will comprise a full depth composite pavement. Details can be found below in **Table 7-9**

Table 7-9: Pavement Type C - UCD Access Road

Depth (mm)	Pavement Type C UCD Service Road	Specification
40	SMA Surface Course PMB 65/105-60	SPW 0900 cl. 5.1.1
260	EME2 Binder/Base	DN-PAV-03021
150	C8/10 Concrete Subbase	SPW 0800 cl. 822
600	Capping	SPW 0600 cl. 613
SUBGRADE CBR ≥2%		

7.7 Future Pavement Assessment

Pavement assessments should be carried out in accordance with TII AM-PAV-06050 Pavement Assessment Repair and Renewal Principles.

A high-level visual condition survey has been completed. Further investigation, inspection and testing is required to complete the investigation. Buried services may restrict the location and depth of in-situ tests and recovery of samples.

7.8 Incorporation of Recycled Aggregates into Pavement Materials

7.8.1 Carbon Footprint

The purpose of in-situ recycling is to effectively restore a failed road pavement by recycling and reusing existing construction materials to construct a new pavement with strength and life expectancy that is equivalent to that of traditional construction. The need to dispose of large volumes of waste materials and import processed virgin aggregates and hot bitumen binder is greatly reduced resulting in a lower carbon footprint. In addition to a reduced environmental impact in-situ recycling can often be a lower cost solution in both urban and rural environments. The design and process of construction should follow the guidelines in:

- TRL 386 Design guide and specification for structural maintenance of highway pavements by cold in-situ recycling; and
- TRL 611 A guide to the use and specification of cold recycled materials for the maintenance of road pavements.

7.8.2 Processes

The following types of re-use and recycling of site-won materials are common practice in the industry.

7.8.2.1 Unbound Mixture Produced as Part of the Works

EN 13285 includes manufactured (such as slags and ashes) and recycled aggregates within its scope without specific mention in the requirement clauses. The approach adopted is blind to the source of the aggregate used in the mixture. The suitability of mixtures containing manufactured and recycled aggregates for use in subbase should be assessed in accordance with the requirements of the project specification.

EN 13242 and EN 13285 specify the operation of a factory production control system to confirm conformance with the relevant requirements of the standards. Although unbound mixtures produced on site as part of the permanent works are not placed on the market, a factory production control system (or a quality plan with equivalent requirements) is still required to provide the necessary level of assurance.

7.8.2.2 Unbound Subbase

EN 13285 applies to unbound mixtures of natural, manufactured aggregates such as slags and recycled aggregates. The materials may comprise the following:

- 100% recycled coarse aggregate and concrete aggregates with up to 50% asphalt planings; or
- 100% asphalt planings – the effects of using this material on the surrounding environment should be fully assessed.

7.8.2.3 Bound Subbase

The different parts of EN 14227 require aggregates to conform to EN 13242 which applies to aggregates obtained by processing natural or manufactured or recycled materials. Recycled coarse aggregate, concrete aggregate and asphalt planings may be incorporated into the mixture. The standard includes the use of a wide range of binders including:

- Cement;
- Slag;
- Fly ash; and
- Hydraulic road binder.

The properties and the appropriate categories of the aggregates should be specified depending on the position of the bound granular mixture in the pavement structure and the traffic to be carried.

7.8.2.4 Capping

Capping material may comprise any material, or combination of materials including recycled aggregates and recycled concrete with not more than 50% by mass of recycled bituminous planings and granulated asphalt, but excluding materials contaminated with tar and tar-bitumen binders.

7.8.2.5 In-situ and Plant Recycling Processes

The types of in-situ and plant recycling processes include:

- **Repave and remix:** these are in-situ processes which conserve/restore the surface layers of structurally sound pavements;
- **Cold deep recycling:** pavement layers can be recycled in-situ to form a foundation or main structural layers of a new pavement;
- **Low energy bound mixtures:** the requirements and processes for plant base cold recycling are specified in TII CC-SPW-00900; and

Central plant hot recycling: good quality unbound aggregates such as subbase and drainage materials and reclaimed asphalt can be fed into the hot mix process.

8. Structures

8.1 Overview of Structures Strategy

A number of structures are proposed along the length of the route, the design of which is progressing in accordance with the various phases as outlined in Transport Infrastructure Ireland (TII) Publications.

The design of structures is developed to a level of detail sufficient to describe the major elements of the structure and obtain preliminary approval in accordance with TII DN-STR-03001 Technical Acceptance of Road Structures on Motorways and Other National Roads (Formerly NRA BD 2). This chapter of the report provides an overview of the structures envisaged, which are presented in more detail in the Structures Option Reports listed in **Table 8-1** below. The Structures Options Reports and associated drawings are contained in **Appendix F.**

Table 8-1: Tabular Summary of Structures Options Reports

Document Title	Document Reference	Appendix
Outline Structures Report: Bray to City Centre	BCIDB-JAC-STR_ZZ-0013_RW_00-RP-CB-0001	**Appendix F.**
Retaining Walls Structures Options Report: Bray to City Centre, Dún Laoghaire-Rathdown County Council	BCIDB-JAC-STR_ZZ-0013_RW_00-RP-CB-0003	**Appendix F.**
Retaining Walls Structures Options Report: Bray to City Centre, Wicklow County Council	BCIDB-JAC-STR_ZZ-0013_RW_00-RP-CB-0004	**Appendix F.**
Loughlinstown Roundabout Retaining Wall Structures Options Report: Bray to City Centre	BCIDB-JAC-STR_ZZ-0013_RW_00-RP-CB-0005	**Appendix F.**
St Laurence's Park Structures Options Report: Bray to City Centre	BCIDB-JAC-STR_ZZ-0013_BR_00-RP-CB-0001	**Appendix F.**
St Anne's Retaining Wall Structures Options Report: Bray to City Centre	BCIDB-JAC-STR_ZZ-0013_RW_00-RP-CB-0007	**Appendix F.**

Where existing structures are expected to be subject to a change in loading conditions or function, Record of Structural Review forms, listed in **Table 8-2** have been produced to capture these changes and allow for Technical Approval in accordance with AM-STR-06042 (formerly NRA BD 101). The Record of Structural Review forms and their associated appendices are contained within **Appendix F.**

Table 8-2: **Tabular Summary of Record of Structural Review Forms**

Document Title	Document Reference	Appendix
Record of Structural Review Form, UCD Bridge: Bray to City Centre	BCIDB-JAC-STR_ZZ-0013_XX_00-RP-CB-0002	**Appendix F.**
Record of Structural Review Form, St Columcille Footbridge: Bray to City Centre	BCIDB-JAC-STR_ZZ-0013_XX_00-RP-CB-0003	**Appendix F.**
Record of Structural Review Form, St Anne Roundabout Retaining Wall	BCIDB-JAC-STR_ZZ-0013_XX_00-RP-CB-0004	**Appendix F.**

Preliminary Design Reports will be produced for all structures listed in **Table 8-3** requiring technical approval in accordance with DN-STR-03001.

Table 8-3: Tabular Summary of Structures Preliminary Design Reports

Document Title	Document Reference	Appendix
Retaining Walls Preliminary Design Report: Bray to City Centre,	BCIDB-JAC-STR_ZZ-0013_RW_00-RP-CB-0009	**Appendix F.**
St Laurence Subway Preliminary Design Report: Bray to City Centre	BCIDB-JAC-STR_ZZ-0013_BR_00-RP-CB-0005	**Appendix F.**
Loughlinstown Roundabout Retaining Wall Preliminary Design Report: Bray to City Centre	BCIDB-JAC-STR_ZZ-0013_RW_00-RP-CB-0010	**Appendix F.**
St Anne's Retaining Wall Preliminary Design Report: Bray to City Centre	BCIDB-JAC-STR_ZZ-0013_RW_00-RP-CB-0011	**Appendix F.**

Throughout the development of the options in the subsequent stages of the scheme the following authorities should be kept apprised of the aspects of the proposals that will impact them:

- Dún Laoghaire-Rathdown County Council;
- Dublin City Council;
- Wicklow County Council; and
- Transport Infrastructure Ireland.

8.2 Summary of Principal Structures

A number of Principal Structures exist along the length of the scheme. Their location and type is indicated in **Table 8-4** below.

Table 8-4: Tabular Summary of Principal Structures

Identity	Irish OS Grid	ITM Grid	Chainage (m)	Description
Eustace/Leeson Street Bridge	316432E 232716N	716373E 732741N	A550	Single span arch bridge built in 1791. The bridge carries the mainline at Leeson Street - R138 and it crosses the Grand Canal. Realignment to kerbs on east side but no carriageway widening required at this location.
Anglesea Bridge	317836E 231323N	717777E 731348N	A2550	Single span arch bridge built in 1832. The bridge carries the mainline Donnybrook Road, Stillorgan Road - R138 and it crosses the River Dodder. Road alignment includes the adjustment of the kerb lines to accommodate widened footpaths or raised cycle path.
Footbridge (Stillorgan Road-Airfield Park junction)	318283E 230841N	718224E 730866N	A3230	2-span steel footbridge crosses Stillorgan Road at the Airfield Park junction. The structure is not affected by any change.
Culvert	320450E 227664N	720391E 727689N	A3830	Existing culvert under R138 Stillorgan Road.
UCD Flyover	318831E 230238N	718772E 730262N	A4080	4-span concrete road bridge carrying the access to UCD over the R138 Stillorgan Road. The proposed highway alignment includes reconfiguration of the highway lanes, footways and cycle tracks without structural modification.
Footbridge (Stillorgan Road-Seafield Road junction)	319283E 229813N	719224E 729838N	A4700	2-span steel footbridge crosses Stillorgan Road at the Seafield Road junction. The structure is not affected by any change.
Footbridge (Stillorgan Road- Merrion Grove / The Rise junction)	319568E 229480N	719509E 729505N	A5140	Single span steel footbridge crosses Stillorgan Road at the Merrion Grove / The Rise junction. The structure is not affected by any change.
St Laurence's Park Subway	320295E 228157N	720235E 728182N	A6710	Existing underpass below the N11 Stillorgan Road mainline proposed to be lengthened at east end to allow for new footpath. The structure has a span of 4 m.
Culvert	324549E 223289N	724489E 723314N	A7200	Existing culvert under N11 Bray Road. The structure is not affected by any change.
Foxrock Church Footbridge	321842E 226360N	721783E 726385N	A9250	1-span concrete footbridge crosses N11 Bray Road at the Kill Lane junction. The structure is not affected by any change.

Identity	Irish OS Grid	ITM Grid	Chainage (m)	Description
Clonkeen Road Footbridge	322840E 225609N	722780E 725634N	A10500	2 span concrete footbridge crosses N11 Bray Road at the Clonkeen Road junction. The structure is not affected by any change.
Johnstown Road Footbridge	323538E 225051N	723479E 725077N	A11400	3-span half-joint concrete footbridge crosses N11 Bray Road at the Johnstown junction. The structure is not affected by any change.
Wyattville Road Overbridge	324385E 223481N	724326E 723507N	A13230	2-spans concrete highway bridge crossing the mainline. No current proposal for adjustments due to highway design.
Loughlinstown River Culvert	324585E 223229N	724469E 723316N	A13500	Existing culvert under N11 Bray Road. West of the structure comprises of a single span masonry arch. Remainder of the structure is a single span in-situ concrete slab. No current proposal for adjustments due to highway design.
Loughlinstown River Bridge	324603E 223234N	724537E 723258N	A13510	Existing culvert under N11 Bray Road. Composite form. East 10m comprise of masonry arch. The remainder of the structure is 3m single span reinforced concrete box culvert. No current proposal for adjustments due to highway design.
St Columcille Footbridge (N11 Bray Road-Loughlinstown Roundabout)	324873E 222908N	724814E 722933N	A13990	3-span reinforced concrete half-joint footbridge crosses N11 Bray Road before the Loughlinstown Roundabout. Change in highway alignment below bridge.
Stonebridge Road Old Railway Bridge	325063E 222160N	725004E 722185N	n/a	Old railway bridge on Stonebridge road. No works proposed to the structure.
Dublin Road Bridge	325314E 221895N	725254E 721921N	A15160	Existing bridge carrying on the mainline after the Shanganagh Road junction. No works proposed to the structure.
The Fran O'Toole Bridge	326338E 218865N	726278E 718891N	A18510	Existing bridge carrying on the mainline and crossing the River Dargle. The scheme terminates to the north of the bridge and ties into the Bray Bridge Improvement Scheme by WCC.

8.3 Summary of Minor Structures

Minor structures are defined as Category 0 structures in accordance with DN-STR-03001:

- Single span simply supported structures with span less than 5m;
- Buried concrete boxes or buried rigid pipes greater than 2m clear but less than 3m span/diameter and having more than 1m cover; and
- Environmental barriers less than 2.0m in height.

There are no current proposals for minor structures of these types on the scheme.

8.4 Summary of Retaining Walls

There are a number of proposed retaining walls along the length of the scheme. The location and type of structure is indicated in the **Table 8-5**.

There are also three existing retaining walls that have been identified as requiring review due to the impact of the proposed road alignment. Of these walls, for two structures R13-RW043 (Louhglinstown Roundabout Retaining wall) and R13-RW046 (St Annes Roundabout retaining wall) a design for load alleviation / strengthening measures has been required.

In accordance with DN-STR-03001 Section 3.4 all walls with a retained height less than 5m are classified as a Category 1 structure, except those of height less than 1.5m (that are not subject to Technical Acceptance).

Table 8-5: Tabular Summary of Retaining Structures

Wall Reference	Structure Type Preferred Option	Retained Height (m)			Chainage Start	Chainage End	Length (m)	Category
R13-RW034	Cast In-Situ RC Wall	Varies	0.5	Max	A2420	A2440	20	N/A
R13-RW039	Earth Embankment	Varies	1.5	Max	A6195	A6240	45	N/A
R13-RW031	Earth Embankment	Varies	1	Max	A6305	A6380	75	N/A
R13-RW044a	Precast RC Wall	Varies	1	Max	A8805	A8825	20	N/A
R13-RW044b	Precast RC Wall	Varies	1	Max	A8805	A8825	20	N/A
R13-RW043	Existing Wall. at Loughlinstown roundabout	Varies	3.6	Max	A14050	A14140	110	1
R13-RW022	Precast RC Wall	Varies	1	Max	A14560	A14660	100	N/A
R13-RW041	Earth Embankment	Varies	2	Max	A14700	A14750	50	N/A
R13-RW023	Cast In-Situ RC Wall	Varies	2.5	Max	E10	A14770	40	1
R13-RW024	Precast RC Wall	N/A	TBC	Max	A14770	A14800	30	1
R13-RW036	Precast RC Wall	N/A	TBC	Max	A14800	A14980	Maximum 180	1
R13-RW045	Existing masonry wall at St Annes Roundabout	Varies	1.5	Max	A15175	A15025	135	1
R13-RW046	Existing masonry wall at St Annes Roundabout	Varies	3.2	Max	A15175	A15025	120	1
R13-RW042	Precast RC Wall	Varies	1.2	Max	A15880	A16010	130	N/A
R13-RW027	Cast In-Situ RC Wall	Varies	0.5	max	A16310	A16350	40	N/A

Wall Reference	Structure Type Preferred Option	Retained Height (m)			Chainage Start	Chainage End	Length (m)	Category
R13-RW029	Earth Embankment	Varies	1.3	Max	A16785	A16840	55	N/A
R13-RW038	Precast RC Wall	Varies	1.8	Max	A17040	A17080	40	1
R13-RW013	Precast RC Wall	Varies	1.5	Max	A17190	A17290	100	1
R13-RW014	Cast In-Situ RC Wall	Varies	1	Max	A17755	A17800	45	N/A
R13-RW016	Cast In-Situ RC Wall	Varies	2.5	Max	A18085	A18130	45	1
R13-RW017	Cast In-Situ RC Wall	N/A	TBC	Max	A18150	A18190	40	1

9. Drainage, Hydrology and Flood Risk

9.1 Overview of Drainage Strategy

The drainage preliminary design was developed following consultation with the relevant local authority and Irish Water where applicable. The strategy and design parameters to be adopted throughout Dublin BusConnects Core Bus Corridor is summarised in the BusConnects Core Bus Corridor Drainage Design Basis Document No. BCIDX_ARP-PMG_PS-0000_XX_00-SD-ZZ-0002-included in **Appendix K.**

The design basis statement was developed whilst taking the Greater Dublin Regional Code of Practice (GDRCoP), Greater Dublin Strategic Drainage Study (GDSDS), Planning requirements of Local Authorities within the Dublin region, TII requirements and international best practices such as CIRIA The SuDS Manual (C753).

The principal objectives of drainage design are as follows:

- To drain surface water from existing and proposed pavement areas throughout the BusConnects development and maintain the existing standard of service;
- To maintain existing runoff rates from existing and newly paved surfaces using SuDS;
- To minimise the impact of the runoff from the roadways on the surrounding environment using SuDS, silt traps and/or oil/petrol interceptors. The drainage system should ensure that surface water drains from existing and new pavement areas be limited by the capacity of the existing road drainage network; and
- No drainage features like gullies or manholes are to be located at, or any ponding will be allowed to occur at, pedestrian cross-walk locations or at bus-stop locations. Where any such drainage features currently exist at such locations they will be relocated.

Drainage of newly paved areas will include SuDS measures to treat and attenuate any additional runoff. These measures will ensure that there is:

- No increase in existing run off rates from newly paved areas; and
- Appropriate treatment to ensure runoff quality.

A hierarchical approach to the selection of SuDS measures has been adopted with ‘Source’ type measures e.g. tree pits implemented in preference to catchment type measures e.g. attenuation tanks. Further details of the SuDS hierarchy are provided in Drainage Design Basis.

9.2 Watercourses Crossings and Culverts/ Bridges

The Proposed Scheme crosses several watercourses, of which these are listed below:

- Grand Canal (bridge);
- River Dodder at Donnybrook Road (bridge);
- Elm Park Stream at UCD;
- Brewery Stream at Stillorgan Road;
- Carrickmines Stream at R837 / N11 roundabout;
- Shanganagh River at Bray Road;
- Rathmichael Stream/ Crinken Woodrook Stream at Woodbrook College;
- River Dargle at Castle Street (bridge); and

- Crinken Woodbrook Stream at Junction 5, M11.

All of these watercourses are in culverts where they pass beneath the existing road. No works are proposed to change the width of the road at any crossing; therefore, the existing culverts will be retained without modification.

Stage 1 and 2 Flood Risk Assessments have been completed on the Preliminary Design and are summarised in **Section 9.6.**

9.3 Existing Drainage Description

The Proposed Scheme extends from Bray to Leeson Street Lower in Dublin City Centre. The Proposed Scheme comprises widening and/or adjustment of the existing road to accommodate segregated cycle and bus lanes, in addition to provision for pedestrians and other traffic.

The existing road along the Proposed Scheme is served by both surface water and foul/combined drainage networks. Flows are typically collected in standard gulley grates and routed via a gravity network to outfalls. There are no SuDS/attenuation measures on the existing drainage networks to treat or attenuate runoff from the existing road.

The existing drainage network along the Proposed Scheme can be split into the 13 catchment areas based on topography and the existing pipe network supplied by Irish Water. The approximate catchment areas, existing sewer networks, outfalls and watercourses are shown on the existing catchment drawings (refer to drawings **BCIDB-JAC-DNG_RD-0013_XX_00-DR-CD-1001-01** to **BCIDB-JAC-DNG_RD-0013_XX_00-DR-CD-1001-11** within **Appendix B)**. The catchments are summarized in **Table 9-1** below.

Table 9-1: Proposed Scheme Existing Drainage

Existing Catchment Reference	Approx. Drainage Catchment Area (km^2)	Existing Network Type	Existing Outfalls
Catchment 12	0.802	Surface water (storm)	Network outfalls to the River Dargle
Catchment 11	5.87	Surface water (storm)	Network outfalls to the Rathmichael Watercourse
Catchment 13	2.29	Surface water (storm)	Network outfalls to the Irish Sea
Catchment 10	2.86	Surface water (storm)	Network outfalls to the Shanganagh Watercourse
Catchment 9	1.80	Surface water (storm)	Network outfalls to the Carrickmines Stream
Catchment 8	3.04	Surface water (storm)	Network outfalls to the Cabinteely Stream
Catchment 7	8.16	Surface water (storm)	Network outfalls to the Kill O The Grange Stream
Catchment 6	1.20	Surface water (storm)	Network outfalls to the Brewery Stream
Catchment 5	1.30	Surface water (storm)	Network outfalls to the Priory Stream
Catchment 4	2.30	Surface water (storm)	Network outfalls to the Booterstown Stream
Catchment 3	1.72	Surface water (storm)	Network outfalls to the Elm Park Stream
Catchment 2	2.90	Surface water (storm)	Network outfalls to the River Dodder
Catchment 1	0.39	Foul/combined	Foul/combined network drains to Ringsend WwTP with sewer overflows to the River Liffey

- Catchments 1 and 2 cover the scheme from St Stephen's Green to the intersection between the R138 and Nutley Lane. This area is served by a surface water network, which discharges to Ringsend WwTP with a sewer overflow to the River Liffey. The approximate total network catchment area is 3.29 km^2.

- Catchment 3 covers the scheme from the intersection between the R138 and Nutley Lane to the UCD entrance. This area is served by a surface water network, which discharges to the River Dodder. The approximate total network catchment area is 1.72 km2.

- Catchment 4 covers the scheme from the UCD entrance to the intersection between the Lower Kilmacud Road and the N11. This area is served by a surface water network, which discharges to the Booterstown Stream. The approximate total network catchment area is 2.30 km2.

- Catchment 5 covers the scheme from the intersection between the Lower Kilmacud Road and the N11 to the House of St John of God. This area is served by a surface water network, which discharges to the Priory Stream. The approximate total network catchment area is 1.30 km2.

- Catchment 6 covers the scheme from the intersection between the House of St John of God and Foxrock Golf Course. This area is served by a surface water network, which discharges to the Brewery Stream. The approximate total network catchment area is 1.20 km2.

- Catchment 7 covers the scheme from Foxrock Golf Course to Killbogget Park. This area is served by a surface water network, which discharges to the Kill O The Grange Stream. The approximate total network catchment area is 8.16 km2.

- Catchment 8 covers the north of the scheme from Foxrock Golf Course to Killbogget Park. This area is served by a surface water network, which discharges to the Cabinteely Stream. The approximate total network catchment area is 3.04 km2.

- Catchment 9 covers the scheme from Killbogget Park to St Columcilles Hospital. This area is served by a surface water network, which discharges to the Carrickmines Stream. The approximate total network catchment area is 1.80 km2.

- Catchment 10 covers the scheme from Killbogget Park to St Joseph Medical Centre. This area is served by a surface water network, which discharges to the Shanganagh Watercourse. The approximate total network catchment area is 2.86 km2.

- Catchment 13 covers the scheme at St Joseph Medical Centre. This area is served by a surface water network, which discharges to the Irish Sea. The approximate total network catchment area is 2.29 km2.

- Catchment 11 covers the scheme from St Joseph Medical Centre to the Dargle View Golf Course. This area is served by a surface water network, which discharges to the Rathmichael Watercourse. The approximate total network catchment area is 5.87 km2.

- Catchment 12 covers the scheme from the Dargle View Golf Course to the city centre of Bray. This area is served by a surface water network, which discharges to the River Dargle. The approximate total network catchment area is 0.802 km2.

9.4 Overview of Impacts of Proposed Works on Drainage/Runoff

The Preliminary Drainage Design for the Proposed Scheme has been developed with reference to the *BusConnects Core Bus Corridor Drainage Design Basis*. The principles for the design as set out in the Drainage Design Basis are as follows:

- All drainage structures for newly paved areas are designed with a minimum return period of no flooding in 1:30 years with a 20% climate change allowance. Unless informed otherwise via hydraulic models or anecdotal advice, drainage structures for existing paved areas are assumed to have been designed with a return period of no flooding in 1:5 years;

- A SuDS drainage design has been developed for all newly paved areas in accordance with the SuDS hierarchy set out in the Drainage Design Basis. SuDS are provided to ensure no increase on existing runoff rates from new or existing paved areas;

- Knowning the largely impermeable nature of soils across Dublin, infiltration rates were assumed to be zero for calculating the required attenuation volumes any SuDS measures. This is a conservative approach and ensures SuDS measures are not knowingly undersized at this stage of the design. Where necessary, permeability tests will need to be completed so that infiltration rates can be considered in a future design stage;

- All run-off from road pavement or any other paved areas is collected in a positive drainage system. Over-the-edge discharges are not permitted; and
- Narrow filter drains or fin drains are not expected for inner city roads that are typical of the Proposed Scheme. An assessment of the provision of any sub-grade drainage will undertaken during the next design stage.

Each catchment area has been broken down into sub-catchments in order to define the change in impermeable surface area as a result of the Proposed Scheme. Where there is a net increase in impermeable surface area, a form of attenuation will be required prior to discharge. Where there is no net change or net decrease, then no form of attenuation will be required prior to discharge. A summary list of the sub-catchments, the associated chainage, and impermeable surface area differential is given in **Table 9-2** containing a column entitled 'Net change' which takes account of the change of use from impermeable to permeable areas and vice versa.

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

Existing Catchment Reference	Chainage	Road Corridor Area (m^2)	Change of use to impermeable areas (m^2)	Change of use to permeable areas (m^2)	Net Change (m^2)	Percentage Change (%)
Catchment 1	A18450 - A18350	1937	90	0	90	4.65%
Catchment 2	A18350 – A18100	6071	303	108	195	3.21%
Catchment 3	A18100 – A17950	7191	874	0	874	12.15%
Catchment 4	A17950 - A17750	3888	271	0	271	6.97%
Catchment 5	A17750 – A17500	5573	1259	0	1,259	22.59%
Catchment 6	A17500 – A17200	9861	2053	1518	535	5.43%
Catchment 7	A17200 – A17100	2200	183	0	183	8.32%
Catchment 8a (North)	A17100 - A16750	8440	2332	0	2,332	27.63%
Catchment 8b (North)	A16750 – A16475	5630	647	0	647	11.49%
Catchment 9a (South)	A16475 – A17100	15734	1486	0	1,486	9.44%
Catchment 10	A16475 - A16050	13372	2717	0	2,717	20.32%
Catchment 11	A16050 - A15900	2440	388	0	388	15.90%
Catchment 12	A15900 - A15700	2737	116	0	116	4.24%
Catchment 13	A15700 - A15150	6017	107	0	107	1.78%
Catchment 14	A15150 - A15100	3833	270	153	117	3.05%
Catchment 15	A15100	2617	109	0	109	4.17%
Catchment 16	A15100 - A14700	7391	596	0	596	8.06%
Catchment 17	E200 – E050	867	673	0	673	77.62%
Catchment 18	A14775 - A14475	2299	718	0	718	31.23%
Catchment 19	A14475 - A14200	2956	420	6	414	14.01%
Catchment 20	A14200 - A13875	11936	725	819	-94	-0.79%
Catchment 21	A13875 - A13700	7298	639	165	474	6.49%
Catchment 22	A13700 - A13450	7197	470	119	351	4.88%
Catchment 23	A13450 - A13200	13125	359	112	247	1.88%
Catchment 24	A13200 – A12900	15220	534	0	534	3.51%
Catchment 25	A12900 - A12500	15272	102	98	4	0.03%

Existing Catchment Reference	Chainage	Road Corridor Area (m^2)	Change of use to impermeable areas (m^2)	Change of use to permeable areas (m^2)	Net Change (m^2)	Percentage Change (%)
Catchment 26	A12500 - A12300	6922	38	0	38	0.55%
Catchment 27	A12300 - A12200	3646	60	0	60	1.65%
Catchment 28	A12200 - A11850	15263	183	47	136	0.89%
Catchment 29	A11850 - A11550	6276	150	98	52	0.83%
Catchment 30	A11550 - A11300	11121	316	139	177	1.59%
Catchment 31	A11300 - A11150	8135	164	52	112	1.38%
Catchment 32a (North)	A10800 - A10500	12623	361	132	229	1.81%
Catchment 32b (South)	A10800 - A10500	12500	234	256	-22	-0.18%
Catchment 33	A10500 - A9800	11162	257	101	156	1.40%
Catchment 34	A9800 – A9300	15068	377	54	323	2.14%
Catchment 35	A9300 - A9200	4400	63	18	45	1.02%
Catchment 36	A9200 – A8525	22449	1468	124	1,344	5.99%
Catchment 37a (North)	A8525 – A8350	7109	197	0	197	2.77%
Catchment 37b (South)	A8525 – A8350	7109	296	208	88	1.24%
Catchment 38	A8350 – A8150	9600	384	474	-90	-0.94%
Catchment 39	A8150 – A7850	9880	395	396	-1	-0.01%
Catchment 40a (North)	A7850 - A7750	3416	157	0	157	4.60%
Catchment 40b (South)	A7850 - A7750	3416	42	0	42	1.23%
Catchment 41a (North)	A7750 - A7550	6945	216	3	213	3.07%
Catchment 41b (South)	A7750 - A7550	6945	391	225	166	2.39%
Catchment 42	A7550 – A7450	4137	173	56	117	2.83%
Catchment 43	A7450 – A7150	11858	331	478	-147	-1.24%
Catchment 44a (South)	A7150 – A6850	13369	472	205	267	2.00%
Catchment 44b (North)	A7150 - A6850	11046	742	9	733	6.64%
Catchment 45	A6850 - A6800	3532	48	172	-124	-3.51%
Catchment 46	A6800 - A6650	4182	170	0	170	4.07%
Catchment 47a (North)	A6700 - A6550	8245	479	0	479	5.81%
Catchment 47b (South)	A6800 - A6550	10137	202	0	202	1.99%
Catchment 48a (North)	A6550 - A6250	7383	615	13	602	8.15%
Catchment 48b (South)	A6550 - A6250	7829	626	0	626	8.00%
Catchment 49a (North)	A6250 – A6150	5020	59	25	34	0.68%
Catchment 49b (South)	A6250 – A6150	5020	67	40	27	0.54%

Existing Catchment Reference	Chainage	Road Corridor Area (m^2)	Change of use to impermeable areas (m^2)	Change of use to permeable areas (m^2)	Net Change (m^2)	Percentage Change (%)
Catchment 50a (North)	A6100 - A6150	2180	21	0	21	0.96%
Catchment 50b (South)	A6100 - A6150	2180	20	46	-26	-1.19%
Catchment 51	A6100 - A5700	16304	52	53	-1	-0.01%
Catchment 52	A5700 - A5550	3820	48	21	27	0.71%
Catchment 53	A5550 - A5450	2021	119	24	95	4.70%
Catchment 54a (North)	A5450 - A5100	12440	325	12	313	2.52%
Catchment 54b (South)	A5450 - A5100	12440	622	174	448	3.60%
Catchment 55a (North)	A5100 – A5050	2414	86	229	-143	-5.92%
Catchment 55b (South)	A5100 – A5050	2414	284	159	125	5.18%
Catchment 56a (North)	A5050 – A4925	6092	142	179	-37	-0.61%
Catchment 56b (South)	A5050 – A4925	6092	85	159	-74	-1.21%
Catchment 57a (North)	A4925 - A4600	13637	379	82	297	2.18%
Catchment 58b (South)	A4925 - A4600	13637	639	163	476	3.49%
Catchment 59a (North)	A4600 - A4350	19849	691	13	678	3.42%
Catchment 59b (South)	A4600 - A4350	19849	240	0	240	1.21%
Catchment 60a (North)	A4350 - A4150	8280	430	66	364	4.40%
Catchment 60b (South)	A4350 - A4150	8280	296	0	296	3.58%
Catchment 61	A4150 - A4100	6902	142	96	46	0.67%
Catchment 62a (North)	A4100 – A3950	8671	428	0	428	4.94%
Catchment 62b (South)	A4100 – A3850 (UCD Bus Interchange)	22100	4461	170	4,291	19.42%
Catchment 63	A3950 - A3850	6579	85	0	85	1.29%
Catchment 64	A3850 - A3400	5060	174	410	-236	-4.66%
Catchment 65	A3400 - A3200	8300	76	107	-31	-0.37%
Catchment 66	A3200 - A3100	3844	77	54	23	0.60%
Catchment 67	A3100 - A000	94582	219	754	-535	-0.57%

9.4.1 Method of Design

The following steps outlines in **Table 9-3** were completed to develop the Preliminary Drainage Design for the Proposed Scheme:

Table 9-3: Proposed Scheme Drainage Design Steps

Design Step	Details
Step 1 – Define Drainage Catchments	The Proposed Scheme was first split into the 13 existing catchments based on topography and the existing sewer network as described in **Section 1.2** above. The Proposed Scheme was then further split into further sub catchments for drainage design. The drainage design sub catchments are based on the road topography, extent of new paved areas and existing road drainage network.
Step 2 – Define Outfalls	The proposed outfall locations for newly paved areas were identified as either: • The existing drainage network; • An appropriate watercourse.
Step 3 – Develop Network	A concept design for each catchment drainage network was developed. Where there is no change in the pavement area within a catchment, it was assumed that the existing network would be retained with new gulley connections provided as required.
Step 4 – Design SuDS Requirements	SuDS measures were designed to attenuate runoff for any newly paved areas. SuDS were design designed to provide sufficient storage to ensure no increase in existing runoff rates. Where there is no change in the pavement area within a catchment, no SuDS measures are proposed as there will be no change in the runoff rate.
Step 5 – Design Treatment Requirements	Where practicable, runoff treatment from newly paved areas was catered for within the proposed SuDS measures. Where this is not practicable a petrol interceptor was provided. Where there is no change in the pavement area within a catchment, no treatment provision is allowed for.

