Ringsend to City Centre Core Bus Corridor Scheme

March 2023

Preliminary Design Report

BUS CONNECTS

SUSTAINABLE TRANSPORT FOR A BETTER CITY.

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Appendices

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
DEHLG	Department of Environment, Heritage and Local Government
DCC	Dublin City Council
DLAM	Dublin Local Area Model
DM	Do Minimum
DMURS	Design Manual for Urban Roads and Streets
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
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
PMSC	The People Movement Signals Calculator

Acronym	Definition
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

Executive Summary

This Preliminary Design Report has been prepared for the Ringsend to City Centre Core Bus Corridor Scheme and builds on the previous Feasibility and Options Report carried out for the scheme.

This report summarises the project background and the need for the Proposed 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 Ringsend to City Centre Core Bus Corridor Scheme wholly achieves the Proposed Scheme objectives. In so doing, 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 policy 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 in-house 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 & cycling facilities on twelve radial Core Bus 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 'Proposed Scheme' measures approximately 1.6 km from end to end for bus corridors works on both sides of the River Liffey to the east of Dublin city centre, and a further 1.1k m long cycle route through the Ringsend and Irishtown area on the south-eastern side of the city.

The Ringsend to City Centre Core Bus Corridor Scheme is routed along both sides of the River Liffey on Custom House Quay and North Wall Quay on the north side, and on City Quay, Sir John Rogerson's Quay, and Britain Quay on the south side. At the south-eastern end of the River Liffey corridor the Proposed Scheme includes a new public transport opening bridge over the mouth of the River Dodder from Britain Quay to the East Link Road at Ringsend. A cycle route will continue from the East Link at, Ringsend, via York Road, Pembroke Cottages and Cambridge Park, then through Ringsend Park and along Strand Street and Pembroke Street in Irishtown, terminating at Sean Moore Road.

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

Figure 1-1: Proposed Scheme Route Overview

1.2 Scheme Aims and Objectives

The aim of the CBC Infrastructure Works is to provide enhanced walking, cycling and bus infrastructure on key access corridors in the Dublin region, which will enable and deliver efficient, safe, and integrated sustainable transport movement along these corridors.

The objectives of the CBC Infrastructure Works 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 Transport Strategy for the Greater Dublin Area 2022-2042 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 .

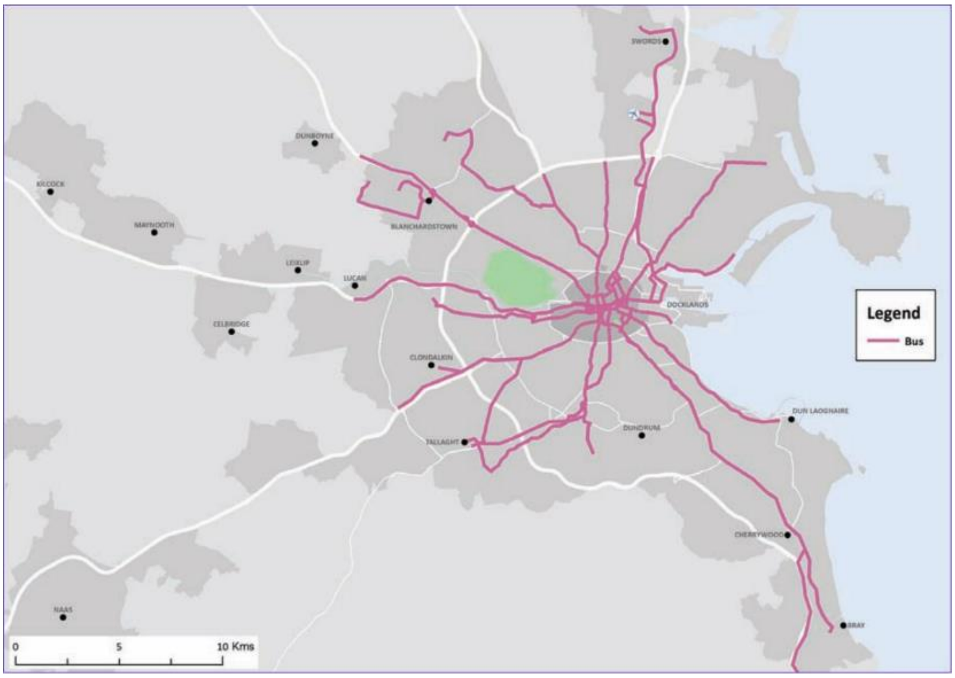

Figure 1-2: 2035 Core Bus Network – Radial Corridors

Collectively, these corridors currently have dedicated bus lanes along less than one third of their lengths which means that for most of the journey, buses and cyclists are competing for space with general traffic and are negatively affected by the increasing levels of congestion. This results in delayed buses and unreliable journey times for passengers. Following the completion of 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 Ringsend to City Centre CBC scheme.

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 route proposed schemes that form the CBC Infrastructure works are shown on Figure 1-3.

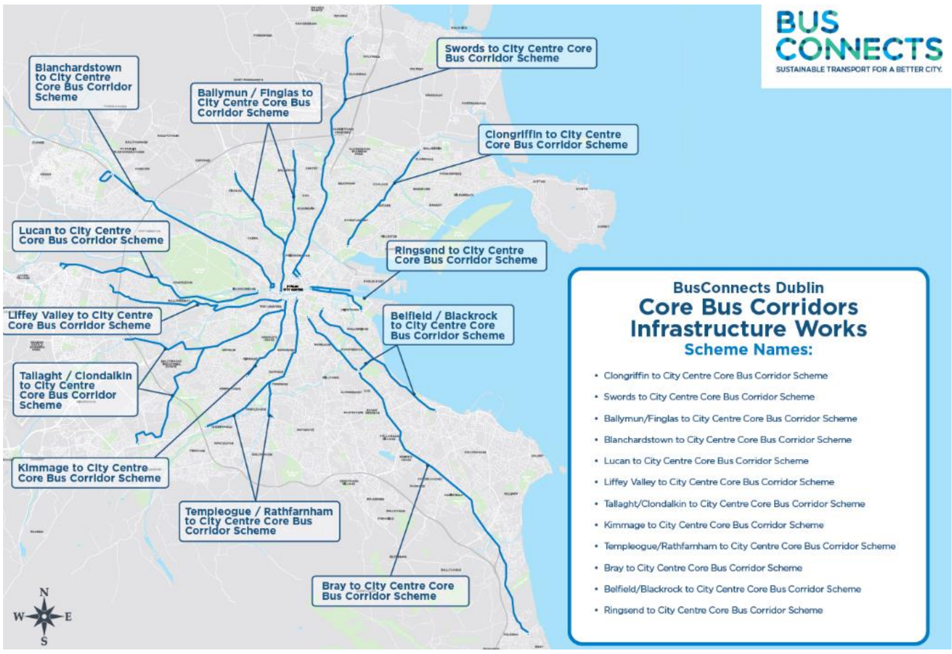

Figure 1-3: BusConnects Radial CBC Network

1.4 Proposed Construction Procurement Method

The Proposed Scheme will proceed on the basis of procurement through a Design-Build tender process.

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 process in order to construct a CBC that will fulfil the design requirements.

1.5 Stakeholder Consultation

Three rounds of public consultation have taken place over the following dates;

- February 2019 to May 2019 - Consultation on Emerging Preferred Route
- 4th March 2020-17th April 2020 - Consultation on Preferred Route Option
- 4th November 2020 – 16th December 2020 - Consultation on Preferred Route Option

Refer to the BusConnects website for the Ringsend to City Centre Core Bus Corridor Consultation Submissions Summary Report for information on the non-statutory consultations at the link below:

https://busconnects.ie/wp-content/uploads/2022/02/16-ringsend-to-city-centre-report-report-on-cbc-public-consultation-2.pdf

Consultation with the principal project stakeholders (i.e. Dublin City Council (DCC), Statutory Undertakers/Utility companies Transport Infrastructure Ireland (TII)) 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 NTA and Local Authorities, and meetings, at Steering Group and Programme level. The Engineering Designer (ED) 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
- Land Owners (i.e. owners of lands at any specific locations)
- 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 Pavement Inspection Audit
- Existing Structures Assessment
- Existing Route Collision Analysis.
- Cellar Survey
- Private Landings Survey
- Baseline Tree Survey
- Cycle Journey Time Survey & Report
- Pavement condition
- Phase 1 Utility Survey
- Bus Stop Survey including boarding and alighting and AVL
- Traffic Survey (JTC, pedestrian and cyclists counts)
- Parking survey
- Bus Journey Time Report

These surveys have been supplemented with secondary record data to include utility information, OPW CFRAM Flood Models, IW Drainage Models and existing traffic signal data from DCC.

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

1.7 Purpose of the Preliminary Design Report

The preliminary design report:

- Sets out the context for the Scheme, the justification for the Scheme, the basis for selecting the proposed scheme improvements, and the design criteria;
- Describes the elements of the 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 tests undertaken in developing the design,
- Sets out traffic management proposals, i.e. permanent changes required as part of the 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 Scheme, and the criteria influencing the associated design; and
- Sets out the benefits of the Scheme.

During design development, 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 Proposed Scheme design principles for each discipline and should be read in conjunction with this Preliminary Design Report. The following table provides a description of the drawings and relevant design content displayed in each of the series as applicable for the Proposed 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) & Site Location Plans (1:2500@A1)	Defines the full extent of the works & 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. (See Appendix B1)
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. (See Appendix B7)
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 & 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) (See Appendix B2)
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. (See Appendix B4)
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). (See Appendix B3)
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 SUDs features and proposed boundary treatment and key street furniture notes. (See Appendix B5)
DNG_RD	Proposed Surface Water Drainage 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 peak discharge management measures (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
		(See Appendix B11)
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**.** (See Appendix B17)
UTL_UD	Irish Water Foul Sewer Alteration Plans (1:500@A1)	Provides an indication of the existing trunk 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. (See Appendix B12)
UTL_UW	Irish Water Potable Water Alteration Plans (1:500@A1)	Provides an indication of the existing trunk 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. (See Appendix B15)
UTL_UE	ESB Asset Alteration Plans (1:500@A1)	Provides an indication of the existing trunk 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. (See Appendix B13)
UTL_UL	Telecommunications Asset Alteration Plans (1:500@A1)	Provides an indication of the existing trunk 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. (See Appendix B16)
UTL_UG	Gas Networks Ireland Asset Alteration Plans (1:500@A1)	Provides an indication of the existing trunk 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. (See Appendix B14)
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. (See Appendix B9)
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. (See Appendix B10)
TSM_GA	Traffic Signs and Road Markings Plans (1:500@A1)	Provides an indication of the proposed key the signage (information/directional/regulatory) design requirements and the design intent for the proposed lane marking arrangements along the route. (See Appendix B8)
PAV_PV	Pavement Treatment Plans (1:500@A1)	Provides an indication of the proposed pavement treatment works along the length of the route. (See Appendix B6)
STR_GA	Bridges and Retaining Structures (Varies)	Provide additional details relating to proposed bridge structure/boardwalk works in addition to structural retaining walls along the route.

Drawing Series Volume Code	Drawing Series Description / Scale	Design Content
		(See Appendix B18)
BLD_ZZ	Bus Interchange (Varies)	Not applicable to the Ringsend CBC Scheme

It should be noted that a significant volume of other drawings and sketches have also been prepared as required to facilitate the design development process. The information shown on the PDR drawings has been deemed sufficient for the purposes of conveying the design intent of the Proposed Scheme in addition to outlining the extent of works in conjunction with the planning red line boundary extents and compulsory purchase order documentation.

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'.

It is noted that the contractor will be restricted to what works can be carried out in the dashed red line areas i.e. to be limited to access and or accommodation works only. Storage of materials/stockpiling and/or temporary traffic management proposals will not be permitted in these areas unless otherwise agreed with landowners and the NTA.

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

The structure for the remainder of this report is set out as follows:

- Chapter 2: Policy Context and Design Standards– This chapter identifies the policies and design standards reviewed and applied to the preliminary design.
- Chapter 3: The Proposed Scheme – This chapter describes the Proposed scheme in more detail
- Chapter 4: Preliminary Design – In this chapter, the geometrical alignment and cross-section of the scheme are described, along with an overview of the operational safety process which has been implemented
- Chapter 5: Junction Design – The junction design methodology and modelling process is then set out for the major, moderate and minor junctions along the length of the route in this chapter
- Chapter 6: Ground Investigation and Ground Conditions – This chapter provides an overview of the ground investigation process and ground conditions
- Chapter 7: Pavement, Kerbs, Footways and Ground Conditions – This chapter gives an overview of the existing pavement situation and proposed pavement design for the scheme, together with and considerations of the kerbs, footways and paved areas in 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
- 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 & 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 – 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 focussing on the existing trees and proposed mitigation
- Chapter 15: How the Proposed Scheme achieves the Objectives – In this chapter benefits provided by the scheme are summarised, principally savings in journey times and improved efficiencies of bus priority
- Appendices – Various appendices and background information as referenced throughout the report and as listed in the Table of Contents.

2 Policy Context & 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
- Department of Transport: Statement of Strategy (2016 - 2019)
- Smarter Travel: A Sustainable Transport Future (2009 – 2020)
- National Cycle Policy Framework (2009)
- Road Safety Strategy (2013 – 2020)
- Building on Recovery: Infrastructure and Capital Investment Plan (2016-2021)
- The Sustainable Development Goals National Implementation Plan (2018-2020)
- Climate Action Plan (2023)
- Eastern & Midland Regional Assembly, Regional Spatial & Economic Strategy (2019-2031)
- Greater Dublin Area Cycle Network Plan
- Transport Strategy for the Greater Dublin Area (2022-2042)
- Dublin City Council Development Plan (2022-2028)

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), its purpose is to provide guidance for the various design teams involved in CBC Infrastructure Works, to ensure a consistent design approach across the Proposed Scheme.

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 deviations have been noted generally within Section 4.16 with specific details in Appendix C.

3 The Proposed Scheme

3.1 Proposed Scheme Description

The ‘Proposed Scheme’ measures approximately 1.6 km from end to end for bus corridors works on both sides of the River Liffey to the east of Dublin city centre, and a further 1.1k m long cycle route through the Ringsend and Irishtown area on the south-eastern side of the city.

The Ringsend to City Centre Core Bus Corridor Scheme is routed along both sides of the River Liffey on Custom House Quay and North Wall Quay on the north side, and on City Quay, Sir John Rogerson’s Quay, and Britain Quay on the south side. At the south-eastern end of the River Liffey corridor the Proposed Scheme includes a new public transport opening bridge over the mouth of the River Dodder from Britain Quay to the East Link Road at Ringsend. A cycle route will continue from the East Link at, Ringsend, via York Road, Pembroke Cottages and Cambridge Park, then through Ringsend Park and along Strand Street and Pembroke Street in Irishtown, terminating at Sean Moore Road.

The two sections are as follows and as shown on Figure 3-1.

Section 1: Matt Talbot Bridge to Tom Clarke East Link Bridge [“Campshires Section”]; and

Section 2: Tom Clarke East Link Bridge to Seán Moore Road [“Cycleway Section”].

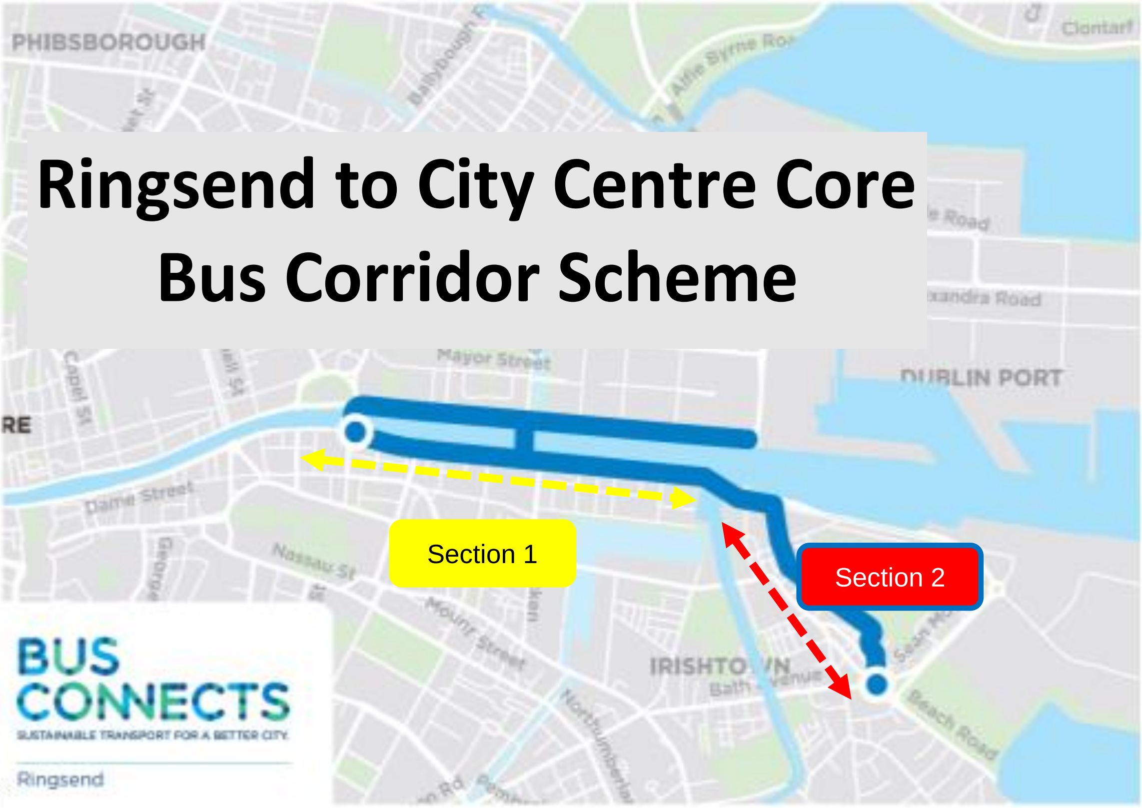

Figure 3-1: Route Sections

3.1.1 Section 1: Matt Talbot Bridge to Tom Clarke Bridge along River Liffey

Section 1 of the Proposed Scheme extends for 1.6km along both banks of the River Liffey from Matt Talbot Bridge at the western end to Tom Clarke Bridge at the eastern end. There are two sub-sections as follows:

Section 1.1 on the north side of the River Liffey comprises part of Custom House Quay east of Matt Talbot Bridge and all of North Wall Quay as far as the “Point Roundabout” junction at the northern of Tom Clarke Bridge.

Section 1.2 on the south side of the River Liffey comprises commences at Matt Talbot Bridge and comprises all of City Quay, Sir John Rogerson’s Quay and Britain Quay to the mouth of the River Dodder where it is proposed to provide a new opening bridge to link across the river to Ringsend on the eastern bank.

These are essentially two parallel corridors that serve their adjoining catchment areas along each bank of the River Liffey, as well as providing radial routes into the city centre from the northeast and southeast directions. Both sides of the river operate largely independent of each other and both routes need full provisions for pedestrians, cyclists and public transport.

This section also includes 4 existing bridges across the River Liffey that connect the two sub-sections:

a) Matt Talbot Bridge at the western end linking Custom House Quay to City Quay.

b) Sean O’Casey footbridge, 250m east of Matt Talbot Bridge,450 linking Custom House Quay to City Quay.

c) Samuel Beckett Bridge, 450m east of Sean O’Casey footbridge, linking North Wall Quay to Sir John Rogerson’s Quay, and

d) Tom Clarke (East Link) Bridge, 900m east of Samuel Beckett Bridge, linking North Wall Quay to Ringsend.

3.1.2 Section 1.1: North Bank of the River Liffey

Section 1.1 of the Proposed Scheme commences at the junction of Custom House Quay, Memorial Road and Talbot Matt Talbot Bridge and will extend eastwards along Custom House Quay and North Wall Quay to the northern end of Tom Clarke (East Link) Bridge over a length of 1.6km.

Proposed Road Layout in Section 1.1 – General Description

The proposed road layout provides for improvements to the facilities for public transport, cyclists and pedestrians as follows:

a) Continuous 3m wide bus lanes are provided along the full length of Section 1 which requires minor road widening in places, replacement of the narrow Scherzer bridges with wider fixed bridges, and removal of some turning lanes with associated restrictions for traffic turning movements. All traffic lanes will be 3m wide, which will involve some narrowing where the existing lanes are wider than this in certain places.

b) Bus stops will be upgraded and rationalised in terms of location, with separate bus laybys provided for coaches that need to stop for longer while loading baggage so that they do not block the busy bus lane.

c) A continuous 3.5m wide two-way cycle track is provided along the river side of the street at the inland side of the campshire area and separated from the road by a 2m wide buffer zone lined with street trees. In places due to constraints on the space available the cycle track will narrow locally to 2.5m. With this facility there will no longer be a need for cyclists to cycle along the northern side of the road in the eastbound direction. This cycling facility on the river side will form part of the *Liffey Cycle Route* as planned to extend westwards through the city centre to the Phoenix Park.

d) The river side pedestrian route will be made continuous with provision of two boardwalks overhanging the river to pass around the buildings that block the campshire. On the northern side of the road the footpath will be widened in one section to provide a continuous and consistent footpath width of at least 3.5m.

e) All junctions will be improved to provide high-quality segregated facilities for pedestrians and cyclists. Some new traffic signals will be introduced at junctions where there are no existing controlled crossing facilities for pedestrians and cyclists.

3.1.3 Custom House Quay from Matt Talbot Bridge to Commons Street

This section is 380m long on Custom House Quay from the junction with Memorial Road to the junction with Commons Street. On Custom House Quay from the Matt Talbot Bridge junction to the George's Dock Scherzer Bridge the existing road is 15.6m wide with a median island that is typically 1m wide but widens to 2m at each end.

The footpath on the northern side of the street is generally 3m wide but narrows to only 2m over a length of 60m mainly alongside the Stack B building (owned by Trinity College) on the eastern side of George's Dock. This will be widened to 3.5m by narrowing of the road carriageway which is wider than necessary for two bus lanes and two traffic lanes.

***Figure 3-2: Narrow footpath on northern side of Custom House Quay and the Scherzer Bridges at George's Dock** (Google Street-View)*

In the Proposed Scheme the existing kerbs, road markings and traffic signalling arrangements on the eastern side of the junction at Memorial Road will be adapted to suit the new configuration which will include a kerbside inbound bus lane on each side of the eastern approach to replace the existing perched bus lane in the middle of the road. This will allow a continuous bus lane along the river side of the road without the need for buses to weave across traffic to the middle of the road. On the outbound (northern) side of the road the lefthand one of the two existing traffic lanes will be converted to a bus lane and the adjoining cycle lane will be removed and replaced with a two-way cycle track on the opposite side of the road through the campshire area along the river side.

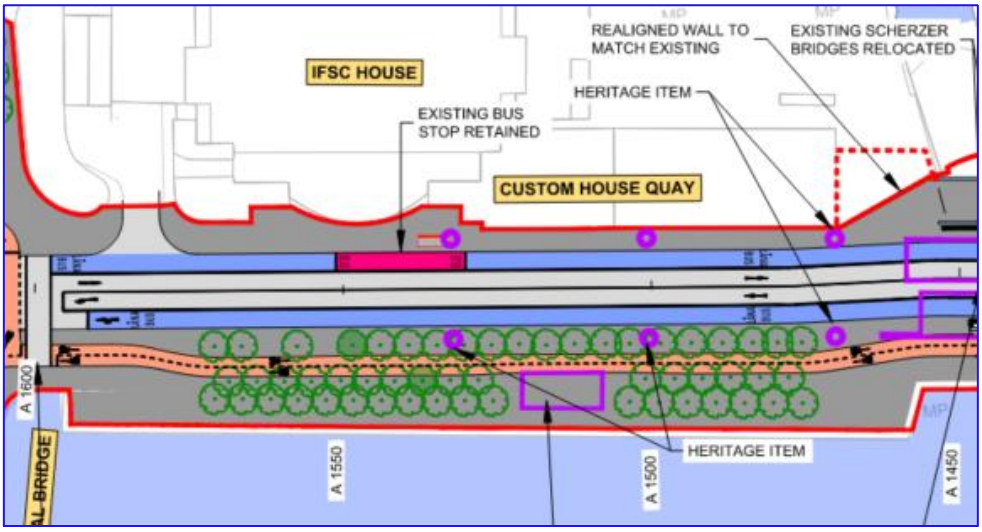

Figure 3-3: Proposed Road Layout on Custom House Quay, west of George's Dock

On Custom House Quay east of George's Dock, the existing median island will be removed, and 4 x 3m lanes will be provided on the road carriageway. The existing off-road cycling facility on the southern side will be widened to 3.5m to accommodate two-way cycling traffic. The existing trees and heritage features will be maintained where practicable along the campshires. Where the realignment of the bus or cycle lanes requires the removal of existing trees, replacement trees will be planted nearby to suit the revised layout.

Scherzer Bridges at George's Dock

At the entrance to George's Dock (a disused harbour) the existing road carriageway narrows to a single lane in each direction and is divided with a median island as shown in Figure 3-4. These bridges no longer need to open for boat traffic, and they are effectively redundant, but they have considerable heritage value in this former docklands area. The road needs to be widened at these bridges to allow for continuous bus lanes in both directions.

Figure 3-4: Scherzer Lifting Bridges on Custom House Quay at George's Dock (Google Street-View)

It is proposed to remove the historic bridges, to renovate them off-site so as to preserve them for posterity, and then to reinstall them on each side of their current positions, but in a reverse orientation to allow for a wider footpath at the north-western corner. A new concrete bridge will be provided in-between the reinstated historic bridges, which will accommodate 2 lanes each for traffic and for buses. The relocated Scherzer Bridges will carry pedestrians and cyclists and they will replace the existing modern lightweight footbridges on each side of the road. An image of the proposed new arrangement is shown in Figure 3-5.

Figure 3-5: Relocated Scherzer Lifting Bridges on Custom House Quay at George's Dock

East of George's Dock, and east of the Sean O'Casey Footbridge, there is an existing building on the campshire that forms an obstacle for pedestrians and cyclists. This building currently houses the Dublin City Council Docklands Office, and provides access to the *Jeanie Johnston* famine memorial ship, as well as facilities for various water-sports that use access to the River Liffey at an adjoining pontoon. This situation is illustrated in Figures 3-5a, 3-5b and 3-5c.

Figure 3-5a: Liffey North Campshire east of the Dublin Docklands Office: Footpath along the river and cycle track beside the road on the right

Figure 3-5b: Riverside footpath deflected inland at the Dublin Docklands Office

Figure 3-5c: Footpath on inland side of the Dublin Docklands Office: No Cycle Track

The existing arrangement at the Dublin Docklands Office on Custom House Quay is unsatisfactory in several respects: it causes a 150m long gap in the westbound cycle track, and it forces the riverside walkway inland over a length of 110m, which detracts considerably from the amenity value of the River. Dublin City Council plans to redevelop these offices and has secured planning permission for same as part of its Part VIII approval for a docklands centre redevelopment.

The Proposed Scheme will provide significant improvements in the road layout on Custom House Quay at the Dublin Docklands Office as follows:

a) The northern footpath will be retained at the existing width.

b) On the road carriageway there are two bus lanes and two traffic lanes: the eastbound bus lane will be extended to the junction at Commons Steet and left-turning general traffic will turn from outside the bus lane instead of from a shared lane with buses.

c) A cantilever boardwalk (6m wide x 110m long) will be provided along the river outside of the building, which will provide continuity of the riverside walkway.

d) The kerb on the southern side of the road will be realigned 1m northwards, which will widen the space between the road and the building to 4.3m, to accommodate a 2.5m wide two-way cycle track and a 1.8m wide footpath.

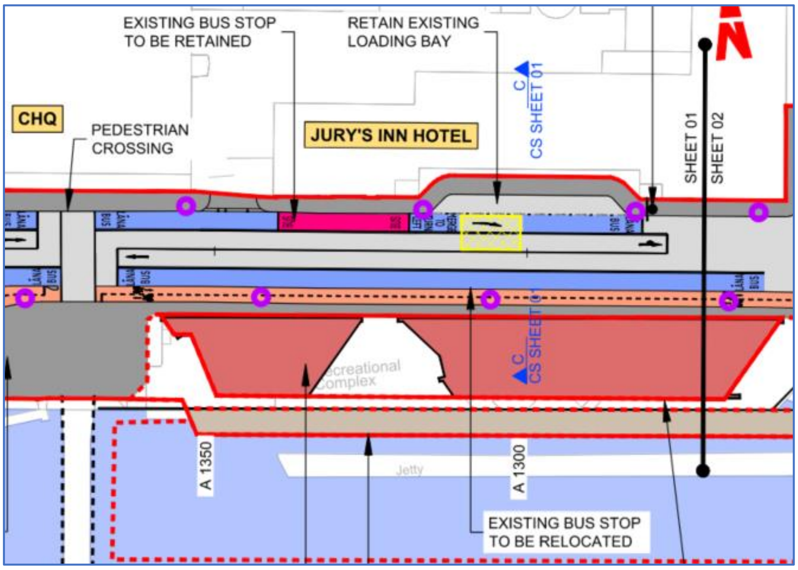

Figure 3-6a: Proposed Road Layout at Custom House Quay West

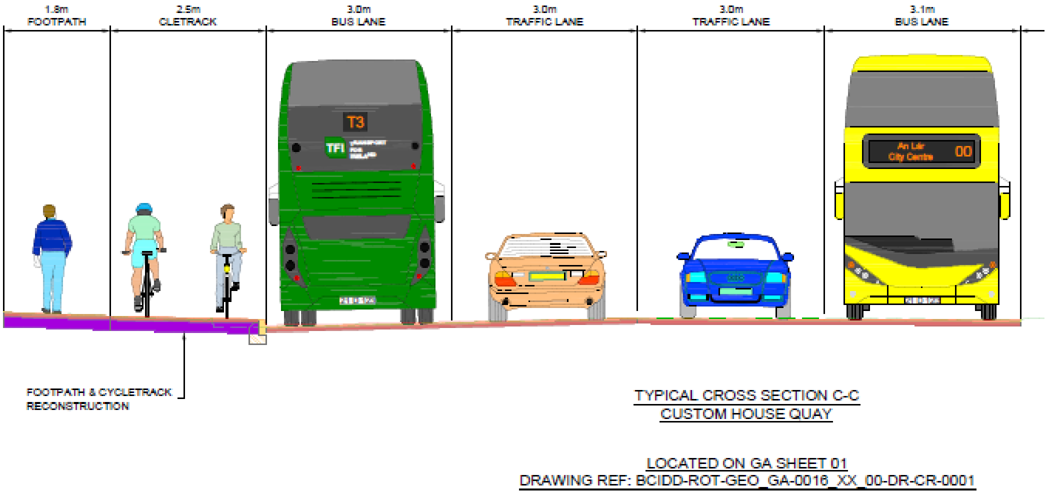

Figure 3-6b: Proposed Road Cross Section at Custom House Quay West

The proposed boardwalk at Custom House Quay will complement other interventions proposed as part of the Proposed Scheme to establish the primary pedestrian route along the riverside. As part of these works, the existing trees between the Docklands Office and the road will be removed, and the existing lighting columns will be relocated. The existing westbound bus stop at Ch 1490 will be relocated to Ch 1400. The existing eastbound bus stop at Ch 1325 will be retained to serve north quays bus services. It is no longer proposed to permit non Dublin Bus services to stop at this location. The existing pedestrian crossings at Sean O Casey Bridge and on the east side of the Commons Street junction will be widened and extended across the cycle track on the southern side. The existing pedestrian crossing on the west side of the Commons Street junction will be removed as it will clash with the cycle track.

3.1.4 North Wall Quay from Commons Street to Guild Street

This section is 320m long on North Wall Quay from the junction with Commons Street to the junction with Guild Street.

From Commons Street to Guild Street there is no eastbound bus lane over a length of 300m. The existing road carriageway on this section of North Wall Quay is typically 11.3m wide which is insufficient to accommodate 4 x 3m wide lanes. The road carriageway will be widened a little along the river side to provide a width of 12m for 4 lanes, with 2 bus lanes and two traffic lanes in each direction.

Figure 3-7: Existing Road Layout on North Wall Quay (looking west)

In the vicinity of the junction with Excise Walk at Chainage A-1,090 there is a pair of existing restaurant buildings on the campshire that form an obstacle for pedestrians and cyclists. The current arrangement causes an 80m long gap in the westbound cycle track and on the riverside the walkway is only 2m wide which detracts from the amenity value of the River Liffey campshire. This situation is illustrated in Figure 3-8.

Figure 3-8: Restaurant Building on the North Wall Quay Campshire (looking east)

At the Commons Street junction the westbound right-turn will be restricted for general traffic so as to avoid blocking of the through traffic lane and possible interference with the westbound bus lane. Traffic can divert to the north along Sheriff Street and Seville Place instead. Right turning movements for buses and coaches only will be permitted from the westbound bus lane at Commons Street which will be controlled by an advance traffic signal before general traffic is released.

A 3.5m wide two-way cycle track will be provided along the southern side of the road, and it will be mostly separated from the road edge by a 2.5m wide buffer zone planted with street trees. At the restaurant buildings on the campshire the cycle track will be aligned directly along the road edge over a length of 80m and this will replace the existing footpath. The cycle track will narrow to 2.6m to fit in the space available between the glass buildings and the roadside. The pedestrian crossing from Excise Walk will be upgraded to a toucan crossing and will be extended across the cycle track. To provide a suitable wating area for turning cyclists wishing to cross the road to Excise Walk, turning pockets will be provided, which will require a small degree of encroachment into the outdoor seating areas at the two restaurants for which small areas of property will be permanently acquired.

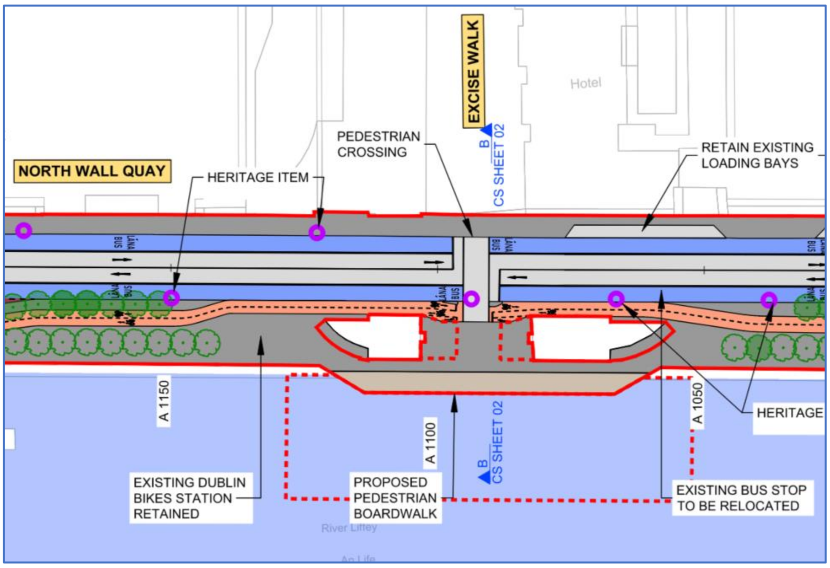

Figure 3-9: Proposed Layout on North Wall Quay with Proposed Boardwalk on the River Side

The pedestrian route along the river will pass around the southern side of the restaurant buildings at the riverside quay wall where a new cantilever boardwalk will provide a 6m wide walkway over a length of 60m.

Figure 3-10a: Proposed Boardwalk on North Wall Quay at Excise Walk

Guild Street Junction at Samuel Beckett Bridge

The junction of North Wall Quay and Guild Street at the Samuel Beckett Bridge is usually congested at peak periods with queues on the approaches. There is significant demand for a continuous eastbound bus lane to cater for a large number of bus, coach and taxi services along this very busy route on the way to Dublin Airport and further north via the Dublin Tunnel. There are some existing turn restrictions for traffic at this junction, including the northbound right turn and the westbound left turn. To enable a continuous eastbound bus lane it is proposed to restrict the eastbound right-turn for general traffic and to remove the right-turn lane on North Wall Quay, with that space reallocated to a bus lane. Buses may turn right from this eastbound bus lane with an early start right-turn filter traffic signal, which will accommodate one of the proposed new city bus services. The eastbound left-turn will also be restricted to remove conflicts across the bus lane. Traffic can divert upstream instead via Commons Street and follow Mayor Street to Guild Street.

In the westbound direction there is no right-turn lane, but traffic is permitted to turn right into Guild Street, and occasional waiting vehicles can sometimes block the single westbound through lane on the narrow Scherzer Bridge at Spencer Dock immediately east of the junction. To avoid this problem it is proposed to also restrict the westbound right turn. There is an alternative route available via Park Lane and Mayor Street to the east.

The southbound left-turn from Guild Street onto North Wall Quay will be restricted so as to enable the parallel cycle route and pedestrian crossing to run at the same time as general traffic in the north-south direction. This will provide a considerable improvement for the north-south cycle route alongside the Royal Canal, which is a major orbital route linking around the northern side of the city centre, and for the connection across the River Liffey to the South Docklands area and the Grand Canal southern orbital cycleway. An alternative route for traffic will be provided along Mayor Street one block to the north of the river, where a new eastbound link will extend to Park Lane that connects to North Wall Quay east of the Convention Centre.

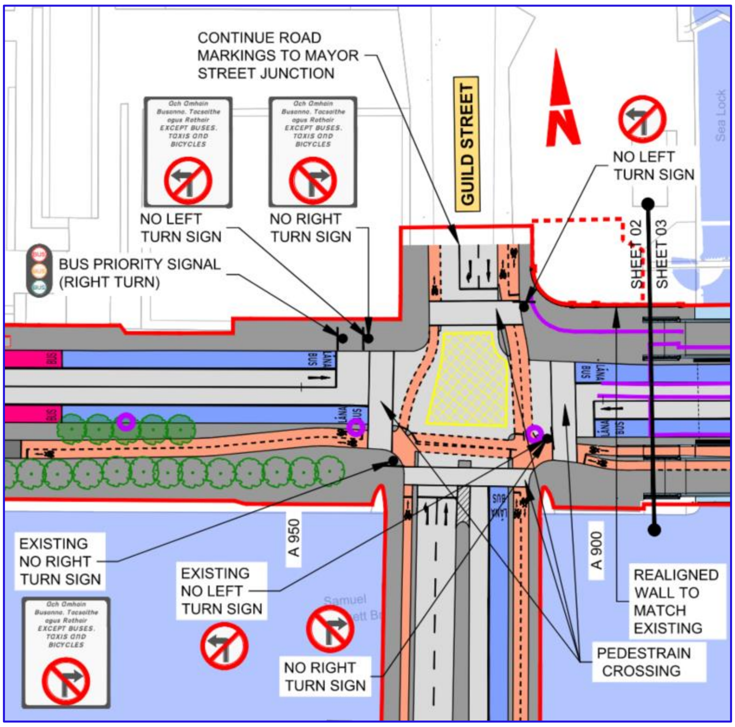

Figure 3-10b: Proposed Traffic Turn Restrictions at Guild Street Junction

3.1.5 North Wall Quay from Guild Street to Tom Clarke Bridge

This section is 930m long on Custom House Quay from the junction with Guild Street to the Point Roundabout junction with East Wall Road at the northern end of Tom Clarke Bridge.

Minor road widening of up to 1.5m will be required on parts of this section of North Wall Quay to provide continuous bus lanes in both directions as an improvement to the existing layout with bus lanes over less than a third of the length in each direction. In order to protect westbound bus priority right turning restrictions are proposed at the junctions at Castleforbes Road and North Wall Avenue where alternative access is available from and Sheriff Street Upper to the north. This allows the removal of existing right turn pockets, and the increased road space will be allocated to providing continuous bus lanes. Similarly, where bus lanes were previously broken to permit general traffic to make left turns, this will no longer be permitted, and all such manoeuvres will take place from the general traffic lane. Right turn manoeuvres for local access will be permitted at Park Lane, including to the National Convention Centre car park. The right-turn at New Wapping Street will be retained to accommodate heavy goods vehicle movements in accordance with the Dublin City HGV Management Strategy and to provide access to Dublin Port Terminal 3 on East Wall Road.

The historic lifting Scherzer Bridges constrain the road width at the crossing of the entrance to the Royal Canal at Spencer Dock. These historic structures no longer serve their original opening function and are unsuitable to the needs of the modern street which is much busier since the expansion of the city eastward, and they will be carefully dismantled and removed from site for restoration. A new four lane concrete road bridge will be constructed to carry the bus lanes and general traffic lanes instead of the removed old bridges. The recently constructed steel pedestrian and cycle bridges at the confluence of the Royal Canal with the River Liffey will be removed and returned to Dublin City Council for possible re-use elsewhere to allow the relocation of the Scherzer Bridges at Spencer Dock. The pedestrian and cycling routes will be diverted through the refurbished and restored Scherzer bridges.

Waterways Ireland has highlighted the need to maintain navigation along the Royal Canal into the future. Since the Liffey is tidal at this point, as sea levels rise, it will become increasingly difficult to access the canal beneath the North Wall Quay bridges. The existing Scherzer Bridges can be opened (subject to maintenance) and their replacement with a concrete structure would preclude this potential. Therefore, it is proposed to lift the soffit levels of all of the structures at Spencer Dock by c. 1m in order to provide climate change resilience and maintain the existing level of canal accessibility for the foreseeable future. The historic capping stones along the quay walls will be unaffected and the levels will be lifted behind them. The levels of footways and roadways adjacent the canal and conference

Figure 3-11: Existing Road Layout in Section 1.1C at the Convention Centre

The area in front of the National Convention Centre will be raised to suit the revised bridge soffit levels at the Royal Canal. The existing landscaping features will be reinstated at the higher level or replaced with revised landscaping to suit Dublin City Council's overall Campshires strategy. The steps to the Convention Centre will be unaffected. A new lay-by for coaches is proposed on the riverside of the road to allow private bus services to stop without affecting the through Dublin Bus services. Separate Dublin Bus stops will be provided in both directions at Ch 800 westbound and Ch 750 eastbound.

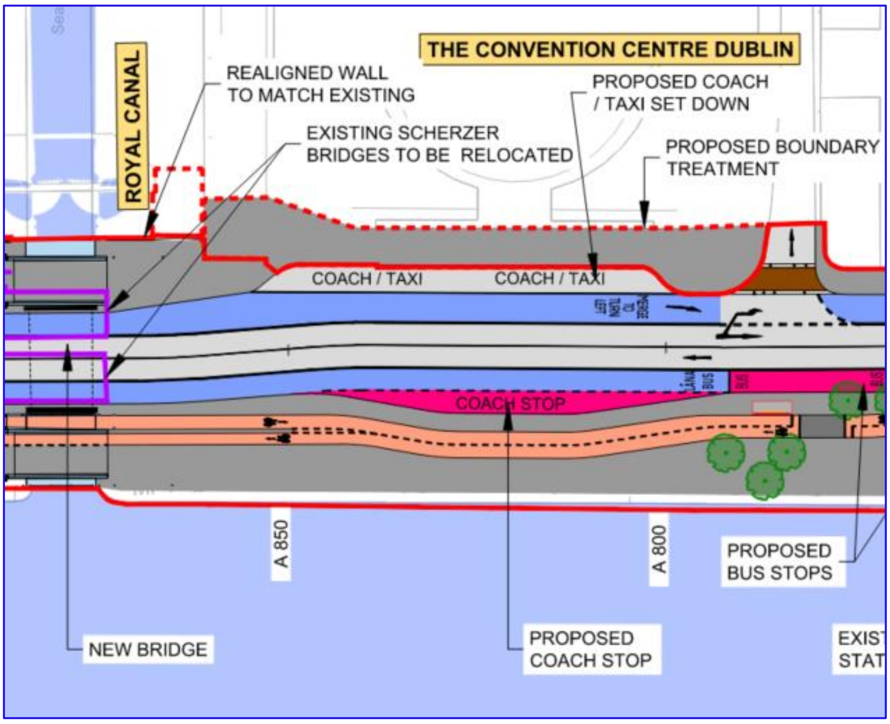

Figure 3-12: Proposed Road Layout in Section 1.1C at the Convention Centre

3.1.6 Section 1.1: General Proposals

Bus Stops in Section 1.1

In-line bus stops are proposed along the northern footpath where there is no conflict with any other mode, cyclists in particular.

Island bus stops will be provided on the southern side of the road along the campshires to separate patrons from cyclists while waiting at the stop. Access to these island bus stops will be by way of a raised platform crossing across the cycle track.

Parking in Section 1.1

All existing parking will generally be removed along the North Quays to provide the necessary road space for continuous bus lanes. On the river side there are 4 short parking laybys that provide 11 parking spaces which will be removed to allow an improved alignment for the cycle track and to remove conflicts at access to the parking spaces. There is alternative public parking available nearby on side streets and in an off-street car park at the *Point Square*.

Figure 3-13: Existing parking layby on the river side in Section 1.1C

Ancillary Works in Section 1.1

The existing road pavement along much of Section 1 will require repair and strengthening due to wear and tear from heavy traffic over the years on what was once the main access route to Dublin Port for heavy goods vehicles.

Disruption to utility services will be limited along Section 1.1 but where required, existing services will be protected, such as watermains, ESB and Gas, or diverted as necessary and as described in Chapter 10 of this PDR. Existing drainage will be retained where practicable or repaired as required. Some gullies will be relocated to suit the proposed new kerb alignments. Gullies will be amended to kerb gullies where they would otherwise coincide with bus wheel tracks.

A general landscaping improvement is proposed along the north quays, with lines of trees along the proposed cycleway. Dublin City Council has separate complementary plans to improve the public realm on the campshires east of the Samuel Beckett Bridge, and the BusConnects works will only include the areas necessary for improvements for public transport, cyclists and pedestrians.

3.1.7 Section 1.2: South Bank of the River Liffey

Section 1.2 of the Proposed Scheme commences at the junction of City Quay and Talbot Matt Talbot Bridge and will extend eastwards along City Quay, Sir John Rogerson’s Quay and Britain Quay to the mouth of the River Dodder over a distance of 1.4km. At the River Dodder there is a 200m gap with no existing link to the southern end of the Tom Clarke (East Link) Bridge at Ringsend, which is a distance of 1.6km east of the start of this section.

The key proposal in Section 1.2 will be the provision of a new link to Ringsend from Britain Quay at the eastern end with the proposed Dodder Public Transport Opening Bridge across the River. This new link will open up a new route for public transport to the Poolbeg Peninsula east of Ringsend where major development is proposed for a significant new residential population.

Due to the constraints at the Samuel Beckett Bridge and in the section of Sir John Rogerson’s Quay to the west of the bridge, it is proposed for the core bus corridor to be one-way westbound only in the western part of Section 1.2. Eastbound buses will share the other bus corridor on the northern side of the River Liffey from Matt Talbot Bridge to the Samuel Beckett Bridge where they can turn south across the bridge and then continue eastwards along the southern side. Continuous bus lanes are not required in Section 1.2 as the traffic flows along the south quays are generally very low for local access only. Instead, bus priority will be achieved through the provision of intermittent sections of bus lane and signal controlled priority to ensure bus priority on the approaches to the major junctions.

There is an existing two-way cycle track along much of Section 1.2 from Matt Talbot Bridge to Forbes Street as shown in Figure 3-14. This will be extended eastwards over the full length of the section, which will entail widening of an existing single track cycleway along the campshire area east of Forbes Street.

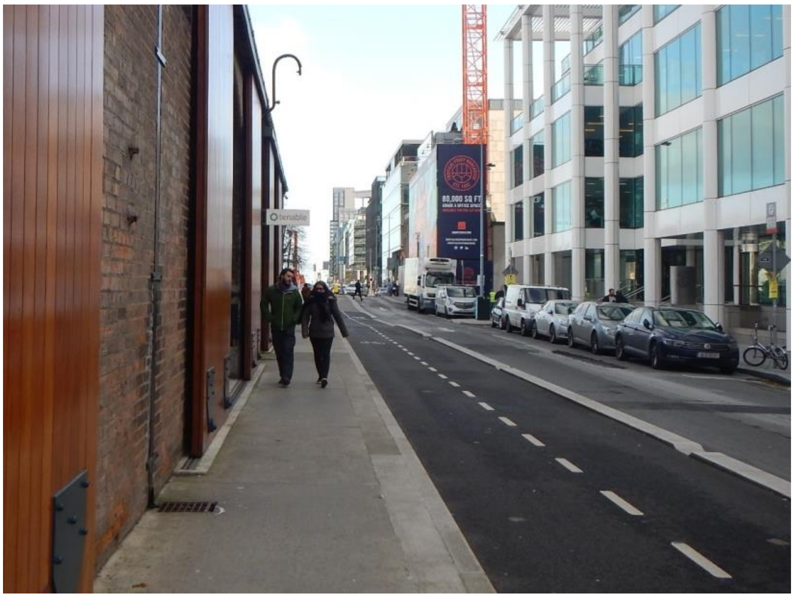

Figure 3-14: Narrow section of Sir John Rogerson's Quay with two-way cycle track

3.1.8 City Quay and Sir John Rogerson's Quay from Matt Talbot Bridge to Samuel Beckett Bridge

For bus priority a westbound bus lane will be provided on City Quay west between Lombard Street East and Matt Talbot Bridge over a length of 220m, reducing the existing two-lane eastbound traffic arrangement to one lane. This will enable a contra-flow bus link to George's Quay against the current one-way eastbound traffic flow. Modifications will be required at the junction of Matt Talbot Bridge and City Quay to accommodate the eastbound bus lane.

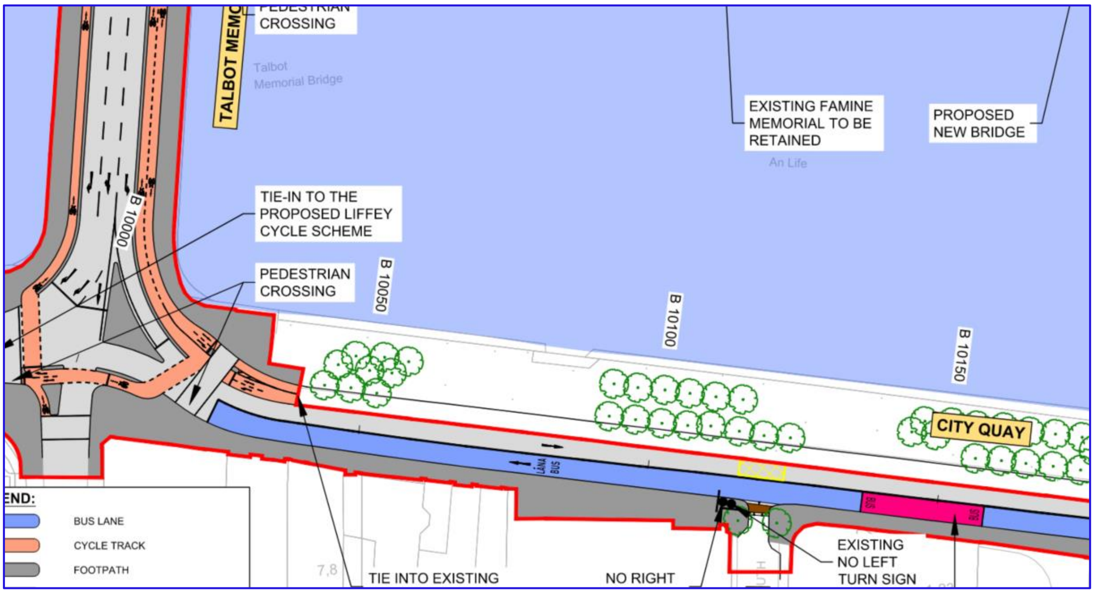

Figure 3-15: Proposed Road Layout on City Quay

The proposed contra-flow eastbound bus lane will commence at the junction of City Quay and Lombard Street East which will require to be modified to allow for through bus movements from east to west, acting as a bus gate. This will require removal of the existing triangular traffic island in the middle of the junction and relocation of the pedestrian and cycle crossings to the entry arms of the junction.

Figure 3-16a: Existing layout at the junction of City Quay and Lombard Street East

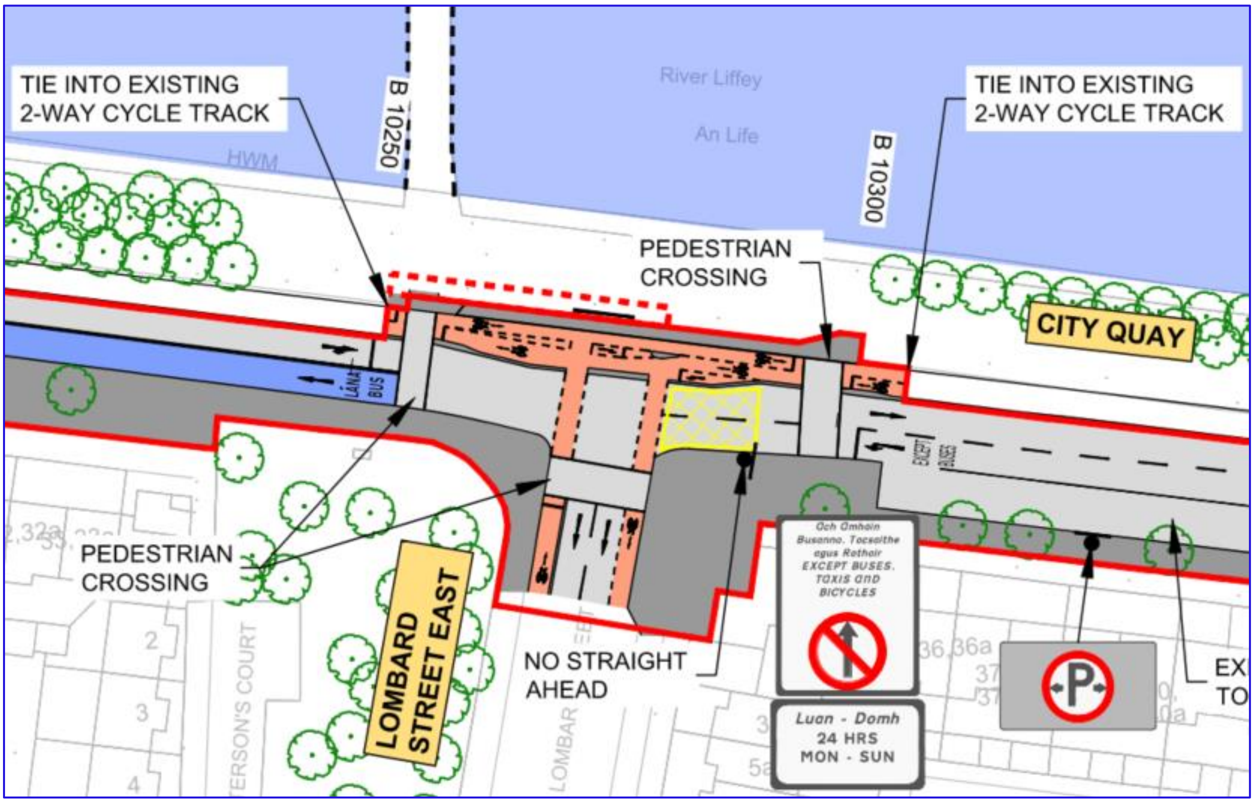

Figure 3-16b: Proposed layout at the junction of City Quay and Lombard Street East

From the junction at Lombard Street East to the Samuel Beckett Bridge there will be no change to the existing road layout.

3.1.9 Samuel Beckett Bridge to the River Dodder

At the junction at the southern end of Samuel Beckett Bridge a new northbound cycle track is proposed to link from Cardiff Lane through the short section on Sir John Rogerson's Quay to the western side of the bridge. This will include a new signal controlled crossing of the westbound traffic lane at the southwestern corner of the bridge, with a new pedestrian crossing adjoining.

For bus priority a westbound contra-flow bus lane will be provided on Sir John Rogerson's Quay between Forbes Street and Cardiff Lane to ensure westbound bus priority through the junction at the southern end of Samuel Beckett Bridge, and this will continue to the southwestern corner of the bridge where signal-controlled priority will be provided for buses to move ahead of general traffic., thus acting as a bus gate. Westbound general traffic on Sir John Rogerson's Quay will divert south at Forbes Street and link through Grand Canal Square to Cardiff Lane.

Eastbound buses will come across the Samuel Beckett Bridge to connect from the north quays to the south quays. At the southern end of the bridge signal-controlled priority will be provided, acting as a bus gate in both directions, for buses to move ahead of general traffic around the corner onto Sir John Rogerson's Quay, and also for some buses headed southwards into Cardiff Lane. The existing road carriageway is 7m wide on this link, and this will be narrowed to facilitate widening of the adjoining cycle track which is a bit too narrow. Additional cycle links will be provided from the cycle track on the campshire to Cardiff Lane so that cyclists can more easily cross the major junction. At the northern side of the junction at Cardiff Lane the existing flood wall will be moved northwards closer to the river to provide more space on a busy pedestrian route.

Along Sir John Rogerson's Quay, the existing two-way cycle track ends at Forbes Street, and this will be extended for 485m to the end of the quays at Britain Quay. The cycle track will deviate around two island bus stops in this section. There is one existing signal-controlled junction at Forbes Street and one new signal controlled junction will be provided at Blood-Stoney Road. At three other side streets there will be uncontrolled crossings for cyclists and pedestrians from the campshire across Sir John Rogerson's Quay.

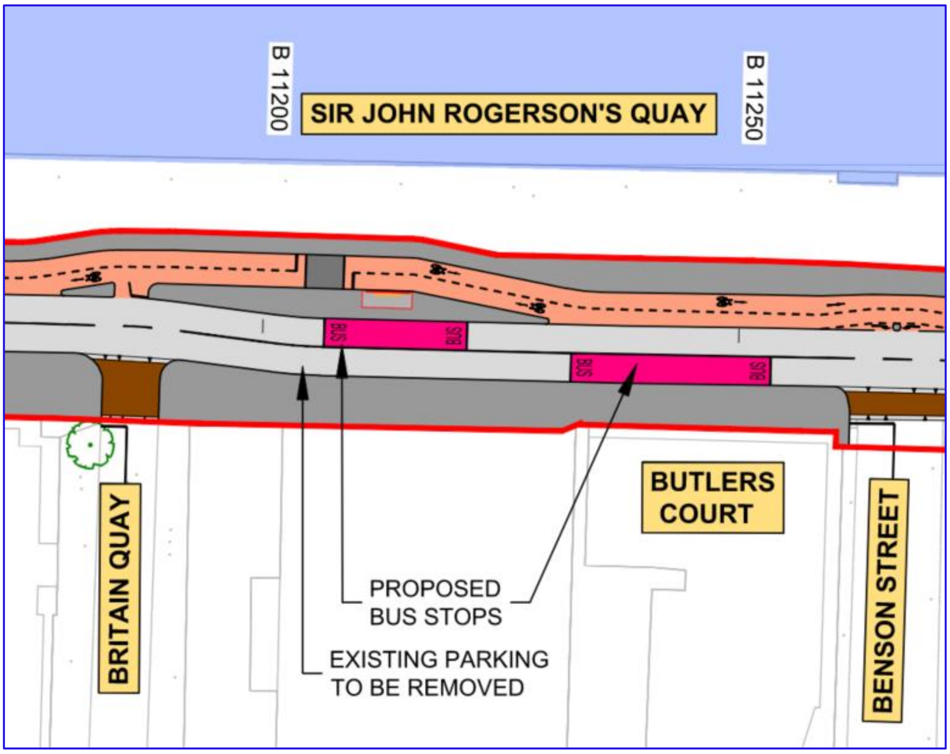

Figure 3-17: Typical proposed layout in Section 1.2B

3.1.10 The River Dodder Public Transport Opening Bridge

The Proposed Scheme includes the proposed Dodder Public Transport Opening Bridge across the mouth of the River Dodder and the access to the Grand Canal Basin as shown in Figure 3-18.

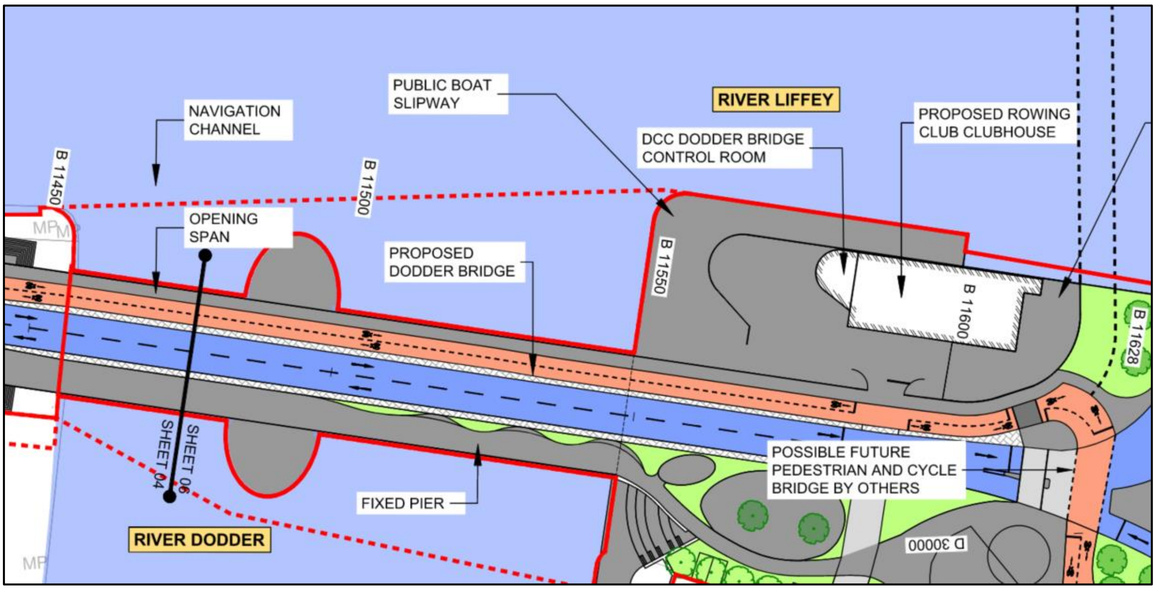

Figure 3-18: Plan of the proposed River Dodder Public Transport Opening Bridge

The proposed bridge will be 96m long and 20.7m wide and will cross over the mouth of the River Dodder from Britain Quay to provide a new 200m long connection to East Link Road in Ringsend. The bridge will facilitate buses, taxis, pedestrians, and cyclists to cross the River Dodder to connect to Ringsend at York Road. No general traffic will be permitted to use this bridge crossing. It will have three spans as shown in Figure 3-19, and the western span will open vertically for passage of boats to the Grand Canal Basin a short distance to the south. A Preliminary Design Report for this bridge is included in Appendix J1.

Figure 3-19: The proposed River Dodder Public Transport Opening Bridge (viewed from the southeast side at Ringsend)

On the eastern side of the river it is proposed to reclaim an area of about 0.3 Hectares from the river estuary to provide land on which the approach road to the new bridge can be supported. A new river quay will be constructed to fill in the south-eastern corner of the River Dodder mouth, where there are tidal mud-flats. The existing situation is shown in Figure 3-20a where there is a triangular area of land at the southwestern corner of the Tom Clarke Bridge. This land was previously reclaimed in the 1980's when the Tom Clarke Bridge was constructed, and East Link Road was constructed on fill within the River Liffey estuary.

Figure 3-20a: Existing situation at the River Dodder Mouth at Ringsend

The proposed land reclamation area is shown on Figure 3-20b with a red dashed line indicating the approximate existing shoreline across the southeast corner at the confluence of the River Dodder with the River Liffey.

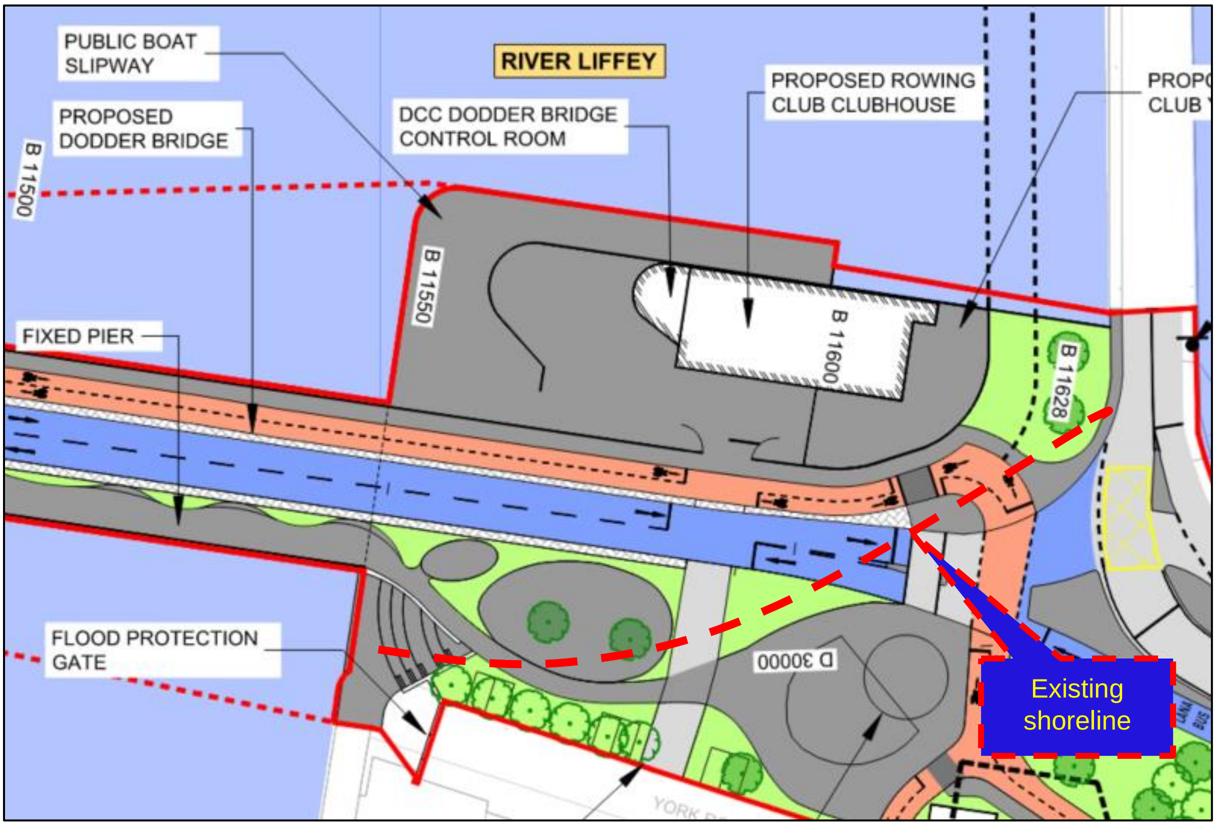

Figure 3-20b: Proposed Land Reclamation east of the River Dodder Public Transport Opening Bridge at Ringsend

St. Patrick's Rowing Club, Ringsend

At the proposed location for the River Dodder Public Transport Opening Bridge on the east bank of the river there is a small open public amenity space on the southeast corner of the confluence of the River Dodder and the River Liffey as shown in Figure 3-21. St. Patrick's Rowing Club is also located at the southeast corner of the confluence with the River Liffey and the River Dodder. There is a clubhouse on Thorncastle Street on the southern side of the public open space, and the jetty for access to the River Liffey is located on the northern side adjacent to Tom Clarke Bridge as shown in Figure 3-21.

The proposed public transport link road and cycleway to connect from the proposed new bridge will extend across this existing open space to connect from Britain Quay on the western side to the East Link Road on the eastern side as shown by the dashed red line on Figure 3-21. The proposed land reclamation from the river will support the proposed new road on the eastern side of the new bridge and will provide compensatory public open space to replace the area lost under the new road. However, the proposed link road to the new bridge will cut between the existing clubhouse and the jetty in the River Liffey, as may be seen Figure 3-21, which will impact on the operations of the rowing club.

Figure 3-21: Amenity Area at the River Dodder Mouth at Ringsend

Several options were considered to address this situation as follows:

1. Retain the existing rowing club facilities in their current positions: This was ruled out for health and safety concerns about the need to cross a potentially busy road junction with large bulky equipment (6.5m long boats, etc), especially for the largely juvenile membership of the rowing club.
2. Relocate the jetty into the River Dodder to south of the proposed bridge: This is not feasible because the River Dodder is too shallow and could not provide a suitable launch location at low tide. There is an existing public slipway at the end of Thorncastle Street on the east bank of the River Dodder, but this can only be used at high tide as it is on the shallow side of the river channel that dries out at most tide levels.
3. An underpass connection: This is not feasible due to flood risk at high tides.

4. Relocate the boathouse to north of the new link road nearer the River Liffey and jetty. This option is satisfactory for the operation of the boat club and avoids severance by the new road.

(For more details refer to relevant technical notes in the appendices to the Preliminary Design Report for the River Dodder Public Transport Opening Bridge, which is in Appendix J1

The Proposed Scheme will therefore require the relocation of the St. Patrick's Rowing Club building to a new site on reclaimed land north of the proposed new link road for the River Dodder Public Transport Opening Bridge as shown in Figure 3-19b. An image of the proposed new clubhouse building is shown in Figure 3-21 as viewed from the Tom Clarke Bridge to the northeast. The proposed River Dodder Public Transport Opening Bridge is visible to the right of the clubhouse. A new slipway will be provided at the western end of the new sea wall on the River Liffey side of the boathouse, and this will provide direct access from the boathouse to the water at all tide levels as it will extend to a level of -2.5mOD, which is 0.7m below mean low water spring tide level (MLWS) of -1.8mOD. The boat club will also adjust their pontoon to suit the new arrangement.

Figure 3-22: Proposed new Clubhouse for St. Patrick's Rowing Club at Ringsend

A control room is required for the operation of the opening mechanism at the proposed River Dodder Public Transport Opening Bridge. This will be located at the western end of the proposed rowing clubhouse building (on the right in Figure 3-22 at ground floor level) where it will have clear visibility of vessel movements along the River Liffey and into the mouth of the River Dodder.

3.1.11 Section 1.2: General Proposals

Bus Stops in Section 1.2

Island bus stops will be provided on the northern side of the road along the campshires to separate patrons from cyclists while waiting at the stop. Access to these island bus stops will be by way of a raised platform crossing across the cycle track. In-line bus stops are proposed along the southern footpath where there is no conflict with any other mode, cyclists in particular.

Parking in Section 1.2

Along the south quays west of the Samuel Beckett Bridges there is a small amount of on-street parking which will all be retained. East of the bridge there is more extensive on-street parking, some of which will be removed. Between Cardiff Lane and Forbes Street the on-street parking and taxi rank along the southern side of the street will be removed to facilitate the westbound contra-flow bus lane. East of Forbes street there are several indented parking bays and these will be retained, but all other on-street parking along the southern side of the street will be removed to facilitate the provision of the two-way cycle track on the northern side of the road which will move the traffic lanes southwards. There is alternative public parking available nearby on side streets and in an off-street car park at the *Grand Canal Square*.

Ancillary Works in Section 1.2

The existing road pavement along much of Section 1.2 will require repair and strengthening due to wear and tear from heavy construction traffic associated with the redevelopment of the south docklands area over the past two decades, and to cater for the expected bus loadings.

Disruption to utility services will be limited along Section 1.2 but where required, existing services will be protected, such as watermains, ESB and Gas, or diverted as necessary and as described in Chapter 10 of this PDR. Existing drainage will be retained where practicable or repaired as required. Some gullies will be relocated to suit the proposed new kerb alignments. Gullies will be amended to kerb gullies where they would otherwise coincide with bus wheel tracks.

Dublin City Council has separate complementary plans to improve the public realm on the campshire east of the Samuel Beckett Bridge, and the BusConnects works will only include the areas necessary for improvements for public transport, cyclists, and pedestrians.

3.2 Section 2: Tom Clarke Bridge to Sean Moore Road

This section consists of a proposed main cycle route to extend for a distance of 1.1km from the southern end of Tom Clarke Bridge through Ringsend and Irishtown as far as the junction of Sean Moore Road and Beach Road as shown in Figure 3-23. It also includes two branch cycle routes linking eastwards to the Poolbeg Special Development Zone (SDZ) where a large new residential population will be accommodated on former industrial lands on the Poolbeg Peninsula south of Dublin Port.

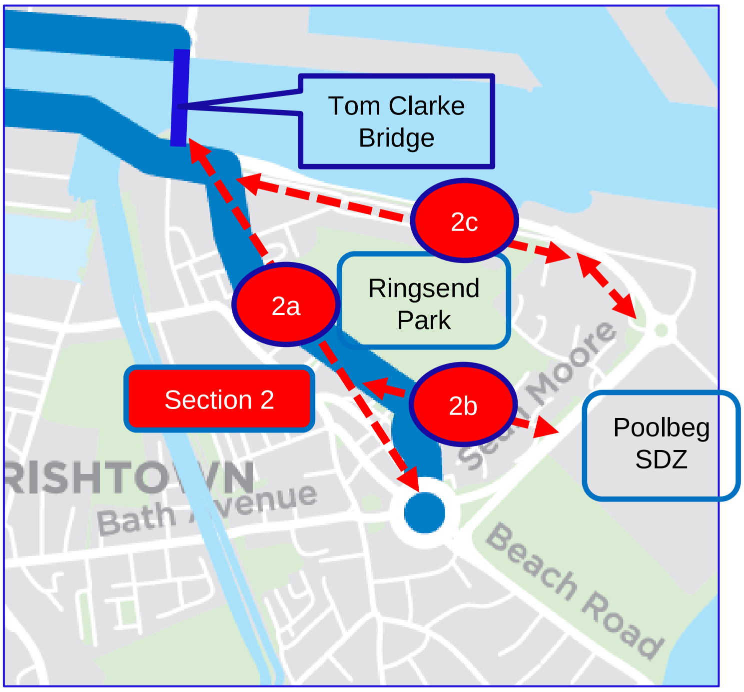

Figure 3-23: Section 2: Proposed Cycle Routes through Ringsend and to Poolbeg

The proposed main cycle route with two branch routes in this section are shown on Figure 3-23 as 2a, 2b and 2c, and they will provide improved cycle connectivity in several respects as follows:

2a) The main Ringsend Cycle Route 2a to Beach Road will form a key central link in the *East Coast Trail* cycle around Dublin Bay, as shown in the *GDA Cycle Network Plan*, extensive parts of which are already completed from Fairview to Sutton on the north side, and from

Booterstown to Sandycove on the south side (with a short gap at Blackrock). This route will consist of a mix of facilities including sections of cycle track, quiet streets, and a shared path with pedestrians in different locations as described later on.

2b) From the southern end of Ringsend Park, a branch Cycle Route 2b as a shared path with pedestrian priority will extend past Irishtown Stadium and through the residential street of Bremen Road to Sean Moore Road at the western edge of the Poolbeg SDZ.

2c) Cycle Route 2c follows the River Liffey along the quiet streets of York Road and Pigeon House Road to the northern end of Sean Moore Road at the north-western edge of the Poolbeg SDZ. This route was closed to through traffic in 2020 and it carries only very low volumes of local access traffic, at low speeds due to traffic calming ramps and the narrow carriageway.

3.2.1 Cycle Route 2a via Ringsend Park

From the southern end of the Tom Clarke Bridge the two-way cycle track will cross the link road from the River Dodder Public Transport Opening Bridge at a signal controlled crossing a shown in Figure 3-24. The cycle track will extend south and eastwards across the public open space beside the east Link Road to Pembroke opposite Pembroke Cottages at York Road. Two gaps will be made in the old sea wall at York Road for the cycle track which will join this quiet local street at a raised platform.

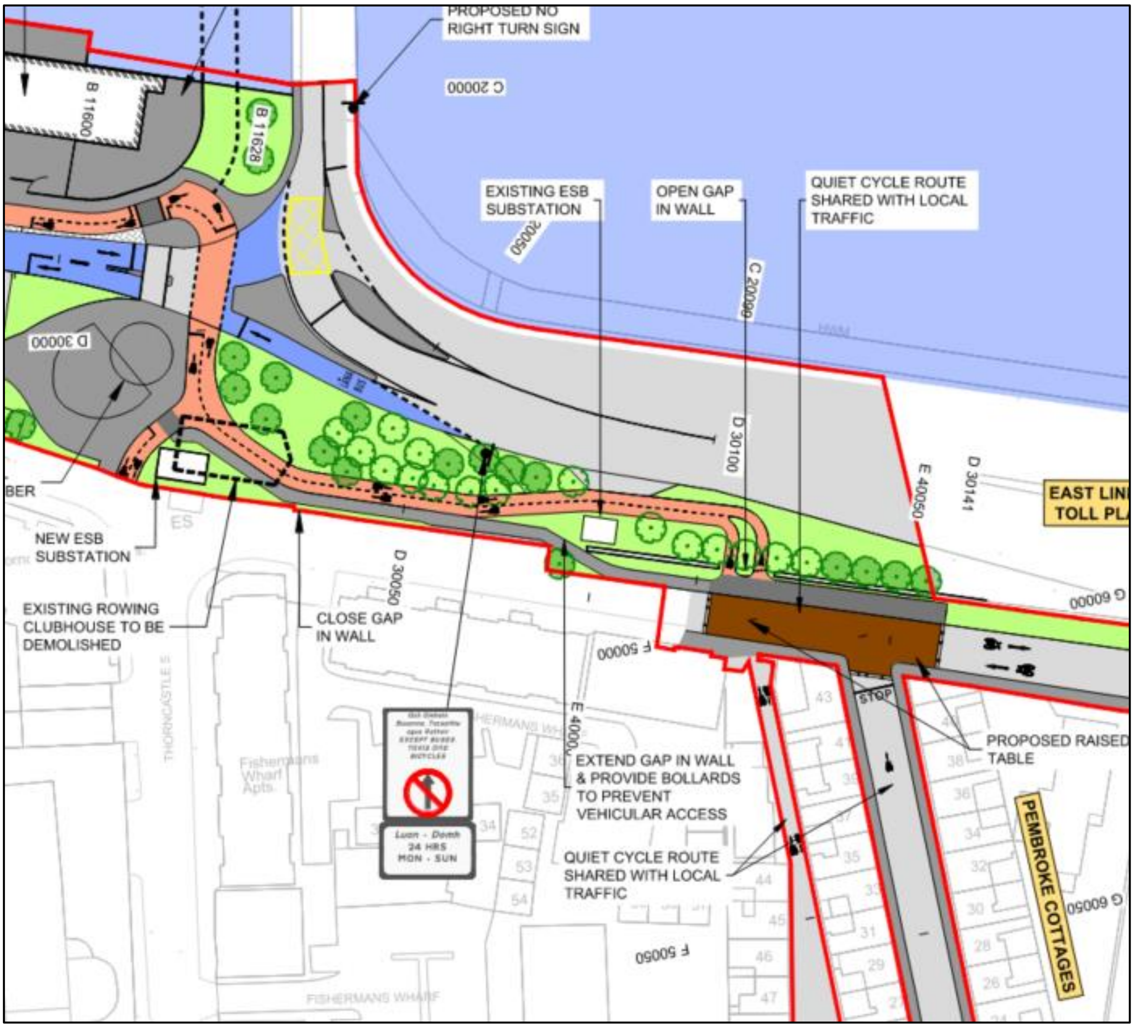

Figure 3-24: Section 2: Proposed Cycle Route 2a at Tom Clarke Bridge & York Road, Ringsend

At York Road Cycle Route 2c branches eastwards along this quiet street.

Pembroke Cottages consists of a narrow quiet street with one-way traffic northbound, and parking on both sides as shown in Figure 3-25a. This street may be used by northbound cyclists, but it is too narrow for contra-flow cycling in the southbound direction. There is a laneway to the rear of Pembroke Cottages on the eastern side as shown in Figure 3-25b which can also be used by cyclists in both directions. No works other than direction signs are required on this 140m long quiet streets link from York Road at the northern to Cambridge Road at the southern end.

Figure 3-25a: Pembroke Cottages

Figure 3-25b: Laneway at Pembroke Cottages

At the southern end of Pembroke Cottages Cycle Route 2a will cross Cambridge Road as shown in Figure 3-26a on a proposed raised platform with zebra crossings to connect into Cambridge Park as shown in Figure 3-26b, and after 70m it will enter Ringsend Park at the north-eastern corner. In this section minor works will be required for the crossing at Cambridge Road, but only direction signs are necessary at Cambridge Park.