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

Further, more detailed modelling using MicroDrainage (WinDes) and/or InfoWorks will need to be completed on a catchment-by-catchment basis to develop the drainage design during the next stage.

The parameters that were applied for the Preliminary Design are stated in the Drainage Design Basis and summarised in **Table 9-4** below.

Table 9-4: Drainage Design Parameters

Parameter and Feature	Design Standard
Runoff Permeability Factors	
Paved areas (new and existing)	1.0 (100% runoff)
Greenfield areas (new and existing)	0.3 (based on Dublin Soil Type 2, GDSDS Volume 2)
Rainfall Design Criteria	
FSR curve region	Scotland/Ireland
M5-60	16.3 (Met Eireann. Return Period Rainfall Depths for sliding Durations. Irish Grid: Easting 315887, Northing: 234669. Values derived from a Depth Duration Frequency Model)
Ratio R	0.279 (Met Eireann. Return Period Rainfall Depths for sliding Durations. Irish Grid: Easting 315887, Northing: 234669. Values derived from a Depth Duration Frequency Model)
Climate change allowance	20% (Dublin City Council Development Plan 2022-2028 and Drainage Requirements for Planning Applications)
Permitted Discharge Rates	
Newly paved catchment areas	Discharge rates throttled to **2l/s/ha** with minimum flow of **2l/s**
Existing paved catchment areas	Taken as the existing **1 in 5-year flow** unless available network/model information shows an alternative existing rate of discharge
Combined new/existing paved catchment areas	Limited to the existing **1 in 5-year flow** unless available network/model information shows an alternative existing rate of discharge from existing paved areas
Attenuation / SuDS Measures	
Combined new/existing paved areas	Attenuation/SuDS measures sized to contain the **1 in 30-year storm** with a 20% allowance for future climate change
Newly paved (existing greenfield) areas	Attenuation/SuDS measures sized to contain the **1 in 100-year storm** with a 20% allowance for future climate change
Exceptions: • Where attenuation measures are proposed in the floodplain, they shall be sized to contain the 1 in 100-year storm plus climate change; and • The design of attenuation/SuDS measures shall ensure no flooding of properties up to and including the 1 in 100-year storm plus climate change.	

9.5 Preliminary Drainage Design

9.5.1 Proposed Drainage System

The following drainage types are proposed for the Proposed Scheme catchments, which comprise newly paved and combined existing/newly paved areas:

- **Sealed Drainage** which collects, conveys and discharges runoff via a sealed pipe network. For the purposes of the BusConnects scheme, this type of drainage comprises sealed pipes which are connected to split gullies within the kerbline. These gullies will be located in the kerbline between the cycle-track and the bus lane and/or the footpath and the cycle track depending on the road profile, but with the location of the bicycle and/or bus wheel-track in mind for cycling safety and ride-quality purposes.

- **Grass Surface Water Channels and Swales** are provided as road edge channels. These receive flows from the sealed pipe network and are designed to convey, attenuate and treat runoff prior to discharge.
- **Filter Drains** are provided as road edge channels. These comprise a perforated pipe with granular surround and are designed to convey, attenuate and treat runoff prior to discharge.
- **Tree Pits** are provided in close proximity to the road. These receive flows from the sealed pipe network and are designed to convey, attenuate and treat runoff prior to discharge.
- **Attenuation Tanks –** Where there is insufficient attenuation volume provided by the proposed SuDS drainage measures, an attenuation tank is required to provide the required volume.
- **Pavement Capping Layer Attenuation** is used under the UCD Bus Interchange. Gullies discharge directly to the capping layer under the pavement. The capping layer discharges at its lowest point to the nearby drainage system.
- **Oversized pipes –** Where there is insufficient space available for SuDS measures it is proposed to provide some attenuation volume online using oversized pipes.

9.5.2 Summary of Surface Water Drainage

SuDS measures are included for each catchment where there is an increase in the impermeable drainage area to ensure no increase in run off and that provision is made for treatment.

For catchments where there is no change in the impermeable surface area and the kerb line is to be changed the existing sealed pipe network will be retained with new split entry gully connections provided as appropriate. As for any new drainage network, the gullies will be located in the kerb line between the cycle-track and the bus lane and/or the footpath and the cycle track depending on the road profile. A split entry gully will be used to ensure the bus wheel track zone does not overlap with a normal road gully. For catchments where there is no change in the impermeable surface area and no change to the kerb line the current drainage will remain unchanged.

A summary of the proposed drainage measures for the Proposed Scheme are presented in **Table 9-5** below:

Table 9-5: Summary of the Proposed Drainage Measures

Catchment	Chainage	Drainage Type
Asset Owner/Location: Wicklow County Council		
Catchment 1	A18450 - A18350	Existing sealed pipe network retained
Catchment 2	A18350 – A18100	Existing sealed pipe network retained
Catchment 3	A18100 – A17950	Tree pits with filter drain underneath, proposed sealed pipe network
Catchment 4	A17950 - A17750	Filter drains, proposed sealed pipe network
Asset Owner/Location: Wicklow County Council/ Dun Laoghaire Rathdown County Council		
Catchment 5	A17750 – A17500	Filter drain, attenuation tank, proposed sealed pipe network
Asset Owner/Location: Dun Laoghaire Rathdown County Council		
Catchment 6	A17500 – A17200	Proposed oversized pipes, existing and proposed sealed pipe network
Catchment 7	A17200 – A17100	Proposed tree pits, existing sealed pipe network
Catchment 8a (North)	A17100 - A16750	Proposed oversized pipes, existing sealed pipe network
Catchment 8b (North)	A16750 – A16475	Proposed oversized pipes, existing sealed pipe network

Catchment	Chainage	Drainage Type
Catchment 9a (South)	A16475 – A17100	Proposed oversized pipes
Catchment 10	A16475 - A16050	Proposed oversized pipes and filter drains, existing sealed pipe network
Catchment 11	A16050 - A15900	Proposed tree pits with filter drain underneath
Catchment 12	A15900 - A15700	Existing sealed pipe network retained
Catchment 13	A15700 - A15150	Existing sealed pipe network retained
Catchment 14	A15150 - A15100	Existing sealed pipe network retained
Catchment 15	A15100	Existing sealed pipe network retained
Catchment 16	A15100 - A14700	Proposed oversized pipes, existing sealed pipe network
Catchment 17	E200 – E050	Proposed filter drain, existing sealed pipe network
Catchment 18	A14775 - A14475	Proposed oversized pipes and attenuation tank
Catchment 19	A14475 - A14200	Proposed filter drains, existing sealed pipe network
Catchment 20	A14200 - A13875	The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area, existing drainage retained, sealed pipe network.
Catchment 21	A13875 - A13700	Proposed oversized pipes, existing sealed pipe network
Catchment 22	A13700 - A13450	Proposed oversized pipes, existing sealed pipe network
Catchment 23	A13450 - A13200	Proposed oversized pipes, existing sealed pipe network
Catchment 24	A13200 – A12900	Proposed oversized pipes, existing sealed pipe network
Catchment 25	A12900 - A12500	Existing sealed pipe network retained
Catchment 26	A12500 - A12300	Existing sealed pipe network retained
Catchment 27	A12300 - A12200	Existing sealed pipe network retained
Catchment 28	A12200 - A11850	Existing sealed pipe network retained
Catchment 29	A11850 - A11550	Existing sealed pipe network retained
Catchment 30	A11550 - A11300	Proposed tree pits with filter drain underneath, proposed and existing sealed pipe network
Catchment 31	A11300 - A11150	Proposed tree pits with filter drain underneath, proposed and existing sealed pipe network
Catchment 32a (North)	A10800 - A10500	Proposed tree pits with filter drain underneath, proposed and existing sealed pipe network
Catchment 32b (South)	A10800 - A10500	The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area, existing drainage retained, sealed pipe network.
Catchment 33	A10500 - A9800	Existing sealed pipe network retained

Catchment	Chainage	Drainage Type
Catchment 34	A9800 – A9300	Proposed tree pits, proposed and existing sealed pipe network
Catchment 35	A9300 - A9200	Existing sealed pipe network retained
Catchment 36	A9200 – A8525	Proposed tree pits with filter drain underneath, oversized pipes, existing sealed pipe network
Catchment 37a (North)	A8525 – A8350	Proposed oversized pipes, existing sealed pipe network
Catchment 37b (South)	A8525 – A8350	Existing sealed pipe network retained
Catchment 38	A8350 – A8150	The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area, existing drainage retained, sealed pipe network.
Catchment 39	A8150 – A7850	The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area, existing drainage retained, sealed pipe network.
Catchment 40a (North)	A7850 - A7750	Existing sealed pipe network retained
Catchment 40b (South)	A7850 - A7750	Existing sealed pipe network retained
Catchment 41a (North)	A7750 - A7550	Proposed oversized pipes, existing sealed pipe network
Catchment 41b (South)	A7750 - A7550	Proposed oversized pipes, existing sealed pipe network
Catchment 42	A7550 – A7450	Existing sealed pipe network retained
Catchment 43	A7450 – A7150	Existing sealed pipe network retained
Catchment 44a (South)	A7150 – A6850	Proposed oversized pipes, existing sealed pipe network
Catchment 44b (North)	A7150 - A6850	Proposed oversized pipes, existing sealed pipe network
Catchment 45	A6850 - A6800	The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area, existing drainage retained, sealed pipe network.
Catchment 46	A6800 - A6650	Filter Drains, existing and proposed sealed pipe network.
Catchment 47a (North)	A6700 - A6550	Proposed oversized pipes, existing sealed pipe network
Catchment 47b (South)	A6800 - A6550	Proposed oversized pipes, existing sealed pipe network
Catchment 48a (North)	A6550 - A6250	Proposed oversized pipes, existing sealed pipe network
Catchment 48b (South)	A6550 - A6250	Proposed oversized pipes, existing sealed pipe network

Catchment	Chainage	Drainage Type
Catchment 49a (North)	A6250 – A6150	Proposed oversized pipes, existing sealed pipe network
Catchment 49b (South)	A6250 – A6151	Propose tree pits, existing sealed pipe network
Catchment 50a (North)	A6100 - A6150	Existing sealed pipe network retained
Catchment 50b (South)	A6100 - A6150	The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area, existing drainage retained, sealed pipe network.
Catchment 51	A6100 - A5700	The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area, existing drainage retained, sealed pipe network.
Catchment 52	A5700 - A5550	Existing sealed pipe network retained
Catchment 53	A5550 - A5450	Proposed tree pits, existing sealed pipe network
Catchment 54a (North)	A5450 - A5100	Proposed oversized pipes, existing sealed pipe network
Catchment 54b (South)	A5450 - A5100	Proposed oversized pipes and attenuation tank, existing sealed pipe network
Catchment 55a (North)	A5100 – A5050	The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area, existing drainage retained, sealed pipe network.
Catchment 55b (South)	A5100 – A5050	Proposed oversized pipes, existing sealed pipe network
Catchment 56a (North)	A5050 – A4925	The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area, existing drainage retained, sealed pipe network.
Catchment 56b (South)	A5050 – A4925	The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area, existing drainage retained, sealed pipe network.
Catchment 57a (North)	A4925 - A4600	Proposed oversized pipes, existing sealed pipe network
Catchment 58b (South)	A4925 - A4600	Proposed oversized pipes, existing sealed pipe network
Catchment 59a (North)	A4600 - A4350	Proposed oversized pipes, existing sealed pipe network
Catchment 59b (South)	A4600 - A4350	Existing sealed pipe network retained
Catchment 60a (North)	A4350 - A4150	Proposed tree pits, existing sealed pipe network
Catchment 60b (South)	A4350 - A4150	Existing sealed pipe network retained
Catchment 61	A4150 - A4100	Existing sealed pipe network retained
Catchment 62a (North)	A4100 – A3950	Proposed tree pits, existing sealed pipe network

Catchment	Chainage	Drainage Type
Catchment 62b (South)	A4100 – A3850 (UCD Bus Interchange)	Proposed capping layer attenuation, existing and proposed sealed pipe network
Catchment 63	A3950 - A3850	Proposed tree pits, existing and proposed sealed pipe network
Asset Owner/Location: Dublin City Council		
Catchment 64	A3850 - A3400	The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area, existing drainage retained, sealed pipe network.
Catchment 65	A3400 - A3200	The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area, existing drainage retained, sealed pipe network.
Catchment 66	A3200 - A3100	Existing sealed pipe network retained
Catchment 67	A3100 - A000	Existing sealed pipe network retained

9.5.3 Runoff Attenuation and Sustainable Drainage Systems (SuDS)

The Proposed Scheme 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.

As noted in **Table 9-4,** SuDS measures are to be provided to ensure **no increase** in existing run off rates from newly paved and combined existing/newly paved catchment areas. The SuDS measures are designed to cater for:

- Combined new/existing paved areas: the **1 in 30-year storm** with a 20% allowance for future climate change; and
- Newly paved areas: the **1 in 100-year storm** with a 20% allowance for future climate change

The capacity of the proposed SuDS measures was based on the incoming flows and permitted discharge for each catchment. The permitted discharge rate was taken to be:

- Combined new/existing paved catchment areas: the existing **1 in 5-year flow** unless available network/model information shows an alternative existing rate of discharge from existing paved areas;
- Existing paved catchment areas: the existing **1 in 5-year flow** unless available network/model information shows an alternative existing rate of discharge; and
- Newly paved catchment areas: **2l/s/ha** with minimum flow of **2l/s**

The permitted discharge from newly paved catchment areas (i.e. the existing greenfield rate) was calculated using the *Institute of Hydrology Report No. 124 Flood Estimation for Small Catchments Method.*

A range of storm durations was tested for each catchment from 30-minutes to 1440 minutes to ensure that the proposed SuDS measures have sufficient capacity to cater for high intensity, short duration storms and longer duration, low intensity storms where the total run off volumes are greater. This hierarchy promotes the concept of a SuDS Management Train, where measures are proposed as a sequence of component to collectively manage catchment runoff. A schematic of the SuDS Management Train is provided in **Table 9-6** below.

Table 9-6: The SuDS Management Train: produced by Jacobs from CIRIA SuDS Manual 2015

Scale		SuDS Management Train
Less Preferred Approach	**Source**	**Rainwater harvesting –** capture and reuse within the local environment
		Pervious surfacing systems – structural surfaces that allow water to penetrate into the ground reducing discharge to a drainage system e.g. pervious pavement
	Site	**Infiltration systems –** structures which encourage infiltration into the ground e.g. bioretention basins
		Conveyance systems – components that convey and control the discharge of flows to downstream storage components e.g. swales
	Regional	**Storage systems –** components that control the flows before discharge e.g. attenuation ponds, tanks or basins

For this Preliminary Design, source scale solutions have been specified where reasonably practicable. Where Source type solutions cannot fully address an increase in runoff from a development, residual flows are discharged to be managed at the site and then regional scales.

The hierarchical approach to select SuDS drainage solutions has been applied for this BusConnects route. This drew upon the management train approach in the CIRIA SuDS Manual Hierarchy and Guidance on SuDS Requirements in Fingal County Council.

9.5.4 Pollution Control

One of principal objectives of the road drainage system is to minimise the impact of the runoff from the roadways on the surrounding environment via the provision of; filter drains, swales, tree pits, oil/petrol interceptors, silt traps and attenuation features as necessary.

Pollution control measures from the proposed road development will be designed in accordance with TII Publications DN-DNG-03022, DN-DNG-03065 and DN-DNG-03066.

The proposed road drainage system incorporates a variety of drainage measures including, kerb and gully drainage, carrier drains, tree pits, sealed pipes, swales/carrier drains, filter drains, attenuation areas and pollution control as required in accordance with the above design standards. Pollution Control will be achieved during the conveyance of the road runoff to the attenuation features along the gullies and pipes to grassed swales/carrier drains and filter drains where the drainage is allowed to filter through the vegetation and filter medium.

The attenuation ponds will include a forebay and oil/petrol interceptor at each outfall location. Any section of drainage where there are no swales or filter drains will also have oil/petrol interceptor installed at the outfall.

The oil/petrol interceptors will be designed as per DN-DNG-03022 CIRIA 142. A minimum class 2 bypass interceptor will be installed where required. Where there is treatment by filtration in a swale, tree pit or filter drain an oil/petrol interceptor will not be required.

9.5.5 Summary of Attenuation Features, SuDS and Outfalls

The proposed drainage for the Proposed Scheme is summarised for each proposed catchment within **Table 9-7.**

Table 9-7: Proposed Scheme Drainage Design Summary

Chainage	Existing Catchment Reference (Refer to Table 9.1)	Approx. Impermeable Surface Area		SuDS Measures Provided	Permitted Discharge (l/s)	SuDS Measures Proposed
		Existing* (m^2)	Proposed Additional (m^2)			
A18450 - A18350	Catchment 1	1937	90	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A18350 – A18100	Catchment 2	6071	195	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A18100 – A17950	Catchment 3	7191	874	Yes	2	24m3 capacity tree pits with filter drain underneath.
A17950 - A17750	Catchment 4	3888	271	Yes	2	4m3 capacity tree pits.
A17750 – A17500	Catchment 5	5573	1,259	Yes	2	20m3 capacity filter drain and 20m3 capacity attenuation tank
A17500 – A17200	Catchment 6	9861	535	No	2	14 m3 capacity oversized pipes
A17200 – A17100	Catchment 7	2200	183	Yes	2	5 m3 capacity tree pits.
A17100 - A16750	Catchment 8a (North)	8440	2,332	No	2	110 m3 capacity oversized pipes
A16750 – A16475	Catchment 8b (North)	5630	647	No	2	14m3 capacity oversized pipes
A16475 – A17100	Catchment 9a (South)	15734	1,486	No	2	55 m3 capacity oversized pipes
A16475 - A16050	Catchment 10	13372	2,717	Yes	2	120 m3 capacity oversized pipes and filter drains
A16050 - A15900	Catchment 11	2440	388	Yes	2	5m3 capacity tree pits with filter drains underneath.
A15900 - A15700	Catchment 12	2737	116	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A15700 - A15150	Catchment 13	6017	107	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A15150 - A15100	Catchment 14	3833	117	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.

Chainage	Existing Catchment Reference (Refer to Table 9.1)	Approx. Impermeable Surface Area		SuDS Measures Provided	Permitted Discharge (l/s)	SuDS Measures Proposed
		Existing* (m^2)	Proposed Additional (m^2)			
A15100	Catchment 15	2617	109	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A15100 - A14700	Catchment 16	7391	596	No	2	14 m3 capacity oversized pipes
E200 – E050	Catchment 17	867	673	Yes	2	23m3 capacity filter drain
A14775 - A14475	Catchment 18	2299	718	No	2	14m3 capacity oversized pipes and 11m3 capacity attenuation tank
A14475 - A14200	Catchment 19	2956	414	Yes	2	12m3 capacity filter drains.
A14200 - A13875	Catchment 20	11936	-94	N/A	As Existing	None required. The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area.
A13875 - A13700	Catchment 21	7298	474	No	2	13m3 capacity oversized pipes
A13700 - A13450	Catchment 22	7197	351	No	2	8 m3 capacity oversized pipes
A13450 - A13200	Catchment 23	13125	247	No	2	6 m3 capacity oversized pipes
A13200 – A12900	Catchment 24	15220	534	No	2	8m3 capacity oversized pipes.
A12900 - A12500	Catchment 25	15272	4	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A12500 - A12300	Catchment 26	6922	38	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A12300 - A12200	Catchment 27	3646	60	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A12200 - A11850	Catchment 28	15263	136	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.

Chainage	Existing Catchment Reference (Refer to Table 9.1)	Approx. Impermeable Surface Area		SuDS Measures Provided	Permitted Discharge (l/s)	SuDS Measures Proposed
		Existing* (m^2)	Proposed Additional (m^2)			
A11850 - A11550	Catchment 29	6276	52	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A11550 - A11300	Catchment 30	11121	177	Yes	2	4m3 capacity tree pits with filter drains underneath.
A11300 - A11150	Catchment 31	8135	112	Yes	2	3m3 capacity tree pits with filter drains underneath.
A10800 - A10500	Catchment 32a (North)	12623	229	Yes	2	4m3 capacity tree pits with filter drains underneath.
A10800 - A10500	Catchment 32b (South)	12500	-22	N/A	As Existing	None required. The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area.
A10500 - A9800	Catchment 33	11162	156	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A9800 – A9300	Catchment 34	15068	323	Yes	2	10m3 capacity tree pits.
A9300 - A9200	Catchment 35	4400	45	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A9200 – A8525	Catchment 36	22449	1,344	Yes	2	60m3 capacity oversized pipes and tree pits with filter drains underneath.
A8525 – A8350	Catchment 37a (North)	7109	197	No	2	20m3 capacity oversized pipes.
A8525 – A8350	Catchment 37b (South)	7109	88	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A8350 – A8150	Catchment 38	9600	-90	N/A	As Existing	None required. The new impermeable area is less than new permeable green area therefore no drainage measures

Chainage	Existing Catchment Reference (Refer to Table 9.1)	Approx. Impermeable Surface Area		SuDS Measures Provided	Permitted Discharge (l/s)	SuDS Measures Proposed
		Existing* (m^2)	Proposed Additional (m^2)			
						are proposed in this area.
A8150 – A7850	Catchment 39	9880	-1	N/A	As Existing	None required. The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area.
A7850 - A7750	Catchment 40a (North)	3416	157	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A7850 - A7750	Catchment 40b (South)	3416	42	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A7750 - A7550	Catchment 41a (North)	6945	213	No	2	6 m3 capacity oversized pipes.
A7750 - A7550	Catchment 41b (South)	6945	166	No	2	9.1m3 capacity oversized pipes.
A7550 – A7450	Catchment 42	4137	117	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A7450 – A7150	Catchment 43	11858	-147	N/A	As Existing	None required. The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area.
A7150 – A6850	Catchment 44a (South)	13369	267	No	2	17m3 capacity oversized pipes.
A7150 - A6850	Catchment 44b (North)	11046	733	No	2	24m3 capacity oversized pipes.
A6850 - A6800	Catchment 45	3532	-124	N/A	As Existing	None required. The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area.

Chainage	Existing Catchment Reference (Refer to Table 9.1)	Approx. Impermeable Surface Area		SuDS Measures Provided	Permitted Discharge (l/s)	SuDS Measures Proposed
		Existing* (m^2)	Proposed Additional (m^2)			
A6800 - A6650	Catchment 46	4182	170	Yes	2	8.2m3 capacity filter drain.
A6700 - A6550	Catchment 47a (North)	8245	479	No	2	14m3 capacity oversized pipes.
A6800 - A6550	Catchment 47b (South)	10137	202	No	2	6m3 capacity oversized pipes.
A6550 - A6250	Catchment 48a (North)	7383	602	No	2	20m3 capacity oversized pipes.
A6550 - A6250	Catchment 48b (South)	7829	626	No	2	22m3 capacity oversized pipes.
A6250 – A6150	Catchment 49a (North)	5020	34	No	2	3.3m3 capacity oversized pipes.
A6250 – A6150	Catchment 49b (South)	5020	27	Yes	2	3.3m3 capacity tree pits.
A6100 - A6150	Catchment 50a (North)	2180	21	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A6100 - A6150	Catchment 50b (South)	2180	-26	N/A	As Existing	None required. The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area.
A6100 - A5700	Catchment 51	16304	-1	N/A	As Existing	None required. The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area.
A5700 - A5550	Catchment 52	3820	27	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A5550 - A5450	Catchment 53	2021	95	Yes	2	3m3 capacity tree pits.
A5450 - A5100	Catchment 54a (North)	12440	313	No	2	8m3 capacity oversized pipes.
A5450 - A5100	Catchment 54b (South)	12440	448	No	2	61m3 capacity oversized pipes and attenuation tank.
A5100 – A5050	Catchment 55a (North)	2414	-143	N/A	As Existing	None required. The new impermeable

Chainage	Existing Catchment Reference (Refer to Table 9.1)	Approx. Impermeable Surface Area		SuDS Measures Provided	Permitted Discharge (l/s)	SuDS Measures Proposed
		Existing* (m^2)	Proposed Additional (m^2)			
						area is less than new permeable green area therefore no drainage measures are proposed in this area.
A5100 – A5050	Catchment 55b (South)	2414	125	No	2	14m3 capacity oversized pipes.
A5050 – A4925	Catchment 56a (North)	6092	-37	N/A	As Existing	None required. The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area.
A5050 – A4925	Catchment 56b (South)	6092	-74	N/A	As Existing	None required. The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area..
A4925 - A4600	Catchment 57a (North)	13637	297	No	2	8m3 capacity oversized pipes.
A4925 - A4600	Catchment 58b (South)	13637	476	No	2	16m3 capacity oversized pipes.
A4600 - A4350	Catchment 59a (North)	19849	678	No	2	20m3 capacity oversized pipes.
A4600 - A4350	Catchment 59b (South)	19849	240	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A4350 - A4150	Catchment 60a (North)	8280	364	Yes	2	8m3 capacity oversized pipe and tree pit.
A4350 - A4150	Catchment 60b (South)	8280	296	N/A	As Existing	10m3 capacity oversized pipes.
A4150 - A4100	Catchment 61	6902	46	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A4100 – A3950	Catchment 62a (North)	8671	428	Yes	2	9.1m3 capacity tree pits.