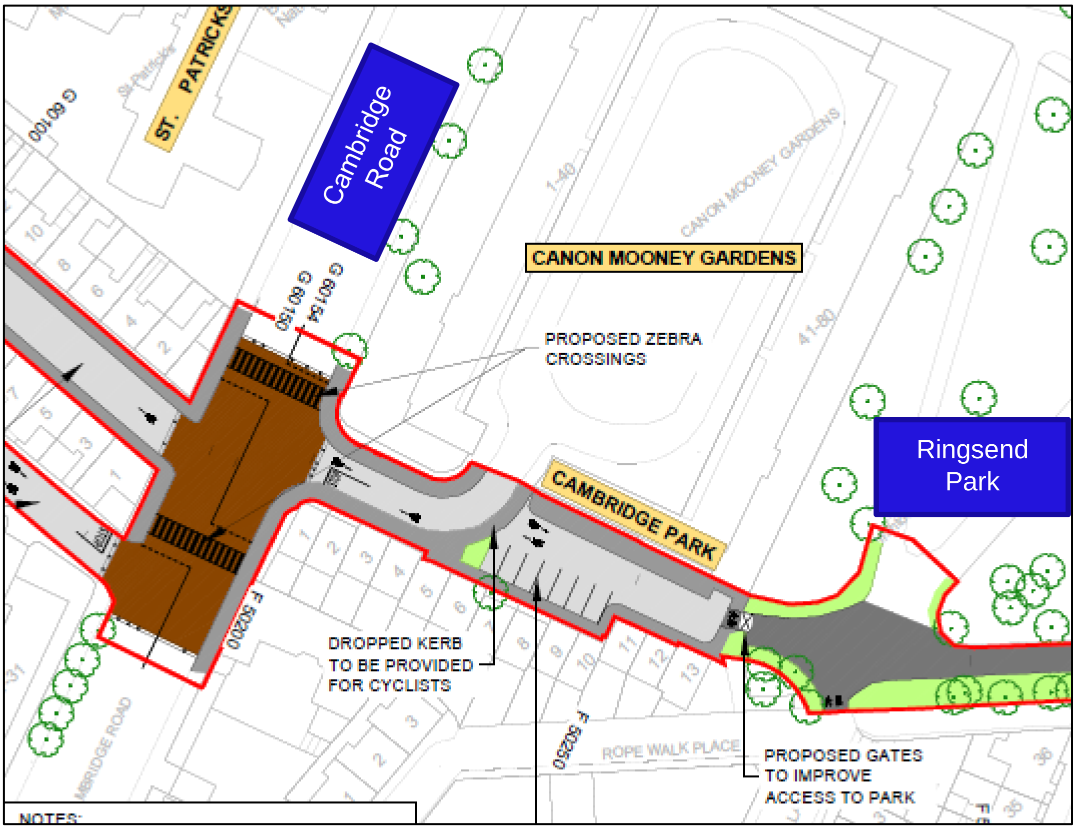

Figure 3-26a: Cycle Route 2a at Cambridge Road to Ringsend Park

Figure 3-26b: Cycle Route 2a at Cambridge Road to Ringsend Park

The proposed Cycle Route 2a will continue southwards through the western edge of Ringsend Park for 380m to the southern gate at Strand Street in Irishtown. This section will consist of a 4m wide shared path with pedestrian priority, similar to the existing arrangement at Fairview Park. Ringsend Park will be open at night and new public lighting will be provided along the shared path. This lighting will be at a low level and will be controlled to minimise light spill and potential impact for bats in the extensive tree lines within the park. The existing footpath in the park is 2.5m wide, and this will be widened to 4m, mainly on the western side so as not to encroach on the adjoining playground and football pitches.

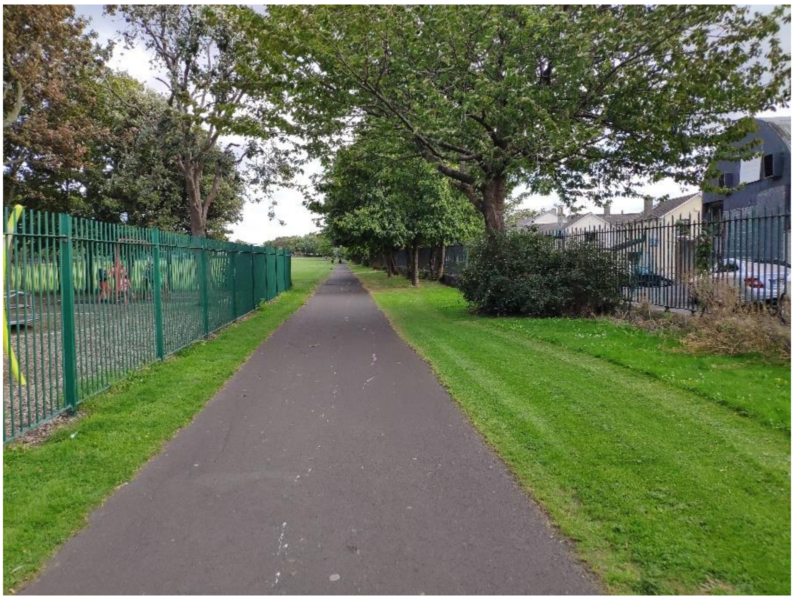

Figure 3-27: Cycle Route 2a at Ringsend Park

At the southern gate of the park the cycle route will exit into a small public car park at Strasburg Terrace off Strand Street in Irishtown as shown in Figure 3-28. The position of 6 parking spaces will be modified to create a wider space for the cycle track to bypass this car park on the eastern side to where it will cross the entrance to Irishtown Athletics Stadium on a raised platform. Just south of this crossing, Cycle Route 2b will branch off to the east.

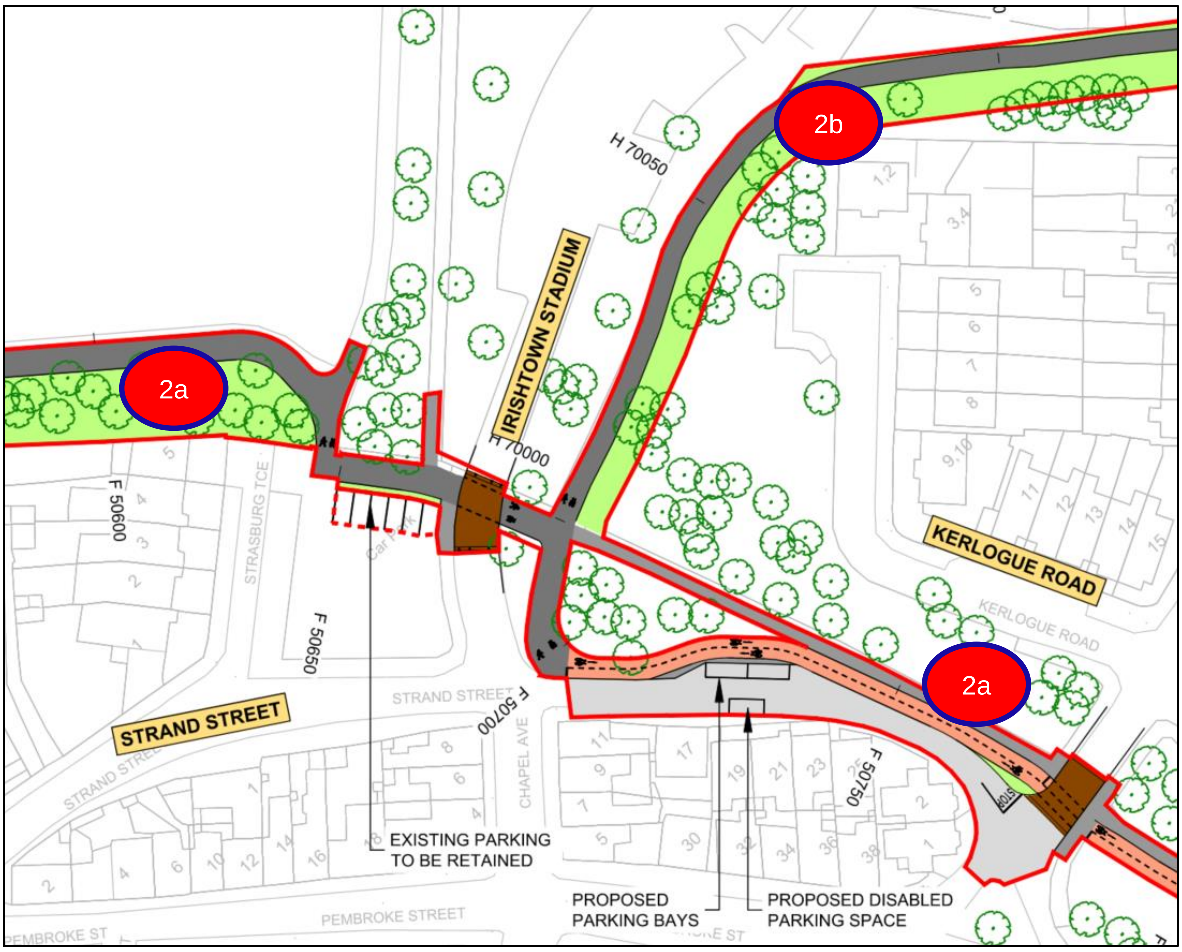

Figure 3-28: Cycle Routes 2a and 2b at Irishtown

As shown in Figure 3-28 Cycle Route 2a will continue southwards from Irishtown Stadium as a two-way cycle track along the eastern edge of Strand Street and Pembroke Street for a distance of 300m. A minor adjustment will be required for parking on Strand Street where the road curves around to the junction at Pembroke Street. The road will be narrowed slightly at the corner and 2 replacement parking spaces will be provided on the eastern side. An existing disabled parking space outside No.25 Strand Street will be relocated 12m northwards to a more suitable place where the street is wider and straighter.

Figure 3-29: Disabled parking space at Pembroke Street, Irishtown

The final section of Cycle Route 2a ends at the junction of Sean Moore Road, which it will cross in two stages to the corner of Sean Moore Park. Another scheme will in future continue the cycle route southwards along Sandymount to Merrion.

3.2.2 Cycle Route 2b via Irishtown Stadium

Cycle Route 2b is a 360m long branch route from Route 2a at Irishtown and will also be a shared path with pedestrian priority that will be widened to 3m. Route 2b will extend for 240m across open public space around the southern side of Irishtown Stadium to join Bremen Road, a quiet residential street which cyclists will share with local traffic for 120m as far as Sean Moore Road, where there have been recent works to provide cycling facilities along the full length.

Figure 3-30: Cycle Route 2b at Irishtown Stadium

3.2.3 Cycle Route 2c via Pigeon House Road

This 1km long branch route departs from Cycle Route 2a at Pembroke Cottages and follows York Road and Pigeon House Road to the roundabout at the junction of Sean Moore Road and East Link Road. No works are required along this quiet street route apart from direction signs. The road was closed to through traffic near the eastern end in 2020, and as a result there is a very low traffic flow.

3.3 Associated Infrastructure Projects and Developments

Various other infrastructure projects are planned within the vicinity of the Proposed Scheme which will interface with the proposals as follows:

3.3.1 Dublin City Council Docklands Centre Redevelopment

Dublin City Council plans to redevelop its offices immediately east of the Sean O’Casey Bridge as part of its planned docklands centre redevelopment in George’s Dock. This has been allowed for in the design of the Proposed Scheme and the design of the proposed new buildings on the campshires allows for the construction of the cantilevered boardwalk now proposed on Custom House Quay

3.3.2 East Wall Road Improvements

Dublin City Council proposes improvements to cycling facilities along East Wall Road and at the Point roundabout. These schemes are still at options development stage and will be subject to separate planning applications. The Proposed Scheme has been designed to be compatible with any future improvements to East Wall Road and/or the Point roundabout, which will allow for onward accessibility from the pedestrian and cycling facilities proposed as part of the Proposed Scheme.

3.3.3 Point Footbridge and Tom Clarke East Link Bridge Widening

Dublin City Council proposes to improve pedestrian and cycle provision at the Tom Clarke East Link Bridge. This will most likely be achieved through the construction of a new opening pedestrian / cycle bridge upstream of the existing bridge. The project may also include the removal of footpaths on the existing bridge and the addition of turning lanes. The project is at the Option Assessment stage. The Proposed Scheme is compatible with any such modifications at the Tom Clarke East link Bridge but is not dependent on its implementation.

3.3.4 Additional Footbridges across the River Liffey

Dublin City Council proposes to develop an additional river crossing between North Wall Quay and Sir John Rogerson's Quay for pedestrians and cyclists. This had originally been proposed at Forbes Street but was subsequently moved to Blood Stoney Road. Dublin City Council is currently reviewing its preferred location for the bridge. The Proposed Scheme is compatible with any such future development.

3.3.5 Liffey Cycle Route and other Cycling Projects

Dublin City Council and the National Transport Authority intend to develop a *Liffey Cycle Route* between the Phoenix Park and Talbot Matt Talbot Bridge. The Proposed Scheme would extend the *Liffey Cycle Route* to the Tom Clarke East Link Bridge. The Proposed Scheme is compatible with any *future Liffey Cycle Route* project, which is subject to its own planning and approval processes, which are yet to commence. In the interim, the Proposed Scheme has been designed to tie-into the existing facilities west of Matt Talbot Bridge.

It is also intended to progress a *Dodder Cycling Route* along the River Dodder from Ringsend upstream to the Dublin Mountains to the southwest, and extensive lengths of this route are already in place between Clonskeagh and Old Bawn. The section of this route east of Clonskeagh in the Dublin City Council area is at Options Assessment Stage. The Proposed Scheme is compatible with any future *Dodder Cycle Route* project, which is subject to its own planning and approval processes, which are yet to commence. In the interim, the Proposed Scheme has been designed to tie-into the existing facilities.

The Proposed Scheme has been designed to connect to other existing and proposed cycling infrastructure identified in the *Greater Dublin Area Cycle Network Plan* and will deliver elements of both the *East Coast Trail* and the *Liffey Cycle Route*. It will be crucial in joining up these various projects, and better connecting them to existing facilities including those along the Royal and Grand Canals, which connect via Samuel Beckett Bridge.

3.3.6 Dublin City Council Campshires Project

Dublin City Council proposes to construct a public realm improvement project along the north and south campshires between Samuel Beckett Bridge and the Tom Clarke East Link Bridge. These works will take place on the remainder of the campshire areas that are not included in the Proposed Scheme, and they will complement the BusConnects proposals.

3.3.7 Poolbeg Strategic Development Zone

Dublin City Council has obtained planning approval for the Poolbeg Strategic Development Zone to develop the brownfield lands between Sean Moore Road and South Bank Road on the Poolbeg Peninsula for the construction of a primarily residential development. The Proposed Scheme will complement this redevelopment, by improving pedestrian, cycling, and public transport connectivity to the development lands.

3.3.8 Private Developments

The Proposed Scheme does not extend onto any private lands for which there are known development proposals that might be affected.

3.4 Integration with Other BusConnects Core Bus Corridor Schemes

The Proposed Scheme will not interact directly with any other proposed CBC Scheme.

In operational terms there will be bus services on the Clongriffin to City Centre CBC that will connect with the Ringsend to City Centre CBC at the junction of Custom House Quay and Memorial Road. The design of the works along and on either side of Talbot Matt Talbot Bridge has taken account of the needs of these other routes, and this has been verified through traffic modelling.

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 Proposed Scheme.

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

Where DMURS contains insufficient design guidance, several documents have been interrogated to provide the correct design guidance including the National Cycle Manual, the TII Design Standards and the Preliminary Design Guidance Booklet for BusConnects Core Bus Corridors.

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

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

Table 4-1 below details the key design parameters which have been generally adopted to inform the Proposed Scheme design layout. The table describes the relevant geometric features set out in order of functional geometrical requirements for each road user including pedestrians(footpaths), cyclists (cycle tracks), bus lanes, general traffic lanes, junctions and parking/loading areas. In designing the geometrical elements of the Proposed 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 4-1: 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)	NDA[1] (Section 1.5.1) DMURS (Figure 4.34)
		Nominal footway widths in moderate – high pedestrian activity areas		2.5m-3m desirable width (moderate to high pedestrian activity area) 3m-4m desirable width (high pedestrian activity area)	NDA[1] (Section 1.5.1) DMURS (Figure 4.34)
	Footway Longitudinal Gradient	New road sections or new offline footpaths		0.5% (1 in 200) absolute minimum 3% (1 in 33) desirable maximum 5% (1 in 20) absolute maximum (where constrained by road geometry and other factors)	DMURS (Section 4.4.6)
		Existing footpaths with localised adjustments		Generally in line with existing site constraints to a maximum of 5% (1 in 20) gradient with no less than 0.5% (1 in 200)	DMURS (Section 4.4.6)
		Ramp gradients – Urban Realm		Nominal gradient of 1 in 25 with landings at maximum 19m intervals and routes with a gradient of 1 in 33 should have landings at no more than 25m intervals with linear interpolation between gradients as required Desirable max gradient 1 in 20 with 0.45m max rise over 9m length between landings	NDA[1] (Section 1.5.2) DN-STR-03005 (Section 6.9, 6.14, 6.15)
		Ramp gradients – Bridge Structures		Desirable max gradient 1 in 20 with 2.5m max rise between landings Absolute max 1 in 15 – 1 in 12 with 0.65m max rise between landings where 1 in 20 is not practical)	
	Footway Crossfall Gradient	Fully reconstructed road sections or new offline footpaths		1 in 50 nominal gradient	NDA[1] (Section 1.5.1.1)

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[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)
		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	5) NCM / BCPDG Section 5
		Minimum cycle track (single file cycling): single-direction, with-flow, raised-adjacent cycle		1.5m minimum width 1m absolute minimum width at constrained island bus stop locations	BCPDG (Section 5.3, 11.2)
		Two-way cycle track (single file cycling)		3.25m desirable minimum cycle track with additional desirable minimum 0.5m buffer & absolute minimum 0.3m buffer	BCPDG (Section 5.3)
		Pedestrian priority zone areas (pedestrian and cyclist) for constrained locations		3m minimum width	NCM 1.9.3
	Horizontal Curvature	Minimum horizontal radius (General Alignment)	20 km/h	10m radius (urban areas)	NCM 4.10.3
			30 km/h	20m	NCM 4.10.3
			40 km/h	25m	NCM 4.10.3
		Minimum horizontal radius (Island Bus Stops)		4m radius (Entry deflection radius) 6m radius (Exit deflection radius)	BCPDG (Figure 34)
		Nominal deflection – Parking & 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

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
Bus Lane	Shared Bus/Cycle Lane	Lane widths (collector/link roads – low speed) in constrained environments	50 km/h	3m max width (consideration for cycle and bus (including taxis + other permitted vehicles) volumes required in addition to bus lane operation hours)	NCM 4.3.3
	Nominal with flow Bus Lane Widths	Nominal lane widths adjacent to cycle track/footpath		3m min width & lane widening as required by vehicle tracking assessment on tight bends	BCPDG (Section 5.1)
		Bus lanes adjacent to on street parking (no cycle track/footpath)		3m min 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	DMURS (Section 4.1.1 & Table 4.1)
	Visibility	Forward Visibility Stopping Sight Distance SSD (Buses & HGV vehicles).	50 km/h	49m	DMURS (Table 4.2 – 50km/h)
	Headroom	Headroom vertical clearance for different structures		Overbridges – 5.3m(new construction), 5.03m (maintained headroom) Footbridges and sign/signal gantries – 5.7m (new construction), 5.41m (maintained headroom)	DN-GEO-03036 (Table 5.1)
Traffic Lane	Design Speed	Design speed for vehicles in general traffic lanes along the Proposed Scheme		50 km/h	DMURS (Section 4.1.1 & Table 4.1)
	Traffic Lane Width	Min carriageway lane width	50 km/h	3m min width & lane widening as required by vehicle tracking assessment on tight bends	BCPDG (Section 5.1)
			60 km/h	3.25m min width	
	Visibility	Forward visibility Stopping Sight Distance SSD (cars & smaller vehicles).	50 km/h	45m	DMURS (Table 4.2 – 50 km/h)
		Forward visibility Stopping Sight Distance SSD (Buses & HGV vehicles).	50 km/h	49m	DMURS (Table 4.2 – 50km/h)
		Visibility to regulatory signage	Up to 50 km/h	60m recommended clear	TSM (Table 5.1)
	Horizontal Curvature	Minimum radius with adverse camber of 2.5%	50 km/h	104m	DMURS (Table 4.3)
	Vertical Curvature	Crest curve K value	50 km/h	4.7	DMURS (Table 4.3)
		Sag curve K value	50 km/h	6.4	DMURS (Table 4.3)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
	Longitudinal Gradient	Longitudinal gradient		0.5% minimum grade 5% desirable maximum grade 8.3% absolute maximum grade	DMURS (Section 4.4.6)
	Cross Fall	Cross-fall		2.5% nominal	DMURS (Section 4.4.6)
All - Junctions	Visibility	Intra-junction visibility envelope		2.5m behind stop lines, inclusive of all signal heads	DN-GEO-03044 (TII DMRB TD50/04) Section 2.10 & 2.14. Figs 2/2 and 2/3.
		Priority junction side road visibility distance (safe gap stopping distance)		X Value = 2.4m 45m SSD (cars & smaller vehicles) 49m SSD (HGV/Buses)	DMURS (Figure 4.63) DMURS (Figure 4.63 / Para 4.4.5)
		Visibility to primary traffic signals	50 km/h	70m desirable min 50m absolute min	TSM (Table 9.1)
	Corner Radii	Few larger vehicles (local streets)		1m -3m radius (subject to vehicle tracking assessment & balance of junction form/function)	DMURS (Section 4.4.3)
		Occasional larger vehicles including buses and rigid body trucks (between arterial and or link streets)		6m maximum radius (subject to vehicle tracking assessment & balance of junction form/function)	DMURS (Section 4.4.3)
		Occasional larger vehicles including buses and rigid body trucks (Arterial/Link to local streets)		4.5m – 6m radius (subject to vehicle tracking assessment & balance of junction form/function)	DMURS (Section 4.4.3)
		Frequent larger vehicles (industrial estates)		9m radius (subject to vehicle tracking assessment)	DMURS (Section 4.4.3)
	Pedestrian Crossings	Signalised crossing type/length *(subject to confirmation by traffic modelling and site constraints)*		Preferred for all locations: Single stage direct crossing up to 19m length Alternative for primary/distributor/dual carriageway roads: Two stage staggered crossings with ideally min 3m staggered offset refuge island (ideally stagger to face oncoming traffic) and ideally min 3m (2m absolute min) wide refuge island. Alternative for primary/distributor/dual carriageway: Two stage crossing in straight crossing with 4m wide refuge island.	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)
				Alternative: Single stage direct crossing greater than 19m length (urban centres)	
		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. 45 degree 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)

4.2 Mainline Cross-section

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

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

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

The desirable minimum width for a single direction, with flow, raised adjacent cycle track is 2.0m. Based on NCM this allows for overtaking within the cycle track. The minimum width is 1.5m. The desirable width for a 2 way cycle track is 3.25m with a 0.5m buffer between the cycle track and the carriageway. 2.0m is a desirable minimum width for footpaths with 1.2m being a minimum width at pinch points.

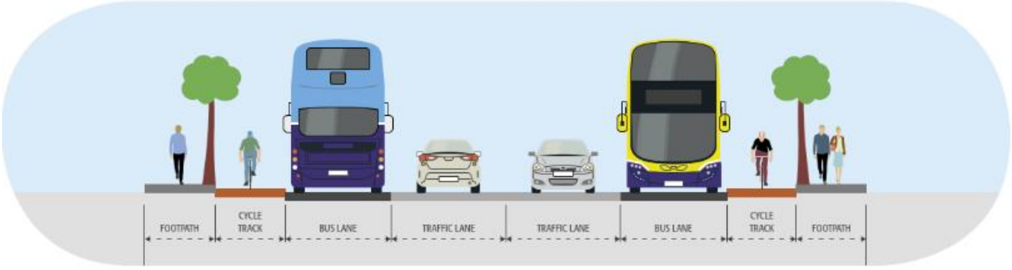


Figure 4-1: Typical CBC Cross Section

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

In the following tables and on the drawings the Proposed Scheme consists of two alignments with associated Chainage references:

Alignment A:

This section extends along the North Quays from the 3 Arena at Tom Clarke Bridge to the junction of Custom House Quay and Memorial Road at Matt Talbot Bridge (CH A 1,610)

Alignment B:

This section extends along the South Quays from Moss St. at Matt Talbot Bridge (CH 10,000) to a location to the east of the proposed Dodder Public Transport Bridge at Tom Clarke Bridge (CH B 11,610).

Table 4-2: Road cross section detail

Location	Existing Outbound Carriageway (eastbound)				Existing Inbound Carriageway (westbound)				Notes
	Proposed Outbound Carriageway (eastbound)				Proposed Inbound Carriageway (westbound)				
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
Ringsend to City Centre Route									
(Alignment A) Custom House Quay to 3 Arena									
CH. A1-600 to CH. A1-450	2.5-3	1.5	N/A	2 × 3.0	3.0	3.0	1.5	13.0-15.0	Central median island varies from 1.0 to 2.0m wide.
	3.5-7.5	N/A	3.0	3.0	3.0	3.0	3.3*	12.0-14.5	*Two-way cycle track
CH. A1-450 to CH. A1-410	3.2-4.5	1.5	N/A	2.6	4.0	N/A	N/A	7.0-7.5	Central median island varies around 4.5m wide.
	10.5	N/A	3.0	3.0	3.0	3.0	3.5*	2.5	*Two-way cycle track
CH. A1-410 to CH. A1-360	3.4	N/A	2.9	3.0	6.1	N/A	1.5	14.5-17.5	Central median island varies from 1.0 to 3.5m wide.
	3.4	N/A	3.0	3.0	3.0	3.0	3.0-3.5*	15.0-15.5	*Two-way cycle track
CH. A1-360 to CH. A1-250	1.5-2.5	N/A	3.5	3.0	3.6	2.9	N/A	3.2-3.5	Parking area bay is of around 3.0m wide on outbound from CH. 1-320 to CH. 1-280.
	2.5-3.0	N/A	3.0	3.0	3.0	3.0	2.5*	1.5-2.0	*Two-way cycle track; Retained existing parking area bay on outbound.
CH. A1-250 to CH. A1-120	3.7-7.5	1.8	N/A	3.5	3.0	2.9	2.5	9.2-10.5	Parking area bay is of around 3.0m wide on outbound from CH. 1-230 to CH. 1-210.
	3.0-7.0	N/A	3.0	3.0	3.0	3.0	3.0*	3.8-9.75	Provided coach stop location on outbound and inbound of width of 3.0m from CH. 1-240 to CH. 1-210 & CH.1-220 to 1-180 respectively.

Location	**Existing Outbound Carriageway (eastbound)** **Proposed Outbound Carriageway (eastbound)**				**Existing Inbound Carriageway (westbound)** **Proposed Inbound Carriageway (westbound)**				**Notes**
	Footpath Width (m)	**Cycle Track Width (m)**	**Bus Lane Width (m)**	**Traffic Lane Width (m)**	**Traffic Lane Width (m)**	**Bus Lane Width (m)**	**Cycle Track Width (m)**	**Footpath Width (m)**	
Ringsend to City Centre Route									
(Alignment A) Custom House Quay to 3 Arena									
CH. A1-120 to CH. A1-060	2.0-4.4	1.8	N/A	3.0	3.0	2.9	N/A	3.8-14.5	Parking area bay is of around 2.4m wide on outbound from CH. 1-080 to CH. 1-040.
	2.0-4.4	N/A	3.0	3.0	3.0	3.0	2.5-3.85*	4.3-10.2	*Two-way cycle track; Retained existing parking area bay on outbound; External boardwalk has introduced on inbound of width of 4.0m from CH. 1-120 to CH.1-060.
CH. A1-060 to CH. A0-930	1.85-5.3	1.5	N/A	2.2-5.2	4.3	N/A	2.5	11.2-14.0	Parking area bay is of around 2.4m wide on outbound from CH. 1-030 to CH. 1-010.
	1.85-5.3	N/A	3.0	3.0	3.0	3.0	3.0*	9.5-10.4	*Two-way cycle track; Retained existing parking area bay on outbound.
CH. A0-910 to CH. A0-860	2.6-3.0	1.7	N/A	3.6	3.6	N/A	1.7+3.4*	7.0-9.5	*Two-way cycle track; Central median island is of 3.3m wide.
	7.8-9.5	N/A	3.0	3.0	3.0	3.0	3.0-3.3*	5.5-8.6	*Two-way cycle track
CH. A0-860 to CH. A0-780	4.4-8.7	1.7	N/A	3.3-4.0	3.0	3.0	3.3*	9.2-13.2	*Two-way cycle track; Parking area bay is of around 4.7m wide on outbound.
	4.4-8.7	N/A	3.0	3.0	3.0	3.0	3.5*	8.5-10.0	*Two-way cycle track; Retained existing parking area bay on outbound & Coach stop location has provided on inbound width of 3.0m.

Location	Existing Outbound Carriageway (eastbound)				Existing Inbound Carriageway (westbound)				Notes
	Proposed Outbound Carriageway (eastbound)				Proposed Inbound Carriageway (westbound)				
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
Ringsend to City Centre Route									
(Alignment A) Custom House Quay to 3 Arena									
CH. A0-780 to CH. A0-700	3.0-5.4	1.4-1.8	N/A	3.0-3.5	3.0	3.0	1.2-2.7	10.8-12.8	Parking area bay is of 2.2m wide on outbound.
	3.0-3.4	N/A	3.0	3.0	3.0	3.0	3.0-3.5*	2.0 min	*Two-way cycle track; **varying
CH. A0-700 to CH. A0-510	1.6-5.2	N/A	2.0-3.0	3.6	3.0-3.4	3.0	1.2-2.7	8.8-11.5	Parking area bay is of 2.55m wide on inbound and outbound.
	3.1-4.1	N/A	3.0	3.0	3.0	3.0	3.5*	2.0 min	*Two-way cycle track
CH. A0-510 to CH. A0-310	3.0-7.3	N/A	3.0	3.5	3.5	N/A	2.7	9.0-11.8	Parking area bay is of 2.75m wide on outbound & loading bay is of 2.90m wide on outbound from CH.0-400 to CH.0-340.
	3.2-5.6	N/A	3.0	3.0	3.0	3.0	3.5*	2.0 min	*Two-way cycle track
CH. A0-310 to CH. A0-040	3.2-4.4	N/A	3.0-3.5	3.0-3.5	3.5**	N/A	2.5-2.7	6.8-10.8	**varies; Parking area & loading bay is of around 3.0m wide on outbound from CH. 0-310 to CH.0-220. Parking area bay is of 2.6m wide on inbound.
	3.2-4.4	N/A	3.0	3.0	3.0	3.0	3.5*	2.0 min	*Two-way cycle track

Location	**Existing Outbound Carriageway (eastbound)**				**Existing Inbound Carriageway (westbound)**				**Notes**
	Proposed Outbound Carriageway (eastbound)				**Proposed Inbound Carriageway (westbound)**				
	Footpath Width (m)	**Cycle Track Width (m)**	**Bus Lane Width (m)**	**Traffic Lane Width (m)**	**Traffic Lane Width (m)**	**Bus Lane Width (m)**	**Cycle Track Width (m)**	**Footpath Width (m)**	
Ringsend to City Centre Route									
(Alignment B) Moss St. to Sir John Rogerson's Quay									
CH. B10+030 to CH. B10+250	2.0 min	2.8-3.3*	N/A	6.5-7.0**	N/A	N/A	N/A	2.0 min	*Two-way cycle track; **One-way traffic
	2.0 min	2.8-3.3*	N/A	3.5	N/A	3.0	N/A	2.0 min	*Retained existing two-way cycle track
CH. B10+250 to CH. B10+700	2.0 min	2.5-3.3*	N/A	3.0-6.5**	N/A	N/A	N/A	2.0 min	*Two-way cycle track; **One-way traffic
	2.0 min	2.5-3.3*	N/A	3.0-6.5**	N/A	N/A	N/A	2.0 min	*Two-way cycle track; **One-way traffic
CH. B10+700 to CH. B10+790	2.0 min	2.0	N/A	6.5	6.5	N/A	N/A	2.0 min	Central median island varies from 1.0 to 2.0m wide. Loading bay is of 2.5 wide on inbound.
	2.0 min	3.0*	N/A	2 × 3.0	3.0	3.0	1.5	2.0 min	*Two-way cycle track
CH. B10+790 to CH. B10+935	2.0 min	2.8*	N/A	3.0	2.4-4.8	N/A	N/A	2.0 min	*Two-way cycle track; Parking area bay is of 2.0-2.4m wide vary on inbound.
	2.0 min	N/A	3.0	N/A	3.0	N/A	3.0*	2.0 min	*Two-way cycle track; Bus-stop Island is of 3.0m wide on outbound.
CH. B10+935 to CH. B11+420	2.0 min	1.5	N/A	3.0-5.3	3.0-5.0	N/A	N/A	2.0 min	Parking area bay is of 2.0-2.4m wide vary on inbound.
	2.0 min	3.0-3.5*	N/A	3.0	3.0	N/A	N/A	2.0 min	*Two-way cycle track; Bus-stop Island is of 3.0m wide on outbound. Provided parking area bay on inbound at various locations of 2.0m wide.
CH. B11+420 to CH. B11+610	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Location of proposed Dodder Public Transport Bridge
	2.0	3.5*	3.0	N/A	N/A	3.0	N/A	2.0 min	Proposed River Dodder Public Transport Opening Bridge; *Two-way cycle track

4.3 Design Speed and Speed Limits

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"*.

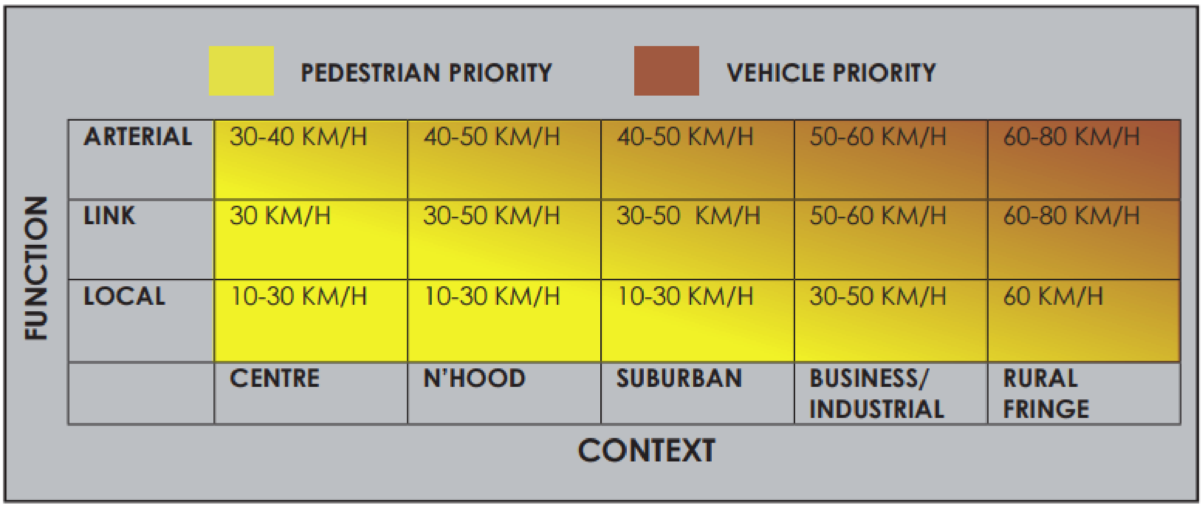
Consideration for selection of an appropriate design speed is undertaken in light of the "Function and Importance of Movement" and "Context" of the street network, as explained further in DMURS Section 3.2. The "Design Speed Selection Matrix" as shown in below is also used to inform the appropriate design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

DMURS advocates an approach to speed that is cognisant of the place and movement function of the road. In relation to 30 km/h speed limits it states:

> *"Lower speed limits of 30km/h are a requirement of Smarter Travel (2009) within the central urban areas, where appropriate."*

and

> *"Where pedestrians and cyclists are present in larger numbers, such as in Centres, lower speed limits should be applied (30-40km/h)."*



🟨 PEDESTRIAN PRIORITY 🟫 VEHICLE PRIORITY

FUNCTION

ARTERIAL	30-40 KM/H	40-50 KM/H	40-50 KM/H	50-60 KM/H	60-80 KM/H
LINK	30 KM/H	30-50 KM/H	30-50 KM/H	50-60 KM/H	60-80 KM/H
LOCAL	10-30 KM/H	10-30 KM/H	10-30 KM/H	30-50 KM/H	60 KM/H
	CENTRE	N'HOOD	SUBURBAN	BUSINESS/ INDUSTRIAL	RURAL FRINGE

CONTEXT

The design speeds used for the existing and proposed mandatory speed limits on the Proposed Scheme are detailed in Table 4-3.

Table 4-3: Existing and Proposed Speed Limits

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)
Alignment A – North Liffey Quays						
A1-600 to A0-040-	Custom House Quay & North Wall Quay	Arterial	Centre	50	50	50
Alignment B – South Liffey Quays						
B10+030 to B10+700	City Quay & Sir John Rogerson's Quay to Beckett Bridge	Link	Centre	30	30	30
B10+700 to B10+780	Sir John Rogerson's Quay: Beckett Bridge to Cardiff Lane	Arterial	Centre	50	50	50
B10+780 to B11+610	Sir John Rogerson's Quay East of Beckett Bridge	Link	Centre	30	30	30
Ringsend & Irishtown						
	York Road, Ringsend	Local	Neighbourhood	30	30	30
	Pembroke Cottages	Local	Neighbourhood	30	30	30
	Cambridge Road	Local	Neighbourhood	30	30	30
	Cambridge Park	Local	Neighbourhood	30	30	30
	Strand Street, Irishtown	Local	Neighbourhood	30	30	30
	Pembroke Street, Irishtown	Arterial	Neighbourhood	50	50	50
	Beach Road, Irishtown	Arterial	Neighbourhood	50	50	50
	Pigeon House Road	Local	Neighbourhood	30	30	30
	Bremen Road	Local	Neighbourhood	30	30	30
	Sean Moore Road	Arterial	Neighbourhood	50	50	50

4.4 Alignment Modelling Strategy

The 3D model design, including the horizontal and vertical alignments, 3D modelling corridors and the associated design features has been developed using the Autodesk Civil 3D software. The purpose of 3D modelling is informing the Proposed 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 practicable. However, the over-riding determining factor for locating the horizontal alignment is to ensure it is positioned in the centre of the proposed carriageway. This is ideally along a central lane marking on the carriageway, in order to minimise rideability issues for vehicles crossing the crown line.

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

However, the philosophy of the design in this Proposed Scheme is the retention of the existing levels all along the routes, specially at footpaths where the levels will require slight changes to adapt appropriate crossfalls and the outer edges of the footpaths will retain the existing levels, especially at the existing accesses.

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.

In light of the above, the existing horizontal alignments of the mainline are retained. The alignment of the Proposed Scheme is generally compatible with the applicable design speed and associated safe stopping sight distances.

4.6 Summary of Vertical Alignment

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

DMURS defines the vertical alignment of a road as follows:

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

Visibility concerns associated with adverse vertical crest and sag curves have not been identified on the Proposed Scheme. The vertical alignment of the proposed road development has 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.

The vertical geometry of the Proposed Scheme takes cognisance of the existing road layout and, particularly through highly constrained locations, and the proposed vertical alignment has been developed to match the existing route.

4.7 Forward Visibility

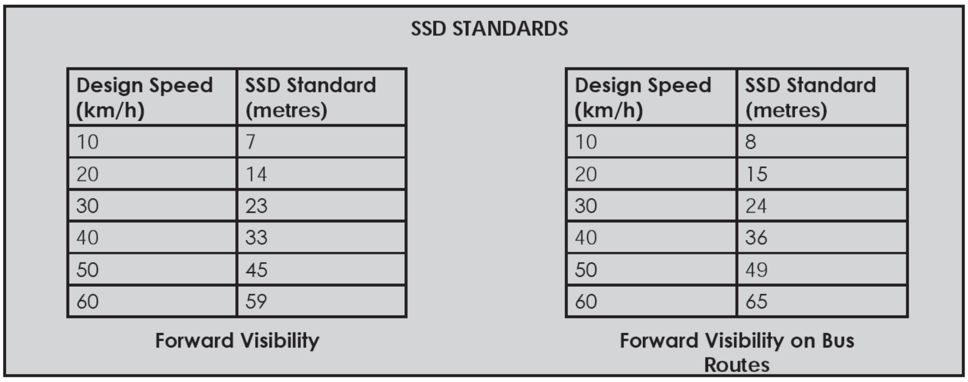
Forward visibility is the distance along the street ahead of which a driver of a vehicle can see. The minimum level of forward visibility required along a street for a driver to stop safely, should an object enter its path, is based on the Stopping Sight Distances (SSD).

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

SSD = perception distance + reaction distance + braking distance.

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

Table 4.4: SSD Design Standards



SSD STANDARDS

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

Forward Visibility

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

Forward Visibility on Bus Routes

4.8 Corner Radii and Swept Path

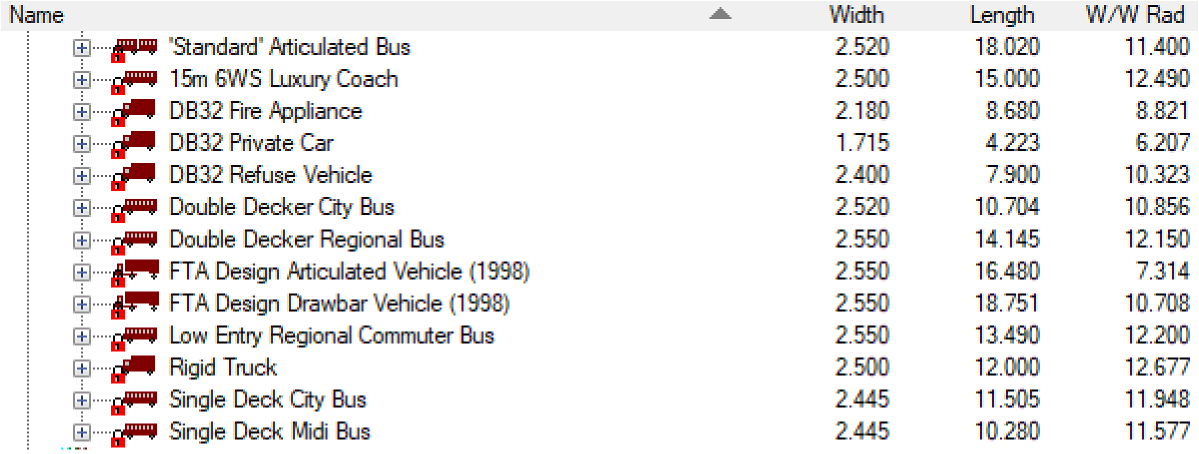
In line with the Proposed Scheme objectives of improving facilities for walking and cycling, corner radii along the route are to be reduced where appropriate in order to lower the speed at which vehicles can turn corners and increase inter-visibility between users.

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. 6m will generally allow larger vehicles, such as buses and rigid body trucks, to turn corners without crossing the centre line of the intersecting road.

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



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

Figure 4-3: Standard Suite of vehicles used for assessment of the Proposed Scheme

In vehicle tracking/ swept path analysis, the list of vehicles and the locations where they have been used is outlined below:

- DB32 Private Car – Analysis undertaken at impacted private residential properties/car parking areas;
- DB32 Refuse Vehicle – Analysis undertaken to ensure refuse vehicles can make 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 concerning bus lanes, including the bus interchange area and at junctions;
- Rigid Truck – Analysis undertaken along the main alignment of the route;
- FTA Design Articulated Vehicle (1998) – Analysis undertaken along the regional roads of the Proposed Scheme.

Some refuge island and some corner radii have been modified to allow vehicles turning path.

4.9 Pedestrian Provision

DMURS defines the footpath cross section by three distinct areas. The ‘footway’ area is designated as the main throughfare within the footpath designated for pedestrian movement along the street. The ‘verge’ area provides an area that can be used for street furniture 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 licenses 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 4-4 below provides an extract from DMURS demonstrating the relevant components of the footpath.

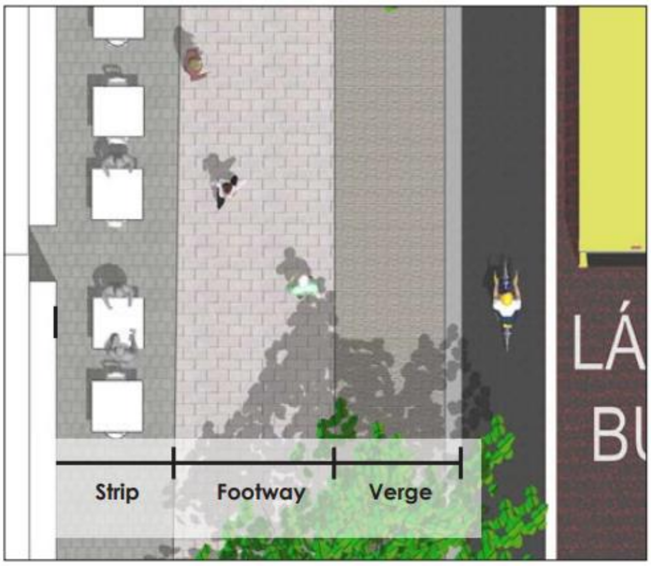


Figure 4-4: Key components of the footpath

4.9.1 Footway widths

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

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

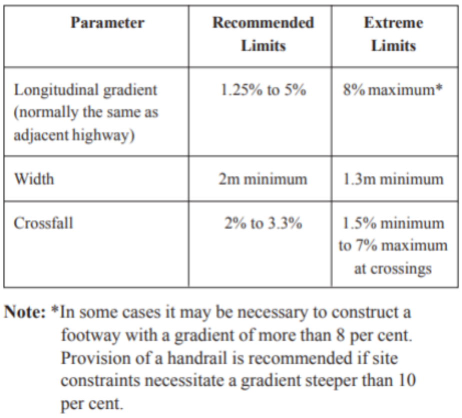
In line with the Road User Hierarchy designated within DMURS, at pinch points, the width of the general traffic lane should be reduced first, then the width of the cycle track should be reduced before the width of the pedestrian footpath is reduced. For the majority of the Proposed Scheme extents minimum 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. The existing and Proposed Scheme nominal footway widths over the length of the corridor have been provided in Table 4-2. The Proposed Scheme will provide significant improvements to the footway width provisions for the most part.

4.9.2 Footway Crossfall

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

Table 4-5: 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, Figure 2.3 shown in Table 4-5 recommends a longitudinal gradient of 1.25%-5%.

Similar to cycle tracks throughout the Proposed 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 possible, DMURS recommends that designers provide pedestrian crossings that allow pedestrians to cross the street in a single, direct movement. To facilitate road users who cannot cross in a reasonable time, the desirable maximum crossing length without providing a refuge island is 18m. This may be increased to 19m as an absolute maximum. This is applicable at stand-alone pedestrian crossings as well as at junctions. However, in two instances it is not possible to meet this requirement and slightly longer crossings are necessary. At the northern end of the Samuel Beckett Bridge, the crossing width is 21m. In this case the existing crossing is modified to separate the pedestrian waiting area from the cycle tracks in order to avoid conflicts. At the southern end, the crossing width is 20m.It is proposed to retain this as there is no scope to reduce the length due to the curve in the alignment at the link to the bridge.

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

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 NDA CEUD;
- How Walkable is Your Town, 2015 NDA CEUD;
- Shared Space, Shared Surfaces and Home Zones from a Universal Design Approach for the Urban Environment in Ireland CEUD;
- Best Practice Guidelines, Designing Accessible Environments. Irish Wheelchair Association;
- DfT Inclusive Mobility;
- UK DfT Guidance on the use of tactile paving surfaces;
- 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 and proposed draft preliminary design for the corridor has been undertaken. 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. It should be noted that the audit was undertaken in the early design stages with the view to implementing any key measures identified as part of the design development process.

A detailed Proposed Scheme breakdown of the relevant existing and proposed footways has been provided in Table 4-2. In achieving the enhanced pedestrian facilities there has been a concerted effort made to provide clear segregation of modes at key interaction points along the corridor which was highlighted as a potential mobility constraint in the Audit of the existing situation, particularly for people with vision impairments. In addressing one of the key aspects to segregation, the use of the 60mm set down kerb between the footway and the cycle track is of particular importance for guide dogs, where by 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.

The main general design issues considered in the Audit are summarized below:

- 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;
- 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.

4.11 Cycling Provision

One of the core objectives of the Proposed Scheme is to provide segregated cycling facilities along the routes. Physical segregation ensures that cyclists are protected from motorised traffic as well as 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 BusConnects CBC Infrastructure Works project consists of protected cycle tracks, providing vertical segregation from the carriageway to the cycle track and vertical segregation from the cycle track to the footway.

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

The desirable minimum width for a single-direction 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 width for a two-way cycle track is 3.25m with a minimum of 2.25m. 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. In Appendix C Relaxations are included for the reduced widths of two-way cycle tracks along the Quays and through Ringsend.

Table 4-6 and Table 4-7 show the cycle facilities provided in the Proposed Scheme:

Table 4-6: Cycle Facilities Provision westbound

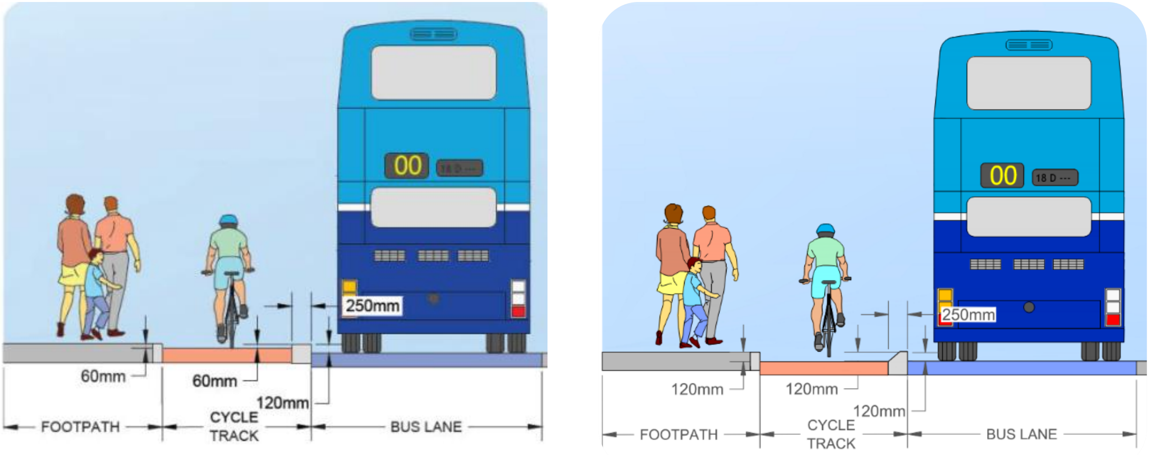
	Road Length (m)	Existing Length (m)		Existing Segregated %	Proposed Length (m)		Proposed Segregated %
Westbound		**Segregated**	**Non-Segregated**		**Segregated**	**Non-Segregated**	
North Quays	1600	1100	100	69%	1600	0	100%
South Quays	1600	900	0	56%	1600	0	100%
Ringsend	1100	0	0	0%	840	260	76%
TOTAL	**4300**	**2000**	**100**	**47%**	**4040**	**260**	**94%**

Table 4-7: Cycle Facilities Provision Eastbound

	Road Length (m)	Existing Length (m)		Existing Segregated %	Proposed Length (m)		Proposed Segregated %
Eastbound		**Segregated**	**Non-Segregated**		**Segregated**	**Non-Segregated**	
North Quays	1600	780	800	49%	1600	0	100%
South Quays	1600	1400	0	88%	1600	0	100%
Ringsend	1100	0	0	0%	840	260	76%
TOTAL	**4300**	**2180**	**800**	**51%**	**4040**	**260**	**94%**

4.11.1 Segregated Cycle Track

A Cycle Track is a segregated cycle lane which is physically segregated from the adjacent traffic lane and/or bus lane horizontally and/or vertically as shown in Figure 4-5 below, taken from the BCBDGP.



Raised Adjacent Cycle Track ***Cycle Track with Upstand Kerb***

Figure 4-5: Fully Segregated Cycle Track

The Proposed Scheme design has provided segregated cycle tracks along the full length of the quays and through Ringsend, between East Link and York Road, and from Irishtown Stadium to Sean Moore Road.

4.11.2 Cycle Lane

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

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

- Transitions to existing cycle lanes, typically on side roads of the main 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, providing a greater level of protection and comfort to cycle users. The segregated cycle tracks along the north quays are generally offset 2m from the road, however, they would not strictly be considered an offline cycle track, being part of the overall transportation corridor. There is a dedicated shared facility (pedestrians/cyclists) through Ringsend Park.

4.11.4 Quiet Street Cycle Route

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 Preliminary Design Guidance Booklet for BusConnects Core Bus Corridors 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."*

They are called Quiet Streets due to the low amount of general traffic and 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 cycle route will involve appropriate advisory and directional signage and lane marking for both the general road users and cyclists.

A quiet street cycle route is proposed through the northern part of Ringsend at Pembroke Cottages and Cambridge Park which are residential streets with very little traffic.

4.11.5 Cycling Facilities at Constraint areas

At some locations along the Proposed Scheme, the desired cycleway width of 2m cannot be achieved, and localised narrowing is required. Providing a standard width would require additional land take from either surrounding private properties or pedestrian areas, or the loss of mature street trees that are of significant value. These locations are recorded in the Deviations Report in Appendix C and are as follows:

- Sir John Rogerson's Quay between Cardiff Lane and Beckett Bridge.

4.11.6 Cycle Parking

There is a limited amount of existing cycle parking directly along the Proposed Scheme, largely because most destinations are off-line with cycle parking provided away from the street. New cycle parking stands (7 no.) will be provided at 10 bus stops along the route when they are upgraded to give a total of 70 cycle stands with capacity for 140 parked bicycles. It is not possible to provide bicycle parking at a number of stops on existing footpaths, where there is no cycle track to create an island.

4.12 Bus Provision

The Proposed Scheme is approximately 1.6 km long from end to end, excluding additional cycling infrastructure at Ringsend. The Proposed Scheme design drawings show the improved extent of bus provision. Table 4-8 summarises the Bus priority provision along the Scheme.

Table 4-8: Bus Lane Provision

RINGSEND TO CITY CENTRE CORE BUS CORRIDOR SCHEME					
	Road Length (m)	**Existing**		**Proposed**	
		Length (m)	**%**	Length (m)	**%**
Bus Lanes – Inbound (westbound)					
(Alignment A) Custom House Quay to 3 Arena	1600	600	38%	1600	100%
(Alignment B) Moss St. to Sir John Rogerson's Quay	1600	0	0%	950	59%
Overall Route Sections Combined – Inbound (westbound)	**3200**	**600**	**19%**	**2550**	**80%**
Bus Lanes Outbound (eastbound)					
(Alignment A) Custom House Quay to 3 Arena	1600	500	30%	1600	100%
(Alignment B) Moss St. to the River Dodder	1600	100*	7%	400	25%
Overall Route Sections Combined - -Outbound eastbound	**3200**	**600**	**19%**	**2000**	**63%**

* On the Samuel Beckett Bridge southbound as part of the eastbound bus route.

4.12.1 Full 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 could request a green signal for buses or similarly a short, generally less than 20m section of shared bus/traffic lane in advance of the junction stop line can be provided and configured in a similar manner using adaptive signalling methods to communicate the arrival of a bus on approach to the junction. Both methods provide a high level of bus priority with the latter solution implemented where left turning traffic volumes are relatively low and/or scenarios where less stages/phases are more desirable for junction capacity and bus priority in a fixed time cycle approach where adaptive bus signalling solutions are not appropriate.

Over the majority of the route a 3m wide dedicated 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.

Where this full priority cannot be provided due to cross-section constraints, measures such as signal controlled priority and bus gates may be utilised to retain bus priority as described in Chapter 3 for each location.

4.12.2 Signal Controlled Priority

Signal Control Priority uses traffic signals to enable buses to get priority ahead of other traffic on single lane road sections, but it is only effective for short distances. This typically arises where the bus lane cannot continue due to obstructions on the roadway. An example might be where a road has pinch-points where it narrows due to existing buildings or structures that cannot be demolished to widen the road to make space for a bus lane. It works through the use of traffic signal controls (typically at junctions) where the bus lane and general traffic lane must merge ahead and share the road space for a short distance until the bus lane recommences downstream. The general traffic will be stopped at the signal to allow the bus pass through the narrow section first and when the bus has passed the general traffic will then be allowed through the lights. In considering Signal Controlled Priority it is necessary to look at the traffic implications both upstream and downstream of the area under consideration. For the Signal Controlled Priority to operate successfully queues or tailbacks on the single (shared bus/traffic) lane portion cannot be allowed to develop as this will result in delays on the bus service. Signal Controlled Priority is proposed at the 6 locations listed in Table 4-9.

Table 4-9: Signal Controlled Priority for Buses Summary

Location	Direction	Reason
A-550: North Wall Quay/New Wapping Street junction	Inbound (westbound)	To facilitate an on-demand priority right turning movement at junction onto New Wapping Street ahead of other traffic
A-700: North Wall Quay/Park Lane	Inbound (westbound)	To facilitate an on-demand priority right turning movement at junction onto Park Lane ahead of other traffic
A-1250: North Wall Quay/Commons Street Junction	Inbound (westbound)	To facilitate an on-demand right turning movement at junction onto Commons Street ahead of other traffic
A-1280: Custom House Quay/Commons Street junction	Outbound (eastbound)	To facilitate an on-demand left turning movement at junction onto Commons Street ahead of other traffic
A-950 North Wall Quay/Guild Street	Outbound (eastbound)	To facilitate an on-demand right turning movement at junction onto Samuel Beckett Bridge ahead of other traffic
B-10710: Samuel Beckett Bridge Southbound towards Cardiff Lane	Outbound (eastbound)	No bus lane downstream of junction towards Sir John Rogerson’s Quay/Cardiff Lane

Signal Controlled Priority will be provided along the south quays, where continuous bus lanes cannot be provided. Bus priority will be assured by assigning signal priority to buses approaching in the sections of bus lanes provided to ensure that delays are minimised in downstream sections where bus lanes cannot be provided. Where right turn movements are required for buses, these will be facilitated by a bus priority signal. Both signal controlled priority and bus priority signals involve a dedicated stage within the traffic signal sequence which is called “on demand”. Locations where this will be included are:

1) North Wall Quay West approach to Beckett Bridge (Alignment A)
2) North Wall Quay East approach to Commons Street (Alignment A)
3) Sir John Rogerson’s Quay approach to Cardiff Lane (Alignment B)
4) City Quay approach to Lombard Street East Alignment B), and
5) City Quay approach to Moss Street (Alignment B)

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.

Such Bus Gates are proposed at three locations on the Proposed Scheme, namely:

1) Dodder Public Transport Bridge (two-way restriction);
2) Sir John Rogerson’s Quay between Forbes Street and Cardiff Lane (westbound restriction);
3) City Quay between Lombard Street East and Moss Street (westbound restriction).

4.13 Bus Stops

This section of the report presents a summary of the Bus Stop Review process which was conducted for the Proposed Scheme.

The purpose of the process was to review the location of the existing Dublin Bus stops to determine whether a stop should be removed, relocated, or remain where it is. This exercise was carried out to optimise the performance of the bus services travelling along the route by reducing the journey time of the bus service, to increase the walking catchment of the bus stops and to ensure key trip attractors located along the route is sufficiently covered within the catchment of bus stops.

Existing bus stops were therefore rationalised based on best practice principles related to bus stop placement. The outcome of this study was to develop a more efficient route which would attract more passengers by creating a wider population catchment and offer a shorter journey time to destinations.

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 4-6.

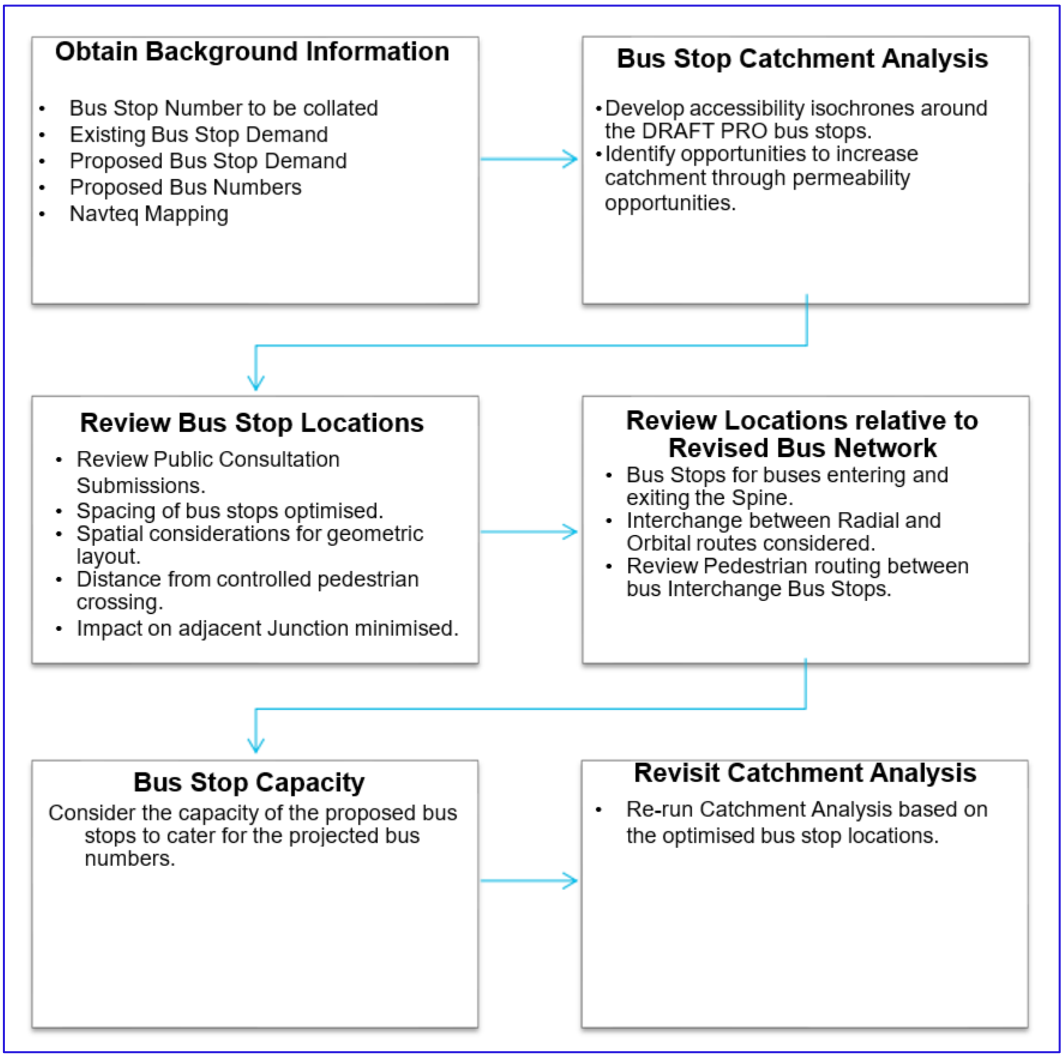


Figure 4-6: Bus Stop Location Assessment Process

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

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

- Driver waiting Passengers are clearly visible to each other.
- Location close to key facilities
- Location close to main junctions without affecting road safety or junction operation
- Location to minimise walking distance between interchange stops
- Where there is space for a bus shelter
- Location 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
- Adequate footway width

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.

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 include 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

The list below provides 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 Appendix H. Where specific feedback in relation to bus stops from the public consultation process has been provided this has been acknowledged in the assessment also.

Summary of Bus Stops

- A total of 20 bus stops, of which 12 are proposed new stops.
    - Island bus stops: 7
    - Lay by bus stops: 3
    - Inline bus stops: 10
- 2 existing stops will be removed as they are too closely spaced to other stops.

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 4-7.

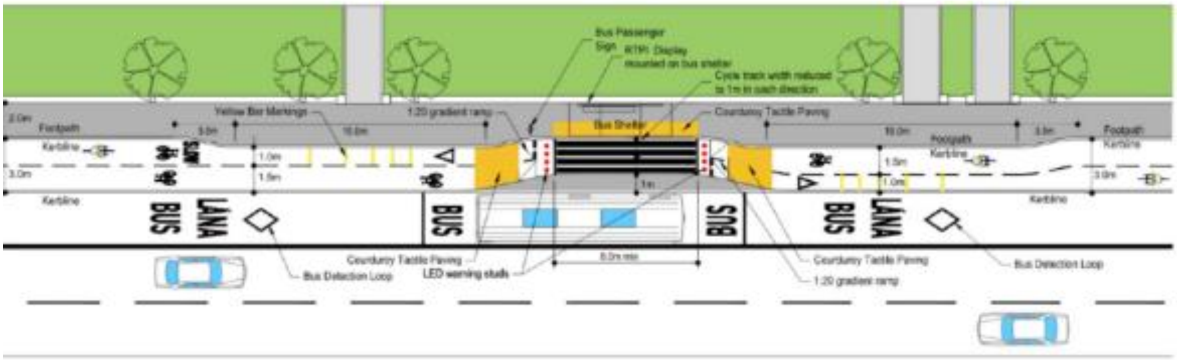


Figure 4-7: Example of an Island Bus Stop

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 4-8. Audible tactile units will also be a featured at the crossing points.

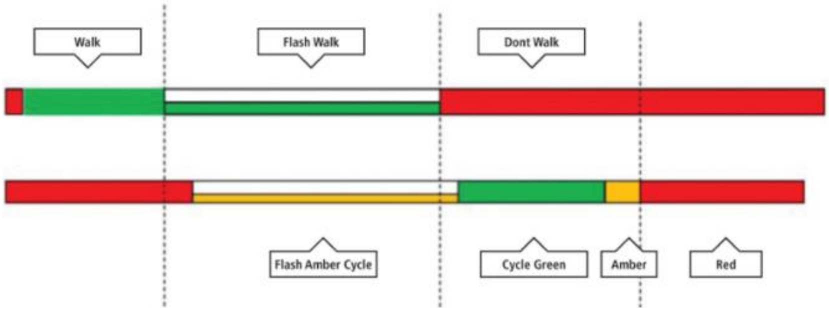


Figure 4-8: Example of nested pelican sequence

Table 4-10: List of Island Bus Stops

Citybound / Outbound	Bus Stop Name	Bus Stop No.	Chainage
Inbound (westbound) -Alignment A	North Wall Quay	New Coach Stop	A 100
Inbound (westbound) -Alignment A	North Wall Quay	Relocated Coach Stop	A 450
Inbound (westbound) -Alignment A	Spencer Dock	New Bus Stop	A 775
Inbound (westbound) -Alignment A	North Wall Quay	Relocated Stop	A 1000
Inbound (westbound) -Alignment A	North Wall Quay	New Coach Stop	A 1200
Inbound (westbound) -Alignment A	Custom House Quay	New Bus Stop	A 1400
Inbound (westbound) -Alignment B	Sir John Rogerson’s Quay	New Bus Stop	B10860
Inbound (westbound) -Alignment B	Sir John Rogerson’s Quay	New Bus Stop	B11200

A 1:20 ramp is provided on the cycle track to raise the cycle track to the level of the footpath/island area onto a 4m wide crossing. Suitable tactile paving is also provided at the crossing point in addition a series of LED warning studs are provided at the crossing location which are actuated by bus detector loops in the bus lane. The exit taper for the bus stop has been nominated at 1 in 3 to provide for a 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 4-9 to promote the use sustainable mode interchange at bus stops for longer distance trips.

Figure 4-9: Example landscaping arrangement at island bus stops on Oxford Road Manchester (source: Google Streetview 2021)

4.13.3 Shared Landing Area Bus Stops

Not applicable to the Proposed Scheme.

4.13.4 Inline Bus Stop

Inline bus stops are proposed where there is no cycle track – i.e. on the north side of the north quays and on the south side of the south quays.

Table 4-11: List of Inline Bus Stops

Stop Number	Stop Name / Location	Chainage	Type	Note
RINGSEND ALIGNMENT				
Inbound (Westbound) -Alignment B				
New	Sir John Rogerson's Quay	B-11240	Inline	Two-way cycle track provided on the north side of Sir John Rogerson's Quay
New	Sir John Rogerson's Quay	B-10845	Inline	
New	Sir John Rogerson's Quay	B-10610	Inline	
New	City Quay	B-10150	Inline	
Outbound (Eastbound) – Alignment A				
2498	Custom House Quay	A-1540	Inline	Two-way cycle track provided on the south side of Custom House Quay/North Wall Quay
2499	Docklands, CHQ	A-1330	Inline	
New (Coach)	Citibank plaza	A-1230	Inline	
2500	North Wall Quay	A-1000	Inline	
2501	North Wall Quay	A-755	Inline	
New (Coach)	North Wall Quay	A-460	Inline	
7623(Changed to Coach)	North Wall Quay	A-110	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 or road capacity reasons.

An example of a layby landing zone bus stop arrangement is shown below in Figure 4-10.

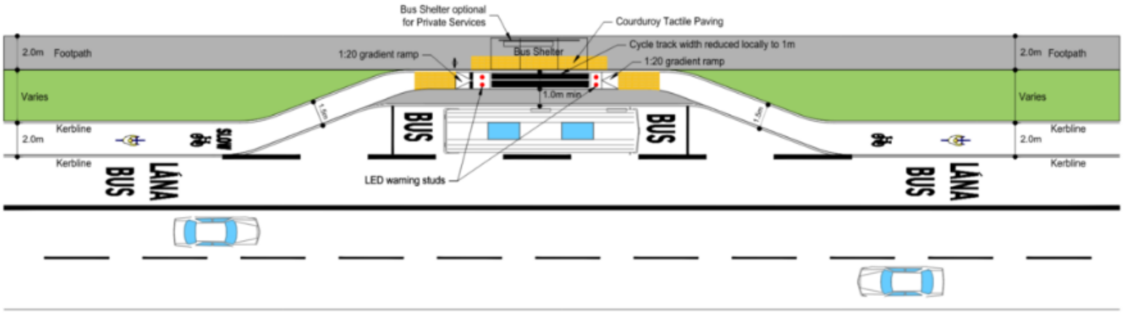


Figure 4-10: Example of a Layby Bus Stop

Layby bus stops are used at the following locations along the Proposed Scheme listed in Table 4.12.

Table 4-12: List of Layby Bus Stops

Inbound/ Outbound	Bus Stop Name	Bus Stop No.	Chainage
Inbound (westbound)	The Convention Centre Dublin – Spencer Dock	(Previously 7398) New Coach Stop	A 825
Inbound (westbound)	Commons Street – North Wall Quay	New Coach Stop	A 1230
Inbound (westbound)	North Wall Quay	New Coach Stop	A 1200

4.13.6 Bus Shelters

Bus shelters provide an important function in design of bus stops. The shelter will offer protection for people from poor weather, with lighting to help them feel more secure, Seating is provided to assist ambulant disabled and older passengers and accompanied with Real Time Passenger Information (RTPI) signage to provide information on the bus services. The locations of the bus shelters have been presented on the GEO_GA General Arrangement drawing series in Appendix B2.

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 4-11 provides an example image of the preferred full end panel shelter arrangement. The desirable minimum footpath/island widths required to accommodate the full end panel shelter is 3.3m with an absolute minimum width of 3m to facilitate a min. 1.2m clearance at the end panel for pedestrians. Alternative arrangements for more constrained footpath widths are considered in the following sections.

Figure 4-11: 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 4-12 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 4-12: Example of a 3-Bay Reliance Cantilever Shelter with full width roof and half end panels (Source: JCDecaux)

Two alternative narrow roof shelter configurations are also available which offer reduced protection against the elements compared to the full width roof arrangements. These shelter configurations are not preferred but do provide an alternative solution for particularly constrained locations where cycle track narrowing to min 1m width has already been considered and 2.4m widths cannot be achieved to facilitate the full width roof with half end panel shelter or for locations where the surrounding environment may offer protection against the elements. The desirable minimum footpath widths for the narrow roof configuration are 2.75m (with end panel) and 2.1m (no end panel). The absolute minimum footpath widths for these shelters are 2.4m (with end panel) and 1.8m (no end panel) to requirements for boarding and alighting passengers in consideration of wheelchair, pram, luggage and other such similar spatial requirements.

Figure 4-13: 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 to perpendicular to the island to the rear of the footpath. Where bus shelters cannot be located directly on the dedicated island or perpendicular to the island due to spatial and or other constraints, they should ideally be located downstream of the stop area. This will inherently promote eye to eye contact between boarding passengers and oncoming cyclists and buses when signalling the bus and also improve the courtesy arrangement for segregation of boarding and alighting passengers. Examples from each of these scenarios are shown below.

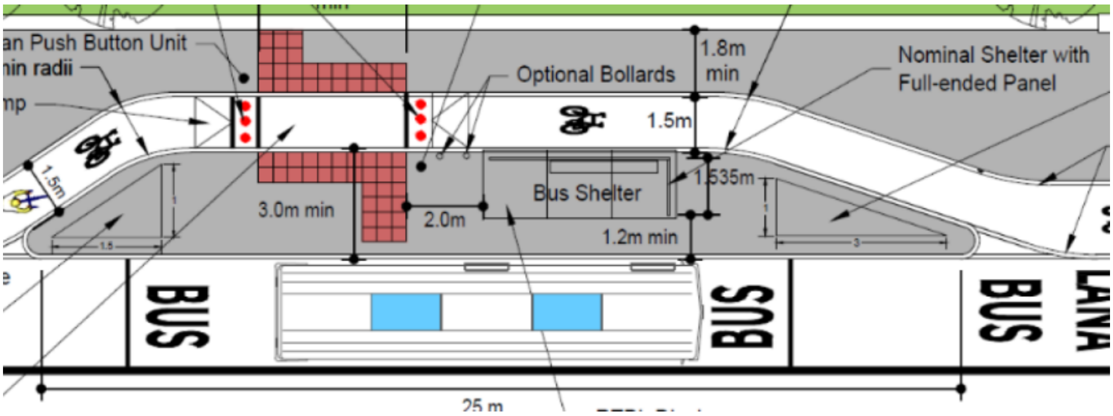


Figure 4-14: Preferred Shelter Location (on island)

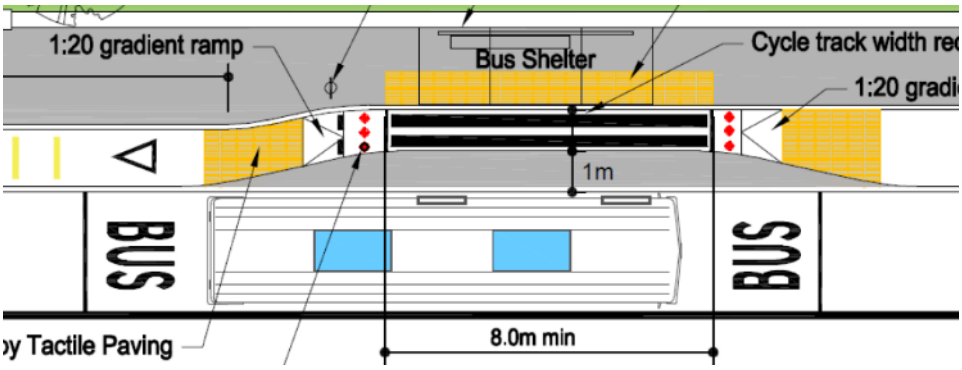


Figure 4-15: Alternative Shelter Location back of footpath (narrow island with adequate footpath widths)

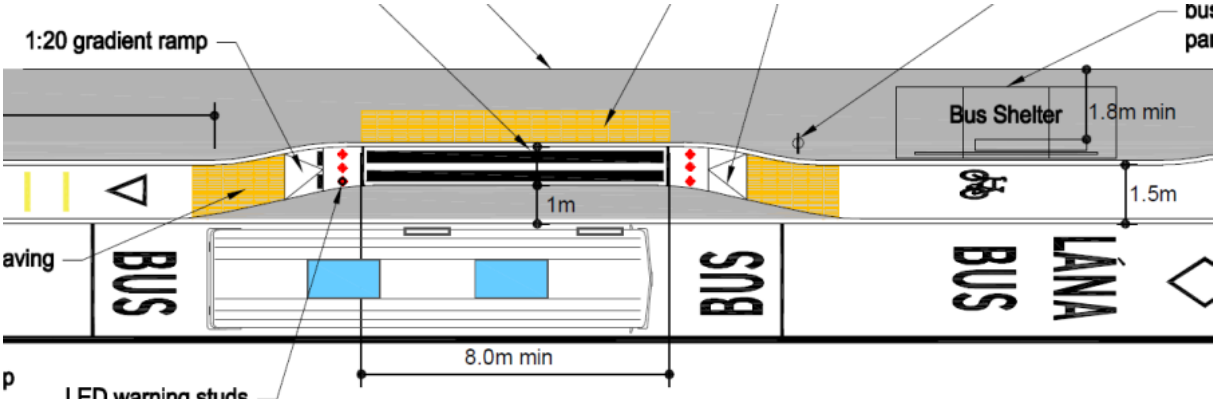


Figure 4-16: Alternative Shelter Location downstream of island (narrow island with narrow footpath widths at landing area)

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 A.7 provides the details of the Parking Survey Report.

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);
- 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;
- Adjacent Parking: Parking which is located in close proximity to the street. This parking includes free and pay parking and also 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.

The proposed changes in parking provision are summarised in Table 4-13 below.

Table 4-13: Summary of Proposed Parking Amendments

Section	Parking Type	Existing	Proposed	Loss of Parking/Loading
Section 1: North Wall Quay (Between Talbot Memorial Bridge and Tom Clarke Bridge) (Alignment A)	Loading	27	18	-9
	Disabled	2	0	-2
	Taxi	5	0	-5
	Pay & Display	15	0	-15
	Informal	12	0	-12
	Adjacent	20	20	0
Section 1 total		81	38	-43
Section 2: South Quay (City Quay/Sir John Rogerson's Quay) (Alignment B)	Loading	4	4	0
	Disabled	2	2	0
	Permit	21	13	-8
	Taxi	3	0	-3
	Pay & Display	50	15	-35
	Informal	14	14	0
	Adjacent	167	167	0
Section 2 total		261	215	-46
Ringsend (Ringsend Park Cycle Route)	Informal	235	233	-2
	New Formalised	0	2	2
	Disabled	2	3	1
Section 3 total		237	238	+1
Overall Totals		Existing	Proposed	Loss
		579	491	-88
Percentage Change		-15%		

4.14.2 Summary of Parking Impact

With the Proposed Scheme in place, the main changes in on-street parking as shown in Table 4-1 are summarised as follows:

- 9 loading bays and 5 taxi spaces removed on north quays
- 29 parking spaces including 2 disabled spaces removed on north quays
- 3 taxi spaces removed on south quays
- 43 parking spaces including 3 permit spaces removed on south quays.
- 1 additional disabled space provided in Ringsend.