Chainage	Existing Catchment Reference (Refer to Table 9.1)	Approx. Impermeable Surface Area		SuDS Measures Provided	Permitted Discharge (l/s)	SuDS Measures Proposed
		Existing* (m^2)	Proposed Additional (m^2)			
A4100 – A3850 (UCD Bus Interchange)	Catchment 62b (South)	22100	4,291	No	2	330m3 capacity capping layer attenuation.
A3950 - A3850	Catchment 63	6579	85	Yes	2	2m3 capacity tree pits.
A3850 - A3400	Catchment 64	5060	-236	N/A	As Existing	None required. The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area.
A3400 - A3200	Catchment 65	8300	-31	N/A	As Existing	None required. The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area.
A3200 - A3100	Catchment 66	3844	23	N/A	As Existing	None. Very small new impermeable areas. No space available for SuDS measures.
A3100 - A000	Catchment 67	94582	-535	N/A	As Existing	None required. The new impermeable area is less than new permeable green area therefore no drainage measures are proposed in this area.

Note – Existing Impermeable Area is the existing impermeable area of the existing road within the red line boundary only. This will underestimate the total impermeable area within the wider drainage catchment. The approximate total catchment area (impermeable + permeable) of each existing catchment is included in **Table 9-1.*

9.6 Drainage at Structures

The Proposed Scheme crosses a number of watercourses, listed in **Table 9-8** below. All watercourses are currently in culvert or there is an existing bridge structure where they pass beneath the existing road. No works are proposed to change the width of the road at either crossing; therefore, the existing culverts will be retained without modification.

Table 9-8: Watercourses Crossed by the Proposed Scheme

Watercourse	Chainage	Crossing Detail
Grand Canal	550	Bridge
River Dodder	2400	Bridge
Elm Park Stream	3900	Culvert
Brewery Stream	7400	Culvert
Carrickmines Stream	13500	Culvert
Shanganagh River	13550	Culvert
Rathmichael Stream / Crinken Woodbrook Stream	17125	Culvert
River Dargle	18500	Multi-span Arch Bridge

Apart from the Rathmichael Stream, no works are proposed to change the width of the road at any of the crossings listed in **Table 9-8**. The existing culverts/bridges will therefore be retained without modification and there will no change in hydraulic capacity or any associated flood risk.

At the Rathmichael Stream crossing, full depth reconstruction of the carriageway might be required which could precipitate the need for works to the culvert if cover is not sufficient. At this stage it is assumed that additional protection will be provided for the culvert if necessary, to prevent the need for replacement. If the culvert is to be replaced this would prompt the need for a wider hydraulic assessment of the culvert and Section 50 consent.

9.7 Flood Risk

9.7.1 Flood Risk Assessment

A Stage 1 and 2 Flood Risk Assessment has been prepared for the Preliminary Design of the Proposed Scheme. The outcomes from the FRA (please refer to BCIDB-JAC-ENV_WE-0013_XX_00-RP-YE-0001) are summarised in this section and **Table 9-9** below. Refer to **Appendix N** for Site Specific Flood Risk Assessment Bray to City Centre.

Table 9-9: Flood Risk Summary

Flood Risk Source	Level of Risk	Notes
Artificial Drainage – Grand Canal	Low	The Grand Canal passes beneath to Proposed Scheme. Water levels along the canal are regulated by a series of lock gates and waste-weirs. There are insufficient flows in the canal to pose a flood risk to the Proposed Scheme.
Fluvial – River Dodder at Anglesea Bridge	High	The Proposed Scheme is at risk from flooding from the River Dodder from flows bypassing Anglesea Bridge in the 1% (1 in 100) Annual Exceedance Probability (AEP) flood. Based on the OPW CFRAM mapping, the potential 1% (1 in 100) AEP flood depth of the road from the Dodder is approximately 400 to 500mm.
Fluvial – Elm Park Stream	Unknown	The Proposed Scheme crosses the Elm Park Stream near University College Dublin. Flood risk mapping of the Elm Park Stream has not been completed meaning the potential risk is unknown.

Flood Risk Source	Level of Risk	Notes
		It is noted however that there are no historic records of flooding in this location. The upstream catchment is small meaning flows and the associated flood risk could be low.
Fluvial – Brewery Stream	Moderate	The Proposed Scheme is at risk from flooding from the Brewery Stream in the 0.1% (1 in 1000) AEP flood. Flood depths are not available however based on the predicted extent on flooding in the CFRAM mapping would be likely to be less than 300mm.
Fluvial – Carrickmines Stream	High	The Proposed Scheme is at risk from flooding from the Carrickmines Stream in the 1% (1 in 100) AEP flood. Based on the OPW CFRAM mapping, the potential 1% (1 in 100) AEP flood depth of the road from the Carrickmines Stream is approximately 400mm.
Fluvial – Shanganagh River	High	The Proposed Scheme is at risk from flooding from the Shanganagh River in the 1% (1 in 100) AEP flood. Based on the OPW CFRAM mapping, the potential 1% (1 in 100) AEP flood depth of the road from the Carrickmines Stream is approximately 500mm.
Coastal – Shanganagh River	Low	The 0.1% AEP peak tidal flood level for the Shanganagh River at the Bray to City Centre Scheme is 3.30mOD. This would not result in flooding of the road.
Fluvial – Rathmichael Stream	High	The Proposed Scheme is at risk from flooding from the Rathmichael Stream in the 10% (1 in 10) and 1% (1 in 100) AEP floods. Flood levels at the Rathmichael Stream have not been published by the OPW. Based on the available information however, it is reasonable to assume flood depths for 1% (1 in 100) AEP flood would be in the order of 500mm.
Fluvial and Coastal - River Dargle at Castle Street	Unknown	OPW CFRAM information for the River Dargle at Castle Street has been withdrawn. Historic records of flooding have been identified from the River Dargle suggesting a possible risk of flooding to the Bray to City Centre Scheme
Pluvial	High	A high risk of pluvial flooding is prevalent across Dublin due to the limited capacity of the existing surface water network. Notable areas of potential pluvial flooding identified along the Bray to City Centre Scheme include at UCD, Donnybrook and the Grand Canal
Coastal – River Liffey	Low	The OPW and ICPSS flood extents do show any risk of coastal flooding to the Bray to City Centre scheme. 0.1% AEP extreme tidal levels for the Bray to City Centre Scheme are at around 3.3mOD, which is below the existing level of the road.

9.7.1.1 Fluvial Flood Risk Summary

The Flood Risk Assessment identified parts of the Proposed Scheme are at risk from fluvial flooding from the River Dodder, Carrickmines Stream, Shanganagh River and Rathmichael Stream during a 1% (1 in 100) AEP Flood. With reference to the Flood Risk Management (FRM) Guidelines, these parts of the route will be identified as being located in Flood Zone A. The scheme is also at risk from fluvial flooding from the Brewery Stream in the 0.1% AEP flood. The FRM Guidelines defines this as being in Flood Zone B. Flood risk from the Elm Park Stream and River Dargle is unknown.

The FRM Guidelines states that strategic infrastructure developments like the Proposed Scheme (and the full BusConnects Scheme) should be located in Flood Zone C, where the flood risk is less than the 0.1% (1 in 1000) AEP. A Justification Test will therefore need to be completed on the Proposed Scheme as part of the FRA.

As the Proposed Scheme comprises extension and adjustment to an existing road, it is understood no works will be undertaken to reduce the existing risk of fluvial flooding to the route. The works proposed for the Proposed Scheme will also result in no change in the risk of flooding from the various rivers that are crossed.

9.7.1.2 Pluvial Flooding

A high risk of pluvial flooding is prevalent across Dublin including the Proposed Scheme. This is due to the size of the existing surface water network, which typically has a capacity to contain the 20% (1 in 5) AEP storm. Where there are no changes to the catchment area served by the existing network, it is beyond the scope of the CBC Infrastructure Works to increase its capacity to reduce the risk of pluvial flooding.

Where the is an increase in impermeable area as for the Proposed Scheme, SuDS measures are provided to ensure no increase in existing runoff rates. These measures are outlined in **Section 9.5** of this report.

9.7.2 Development of Specific Flood Alleviation Proposal

There is no change in fluvial flood risk as consequence of the Proposed Scheme. No specific flood risk measures are therefore proposed to reduce fluvial flood risk along the Proposed Scheme. There is the potential for an increase in pluvial flood risk; however, the Proposed Scheme will include full mitigation in the form of Sustainable Drainage and runoff attenuation to ensure no change to the existing runoff rates.

9.8 Section 50 Consents

There are no new or modifications proposed to existing culverts/bridges that cross watercourses along the Proposed Scheme. OPW Section 50 consent will therefore not be required as part of the Proposed Scheme.

10. Services and Utilities

10.1 Overview of Utilities Design Strategy

Utility records from all providers were sought at an early stage of the scheme design. These records combined with topographic survey records, GPR Survey, walk over inspections and desktop analysis of the proposed scheme identified areas of risk to existing assets. Where risk was initially identified to high value assets, such as high voltage ESB cables, high pressure gas mains and trunk water mains, a review was undertaken to ascertain if the risk could be mitigated by amending the road design whilst still meeting the objectives of the scheme. Some areas of conflict were designed out at this stage; however, some remained and had to be accommodated within the overall scheme design.

10.1.1 Record information

Available utility records were submitted by service providers and reviewed along the Proposed Scheme. These records have assisted with informing the scheme design. Utility records were received from the following service providers:

- Irish Water;
- Gas Networks Ireland (GNI);
- Electricity Supply Bord (ESB);
- Eir;
- Virgin Media;
- BT;
- Vodafone;
- Enet;
- DCC;
- SDCC;
- FCC; and
- DLRCC.

10.1.2 Phase 1 Utility Survey

A targeted utility survey to PAS128A, including a GPR (Ground Penetrating Radar) survey, was commissioned by the NTA to investigate areas where there is risk identified to existing high value assets such as high voltage ESB cables, high pressure gas mains and trunk water mains due to the proposed carriageway alignment. Some areas where there is a high concentration of utility diversions proposed were also surveyed to ensure that adequate spacing is available for relocation of assets. The results of the utility survey have been reviewed to confirm the adequacy of design provisions made with respect to diversion proposals. Additionally, a more extensive utility survey will be completed to inform the detailed design phase of the scheme.

10.1.3 Consultation with Utility Service Providers

Consultation with all relevant utility service providers was undertaken to evaluate the impact of the Proposed Scheme on existing utilities.

Based on records and topographical survey that was available, utility diversions and areas where protection measures might be required were identified. These potential impacts were documented on a set of consultation drawings and a technical note which was prepared for each utility company.

Consultation meetings were held with ESB, Gas Networks Ireland, Irish Water and Eir. The Proposed Scheme proposals were outlined and scenarios where utility infrastructure might be impacted by the Proposed Scheme were discussed.

10.2 Overview of Service Conflicts

The construction of the Proposed Scheme will result in conflicts with several existing utility assets.

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;
- Irish Water (Water and Public Sewer);
- GNI; and
- Telecommunication Services – Eir, Virgin Media, eNet and 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 Proposed Scheme.

The services conflicts and the associated diversions will need to be considered in the design and construction of the Proposed Scheme. The preliminary design considerations have been taken into account 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 will 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 take into account 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, Table 10-2, Table 10-3,Table 10-4, Table 10-5 and Table 10-6** of this report**.**

The locations of all known services from records provided from the service providers are shown on Combined Utility Drawings included in **Appendix B.**

10.3 Summary of Recommended Diversions

10.3.1 ESB Networks

Jacobs has undertaken consultation with ESB Networks regarding the impact of the Proposed Scheme on their assets and their requirements have been incorporated within the design. There is one location on the Dublin Road south of Stonebridge Road in Shankill where 38kV high voltage cables have been identified that require relocation. There are several locations where medium voltage cables and low voltage cables are identified which will require diversion along the length of the route. These conflicts are listed in **Table 10-1** below and are illustrated on the drawing set BCIDB-JAC-UTL_UE-0013_XX_00-DR-CU-9001 included within **Appendix B.**

Table 10-1: ESB Asset Diversions

Ref Number	Utility Provider	Chainage	Asset Impacted	Description of Works
R13-UE-UCD-MV-001	UCD/ ESB	A3950 – A4050	MV Underground	MV diversion of c. 135m required in proximity of the Proposed Bus Interchange at UCD.
R13-UE-MV-P110	ESB	A 11250 - 11350	MV Underground	Diversion of c. 120m of MV diversion required due bus layby on N11.
R13-UE-MV-P113A	ESB	A 12000 - 12150	MV Underground	Potentially partly already dealt with by a developer and new junction construction at this location. Diversion of c. 155m of MV cables in verge/footway of N11 Bray Road.
R13-UE-LV-OH-P149A	ESB	A 14550	LV Overhead	Diversion of c. 10m of LV overhead cables in footway of R837 Dublin Road
R13-UE-LV-OH-155	ESB	A 14770 - 15100	LV Overhead	Diversion of c. 320m of LV overhead cables in footway of R837 Dublin Road
R13-UE-MV-P120	ESB	A 14700 - 14800	MV Underground	Relocation of MV Kiosk substation and localised MV cable diversion of c. 90m.
R13-UE-HV-P069	ESB	A 14750 - 14950	HV Underground	Diversion of c. 155m of 38kV HV required. Widening into footway over cables whose alignment is shown meandering in and out of footway.
R13-UE-LV-OH-155A	ESB	A 14775	LV Overhead	Diversion of c. 45m of LV overhead cables in footway of R837 Dublin Road/Stonebridge Road.
R13-UE-LV-OH-P157	ESB	A 15780 - 15880	LV Overhead	Diversion of c. 110m of LV overhead cables in footway of R837 Dublin Road
R13-UE-LV-OH-158	ESB	A 15900	LV Overhead	Diversion of c. 5m of LV overhead cables in footway of R837 Dublin Road
R13-UE-LV-OH-213	ESB	A 15990	LV Overhead	Diversion of c. 10m of LV overhead cables in footway of R837 Dublin Road
R13-UE-LV-OH-162	ESB	A 16140-16300	LV Overhead	Diversion of c. 165m of LV overhead cables in footway of R837 Dublin Road
R13-UE-MV-125	ESB	A 16260	MV Underground	Diversion of c. 20m of MV underground cables in footway of R837 Dublin Road
R13-UE-LV-OH-220	ESB	A 16650-16750	LV Overhead	Diversion of c. 100m of LV overhead cables in footway of R837 Dublin Road
R13-UE-LV-OH-205	ESB	A 16750-17100	LV Overhead	Diversion of c. 375m of LV overhead cables in footway of R837 Dublin Road
R13-UE-LV-OH-167	ESB	A 17200-17300	LV Overhead	Diversion of c. 90m of LV overhead cables in footway of R837 Dublin Road
R13-UE-MV-128	ESB	A 17430	MV Underground	Relocation of MV Kiosk substation and Diversion c. 85m of MV cables in verge/footway of Dublin Road. Additional low voltage underground cabling of c. 85m required along Dublin road
R13-UE-LV-OH-169	ESB	A 17430 - 17575	LV Overhead	Diversion of c. 135m of LV overhead cables in footway of R837 Dublin Road
R13-UE-MV-130	ESB	A 17760 - 17780	MV Underground	Diversion of c. 40m of MV underground cables in footway of R837 Dublin Road
R13-UE-LV-OH-172A	ESB	A 17780	LV Overhead	Diversion of c. 20m of LV overhead cables in footway of R837 Dublin Road

Ref Number	Utility Provider	Chainage	Asset Impacted	Description of Works
R13-UE-LV-OH-172	ESB	A 17810 - 17900	LV Overhead	Diversion of c. 105m of LV overhead cables in footway of R837 Dublin Road
R13-UE-LV-OH-237	ESB	A 18100	LV Overhead	Diversion of c. 100m of LV overhead cables in footway of R837 Dublin Road and Upper Dargle Road
R13-UE-LV-OH-221	ESB	A 17950 - 18340	LV Overhead	Diversion of c. 500m of LV overhead cables in footway of R837 Dublin Road and St. Columcille's Terrace
R13-UE-LV-OH-178	ESB	A 18350 - 18470	LV Overhead	Diversion of c. 120m of LV overhead cables in footway of St. Columcille's Terrace and Castle Street. Cables to be installed underground.
R13-UE-MV-P134	ESB	A 18500	MV Underground	Diversion of c. 30m of MV underground cables in footway of Castle Street.

10.3.2 Irish Water – Water and Foul Sewer

Jacobs has undertaken consultation with Irish Water regarding the impact of the Proposed Scheme on their assets, and their requirements have been incorporated within the design. There are several water mains along the route where conflicts occur, and diversions are therefore required. These items are listed in **Table 10-2** below and are illustrated on the drawing sets **BCIDB-JAC-UTL_UW-0013_XX_00-DR-CU-9001** and **BCIDB-JAC-UTL_UD-0013_XX_00-DR-CU-9001** included within **Appendix B.**

Table 10-2: Irish Water Asset Impacts

Ref no.	Utility Provider	Chainage	Asset Impacted	Description of Works
R13-UW-IW-037	IW	A 6200	6" Cast Iron Main	Diversion of c. 70m of 6" cast iron around proposed retaining wall.
R13-UW-IW-P045	IW	A 10650-10740	12" Asbestos Main	Diversion of c. 90m of 12" asbestos water main.
R13-UW-IW-047	IW	A 11970 - 12060	14" Asbestos Main	Diversion of c. 95m of 14" asbestos water main.
R13-UW-IW-050	IW	A 14300 - 14800	6" Cast Iron Main	Diversion of c. 490m of 6" Cast Iron Underground mains in footway of Dublin Road where widening into footway.
R13-UW-IW-P056	IW	A 15900 - 16120	6" Cast Iron Main	Diversion of c. 235m of 6" Cast Iron Underground mains in footway of Dublin Road where widening into footway.
R13-UW-IW-P058	IW	A 16300-16350	6" Cast Iron Main	Diversion of c. 55m of 6" Cast Iron Underground mains in footway of Dublin Road where widening into footway.
R13-UW-IW-P058A	IW	A 16500-16850	6" Cast Iron Main	Diversion of c. 360m of 6" Cast Iron Underground mains in footway of Dublin Road where widening into footway.

Ref no.	Utility Provider	Chainage	Asset Impacted	Description of Works
R13-UW-IW-P060A	IW	A 17150-17200	6" Cast Iron Main	Diversion of c. 50m of 6" Cast Iron Underground mains in footway of Dublin Road.
R13-UW-IW-061	IW	A 17275	150mm uPVC main	Diversion of c. 20m of 150mm uPVC underground mains in footway of Dublin Road.
R13-UW-IW-P062	IW	A 17450	150mm DI Main	Diversion of c. 40m of 150mm DI underground mains in footway of Dublin Road.
R13-UW-IW-P063	IW	A 17500	100mm uPVC	Diversion of c. 25m of 100mm uPVC Underground mains in footway of Dublin Road.
R13-UW-IW-P065	IW	A 17730	6" Cast Iron Main	Diversion of c. 50m of 6” Cast Iron Underground mains in footway of Dublin Road.
R13-UW-IW-P066	IW	A 17750	6" Cast Iron Main	Diversion of c. 40m of 6” Cast Iron Underground mains in footway of Dublin Road.
R13-UW-IW-P067	IW	A 18050	100mm Cast Iron Main	Diversion of c. 20m of 100mm Cast Iron Underground mains in footway of Dublin Road.
R13-UW-IW-P069	IW	A 18150-18275	100mm Cast Iron Main	Diversion of c. 120m of 100mm Cast Iron Underground mains in footway of Dublin Road.

10.3.3 Eir

Jacobs has undertaken consultation with Eir regarding the impact of the Proposed Scheme on their assets. There are several locations along the route where conflicts with Eir infrastructure occur, and diversions are therefore required. These diversions are listed in **Table 10-3** below and are illustrated on the drawing set **BCIDB-JAC-UTL_UX-0013_XX_00-DR-CU-9001** included within **Appendix B.**

Table 10-3: Eir Diversions

Ref no.	Utility Provider	Chainage	Asset Impacted	Description of Works
R13-UX-EIR-P089	Eir	A 3+920 - 4+120	Eir Ducting	Diversion of c. 200m of Eircom Ducting and Chambers in footway/cycleway where clashing with proposed bus interchange at UCD
R13-UX-EIR-P102B	Eir	A 6+190	Eir Ducting	Diversion of c. 120m of Eircom Ducting and Chambers in footway/cycleway of Stillorgan Road where clashing with proposed retaining wall
R13-UX-EIR-P102C	Eir	A 6+290 - 6+390	Eir Ducting	Diversion of c. 100m of Eircom Ducting and Chambers in footway/cycleway of Stillorgan Road where clashing with proposed retaining wall

Ref no.	Utility Provider	Chainage	Asset Impacted	Description of Works
R13-UX-EIR-P102D	Eir	A 7+760-7+810	Eir Ducting	Diversion of c. 60m of Eircom Ducting and Chambers in footway/cycleway of Stillorgan Road where clashing with proposed bus stop
R13-UX-EIR-P102E	Eir	A 7+640 - 7+730	Eir Ducting	Diversion of c. 90m of Eircom Ducting and Chambers in median of Stillorgan Road where carriageway is widening
R13-UX-EIR-106	Eir	A 12+030 - 12+070	Eir Ducting	Diversion of c. 70m of Eircom Ducting and Chambers in footway/cycleway of N11 where clashing with proposed retaining wall.
R13-UX-EIR-106B	Eir	A 12+080 - 12+130	Eir Ducting	Diversion of c. 55m of Eircom Ducting and Chambers in in footway of N11.
R13-UX-EIR-P112A	Eir	A 13+760 - 14+000	Eir Ducting	Diversion of c. 240m of Eircom Ducting and Chambers in central verge of N11 where clashing with carriageway realignment
R13-UX-EIR-P128	Eir	A 14+690 - 14+770	Eir Ducting	Diversion of c. 85m of Eircom Ducting and Chambers in footway of Dublin Road where widening into footway.
R13-UX-EIR-132	Eir	A 14+730 - 15+070	Eir Ducting	Diversion of c. 340m of Eircom Ducting, Chambers and Kiosks in footway of Dublin Road where the bus lane and carriageway are widening into footway all along here
R13-UX-EIR-133	Eir	A 15+000 - 15+100	Eir Ducting	Diversion of c. 100m of Eircom Ducting, Chambers and Kiosks in footway of Shanganagh Road where the bus lane and carriageway are widening into footway all along here
R13-UX-EIR-146	Eir	A 15+830 - 16+110	Eir Ducting	Diversion of c. 280m of Eircom Ducting and Chambers in footway of Dublin Road where widening bus lane into footway.
R13-UX-EIR-150	Eir	A 16+040 - 16+320	Eir Ducting	Diversion of c. 280m of Eircom Ducting and Chambers in footway of Dublin Road where widening bus lane into footway.
R13-UX-EIR-159	Eir	A 16+600 - 16+875	Eir Ducting	Diversion of c. 400m of Eircom Ducting and Chambers in footway of Dublin Road where widening bus lane into footway.
R13-UX-EIR-169	Eir	A 16+630 - 17+300	Eir Ducting	Diversion of c. 665m of Eircom Ducting, Chambers and Kiosks in footway of Dublin Road where the bus lane and carriageway are widening into footway all along here.
R13-UX-EIR-169A	Eir	A 17+440 - 18+320	Eir Ducting	Diversion of c. 870m of Eircom Ducting, Chambers and Kiosks in footway of Dublin Road where the bus lane and carriageway are widening into footway all along here.
R13-UX-EIR-165	Eir	A 17+140 - 17+280	Eir Ducting	Diversion of c. 155m of Eircom Ducting and Chambers in footway of Dublin Road where widening bus lane into footway.

10.3.4 Virgin Media

Jacobs has undertaken consultation with Virgin Media regarding the impact of the Proposed Scheme on their assets. There are two locations along the route where conflicts with Virgin Media infrastructure occur, and diversions are therefore required. These diversions are listed in **Table 10-4** below and are illustrated on the drawing set **BCIDB-JAC-UTL_UX-0013_XX_00-DR-CU-9001** included within **Appendix B**.

Table 10-4: Virgin Media Diversions

Ref no.	Utility Provider	Chainage	Asset Impacted	Description of Works
R13-UX-VM-042	Virgin Media	A 12+050 - 12+140	Virgin Media Ducting	Diversion of c. 90m of Virgin Media Ducting and Chambers in footway of Stillorgan Road where widening carriageway into footway.
R13-UX-VM-P041A	Virgin Media	A 12+090 - 12+140	Virgin Media Ducting	Diversion of c. 50m of Virgin Media Ducting and Chambers in footway of Stillorgan Road.
R13-UX-VM-P041B	Virgin Media	A 12+050 - 12+145	Virgin Media Ducting	Diversion of c. 55m of Virgin Media Ducting and Chambers in footway of Stillorgan Road where widening carriageway into footway.
R13-UX-VM-P029	Virgin Media	A 14+640 - 14+675	Virgin Media Ducting	Diversion of c. 35m of Virgin Media Ducting and Chambers in footway of R837 Dublin Road where widening carriageway into footway.
R13-UX-VM-P028	Virgin Media	A 14+740 - 14+820	Virgin Media Ducting	Diversion of c. 65m of Virgin Media Ducting and Chambers in footway of R837 Dublin Road where widening carriageway into footway.
R13-UX-VM-P027	Virgin Media	A 15+000 - 15+065	Virgin Media Ducting	Diversion of c. 65m of Virgin Media Ducting and Chambers in footway of R837 Dublin Road where widening carriageway into footway.
R13-UX-VM-P026	Virgin Media	A 15+050 - 15+150	Virgin Media Ducting	Diversion of c. 100m of Virgin Media Ducting and Chambers in footway of R837 Dublin Road where widening carriageway into footway.
R13-UX-VM-P018	Virgin Media	A 15+900 - 16+000	Virgin Media Ducting	Diversion of c. 85m of Virgin Media Ducting and Chambers in footway of R837 Dublin Road where widening carriageway into footway.
R13-UX-VM-P016	Virgin Media	A 16+030 - 16+090	Virgin Media Ducting	Diversion of c. 60m of Virgin Media Ducting and Chambers in footway of R837 Dublin Road where widening carriageway into footway.
R13-UX-VM-P013	Virgin Media	A 16+300 - 16+350	Virgin Media Ducting	Diversion of c. 45m of Virgin Media Ducting and Chambers in footway of R837 Dublin Road where widening carriageway into footway.
R13-UX-VM-P012	Virgin Media	A 16+500 - 16+590	Virgin Media Ducting	Diversion of c. 85m of Virgin Media Ducting and Chambers in footway of R837 Dublin Road where widening carriageway into footway.
R13-UX-VM-P011	Virgin Media	A 16+610 - 16+840	Virgin Media Ducting	Diversion of c. 230m of Virgin Media Ducting and Chambers in footway of R837 Dublin Road where widening carriageway into footway.
R13-UX-VM-P004	Virgin Media	A 17+440 - 17+740	Virgin Media Ducting	Diversion of c. 300m of Virgin Media Ducting and Chambers in footway of R837 Dublin Road where widening carriageway into footway.
R13-UX-VM-P003	Virgin Media	A 17+740 - 17+880	Virgin Media Ducting	Diversion of c. 140m of Virgin Media Ducting and Chambers in footway of R837 Dublin Road where widening carriageway into footway.

10.3.5 BT

Jacobs has undertaken consultation with BT regarding the impact of the Proposed Scheme on their assets. There is one location along the route where conflicts with BT infrastructure occur, and diversions are therefore required. These diversions are listed in **Table 10-5** below and are illustrated on the drawing set **BCIDB-JAC-UTL_UX-0013_XX_00-DR-CU-9001** included within **Appendix B**.

Table 10-5: BT Diversions

Ref no.	Utility Provider	Chainage	Asset Impacted	Description of Works
R13-UX-BT-P002	BT	A 9+100 - 9+185	BT Ducting	Diversion of c. 85m of BT Ducting and Chambers in footway of N11 Stillorgan Road where widening carriageway into footway.

10.3.6 Gas Networks Ireland

Jacobs has undertaken consultation with GNI regarding the impact of the Proposed Scheme on their assets, and their requirements have been incorporated within the design. There are several locations where a GNI medium and low-pressure gas mains have been identified that require diversion along the scheme. The conflicts are listed in **Table 10-6** below and are illustrated on the drawing set **BCIDB-JAC-UTL_UG-0013_XX_00-DR-CU-9001** included within **Appendix B.**

Table 10-6: GNI Diversion

Ref no.	Utility Provider	Chainage	Asset Impacted	Description of Works
R13-UG-LP-001	GNI	A 2360 - 2460	LP Underground	Diversion of c. 100m of LP Underground mains in cycleway of Donnybrook Road where widening into footway.
R13-UG-MP-055	GNI	A 3950 - 4030	MP Underground	Diversion of c. 105m of MP Underground mains at UCD Bus Interchange.
R13-UG-LP-002	GNI	A 13560 - 13770	LP Underground	Diversion of c. 210m of LP Underground mains in cycleway of N11 Bray Road where widening into footway.
R13-UG-LP-003	GNI	A 14320 - 14665	LP Underground	Diversion of c. 350m of LP Underground mains in footway of Dublin Road where widening into footway.
R13-UG-LP-004	GNI	A 15030 - 15100	LP Underground	Diversion of c. 75m of LP Underground mains in footway of Shanganagh Road where widening into footway.
R13-UG-LP-005	GNI	A 15120 - 15145	LP Underground	Diversion of c. 30m of LP Underground mains in footway of Dublin Road where widening into footway.
R13-UG-LP-006	GNI	A 16030 - 16060	LP Underground	Diversion of c. 25m of LP Underground mains in footway of Dublin Road where widening into footway.
R13-UG-LP-007	GNI	A 17180 - 17300	LP Underground	Diversion of c. 120m of LP Underground mains in cycle lane of Dublin Road where widening into footway.