4.15 Turning Bans and Traffic Management Measures

Proposed turning bans and restricted movements along the route are shown on the General Arrangement Drawings within Appendix B2, and as shown in Table 4-14

Table 4-14: Summary of Proposed Turning Bans and Traffic Management Measures

Chainage	Minor Road	Major Road	Measure	Reason	Impact
A1250	Commons Street	Custom House Quay	Right Turn Ban onto minor road	Remove turning lane to provide continuous bus lanes	Rerouting of traffic via Sheriff Street, Seville Place and Oriel Street.
A920	Guild Street	North Wall Quay	Left Turn Ban onto minor road	Provide continuous bus priority to stop line	Rerouting of traffic via Park Lane for access to CCD
A920	Guild Street	North Wall Quay	Right Turn Ban onto Beckett Bridge	Provide continuous bus lanes in both directions.	Rerouting of traffic via Memorial Bridge and south quays.
A920	Guild Street	North Wall Quay	Right Turn Ban onto minor road	Improved priority for pedestrians, cyclists and buses at junction	Rerouting of traffic via Seville Place and Amiens Street
A920	North Wall Quay	Beckett Bridge	Left Turn Ban	Existing	Not applicable
A300	Castleforbes Road	North Wall Quay	Right Turn Ban onto minor road	Remove turning lane to provide continuous bus lanes	Rerouting of traffic via Sheriff Street
A160	North Wall Avenue	North Wall Quay	Right Turn Ban onto minor road	Remove turning lane to provide continuous bus lanes	Rerouting of traffic via Sheriff Street
B11380	Sir Rogerson’s Quay	Dodder PT Bridge	No Straight Ahead	Public Transport Bridge	Not applicable
B 11370 / D 30050	Stevens Walk	Sir Rogerson’s Quay	Two-way Bus Gate on Sir Rogerson’s Quay / Proposed Dodder Bridge	To minimise delays for buses.	Through traffic, eastbound and westbound diverted to other routes.
B11000	Asgard Road	Sir Rogerson’s Quay	Right Turn Ban onto minor road	Existing	Not applicable
B11020	Asgard Road	Sir Rogerson’s Quay	Left Turn Ban onto minor road	Existing	Not applicable
B10950	Forbes Street	Sir Rogerson’s Quay	Left Turn Ban onto major road	Bus lane	Rerouting of traffic via Misery Hill
B 10930	Forbes Street	Sir Rogerson’s Quay	Westbound Bus Gate on Sir Rogerson’s Quay	To minimise delays for buses.	Through traffic diverted to other routes
B10760	Cardiff Lane	Sir Rogerson’s Quay	Right Turn ban onto major road	Existing	Not applicable
B10550	Lime Street	Sir Rogerson’s Quay	Right Turn ban onto major road	Existing	Not applicable
B10300	Lombard Street E	City Quay	No Straight Ahead	Existing	Not applicable
B10250	Lombard Steet E	City Quay	Westbound Bus Gate on City Quay	To minimise delays for buses.	Through traffic diverted to other routes.
B10100	Prince Street S	City Quay	Right Turn Ban onto minor road	Existing	Not applicable
B10100	Prince Street S	City Quay	Left Turn Ban onto major road	Existing	Not applicable

4.16 Relaxations, Departures and Deviations

The terms relaxation and departure are derived from the TII requirements for national roads projects.

- A Relaxation from Standard is where a design element is below the desirable parameter, but still meets the minimum requirement permitted in the standard.

As defined in GE-GEN-01005, a Departure from Standard shall mean any of the following:

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

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

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

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

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

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

For the BusConnects Infrastructure the design is required to adhere to the BusConnects Preliminary Design Guidance Booklet (BCPDG), which provides project specific details that are not included in the other applicable national design standards.

Details of deviations, departures and relaxations from standards are provided in Appendix C.

4.17 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 Proposed Scheme proposals have been developed in direct response to the aims and objectives of the as set out in Section 1.2 which have common synergies with the Core Design Principles of DMURS.

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

- Prioritising pedestrians and cyclists through the implementation of designated footpaths, and cycle tracks and limiting vehicles' speed through the use of tight kerb radii on all internal junctions within the development.
- Provision of cycle protected junctions will control speed at which vehicles can travel through the junction and incorporates tight kerb radii to limit vehicles' speed but also allow occasional larger vehicles to manoeuvre safely through the junction, while also reducing pedestrian crossing distances.
- The inclusion of new and enhanced pedestrian crossing facilities will promote increased pedestrian activity along the Proposed Scheme, providing safe desire lines for pedestrians to/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 Proposed Scheme will improve the interaction between parked vehicles, pedestrians and cyclists.
- The implementation of traffic calming measures and side entry treatments promote pedestrian activity on the junction side arms

The Proposed 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.

4.18 Road Safety and Road User Audit

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

Stage F: Route selection, prior to route choice.

Stage 1: Completion of preliminary design prior to land acquisition procedures.

Stage 2: Completion of detailed design, prior to tender of construction contract. In the case of Design and Build contracts, a Stage 2 audit shall be completed prior to construction taking place.

Stage 1 & 2: Completion of detailed design, prior to tender of construction contract, for small 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 Road Safety Audit (RSA) was undertaken as part of the Preliminary Design development. This RSA has been included in Appendix M complete with the proposed designer’s responses.

The Stage 1 RSA represents the response of an independent audit team to various aspects of the Proposed Scheme. 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 Proposed Scheme as constructed can be improved to address issues of road safety.

5 Junction Design

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 Proposed Scheme measures may have against the likely receiving environment. The impact assessments have been carried out using the following scenarios:

- Do Minimum' – 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
- Do Something' – 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 'Do Minimum' 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 Do Minimum and or base 2019 survey flows have been considered. Similarly, the final junction designs have been supplemented with additional cycle volumes to 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 throughput 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;
- People Movement Calculator (PMC) to inform junction staging and design development;
- LINSIG junction modelling to assess junction design performance and refinement;

- Micro-Sim modelling to assess and refine bus priority designs;
- Cyclist quantification

5.3 Junction Geometric 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 some instances, this hasn't been feasible e.g. due to the need to maintain capacity for buses and cyclists. A "walk with traffic" system is therefore proposed at certain junctions, such as the Beckett Bridge / Guild Street junction. At these locations, controlled crossing for pedestrians is provided across part of the junction, whilst some of the traffic movements that are not in conflict with the pedestrian movement, are allowed to run at the same time. This facility has the advantage to allowing pedestrians to cross during the cycle whilst having less effect on traffic capacity.

The cycle times at all signalised junctions in the DoSomething scenario in comparison to the Do Minimum cycle times, are shown in the summary Table 5-1. For coordination of successive traffic signals to ensure smooth progression of buses along the corridor, the same signal cycle times are proposed even if shorter cycle times would be possible if the junctions were operating in isolation.

Table 5-1: Signal Junction Cycle Times

No.	**Junction Name**	**Cycle Time (Seconds)**		
		Do Minimum	**Do Some-thing AM**	**Do Something PM**
(Alignment A) Custom House Quay to 3 Arena				
1	Commons Street / Custom House Quay	75	120	105
2	Guild Street / North Wall Quay / Beckett Bridge	120	120	105
3	Park Lane / North Wall Quay	116	120	105
4	New Wapping St / North Wall Quay	120	120	105
5	Castleforbes Road / North Wall Quay	Unsignalled	120	105
6	North Wall Avenue / North Wall Quay	120	120	105
7	Memorial road / Custom House / Talbot Bridge	81	120	105
(Alignment B) Moss St. to Sir John Rogerson's Quay				
8	Lombard Street / City Quay	120	120	105
9	Cardiff Lane / Sir John Rogerson's Quay / Beckett Bridge	130	120	105
10	Forbes Street / Sir John Rogerson's Quay	-	60	60
11	Blood Stoney Road / Sir John Rogerson's Quay	Unsignalled	60	60
12	Dodder PT Bridge / East Link Road	-	60	60
13	Talbot Bridge / City Quay / Moss Street / George's Quay	117	120	105

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, which 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, in this instances 2-3m separation should be provided between crossings. 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 BCPDG includes four different types of junction to achieve bus priority - referred to in order of preference as Junction Types 1-4. Only Junction Type 1 is proposed on the Ringsend CBC scheme and the other options are therefore not discussed herein.

5.3.3.1. Junction Type 1

Junction Type 1, described at BCPDG Section 7.4.1 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 while general traffic is held. The bus lane gets red, allowing the general traffic lane to proceed. If the volume of left-turning vehicles is greater than 150 PCUs (passenger car units), 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 can proceed with general traffic, while also receiving an early start. See Figure 5-1.

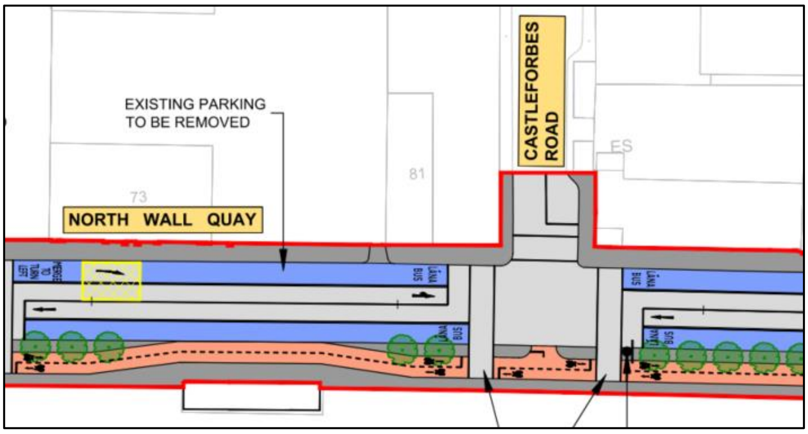


Figure 5-1: Junction Type 1

5.3.4 Staging and Phasing

The optimum staging for each junction is determined by the junction configuration and the level of demand for each movement. One of the key considerations in the design of the signalised junctions is the conflict between left turning traffic and buses, and cyclists and pedestrians continuing along the main corridor. The following presents an overview of the design approach:

- 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 for straight-ahead cyclists on the main corridor will enable cyclists to advance before general traffic. The amount of green given to cyclists is subject to junction dimensions and signal operation;
- Cycle movements along the main corridor, crossing the side road, can run simultaneously with the bus stage in the same direction, so long as the bus is not permitted to turn left from the bus lane; 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 are provided for right turning cyclists.

5.3.5 Junction Design Summary

The following summary Tables 5-2, 5-3 and 5-4 provide an overview of the key design principles adopted at each junction location. More detailed information for each junction can be found in the Junction Design Reports in Appendix L

Table 5-2: Major Junctions

No.	Junction Location	Type	Summary
1	Commons Street / Custom House Quay	1	Protected cycle tracks. Bus lanes to stop lines.
2	Guild Street / North Wall Quay / Beckett Bridge	1	Turning bans from western arm. Bus lanes to stop lines. Protected cycle tracks.
3	Cardiff Lane / Sir John Rogerson's Quay / Beckett Bridge	1	Protected cycle tracks. Bus lanes to stop lines.

No.	Junction Location	Type	Summary
4	Memorial road / Custom House / Talbot Bridge	1	Single Pedestrian crossings on the east and northern arms. Left-slip Lane removed on northern arm. Protected cycle tracks. Bus lanes to stop lines.
5	Cardiff Lane / Sir John Rogerson's Quay / Beckett Bridge	1	Protected cycle tracks. Bus lanes to stop lines.

Table 5-3: Moderate Junctions

No.	Junction	Type	Summary
1	New Wapping St / North Wall Quay	1	Bus lanes to the stop lines. Protected cycle tracks.
2	Castleforbes Road / North Wall Quay	1	New signalised junction with controlled pedestrian crossing facilities. Bus lanes to the stop lines. Protected cycle tracks.
3	North Wall Avenue / North Wall Quay	1	Right turn ban Bus lanes to the stop lines. Protected cycle tracks.
4	Lombard Street / City Quay	1	Protected cycle tracks. Central island removed to facilitate a Contra-flow bus lane
5	Dodder PT Bridge / East Link Road	1	New signalised junction with controlled pedestrian and cycle crossing facilities Bus priority inbound and outbound proposed

Table 5-4: Minor Junctions

No.	Junction	Type	Summary
1	Park Lane / North Wall Quay	1	Bus lanes to the stop lines. Protected cycle tracks.
2	Forbes Street / Sir John Rogerson's Quay	1	Protected cycle tracks. Bus gate for westbound routes
3	Blood Stoney Road / Sir John Rogerson's Quay	1	New signalised junction with controlled pedestrian crossing facilities. Protected cycle tracks.

5.3.3.1. Roundabouts

No new roundabouts are proposed as part of the Proposed Scheme.

5.4 Junction Modelling

5.4.1 Overview

Junction modelling was undertaken with the LINSIG software to enable understanding of the likely impact of the proposed route design on traffic operation on the surrounding road network and

- To formulate appropriate signal staging for all movements at signal-controlled junctions;
- To understand delays / capacity characteristics for bus movements;

- To ensure that appropriate timings are included within the signal cycle to accommodate the necessary pedestrian and cyclist crossing times.

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.

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 Local Area Model (LAM) which is a subset model of the NTA's Eastern Regional Model (ERM). The LAM outputs provided projected traffic flows for the DoSomething Operational Year for the peak periods. In addition, traffic dispersion plots were provided, comparing the DoSomething (DS) vs the Do Minimum (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 as part of an iterative process until a suitable level of dispersion was achieved;
- **LINSIG & 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.
- **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 minimum 10% cycle mode share in terms of people movement at each junction.

Figure 5-2 illustrates an overview of the traffic modelling hierarchy for the Proposed Scheme.

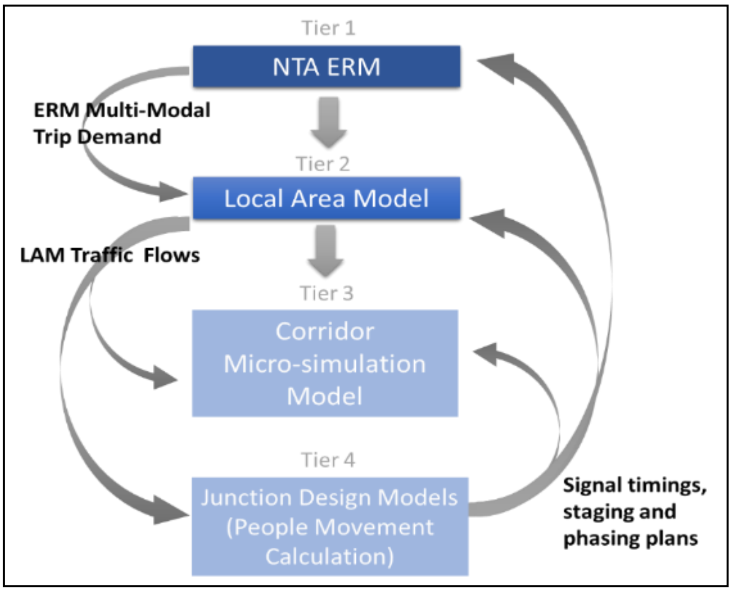
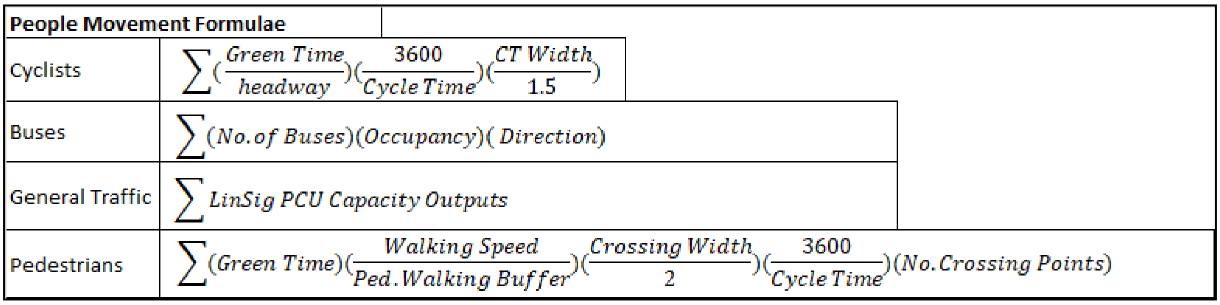


Figure 5-2: Proposed Scheme Traffic Modelling Hierarchy

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 5-3 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 5-3: People Movement Formulae

The emerging proposed designs were inputted to the People Movement Calculation 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 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 revaluated during the iteration process, 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 Local Area Model. The LAM outputs provided projected traffic flows for the DoSomething Operational Year 2028 and Future Year 2043 for the respective AM and PM peak periods. In addition, traffic dispersion plots were produced, comparing the DoSomething (DS) vs the Do Minimum (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 proves, Figure 5-4 illustrates an initial 2028 AM distribution plot, whilst Figure 5-5 illustrates a final iterated distribution plot. Figure 5-4 illustrates more significant traffic dispersion onto the surrounding road network, whilst the refined Figure 5-5 demonstrates a more optimised Proposed Scheme, where traffic dispersion has been minimised without compromising the sustainable modes.

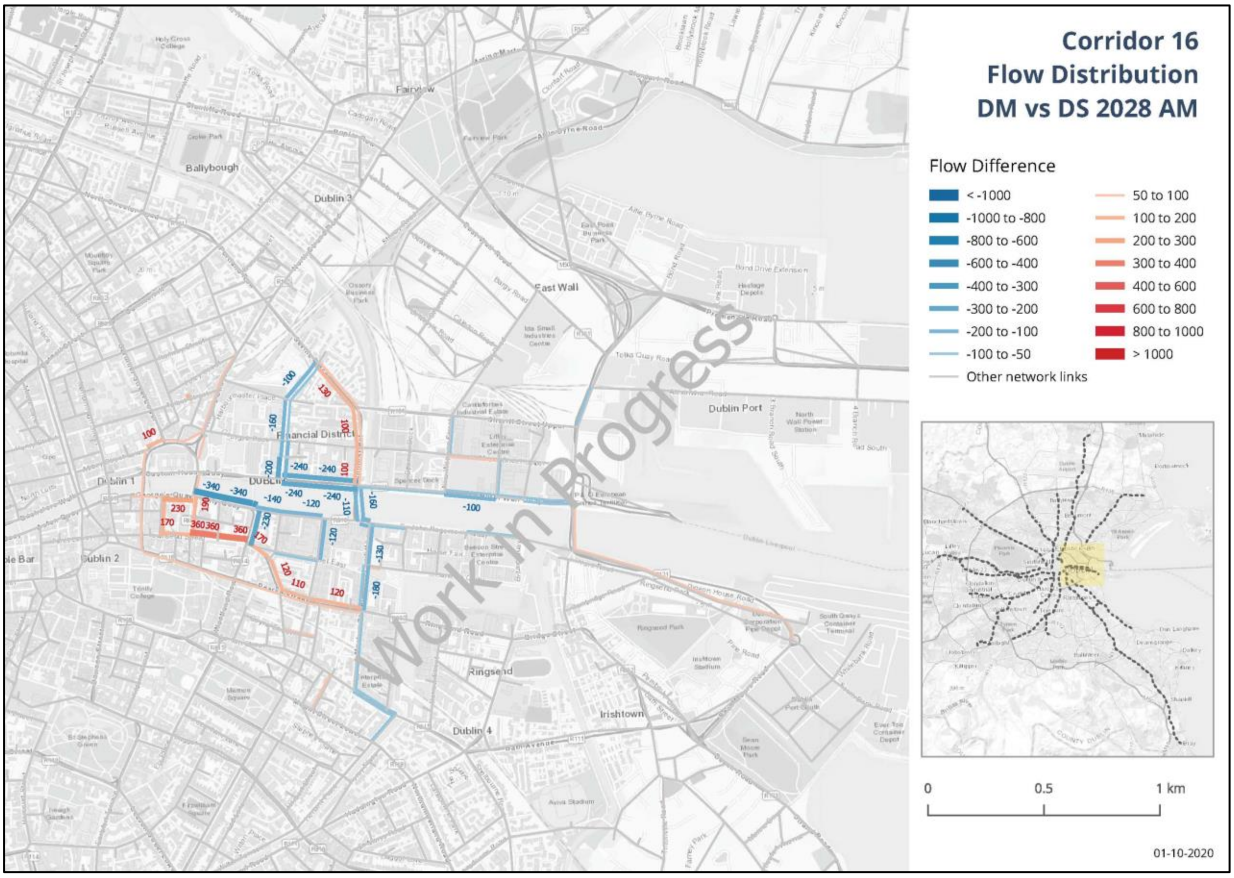


Figure 5-4: An initial 2028 AM Peak DLAM Distribution Plot

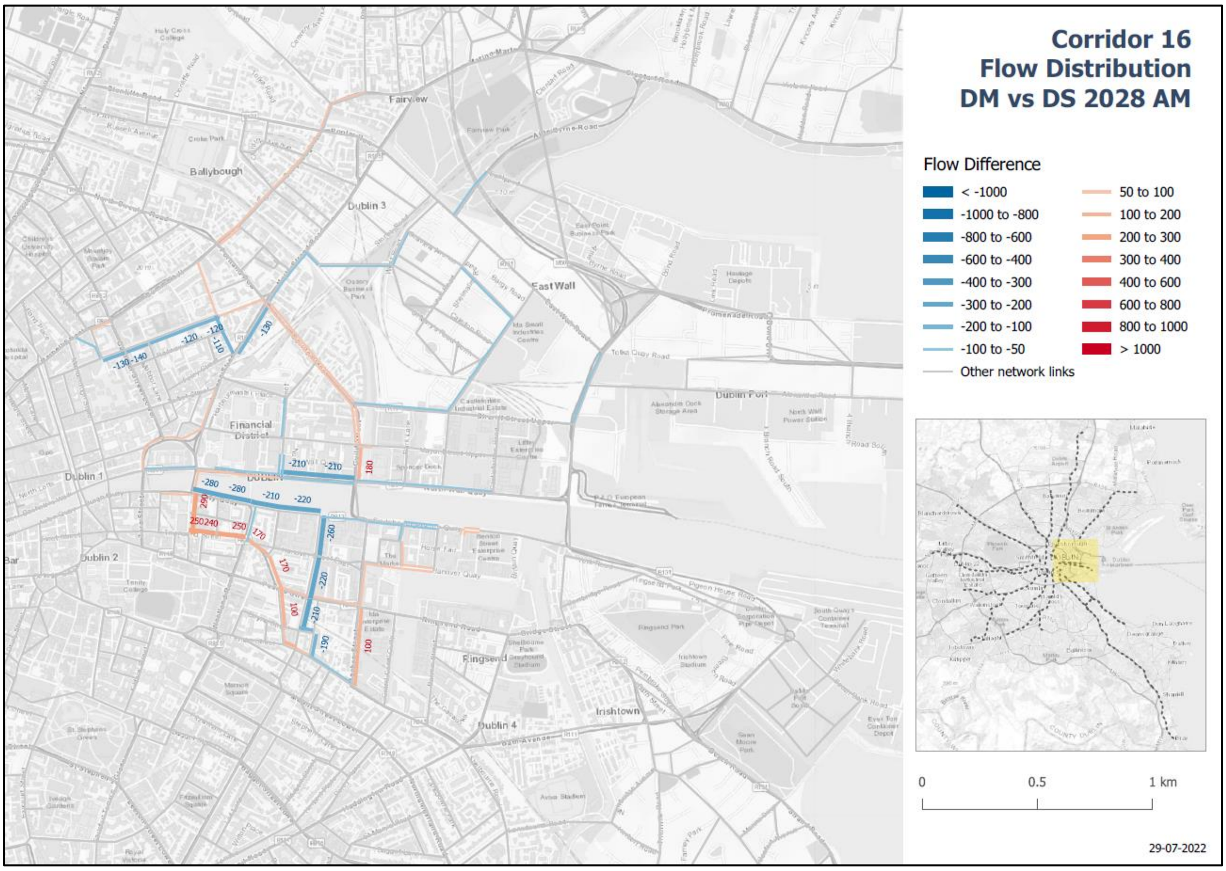


Figure 5-5: Optimised and Iterated 2028 AM Peak DLAM Distribution Plot

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 DLAM model iterations had been concluded and a final preliminary design was achieved. The LINSIG modelling adopted the future year traffic flows from the Saturn DLAM model runs for the Do-Something 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: 7s minimum green time for pedestrians;
- Inter-green: based on a walking speed of 1.2m per second plus a 2 second all red safety buffer.

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.
- 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). If the existing demand is already 10% mode share or more, then a growth provision of 20% has been added for increased future demand.

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 National Cycle Policy Framework. 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.

The Cycle demand calculation 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:

1) A minimum 10% cycle mode share is provided for when summing people movement across all arms (including side roads).
2) The calculated cycle capacity (calculated from above) exceeds existing cycling flow.
3) 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	**Cycle Quantification (Number of Cyclists)**			
	2028 AM Peak Hour		**2028 PM Peak Hour**	
	Design Target	**Total Modelled**	**Design Target**	**Total Modelled**
Commons Street / Custom House Quay	388	396	268	274
Guild Street / North Wall Quay / Beckett Bridge	888	893	546	582
Park Lane / North Wall Quay	342	356	270	295
New Wapping St / North Wall Quay	512	520	400	401
Castleforbes Road / North Wall Quay	192	203	169	182
North Wall Avenue / North Wall Quay	118	127	102	115
Lombard Street / City Quay	568	568	598	598
Cardiff Lane / Sir John Rogerson's Quay / Beckett Bridge	1386	1426	1062	1104
Forbes Street / Sir John Rogerson's Quay	750	769	562	579
Blood Stoney Road / Sir John Rogerson's Quay	170	198	141	166
Dodder PT Bridge / East Link Road	20	64	159	199
Memorial road / Custom House / Talbot Bridge	1075	1102	514	559
Talbot Bridge / City Quay / Moss Street / George's Quay	888	910	504	538

5.4.4.3 LinSig Results

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

Table 5-6: Signalised Junction Analysis

No	**Junction Name**	**Cycle Time (Seconds)**			**Practical Reserve Capacity (%)**	
		Do Minimum	**Do-Something AM**	**Do-Something PM**	**AM Peak Hour**	**PM Peak Hour**
NORTH QUAYS ALIGNMENT						
1	Commons Street / Custom House Quay	75	120	105	74.1	58.2
2	Guild Street / North Wall Quay / Beckett Bridge	120	120	105	-52.2	-9.9
3	Park Lane / North Wall Quay	116	120	105	-36.4	50.3
4	New Wapping St / North Wall Quay	120	120	105	61.3	143.2
5	Castleforbes Road / North Wall Quay	Un-signalled	120	105	202.4	143.2
6	North Wall Avenue / North Wall Quay	120	120	105	59.6	82.4
7	Memorial road / Custom House / Talbot Bridge	81	120	105	-32.5	0.9
SOUTH QUAYS ALIGNMENT						
8	Lombard Street / City Quay	120	120	105	0.1	52.4
9	Cardiff Lane / Sir John Rogerson's Quay / Beckett Bridge	130	120	105	-2.3	32.2
10	Forbes Street / Sir John Rogerson's Quay	-	60	60	105.1	162.2

No	**Junction Name**	**Cycle Time (Seconds)**			**Practical Reserve Capacity (%)**	
		Do Minimum	**Do-Something AM**	**Do-Something PM**	**AM Peak Hour**	**PM Peak Hour**
11	Blood Stoney Road / Sir John Rogerson's Quay	Un-signalled	60	60	498.4	713
12	Dodder PT Bridge / East Link Road	-	60	60	54.8	101.6
13	Talbot Bridge / City Quay / Moss Street / George's Quay	117	120	105	32.3	40

To allow for a consistent flow through the various linked junctions; cycle times are linked by the most constrained junction being Memorial road / Custom House / Talbot Bridge. The Memorial Road junction presents a challenging arrangement where a high volume of traffic approaching the junction being a key node with movements in all directions are taken across the junction to and from both ends of the quays using storage zones to the new and existing two-way cycle facilities while incorporating a core bus corridor in the eastern and western directions. As such this creates a challenge from an operational and staging perspective and requires an additional stage in the cycle to facilitate the movement. Consequently, green time has been maximised in the northern and southern arms to facilitate the flow of traffic.

6 Ground Investigation and Ground Conditions

6.1 Ground Investigation Overview

The existing site investigation information for the area has been taken from the Geological Survey of Ireland (GSi) website and the British Geological Survey (BGS) website, including the Quaternary and Bedrock Geology of Dublin and Depth of Bedrock digital maps.

Refer also to Geotechnical Interpretation Report contained in Appendix E.

6.2 Desktop Review

The following selection of published papers has found to be of relevance to estimate the lithology and geotechnical properties:

- “Geotechnical properties of Dublin boulder clay”. Authors: Long, Michael M and Menkiti, Christopher O. Sept 2007, Géotechnique 57 (7): 595-611. Published by the ICE.
- Ground Investigation Report of the National Paediatric Hospital Project, Dublin. Roughan & O’Donovan Consulting Engineers, January 2015.
- Geological Survey of Ireland (GSI) website, thematic maps related to the study area

6.2.1 Overview of Existing Ground Conditions along the Proposed Scheme.

Quaternary sediments cover up to 80% of the Dublin region. Quaternary thicknesses at the city area range from 5 to 20m. Maximum thicknesses are recorded along a Tertiary channel occurring on the north shore of the River Liffey valley, reaching 45m, and along a channel-like feature running along the south margin of the Dodder valley Quaternary sediments, with a thickness of 15 to 25 m.

The most commonly occurring Quaternary deposit in the area has been termed locally as the Dublin Boulder Clay. It is a glacial deposit derived from the Lower Carboniferous Limestone and it is classified by its two main members: the Black Boulder Clay (BkBC) and the Brown Boulder Clay (BrBC). The Brown Boulder Clay is less consolidated and since it overlies the Black Boulder Clay it has been interpreted as its weathered upper layer.

The Upper Brown Boulder Clay (UBrBC) is the outcome of the oxidation of the clay particles in the top 2m to 3m of the UBkBC, resulting in a change in colour from black to brown and a lower strength material. It is usually described as thick stiff to very stiff brown, slightly sandy clay, with rare silt / gravel lenses and some rootlets, particularly in the upper metre.

The Upper Black Dublin Boulder Clay (UBkBC) is a very stiff, dark grey, slightly sandy clay, with some gravel and cobbles. It is typically 4 m to 12 m thick.

The Lower Brown Dublin Boulder Clay (LBrBC) exists as a 5 m to 9 m thick hard, brown, silty clay, with gravel, cobbles and boulders. It has previously been called the “sandy boulder clay” as it is similar to but siltier than the UBkBC above.

The Lower Black Dublin Boulder Clay (LBkBC) is a patchy layer of hard slightly sandy gravelly clay with an abundance of boulders. Its thickness does not exceed 4 m and is typically less than 2 m.

Note that not all four distinct formations of the Dublin Boulder Clay are always present. The upper two units though have been proven at all investigation sites across the city.

Bedrock close to the surface occurs mostly along the main riverbeds as well as the coastline and the higher ground areas of the Howth peninsula. The bedrock map of Ireland shows a wide variety of rock types which have originated at different periods of geological time. Underlaying the project area consists of Lower Carboniferous Limestone of the Lucan Formation (Calp), which is typically described as a dark grey to black fine grained limestone.

The following image from the Geological Survey Ireland website shows the expected depth to Bedrock.

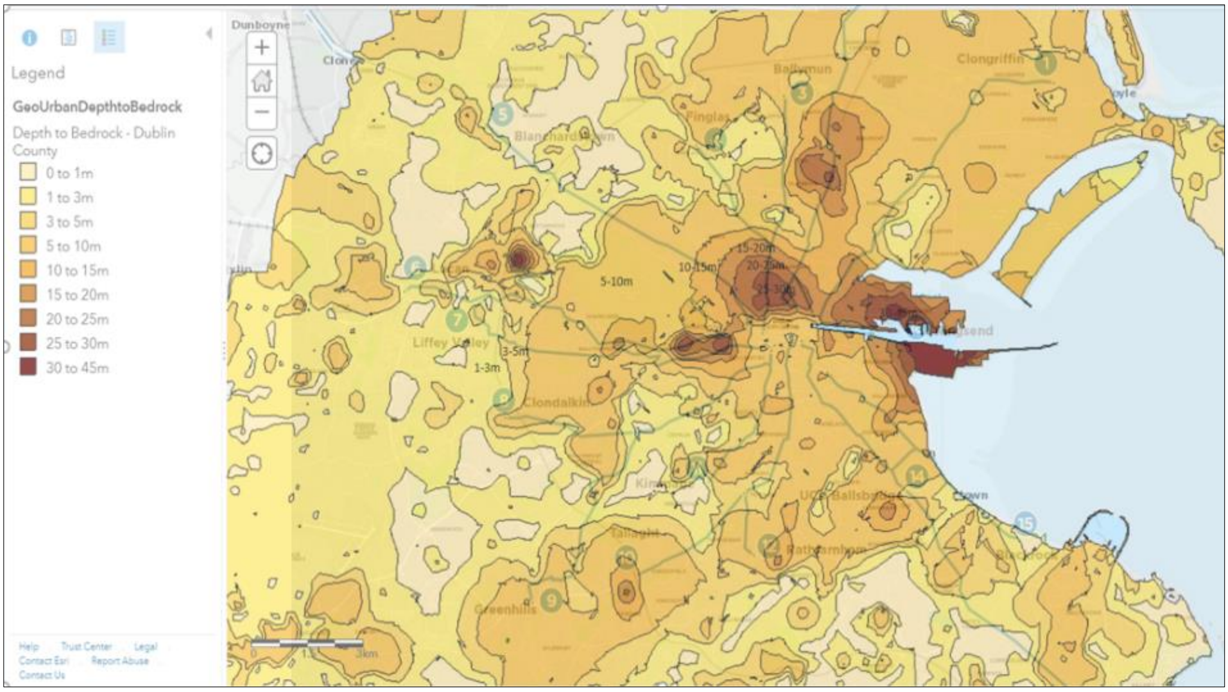


Figure 6-1: Depth of Bedrock from the Geological Survey Ireland website

The water pressures correspond to hydrostatic conditions with a groundwater table about 2m below ground level.

6.2.2 Summary of Desktop Review.

The following preliminary lithology and geotechnical properties has been assumed based on the Desktop Review for the full length of the Proposed Scheme.

Table 6-1: Geotechnical and lithology summary

Layer	Depth	Thickness	Undrained shear strength, c_u (kPa)
Made ground / Urban / Alluvium	0 to 1 m	1	0
Upper Brown Boulder Clay, UBrBC	1 to 3 m	2	80
Upper Black Boulder Clay, UBkBC	3 to 10 m	7	200
Lower Brown Boulder Clay, LBrBC	10 to 18 m	8	400
Lower Black Boulder Clay, LBkBC	18 to 22 m	4	600
Bedrock	>22 m	N/A	>600

6.3 Summary of Ground Investigations

The ground investigation works aimed to assess the geology of the site and determine the ground properties and conditions to enable the design of the Proposed Scheme works. The GI provided for boreholes, trial pits, dynamic probes, standpipes/piezometer installation and monitoring, in-situ testing, geotechnical and environmental laboratory testing and preparation of a factual report, all in accordance with the "*Specification and Related Documents for Ground Investigation in Ireland*".

In situ tests mainly include standard penetration tests. Laboratory tests mainly include particle size distribution, Atterberg limits, density and moisture content to identify soils and direct shear strength, triaxial CU or UU and uniaxial compression to determine the strength of the soil/rock.

Completed ground investigation points for structures are summarised in Table 6-2:

Table 6-2: Ground Investigation Points

Structure	Borehole Ref.	Expected Depth to Bedrock	Borehole Depth (m) – Cable Percussion	Borehole Depth (m) – Rotary Core	Notes
Ringsend 01	R16-CP01	10-15m	15		
Ringsend 01	R16-CP02	10-15m	15		
Ringsend 03	R16-CP03	15-20m	15		
Ringsend 03	R16-CP04	15-20m	15		

6.3.1 Laboratory Testing

The GI works undertaken comprise 4 No. Cable Percussion Boreholes to a maximum depth of 13.5m BGL; 22 SPT tests at 1 metre intervals alternating with disturbed samples and 6 GWL recordings.

13 disturbed samples were taken at each change of soil consistency or between SPT tests and 4 undisturbed samples (UT100) where ground conditions permit. Geotechnical testing consisting of 13 moisture content, 2 Atterberg limits, 2 Bulk Density and 9 Particle Size Distribution. Soil strength testing consisted of 4 Vane tests and 4 Shear Box.

Environmental & Chemical testing, including 19 Suite E samples, pH and organic matter content.

The following factual report has been received as part of the Lot 1 GI:

- Detailed Stage 1 Lot 1 Route 16. June 2021

Completed investigation points are as summarised below:

Table 6-3: Investigation points

Structure	Borehole Ref.	Expected Depth to Bedrock	Borehole Depth (m) – Cable Percussion	Borehole Depth (m) – Rotary Core
Ringsend 01	R16-CP01	10-15m	5.0	-
	R16-CP02	10-15m	9.1	-
Ringsend 03	R16-CP03	15-20m	12.3	-
	R16-CP04	15-20m	13.5	-

6.4 Overview of Soils Classification

The investigation has been done in structures locations only, and those are all concentrated in a short central section. One typical lithology has been proposed for all the scheme, although this is not used for the design of any structure. A particular lithology has been defined for every bridge based on the specific investigation carried out at each structure location.

6.4.1 Made Ground

Made Ground deposits were encountered beneath the Topsoil/Surfacing and were present to depths of between 2.50m and 5.30m BGL.

Made ground deposits were described generally as either brown, sandy gravelly Clay with cobbles or greyish brown clayey gravely Sand with occasional cobbles and contained occasional fragments of concrete, plastic, red brick and wood.

Note that a culvert was encountered in borehole R16-CP02 between 3.0 and 5.3m, which was noted as a void on the log.

The Particle Size Distribution tests confirm that generally the Made ground deposits are well-graded graded with percentages of sands between 22% and 53% and percentages of gravels between 31% and 69%.

PH and total organic carbon (TOC) were determined at R16-CP04 at 0.5m depth. Organic matter content (OMC) was estimated from TOC. PH, TOC and OMC values were 9.3, 1.6% w/w C and 2.8% w/w respectively.

Asbestos was detected at 0.5m depth at borehole R16-CP03.

6.4.2 Cohesive deposits

Cohesive deposits were encountered beneath the Made Ground or interbedded with Granular Deposits and were described typically as grey slightly sandy silty CLAY.

The strength of the cohesive deposits was typically very soft till depths of 11.7mBGL.

Cohesive deposits found to be a CLAY of high plasticity, with a plasticity index ranging between 29% and 31%. Particle Size Distribution tests confirm generally well-graded deposits with percentages of sands and gravels ranging between 11% and 15% and 2% and 5%, respectively.

6.4.3 Granular deposits

Granular deposits were encountered interbedded with cohesive deposits in the majority of holes and were typically described as either greyish sandy sub rounded to rounded fine to coarse GRAVEL with occasional cobbles or gravelly fine to coarse SAND.

Based on the SPT N values the deposits vary from loose to dense.

Particle Size Distribution tests confirm generally well-graded deposits with percentages of sands and gravels ranging between 18% and 58% and 33% and 69%, respectively.

6.5 Summary of Ground Investigation Interpretative Report

For the Proposed scheme, the lithology and soil strength properties has been determined based on the GI findings as shown in Table 6-4.

Table 6-4: Geotechnical parameters

Layer	**Depth (m)**	**SPT**	**Undrained shear strength, c_u (kPa)**
Topsoil, Concrete	0 to 0.5	-	-
Made Ground: Brown Clay (possibly UBrBC) / Sand / Gravel	0.5 to 6	6	40
Very soft silty Grey Clay (only found in 2 out of 4 boreholes)	6 to 12	3.5	20
Gravel	Top level between 6 and 12m	50	325

- 2 Vane tests at Made Ground Sand layer, defined as brown very sandy Gravel or brown very gravelly Sand, have shown Peak shear strength values higher than 146 KPa.
- 2 Vane tests at soft silty clay layer, shown Peak shear strength values between 11 and 13 kPa.
- 2 Shear Box tests at Made Ground Sand layer, defined as brown silty (very) gravelly Sand, shown angle of peak shearing resistant values between 34 and 44 degrees and effective cohesion values between 4 and 13 kPa.

The geological geotechnical ground profile and ground parameters can be found in Appendix E.

6.6 Hydrogeology

Groundwater was noted during the investigation although the exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime. However, standpipes were installed to allow the equilibrium groundwater level to be determined, which is unnecessary for the Proposed Scheme which will involve only shallow excavations. The proposed scheme does not lie within a Group Water Scheme or Public Source Protection Area.

Groundwater levels recorded during the GI works are summarized below in Table 6-5.

Table 6-5: Ground water levels

Borehole Ref.	**GWL (mBGL)**	
Date:	10/04/21	16/06/21
R16-CP01	4.46	4.72
R16-CP02	5.03*	-
R16-CP03	-	2.47
R16-CP04	3.73	4.40
* Water depth might be unrepresentative due to culvert		

6.7 Geotechnical Input to Structures

The following table shows the expected depth to bedrock, based on the data from the Desktop Review, as well as the depth of the encountered bedrock in the GI undertaken.

A preliminary number of the characteristic compressive resistance of piles has been obtained following the alternative procedure in accordance with the Eurocode 7 and the Irish National Annex. This procedure makes use of the ground parameters (such as the undrained shear strength, c_u) to estimate the shaft and base compressive resistance of piles.

Cu values have been derived from SPT values obtained in each borehole following the SPT-Cu relationship proposed by Stroud and Butler (1975). Refer to Appendix E.

For piles embedded in the Dublin boulder clay, the estimated pile lengths are shown in Table 6-6.

In Ringsend 01 and 03 with 0.5m diameter driven piles embedded in the Dublin boulder clay and Ringsend 02 with 0.2m piles, the estimated piles length that satisfies the ULS is as detailed in Table below.

Table 6-6: Geotechnical Conclusions for Structures

Structure	Permanent loads / Variable loads (KN)	Borehole Ref.	Expected Depth to Bedrock	Depth to encountered Bedrock	Depth to NSPT values of Refusal	Piles estimated length (m)
Ringsend 01 D=0.5m	294 / 623	R16-CP01	10-15m	-	5m	11.0
		R16-CP02	10-15m	-	6m	11.5
Ringsend 03 D=0.2m	50	R16-CP03	15-20m	-	12.5m	11.5
		R16-CP04	15-20m	-	12.5m	12.5
Ringsend 03 D=0.5m	210 / 604	R16-CP03	15-20m	-	12.5m	15.5
		R16-CP04	15-20m	-	12.5m	16.5

6.7.1 Retaining Structures

There are no significant retaining walls proposed for this scheme other than as part of the Dodder Public Transport Opening Bridge (See appended PDR). Small blockwork retaining walls of less than 1m height will be provided to resolve levels at a number of locations on approaches to bridges.

7 Pavement, Kerbs, Footpaths and Paved Areas

7.1 Pavement

7.1.1 Introduction

This section covers the preliminary design for:

- Widening of existing carriageways including bus lanes.
- Rehabilitation and strengthening of the existing carriageways.
- New on road cycleways.
- Other specific trafficked areas (e.g. off-line bus stops, bus terminals, off-line parking and loading bays)

In the preliminary design stage, the pavement evaluation studies the nature, severity and extent of the road deterioration, the cause of the deterioration and the strength of the existing road pavement.

In the preliminary design stage, the pavement evaluation studies the nature, severity and extent of the road deterioration, the cause of the deterioration and the strength of the existing road pavement.

The road pavement design for the Proposed Scheme considers rehabilitation of the existing road pavement and new road pavement construction resulting from road widening or changes in geometry along the scheme extents.

7.1.2 Relevant Documents

- TII AM-PAV-06050 Pavement Assessment, Repair and Renewal Principles. Volume 7 Section 3 Part 4. NRA HD31/15. March 2020.
- TII AM-PAV-06045, Management of Skid Resistance. Volume 7 Section 3 Part 1. NRA HD 28/11.November 2011.
- Irish Pavement Asset Group IPAG. Pavement Asset Management Guidance. December 2014.
- DN PAV-03021 Pavement & Foundation Design. Volume 7 Section 2 Part 2A. NRA HD 25-26/10. December 2010.
- DN-PAV-03026. Footway Design. January 2005
- DN-PAV-03023 Surfacing Materials for New and Maintenance Construction for use in Ireland. June 2020
- DCC CSRSW- Construction Standards for Road and Street Works in Dublin City Council
- SRW-Specification for Road Works. Transport Infrastructure Ireland (TII)

7.1.3 Dublin City Council (DCC) Pavement Management System

The extents of the Proposed Scheme assessed in this report comprise radial roads mostly managed by Dublin City Council (DCC). The DCC pavement management system provided relevant information for the assessment of the existing structural and surface condition of road pavements along the route of the Proposed Scheme as described in this section.

7.1.3.1 Road Pavement surveys

- The Road Condition Index (RCI) data recorded in September 2019.
- Sideway force Coefficient Routine Investigation Machine (SCRIM) surveys in September 2019.
- SCANNER surveys of all regional and primary roads undertaken in different seasons each year.

7.1.3.2 Pavement inventory

- There is no comprehensive historical record of all pavement construction, but details of schemes built in the last 6-7 years are available.
- The extent of concrete slabs are not recorded, but this is known to be the most common form of pavement construction beneath a macadam surface layer on most main roads in the inner parts of the urban area in Dublin.

7.1.3.3 Pavement Maintenance Works Strategy

- DCC uses the TAMS (Transportation Asset Management System) by Confirm ® system to prioritize maintenance works, which includes many parameters.
- Normal surface course renewal practice consists of planning off and replacement with a new wearing course consisting of either Hot Rolled Asphalt (HRA) or Stone Mastic Asphalt (SMA).
- The trigger level for resurfacing is the SCRIM Investigatory level of 0.35.
- In jointed concrete slabs, typically 150mm thick, rehabilitation generally comprises removal of 60mm material and overlaying with asphalt over a geogrid, where required. Concrete slabs are rarely replaced, and only on a bay-by-bay basis typically where damaged by utility excavation.
- March to December is the resurfacing season.

7.1.4 Design Constraints

The major design constraints which need to be considered to determinate the required pavement structure are as follows:

- Traffic Loading
- Geometry
- Existing pavement condition

7.1.4.1 Traffic Loading Considerations

- Pavement design for the required design life and the projected traffic volumes.
- The new pavement is be designed for a 40-years design life.
- Existing pavement is be rehabilitated where required to provide 20 years design life.
- Specific paver loading areas were categorized based on the loading or end use.

7.1.4.2 Geometry Considerations

Horizontal realignment: widening or narrowing of the road will change in the positions of traffic lanes with a relocation of the wheel-tracks. Particular care should be given in the placement of longitudinal joints to avoid being in the wheel-track. All surface joints should be considered as a weakness in the system and should be positioned to avoid areas of high stress turning, acceleration and braking zones.

Where pavement widening is proposed this shall be tied to the existing pavement in accordance with the construction details TII CC-SCD-00704-02 in Figure 7-1 and CC-SCD-00704-03 in Figure 7-2.

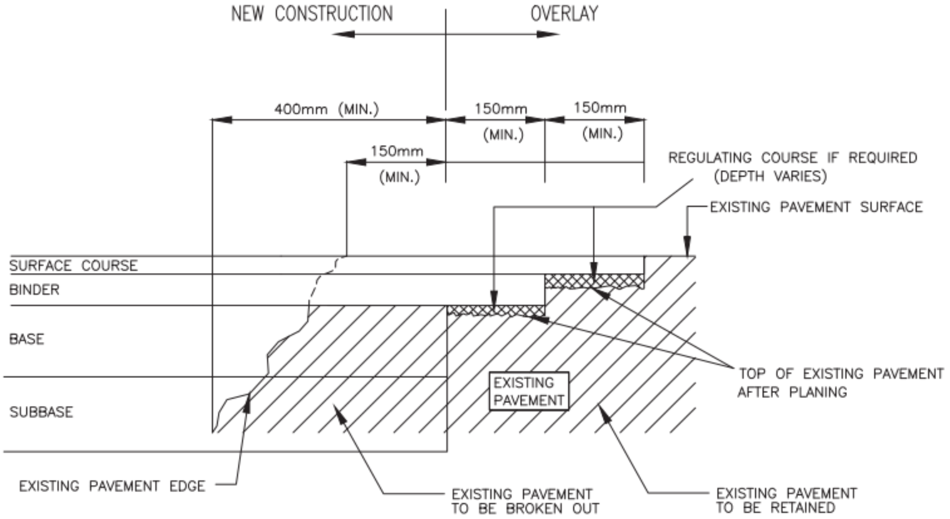


Figure 7-1: Longitudinal Joint between new construction and existing road as per CC-SCD-00704-02

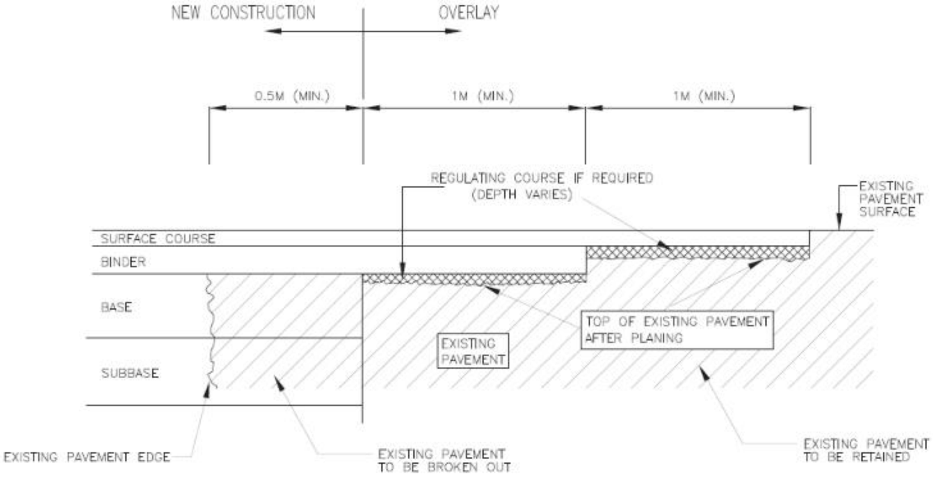


Figure 7-2: Transversal Joint between new construction and existing road as per CC-SCD-00704-03

- Narrowing the existing pavement to be located new footpaths and off-road cycleways and will separated from existing pavement by new granite/concrete kerbs.
- Increase/decrease vertical alignment: There is no anticipated change in the vertical alignment. In the pavement rehabilitation works, existing layers will be planed and replacement with treatment inlays in order to maintain the existing level.
- Cross sections: Widening and narrowing will the change of current cross section. Crossfalls may vary and the existing pavement need to be milled down or overlaying with regulating layers.

7.1.4.3 Existing Pavement Conditions

7.1.4.3.1 Inner urban routes

The typical construction of the main radial roads is as follows:

- 40mm to 60mm of macadam overlay, probably resurfaced periodically and often in Hot Rolled Asphalt, which could be 20 years old or more depending on durability. Some roads may have been resurfaced more recently in Stone Mastic Asphalt.

- Possible old reinforcement layer in hessian across joints in the concrete slabs.
- 200mm thick (or possibly 150mm to 250mm) concrete slabs – usually unreinforced.
- Possible sub-base and probably of doubtful quality.
- Capping Layer: unlikely.

It is not generally feasible to undertake structural overlays on such streets due to interface complications at numerous frontage properties.

Towards the coast in the eastern part of the city the ground conditions differ from the inland areas, with silty and sandy ground conditions in low-lying former tidal areas at Fairview and Sandymount and Ringsend around the mouths of the Rivers Liffey and Tolka that are weaker than the boulder clays found further inland.

7.1.4.3.2 City Docklands Area

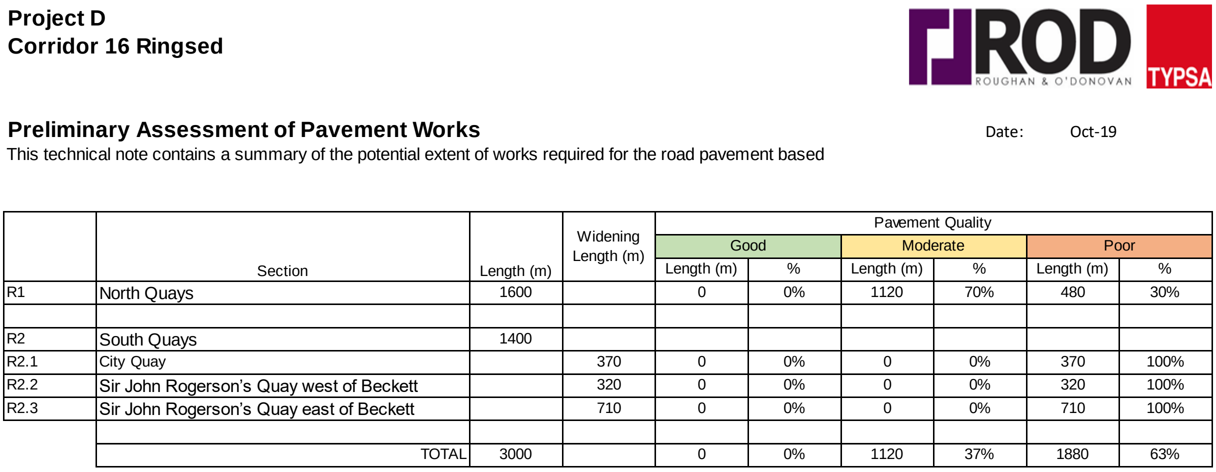
There has been extensive land reclamation, often using dredging's from the river, behind the extended quay walls, that have trained the River Liffey through Dublin Port. Ground conditions in this area are very weak and this has led to subsidence of some streets as the fill below has settled over time. Construction of new streets as part of the docklands redevelopment has required use of geotextile mattresses in the capping layer to support floating road pavements to reduce the risk of future settlement.

7.1.4.3.3 Road Pavement Condition Assessment

Visual Inspections

Following tables below provide an assessment for the condition of the pavements based on the visual inspection on site by the design team.

Table 7-1: Ringsend to City Centre. Preliminary Visual Inspection. Condition Assessment



Project D
Corridor 16 Ringsed

ROD ROUGHAN & O'DONOVAN TYPSA

Preliminary Assessment of Pavement Works
This technical note contains a summary of the potential extent of works required for the road pavement based

Date: Oct-19

	Section	Length (m)	Widening Length (m)	Pavement Quality					
				Good		Moderate		Poor	
				Length (m)	%	Length (m)	%	Length (m)	%
R1	North Quays	1600		0	0%	1120	70%	480	30%
R2	South Quays	1400							
R2.1	City Quay		370	0	0%	0	0%	370	100%
R2.2	Sir John Rogerson's Quay west of Beckett		320	0	0%	0	0%	320	100%
R2.3	Sir John Rogerson's Quay east of Beckett		710	0	0%	0	0%	710	100%
	TOTAL	3000		0	0%	1120	37%	1880	63%

Data Collection Analysis

Two pavement survey data have been provided for the routes: Road Maintenance Office (RMO) and Dublin City Council (DCC) datasets, which include

- RMO Pavement Survey: SCRIM coefficient, International Roughness Index IRI, Rut depth, Longitudinal Profile Variance LPV; Mean Profile Depth MPD, Pavement Surface Condition Index PSCI, Surface inventory material type, Road schedule, Completed and planned interventions. Survey date are from 2011 to 2019.
- DCC Pavement Survey: Road Condition Index RCI and SCRIM coefficient carried out in 2019.

For assessment purposes, condition data values before 2016 were discarded, assumed they do not reflect the current condition of the pavement because the age of the survey. In the same way, recent RCI and SCRIM coefficient values by DCC have been considered for the condition assessment instead of older RMO's PSCI and SCRIM survey. Below, the results of those condition pavement surveys are assessed and detailed.

RMO Pavement Survey

Some main indicators: IRI, rut depth, Longitudinal Profile Variance LPV; and Surface inventory material type database have been assessed. International Roughness Index IRI and Longitudinal Profile Variance LPV are measurements of the longitudinal profile and indicate the irregularities in the pavement that influence the public's perception of the quality of service (ride quality).

SCRIM measures the frictional resistance generated between the road surface and a tyre under wet conditions. The micro-texture is the main contributor to skid resistance at low speeds. Statistically, low skid resistance values are directly related to traffic accidents.

Rut depth is defined as the difference in elevation between the centre of the wheel path and the centre of the travel lane. Ruts can form through the inadequate asphalt, underlying material or repeated heavy loadings.

This data is presented in Figure 7-3.

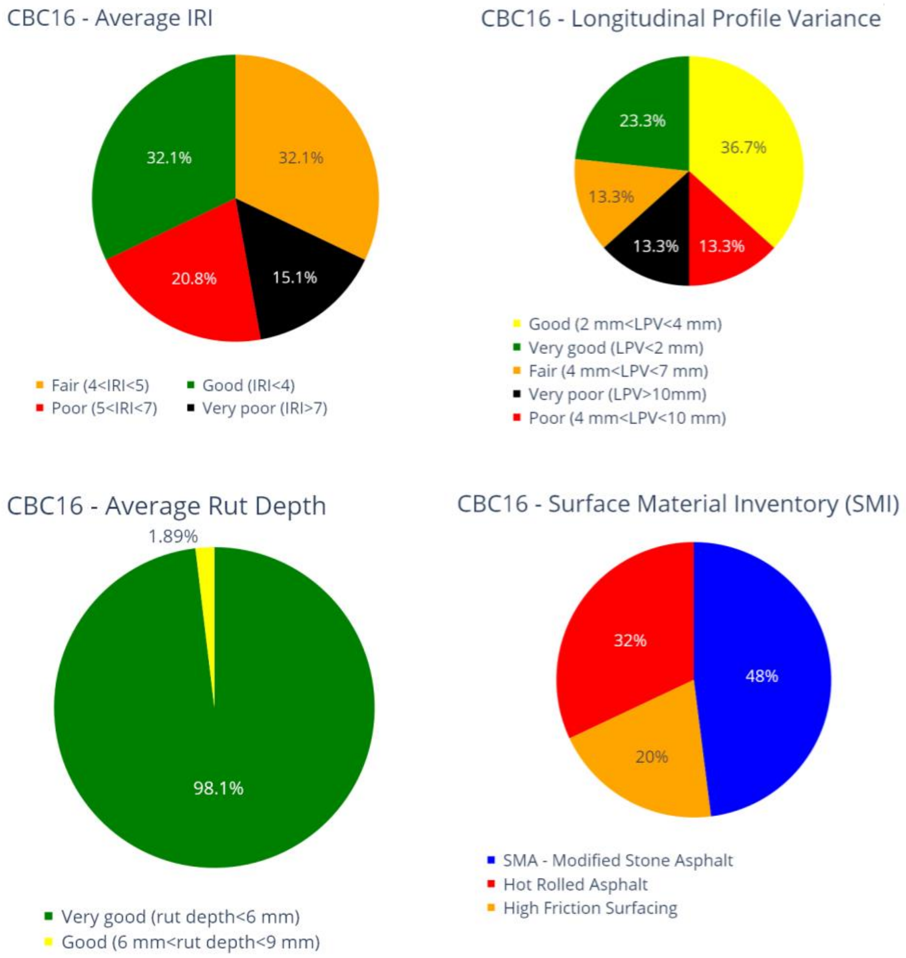


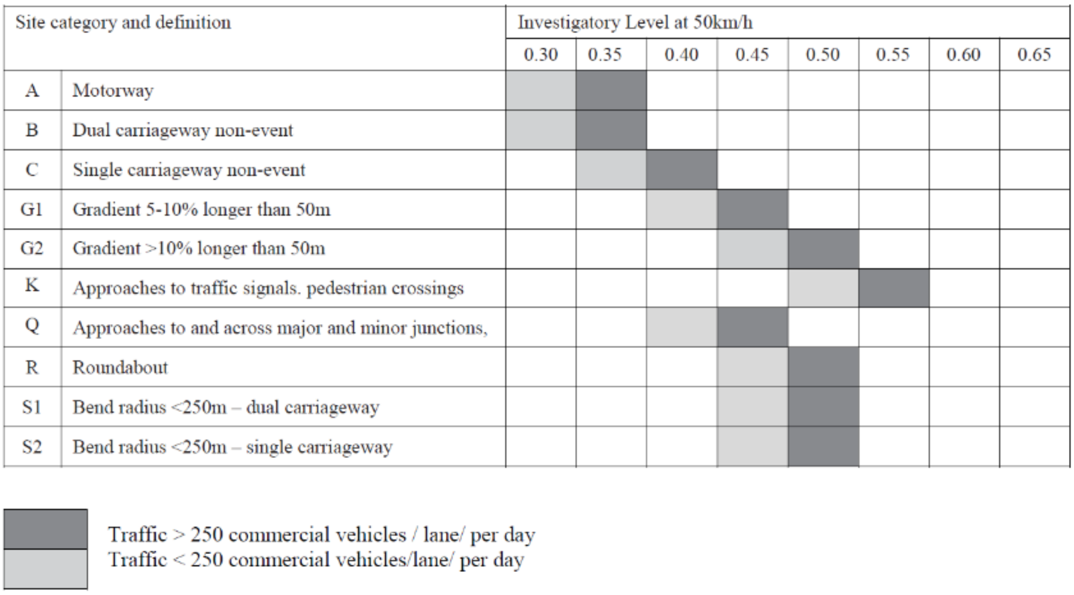
Figure 7-3: Ringsend to City Centre. IRI, LPV, Rut depth and SMI. Source: RMO dataset

Regarding Ringsend to City Centre CBC, more than 30% IRI and LPV values are in very good and good condition. Ruth depth in good and very good condition in almost all the route, and pavement surface are mainly comprised of Hot Rolled Asphalt (48%) and Stone Mastic Asphalt (32%) and High Friction surfacing (20%).

Road Condition Indicator

The Road condition Indicator (RCI)indicates the current overall condition and a value of the pavement asset. The measured parameters that describe the existing condition are longitudinal profile (ride quality), transverse profile, condition of the edge, texture surface, cracking, which indicate defects in the surface, binder and the base course. Noted RCI values on its own in not sufficient to design a pavement rehabilitation but provides information to prioritize and plan future interventions by Authorities.

For skid resistance, SCRIM of the existing pavement identifies the sections with need of resurfacing if skid resistance values do not comply with the threshold values. In order to assess the SCRM coefficient results and assign the appropriate level of skid resistance in accordance with the investigatory levels defined in Table 4.1 of the TII Standard for Management of Skid Resistance AM-PAV-06045.



Site category and definition		Investigatory Level at 50km/h							
		0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65
A	Motorway	░	▓						
B	Dual carriageway non-event	░	▓						
C	Single carriageway non-event		░	▓					
G1	Gradient 5-10% longer than 50m			░	▓				
G2	Gradient >10% longer than 50m				░	▓			
K	Approaches to traffic signals. pedestrian crossings					░	▓		
Q	Approaches to and across major and minor junctions,			░	▓				
R	Roundabout				░	▓			
S1	Bend radius <250m – dual carriageway				░	▓			
S2	Bend radius <250m – single carriageway				░	▓			

▓ Traffic > 250 commercial vehicles / lane/ per day
░ Traffic < 250 commercial vehicles/lane/ per day

Figure 7-4: CSC investigatory level depending on Site Category. Source: TII

The roads in the Proposed Scheme are in Category Q, with an investigatory level of 0.45 (traffic greater than 250 commercial vehicle/lane per day) and not including the approach to traffic signals and pedestrian crossings, the SCRIM thresholds are shown below.

- GREEN: Good condition (Corrected SCRIM values >=0.45)
- AMBER: Regular condition (Corrected SCRIM values <0.45 and <=0.35)
- RED: Bad condition (Corrected SCRIM values <0.35)

The following figure shows the RCI and SCRIM values for the route:

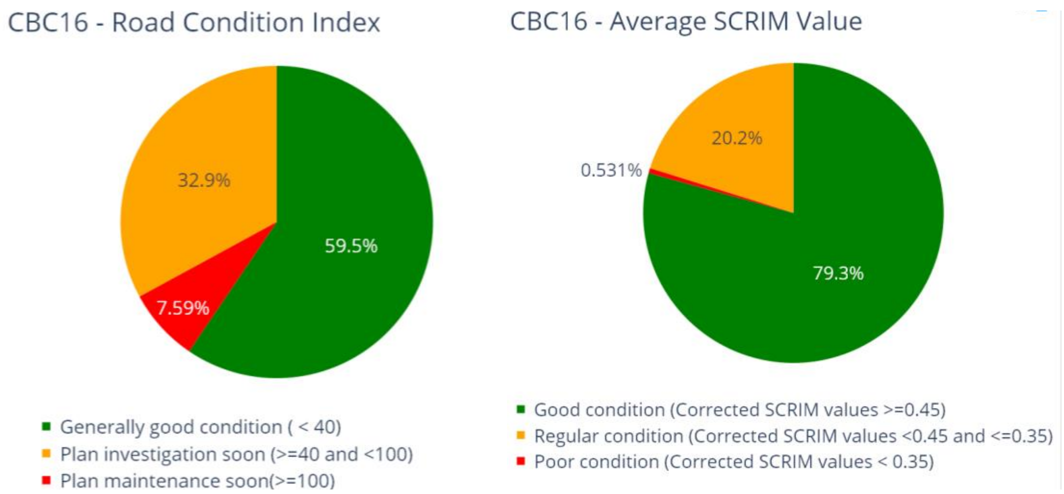


Figure 7-5: Ringsend to City Centre. RCI and SCRIM condition

The RCI survey indicates that the pavement is generally in good to regular condition along the Ringsend route at the North Quays with a few localised areas of poor condition, mainly at junctions and most of the length of the South Quays, with extensive areas of moderate and poor pavement condition. The SCRIM assessment indicates that the North Quays the surface is in good condition, against regular and poor condition at South Quays.

Subgrade Conditions

No information was available, in terms of bearing capacity, represented by California Bearing Ratio-CBR, required to the design for full depth reconstruction at the widening areas. A Design CBR of 2.5% is assumed as the minimum permitted value stated in Clause 3.23 of DN-PAV-03021.

7.2 Pavement Design

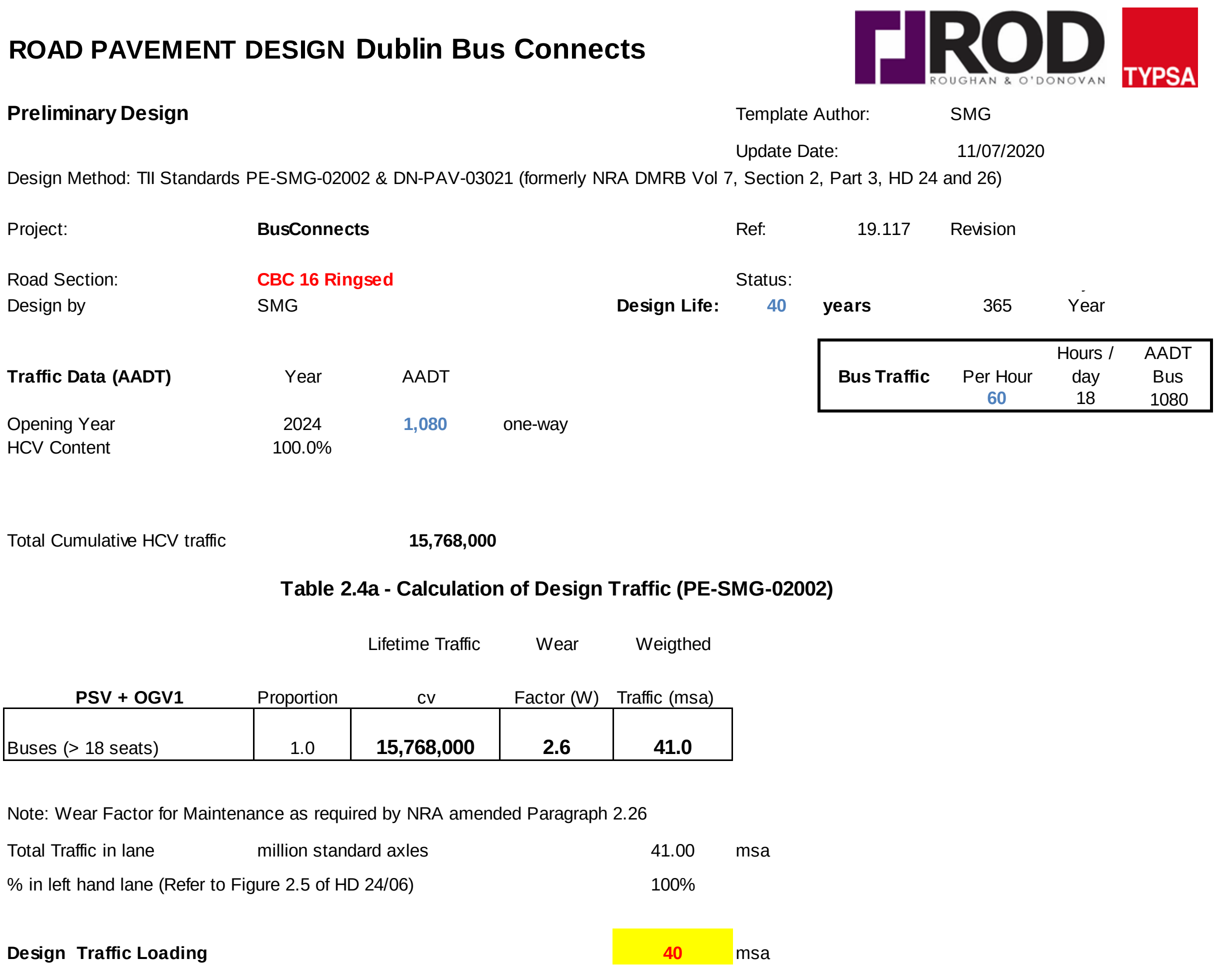
7.2.1 Pavement Widening & Reconstruction

7.2.1.1 Areas of Widening - Full Depth Construction

The pavement has been designed in accordance with DN PAV-03021 Pavement & Foundation Design. Volume 7 Section 2 Part 2A. NRA HD 25-26/10 for the traffic loading considerations described below.

Design Life and Design Load

Where pavement reconstruction is required within a bus lane, the design thickness may vary according to the frequency of bus services and the associated traffic loading. These loadings are shown in Figure 7-6. The associated pavement thicknesses are shown in Figure 7-7 for a 40 Year Design Life.



ROAD PAVEMENT DESIGN Dublin Bus Connects

Preliminary Design

Template Author: SMG
Update Date: 11/07/2020

Design Method: TII Standards PE-SMG-02002 & DN-PAV-03021 (formerly NRA DMRB Vol 7, Section 2, Part 3, HD 24 and 26)

Project: **BusConnects**
Ref: 19.117
Revision

Road Section: **CBC 16 Ringsed**
Status:
Design by SMG
Design Life: 40 **years** 365 Year

Bus Traffic	Per Hour	Hours / day	AADT Bus
	60	18	1080

Traffic Data (AADT)	Year	AADT	
Opening Year	2024	1,080	one-way
HCV Content	100.0%		

Total Cumulative HCV traffic **15,768,000**

Table 2.4a - Calculation of Design Traffic (PE-SMG-02002)

PSV + OGV1	Proportion	Lifetime Traffic cv	Wear Factor (W)	Weigthed Traffic (msa)
Buses (> 18 seats)	1.0	**15,768,000**	**2.6**	**41.0**

Note: Wear Factor for Maintenance as required by NRA amended Paragraph 2.26

Total Traffic in lane	million standard axles	41.00	msa
% in left hand lane (Refer to Figure 2.5 of HD 24/06)		100%	
Design Traffic Loading		40	msa

Figure 7-6: Ringsend to City Centre. Design Traffic Loading

Pavement Design Thickness

Flexible pavement design is being considered in line with DCC CSRSW and also existing pavement build up are highly likely have the same features. Options are provided for Asphalt Concrete using 70/100 Pen Bitumen (the least stiff material requiring the thickest construction) and Asphalt Concrete utilizing 40/60 Pen Bitumen (a stiffer material requiring a reduced pavement thickness to provide the same structural equivalence.).

Pavement design options for the constructions proposed above, have been designed in accordance with the allowable materials and requirements presented in Figure 4.2 of DN-PAV-03021.

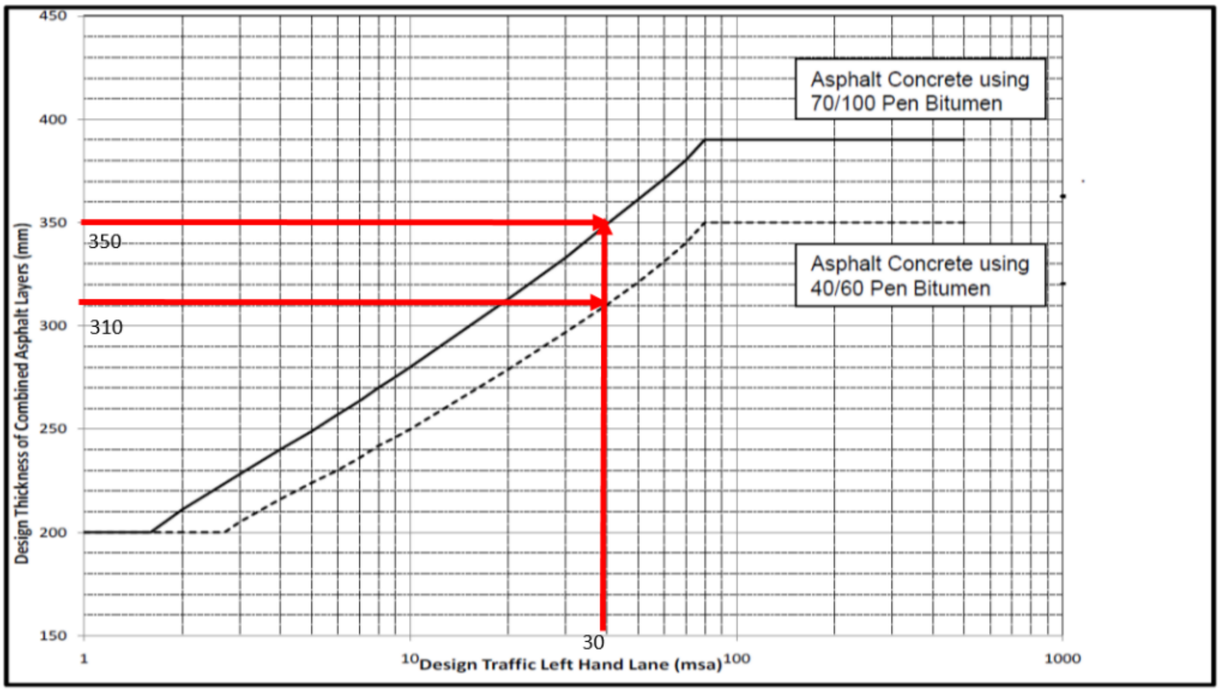


Figure 7-7: Ringsend to City Centre. Pavement Design Thickness

Then, the pavement asphalt thickness for Ringsend to City Centre CBC designed by DN-PAV-03021 and DCC CSRSW are.

Table 7-1: Comparative Asphalt Design Thickness between DN-PAV-03021 and DCC CSRSW

Corridor	Bus Frequency Per hour	Traffic Loading Million standard axles (msa)	Pavement Thickness (mm) / Material		DCC CSRSW Bus Corridor
			40/60 Pen	70/100 Pen	40/60 Pen
CBC 16 Ringsend	60	40	310	350	350

Pavement structure of DCC CSRSW Standards for bus corridor is similar than the pavement structures designed with DN-PAV-0302 standard. The DCC's pavement section would support traffic loadings up to 80 msa.

Pavement Foundation Design

The subgrade testing (CBR determination) in widening and full depth reconstruction areas will be left for the successful Contractor to perform. For preliminary design purpose, it is proposed a Design CBR of 2.5% to be used as per minimum permitted value stated in Clause 3.23 of DN-PAV-03021.

Foundation design options have been designed in accordance with the allowable materials and requirements presented in DN-PAV-03021 and are summarised in Table 7-2:

Table 7-2: Foundation Design for Fully flexible pavement with Asphalt Concrete Base

Pavement Type	Single Foundation Layer	Subbase on Capping Foundation Layers
Fully Flexible Pavement with Asphalt Concrete base	350mm Granular Subbase	150mm Granular Subbase on 400mm Capping

Pavement Construction Layers

Full depth construction layers are as follows:

- Capping Layer: Considering Design CBR of 2.5%, 350 mm thickness of capping material class 6F2 material, in accordance with Clause 613 and compacted in compliance with Clause 612.
- Sub-base: 300 mm thickness of subbase material Type B granular material, in accordance with Clause 804 and compacted in compliance with Clause 802.
- Base course: 250 mm thickness of AC 32 HDM base 40/60 des. It shall comply with the requirements of Clause 929, 930, 937 and 943, S.R.W. It shall be laid and compacted to Clause 903
- Binder course: 60/65 mm thickness of AC20 HDM bin 40/60 des. It shall comply with the requirements of Clause 929, 930, 937 and 943, S.R.W. It shall be laid and compacted to Clause 903
- Surface course: 35/40 mm thickness of HRA (HRA 30/14 F surf 40/60 des or HRA 35/14 F surf 40/60 de) or SMA 10 surf des PMB 65/105-60 It shall comply with the requirements of Clause 929, 930, 937 and 943, SRW. It shall be laid and compacted to Clause 903.

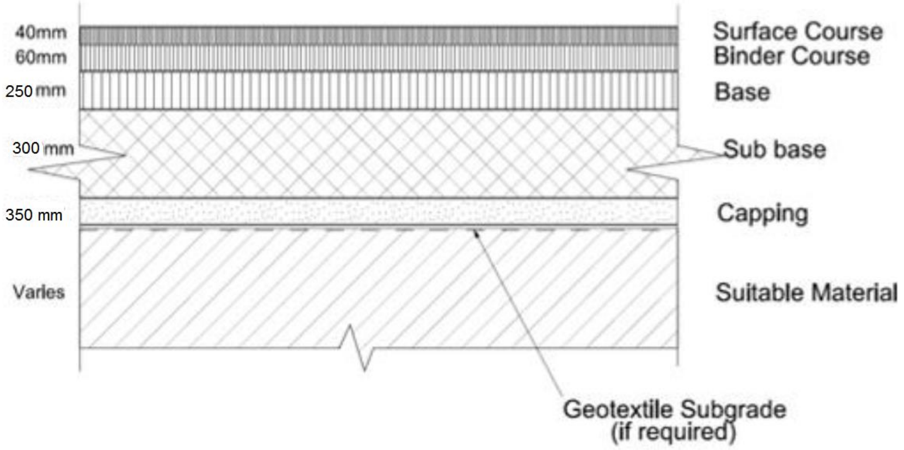


Figure 7-8: Pavement Structure of Bus Lane. Typical detail

7.2.1.2 Existing Road Treatment

The condition of the existing pavement structure along the proposed scheme was assessed based on Surface Condition Index surveys conducted for the road authority, which categorises the pavement as follows:

- Green condition: good
- Amber condition: moderate
- Red condition: poor

For each type of pavement structure the required strengthening will be as follows:

Strengthening for fully flexible pavement

- Green condition : Do nothing
- Amber condition: Pavement reinforcement: 150 mm new surface and binder course : 40 mm wearing course +110 mm binder course.
- Red condition: Full pavement reconstruction. New surface, binder, base and subbase course: 40 mm wearing course+110 mm binder course + 150 mm base course+ 300 mm sub-base.

Strengthening requirements for rigid pavement with asphalt surface course according to Condition Assessment

- Green condition : Do nothing
- Amber condition: 40 mm wearing course overlay.
- Red condition: New surface and concrete slab reconstruction: 40 mm wearing course +200mm concrete slab+300 mm subbase.

Surfacing improvements

Following treatment to improve the skid resistance depending on condition are:

- Green condition: Do nothing
- Amber condition: 40 mm wearing course overlay
- Red condition: 40 mm wearing course overlay.

Table 7-3: Rehabilitation treatment for existing fully flexible pavement

Condition	Proposed treatment	Proposed works
RCI<40 and SCRIM ≥0.45	Do nothing	
RCI<40 and 0.35≤SCRIM <0.45	Retexturing treatment	Shot blasting
RCI<40 and SCRIM <0.35	New surface inlay	40 mm PSMA wearing course inlay
40 ≤RCI<100	New surface and binder course inlay	40 mm PSMA wearing course+110 mm binder course
RCI ≥100	New surface, binder, base and subbase course inlay	40 mm PSMA wearing course+110 mm binder course + 150 mm base course+ 300 mm subbase

Table 7-4: Rehabilitation treatment for Rigid pavement with asphalt surface course

Condition	Proposed treatment	Proposed works
RCI<40 and SCRIM ≥0.45	Do nothing	
RCI<40 and 0.35≤SCRIM <0.45	New surface overlay	40 mm PSMA wearing course
RCI<100 and SCRIM <0.35	New surface overlay	40 mm PSMA wearing course
RCI ≥100	New surface and concrete slab reconstruction	40 mm PSMA wearing course +200mm concrete slab+300 mm subbase.