Ref no.	Utility Provider	Chainage	Asset Impacted	Description of Works
R13-UG-LP-008	GNI	A 17440 - 17550	LP Underground	Diversion of c. 110m of LP Underground mains in cycle lane of Dublin Road where widening into footway.
R13-UG-MP-052	GNI	A 17830 - 17900	MP Underground	Diversion of c. 76m of MP Underground mains in footway of Dublin Road where widening into footway.
R13-UG-LP-009	GNI	A 18180 - 18315	LP Underground	Diversion of c. 135m of LP Underground mains in cycle lane of Dublin Road where widening into footway.
R13-UG-LP-010	GNI	A 18320 - 18450	LP Underground	Diversion of c. 140m of LP Underground mains in cycle lane of Dublin Road where widening into footway.

11. Waste Quantities

11.1 Overview of Waste

The majority of the waste arisings from the works are likely to accumulate from excavation related activities resulting from road widening and drainage/utility works in addition to proposed public domain street works. A waste calculator was developed for the Proposed Scheme to quantify and classify the likely material types in accordance with TII GE-ENV-01101 and the European Waste Catalogue waste codes. The waste quantities associated with Soil and Stones (waste code 17 06 02) were further broken down into the likely TII material specification to establish an understanding of the volume of materials that could potentially be reused/recycled. In developing the waste estimate quantities, a number of assumptions were required to be undertake the assessment which have been outlined in **Section 11.2.**

Due to the nature of the works in an urban environment there are limited opportunities to provide 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 could be sent to a suitable recovery facility for recycling and reuse as recycled aggregate material in the industry. The existing made ground material will need to be tested for quality and contamination and could potentially to be sent to a suitable soil recovery facility also for reuse as general fill or general landscape fill material in the industry under the provisions of Article 28 of the European Communities (Waste Directive) Regulations, 2011. Similarly, alternative sites could be identified under the provisions of Article 27 for material re-use during future design stages. No such suitable sites have been identified for the Proposed Scheme during the preliminary design phase.

Future design stages will undertake additional site investigations to inform the detailed pavement design and associated excavation quantity assessment. Various mitigations could be considered during the design and construction works to offset the net volume of material that will be sent off site to a soil recovery facility including stockpiling of existing subbase, capping layer and topsoil material on site for direct reuse in the proposed works (subject to quality testing, construction sequencing and material availability versus demand given the intermittent nature of the street works). Similarly, there are potentially other opportunities within the proposed pavement design/construction to further offset the net volume of natural aggregate material requirements through consideration for the use of recycled aggregates and reclaimed asphalt material. Suitable recycled aggregates and appropriate site won material could be implemented in the proposed road base/binder layers, subbase layers under footpath/cycle tracks, and capping layer material within the road pavement. Adopting these mitigations in the proposed designs may have significant benefits in offsetting the overall quantity of natural aggregate materials requirements and could potentially realise up to a significant volume of recycled/reused aggregates to improve the overall sustainability of the scheme.

Waste arisings from street furniture, trees, and materials from within the public domain (17 01 02 Bricks, 17 04 07 Mixed metals, 17 02 03 Plastic, 17 02 01 wood, 17 02 02 Glass) are also likely to result from the nature of the works. These materials will need to be segregated by waste classification on site and sent to a suitable recovery facility for recycling. The principles of prevention and minimisation will be further considered in detailed design/construction stages through value engineering, substitution or reuse of materials, and effective methods or control systems (e.g., just in time deliveries/ effective spoil management) so that waste production is minimised.

11.2 Waste Calculation Assumptions

The following tables provide an overview of the various material weights that have been applied in consideration of the overall materials waste estimate quantities for the Proposed Scheme.

Table 11-1: Street Furniture Weight Units

Item	Material	Assumed Nominal Weight	Notes
Timber arising from trees	Timber/ Wood	150 kg per tree	Average value per tree across the scheme length.
Vegetation (e.g. hedges, shrubs, leaves and branches)	Organic	N/A	Organic material from hedges, shrubs, leaves and branches have not been quantified.
Walls	Masonry/ Bricks	1.5m height 0.3m width	Nominal assumed dimensions for purposes of assessment
Gates	Metal	100 kg/unit	Nominal assumed average weight per gate over scheme
Metal railings	Metal	15 kg/m	Nominal assumed average weight per railing over scheme
Fencing	Metal	40 kg/m	Nominal assumed average weight per railing over scheme
Traffic Signals	Metal	68 kg/ 4m pole 15kg per traffic signal head Assumed 2 heads per pole	*Source: Siemens Helios General Handbook Issue 18.* Nominal assumed average scenario per signal over scheme length
	Plastic	9 kg	
Traffic Signs	Metal	20kg/ 3m pole 0.75 m sign height 0.01 m pole thickness	Nominal assumed average scenario per traffic sign over scheme length
Lighting poles	Metal	100 kg per 8m pole	Nominal assumed average scenario over scheme length
ESB/EIR poles	Timber/wood	250 kg per 9m pole	Nominal assumed average scenario over scheme length

Item	Material	Assumed Nominal Weight	Notes
Bus stops	Plastic	365 kg per bus stop	JCDecaux and NTA (2017) *Reliance Bus Shelter information*
	Metal	2400 kg per bus stop	JCDecaux and NTA (2017) *Reliance Bus Shelter information*
	Glass	54 kg per bus stop	JCDecaux and NTA (2017) *Reliance Bus Shelter information*
Litter bins	Metal	60 kg per bin	Omos specification. Nominal assumed average scenario over scheme length
Safety barrier	Metal	20 kg/m	Nominal assumed average scenario over scheme length
Cabinets	Metal	85 kg	ESB (2008). *National Code of Practice for Customer Interface 4th Edition.* Available online: https://www.esbnetworks.ie/docs/default-source/publications/national-code-of-practice.pdf (Accessed on 6 May 2021)
Benches	Metal	32kg	Lost Art (2016). *Benches: Product information operation and maintenance instructions.* Available online: https://www.lostart.co.uk/pdf/lost-art-limited-product-information.pdf (Accessed on 6 May 2021)
	Wood	8kg	
Cameras	Metal	35 kg	2b Security Systems (2021) *PTZ-7000 Long range IP PTZ camera*. Available online: https://www.2bsecurity.com/product/long-range-ptz-camera/ (Accessed on 6 May 2021)
Overhead Gantry (steel)	Metal	7000 in per m^3	TII (nb). *CC- SCD- 01804-02*. Available online:https://www.tiipublications.ie/library/CC-SCD-01804-02.pdf (Accessed on 6 May 2021) TII (nb). *CC- SCD- 0180-02*. Available online:https://www.tiipublications.ie/library/CC-SCD-01805-02.pdf (Accessed on 6 May 2021)
Cast Iron Bollard	Metal	50 kg	Furnitubes (2013) *Cast Iron Bollards: Product Brochure.* Available online: https://www.furnitubes.com/uploads/assets/brochures-2013/furnitubes-e-008-01-13-cast-iron-bollard-brochure.pdf (Accessed on 6 May 2021)
Non-Assigned Bollard	Metal	40kg	Furnitubes (2013) *Cast Iron Bollards: Product Brochure.* Available online: https://www.furnitubes.com/uploads/assets/brochures-2013/furnitubes-e-008-01-13-cast-iron-bollard-brochure.pdf (Accessed on 6 May 2021)

Item	Material	Assumed Nominal Weight	Notes
Stainless Steel Bollard	Metal	30kg	Furnitubes (2013) *Cast Iron Bollards: Product Brochure.* Available online: https://www.furnitubes.com/uploads/assets/brochures-2013/furnitubes-e-008-01-13-cast-iron-bollard-brochure.pdf (Accessed on 6 May 2021)
Vehicle Restraint Bollard	Metal	130 kg	Furnitubes (2013) *Cast Iron Bollards: Product Brochure.* Available online: https://www.furnitubes.com/uploads/assets/brochures-2013/furnitubes-e-008-01-13-cast-iron-bollard-brochure.pdf (Accessed on 6 May 2021)
Bike Railings / handrails	Metal	16 kg	Dublin City Council (2016) *Construction Standards for Road and Street Works in Dublin City Council*
Gully grates	Metal	40 kg	Pam Saint- Gobain (2016). *Ductile Iron Access Covers and Gratings: Product selection and specification guide*. Available online: https://www.saint-gobain-pam.co.uk/sites/pamline_uk/files/access_covers_and_gratings_product_guide_0.pdf (Accessed on 6 May 2021) Greater Dublin Region (2012) *Greater Dublin Regional Code of Practice for Drainage works.* Available online: (https://www.sdcc.ie/en/download-it/guidelines/greater-dublin-regional-code-of-practice-for-drainage.pdf (Accessed on 6 May 2021)
Chamber covers and frame	Metal	0.112 tonnes	Pam Saint- Gobain (2016). *Ductile Iron Access Covers and Gratings: Product selection and specification guide*. Available online: https://www.saint-gobain-pam.co.uk/sites/pamline_uk/files/access_covers_and_gratings_product_guide_0.pdf (Accessed on 6 May 2021) Greater Dublin Region (2012) *Greater Dublin Regional Code of Practice for Drainage works.* Available online: (https://www.sdcc.ie/en/download-it/guidelines/greater-dublin-regional-code-of-practice-for-drainage.pdf (Accessed on 6 May 2021)
Manholes	Metal	0.04 tonnes	Pam Saint- Gobain (2016). *Ductile Iron Access Covers and Gratings: Product selection and specification guide*. Available online: https://www.saint-gobain-pam.co.uk/sites/pamline_uk/files/access_covers_and_gratings_product_guide_0.pdf (Accessed on 6 May 2021) Greater Dublin Region (2012) *Greater Dublin Regional Code of Practice for Drainage works.* Available online: https://www.sdcc.ie/en/download-it/guidelines/greater-dublin-regional-code-of-practice-for-drainage.pdf (Accessed on 6 May 2021)

Table 11-2: In-situ Pavement and Earthworks Densities

Material	Densities (tonnes/m3)	Notes
Soil	2.2	Professional judgement (Dublin boulder clay), laboratory testing - Nominal assumed average scenario over scheme length
Bitumen containing material	2.4	Professional judgement (Engineering Designers) - Nominal assumed average scenario over scheme length
Concrete	2.4	Professional experience and (Bath Inventory - Version 2.0 (2011)) - Nominal assumed average scenario over scheme length
Granite	2.7	https://pubs.usgs.gov/of/1983/0808/report.pdf - Nominal assumed average scenario over scheme length
Paving stones (assumed concrete or natural stone)	2.4	Professional judgement (Engineering Designers) Nominal assumed average scenario over scheme length
Granular material	1.6	Nominal assumed average scenario over scheme length

Table 11-3: Utilities Material Excavation Assumptions

Asset type	Assumed nominal average trench width (m)	Assumed material spec. (TII)	Assumed nominal average trench depth under pavement layer (m)	Notes
Drainage Pipe Bedding Excavation Assessment (assumed at 1.2m cover i.e. obvert at 0.35m under capping layer of road)	0.9	Class 2/4/U1 Cohesive subgrade material	1.25	Irish Water (2020) *Water Infrastructure Standard Details: Connections and Developer Services.* Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)
Foul Sewer Pipe Bedding Excavation Assessment (assumed at 1.2m cover i.e. obvert at 0.35m under capping layer of road)	0.9	Class 2/4/U1 Cohesive subgrade material	1.25	Irish Water (2020) *Water Infrastructure Standard Details: Connections and Developer Services.* Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)

Asset type	Assumed nominal average trench width (m)	Assumed material spec. (TII)	Assumed nominal average trench depth under pavement layer (m)	Notes
Potable water Pipe Bedding Excavation Assessment (assumed at 1.2m cover i.e. obvert at 0.35m under capping layer of road)	0.9	Class 2/4/U1 Cohesive subgrade material	1.25	Irish Water (2020) *Water Infrastructure Standard Details: Connections and Developer Services.* Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)
Road Pavement Excavation (extra over in addition to road widening allowances e.g. transverse trenching)	0.9	Bitumen (surface + binder and base)	0.35	Irish Water (2020) *Water Infrastructure Standard Details: Connections and Developer Services.* Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)
		Class 1/2 Granular Subbase material	0.3	Irish Water (2020) *Water Infrastructure Standard Details: Connections and Developer Services.* Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)
		Class 6 Granular Capping material	0.2	Irish Water (2020) *Water Infrastructure Standard Details: Connections and Developer Services.* Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)
Electric/Power bedding excavation Assessment (assumed at 0.75m cover under footpath i.e. obvert at 0.55m under subbase layer of	0.05	Class 2/4/U1 Cohesive subgrade material	0.925	ESB (2008) *Standard Specification for ESB MV/LV Network Duction (Minimum Standards).* Available online: https://www.esbnetworks.ie/docs/default-source/publications/summary-of-standard-specification-for-esb-networks-mvlv-

Asset type	Assumed nominal average trench width (m)	Assumed material spec. (TII)	Assumed nominal average trench depth under pavement layer (m)	Notes
footpath/cycle track)				ducting.pdf?sfvrsn=f34b33f0_4 (Accessed on 6 May 2021)
Comms bedding Excavation Assessment (assumed at 0.75m cover under footpath i.e. obvert at 0.55m subbase layer of footpath)	0.5	Class 2/4/U1 Cohesive subgrade material	0.925	ESB (2008) *Standard Specification for ESB MV/LV Network Duction (Minimum Standards).* Available online: https://www.esbnetworks.ie/docs/default-source/publications/summary-of-standard-specification-for-esb-networks-mvlv-ducting.pdf?sfvrsn=f34b33f0_4 (Accessed on 6 May 2021)
Street Lighting/Comms/Traffic Excavation Assessment (assumed at 0.6m cover under footpath i.e. obvert at 0.4m subbase layer of footpath)	0.5	Class 2/4/U1 Cohesive subgrade material	0.56	South Dublin County Council (2016) *Public Lighting Specification.* Available online: https://www.sdcc.ie/en/services/transport/public-lighting/sdcc-public-lighting-specification.pdf (Accessed on 6 May 2021)
Gas Excavation Assessment (assumed at 0.6m cover i.e. obvert at 0.4m under subbase layer of footpath)	0.45	Class 2/4/U1 Cohesive subgrade material	0.7	Gas Network Ireland (2018) *Guidelines for Designers and Builders- Industrial and Commercial (Non-domestic) Sites. Available online: https://www.gasnetworks.ie/Guidelines-for-Designers-and-Builders-Industrial-and-Commercial-Sites.pdf (Accessed 6 May 2021)*

Table 11-4: Footpath and Verge Widening Excavation Assumptions

Layer	Assumed layer thickness (m)	Assumed material spec. (TII)
Footpath surface treatment due to all works (remove and replace)	0.1	Concrete

Layer	Assumed layer thickness (m)	Assumed material spec. (TII)
FDC new pavement depth	0.85	As per DCC standard bus corridor detail with 200mm capping assumed.
Footpath sub-layer excavation due to Full Depth Construction (FDC) widening (material under footpath)	0.1	Granular material- Class 1/2 Granular Subbase material
	0.75	Soil and stones- Class 2/4/U1 Cohesive subgrade material
Verge and sub-layer excavation due to FDC widening (material under verge)	0.3	Soil and stones- Class 5 Topsoil material
	0.55	Soil and stones- Class 4/U1 Cohesive subgrade material
Verge and sub-layer excavation due to footpath widening (material under verge)	0.3	Soil and stones- Class 5 Topsoil material
	0	Soil and stones- Class 4/U1 Cohesive subgrade material
Road surface treatment due to road markings and utilities trench reinstatement(mill and re-sheet)	0.05	Bitumen containing material - Bitumen (surface)
Road sub-layer excavation due to FDC (material under road)	0.3	Bitumen containing material - Bitumen (binder and base)
	0.3	Class 1/2 Granular Subbase material
	0.2	Granular material - Class 6 Granular Capping material
	0	Soil and stones- Class 2/4/U1 Cohesive subgrade material

11.3 Waste Estimate Summary

The majority of the waste arisings from the works are likely to accumulate from excavation related activities resulting from road widening and drainage/utility works in addition to proposed public domain street works.

It is estimated that an order of magnitude of 107,000 Tonnes of pavement and made ground material (17 01 01 Concrete/ 17 06 02 non-hazardous bituminous mixture/17 05 04 - Soil and stones (non-contaminated)) will be excavated as part of the works, refer to **Table 11-5** . Due to the nature of the works in an urban environment there are limited opportunities to provide 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 could be sent to a suitable recovery facility for recycling and reuse as recycled aggregate material in the industry as further described below. The existing made ground material will need to be tested for quality and contamination and could potentially to be sent to a suitable soil recovery facility also for reuse as general fill or general landscape fill material in the industry under the provisions of Article 28. There are no known Article 27 sites available at the time of planning for the site however this could also be considered for reuse of material arisings from the project at a later date.

Potentially up to 100% of concrete and asphalt material could be sent to a suitable aggregate recovery facility for recycling. Under TII specification crushed concrete material could be used in selected granular fill material under Series 600 for Earthworks (6A,6B,6C,6F, 6G,6H,6I, 6M, 6N) or as Type A Clause 803 unbound subbase material under Series 800 for Road Pavements. Similarly, TII specification allows for use of recycled bituminous planning's to be used in capping material and 803 sub-base material type A (for use under bituminous footpath) in addition to LEBM pavements for roads with <5MSA or consideration in offline cycle track base material.

Potentially up to 90% of excavated subbase material and capping material could be reused as subbase material under footways and cycle track (subject to quality testing). It is assumed that potentially 10% of this material will contain excessive cohesive material during the excavation process (unsuitable for direct reuse). The 10% excess material would likely be sent to a suitable recovery facility as general fill or landscape fill material (Class 2/4 material) depending on excavation methods employed by the contractor and existing ground conditions.

Future design stages will undertake additional site investigations to inform the detailed pavement design and associated excavation quantity assessment. Various mitigations could be considered during the design and construction works to offset the net volume of material that will be sent off site to a soil recovery facility including stockpiling of existing subbase, capping layer and topsoil material on site for direct reuse in the proposed works (subject to quality testing, construction sequencing and material availability versus demand given the intermittent nature of the street works). Similarly, there are potentially other opportunities within the proposed pavement design/construction to further offset the net volume of natural aggregate material requirements through consideration for the use of recycled aggregates and reclaimed asphalt material. Suitable recycled aggregates and appropriate site won material could be implemented in the proposed road base/binder layers, subbase layers under footpath/cycle tracks, and capping layer material within the road pavement. Adopting these mitigations in the proposed designs may have significant benefits in offsetting the overall quantity of natural aggregate materials requirements and could potentially realise up to 34,674 Tonnes of recycled/reused aggregates to improve the overall sustainability of the scheme.

It is estimated that an order of magnitude of 5,380 Tonnes of waste arisings from street furniture, trees and materials from within the public domain (17 01 02 Bricks, 17 04 07 Mixed metals, 17 02 03 Plastic, 17 02 01 wood, 17 02 02 Glass) are also likely to result from the nature of the works. These materials will need to be segregated by waste classification on site and sent to a suitable recovery facility for recycling. The principles of prevention and minimisation will be further considered in detailed design/construction stages through value engineering, substitution or reused of materials, and effective methods or control systems (e.g. just in time deliveries/ effective spoil management) so that waste production is minimised.

Table 11-5 Summary of Excavation Material Type and Quantities

Materials from C&D Sources	Approximate Waste and Material Quantity (Tonnes)
Concrete, bricks, tiles and similar (including street furniture elements - metal, plastics, wood and glass)	33,380
Bituminous mixtures	42,000
Soil and stone	111,000
TOTAL	**186,380**

12. Traffic Signs, Lighting and Communications

12.1 Traffic Signs and Road Markings

Signage and road markings will be provided along the extents of the proposed scheme to clearly communicate information, regulatory and safety messages to the road user. In addition, the existing lighting and communication equipment along the route has been reviewed and proposals developed to upgrade where necessary. Refer to the preliminary design drawings contained within **Appendix B** for Traffic Signs and Road Markings Drawings and Lighting Drawings.

12.2 Traffic Sign Strategy

A preliminary traffic sign design has been undertaken to identify the requirements of the Proposed Scheme, whilst allowing for further design optimisation at the detailed design phase. A combination of information, regulatory and warning signs have been assessed taking consideration of key destinations/centres; intersections/decision points; built and natural environment; other modes of traffic; visibility of signs and viewing angles; space available for signs; existing street furniture infrastructure; existing signs. In line with DMURS, the signage proposals have been 'kept to the minimum requirements of the Traffic Signs Manual (TSM).

Prior to assessing the requirements for individual signs, a review was carried out on the impact that proposed traffic restrictions and changes to the road layout will have on the key traffic routes in the vicinity of the Proposed Scheme.

A set of Route Strategy Plans were created which display the following information relating to the five sections above; the existing direction signs in the vicinity of the route, the associated existing traffic routes, the routes which traffic will be directed along as a result of the proposed traffic restrictions and road layout amendments, and the proposed traffic sign locations for the new routes. The proposed traffic signs will be located at the decision points for key destinations, which have been determined using the information displayed on the existing signs.

A review of the existing regulatory and warning signs in the vicinity of the route was carried out to identify unnecessary repetitive and redundant signage to be removed. This includes rationalising signage structures by better utilising individual sign poles and clustering signage together on a single pole.

12.3 Traffic Signage and Road Marking

12.3.1 Traffic Sign General

A preliminary assessment was undertaken which involved an assessment of major road traffic signage, including requirements for all information signs (TSM Chapter 2), regulatory signs (TSM Chapter 5), warning signs (TSM Chapter 6), and road markings (TSM Chapter 7).

As stated in TSM Chapter 1, in urban areas the obstruction caused by posts located in narrow pedestrian footways should be minimised, ensuring that pedestrian and cycle access is unimpeded by any such signage infrastructure. 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. Passively safe posts will be introduced where practicable to eliminate the need for vehicle restraint systems.

12.3.2 Gantry Signage

No gantry signage exists along the Proposed Scheme. The original concept design and its development through EPR and Preliminary Design did not identify the requirement for any new gantry signage.

12.3.3 Road Marking

A preliminary design of road markings has been undertaken in accordance with TSM Chapter 7 and the BCPDGB. For further details refer to the preliminary design drawings contained within **Appendix B.** The preliminary road marking design included the following items:

- Bus lanes are provided along the Proposed Scheme and will be marked accordingly.
- Cycle tracks have been provided along the Proposed Scheme. The pavement will be marked according to best practice guidelines such as DMURS and the National Cycle Manual with particular attention given to junctions. Advance Stacking Locations (ASLs) have been designed where practicable to provide a safer passage for cyclists at signal-controlled junction for straight ahead or right turn movements.
- Pedestrian crossings have been incorporated throughout the design to connect the network of proposed and existing footways. Wider pedestrian crossings have been provided in locations expected to accommodate a high number of pedestrians. DMURS classifies pedestrian crossing widths in areas of low to moderate pedestrian activity as 2.5m and areas of moderate to high pedestrian activity as 3m.

12.4 Public Lighting

A high-level review of the existing lighting provision along the extent of the route has been carried out to understand the impact of the proposed scheme on lighting columns and associated infrastructure. A number of existing columns are proposed to be relocated or replaced to accommodate the Proposed Scheme, as shown on the preliminary design drawings within **Appendix B**.

12.4.1 Existing Lighting

Light emitting diode (LED) lanterns will be the light source for any new or relocated public lighting provided. The lighting design will involve works on functional, heritage and contemporary lighting installations on a broad spectrum of lighting infrastructure along the Proposed Scheme. This shall include, but not exclusively, luminaires supplied by underground and overhead cable installations and those located on ESB infrastructure.

In locations where road widening and/or additional space in the road margin is required, it is proposed that the public lighting columns shall be replaced and relocated to the rear of the footpath to eliminate conflict with pedestrians, 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 to ensure that the current standard of public lighting is maintained or improved. The New lighting requirement will be determined by BCID lighting design in accordance with the standards and best practice. To determine whether existing public lighting is to be improved / relocated or where new public lighting is required, an inspection shall be carried out to identify any new column locations required for particular sections of the Proposed Scheme. For existing columns that have specific aesthetic requirements, the intent for the replacement of such columns will include:

- Replacing the existing heritage columns and brackets with identical replica columns and brackets;
- Replacing existing luminaires with approved LED heritage luminaires; and
- Ensuring that the electrical installation is compliant with standards detailed in **Section 12.4.2.**

12.4.2 New Lighting

All new public lighting shall 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; and
- Institution of Lighting Professionals "GN01 Guidance Notes for Reduction of Obtrusive Light"

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

12.4.3 Lighting at Stops

The design shall include for the provision of lighting in covered areas, open areas and passenger waiting areas. The location of the lighting column shall be dictated by light spread of fittings to give the necessary level of illumination (the columns at stops provide clearance for buses).

12.5 Traffic Monitoring Cameras

A network of digital cameras is proposed to be introduced at key locations along the Proposed Scheme. These cameras will enable the monitoring of traffic flows along the route and provide rapid identification of any events that are causing, or are likely to cause, disruption to bus services on the route and to road users in general.

This preliminary design assumes the use of high-definition (1080p or greater) digital cameras with a digital communications network providing transmission of video and camera monitoring/control functionality.

Additionally, a mains power source will be required at each location where a camera is installed. Further details of the requirements for power and data communications are provided below. The cameras may be fixed position or pan, tilt and zoom (PTZ) depending on the most suitable option for a given location as well as general operational preferences for fixed or PTZ.

The requirement for cameras along the Proposed Scheme route and the exact locations for these cameras will be determined at detailed design stage. The initial design assumption has been for the installation of camera(s) at each traffic signal junction although it is possible that not all such junctions will require a camera and there may also be situations where a camera is required between junctions. However, the design approach outlined below applies irrespective of the camera location or the number of cameras at any given location. The proposed junction signal camera locations are shown on the Junction System Design drawings within **Appendix B.**

CCTV requirements at the UCD Interchange will be developed in coordination with UCD.

12.5.1 Camera Positioning and Mounting

The precise position of a camera at each selected location will be considered on a site-by-site basis to ensure the optimum view of the road network in the vicinity of the site. In some cases there may be a requirement for more than one camera at a location in order to obtain the required view.

The method of mounting the camera and the height at which it is mounted depends to a large extent on this position. Thus, for example, it may be possible to mount a camera on a traffic signal post (which may require a height extension to that post) or on a street lighting column. If neither of these options is feasible then it will be necessary to consider installation of a dedicated mounting post for the camera. Whichever of these mounting arrangements is used, the camera will typically be mounted at a height between 5m and 10m, with most cameras being mounted at around 6m, although again this depends largely on the scene required to be monitored at each location. It is noted that the existing approximately 20m CCTV pole at the Tonlegee Junction will need to be moved or an alternative camera arrangement installed.

Where a site requires installation of a new mounting post then consideration will be given to using a “tilt-down” post design. This will provide for easier access to the camera for maintenance operatives and will avoid the need for operatives to work at height. However, there may be space restrictions (e.g. other street furniture, nearby trees, walls and buildings) that prevent the safe operation of a tilt-down pole, in which case a “static” post will be proposed. Whichever type of new post is used, where practicable, the design will assume that the post will be mounted in a NAL-type post, or similar, socket installed at footway floor level. This will provide for easier installation as well as replacement, for example where the pole has been damaged and structurally compromised.

12.5.2 Housing of Camera Power and Communication Equipment

The requirements for power and data communications described below require installation of a cabinet and/or feeder pillar to house the termination and control equipment for power and data communications services and for any other camera control equipment that may be needed. Where a camera is located at a traffic signal junction, consideration was initially given to housing the camera power, data comms and camera control equipment within the traffic signal controller cabinet. However, this could lead to practical difficulties in terms of access for maintenance where the traffic signals maintenance provider, the camera maintenance provider and the comms network operator will all require access to the cabinet. This could also lead to operational problems, for example if a camera maintenance operative inadvertently affects traffic signal control by disabling mains power to the cabinet, or if a signals maintenance operative disables camera or comms operation in the same manner.

It was therefore considered appropriate to assume the installation of a separate cabinet for camera equipment from that of the traffic signal control equipment. However, at each traffic signal junction where a camera is installed, consideration will be given to providing a duct between the traffic signal control cabinet and the camera equipment/comms cabinet to allow the connection of the traffic signal control equipment to the data communications network (further details of which are provided below). This would avoid the need for installation of a dedicated comms cabinet for the traffic signal control equipment.

There are sections of the Proposed Scheme where camera locations at or between junctions may be closely spaced. In such cases consideration will be given to using one camera equipment/comms cabinet to serve both camera locations in order to reduce installation costs and minimize the presence of street furniture. This may require positioning the cabinet (and its power supply) between junctions or running ducting from one junction to another. The exact requirement for this will be investigated on a location-specific basis at detailed design stage. In all cases the consideration of the siting of such roadside equipment shall prioritize the access for pedestrians and cyclists in the area and the aesthetics of the street urban landscape

12.5.3 Camera Power Supply

Modern digital cameras use a low voltage (ELV) supply - typically 12V, 24V or 48V - provided either from a dedicated mains power adapter (converting mains voltage to the required ELV) or a power-over-ethernet (PoE) injector, a device that provides the low voltage over the same cabling (Ethernet) as the data communications for the camera. PoE is generally preferred as it only requires a single cable for both power and communications. In both cases the adapter/injector is located either in the base of the camera mounting post or in a cabinet at the camera location, as described above. Wherever it is located, a mains power supply is required for it.

One advantage of mounting a camera on a street lighting column is that there is a mains power supply readily available such that, subject to availability of space, the camera power adapter may be installed in the lighting column base and connected at that point to the mains supply. There is still, however, a need for a connection from the camera to the data comms network service as described below even though power need not then be provided via the Ethernet connection to this service.