7.2.1.3 Reuse and Recycling of Pavement Materials

Opportunities for reuse and recycling of secondary materials include:

- Incorporation of minimum 20% of Reclaimed Asphalt into new base and binder layers of the pavement;
- Excavated capping layer material to be reused as new capping material if compliant with current standards; and
- Excavated subbase layer material to be reused as new subbase material if compliant with current standards.

7.3 Kerbs, Footpaths and Paved Areas

The design is based on the following:

- Preliminary Design Guidance Booklet for BusConnects Core Bus Corridors.
- DCC CSRSW- Construction Standards for Road and Street Works in Dublin City Council. May 2016.
- DN-PAV-03026. Footway Design. January 2005
- CC-SPW—Specification for Road Works. Transport Infrastructure Ireland (TII).
- BS 7533 Pavement constructed with clay, natural stone or concrete pavers.1999-2021.
- Landscape Architects Requirements
- Existing condition and construction build-up.

7.3.1 Design Constraints

7.3.1.1 Traffic Loading Considerations

Footpath foundations should be sufficiently robust to give satisfactory performance over a design life of 40 years. For the traffic consideration, the designs are given for three construction categories, the appropriate category being chosen according to the necessity to consider the pedestrian and vehicular which the footpath may to support.

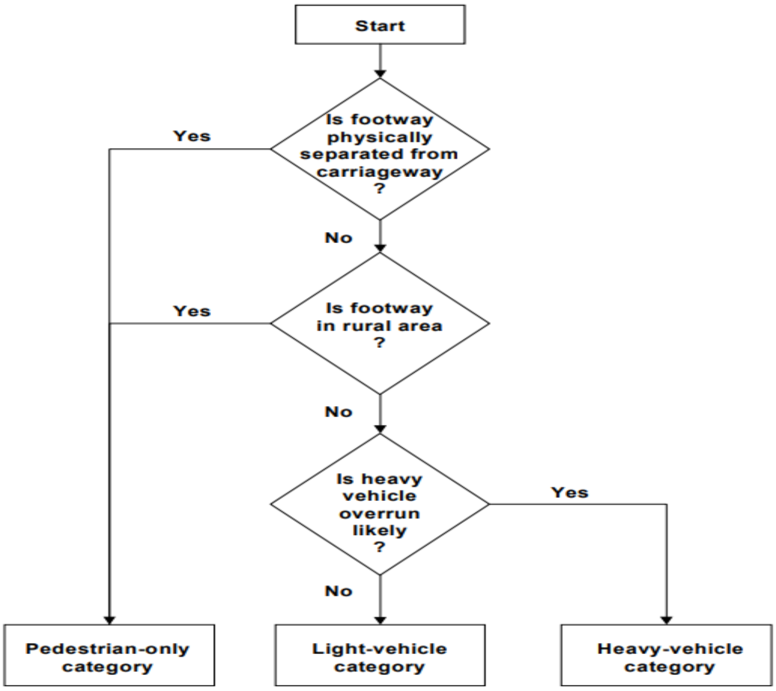


Figure 7-9: Flowchart for Selection of Footpath Category. Source: DN-PAV-03026. Footway Design

- Pedestrian-only Category: When are not designed to support any type of vehicle use, not even small cleaning and maintenance vehicles, except those that are pedestrian controlled.
- Light-vehicle Category: For Residential Vehicular Access. Light vehicle overrun is common but overrun by heavy vehicles would not be expected to occur more than very occasionally, vehicle overrun, such as might occur two or three times a year with occasional delivery vehicles to private houses.
- Heavy Vehicle Category: In case of the footpath is adjacent to a busy road and overrun is not prevented by some physical means, then the footpath should be designed to sustain heavy vehicle overrun. For this category of footpath the design traffic is assumed to be 50,000 standard axles (approximately one vehicle per working day over a design life of 40 year, assuming that one heavy vehicle is, on average, equivalent to one standard axle and multiplied by 3 to take channelisation into account and some allowance has been made for dynamic loading due to the vehicle mounting the footpath) But, in areas when see a significant amount of delivery or maintenance vehicles, pavement design shall be carried out according in HD 26 (DMRB 7.2.3.2).

In general, most of the footpaths are listed as pedestrian-only footpath and light-vehicle Category.

Off road cycleways will be constructed adjacent footpaths and should be designed as per National Cycle Manual. The section 5.6 of the NCM refers details for appropriate cycle track surfacing and materials.

7.3.1.2 Geometry Considerations

Various changes in footpath geometry are the result of realignment of kerbs and changes in the configuration of junctions.

7.3.1.3 Existing Footpath Pavement Condition Considerations

The footpath pavement conditions are quite diverse along the quays featuring decorative stone pavers in various shapes, sizes and types. Most are in good condition and are quite recent. Along the parks and peripheral neighbourhoods to the east, more conventional asphalt surfaces and poured concrete paths can be found. These are often in poor conditions and must be replaced in large areas.

7.3.2 Footpath Pavement Design

7.3.2.1 Pavement Materials

The pavement materials for kerbs, footpaths, off road cycleways and paved areas have been specified in collaboration with the landscaping architects and the construction requirements set out in DCC Standards and TII DN-PAV-03026 “Footway Design”.

For areas outside city centres and commercial zones, poured concrete surfaces have been proposed as the main pavement material. Asphalt hasn´t been proposed but it could be considered to complement any existing area disturbed by rehabilitation works. The stone paving considered in Landscaping plans include large stone pavers (0.60x0.60m) and cobble setts (0.10x0.10m). In 1:200 scale detail plans the stone pavers are to be used in historical/ conservation zones and around heritage buildings while the cobble setts, are proposed in smaller areas marking mixed pedestrian vehicular areas, small, landscaped areas, or vehicular entrances. Concrete paving on the other hand refers exclusively to (0.60x0.60m) square blocks proposed for commercial areas. Proposed Self Binding-gravel is used in some areas namely small gardens and plazas that have been proposed.

All historical stone pavers in areas to be restored must be conserved and reused onsite or kept in good conditions to be used elsewhere, preferably in nearby locations. Concrete paver areas in medians proposed to be reverted to green zones must be salvaged as much as possible: If they are not set over sand or gravel, they may be reused. Whenever the kerb edges are affected by the road/ cycle path design new granite kerbs (for stone paving) or concrete kerbs (for concrete pavers and poured concrete) will be included to limit the new footpaths.

Areas with proposed stone paving are shown on the Landscaping Drawings in Appendix B5 and include large stone pavers (0.60x0.60m) and cobble setts (0.10x0.10m). Stone pavers are proposed in historical / conservation zones and around heritage buildings. Cobble setts are proposed in smaller areas marking mixed pedestrian vehicular areas, small, landscaped areas, or vehicular entrances. Otherwise concrete paving slabs (0.60x0.60m) are proposed for commercial areas. Proposed Self Binding-gravel is used in some plaza and park areas.

All historical stone pavers will be conserved and reused onsite or kept in good conditions to be used elsewhere, preferably in nearby locations.

7.3.2.2 Footpath and Paved Areas

The primary concept of the landscape proposal regarding pavement design is to propose an adequate and proportionate array of the basic paving types so maintainability is preserved. Central village and conservation areas with higher demands by users will concentrate the most expensive paving materials. The more extensive peripheral areas will feature poured concrete footpaths since these are more cost-effective and low-maintenance surfaces.

Locations of new footpath pavement, predominantly anticipated to be at areas of widening for bus lane pavement, will be designed in accordance with CSRSW.

Examples of the various footpath paving types are presented in the Figure 7-10 below

Asphalt Footway **Concrete Paving Footway**

Granite Flagstone Footway **Concrete Footway**

Figure 7-10: Footpath Paving Types

The types of surfacing for footpaths proposed will be as follows:

- For concrete footpaths, in situ concrete shall be C30P and shall comply with Clause 1106 of CC-SPW-01100.
- Paving stones are natural stones or precast concrete as per DCC CSRDW Standards. For paved footpaths with the concrete blocks shall comply Clause 11007 of CC-SPW-01100 and BS 6717: Part 1 and Concrete Flags shall comply Clause 1104 of CC-SPW-01100 and BS 7263: Part 1.
- Subbase shall be Granular material Type A, shall comply with Clause 803 of CC-SPW-00800 or Granular adjacent Cement Bound Material, and shall comply with Clause 808 of CC-SPW-00800.
- Base shall be CBGM B shall comply with Clause 822 of CC-SPW-00800 or AC 20 dense bin 40/60 des and shall comply with CC-SPW-00900.
- Reclaimed Asphalt shall be assessed and classified according to IS EN 13108-8, Table 13a, Table 13b and Table 13c of with CC-SPW-00900.
- All Capping materials shall be Class 6F1 or 6F2 and shall comply with Clause 613 of CC-SPW-00600.

7.3.2.3 Cycleways

To improve legibility, it is proposed that all cycle tracks and cycle lanes are to have red coloured epoxy type surfacing, or red coloured asphalt, or similar in accordance with the National Cycle Manual.

The National Cycle Manual route surface indicated that surface should be as smooth as possible to ensure efficient surface water run-off and a rough texture will provide for increased grip and reduced wheel spray compared to a smooth texture. Therefore, wearing course should consist of smaller aggregates 10 mm or less. The materials commonly used include: 45/6F or 45/10F hot rolled asphalt wearing course, 0/6 or 0/10 Dense bitumen macadam surface course (30 mm AC 10 close surf 70/100 des) or close graded SMA (10/6mm aggregate) and Coloured high-friction (anti-skid) surfacing. The materials shall be in accordance with CC-SPW-00900.

Resin Based Surface
(Treatment (High Friction Surfacing Type 2)

The proposed segregated cycleway pavement construction is:

- Red epoxy resin with 3 mm uncoated chips
- 30 mm AC 10 close surf 70/100 des.
- 50 mm AC 20 dense bin 70/100 des
- 150 mm granular subbase Type B

7.3.2.4 Kerbs

- Precast concrete kerbs shall comply with Clause 1101 of CC-SPW-01100.
- In situ concrete kerbs shall comply with the Clause 1104 of CC-SPW-01100 and meet the requirements for exposure class XF4 in ISEN 206-1.
- Granite kerbs shall comply with IS EN 1341 “Kerbs of Natural Stone for external Paving”.

8 Structures

8.1 Overview of Structures Strategy

The Proposed Scheme aims to provide enhanced walking, cycling and bus Infrastructure, which will enable and deliver efficient, safe, and integrated sustainable transport movement in this corridor. Priority for buses is provided along its entire route consisting primarily of dedicated bus lanes in both directions, with alternative measures proposed at particularly constrained locations along the scheme. Cycle tracks and footpaths will be also provided separated from the bus lanes. At constrained points, it is necessary to build new structures or widen the existing ones to provide adequate space for the proposed road layout.

The structural design proposed for the new bridges and other structures has been developed complying with the applicable regulations for this matter. In general, the standards that have been considered are the following:

- TII Design Manual for Road and Bridges, and related publications.
- Irish Standards: Eurocodes with the Irish National Annex

The principal objectives that have been considered in relation to the design of the structures, in addition to the structural ones such as resistance or durability, are as follows:

- To satisfy the new layout and roadway design requirements in terms of space for proposed lanes, footpaths, maximum slopes, etc.
- To provide a pleasant structure, with minimal visual impact and environmental impact on its environs.
- To minimise construction disruption and duration, and traffic impact for all road users.
- To satisfy the requirements of the stakeholders engaged, particularly Iarnród Éireann and Waterways Ireland.
- To avoid or minimise the impact on the existing structures, especially older retaining walls in order to avoid introducing extra loads onto these structures.

Liaison has been held with Iarnród Éireann and Waterways Ireland to discuss about the design and to implement any suggestion that was raised to fulfil their requirements.

A structural survey was carried out by the structures specialist to know better the condition and typologies of the existing bridges. The information collected during the site visit can be seen in more detail in the Appendix F.

The following table lists a summary of the existing structures in the Proposed Scheme. The last column shows whether there is any expected work at the existing structure location and, if there is, the name of the proposed structure.

8.2 Summary of Existing Structures

Table 8-1: Existing Structures along Ringsend to City Centre CBC

ID	Name	Description	Obstacle	Expected structural Works?
CBC16-Ex04	East Link Bridge	Precast beams bridge/Steel bascule bridge	Liffey River	None

ID	Name	Description	Obstacle	Expected structural Works?
CBC16-Ex03a	Spencer Dock Draw Bridges	Steel rolling Scherzer bridges	Royal Canal / Liffey River	Replacement, relocation and reconstruction
CBC16-Ex03b	Royal Canal Footbridges	Stainless steel beam bridges	Royal Canal / Liffey River	Removal
CBC16-Ex02	Samuel Beckett Bridge	Cable-Stayed bridge	Liffey River	None
CBC16-Ex01a	George's Dock Swing Bridge	Steel rolling Scherzer bridges	George's Dock Canal	Replacement, relocation and reconstruction
CBC16-Ex01b	George's Dock Pedestrian Bridges	Wooden / steel structures	George's Dock Canal	Removal

8.3 Summary of Principal Structures

There are 5 new structures required for the Proposed Scheme:

Ringsend 01 – New and Relocated Bridges at George's Dock

Ringsend 02 – Boardwalk at North Wall Quay

Ringsend 03 – New and Relocated Bridges at Spencer Dock Royal Canal

Ringsend 04 – Custom House Quay Boardwalk

Ringsend 05 – Dodder Public Transport (Opening) Bridge

8.3.1 Structure Ringsend 01 – New and Relocated Bridges at George's Dock

The purpose of the proposed bridge design at this location is to provide increased lane capacity for cyclists and public transport in comparison to the existing Scherzer Bridges in the George's Dock area. The design requirements cannot be accommodated within the configuration of the existing structures. The proposed solution therefore is to construct a new road bridge (Ringsend 01) at the location of the existing Scherzer Bridges in the area. There is however a desire to keep the existing Scherzer Bridges in operation due to their historic and unique nature. The proposal is that these existing bridges will be relocated adjacent to the new bridge Ringsend 01, and will accommodate the new cycle lane and footpaths.

A composite plan view of the new Ringsend 01 bridge together with the existing Scherzer bridges in their new position is shown in Figure 8-1 below.

The new bridge is skewed in plan due to the new abutments being parallel to the direction of the existing quay walls. The structural configuration is a single span, fully integral portal bridge 17.55 m long and 15.70 m wide, as shown in Figure 8-.2 below.

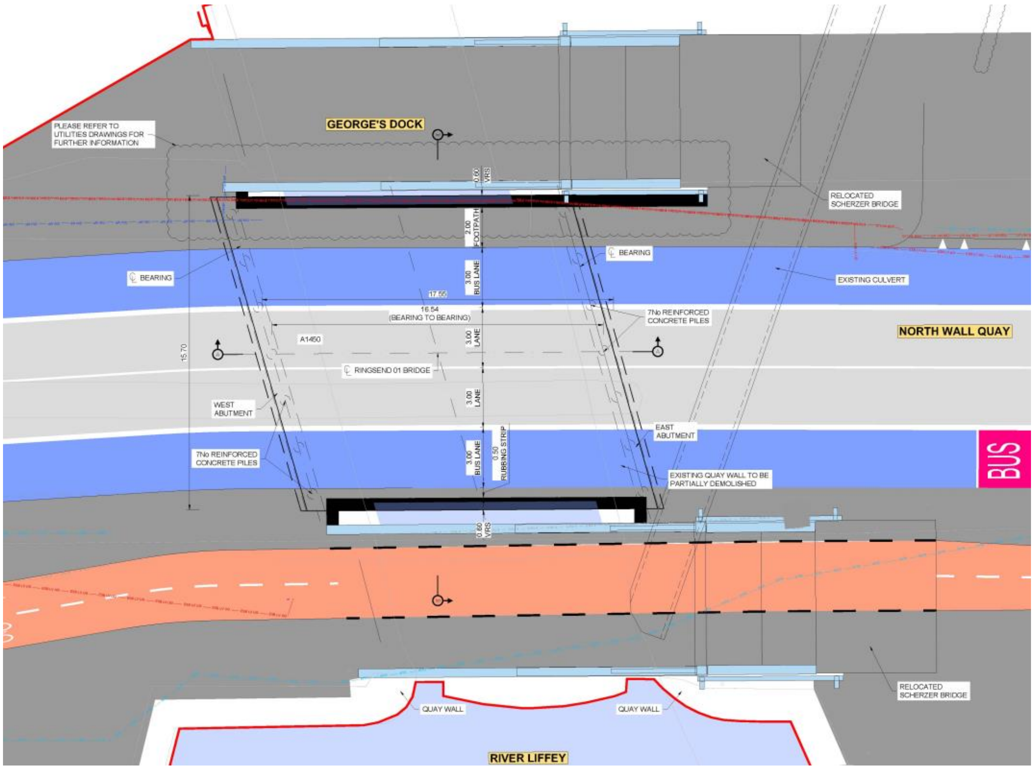


Figure 8-1: Plan view Ringsend 01

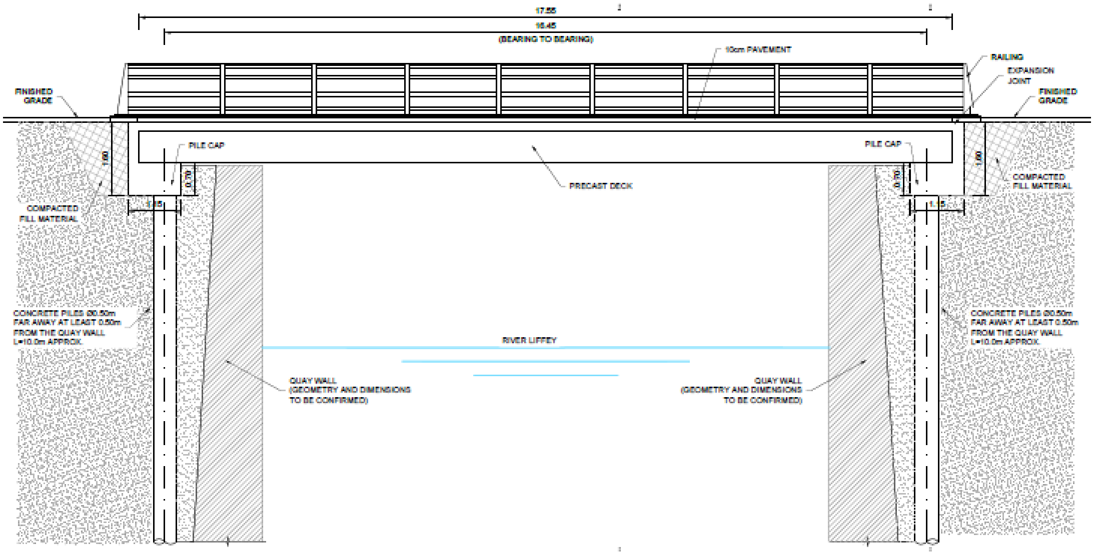


Figure 8-2: Elevation view Ringsend 01

The typical cross section of the new bridge consists of 13No. precast prestressed concrete beams, 11No. type TY and 2No. type TYE, and a cast in-situ reinforced concrete slab. The proposed beams have a depth of 0.70m and the slab has a depth of 0.20 m. The total depth of the deck is therefore 0.90m.

The new bridge is to carry a four-lane road - 2No. bus lanes and 2No. traffic lanes, one lane of each type per direction, and 1No. footpath. The road layout also includes a rubbing strip, and the bridge deck allows for sufficient space for a traffic restraint system on both sides. The typical cross section is shown in Figure 8-3.

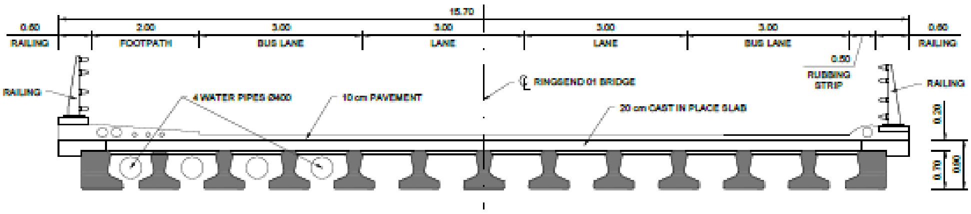


Figure 8-3: Deck Section Ringsend 01

The proposed bridge will be supported on piled foundations. This will comprise 7No. reinforced concrete piles of 0.50m diameter per abutment; a reinforced concrete pile cap at the top of the piles (for load transfer from the bridge deck to the piles), and a ballast wall to retain the ground. The length of the piles has been estimated to be approximately 11.5m (this figure will be finalised in later design stages). The integral connection between the deck and the substructure is to be made at the pile cap during construction. Due to the bridge being integral, expansion joints are not needed. The typical section of the abutments is shown in Figure 8-4.

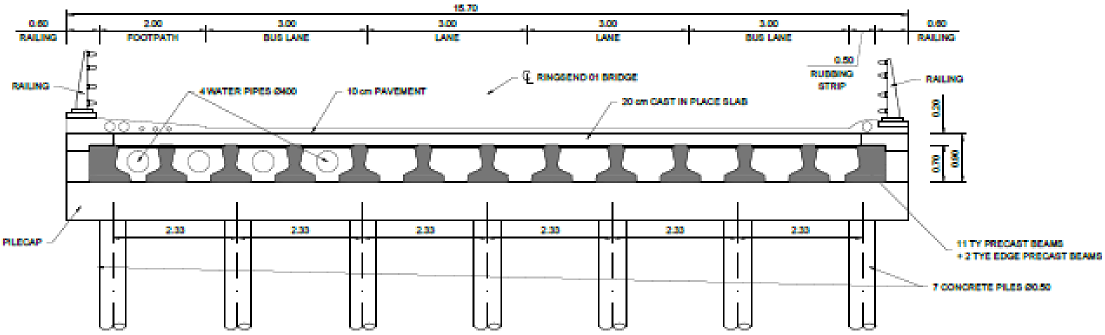


Figure 8-4: Abutment Section Ringsend 01

The piled foundation is to be located at the back of the existing Quay Walls.

The Scherzer Bridges will be carefully dismantled and restored before being re-erected on either side of the proposed new bridge Ringsend 01. New piled foundations will be installed to support the relocated structures.   A detailed investigation of the existing bridges will be required to inform the dismantling and restoration process.

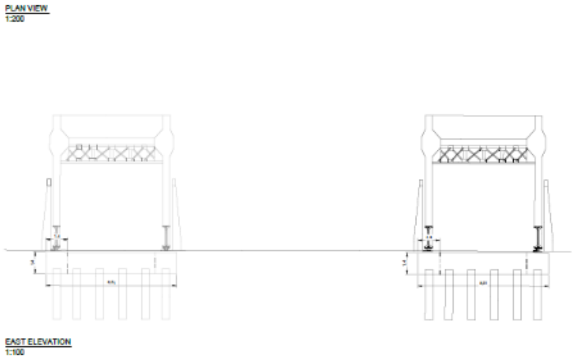


Figure 8-5: Cross Section of Relocated Scherzer Bridges

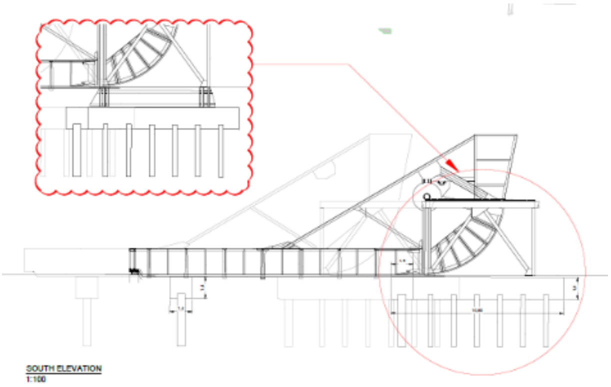


Figure 8-6: Elevation of Relocated Scherzer Bridges

The works associated with the relocation of the Scherzer Bridges and construction of the new bridge Ringsend 01 have the potential to cause considerable temporary traffic disruption. An options exercise was therefore undertaken to assess the most appropriate construction sequence.

The three construction options considered were as follows:

Option 1

In summary, this option allows for the Scherzer bridges to be dismantled and reinstated in one phase towards the end of the proposed 24-month programme. This option would require a single traffic lane to operate under the control of traffic lights for a period of 20 months. The proposed phasing for this option is:

1) Divert west bound general traffic from the North Quays to Sheriff Street Upper;
2) Deconstruct the northern Scherzer bridge but maintain eastbound traffic and westbound public transport on the southern Scherzer bridge – this will be a single lane, under the control of traffic lights;
3) Construct the northern half of the new bridge and, once this half is complete, divert eastbound traffic and westbound public transport onto this new bridge section. Again, this will be a single lane, under the control of traffic lights;
4) Remove the southern Scherzer bridge;
5) Complete southern half of the new bridge and once complete, open the new bridge to two-way traffic (single lane in each direction) along the north quays;
6) Re-instate the Scherzer bridge structures in their new locations following off-site refurbishment; and
7) Open to two lanes of traffic in each direction.

Option 2

In summary, this option allows for the Scherzer bridges to be dismantled and reinstated in a phased manner, with early installation of the northern Scherzer bridge deck. This would require a single traffic lane operating under the control of traffic lights for a period of 12 months. The phasing for this option is:

1) Divert west bound general traffic from the North Quays to Sheriff Street Upper;
2) Deconstruct the northern Scherzer bridge but maintain eastbound traffic and westbound public transport on the southern Scherzer bridge, single lane, under the control of traffic lights;
3) Construct northern half of new bridge and, in parallel, reconstruct the deck of the northern Scherzer bridge in its new location. Once these tasks are complete, there would be temporary

diversion of eastbound traffic onto the Scherzer bridge and westbound public transport onto the newly constructed section of the new bridge;

4) Remove the southern Scherzer bridge;
5) Complete the southern half of new bridge and once complete, remove the eastbound traffic from the northern Scherzer bridge and divert over the new bridge, thus opening the new bridge to two-way traffic (single lane in each direction) along the north quays;
6) Reconstruct the remainder of the northern Scherzer bridge and the southern Scherzer bridge structures in their new locations following off-site refurbishment; and
7) Open to two lanes of traffic in each direction.

Option 3

This option is similar to Option 2, except a temporary bridge would utilise, instead of the relocated northern Scherzer deck, to provide two lanes of traffic after 12 months.

A qualitative Multi-Criteria Analysis was undertaken to evaluate the options for the construction works associated with the relocation and reinstatement of the Scherzer bridges using the following criteria: Risk; Cost; Programme; Traffic Impacts; Constructability and Environment.

Options 1 and 2 are considered to be the most robust in terms of construction programme, when compared to Option 3. Option 1 is also considered to have some advantages in terms of the risk criteria, when compared to the other options. It is considered to be a more straightforward option to construct as it removes the risk of the potential unforeseen delays associated with the deck of the northern Scherzer bridges (e.g. delays due to unknown ground conditions, possible archaeological finds, potential issues in determining the structural soundness of relocated Scherzer bridges for road traffic). In terms of the environmental aspects, all the options will give rise to comparable architectural heritage and landscape and visual impacts. While Option 1 is considered to have some disadvantages in terms of traffic impacts in comparison to the other options, it is considered that on balance Option 1 provides the most advantages of the three evaluated.

It was therefore concluded that Option 1 is the preferred option for the undertaking of the works associated with the Scherzer bridges. Further detail is included in Appendix J.

8.3.2 Structure Ringsend 02 – Boardwalk at North Wall Quay

The available footpath space at the intersection of Excise Walk and North Wall Quay is constrained by the presence of 2 No. commercial units / restaurants. To increase the available space for pedestrians, a new cantilevered footpath extension is proposed above the River Liffey. The plan view of the new structure (Ringsend 02) is shown in Figure 8-7.

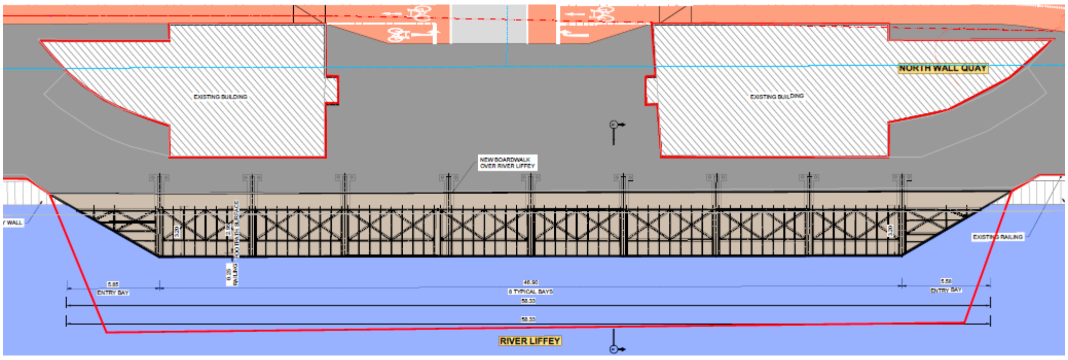


Figure 8-7: Plan view Ringsend 02

The new structure is a boardwalk or elevated walkway cantilevering from the existing quay Wall. The boardwalk has a total length of 58.33 m and a width of 3.20 m, measured from the edge of the existing quay wall. The elevation of the structure is shown in Figure 8-8.

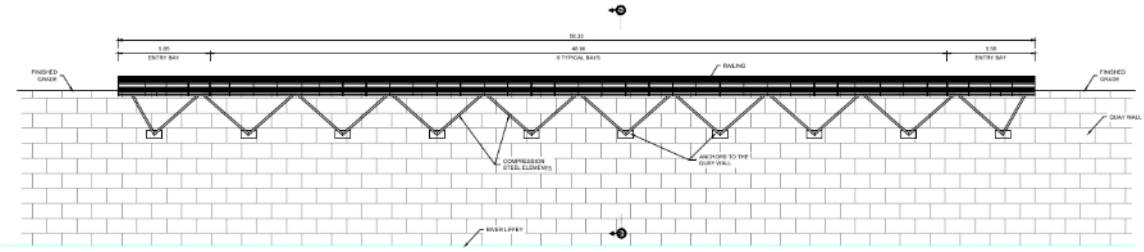


Figure 8-8: Elevation view Ringsend 02

The structure consists of a cantilevered steel deck, supported by a compression steel beam anchored to the front face of the existing quay wall, and with a reinforced concrete back-span counterweight block with tension micropiles at the back of the quay wall. The cantilevered steel deck is formed by the main structural beams, supported by compression steel beams. These are embedded into the concrete counterweight block by steel beam X-bracings, between the main beams. Transverse steel I-section beams are employed to support the timber deck. Anti-slip timber planks form the deck, will be constructed on top of the bracings and the counterweight concrete block to provide a uniform walking surface. The typical section of the structure is shown in Figure 8-9.

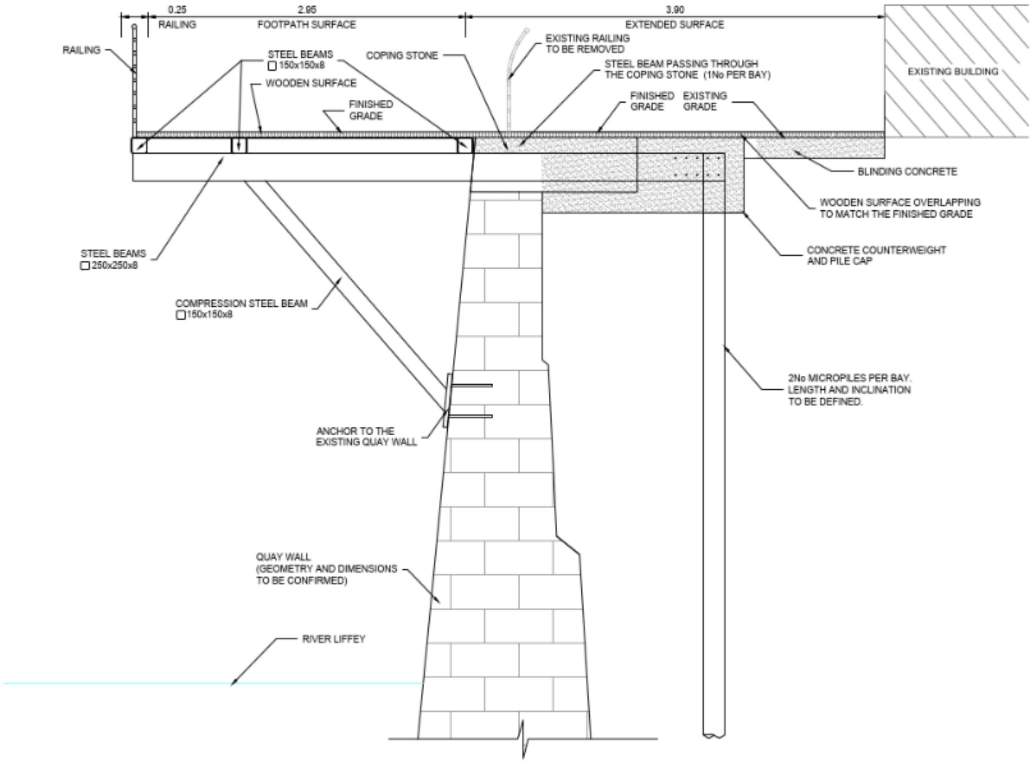


Figure 8-9: Cross Section Ringsend 02

The number of micro-piles, inclination and embedment length will be finalised at later design stages.

The coping stones atop the quay wall and the wall itself will be partially demolished to accommodate the new boardwalk. The main beams will span over the existing quay wall without being in direct contact; therefore, there will not be additional vertical loads on top of the quay wall.

8.3.3 Structure Ringsend 03 – New and Relocated Bridges at Royal Canal

As part of the Proposed Scheme, the design provides increased lane capacity for cyclists and public transport in comparison to that available in the existing Scherzer Bridges in the Spencer Dock area where the Royal Canal enters the River Liffey. The proposed design cannot be accommodated within the layout of existing structures. Therefore, it is proposed to construct a new road bridge (Ringsend 03) at the location of the existing bridges in the area. There is, however, a desire to keep the existing Scherzer Bridges in operation due to their historic and unique nature; therefore, the existing bridges are to be relocated adjacent to the new bridge, to carry the new cycle lane and footpaths.

The plan view of the new Ringsend 03 bridge and the existing Scherzer Bridges relocated to their new position are shown in Figure 8-10.

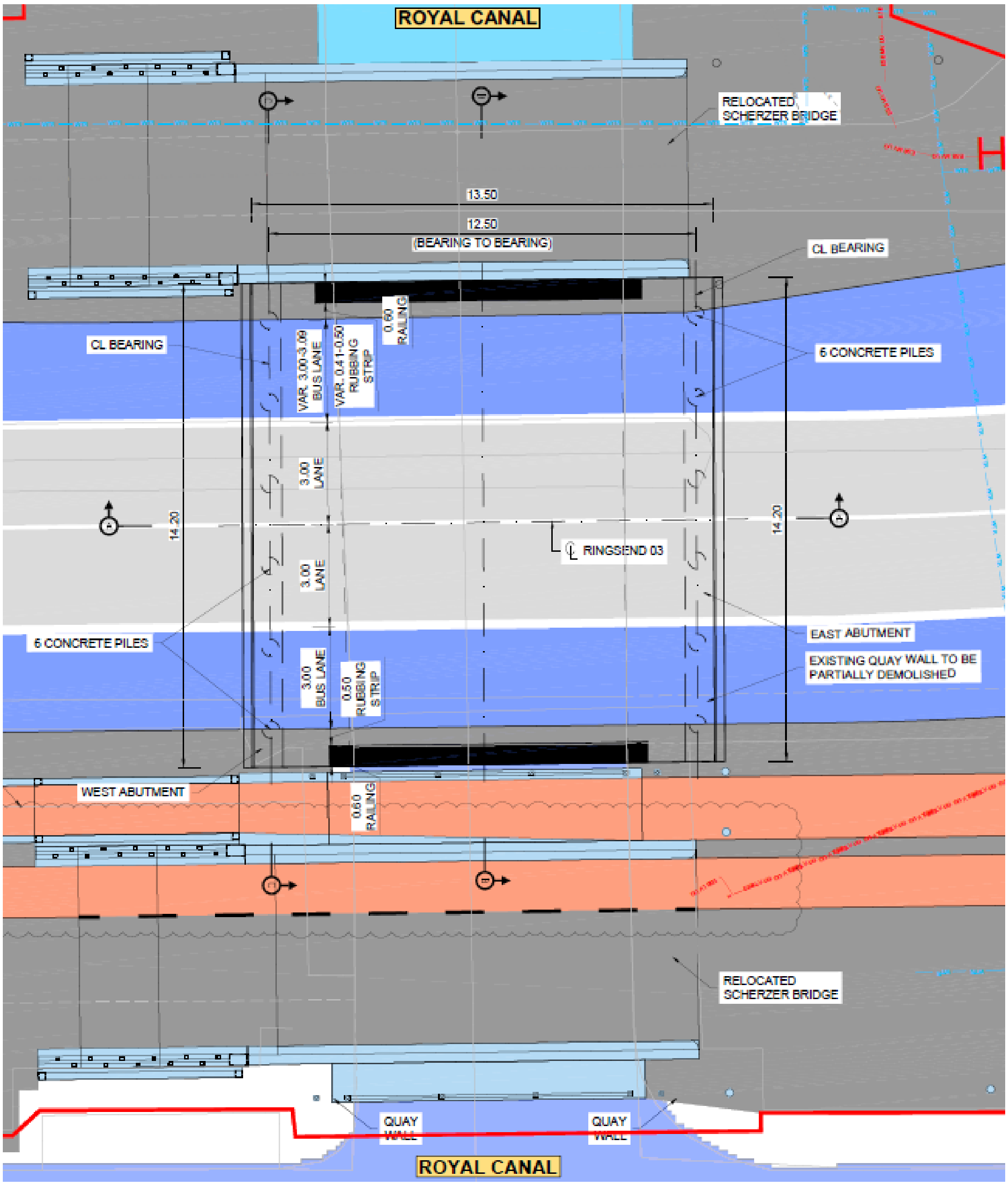


Figure 8-9: Plan view Ringsend 03

The new bridge is slightly skewed in plan due to the new abutments are parallel to the direction of the existing quay walls.

The new bridge is a single span, fully integral portal bridge 13.50m long and 14.20m wide. Figure 8-11 shows the elevation view of the bridge.

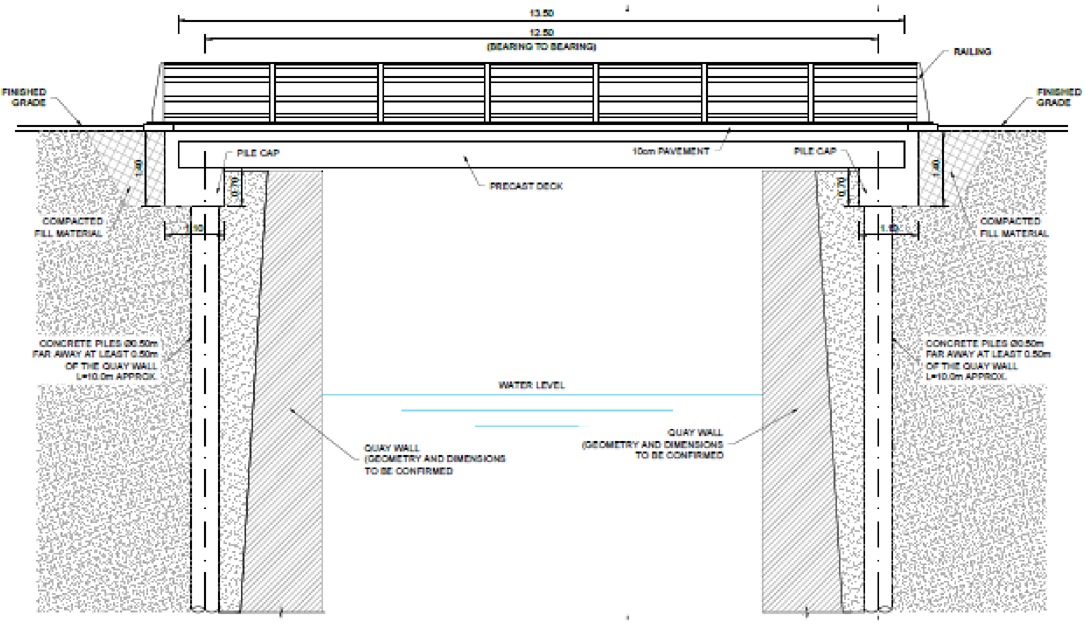


Figure 8-10: Elevation view Ringsend 03

The typical section of the bridge consists of 12No. precast prestressed concrete beams, 10No. type TY and 2No. type TYE, and a cast in-situ reinforced concrete slab. The proposed beams have a depth of 0.50m and the slab has a depth of 0.20m. The total depth of the deck is therefore 0.70m.