12.5.4 Data Communications

It is increasingly common for operations centres that use digital cameras to require at least high definition (HD) quality (1080p resolution) video images. To achieve this, each camera requires a high bandwidth connection, preferably with a data download speed of 10Mbits/sec or higher. This connection is normally provided at the camera site either as a "private" connection (i.e. provided by the service owner/operator) or by a commercial service such as Eir or Virgin Media. In either case, this connection is normally terminated at a data comms cabinet installed at the camera location, as described above.

Where it is not practicable to use existing network for a continuous fibre optic cable network the Proposed Scheme will require a new telecommunications ducting network consisting of two ducts with chambers at 180m centres along one side of the road with spurs to connect to cabinets and equipment. This will require a duct chamber at each camera location to connect the main optical fibre duct network to the camera equipment/comms cabinet. The cabinet will need to be of a design to allow installation of the required optical fibre termination equipment in addition to any camera power/control equipment and mains power supply. The number of items of equipment, and the space and power supply requirements for it, will vary according to the type of service provided. However, it will require at least one mains supply point in the cabinet, and possibly up to three such points. A standard design for this cabinet will be produced at detailed design stage.

Alternatively, each junction could contain a wireless connection to nearby optical fibre (or copper) backhaul point. However, this would require a detailed (site-by-site) understanding of requirements to determine lines-of sight, equipment mounting options/limitations, etc. both at the junction and at the optical fibre/copper backhaul point. The initial approach will therefore be to assume direct connection of each camera to the main optical fibre network and any additional requirement for wireless communication will be considered on a site-by-site basis if it is considered more appropriate to do so rather than using a direct optical fibre/copper connection.

12.5.5 Camera Ducting and Cabling Requirements

Ducting will be required to link the camera equipment/comms cabinet to the camera at each location. Where the camera is located at a traffic signal junction, the ducting used for connecting the traffic signals can be used wherever possible and if necessary, additional ducting will then be included in order to link the traffic signal ducting to the camera equipment/comms cabinet and to the camera itself.

As mentioned above, Ethernet cabling is most often used to connect the camera to the comms service and this cable may or may not also carry power to the camera. It is generally accepted that an Ethernet cable run of up to 100m between the cabinet and camera is acceptable but beyond this signal degradation can lead to comms issues. In such cases a PoE signal extender can be introduced into the cable run. This does not need any additional power supply as it draws the power it needs from the PoE input in the cable. These devices can be cascaded along the Ethernet cable run to extend the cable distance considerably although it is sensible to coincide the location of these units with duct chambers for ease of installation and to allow for maintenance access. The detailed design stage will consider the need for this approach on a site-by-site basis where there are cable runs in excess of 100m.

12.6 Real Time Passenger Information

The design for the Proposed Scheme includes the provision of RTPI at all of the bus stops. This will comprise a "live" display identifying the estimated arrival time of each bus at the stop. RTPI displays will also be incorporated within UCD Interchange.

This will require a flag-type display on a dedicated mounting post, as illustrated in **Figure 12.1**.

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Figure 12.1: RTPI Display at Bus Stop

12.6.1 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 as per **Figure 12.2**.

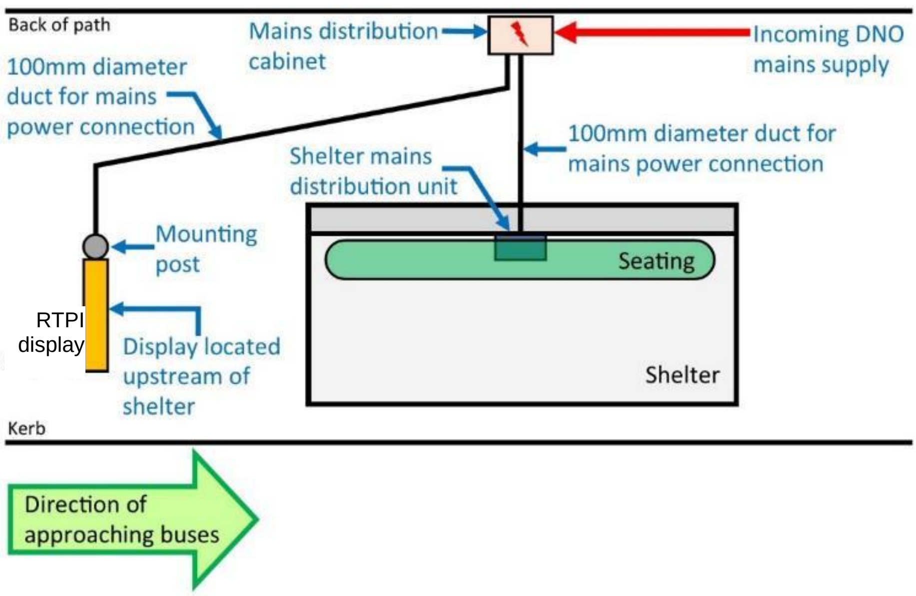

Figure 12.2: Typical Layout for Bus Stop with RTPI Display

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.

In any case, where an RTPI display is to be installed, the detailed design will assume that the mounting post for the display will be located in a NAL-type, or similar, post socket installed at footway floor level. As for the cameras, this will provide for easier installation as well as replacement, for example where the pole has been damaged and structurally compromised.

12.6.2 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 12.2**, 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 12.2**.

12.6.3 Data Communications for RTPI Display

The majority of RTPI systems currently in operation 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 Scheme, 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.

12.7 Roadside Variable Message Signs

Consideration was also given to the inclusion of roadside Variable Message Signs (VMS) to provide traffic information to road users. To ensure efficient operation of the UCD Interchange and its associated bus, pedestrian and cyclist movements, the traffic flow to and from the existing N2 O'Reilly Hall car park may need to be regulated at peak hours. Liaison has taken place with UCD to ensure that the interchange proposals are coordinated with the wider UCD campus including the UCD Future Campus masterplan.

12.8 Maintenance

Maintenance of signs, lighting and communication infrastructure has been considered and allowed for as part of the design process.

12.9 Traffic Signals

12.9.1 Above Ground Infrastructure

12.9.1.1 Traffic Signal Poles

All traffic signal equipment is designed in accordance with Chapter 9 (Traffic Signals) of the TSM. Traffic signal modelling, including LinSig models, determines the phasing and staging of the traffic signals which determines the design and positioning of the traffic signal heads. The TSM clearly defines the requirements and positioning of traffic signal heads, detection equipment, and associated traffic signal poles.

Traffic signal poles typically come in two lengths, 3m and 6m (as measured from the ground), or single or double height poles. Single height poles will be predominantly used on the Proposed Scheme to mount traffic signal heads, push button units, and other equipment. Double height poles will be used at locations where additional visibility of the signals is required by the motorist, e.g. high-speed approaches.

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.

12.9.1.2 Cantilever Traffic Signal Poles

Cantilever poles will be installed on 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 installed at 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.

12.9.1.3 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, including:

- Traffic signal control cabinets;
- Fibre breakout cabinets; and
- Electricity supply metering, mini and micro pillars.

Cabinets are 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 position at the back of footpaths, to minimise the impact on the effective width of the footpath. In all cases the consideration of the siting of such roadside equipment shall prioritize the access for pedestrians and cyclists in the area and the aesthetics of the street urban landscape. 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.

12.9.2 Under Ground Infrastructure

12.9.2.1 Ducts

Where practicable, existing chambers and ducting will be reused, 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 along the Proposed Scheme it will be necessary to provide a telecommunication ducting network consisting of two communication ducts, with chambers at 180m centres, along one side of the carriageway. This longitudinal ducting will be continuous along the length of the Proposed Scheme, with local duct spurs to connect to cabinets and devices; and
- Device cables – devices will require cabling between field equipment and control equipment. For example, a ring of six ducts will be provided at each 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.

12.9.2.2 Chambers

Chambers will be required at the termination points of ducts, at regular intervals along ducts (180m), at changes in direction, and at breakout points for devices. The position of chambers will be designed to be away from carriageways, pedestrian and cycle desire lines, and tactile paving. It is important when positioning chambers that they can be access in a safe manner, without the need, where practicable, for extensive traffic and pedestrian management. Where practicable, existing chambers will be reused.

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 be shared between users.

12.9.2.3 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, 5m -8m CCTV poles, cantilever signal poles and other lightweight mounting structures that retention sockets will be installed to allow for the easy installation, maintenance and replacement of structures.

For larger structures, such a high CCTV masts, bespoke mass concrete foundations will be designed for incorporation into the works. Cabinet mountings will be designed and constructed in accordance with the manufactures and local authorities' standard details, including the incorporation of required vaults, chambers, earthing rods and mats.

12.9.3 Traffic Signal Priority

12.9.3.1 Overview

Further to the information discussed in **Section 4.12** and **Section 5.3.3** it is the intention to provide specific detection for buses located a sufficient distance from the junction to allow the traffic signal junctions to respond efficiently to the requested bus priority request. There will be further back up loop or other above ground detection provided to ensure that all vehicles permitted to use the lane will be detected although these would be standard non-priority demands.

The automatic vehicle locating (AVL) system is configured to detect when buses pass defined georeferenced locations or zones. When a bus enters these zones, a demand will be passed to the traffic signalling system. The current system capability allows this to be achieved either using local or network-based communications where the site is controlled using an overarching urban traffic control (UTC) system.

The system provided can interface with all of the junctions along the corridor, and where required other parts of the network. This will require utilising an existing, or updated version, AVL system that communicates both with the Central Dublin Sydney Coordinated Adaptive Traffic System (SCATS), in an updated version of the DPTIM SCATS centralised priority system. Options for local control include direct from optical sensors or using an AVL system interface.

The Proposed Scheme will operate on a service headway approach rather than on specific timetabled service pattern. To support this the AVL priority will need to be developed to provide priority inputs for those services that fall within the defined headway, with others receiving standard inputs. The detailed approach for implementing priority differs somewhat between the various control system however the general principle applied is as follows whereby three levels of priority are possible as shown in **Table 12-1** .

Table 12-1 Levels of Bus Priority

Level of Priority	Normal Actions
Low	Add Phase extensions for buses arriving at the end of green.
Medium	Truncation of all non-priority phases to minimum values. Bonus green compensation for all truncated phases during following cycle, where appropriate. Phase extensions for buses arriving at the end of green.
High	Truncation of the non-priority stage to minimum value. Immediate insertion of bus priority stage. Bonus green compensation for all truncated phases during following cycle, where appropriate. Phase extensions for buses arriving at the end of green.

It is proposed that priority will be achieved using either using demand dependent bus phases that can appear within the normal cyclic operation, or by configuring some stages to be conditional demand types that would not appear when priority is being demanded. This will achieve the high level of priority without losing the overall coordination and compensation times that are needed to balance the time needed for the skipped stages.

As discussed in **Chapter 5**, the junction designs for the Proposed Scheme comprise predominately of Junction Types 2, 3 and 4. These junction types facilitate general traffic and bus through movements travelling in unison. This therefore gives BusConnects a high degree of flexibility regarding the level of bus priority applied at the respective junctions along the Proposed Scheme.

12.9.3.2 Infrastructure

Public Transport Priority will be provided through a number of passive and active means. The means of passive priority are discussed in **Section 4.12** and are based on the design of the geometry, signing and road markings of the junctions. These include measures such as bus gates and bus lanes. 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.

The local authorities utilise different controllers and adaptive urban traffic control systems. The systems can operate in several modes including adaptive, linked, vehicle actuated, scheduled plans and fixed time modes. DCC use SCATS traffic signal controllers.

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

- Specialised induction detectors can be utilised to detect cyclists on particular approaches to junctions. These detectors use a concentrated induction pattern to detect the passage of cyclists; and

- 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.

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; and

- 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 (PBU) 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. The use of on crossing detection can also be configured at key locations to extend pedestrian crossing phases, where necessary.

Additional inputs from the AVL system 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.

12.9.3.3 Communication

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

Fibre optic cable network:

- All local authorities operate fibre optic cable networks. It is envisaged that each of these networks will be extended along the length of the Proposed Scheme to provide high bandwidth/low latency communication to traffic signal controllers, CCTV cameras, and other apparatus deployed on the Proposed Scheme;

- Longitudinal ducting, provisionally two communications ducts, shall be provided along the length of the Proposed Scheme with access chambers at 180m centres; and

- Fibre breakout cabinets will be provided at each traffic signal controller, or CCTV camera.

Microwave wireless point-to-point links - Where it is not possible 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 RTPI and VMS.

12.10 Safety and Security

12.10.1 CCTV

CCTV poles will be placed at positions, within the junction, to minimise the impact of solar glare, and to maximise the field of view of the CCTV. The requirement for CCTV along the Proposed Scheme route and the exact locations for these cameras will be determined at detailed design stage. The locations of CCTV have been indicated in the system design drawing for planning purposes. The initial design assumption has been for the installation of camera(s) at each traffic signal junction although it is possible that not all such junctions will require a camera and there may also be situations where a camera is required between junctions. However, the design approach adopted applies irrespective of the camera location or the number of cameras at any given location.

12.10.2 Bus Stops

The requirement for a pleasant, safe and secure environment for passengers waiting at 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 RTPI 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

12.11 Maintenance

All traffic signal, CCTV, and communications equipment shall be designed and located to be accessed and maintained frequently. All equipment shall 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 Scheme into the future. This will include the provision of:

- Use of retention sockets, where applicable, for the erection of traffic signal, CCTV, 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 180m 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.

13. Land Use and Accommodation Works

13.1 Summary of Land Use and Land Acquisition Requirements

As part of the proposed works, land is to be acquired at key locations along the proposed route. A list of land to be acquired is shown in **Table 13.1**.

The land use along the Proposed Scheme comprises a mix of residential and commercial properties. The various land uses are described in the sections below. The extent of the impact due to the Proposed Scheme on a landowner's holding is shown on the Compulsory Purchase Order (CPO) Deposit Maps. The total area that lies within the proposed road development boundary is approximately 25ha. including the existing roads and footpaths.

13.2 Summary of Compulsory Land Acquisition

From the outset of the design of the Proposed Scheme every effort was made to avoid compulsory land acquisition. However, there are a number of public and private lands that are necessary for the construction of the proposed road development and to secure the many benefits for the Proposed Scheme. Reference should be made to the CPO Documents' prepared as part of the planning application.

In total approximately 5.5ha. of land will be required to be permanently acquired, of which approximately 0.05ha is currently in DCC ownership, 5.3ha is currently in DLCC ownership, 0.2ha is currently in WCC ownership to construct the Proposed Scheme. There will also be an additional 7.2ha of temporary land required to allow for construction of boundary treatment and surface tie in work. This includes approximately 0.2ha currently in DCC ownership, 6.5ha currently in DLCC ownership and 0.6ha currently in DCC ownership.

13.3 Summary of Effected Landowners/Properties

The determination of the lands to be acquired for purposes of constructing the Proposed Scheme was as a result of an iterative design process, including non-statutory public consultation and detailed engagement with potentially impacted owners and occupiers.

Table 13.1: Impacted CPO Properties

Address	Permanent Landtake	Temporary Landtake
St. Stephen's Green Park - Heritage footway	N	Y
Gerards Deli, 4 Leeson Street Lower, Saint Kevin's, Dublin 2, D02 DA09	N	Y
Boots, 75 Morehampton Rd, Donnybrook, Co. Dublin, D04 FE06	Y	N
Insomnia Coffee Company, 77 Morehampton Road, Dublin 4, D04 DH51	Y	N
Pure Pharmacy/ Dental Practice, 79 Morehampton Road, Dublin 4, D04 H2Y3	Y	Y
Happy Out/ Sayam Thai Massage, 81 Morehampton Road, Dublin 4, D04 X8R5	N	Y
McCloskeys, 83/85 Morehampton Road, Dublin 4, D04 K589	N	Y
Donnybrook Fair, 87-91 Morehampton Road, Dublin 4, D04 K6F2	N	Y
93A, Hampton Books, John P O'Malley & Company Solicitors, Skin First Beauty Clinic, 93A Okehampton Road, Dublin 4, D04 Y1X7	N	Y
Wilde, 93 Morehampton Road, Dublin 4, D04 HD79	N	Y

Address	Permanent Landtake	Temporary Landtake
Papermint Store/ Medical Centre, 95A Morehampton Road, Dublin 4, D04 N903	N	Y
Green Beard's Juice & Coffee/ Bespoke Beauty, 95B Morehampton Road, Dublin 4, D04 H5X5	N	Y
Nourish, 97A Morehampton Road, Dublin 4, D04 R8W6	N	Y
The Butler's Pantry, 97B Morehampton Road, Dublin 4, D04 YH50	N	Y
Mesh Design Consultants Limited, 97C Morehampton Road, Dublin 4, D04 PH94	N	Y
The Grafton Barber, 99 Morehampton Road, Dublin 4, D04 R791	N	Y
Moloney Mortgages/ New Money/ O'Regan Financial Services, 101 Morehampton Road, Dublin 4, D04 T0C2	N	Y
Terriors, 103 Morehampton Road, Dublin 4, D04 NX27	N	Y
Liston & Company Solicitors, 103/105 Morehampton Road, Dublin 4, D04 T2X5	N	Y
Kevin Kelly Interiors, 105 Morehampton Road, Dublin 4, D04 X573	N	Y
MOLA Architecture, 2 Donnybrook Road,Dublin 4, D04 NN50	Y	N
Circle K Donnybrook, Donnybrook Road, Dublin 4, D04 K3T8	Y	Y
Fast Fit Donnybrook, Eveready Centre, Donnybrook Road, Dublin 4, D04 CV08	Y	Y
First Stop Donnybrook, Eveready Centre, Donnybrook Road, Dublin 4, D04 P5Y0	Y	Y
Cairn Homes Montrose Limited/ Radio Telefis Eireann, Donnybrook, Dublin 4	Y	Y
Radio Telefis Eireann, Complex, Donnybrook, Dublin 4	Y	Y
118 Stillorgan Road, Donnybrook, Dublin 4, D04 CC01	N	Y
Access to Belfield Court, Stillorgan Road, Donnybrook, Dublin 4	N	Y
Council Land adjacent to University College Dublin, Belfield, Dublin 4	Y	Y
Green Area at entrance to Fosterbrook, Stillorgan Road, Booterstown, Blackrock, Co. Dublin	Y	Y
Green Area at Fosterbrook for Site Compound, Stillorgan Road, Booterstown, Blackrock, Co. Dublin	N	Y
Green Area adjacent to St. Thomas Church, Foster Avenue, Booterstown, Blackrock, Co. Dublin	N	Y
Green Area adjacent to The Rise/ N11 Stillorgan Road, Booterstown, Blackrock, Co. Dublin	Y	Y
Colaiste Eoin, Stillorgan Road, Boosterstown, Blackrock, Co. Dublin	N	Y
Verge along Merrion Grove / Entrance to Colaiste Eoin, Stillorgan Road, Boosterstown, Blackrock, Co. Dublin	Y	Y

Address	Permanent Landtake	Temporary Landtake
Green Area adjacent to Greygates/ N11 Stillorgan Road, Booterstown, Blackrock, Co. Dublin	Y	Y
James Hennessy Motors Limited, Stillorgan Road, Woodland, Mount Merrion, Co. Dublin, A94 XH58	N	Y
Green Area adjacent to Oatlands Collage, Woodland, Blackrock, Co. Dublin, A94 HX38	Y	Y
Green Area adjacent to Oatlands Collage, Woodland, Blackrock, Co. Dublin, A94 HX38	Y	N
Green Area adjacent to Priory Grove & Patrician Villas/ N11 Stillorgan Road	Y	Y
N11 Verge, Stillorgan Road (part of Stillorgan Development)	Y	N
N11 Verge, Stillorgan Road (Near the Hill)	Y	N
Green Area adjacent to Stillorgan Park Avenue/ N11 Stillorgan Road	N	Y
Green Area adjacent to The Hill/ N11 Stillorgan Road	N	Y
Green Area adjacent to Glenalbyn Road/ N11 Stillorgan Road	Y	Y
Green Area adjacent at Brewery Road/ N11 Stillorgan Road Junction	Y	Y
N11 Verge at Beechwood Court, Stillorgan Road	N	Y
Green area at apartments & Offices at The Grange (Kennedy Wilson) , Galloping Green North, Stillorgan, Blackrock, Co. Dublin	Y	Y
Laurleen House, Stillorgan Road	N	Y
Belmont Terrace, Galloping Green North, Blackrock, Co. Dublin	Y	N
Entrance to Rubric, Hermiston & Another Propety, Stillorgan Road, Dublin 18	N	Y
Green Area adjacent to Westminsiter Road/ N11 Stillorgan Road	Y	Y
Green Area adjacent to AIB Bank, Cornelscourt Village, Bray Rd, Cornelscourt, Co. Dublin, 18	Y	Y
114 South Park & 116A South Park	N	Y
Green Area for the Footpath Link at South Park Estate	Y	Y
Car Park area at Interlock Hardware Limited, Monaloe House, Clonkeen Road, Deansgrange, Co. Dublin A94 PP70	Y	Y
Green Area at Cabinteely Way	Y	Y
Green Area adjacent to Maple Manor Housing Estate, Johnstown Road, Co. Dublin	N	Y

Address	Permanent Landtake	Temporary Landtake
N11 Verge at Shrewsbury Lawn Housing Estate, Kilbogget, Co. Dublin	N	Y
Entrance to Shanganagh Vale, Bray Rd, Cabinteely, Co. Dublin	N	Y
Proposed entrance to Shanganagh Vale, Bray Rd, Cabinteely, Co. Dublin	N	Y
Existing Green Area at Shanganagh Vale, Bray Rd, Cabinteely, Co. Dublin	Y	Y
Green Area in verge of N11 at Willow Avenue	N	Y
St. Laurence College, Wyattville Road, Glenageary, Loughlinstown, Co. Dublin	Y	Y
Green Area adjacent to Wyattvile Link Road Flyover and N11 Bray Road	Y	N
Whelehans Wines, The Silver Tassie, Bray Road, Dublin, D18 VK37	Y	N
Green Area in verge at Parc Na Silla Rise/ M11	Y	Y
The Paddocks, St. Rita's, Dublin Road, Shankill, Dublin 18	N	Y
Green Area between N11 and Dublin Road at Shankill	N	Y
Green Area at entrance to Seaview Park Housing Estate	Y	N
Green Area at Entrance to Kentfield Estate, Shankill	Y	N
Green Area at Entrance to Kentfield Estate, Shankill	Y	N
Clonmore, Dublin Road, Shankill, Co. Dublin	Y	Y
Thingwall, Dublin Road, Shankill, Co. Dublin	Y	Y
Fairymount, Dublin Road, Shankill, Co. Dublin	Y	Y
Kendor, Dublin Road, Shankill, Co. Dublin	Y	Y
Coltsfoot, Dublin Road, Shankill, Co. Dublin	Y	Y
Woodbank Housing Estate, Shankill, Co. Dublin	Y	Y
Bari, 4 Rathmichael Lawns, Shankill, Dublin 18	N	Y
3 Rathmichael Lawns, Shankill, Dublin 18	N	Y
Green Area at Rathmichael Lawns/ Rathmichael Woods, Shankill, Co. Dublin	Y	N
Cailma, Dublin Road, Shankill, Co. Dublin	N	Y
Rathmichael School, Shankill, Co. Dublin	Y	Y
Rathmichael School, Shankill, Co. Dublin	Y	Y
Rathbeg Site, Stonebridge Lane, Shankill, Co. Dublin	Y	Y

Address	Permanent Landtake	Temporary Landtake
Northlands, Rathmichael Park, Dublin 18	Y	Y
Kiltuc, Dublin Road, Shankill, Dublin 18	Y	Y
Narrow Meadow, Dublin Road, Shankill, Dublin 18	Y	Y
Carezza, Dublin Road, Shankill, Dublin 18	Y	Y
Saint Annes, Dublin Road, Shankill, Dublin 18	Y	Y
Saint Annes Resource Centre/ Saint Anne's Church, Shanganagh Road, Shankill, Dublin 18	Y	Y
Green area adjacent to Windrush Housing Estate, Shanaganagh Road, Shankill, Dublin 18	Y	N
Green area adjacent to Beechfield Manor Nursing Home, Shanaganagh Road, Shankill, Dublin 18	Y	Y
Green area adjacent to Lavarna, Dublin Road, Shankill, Dublin 18	Y	N
Green area adjacent to Lavarna, Dublin Road, Shankill, Dublin 18	Y	N
Green area adjacent to Saint Benin's, Dublin Road, Shankill, Dublin 18	Y	N
Green area adjacent to Eastbourne, Dublin Road, Shankill, Dublin 18	Y	N
Green area adjacent to Linden, Dublin Road, Shankill, Dublin 18	Y	N
Green area adjacent to Ashdown, Dublin Road, Shankill, Dublin 18	Y	N
Green area adjacent to Costa Coffee Shankill, Shanaganagh Road, Shankill, Dublin 19	Y	Y
Green Area adjacent to Dorney Court Housing Estate, Shankill, Dublin 18	Y	Y
Green Area at Cherrington Road/ Quinn's Road Roundabout, R119, Shankill, Dublin 18	N	Y
Green Area at Quinn's Road/Cherrington Road Roundabout, R119, Shankill, Dublin 18	Y	N
1,2 & 3 Sherrington Lodge, Shankill, Dublin 18	N	Y
Green Area at entrance to Castle Farm Housing Estate, Shankill, Dublin 18	Y	Y
Olcovar Housing Estate, Dublin 18	Y	Y
Green Area at 4, Beech Road Housing Estate, Shankill, Dublin 18	Y	Y
Green Area adjacent to Beech Road Housing Estate, Shankill, Dublin 18	Y	Y

Address	Permanent Landtake	Temporary Landtake
Access to the Barbeque Centre, Dublin Road, Shankill, Dublin 18	N	Y
Crinken Lodge, Dublin Road, Shankill, Dublin 18	Y	Y
Crinken Lane, Dublin 18	Y	Y
Green area at 1, Aughmore Lane, Dublin Road, Shankill, Dublin 18	Y	Y
Plot of land between Aughmore Lane Estate and Allies River Road	Y	Y
Plot of land between Allies River Road and The Orchard Lodge, Dublin Road, Bray, Bray, Co. Wicklow	Y	Y
Shanganagh Park, Shankill, Dublin 18	Y	Y
The Orchard, Dublin Road, Bray, DLRCC	N	Y
Shanganagh Marble and Stone Centre, Dublin Road, Shankill, Dublin	Y	Y
Askefield House, Dublin Road, Bray, DLRCC	Y	Y
Askefield Lodge, Dublin Road, Bray, Co. DLRCC	N	Y
Green Area at Shanganagh Cemetery, Dublin Road, Cork Little, Dublin 18, DLRCC	Y	Y
Beauchamp House, Dublin Road, Bray, DLRCC	Y	Y
Crinken Church, Dublin Road, Bray, DLRCC	Y	Y
Beauchamp Lodge, Dublin Road, Bray, DLRCC	Y	Y
Green Area Adjacent to Beauchamp Lodge, Dublin Road, Bray, DLRCC	Y	Y
Beauchamp Lodge, Dublin Road, Bray, DLRCC	Y	N
Green adjacent to Beauchamp Lodge, Dublin Road, Bray, DLRCC	Y	Y
Green adjacent to Beauchamp Lodge, Dublin Road, Bray, DLRCC	Y	Y
Proposed Woodbrook Housing Estate, Dublin Road, Bray, DLRCC	Y	Y
Woodbrook Estate, Dublin Road, Bray, DLRCC	Y	Y
Woodbrook College, Dublin Rd, Woodbrook Glen, Wicklow, DLRCC	Y	Y
Woodbrook Estate, Dublin Road, Bray, DLRCC	Y	Y
Wilford Cottage, Dublin Road, Bray, DLRCC	N	Y
Wilford House, Dublin Road, Bray, DLRCC	N	Y

Address	Permanent Landtake	Temporary Landtake
Green area at M11 Bray North Roundabout, DLRCC	N	Y
Woodbrook Side Lodge, Dublin Road, Bray, DLRCC	Y	Y
Windsor Bray Renault, Dublin Road, Cork Great, Bray, DLRCC	Y	Y
Green area adjacent to Green area adjacent to Willbrook, 1 Dublin Road, Bray, DLRCC	Y	Y
Green area adjacent to St. Pius, 2 Dublin Road, Bray, DLRCC	Y	Y
Green area adjacent to San Miguel, 3 Dublin Road, Bray, DLRCC	Y	Y
Green area adjacent to Valima, 4 Dublin Road, Bray, DLRCC	Y	Y
Front garden at Meentogues, 5 Dublin Road, Bray, DLRCC	Y	Y
Front garden at Brookvale, 6 Dublin Road, Bray, DLRCC	Y	Y
Front garden at Saint Anthony's, 7 Dublin Road, Bray, DLRCC	Y	Y
Green area adjacent to Sharavogue, 8 Dublin Road, Bray, DLRCC	Y	Y
Green area adjacent to, 9 Dublin Road, Bray, DLRCC	Y	Y
Green area adjacent to Derrybawn, 10 Dublin Road, Bray, DLRCC	Y	Y
Green area adjacent to Saint Joseph, 11 Dublin Road, Bray, DLRCC	Y	Y
Green area adjacent to 12 Dublin Road, Bray, DLRCC	Y	Y
Green area adjacent to Saint Goretti, 13 Dublin Road, Bray, DLRCC	Y	Y
Green area adjacent to 14 Dublin Road, Bray, DLRCC	Y	N
Green area adjacent to 14 Dublin Road, Bray, DLRCC	N	Y
Paved Area infront of shops at St. Peters Road/ Dublin Road junction, Bray, DLRCC	N	Y
AXA Insurance - Bray Branch, Dublin Road, Cork Great, Bray, DLRCC	Y	Y
Circle K Bray, Dublin Road, Cork Grreat, Bray, DLRCC	Y	Y
Area infront of Lidl, Industrial Yarns Complex, Dublin Road, Cork Great, Bray, Co. Dublin, Co. Wicklow/ DLRCC	Y	Y
Thin strip of land (cycle track) at Dublin-Wicklow Border, Dublin Road, Bray, Co. Wicklow	Y	Y

Address	Permanent Landtake	Temporary Landtake
North Wicklow Educate Together Secondary School, Dublin Road, Ravenswell, Bray, Co. Wicklow	Y	Y
Old Everest Centre Site, Bray Co. Wicklow	Y	Y
Dargle Shopping Centre, Castle Street, Bray, Co. Wicklow	Y	Y
Development Site at Castle Street, Bray, Co.Wicklow	Y	Y
79 Castle Street, Bray, Co. Wicklow	N	Y
Castlestreet Shopping Centre, Ravenswell, Bray, Co. Wicklow	Y	Y
Plot at Revenswell, Main Street, Bray, Co. Wicklow	Y	Y

13.4 Demolition, if any

There is a requirement for demolition of existing infrastructure along the extents of the Proposed Scheme, these are listed below:

- The Side Lodge at the Woodbrook Estate, south of Wilford Roundabout will require demolition based on current design (Chainage A17480)
- Part of the forecourt of the Circle K petrol station at North Bray (Chainage A 17850)

All existing boundary walls and railings will be removed and replaced as part of the works listed in **Section 13.5**.

All reasonable precautions to prevent pollution of the site, works and the general environment including streams and waterways will be taken. All demolition waste to be segregated and, where practicable, sent for recycling. All in accordance with guidelines as set out by the National Construction and Demolition Waste Council (NCDWC).

A waste management plan following guidelines as set out by the NCDWC shall be produced outlining the proposals with respect to waste recycling, segregation and details of landfill proposals with target percentage of each element. The following legislation should be noted:

- Protection of the Environment Act 2003;
- Waste Management (Amendment) Act 2001;
- Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste;
- EU Council Decision on Waste Acceptance (2003/33/EC);
- WMA Amendment Act (#2) 2001;
- Protection of the Environment Act No. 27 2003;
- Best practice Guidelines on the preparation of Waste Management Plans for Construction and Demolition Waste; and
- Department of Environment, Heritage and Local Government July 2006.

13.5 Summary of Accommodation Works and Boundary Treatment

The locations for proposed new boundary treatments along the Proposed Scheme have been shown on the SPW_BW Fencing and Boundary Treatment Plans located in **Appendix B**.

For boundary treatment requirements the following criteria has been used to calculate the area of temporary land take needed during construction:

- Walls - Typically 2m working room offset for temporary land take;
- Fences - Typically 2m offset for temporary land take;
- Significant retaining walls –There are no significant retaining walls within this scheme; and
- Specific structures (bridges etc) –There are no specific structures within this scheme that require temporary land take.

To maintain the character and setting of the Proposed Scheme, the approach to undertaking the new boundary treatment works along the corridor is replacement on a 'like for like' basis in terms of material selection and general aesthetics unless otherwise noted on the drawings.

Modifications to driveways and entrances will be in line with DCC's Parking Cars in Front Gardens Advisory Booklet. The basic dimensions to accommodate the footprint of a car in the front garden are 3m x 5m and a vehicular opening would typically be between 2.5m and 3.6m in width though this may need to be widened to allow for sightlines and manoeuvrability.

Existing gates will be reused where possible however considerations will be required for the use of bifold/roller gates to mitigate impacts on parking in driveways.

Where cellars and private landings are affected by the Proposed Scheme, 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.

There are a number of areas along the extents of the Proposed Scheme that will result in the requirement for accommodation works. Liaison has taken place with landowners to understand existing property/land usage and potential impacts at affected sites. Careful consideration has been given to urban realm improvement opportunities where appropriate. Detailed accommodation works proposals will be discussed and agreed with each individually affected landowner. Areas where significant accommodation works are required are outlined below.

Circle K, Fastfit, Firststop, Donnybrook

Reconfiguration of the car park area is proposed at the Fastfit and Firststop, Donnybrook to minimise space loss due to the proposed cross-section widening.

Coláiste Eoin

A two-way cycle track connection and local footway widening is included within the scheme proposals to improve access from the Merrion Grove junction to Coláiste Eoin and to address a local footway pinch point at the existing pedestrian bridge access stairs. Accommodation works are proposed within the school grounds to connect the external cycle track tie-in to the main school cycle routes.

St Anne's Church, Shankill village

Accommodation works are required at the church grounds to accommodate the proposed cross section widening. Wider accommodation works can also be undertaken within the church grounds to minimise parking loss and also improve the urban realm at this location. This is discussed in further detail in **Section 14.7.**

The Side Lodge at the Woodbrook Estate, south of Wilford Junction, Dublin Road, Bray

The proposed cross-section widening south of Wilford Junction will require the demolition of the Woodbrook Side Lodge, which is part of the Woodbrook Estate. Proposed reinstatement works include the rebuild of the Side Lodge in a similar style to that of the existing property while adopting current building regulations. The new building position is such that tree impacts are minimised and accommodates a bell mouth entrance to the driveway and an entrance driveway that allows vehicles to turn within the plot. A new boundary wall is proposed to relocate pedestrian and vehicle openings and re-use the existing stone piers. Re-use of some materials such as roof slates, bricks, chimney pots and bargeboards is proposed where appropriate. The Side Lodge proposals are included in **Appendix R.**

AXA Bray, at Corke Abbey Avenue/Dublin Road Junction, Bray

Reconfiguration of the car park area is proposed at AXA Bray to minimise space loss due to the proposed cross-section widening. As part of these works, the entrance to the car park will be relocated further east on Corke Abbey Avenue to tie into the proposed junction works at Corke Abbey Avenue/Dublin Road.

Circle K site, Dublin Road, Bray

The proposed cross section widening at Circle K in Bray will result in the requirement to partially demolish the forecourt area. Accommodation works will be required to reconfigure the site as a result. The Circle K proposals are included in **Appendix S.**

Windsor Motors, Bray

The proposed cross-section widening at Windsor Bray, will result in demolition of the existing boundary wall and the font car display area. Accommodation works will be required to reconfigure the site as a result.

The Dargle Centre, Castle Street, Bray

Reconfiguration of the car park area is proposed at the Dargle Centre in Bray to minimise space loss due to the proposed cross-section widening.

Castle Street Shopping Centre, Castle Street, Bray

Reconfiguration of the car park area is proposed at Castle Street Shopping Centre in Bray to minimise space loss due to the proposed cross-section widening. It is also proposed to change the shopping centre access on to the Lower Dargle Road from two-way to one-way to accommodate the widened cross section and avoid residential land take impacts on the eastern side of Castle Street.

Relocation of Existing Entrances

Entrance at 118 Stillorgan Road will be retained for pedestrian and cyclists only and entrance at Hennessy Motors, N11 is proposed to be closed where their existing location opens on to the junction. Both of these properties have alternative existing vehicular entrances which will be retained. The entrance to Beauchamp Lodge at Woodbrook Downs, south of Shankill village is proposed to be relocated from the Dublin Road to Woodbrook Downs to provide safe access to the property following construction of the proposed protected junction at the new Woodbrook Strategic Housing development.

The remainder of accommodation works across the scheme consist of boundary treatments and tie-ins to the existing road layout.

14. Landscape and Urban Realm

14.1 Overview of Landscape and Urban Realm

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 commute to/from work. The Urban Realm encompasses all streets, squares, junctions, whether in residential, commercial or civic use. When well designed and laid out with care in a community setting, it enhances the everyday lives of residents and those passing through. It typically relates to all open-air parts of the built environment where the public has free access. It would include seating, trees, planting and other aspects to enhance the experience for all. Successful urban realms or public open space tend to have certain characteristics.

- They are welcoming and apealing;
- They have a distinct identity;
- They are safe and pleasant;
- They are easy to move through.

The following are the key policy and strategy documents that have been considered as guidance in developing the proposals for the BusConnects landscape and urban realm proposals.

The Dublin City Development Plan 2022-2028 is the county level planning framework applicable to the section of the Proposed Scheme south of the Santry Avenue.

- Chapter 9 Sustainable Environmental Infrastructure and Flood Risk includes Policy SI22 to use SuDS in all new developments where appropriate, as set out in the Greater Dublin Regional Code of Practice for Drainage Works.
- Chapter 10 Green Infrastructure and recreation includes Objective GI08 to support the implementation of the Dublin City Biodiversity Action Plan 2021- 2025 and reflects the Strategic Objectives of Ireland's National Biodiversity Plan (Actions for Biodiversity 2017-2021).
- Chapter 10 Green Infrastructure also includes the Dublin City Tree Strategy 2016-2020 incorporating a set of policies for the long-term promotion and management of public trees in Dublin and Objective GI40 to identify opportunities for new tree planting.

Dublin City Tree Strategy 2016-2020

A set of policies for the long-term promotion and management of public trees in Dublin. "Within the city, trees clean the air, provide natural flood defences, mask noise and promote a general sense of wellbeing".

Dublin City Biodiversity Action Plan 2021-2025

Covers all areas of the City including roadsides and footpaths and reflects the Strategic Objectives of Ireland's National Biodiversity Plan (Actions for Biodiversity 2017-2021)

- Strengthen the knowledge base of decision makers to protect species and habitats;
- Strengthen the effectiveness of collaboration between all stakeholders for the conservation of biodiversity in the greater Dublin region;
- Enhance opportunities for biodiversity conservation through green infrastructure and promote ecosystem services in appropriate locations throughout the City; and
- Develop greater awareness and understanding of biodiversity and identify opportunities for engagement with communities and interest groups.

14.2 Consultation with Local Authority

Consultation has taken place with DCC, DLRCC and WCC throughout the design process. Stakeholders and statutory bodies including the OPW have been consulted through the process as well as through the Public Consultations and various scheme presentations.

14.3 Landscape and Character Analysis

The landscape and urban realm proposals are derived from analysis of the existing urban realm, including existing character, any heritage features, existing boundaries, existing vegetation and tree planting, and existing materials. The following document BusConnects Dublin - Urban Realm Concept Designs, https://busconnects.ie/media/2089/busconnects-urban-realm-concept-designs.pdf, was also used as guidance in developing the proposals. For each section of the route, a broad overview of typical dwelling age and style, extents of vegetation and tree cover was undertaken. The predominant mixes of paving types, appearance of lighting features, fencing, walls, and street furniture was considered. The purpose of this analysis was to assess the existing character of the area and how the Proposed Scheme may alter this. The outcome of the analysis allowed the urban realm design to consider appropriate enhancement opportunities along the route. The enhancement opportunities include key nodal 'Potential Development Opportunities which focus on locally upgrading the quality of the paving materials, extending planting, decluttering of streetscape and general placemaking along the route. These areas are further discussed in **Section 14.7**

Where possible, a SuDS approach will be taken to assist with drainage along the route. SuDS principles will be used as much as possible to deal with run-off at, or close to, the surface where rainfall lands.

14.4 Arboricultural Survey

14.4.1 Scope of Assessment

An Arboricultural Impact Assessment Report identified the likely direct and indirect impacts of the Proposed Scheme along with suitable mitigation measures, as appropriate. The Tree Protection Plan identified trees to be removed, and the Arboricultural Method Statement set out how retained trees are to be successfully protected. A copy of the report has been provided in **Appendix D** and the inputs from the report have been incorporated in the Landscaping Drawings in **Appendix B.**

The assessment was informed by an extensive tree survey prepared by John Morris Arboricultural Consultancy (JMAC) (ref: 20-092-03), based on the requirements of BS5837:2012 Trees in relation to design demolition and construction – Recommendations (BS5837).

The Arboricultural Impact Assessment set out the likely principal direct and indirect impacts of the Proposed Development on the trees on or immediately adjacent to the Site, and suitable mitigation measures to allow for the successful retention of significant trees, or to compensate for trees to be removed, where appropriate.

The report considered the following:

- Description of the site/route and summary of the trees surveyed;
- Summary of any statutory or non-statutory designations affecting trees within the survey area;
- 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;
- Schedule of surveyed trees and key;
- Recommendations for tree works and incursions related to the proposed development; and
- Tree constraints plans.

14.5 Hardscape

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 scheme 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 Typical Material Typologies

Through the process of developing the Preliminary Design a typology and palette of proposed materials was developed to create a consistent design response for various sections of the route. The proposed materials were based on the existing landscape character, existing materials, historical materials while also identifying areas for betterment through the use of higher quality surface 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 without a kerb, can have neatly trowelled edges and textured surface for a clean, durable, slip resistant surface;
- **Asphalt footpath** - Widely used on existing footpaths and will tie in with other sections of public realm. Laid with a road kerb, can have a smooth finish or textured aggregate surface, provides a strong flexible slip resistant surface. Opportunities to retain good quality kerbs have been explored and tie-in points considered;
- **Precast concrete unit paving** - Either concrete paving slabs or concrete block, there is a very wide variety of sizes and colours available to provide an enhanced public realm. The use/reuse of granite kerbs where appropriate will further enhance the public realm. This type of material use is mostly employed in non-inner-city public realm enhancements;
- **Natural stone paving** - Employed for high quality urban realm areas, mostly in city centre locations. This typology represents natural stone surface treatments such as granite and are used to create enhanced public spaces for major urban realm interventions;
- **Stone or Concrete setts** - Proposed for distinguishing pedestrian crossing points either on raised table or at road level;
- **Self-binding gravel** - Proposed for pedestrian paths set away from the road expected to see less traffic. Used for natural areas, for example, paths through wildflower meadows. They provide a defined informal route as an alternative to asphalt or concrete; and
- **No change** - In addition to areas with proposed material changes, there were also areas identified where no change in materials would be required. For example, where pavement has recently been laid and is in good condition. The design also explores opportunities where good quality kerbs such as granite kerbs could be re-laid in the same location, which would have both cost and sustainability advantages.

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.

14.6 Softscape

14.6.1 Tree Protection and Mitigation

The first priority of the landscape strategy is to protect existing trees along the route. Where practicable, the initial conservation of existing biodiversity has been considered. The arboricultural survey identified the quality of existing trees. The information was overlaid on the proposed routes to inform the design process. The impact of roadworks will be minimised near existing trees by utilising no-dig construction as described in **Appendix D.** Review and re-design of the alignment and extent of proposals through sensitive areas has minimised the loss of high-quality trees.

The following key areas were identified as potential conflicts and the road layout was reconfigured to preserve as many trees as possible.

- Along Morehampton Road, the alignment and arrangement of components was refined to minimise the loss of quality trees;
- Where the scheme passes Cherrington Drive, a dedicated bus lane was dropped as the retention of high quality trees was the priority through this narrow section;
- Along Dublin Road between Shanganagh Park and Wilford Roundabout, following consultation with stakeholders, the route alignment was adjusted to minimise the impact on trees. The area in the vicinity of Woodbrook Downs focuses tree removals predominantly to the east in order to retain screening and structure along the west side;
- The junction at Upper Dargle Road was amended to retain a prominent, mature tree that contributes to the local landscape character.

14.6.2 Tree Loss and Mitigation

Despite the best efforts to protect trees, especially trees of a mature and significant stature there will be inevitable impacts on local trees. In total it is estimated that there will be 331 trees lost and 26,987m2 of woodland area removed, refer to **Table 14-1** below. This loss has been addressed through mitigation and replanting efforts as outlined in the planting strategy (**Section 14.6.3**) below resulting in a substantial tree planting plan with a net increase of 224 additional semi-mature tress and 22,834m2 of woodland area along the Proposed Scheme.

Table 14-1: Summary of Trees Retained, Removed and Proposed as part of the BusConnects Route (excludes category U trees)

Individual Trees				
Do Minimum	Do Something	Do Something Removed tree count	Do Something	Do Something Total tree count
Tree Count	Total retained tree count		New tree count	
1384	1025	359	551	1576
Approximate increase in trees within the development area of approximately 14% along proposed scheme				
Woodland Trees				

Do Minimum Tree area (m^2)	Do Something Total Retained Woodland Tree Area (m^2)	Do Something Removed Woodland Tree Area (m^2)	Do Something New Woodland Tree Area (m^2)	Do Something Total Woodland Tree Area (m^2)
166,957	147,771	19,246	4,153	151,924
Approximate decrease in woodland planting within the development area of approximately 9.0% along proposed scheme				

14.6.3 Planting Strategy

The planting strategy has been developed to meet the objectives of the Proposed Scheme and the needs of the Dublin City Tree Strategy and the Dublin Biodiversity Action Plan. The strategy aims to influence the local environment to improve amongst others: air quality; stormwater runoff; health and well-being; and habitat provision.

- Opportunities have been identified to enhance biodiversity through green infrastructure.
- The scheme promotes the role of street trees planting consistent with the recommendations of the Dublin City Tree Strategy.
- SuDS opportunities have been developed within the scheme in coordination with the drainage engineers. (Refer the Drainage, Hydrology and Flood Risk section of this report).

14.6.4 Typical Planting Typologies

Several typologies were developed to address the above issues. Details of the proposed tree species and planting regime are provided on the ENV_LA Landscaping General Arrangement Drawings. Additional information on suitable plant species is also provided in **Section 14.6.5.**

14.6.4.1 New Street Trees

A variety of new tree species and sizes appropriate for their location are to be planted in urban tree pit systems to allow for protection of the soil structure and allow for good root development. (See example

Figure 14.1 below.)

Figure 14.1: Example of New Tree Planting in an Area of Public Realm.

14.6.4.2 Central Median Planting

Central median planting varies depending on the context of the landscape character and road. Dual carriageways or wide roads to the edge of settlements are more likely to have wider central medians where tree planting and grass verges can be found. A combination of tree and shrub/or species rich grassland is possible to create a formalised corridor of planting within wide a wide section of road.

Figure 14.2: Example of Tree Planting Within Species Rich Grassland

14.6.4.3 Native Planting / Tree Planting

In some locations, edges of existing wooded and native planted areas have been encroached by road widening. There will be replanting of native trees and understorey shrubs to repair these woodland edges. (See example **Figure 14.3** below).

Figure 14.3: Example of Native Planting Group on Highway Verge

14.6.4.4 Boundary Planting Associated with Commercial and Community Land Use

The interfaces with these types of land use vary across the scheme from verges adjacent to industrial units, retail frontages, schools, medical centres, churches, and golf course boundaries. The primary function of planting along these boundaries is to enhance the visual setting of these buildings and spaces whilst creating containment and a buffer between adjacent functions. Proposed planting includes linear tree belts, tree avenues and more informal tree groupings in combination with species rich grassland and SUDS features. (See example **Figure 14.4** below).

Figure 14.4: Example of Commercial Boundary Planting

14.6.4.5 Key Areas of Public Realm

Intermittently throughout the scheme there are several key community and civic spaces where small landscape interventions are proposed. These spaces contain formal planting arrangements including large semi mature street trees, raised planting beds, seating, public art and play spaces. (See example **Figure 14.5** below).

Figure 14.5: Example of Key Public Realm Spaces

14.6.5 Tree Species list

The proposed tree species, sizes and spacings are indicative of the design intent and subject to availability and further ground investigation at detail design stage.

Table 14-2: Proposed Tree Species

Species - Scientific name	Common names in English - Irish	Size
Acer campestre	Field maple	8-10
Acer platanoides 'Emerald Queen'	Norway maple	14-16
Acer platanoides	Norway maple	14-16
Acer pseudoplatanus	Sycamore	10-12, 12-14
Acer rubrum	Red maple	14-16
Aesculus x carnea 'Brioti'	Red horsechestnut	12-14
Betula pendula	Silver birch / Beith gheal	12-12, 14/16, MS
Betula pendula Jacuemontii	Himalayan Birch	14-16
Carpinus betulus	Hornbeam	12-14
Castanea satvia	Sweet chestnut	14-16
Corylus colurna	Turkish hazel	14-16, 20-25
Crataegus monogyna	Hawthorn	8-10
Fagus sylvatica	Beech	10-12, 14-16
Junglans nigra	Black walnut	16-18
Junglans regia	English walnut	16-18
Liquidambar styraciflua	Sweet gum	14-16
Platanus x hispanica	London plane	14-16
Pinus nigra	Black pine	20-25
Pinus radiata	Monterey pine	250-300cm
Pinus sylvestris	Scotts pine	300-350cm
Populus nigra	Black poplar	12-14
Prunus avium 'Plena'	Wild cherry (double gean)	14-16
Prunus avium	Wild cherry	10-12
Prunus padus	Bird cherry	12-14
Prunus serrula	Tibetan cherry	200-250cm MS
Pyrus calleryana 'Chanticleer'	Ornamental pear	14-16
Quercus Ilex	Holm oak	18-20
Quercus petraea	Sessile oak	14-16
Quercus robur 'Fastigiata'	English oak (upright)	14-16, 18-20
Quercus robur	English oak	10-12, 14-16

Species - Scientific name	Common names in English - Irish	Size
Sorbus aria 'Majestica'	Whitebeam	14-16
Sorbus aucuparia 'Streetwise'	Rowan - Caorthann	18-20
Sorbus aucuparia	Rowan - Caorthann	12-14
Sorbus torminalis	Wild service tree	10-12
Taxus baccata	Yew	150-175cm
Tilia cordata 'Green Spire'	Small leaved lime (upright)	14-16, 20-25
Tilia cordata	Small leaved lime	10-12, 14-16
Tilia tomentosa 'Brabant'	Silver lime	14-16
Tilia tomentosa	Silver lime	14-16
Ulmus 'New Horizon'	Elm (resistant Elm)	12-14, 20-25
Zelkova serrate 'Green Vase'	Green Vase Japanese Elm	14-16

14.7 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.**

14.7.1 Leeson Street Lower to Eustace Bridge

Existing Character: City centre character with four storey buildings with continuous frontages with some pedestrian guardrails. The carriageway is generally wide with minimal pedestrian crossing points. The end of Leeson Street Lower, at the canal, marks a threshold between the city street and inner suburban character. Eustace Bridge junction is a complex and busy area with multiple pedestrian and cycle crossings.

Design Proposals: The aim is to provide an upgraded and consistent urban realm quality along this section. At the northern end of Leeson Street Lower, a new combined coach and local southbound bus stop is proposed. The new kerb alignment results in a resurfaced section of footway. It is proposed to retain the existing kerb line and footways elsewhere along this section. Where the kerb line is to be moved, granite kerbs would be retained and reused where possible. High quality concrete paving is proposed to enhance footways. Priority crossing with concrete setts is proposed to enhance pedestrian priority. The street is to be de-cluttered where possible.

The design proposes public realm improvements to enhance the Eustace Bridge threshold into the City Centre for pedestrians and cyclists. 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 this complex junction. Existing tree surrounds would be widened and surfaced with self-binding gravel. The island at Adelaide Road with the existing café is to be re-designed and surfaced with a new paving layout as part a separate scheme by Dublin City Council. The layout for this location can be seen below in **Figure 14.6.**

Figure 14.6: Proposals Either Side of Eustace Bridge

14.7.2 Leeson Street Upper, Sussex Road

Existing Character: An Inner suburban residential character with a one-way gyratory. A large central median on Leeson Street Upper with existing trees and a sculpture. Leeson Street Upper has significant pedestrian movements which reduce on the approach to Sussex Road. There are two and three storey residential buildings along Leeson Street Upper and Sussex Road, with a small section of four storey residential buildings along part of Leeson Street Upper. Front gardens with numerous trees are present along Leeson Street Upper. Popular pubs, restaurants and retail area at the junction with Sussex Terrace. Standard materials are applied to footways.

Design Proposals: The proposed design is to enhance the footways where works to the kerb alignment are proposed with high quality concrete paving and wide granite kerbs to match existing. Much of the inner footway along the gyratory and Leeson Street Upper will remain unaffected with enhancements focussed on the retail/commercial areas. The existing loading bay on the north side of Sussex Road between the two pubs will be removed to eliminate any safety concerns regarding interactions with the cycle track/bus lane. Loading will be focussed on the bay around the corner on Sussex Terrace. The footway here is proposed to be widened and resurfaced in concrete paving and granite kerbs to create additional space outside the pub and greater protection from passing vehicles. In addition, the existing parking/loading facility on the south side of Sussex Road will be lengthened along with the introduction of low-level planting beds with robust ornamental planting.

The eastern part of Sussex Road will be enhanced with concrete paving to facilitate the extension of the city centre materials into this area, while the consistent use of materials will unify this section. Good quality granite kerbs are proposed to be retained and re-used where possible. The central median island where Leeson Street Upper transitions to Leeson Street Lower, is to be resurfaced in concrete paving where pedestrian movements are, along with granite kerbs to enhance the setting of the existing sculpture and trees. The surfaces surrounding the trees are to be improved by opening it up and surfacing with a self-binding gravel. The general arrangement at this location can be seen in **Figure 14.7 and Figure 14.8**

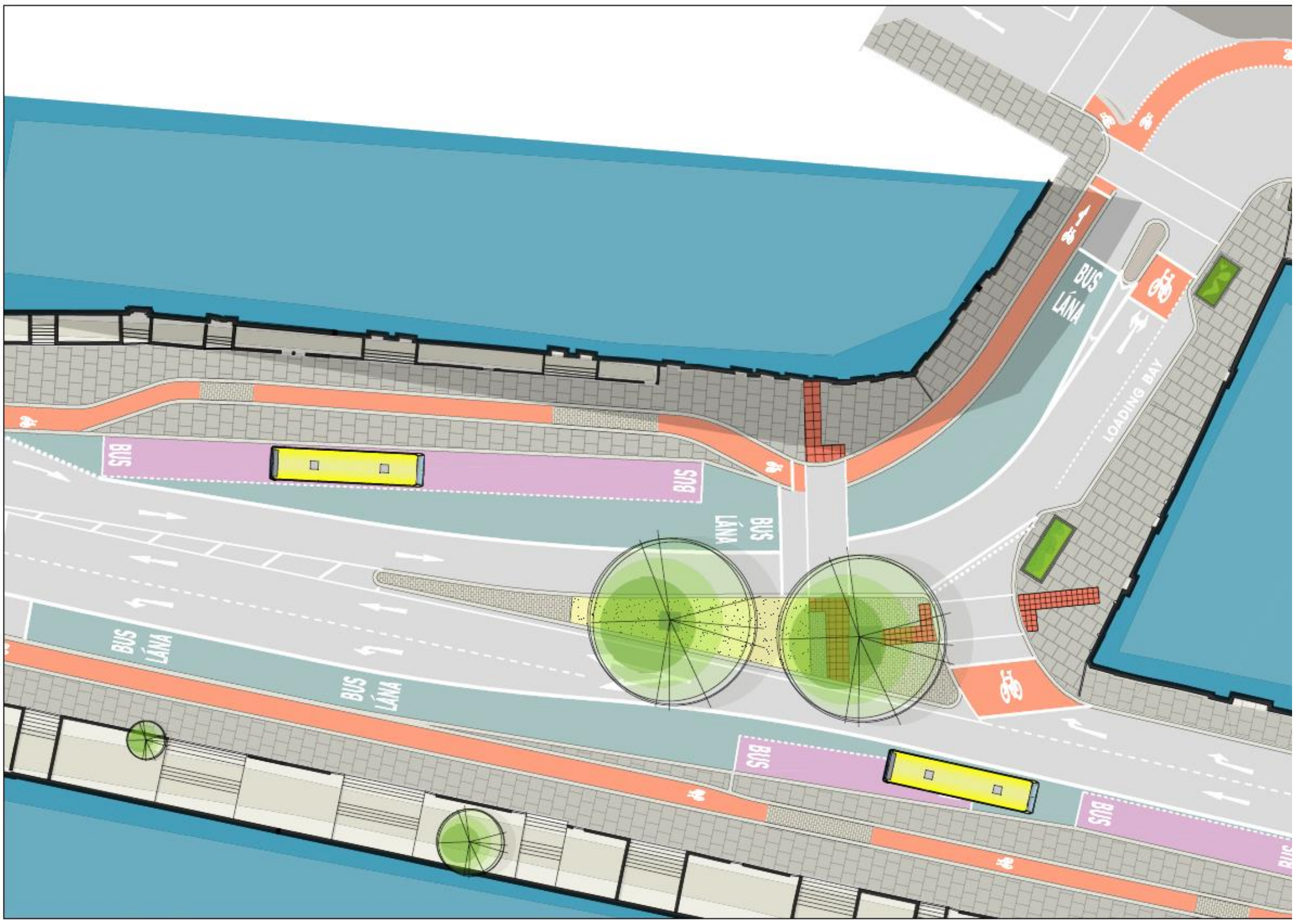

Figure 14.7: The Integration of Dedicated Cycle Lanes and Bus Stop Facilities at Leeson Street Upper

Figure 14.8: Widened and Enhanced Footway near Sussex Terrace

14.7.3 Leeson Street Upper to Wellington Place

Existing Character: This section is predominantly inner suburban residential in character with front gardens, hedges and mature street trees. It is dominated by vehicular movements with limited active frontages. There is a listed building in this section. Standard concrete materials are applied along footways.

Design Proposals: Proposed footways are predominantly poured concrete with concrete kerbs to match the existing in order to unify footway materials. Pedestrians are given greater priority at side road crossings with raised sections in concrete setts to enhance pedestrian access. In places, driveway cross overs are also treated in concrete setts to differentiate the use of the space. Additionally, there will be a change in the surface material of the cycle track to concrete setts, where the location coincides with pedestrians boarding and alighting buses at the designated stop. This applies throughout the route.

A new local intervention is proposed at the junction of Wellington Place to enhance the local character and contribute to the wider ecological value of the area in relation to Morehampton Road Wildlife Sanctuary. This is also proposed as a SuDS area with medium to large scale trees and species-rich grass. Poured concrete footways are proposed to match existing with a driveway crossover detail in concrete setts. Existing tree surrounds would be widened and surfaced with self-binding gravel. The general arrangement at this location can be seen in **Figure 14.9**

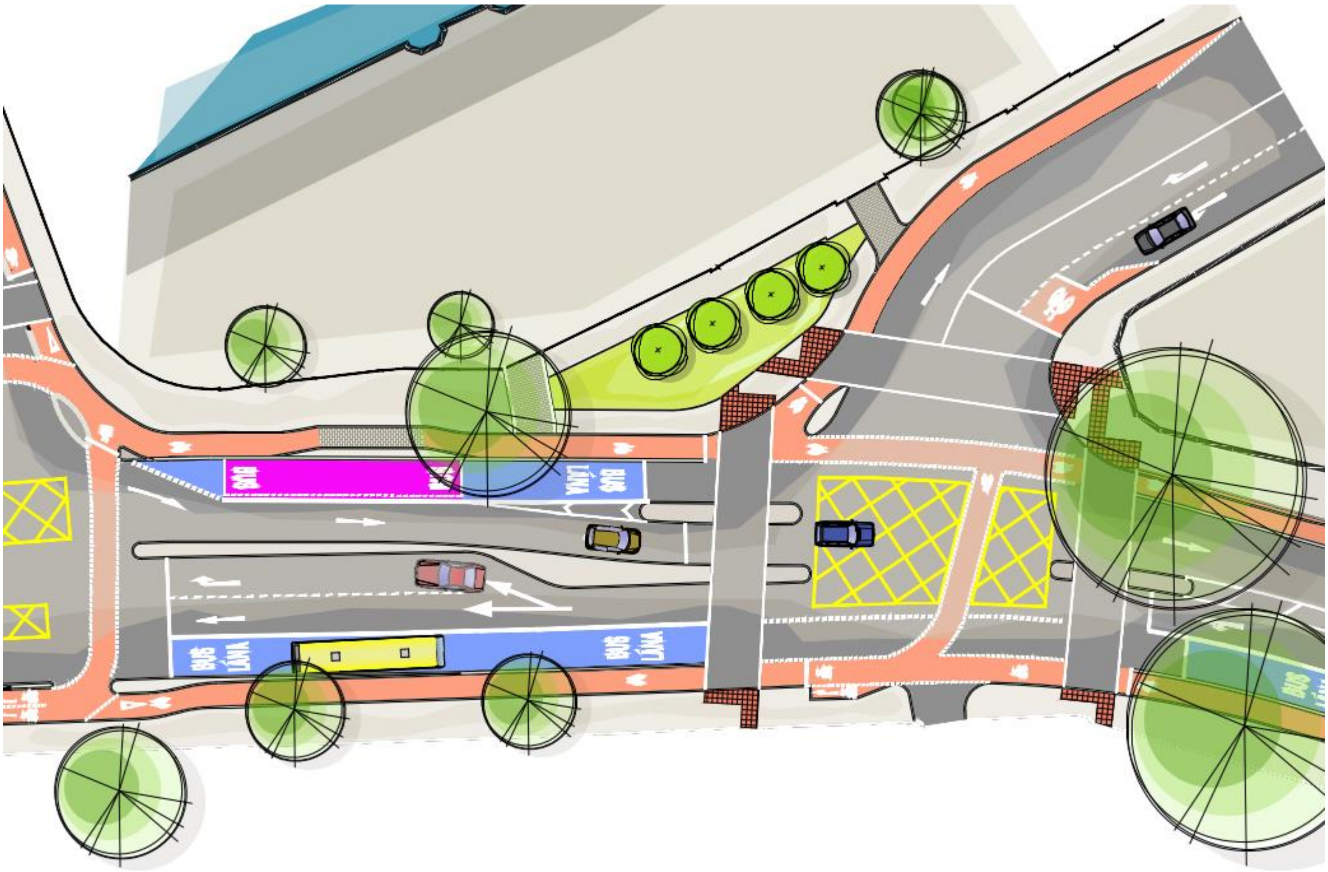

Figure 14.9: Wellington Place Local Area Enhancement

14.7.4 Morehampton Road - Wellington Place to Victoria Avenue

Existing Character: This avenue is predominantly residential in character with two and three storey buildings with front gardens and hedges. Significant mature trees line this section of road on either side. There is some on street parking and footways consisting of poured concrete and concrete kerbs. A local retail area is well used near Herbert Park Junction.

Design Proposals: In order to retain as many high-quality existing trees as possible, a narrower footway/cycle track is proposed for short sections whilst passing the trunk of the tree in this area. There are some unavoidable tree losses on the north side of Morehampton Road, but the existing tree cover within adjacent private properties is strong and contributes to the street scene.

Opportunities for new street tree planting have been incorporated where possible and the existing tree surrounds are proposed to be widened and surfaced with self-binding gravel. The proposals are for footways to be poured concrete/concrete paving slabs (depending on location), with concrete setts at driveway crossovers and raised pedestrian crossings with concrete kerbs and edges.

The coach parking arrangement close to the Hampton Hotel ensures the retention of existing high-quality trees on the south side. The general arrangement at this location can be seen in **Figure 14.10 and Figure 14.11**

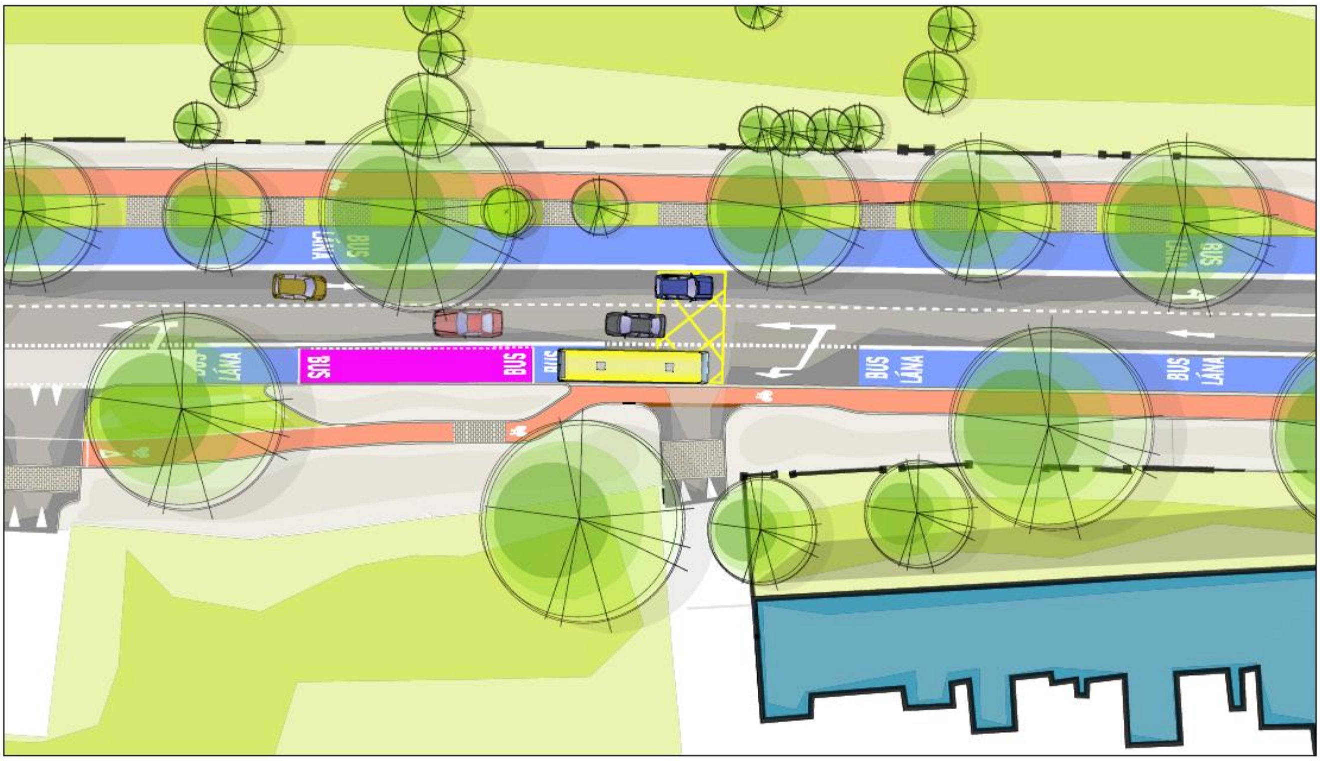

Figure 14.10: Morehampton Road Showing Retained Access to Driveways and Retention of High-Quality Trees

The local retail area near Herbert Park junction is proposed to be enhanced with high quality concrete paving and granite kerbs. Existing trees are retained where possible with enhancements to the tree surrounds by opening them up by removing the paved material laid right up to the trunk. Priority crossings are proposed over side streets in concrete blocks/setts.

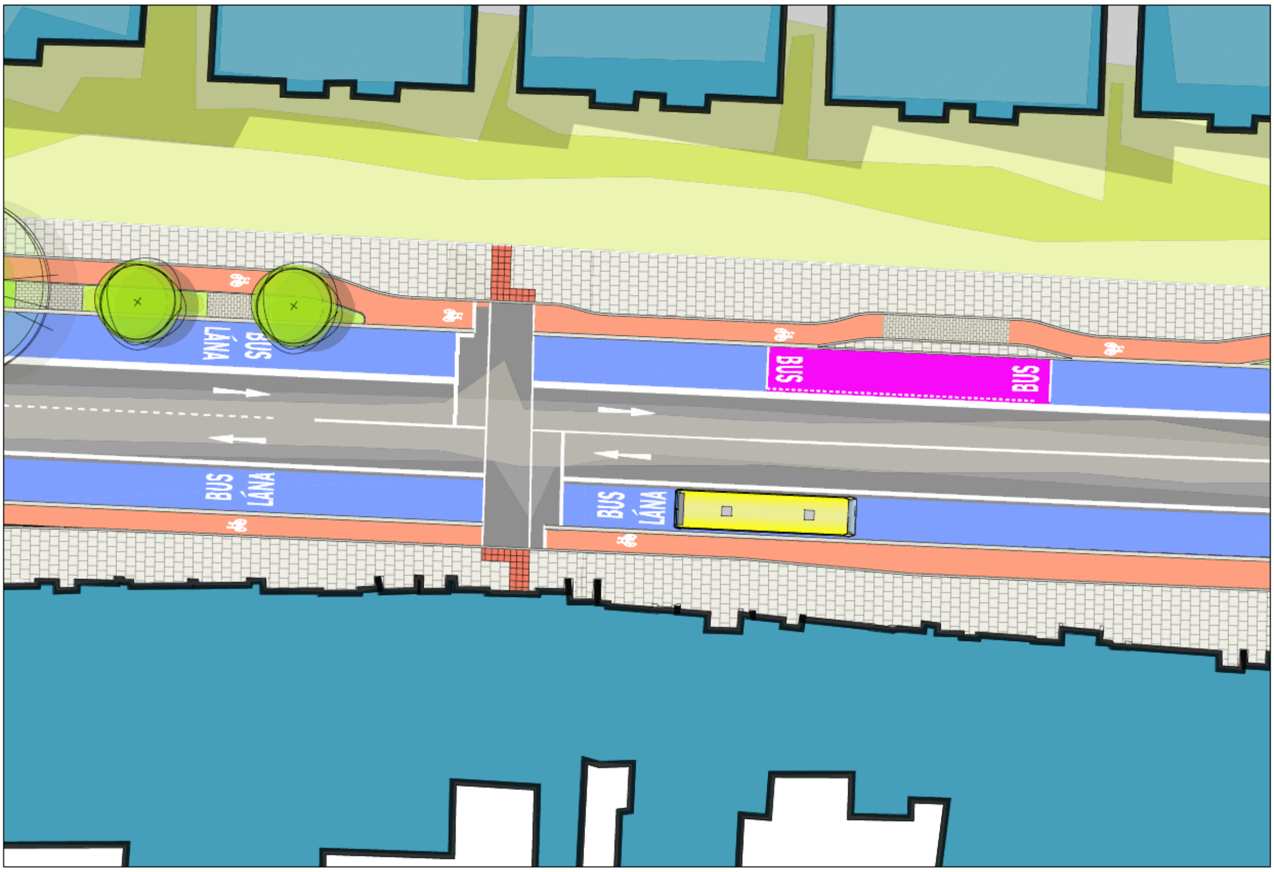

Figure 14.11: Morehampton Road Near Herbert Park Junction

14.7.5 Donnybrook Road – From Victoria Avenue to Eglinton Road

Existing Character: This section of Donnybrook Road is a local retail centre with other mixed-use buildings. There are predominantly two and three storey buildings many offering active edges to the street. The wide carriageway dominates the area with limited pedestrian crossing points. Significant parking is available along retail frontages. High quality mature trees make a significant contribution to the character of this area.

Design Proposals: The retail centre is proposed to be enhanced with concrete paving slabs and granite kerbs. To ensure the existing important trees are retained and for safety to cyclists, the northbound cycle path is routed to the front of the trees where the existing footway is wide. The tree surrounds are enhanced by opening out and surfacing with self-binding gravel. The general arrangement at this location can be seen in **Figure 14.12**

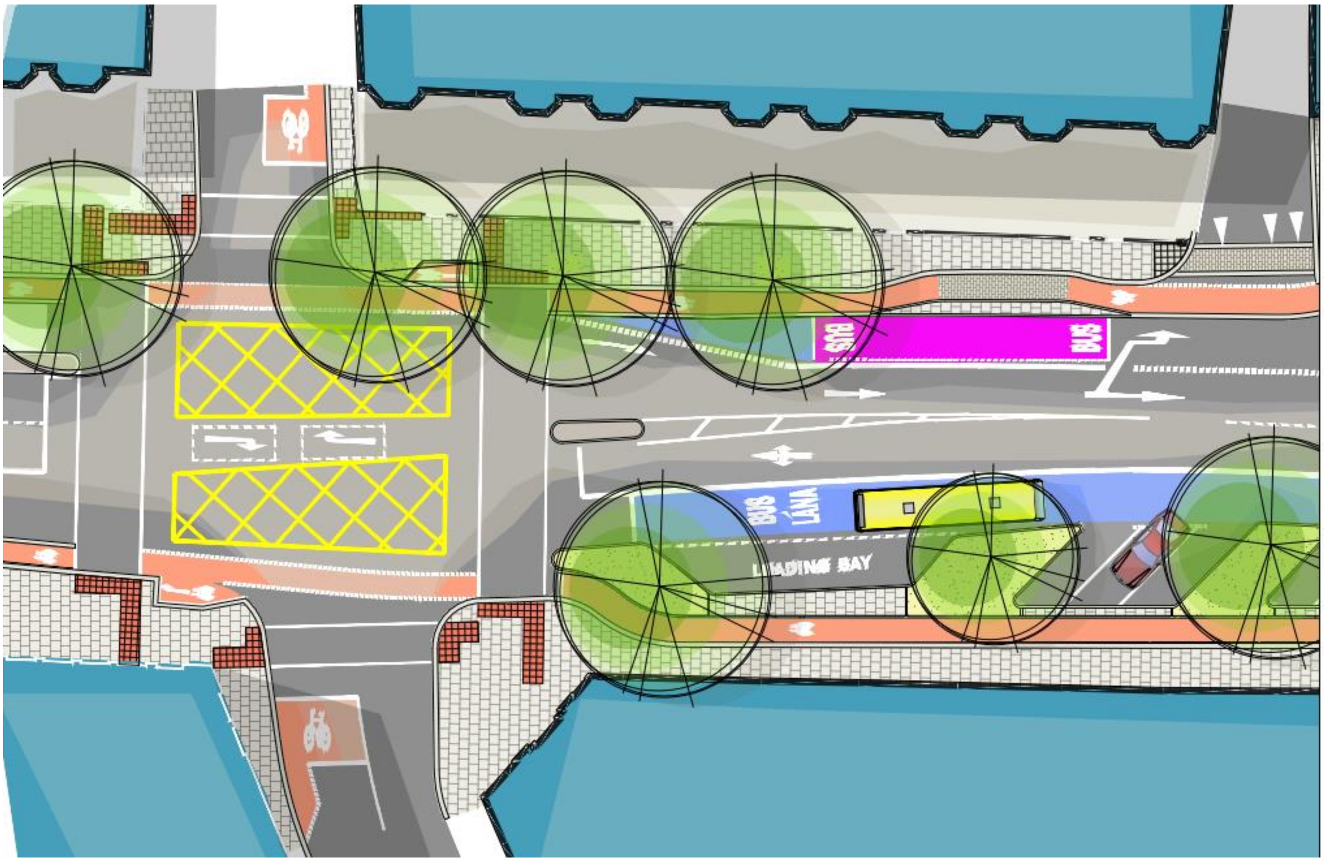

Figure 14.12: Donnybrook Retail Area

The retail area near Mulberry Lane is proposed to be enhanced with an extended area of concrete paving slabs and blocks with granite kerbs. New street trees are proposed with raised seating surrounds. 'Driveway' style crossover in concrete setts increase the priority for pedestrians. Parking provision decreases and is switched from perpendicular to parallel to the carriageway, allowing the cycle path to be routed to the inside away from the opening of car doors.

The existing public area near The Crescent is retained and the existing paving tied-in to accommodate the new road alignment. The Crescent carriageway would be raised to create a shared surface from the car park. Granite kerbs are retained and re-used where possible. The general arrangement at this location can be seen in **Figure 14.13**

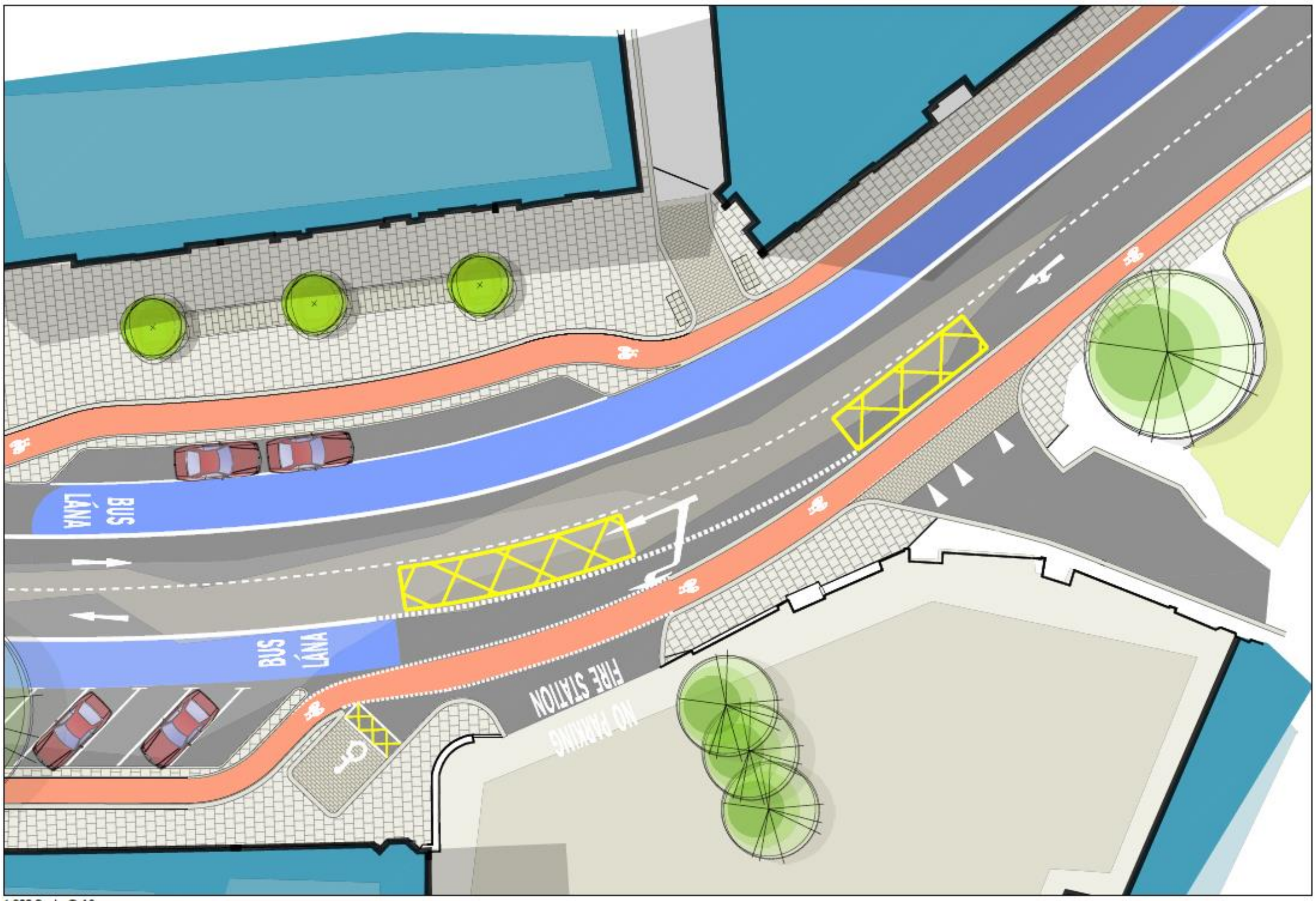

Figure 14.13: Donnybrook Retail Area, Mulberry Lane

14.7.6 Donnybrook Road - Eglinton Road to Stillorgan Road

Existing Character: An inner suburban mixed-use character area. Energia Park is a local landmark with a high boundary wall edge along Donnybrook Road. The road is relatively wide road through this section with minimal public realm amenity.

Further south, Donnybrook Parish Church is another notable local landmark with mature trees along its boundary.

Design Proposals: The area is enhanced with the same concrete paving and granite kerbs materials of Donnybrook retail centre extended as far as the Eglinton Terrace junction at the Energia Park entrance. Rampart Lane access is proposed to be resurfaced in concrete blocks to create a shared surface with a planting bed at the entrance with seating surrounds. Eglinton Terrace junction is narrowed to create a more pedestrian footway space and features concrete paving with granite kerbs. Granite paving is applied to the footway at the entrance to Donnybrook Cemetery. The parking area in front of a parade of cafes/shops opposite the entrance to Energia Park is realigned and resurfaced in concrete blocks. This reinforces the message that the space is used by both pedestrians and vehicles. 7 'short stay' places spaces are retained fronting the building line with an additional paved area created for outdoor seating. The footways to the periphery are surfaced with concrete paving and granite kerbs. Energia Park entrance is enhanced with concrete setts and granite kerbs. The general arrangement at this location can be seen in **Figure 14.14**

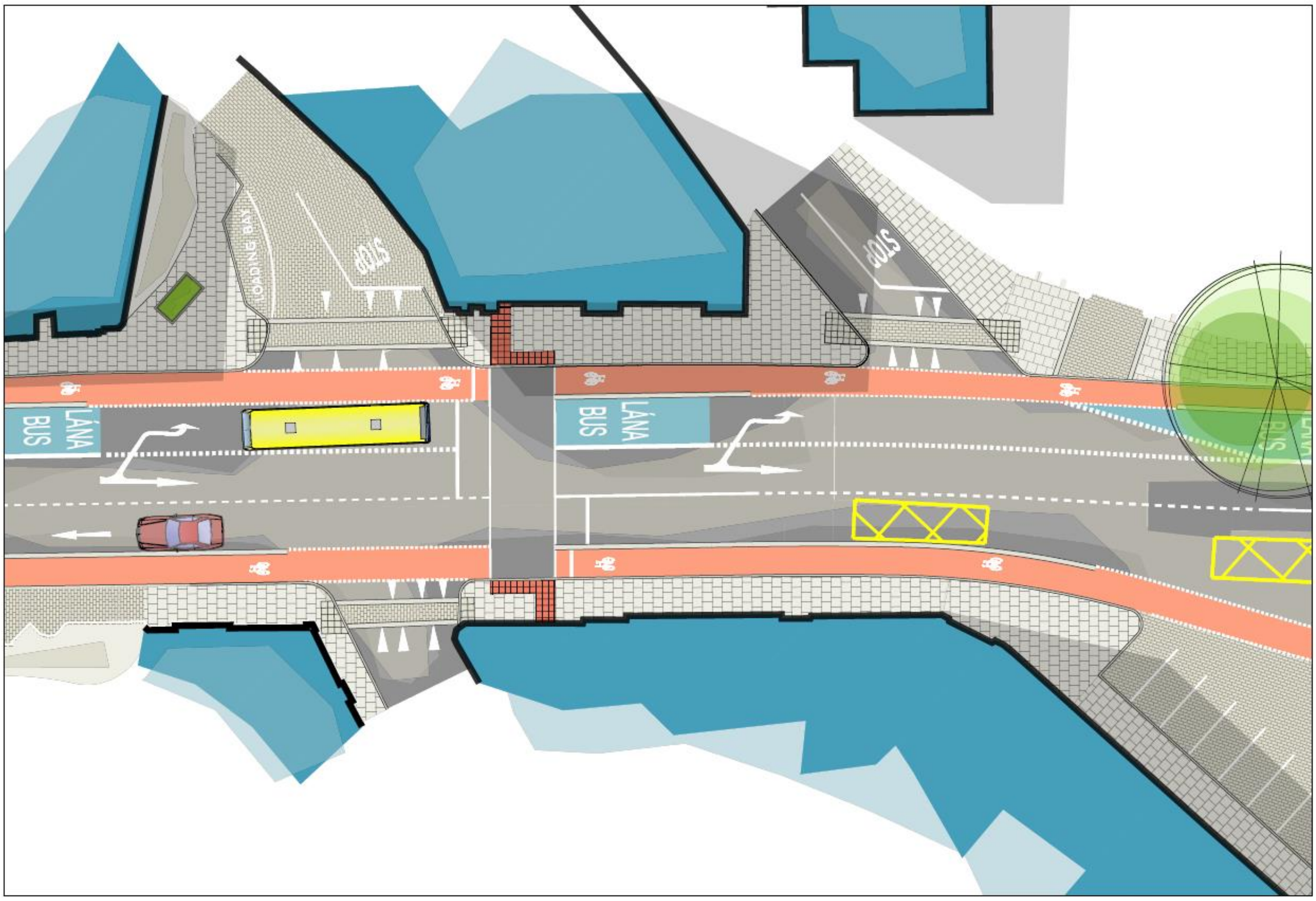

Figure 14.14: Donnybrook Road, Rampart Lane and Eglinton Terrace Junction Enhancements

The kerbs and footway alignment along the Energia Park frontage are to be retained with the trees remaining unaffected. New poured concrete footways are proposed along the western section. Concrete paving and granite kerbs are proposed to enhance the bus stop area near Eglinton Road. Concrete paving and concrete kerbs on Anglesea Bridge at future interface with Dodder Greenway are to be considered in further design stages. Poured concrete footways by Donnybrook Parish Church will match the existing, with the 'Welcome' sign retained in the median.

14.7.7 Stillorgan Road – Anglesea Road to UCD campus

Existing Character: Wide Arterial Road. Standard footway materials which are mostly poured concrete. An existing cycle lane runs parallel to the footway. In some areas guardrails and street clutter diminish the quality of character. There is a continuous median along most of this section, mostly grassed, with some trees often of low quality.

Design Proposals: Poured concrete or tarmac footways are proposed to match the existing materials where kerb realignments occur. There are considerable lengths of footways and cycle track that are not changed by kerb realignments are therefore retained as existing with minor repairs or resurfacing as needed. Land acquisition has been minimised through this wide corridor but in places where, for example a new bus stop is required, boundary wall reinstatement will match existing. It is proposed to transplant young trees and reinforce with new planting where the new coach stop requires land take opposite The Court. Stone boundary walls that are affected would be reinstated to match the existing.

14.7.8 Stillorgan Road - UCD entrance to Lower Kilmacud Road

Existing Character: Connector access roads into UCD campus on either side of the main arterial road. Wide roads separated by arterial road and with significant planted verges. Footway materials are mostly poured concrete. UCD access arrangement subject to change based on UCD Masterplan.

Wide Arterial Road for the rest of the route with residential and mixed-use edges. Trees and green spaces along the route and median along the route.

Design Proposals: Pedestrian and cycle desire lines within UCD campus area are enhanced through better crossings and surface materials of stone and concrete. The new UCD bus interchange has been designed to tie into the UCD masterplan proposals at this location. A large group of trees from the exiting woodland block are to be removed to make space for a new access road and an enlarged bus interchange with bespoke canopy shelters to accommodate large numbers of pedestrians. New tree planting set within paved areas is proposed throughout the interchange to complement the new structures and continue design details of the proposed masterplan. The transition from the interchange area to the masterplan has been carefully considered to ensure a cohesive public realm design. The general arrangement at this location can be seen in **Figure 14.15.**

Tree pits will include SuDS provision and tree species will be selected according to available space. Amenity lighting such as uplighters are proposed at certain locations where protected species (bats) will not be affected. Seating and cycle parking are included.

Refer to **Appendix N** for details of the proposed interchange plaza feature shelters which are integral to the urban realm proposals for this area. Refer to **Appendix Q** for details of the proposed interchange site layout.

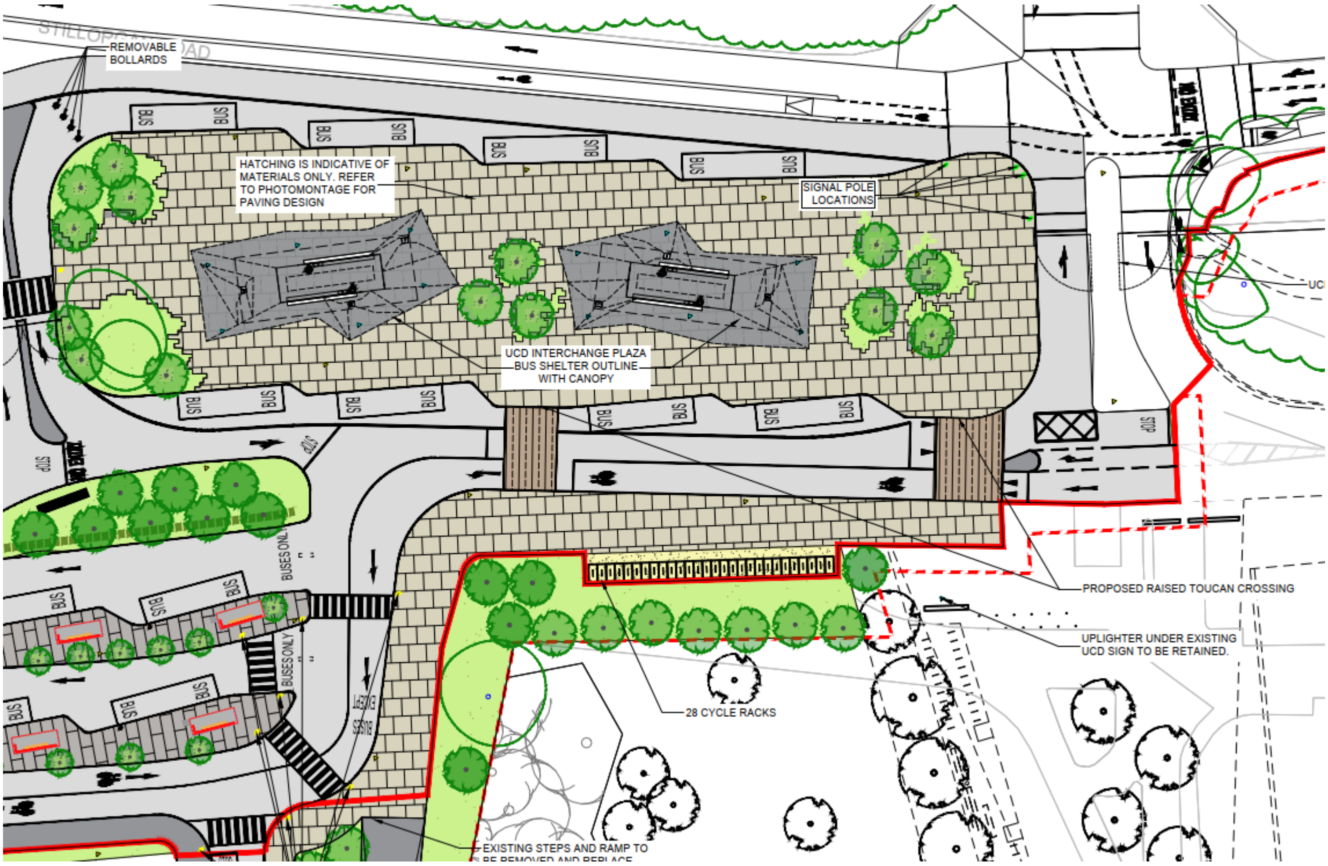

Figure 14.15: UCD Bus Interchange Plaza

On the north side of the UCD/Stillorgan Road intersection a new set of steps on the embankment are proposed to improve pedestrian connections and these will be designed to minimise impact on tree roots. Pedestrians and cyclists are routed along the south and north side of the embankment respectively. Proposed surface materials are poured concrete for the footways and coloured asphalt for the cycle track. A small local intervention consisting of new concrete paving and concrete kerbs together with new trees is proposed to improve the bus stop area in south eastern corner which is well used by students.

In other areas along this section of the route, poured concrete or asphalt footways are proposed to match existing where kerb realignments occur. Footways and cycle tracks that are not adjusted by kerb realignments are retained as existing with minor repairs and resurfacing as needed. Boundary wall reinstatements are to match existing where land acquisition occurs and impacts on the existing boundaries. Amenity grass areas on verges and medians are retained and enhanced where needed along this section. New tree planting is proposed in suitable locations where space and underground utilities allow.

The grass verge between Ashfield Park and Seafield will be enhanced with new hedge planting for improved biodiversity and visual separation.

Two stones with a memorial plaque and 'Mount Merrion' wording are to be retained, and the paths positions rationalised to co-ordinate with pedestrian crossings and the realigned cycle track at the junction with The Rise. At Merrion Grove, a new cycle path connection will be established into Coláiste Eoin which will be an accessibility enhancement during the peak school flows. This will require the loss of some poor quality trees and the adjacent boundary wall will be lowered to open up visibility. The large ornate hotel plinth and signage will be re-positioned locally.

At Booterstown Avenue the grass verge is widened out along with new tree planting where below ground services allow.

The edge of the wooded area is to be repaired with native planting and trees at Old Dublin Road (Stillorgan) junction.

Native shrub planting is proposed to make good the edge where land take and vegetation removal occurs near Patrician Villas. At the pedestrian subway near Patrician Villas, the existing underpass is to be lengthened to the east. A new ramped and stepped access is proposed within the green space which will be tied into the existing earth works and visually softened with new tree planting. Surface materials will be poured concrete paving and concrete kerbs to match the existing near to the subway. The existing ramped subway access on the western side is retained.

14.7.9 Lower Kilmacud Road to Loughlinstown Roundabout

Existing Character: A wide Arterial Road with residential and mixed-use edges. Much of the route is edged with trees and occasional green spaces along this section. Loughlinstown Roundabout is a threshold point that leads the route into the Shankill and Bray area.

Design Proposals: Footway surface materials are to be poured concrete or asphalt footways to match the existing where kerb realignments occur. Footways and cycle tracks that are not changed by kerb realignments are retained as existing with minor surface repairs or resurfacing as needed. Boundary wall reinstatements would match existing materials where land acquisition occurs. Replacement planting is proposed to tie back any disruption to blocks of existing vegetation as required. Areas of amenity grass on verges and medians are to be retained and repaired where needed along this section.

Local intervention is proposed at Belmont Terrace. A new native hedge is planted to create separation between the N11 and the pub and housing whilst encouraging pedestrians to cross over onto the existing footway fronting properties on Belmont Terrace. A raised table is also proposed to encourage pedestrians to use this route.

On the north side of the N11 just north east of the Westminster Road junction, the footway is to be realigned. A new hedgerow and tree planting is proposed where space is sufficient to provide a partial reinstatement of removed vegetation along the service road.

New native tree and shrub planting is proposed in the grass verge at the Johnstown Road junction as a local intervention.

New trees are proposed in the grass verge at the service road north of Willow Avenue to offer increased separation and partial screening to the adjacent residential area.

Loughlinstown Roundabout is a threshold point that leads the route into the Shankill and Bray area. It is proposed to improve the access to the pedestrian bridge with new poured concrete footways to match the existing, with a two way cycle lane link, reinstatement of affected areas of native planting and some verges enhanced with wildflower mixes. An enhancement to the roundabout is proposed by integrating a SUDs system linked to tree pits as well as wildflower grassed areas.

14.7.10 Loughlinstown Roundabout to St. Anne's Church Shankill, including Stonebridge Road

Existing Character: Outer suburban character. The route typically bounds residential properties with a mix of boundary types including timber fences, hedges, railings and walls, as well as mature trees behind. The built form is generally two storey houses, some with high boundaries. In places the existing road widths are narrow. Two schools are located on Stonebridge Road. St. Anne's Church is a significant local landmark in the area. This section also links with the Shankill DART station area.

Design Proposals: It is proposed to replant native planting to repair edges of woodland where tree loss occurs due to kerb realignment along Dublin Road. Footways are to be reinstated with asphalt and concrete kerbs to match the existing. Where stone wall boundaries are proposed to be reinstated and set back, the materials are to match existing utilising any existing stone where possible.

At the Stonebridge Road junction, reinstating boundary treatments in a consistent manner and providing replacement trees and ornamental planting within private properties will be the focus for landscape proposals. Engagement has taken place with landowners and further discussions will be held at detailed design to agree final proposals. Footways will be surfaced in asphalt and concrete kerbs to match the existing.

The cycle path and footpath along north side of Stonebridge Road is routed through the proposed residential development site. Although some tree removal is required, the overall impact on the group is minimised. 'No-dig' construction methods are to be utilised where the paths run through root protection areas.

Reconfiguration works outside of the Proposed Scheme land take boundary are proposed to be undertaken as accommodation works subject to further liaison and agreement with the property owner. **Figure 14.6** shows an example of how the urban realm improvements could be undertaken in the accommodation works area associated with St. Anne's Church. The church forecourt and grounds can be redesigned to adjust the parking layout to ensure no net loss of spaces as well as including a tree avenue towards the southern elevation. A new stone boundary wall and associated ornamental planting and concrete paving can be created as a focal point at the pedestrian entrance to accommodate the re-positioned statue. The surrounding footways that form part of the scheme are to be reinstated with concrete paving and kerbs will match existing. The general arrangement at this location can be seen in **Figure 14.16.**

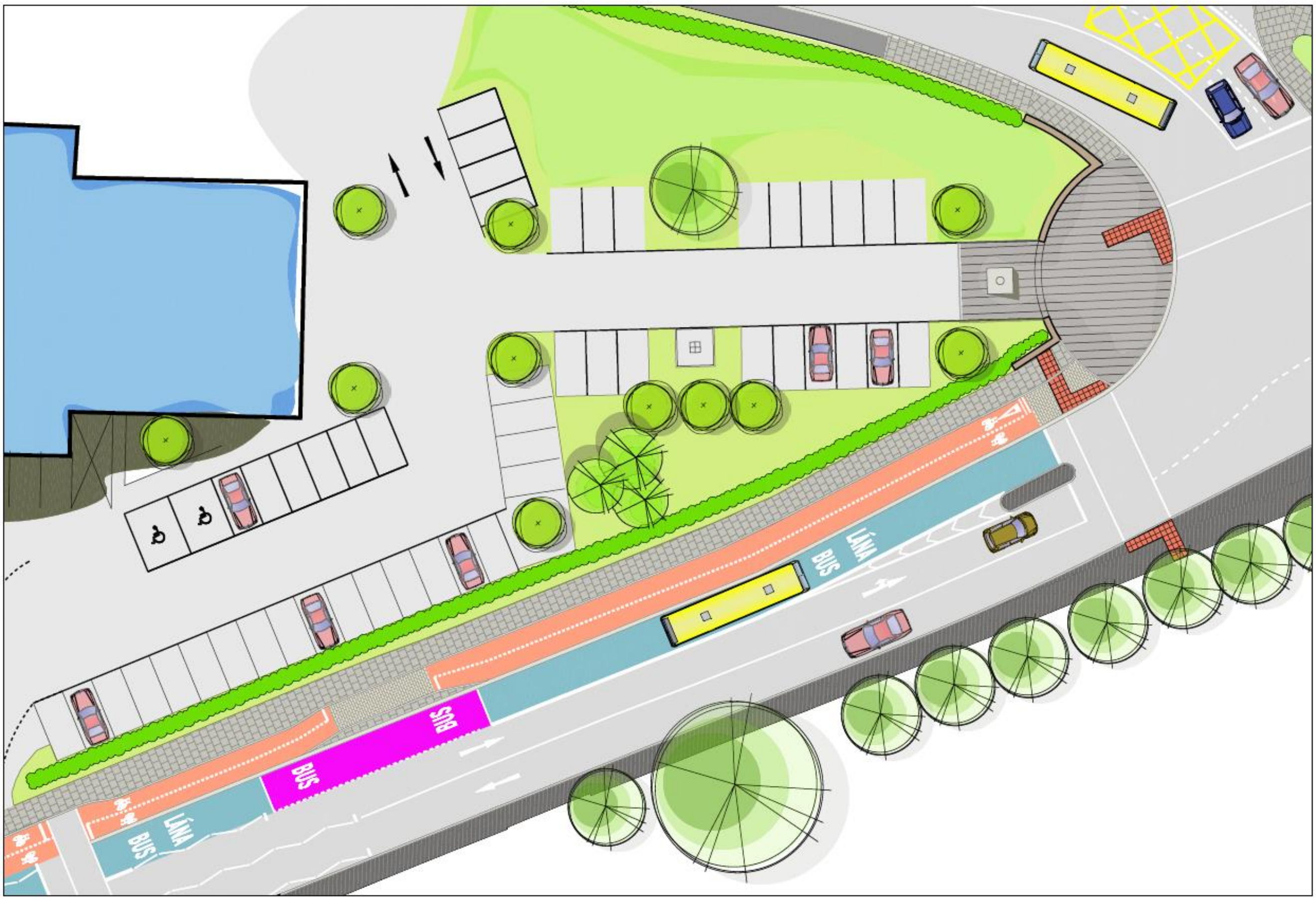

Figure 14.16: St Anne's Church Grounds Reinstatement Proposal

14.7.11 St. Anne's Shankill to Cherrington Road, including Shankill Village

Existing Character: Narrow road leading into the Shankill Village Centre with retail on the western side and residential properties on the eastern side. Two storey, fine grain retail frontages in a Village setting. Small trees are present within planters along the retail side and mature trees line the residential edge. A 'heritage' style lighting in black is laid out through the village centre.

Design Proposals: Through Shankill Village, four pedestrian crossings on Dublin Road will be enhanced by introducing concrete set paving. This will be applied at a pedestrian crossing at the Quinn's Road junction and one just south of Corbawn Lane which will define the start/end to the village core. Two further pedestrian crossings within the village will be treated in the same manner. Other proposed interventions through the village centre are minimal. A local enhancement is to plant two new street trees within new low level planting beds rather than in existing containers. Footways will be locally widened at identified pinch points. Raised tables will be provided to enhance pedestrian crossings at local side roads within the village.

14.7.12 Quinn's Road to M11 Diverge (Wilford Roundabout)

Existing Character: A suburban character with narrow carriageway widths in some sections. The main residential areas are set apart from the roadway by areas of green space. Significant lengths of this section of road are tree lined. A small retail area is located at the Barbeque Centre. High fences and hedges are present along parts of the route. Shanganagh Park and Cemetery are local landmarks. There are numerous property entrances and listed structures along the route.

Design Proposals: All trees along Cherrington Drive are retained along this section of Dublin Road. Asphalt footways with concrete kerbs are proposed to match the existing. Concrete setts are proposed at the driveway crossover into the Barbeque Centre.

South of Castle Farm entrance, the footway is to be routed to the rear of existing mature trees to minimise vegetation loss. A The wall is to be re-built to a reduced level and set to the back of the footway utilising the existing stone material where possible. A 'No-dig' construction method is to be utilised where the path runs through root protection areas.

Where property boundaries are impacted by kerb realignments, walls will be reinstated to match existing along with and replacement planting behind.

The landscape proposals have been co-ordinated with the Shanganagh Castle housing development proposals, just north of Shanganagh Park. Cycle path and pedestrian connections have been aligned and the footway has been positioned to maximise the space for new tree planting along the frontage.

The interface with the Shanganagh Park masterplan has been considered in consultation with the local authority. It is proposed to route the two-way cycle path through the park, utilising in part the existing footpaths. Paths will tie into proposals for the wider park masterplan, while a footpath will also be retained along the roadside to provide a more direct route. Some tree losses are required to accommodate bus and coach stops. Mitigation tree planting opportunities along the boundary are possible that accord with the masterplan proposals.

Land take into the western boundary of the cemetery is required to help retain some of the mature trees in the grass verge adjacent to the carriageway. An over mature row of conifers within cemetery is to be replaced in consultation with the local authority. A more suitable native hedge is proposed following engagement with the local authority.

The stone piers and railings forming the boundary of Crinken Church remain untouched. The proposed alignment along the west side results in tree loss to the front face of the woodland block which will be repaired with a band of native planting set behind the reinstated stone wall. The alignment south of Woodbrook Downs widens to the east only, therefore protecting all trees and stone walls on the west side. New tree planting and re-built stone walls is focussed on the east side providing a consistent landscape approach through this section. The new proposals on the east side will tie into the Woodbrook Strategic housing development site and the associated new junction opposite Woodbrook Downs. Liasion has taken place with the development organisation and the local authority regarding boundary treatments and tie-in proposals.

The historic gated entrance into the Woodbrook Estate remains unaffected by any carriageway widening. The surface treatment of the wide footway in front of the gates is enhanced with stone setts and wide granite kerbs. South of the gated entrance the proposed southbound bus stop and carriageway widening in close proximity to St Brendan's College results in the loss of some mature trees, with set-back of the wall also required. The alignment through this section has been considered carefully to minimise tree loss and retain a row of mature trees set further back. Replacement native planting is proposed to re-establish the vegetation belt along this side. The proposed wall reinstatement north of the M11 diverge junction will be detailed to match the stone material seen elsewhere along this section.

Immediately south of Wilford roundabout the Woodbrook Estate is impacted with the demolition of Woodbrook Side Lodge. A new lodge is to be re-built in a more central position within the plot and designed to meet current building regulations in a style similar to the existing. The boundary wall, pedestrian and vehicle gated access points will also be re-built utilising existing materials where possible. The general arrangement at this location can be seen in **Figure 14.17**

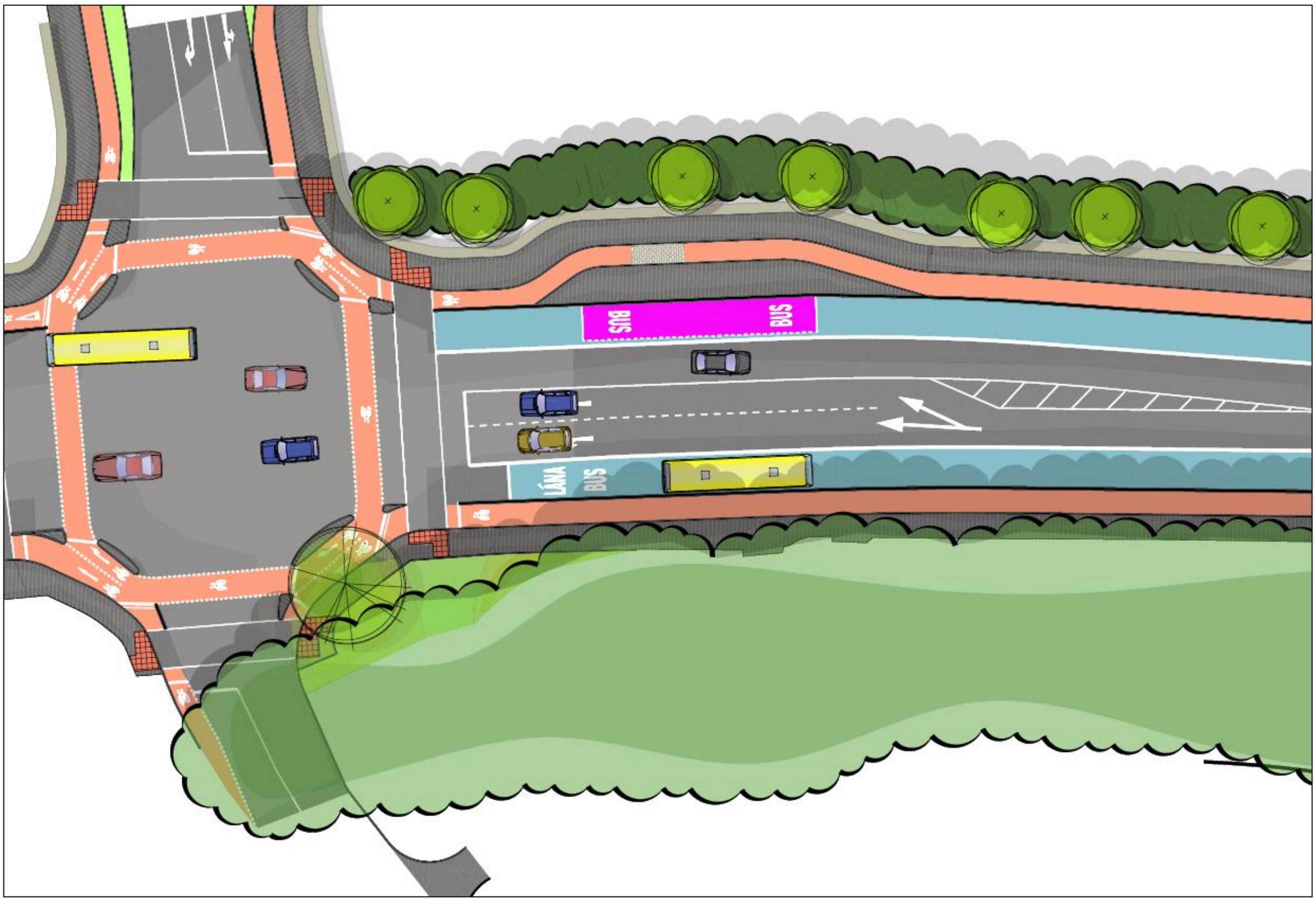

Figure 14.17: New Woodbrook Estate Junction with New Landscape Treatment Along the East Side of the Carriageway

14.7.13 M11 Diverge (Wilford Roundabout) to Old Connaught Avenue

Existing Character: The M11 Diverge is a wide roundabout with existing grassed area, planting and stone boundary walls. South of the roundabout is of outer suburban character with one and two storey residential edges. Large front gardens in front of houses with some high fences and edges. Out of town commercial lots feature in this section. Residential properties are set back from the road edge.

Design Proposals: The M11 Diverge roundabout has been redesigned as a T-junction with proposed surrounding landscape areas including new native trees and species rich grassland to enhance biodiversity. Any changes to the stone wall will be reinstated to match existing where required.

Properties are impacted on the east side of Dublin Road as the scheme enters the edge of Bray. Woodbrook Side Lodge and the boundary wall will be demolished and re-built, refer to **Chapter 13** for more detail. The Windsor Bray Nissan dealership protruding forecourt display area will be reduced in size and any railings/bollards reinstated appropriately to ensure the existing security function is retained. A number of residential gardens will be impacted which will result in replacement garden hedges, boundary walls and garden restoration proposed on a like for like basis and will be agreed in detail with landowners at the next design stage. Footway surface treatment is asphalt through this section.

Along Dublin Road, north of Old Connaught Avenue where the houses are set back from the road, new street trees are proposed to be planted on the reinstated grass verge to mitigate for loss of trees elsewhere.

14.7.14 Old Connaught Avenue to Castle Street (End of route)

Existing Character: There are retail areas in several parts of this section, including the Industrial Yarns Complex. One to three storey residential properties are present approaching the Village Centre. There is a significant change in topography towards the Village Centre. Castle Street has a local Village Centre character with retail and mixed uses. The street is relatively wide with narrow footways and car parking along Castle Street. A recently upgraded small area of public realm exists close to Fran O'Toole Bridge.

Design Proposals: A local enhancement of public realm is proposed at Upper Dargle Road junction with low planters and integrated seats and enhanced pedestrian crossings. Footways are to be surfaced in concrete paving with granite or conservation kerbs at the junction continuing south to the end of the section. North of Upper Dargle Road footways will be asphalt with concrete kerbs. New roadside tree planting is proposed within the green space fronting Lidl with linked tree pits designed to utilise surface water as part of a SUDs system.

Bray retail area footways enhanced with high quality concrete paving with wide granite or conservation kerbs. A new boundary railing is proposed between the setback footpath and shopping centre car park. The existing public space near the bridge is to be retained with adjustment to paving as required.

As part of the accommodation works required to adjacent impacted businesses at locations such as the Dargle Centre, urban realm improvements will be introduced where appropriate and where space allows. Typically, this could be new shrub planting, replacement paving and realigned boundary railings or walls.

15. Scheme Benefits / How we are Achieving the Objectives

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

- Enhance the capacity and potential of the public transport system by improving bus speeds, reliability and punctuality through the provision of bus lanes and other measures to provide priority to bus movement over general traffic movements;
- Enhance the potential for cycling by providing safe infrastructure for cycling, segregated from general traffic wherever practicable;
- Support the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets;
- Enable compact growth, regeneration opportunities and more effective use of land in Dublin, for present and future generations, through the provision of safe and efficient sustainable transport networks;
- Improve accessibility to jobs, education and other social and economic opportunities through the provision of improved sustainable connectivity and integration with other public transport services; and
- 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.

Currently, bus priority is characterised by discontinuity. Bus priority is only provided along certain 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. Within the extents of the Proposed Scheme route, bus lanes are currently provided on only approximately 69% and 68% of route outbound and inbound respectively of which significant portions of the route are shared with cyclists and or parking lanes.

Issues related to frequency, reliability and a complex network have persisted for many years and will continue to do so without further intervention. As well as the existing services on the Proposed Scheme there are a number of planned high frequency public bus services along the route which are anticipated to be in operation prior to the Proposed Scheme being implemented, including the B and E spine routes B1, B2, E1 and E2 and local and peak time bus routes L13, P11, P12, P13, P16, L25, L26, L27, L11, L14 AND L15, as well as multiple orbital routes including S2, S4, S6 and S8. In addition to this there are multiple other bus services which run along this corridor intermittently, providing interchange opportunities with other bus services. The Proposed Scheme interventions will seek to make all these services more reliable, particularly in peak times, thus providing a more attractive and sustainable alternative mode of transport. The introduction of segregated cycle and parking facilities will facilitate optimum bus speeds to improve on the punctuality and reliability of the bus service. Similarly, the use of active bus signalling measures will improve continuity of bus journey times through junctions.

Without the interventions of the Proposed Scheme there would likely be an exacerbation of the issues which informed the need for the Proposed Scheme 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 Scheme 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 Scheme is to enhance the potential for cycling along the route. Without the provision of safe cycling infrastructure, intended as part of the Proposed Scheme, there would continue to be an insufficient level of safe, segregated provision for cyclists who currently, or in the future would be attracted to use the route of the Proposed Scheme.

In terms of the need to improve facilities for cyclists along the route of the Proposed Scheme, the design intent is that segregated facilities should be provided where practicable to do so. Within the extents of the Proposed Scheme cycle tracks are currently provided on only approximately 52% and 44% of the route both outbound and inbound, while advisory cycle lanes are provided on only approximately 42% and 40% of the route outbound and inbound respectively. The remaining extents have no dedicated cycle provision or cyclists must cycle within the bus lanes provided.

The Proposed Scheme is implementing safe, segregated. infrastructure along the corridor in both directions and as such is greatly enhancing the potential for cycling.

Within the extents of the Proposed Scheme there are a number of amenities, village and urban centres which will be enhanced as part of the proposed works. 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 Scheme. There are a number of uncontrolled crossings along the route of the Proposed Scheme, particularly at side roads which are generally of poor standard, including lack of provision for the mobility and visually impaired. There are multiple incidences of 'patch repairs' along footpaths that in some instance has led to undulating, uneven surfaces caused by settlement of patch repair material. This is often a hazard to pedestrians, particularly the mobility impaired. A number of submissions were also received as part of the non-statutory consultation in which members of the public indicated specific locations where the existing provision is unsafe for pedestrians – many of which are proposed to be addressed by the Proposed Scheme.

The Proposed Scheme includes significant improvements to the pedestrian environment, both along links and at both junctions and crossings by the provision of enhanced footpath widths and additional pedestrian crossing facilities. As such the Proposed Scheme 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 Scheme are based on an urban context and landscape character analysis of the route. The proposals have been informed through discussions with the NTA, local authorities and stakeholders.

The overall landscape and public realm design strategy for the Proposed Scheme was developed to create attractive, consistent, functional and accessible places for people alongside the core bus and cycle 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 public realm and landscape design where practicable.

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 Scheme 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. Bus stops have also been carefully designed to incorporate cycle parking, where practicable, providing an integrated sustainable solution for combining active travel with longer distance trips by bus. Therefore, it is considered that the Proposed Scheme as described enables compact growth, regeneration opportunities and more effective use of land in Dublin, for present and future generations.

It is therefore considered that the design of the Proposed Scheme wholly achieves the objectives set out herein. In doing so it fulfils the aim of the Proposed Scheme in providing enhanced walking, cycling and bus infrastructure on key access corridors in the Dublin region, enabling the delivery of efficient, safe, and integrated sustainable transport movement along this corridor.

Appendices

Appendix A. Designers Risk Assessment

Appendix B. Preliminary Design Drawings

Appendix C. Relaxations, Departures and Deviations

Appendix D. Arborist Report

Appendix E. Ground Investigation Factual Report

Appendix F. Structures Reports

- Structures Preliminary Design Report - Retaining Walls DLRCC
- Structures Preliminary Design Report - Retaining Walls WCC
- Structures Preliminary Design Report – St Laurence/ Patrician Vilas Subway
- Structures Preliminary Design Report – Loughlinstown Retaining Wall
- Structures Preliminary Design Report - St Anne's Retaining Wall
- Record of Structural Review Forms - St Columcille FOB
- Record of Structural Review Forms – UCD Flyover
- Record of Structural Review Forms – St Anne's Retaining Wall

Appendix G. Parking Survey Report

Appendix H. 1 BusConnects Bus Stop Review Methodology

Appendix H.2 Bus Stop Review Analysis

Appendix I. Accessibility Audit

Appendix J. Not Used

Appendix K. Drainage Design Basis Document

Appendix L. Junction Design Report

Appendix M. 1 Quality Audit Report

Appendix M. 2 Road Safety Audit Report

Appendix N. Flood Risk Assessment

Appendix O. BusConnects Preliminary Design Guidance Booklet

Appendix P. UCD Bus Interchange – Plaza Shelters

Appendix Q. UCD Bus Interchange – Proposed Layout (1:250 Plan)

Appendix R. Woodbrook Side Lodge Rebuild Proposals

Appendix S. Circle K Proposals