The new bridge is to carry a four-lane road - 2No. bus lanes and 2No. traffic lanes, one lane of each type per direction. The road layout also includes 2No. rubbing strips, and the bridge deck allows for sufficient space for the traffic restraint system at both sides. The typical cross section, with proposed widths for each lane, is shown in Figure 8-12.

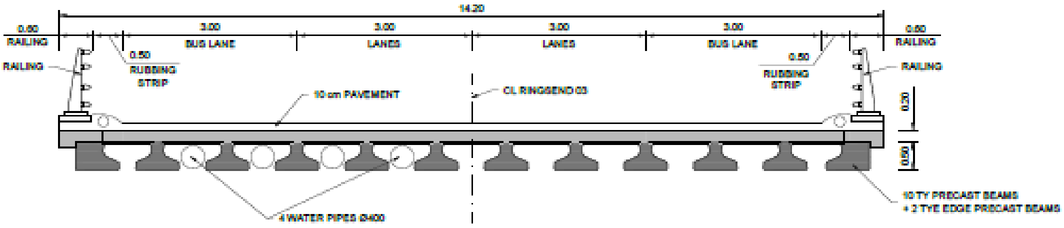


Figure 8-11: Deck Section Ringsend 03

The proposed bridge will be supported on piled foundations. The bridge's foundation consists of 6No. reinforced concrete piles of 0.50 m diameter per abutment; a reinforced concrete pile cap at the top of the piles, to transfer the loads from the deck to the piles; and a ballast wall to retain the ground. The length of the piles has been estimated to be approximately 16.5m (this figure will be finalised in later design stages). The integral connection between the deck and the substructure is to be made at the pile cap during construction. Due to the bridge being integral, expansion joints are not needed. The typical section of the abutments is shown in Figure 8-13.

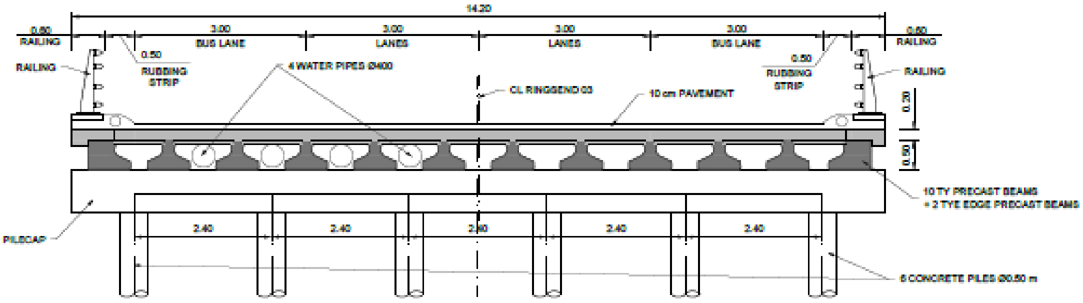


Figure 8-12: Abutment Section Ringsend 03

The piled foundation is to be located at the back of the existing Quay Walls.

The Scherzer Bridges will be carefully dismantled and restored before being re-erected on either side of the proposed concrete bridge. New piled foundations will be installed to support the re-erected bridges. A detailed investigation of the existing bridges will be required to inform the dismantling and restoration process.

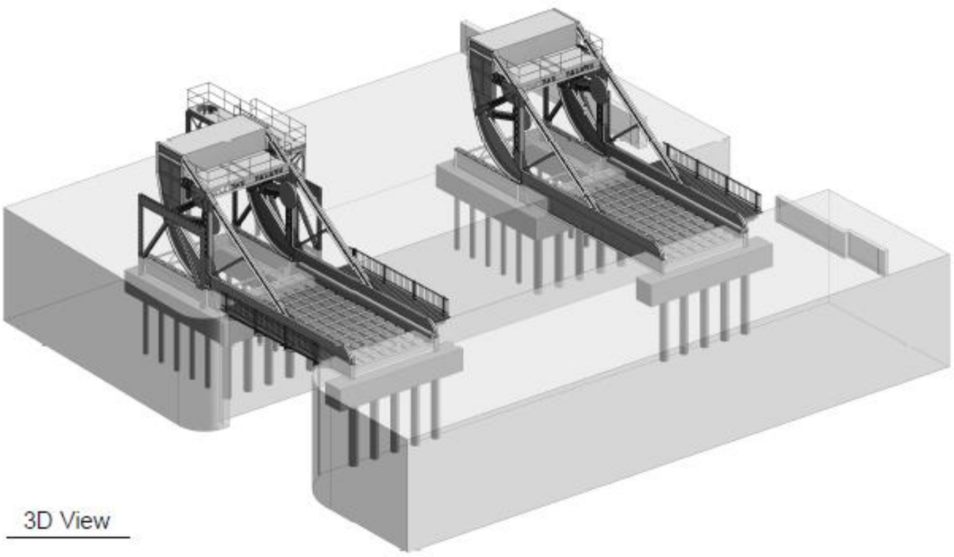


Figure 8-13: Isometric View of Relocated Scherzer Bridges

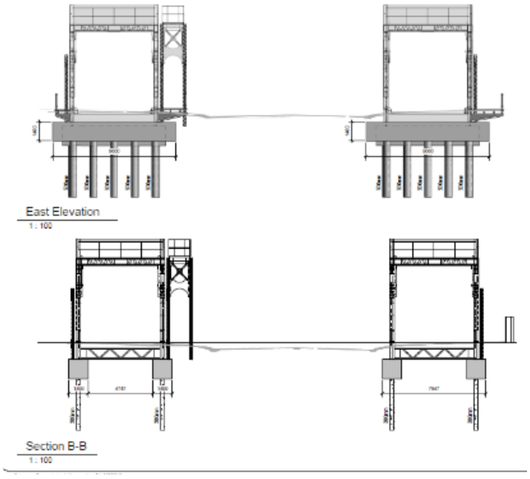
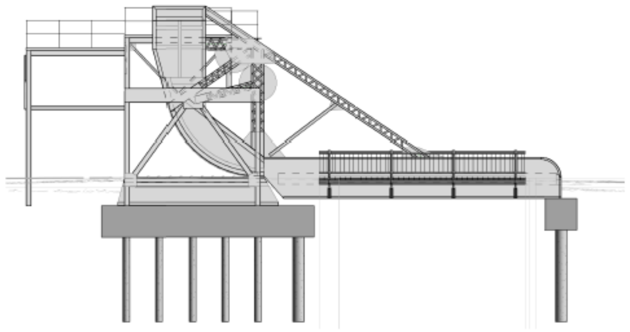
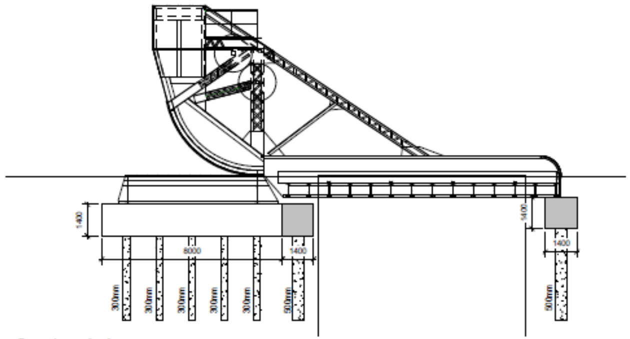


Figure 8-14: Cross Sections of Relocated Scherzer Bridges



South Elevation
1 : 100



Section A-A
1 : 100

Figure 8-15: Elevations of Relocated Scherzer Bridges

Similar to the bridges at George's Dock, the works associated with the relocation of the Scherzer Bridges and construction of the new bridge have potential to cause considerable temporary traffic disruption. An options exercise was therefore undertaken to assess the most appropriate construction sequence and reached the same conclusion outlined in Section 8.3.1. This is included in Appendix J.

8.3.4 Structure Ringsend 04 – Custom House Key Boardwalk

On Custom House Quay, the existing DCC offices just east of Sean O'Casey Bridge constrain the available width for pedestrians and cyclists. on the campshires. The proposed reconfiguration of the roadway at this location requires widening the existing path by 1m to achieve a total width of 4.3m. It is proposed to provide a 2.5m wide two-way cycle route and 1.8m footpath within this space. However, it would be desirable to increase this if practicable.

As noted above, Dublin City Council has proposals for a planned docklands centre redevelopment at George's Dock. The design teams for the two projects have consulted with one another and the DCC project design team has confirmed that the structural design for the docklands centre development can accommodate the proposed boardwalk on the riverside of the proposed structure. The plan view of the new structure (Ringsend 04) is shown in Figure 8-17.

Figure 8-116: Plan view Ringsend 04

The new structure is a boardwalk or elevated walkway cantilevering from the building and resting on the existing quay Wall. The boardwalk has a total length of 111 m and a total width of 6m. To achieve this the structure cantilevers 4.2m from the edge of the existing quay wall. It is not possible to cantilever the structure at its eastern end, requiring a free-standing section supported by three piles into the riverbed. Cross sections of the proposed structure are shown in Figures 8-18 and 8-19.

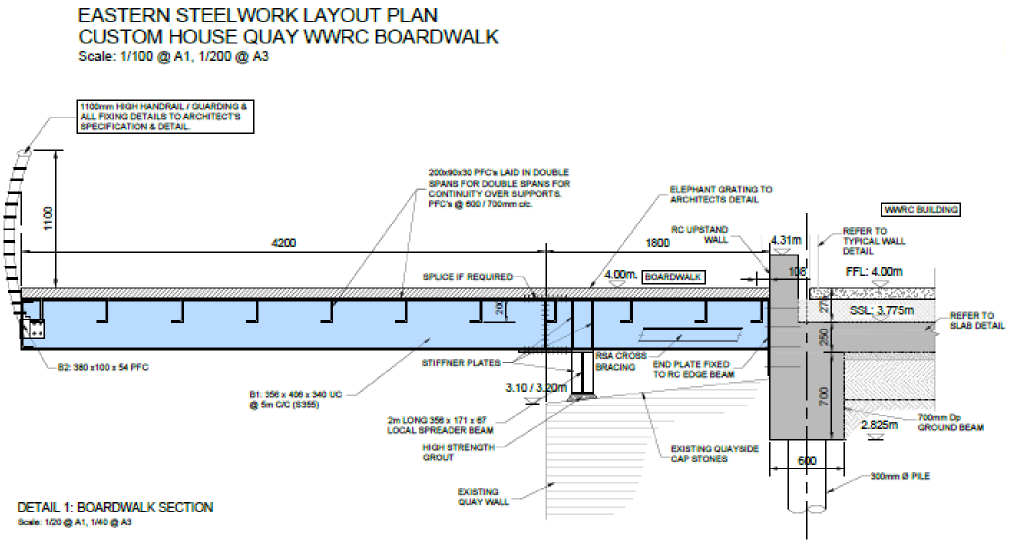


Figure 8-117: Elevation view Ringsend 04 (Cantilever element)

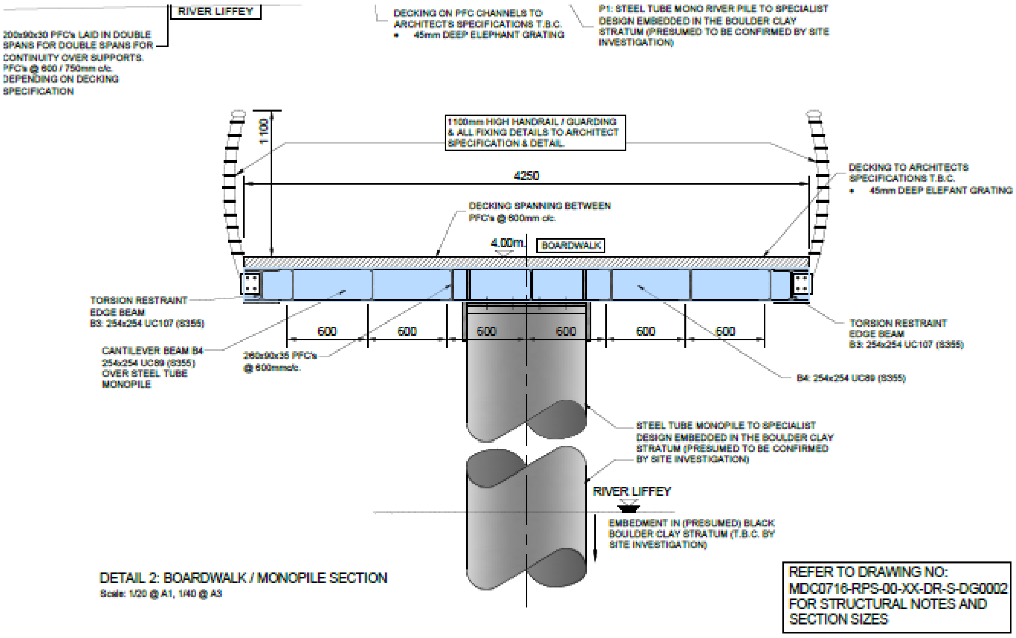


Figure 8-118: Elevation view Ringsend 04 (Free-standing element)

The primary structural loading on the cantilever element will be transferred through the building foundations. The structure will rest on pads atop the existing quay wall, however the load transfer to the quay wall will be minimal, and the existing structure can be retained without modification. The coping stones atop the quay wall and the wall itself will fully maintained. The main beams will span over the existing quay wall without being in direct contact.

The freestanding element will be wholly supported by three piles that will be continuous with the piers.

8.3.5 Structure Ringsend 05 – Dodder Public Transport (Opening) Bridge

The most significant structure included within the Proposed Scheme is the bridge across the confluence of the River Dodder and the entry channel to Grand Canal Dock with the River Liffey. This multi-span structure includes an opening span to maintain navigation into the Grand Canal Basin. The bridge also requires the construction of a new quay wall on the southwestern corner of the Tom Clarke East Link Bridge.

The scheme had previously been developed for Dublin City Council as a standalone scheme prior to its incorporation into the Proposed Scheme. A comprehensive Preliminary Design Report was prepared, and this is included in Appendix J.

This bridge comprises an orthotropic steel superstructure over the River Dodder including an opening bascule span. The substructure shall comprise an in-situ reinforced concrete pier and abutments supported by bored cast-in-place concrete foundation piles. The west abutment wingwall includes a short section of back to back retaining walls supporting the road onto Sir John Rogerson's Quay (west). The proposed bridge will be 96m long and 20.7m wide. The bridge will allow buses, taxis, pedestrians, and cyclists to cross the River Dodder to connect to Ringsend at York Road. No general traffic will be permitted to use this bridge crossing. It will have three spans as shown in Figure 8-20, and the western span will open vertically for passage of boats to the Grand Canal Basin a short distance to the south. A Preliminary Design Report for this bridge is included in Appendix J1.

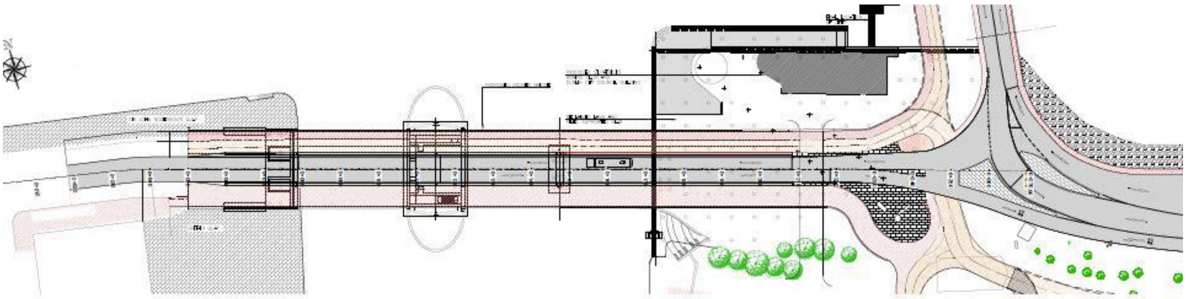


Figure 8-20 Plan of Proposed Dodder Public Transport Opening Bridge

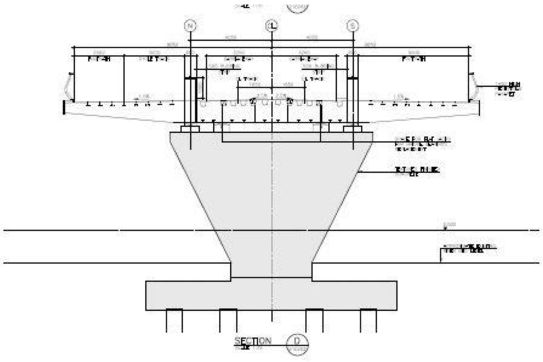


Figure 8-21 Cross Section and Pier Detail

Figure 8-22 View Looking West Towards Bascule Abutment

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 i.e. Dublin City Council) and Irish Water where applicable. The strategy and design parameters to be adopted throughout Dublin BusConnects is summarised in the Design Basis included in Appendix K.

The design basis statement was developed whilst taking the Greater Dublin Greater Dublin Regional Code of Practice (GDRCoP), Greater Dublin Strategic Drainage Study (GDSDS), Planning requirements of Local Authorities within the Dublin region, Transport Infrastructure Ireland 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 Sustainable Urban Drainage Systems (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 as limited by the capacity of the existing highway drainage network.

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 Existing Watercourses and culverts

The location of existing watercourses and culverts has been identified using OS Mapping (www.osi.ie). Stage 1 and Stage 2 Flood Risk Assessments have been completed on the Preliminary Design and are summarised in Section 9.7. (Refer to Appendix N).

Table 9-1 lists the watercourses which are crossed by the Proposed Scheme. The table also lists both existing bridges crossing these watercourses together with new structures where proposed.

Table 9-1: Existing Watercourses

Watercourse	Crossing type
River Liffey	Existing Tom Clarke Bridge Existing Samuel Beckett Bridge Existing Sean O'Casey Bridge (pedestrians) Existing Talbot Memorial Bridge
Royal Canal	Existing Scherzer Bridges (to be relocated) Proposed bridge Ringsend 03 Existing Stainless Steel Footbridges (to be removed)
George's Dock Canal	Existing Scherzer Bridges (to be relocated) Proposed Bridge Ringsend 01 Existing wooden/steel structures (to be removed)
River Dodder	Proposed Dodder Public Transport Opening Bridge – Ringsend 05 - at St. Patrick's Rowing Club

The proposed scheme will be drained by existing storm water outfalls into the Liffey and which are located on the north and South quays. No additional outfalls are foreseen.

9.3 Existing Drainage Description

The Bus Corridor is generally divided into four catchments. The north and south quays of the Liffey, the Area around Ringsend Park and the new Proposed Public Transport Dodder Opening Bridge construction at St. Patrick's Rowing Club. The storm water of the northern quays are draining by a separate storm water network into the Liffey. The southern quays are draining by two storm water catchments into the Liffey and two combined water catchments towards Ringsend treatment plant. The area at Ringsend Park is divided into a surface water catchment that is draining into the Liffey and a combined water catchment that is draining towards Ringsend treatment plant. (refer to drawing number BCIDD-ROT-DNG_ZZ-0016_XX_00-DR-CD-0001- BCIDD-ROT-DNG_ZZ-0016_XX_00-DR-CD-0002). An overview of the catchment sizes is listed in Table 9-2 below.

Table 9-2: Existing Catchments

Existing Catchment Reference	Approx. Drainage Catchment Area (m^2)	Type of Network, Foul/Combined (CW), Surface Water (SW)	Existing Outfalls
R_01	57,130.00	SW	Network outfalls to River Liffey
R_02	55,860.00	SW	Network outfalls to River Liffey
R_03	65,330.00	SW	Network outfalls to River Liffey
R_04	142,190.00	SW	Network outfalls to River Liffey
R_05	37,160.00	SW	Network outfalls to River Liffey
R_06	17,480.00	CW	Foul/combined network drains to Ringsend WwTP with sewer overflows to River Liffey
R_07	93,310.00	SW	Network outfalls to River Liffey
R_08	187,730.00	CW	Foul/combined network drains to Ringsend WwTP with sewer overflows to River Liffey
R_09	N/A (DPTOB not in place)		
R_10	241,520.00	SW	Network outfalls to River Liffey
R_11	221,530.00	CW	Foul/combined network drains to Ringsend WwTP with sewer overflows to the River Liffey

9.4 Overview of Impacts of Proposed Works on Drainage / Runoff

Whilst in some areas the proposed development increases the impermeable areas, additional permeable areas are also provided by the softening of public realm along the routes. The drainage design aims to sustain flow levels within the existing pipe network after a rainfall event by controlling discharge rate within each catchment. Flows will be controlled by the implementation of SuDS techniques. One of the principal objectives of the road drainage system is to minimise the impact of the runoff from the roadways on the surrounding environment via the position of: filter drains, swales, bio retention areas, tree pits, silt traps and attenuation features if necessary.

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 below in Table 9-3 for the Proposed Scheme. The table contains a column entitled “net change” which takes account of the change of use from impermeable to permeable areas and vice versa. (Refer to Drainage drawings in Appendix B for locations) .

Table 9-3: Proposed changes in Catchments

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 (%)
R_01	A1420 - A1540	4,254	0	0	0	0.00%
R_02	A1225 - A1420	7,134	0	0	0	0.00%
R_03	A550 - A1225	20,462	0	0	0	0.00%
R_04	A175- A550	9,457	0	0	0	0.00%
R_05	A0 - A175	4,636	0	0	0	0.00%
R_06	B10000-B10370	9,201	0	0	0	0.00%
R_07	B10370-B10640	3,856	0	0	0	0.00%
R_08	B10640-B11410	10,469	0	0	0	0.00%
R_09	B11410-F50000	14,400	7,257	1,207	6,050	42.01%
R_10	F50000 - E40610&F50725	19,256	1,901	0	1,901	9.87%
R_11	F50725&H70000-F50992&H70233	8,824	1,086	0	1,086	12.31%

9.5 Preliminary drainage design

The following drainage types are proposed for Proposed Scheme catchments comprising newly paved and combined existing/newly paved areas:

- **Reuse** of existing drainage.
- Sealed Drainage which collects, conveys and discharges runoff via a sealed pipe network. For the purposes of the BusConnects Development, this type of drainage comprises sealed pipes which are connected to side entry gullies within the kerb line. These 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.

- **Grass Surface Water Channels & 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. **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.
- **Oversized pipes** – Where there is insufficient space available for SuDS measures it is proposed to provide some attenuation volume online using oversized pipes.

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 provision is made for treatment.

For catchments where there is no change in the impermeable surface area, the existing sealed pipe network will be retained with new side 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 highway profile. Development of the design for the side entry gully and their associated spacing requirement is currently ongoing and will be confirmed at a later stage in the design.

9.5.1 Summary of Surface Water Drainage

A summary of the Proposed Surface Water Infrastructure is presented in Table 9-4.

Table 9-4: Summary of Drainage Types

Catchment	Chainage	Local Authority	Drainage Type
R_01	A1420 - A1540	DCC	Existing drainage retained
R_02	A1225 - A1420	DCC	Existing drainage retained
R_03	A550 - A1225	DCC	Existing drainage retained
R_04	A175- A550	DCC	Existing drainage retained
R_05	A0 - A175	DCC	Existing drainage retained
R_06	B10000 - B10370	DCC	Existing drainage retained
R_07	B10370 - B10640	DCC	Existing drainage retained
R_08	B10640 - B11410	DCC	Existing drainage retained
R_09	B11410 - F50000	DCC	Inflow from proposed Dodder bridge, oversized pipe
R_10	F50000 - E40610&F50725	DCC	infiltration trenches
R_11	F50725&H70000-F50992&H70233	DCC	infiltration trenches

9.5.2 Summary of Attenuation Features, SuDS and Outfalls

The Proposed Scheme will create entail additional impermeable areas through widening of the carriageway to provide designated bus, cycle and running lanes in addition to a footpath. Without mitigation, the increased impermeable area would lead to increased runoff rates and faster time to peak flow in the existing drainage network.

In Figure 9-1 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
- 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
- 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 Figure 9-1.

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

Figure 9-1: The SuDS Management Train. Source: CIRIA SuDS Manual 2015

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 proposed attenuation measures in Proposed Scheme are summarized for each proposed catchment in Table 9-5.

Table 9-5: Proposed SUDs measures

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/s)	SuDS Measures Proposed	Catchment Outfall
		Existing* (m²)	Proposed (m²)			
A1420 - A1540	R_01	4,254	4,254	As existing	None	Existing SW DCC
A1225 - A1420	R_02	7,134	7,134	As existing	None	Existing SW DCC
A550 - A1225	R_03	2,0462	2,0462	As existing	None	Existing SW DCC
A175- A550	R_04	9,457	9,457	As existing	None	Existing SW DCC
A0 - A175	R_05	4,636	4,636	As existing	None	Existing SW DCC
B10000 - B10370	R_06	9,201	9,201	As existing	None	Existing SW DCC
B10370 - B10640	R_07	3,856	3,856	As existing	None	Existing Foul / Combined network DCC
B10640 - B11410	R_08	10,469	10,469	As existing	None	Existing Foul / Combined network DCC
B11410 - F50000	R_09	6,224	12,274	2 l/s	Oversized pipe	New drainage to discharge to the existing Foul / combined network via SuDS measures.
F50000 - E40610&F50725	R_10	12,722	14,624	Infiltration	Infiltration trenches	Existing SW DCC. No outfall for Infiltration trenches
F50725&H70000 - F50992&H70233	R_11	5,129	6,215	Infiltration	Infiltration trenches	Existing Foul / Combined network DCC. No outfall for Infiltration trenches

9.6 Drainage at New Bridge Structures

Along the Proposed Scheme there are four structures that will be either totally new or upgraded due to the development of this Bus Connects corridor. These are summarised in Table 9-6 below:

Table 9-6: Drainage at Proposed Structures

Structure code	Proposed works	Drainage strategy	Comment
Ringsend 01	New bridge over the River Liffey / George's Dock	As existing – bridge will drain to road drainage system.	No appreciable change in impermeable area.
Ringsend 02	New boardwalk over the River Liffey at North Wall Quay	Over the edge drainage into river Liffey.	Catchment area currently draining directly into the river Liffey
Ringsend 03	New bridge over the Royal Canal	As existing – bridge will drain to road drainage system.	Modest local increase in impermeable area.
Ringsend 04	Boardwalk at Custom House Quay	Over the edge drainage into river Liffey.	Catchment area currently draining directly into the river Liffey
Ringsend 05	Proposed Dodder Public Transport Opening Bridge	Run off from additional catchment to be treated by permeable paving, swales/basins and attenuated by means of oversized pipe	Catchment area currently draining directly into the river Dodder

9.7 Flood Risk

9.7.1 Flood Risk Assessment

A Stage 1 and 2 Flood Risk Assessment (FRA) has been prepared for the Preliminary Design of the Proposed Scheme as included in Appendix N. The outcomes from the FRA are summarised Table 9-7.

Table 9-7: Flood Risk Summary

Flood Risk Source	Level of Risk	Notes
Fluvial & Sea Level Rises / Coastal	Low - Medium	Alignment is in close proximity to the Liffey and Dodder rivers. OPW flood maps show that Proposed scheme is outside the boundaries of the flood zones and therefore no likelihood of flooding from this source can be expected.
Surface Water	Low - Medium	The proposed sites are not considered to require a detailed flood risk assessment with respect to flooding derived from surface water flooding.
Groundwater	High - Medium	The sources consulted such as the OPW mapping and GSI records show no indication that Proposed Scheme is subject to Groundwater derived flooding.
Pluvial	Low - Medium	OPW flood maps show distributed flooding from this source, SuDS measures have been proposed to mitigate the risk. Pluvial flooding will be considered in the modifications of the drainage systems when needed.

9.7.2 Development of specific Flood Alleviation Proposals

There is no change in flood risk as consequence of the Proposed Scheme and no specific flood risk measures are therefore proposed to reduce flood risk.

9.7.3 Section 50 Consents

There are 3 proposed new bridges and modifications proposed to 2 existing bridges that cross watercourses along the Proposed Scheme for which Section 50 Consents are required.

10 Services and Utilities

10.1 Overview of Utilities Strategy and Survey

Utility records from all providers were sought at an early stage of the Scheme design. These records combined with topographic survey records, 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 Proposed Scheme. Some areas of conflict were designed out at this stage; however, some remained and had to be accommodated within the overall Proposed 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 Proposed 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;
- Dublin City County Council.

10.1.2 Phase 1 Utility Survey

A targeted utility survey to PAS 128A, including GPR (Ground Penetrating Radar), 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 required to inform the detailed design phase of the Proposed 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 was prepared for each utility company.

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

Table 10-1: Service Data Received Summary

Service Type	**Data Available**	**Comments**	**Date Received**
High Pressure (HP) Gas	Yes	No network present for sheets 1, 2, 11 & 12 TBC by utility provider.	15/10/2019
Medium Pressure (MP) Gas	Partial	No network present for sheets 6-12	15/10/2019
Low Pressure (LP) Gas	Yes	No network present for sheet 11 TBC by utility provider.	15/10/2019
Telecommunications Duct	Yes	EIR - Data is available for all sheets Virgin Media - Data is available for all sheets ENET - No network present for sheets 7-12 VDF - No network present for sheets 3, 4, & 7-12	15/10/2019, 05/08/2020, 23/01/2020, 07/08/2020
Foul Sewer (FS)	Yes	Data is available for all sheets	15/10/2019, 26/03/2020
HV Electricity	Yes	No network present for sheets 1-4 & 11 TBC by utility provider.	15/10/2019
MV Electricity	Yes	No network present for sheet 11 & 12 TBC by utility provider.	15/10/2019
LV Electricity	Yes	No network present for sheet 11 & 12 TBC by utility provider.	15/10/2019
IW Water Network (WN)	Yes	No network present for sheets 11 & 12 TBC by utility provider.	15/10/2019, 26/03/2020
IW Abandoned Lines	Yes	No network present for sheets 1-6 and 8-21 TBC by utility provider.	15/10/2019, 26/03/2020

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,
- Gas Networks Ireland
- Irish Water (Water & Public Sewer),
- Telecommunication Services – Eir, Virgin Media, eNet & BT.

In addition to the above, it will be necessary to relocate and upgrade some of the existing public lighting and traffic signals cabling 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 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 may be necessary to maintain supply to certain services. This will require the retention and protection of existing utility supplies until such time as permanent diversions can be commissioned, or alternatively the construction of temporary diversions to facilitate completion of the roadworks including the permanent diversion of services. The sequence of roadworks 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.

10.3 Summary of Service Conflicts with Critical Services and Recommended Diversions and/or Protection Measures

A summary for each critical service infrastructure has been identified for consideration in the overall Proposed Scheme design. Trunk assets were incorporated into the design with diversions or specific protection measures where necessary.

10.3.1 ESB

Consultations took place with ESB Energy regarding the impact of the Proposed Scheme on their assets and their requirements have been incorporated within the design. The Proposed Scheme with ESB assets overlaid is included on drawings within Appendix B13.

No direct impacts on existing high voltage cables have been identified, and no relocations are necessary. However, it will be necessary to provide a new HV ducting connection from the existing ESB substation on East Link Road to the proposed ESB substation at the junction of Thorncastle Street and York Road. Modifications to medium and low voltage services will be required. Table 10-2 outlines the required diversions/protections of existing ESB services.

Table 10-2: ESB Asset Diversions/Protections

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R16-UG-MV-003	ESB	A1143 - A1057	Medium Voltage Underground ESB Electricity	97m Localised Diversion Required to ESB Specification
R16-UG-LV-016	ESB	A762 - A714	Low Voltage Underground ESB Electricity	56m Localised Diversion Required to ESB Specification
R16-UG-LV-020	ESB	B11426 - B11466	Medium Voltage Underground ESB Electricity	40m Localised Diversion Required to ESB Specification
R16-UG-HV-013	ESB	D30025 – D30100	High Voltage Underground ESB Electricity	77m network extension

10.3.2 Gas Networks Ireland

Consultations took place with Gas Network Ireland (GNI) regarding the impact of the Proposed Scheme on their assets, and their requirements have been incorporated within the design. The Proposed Scheme with Gas Networks Ireland assets overlaid is included on drawings within Appendix B14. No diversions of existing GNI plant are required.

10.3.3 Irish Water

Consultations took place with Irish Water regarding the impact of the Proposed Scheme on their Watermain and Foul Sewer assets, and their requirements have been incorporated within the design. Drawings of the Proposed Scheme with Irish Water assets overlaid is included within Appendix B15.

Table 10-3 outlines the required diversions/protections of existing Irish Water services.

Table 10-3: Ringsend to City Centre – Irish Water Watermain Asset Diversions/Protections

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R16-UW-001	Watermain	A1468 - A1425	Water Network DN610mm CI	80m Localised Diversion to Irish Water Specification
R16-UW-007	Watermain	A1420 - A1384	Water Network DN610mm CI	80m Localised Diversion to Irish Water Specification
R16-UW-013	Watermain	A900 - A865	Water Network DN600mm DI	35m Localised Diversion to Irish Water Specification

10.3.4 Telecommunications

Consultation took place with telecommunications providers regarding the impact of the Proposed Scheme on their assets for incorporation within the design. Drawings of the Proposed Scheme with telecommunications assets overlaid is included within Appendix B.16.

There are sections of telecommunications ducting requiring diversions along the route. Table 10-4 outlines the required works for telecommunications services.

Table 10-4: Ringsend to City Centre – Telecommunications Asset Diversions/Protections

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R16-UG-001	EIR	A1438 - A1418	Eir Existing	42m Localised Diversion to Eir Specification
R16-UG-003	EIR	A894 - A872	Eir Existing	32m Localised Diversion to Eir Specification
R16-UG-018	Virgin Media	A907 - A867	Virgin Media Existing	42m Localised Diversion to Virgin Media Specification

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 stockpiled and 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. 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 need to 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 top soil 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 Proposed 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.

Materials waste estimate quantities for the Proposed Scheme.

Table 11-1: Street Furniture unit weights

Item	Material	Assumed nominal weight	Notes
Timber arising from trees	Timber / Wood	100 kg per tree	Average value per tree across the entire route
Vegetation (e.g. hedges, shrubs, leaves and branches)	Organic	N/A	*Organic material from hedges, shrubs, leaves and branches have not been quantified. It is assumed that this material will be collected and mulched before removal from site to organic treatment facility. Therefore, the quantity of organic waste will be minimal and not significant for the assessment.*
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 Proposed Scheme
Metal railings	Metal	15 kg/m	Nominal assumed average weight per railing over Proposed Scheme
Fencing	Metal	40 kg/m	Nominal assumed average weight per railing
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 Proposed 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 Proposed Scheme length
Lighting poles	Metal	100 kg per 8m pole	Nominal assumed average scenario over Proposed Scheme length
ESB/EIR poles	Timber/wood	260 kg per 9m pole	Nominal assumed average scenario over Proposed Scheme length
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 Proposed Scheme length
Safety barrier	Metal	20 kg/m	Nominal assumed average scenario over Proposed 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-

Item	Material	Assumed nominal weight	Notes
			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	27.9 kg per m width of road	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)
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/hand rails	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	50kg	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:

Item	Material	Assumed nominal weight	Notes
			(https://www.sdcc.ie/en/download-it/guidelines/greater-dublin-regional-code-of-practice-for-drainage.pdf (Accessed on 6 May 2021)
Manholes	Metal	50kg	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/m^3)	Notes
Soil	2.2	Professional judgement (Dublin boulder clay), laboratory testing - Nominal assumed average scenario over Proposed Scheme length
Bituminous material	2.4	Professional judgement (Engineering Designers) - Nominal assumed average scenario over Proposed Scheme length
Concrete	2.4	Professional experience and (Bath Inventory - Version 2.0 (2011)) - Nominal assumed average scenario over Proposed Scheme length
Granite	2.7	https://pubs.usgs.gov/of/1983/0808/report.pdf - Nominal assumed average scenario over Proposed Scheme length
Paving stones	2.4	Professional judgement (Engineering Designers) Nominal assumed average scenario over Proposed Scheme length
Granular material	1.6	Nominal assumed average scenario over Proposed 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	0.9	Class 2/4/U1 Cohesive	1.25	Irish Water (2020) *Water Infrastructure Standard Details: Connections and Developer Services.* Available online: https://www.water.ie/connections/Water-

Asset type	Assumed nominal average trench width (m)	Assumed material spec. (TII)	Assumed nominal average trench depth under pavement layer (m)	Notes
cover i.e. obvert at 0.35m under capping layer of road)		subgrade material		Standard-Details.pdf (Accessed on 6 May 2021)
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 ½ 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 footpath / cycle track)	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-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	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)

Asset type	Assumed nominal average trench width (m)	Assumed material spec. (TII)	Assumed nominal average trench depth under pavement layer (m)	Notes
subbase layer of footpath)				
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
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 ½ 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 & 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 ½ 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 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 18,000 Tonnes of pavement and made ground material (concrete, non-hazardous bituminous mixture, Soil and stones (non-contaminated)) will be excavated as part of the works as summarised in Table 11-5.

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	7,000
Bituminous mixtures	7,000
Soil and stone	4,100
TOTAL	**18,100**

Potentially up to 100% of concrete and asphalt material could be sent to a suitable aggregate recovery facility for recycling. Under the 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 planings 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. These pavement materials could be removed directly from site or temporarily stockpiled on site and removed at a later date as part of a spoil/waste management strategy in consideration of the intermittent nature of the street works construction activities.

Potentially up to 90% of excavated subbase material and capping material could be stockpiled on site for reuse as sub-base material under footpaths & 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.

As mentioned above, material reuses will be developed with additional site investigations in later design stages.

Potential mitigations to be considered include soil recovery (existing sub-base, capping layer and topsoil material) and new asphalt pavement using recycled aggregates and reclaimed asphalt material.

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 18,700 Tonnes of recycled/reused aggregates to improve the overall sustainability of the Proposed Scheme.

It is estimated that an order of magnitude of 650 Tonnes of waste arisings from street furniture, trees and materials from within the public domain (Bricks, Mixed metals, Plastic, wood, 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.

12 Traffic Signs, Lighting Communications

12.1 Traffic Signs

Traffic Signs 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.

A preliminary Traffic Sign and Road Markings design has been undertaken to identify the requirements of the Proposed Scheme, as shown on the drawings in Appendix B8, 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; junctions/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 TSM, particularly where place values are very high, such as in the Centre context'.

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 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.

12.1.1 Traffic Signs - General

As stated in Chapter 1 of the Traffic Signs Manual, in urban areas the obstruction caused by posts located in narrow pedestrian footpaths should be minimised. Therefore, where practicable, signs are to be placed on single poles, or larger signs will be cantilevered from a post at the back of the footpath using H-frames where necessary. Passively safe posts will be introduced where practicable to eliminate the need for vehicle restraint systems.

12.1.2 Traffic Diversion Routes

Permanent diversions of traffic will be required at a number of locations as a result of the Proposed Scheme. These are set out below.

In conjunction with the proposed westbound bus gate on Sir John Rogerson's Quay, east of Samuel Beckett Bridge, it is proposed to provide direction signs for an alternative traffic diversion route as follows and as illustrated in Figure 12.1:

- Local traffic diversion for westbound traffic from Sir John Rogerson's Quay southbound via Forbes Street, heading west via Misery Hill to meet the R813 at Macken Street.

Local Diversion Route

Figure 12.1: Local Diversion Route for Westbound Traffic on Sir John Rogerson's Quay

The proposed turning restrictions at the Samuel Beckett Bridge junction will impact on the accessibility to the Convention Centre Dublin [CCD] Car Park and it is proposed to provide direction signs for an alternative traffic diversion route as follows and illustrated in Figure 12.2.

- For traffic on North Wall Quay in the eastbound direction, traffic will continue straight through the Guild Street junction and directed to turn left to Park Lane where existing signs will notify drivers of the route to the car park.
- For traffic on North Wall Quay in the westbound direction, traffic will be directed to turn right to Park Lane where existing signs will notify drivers of the route to the car park.

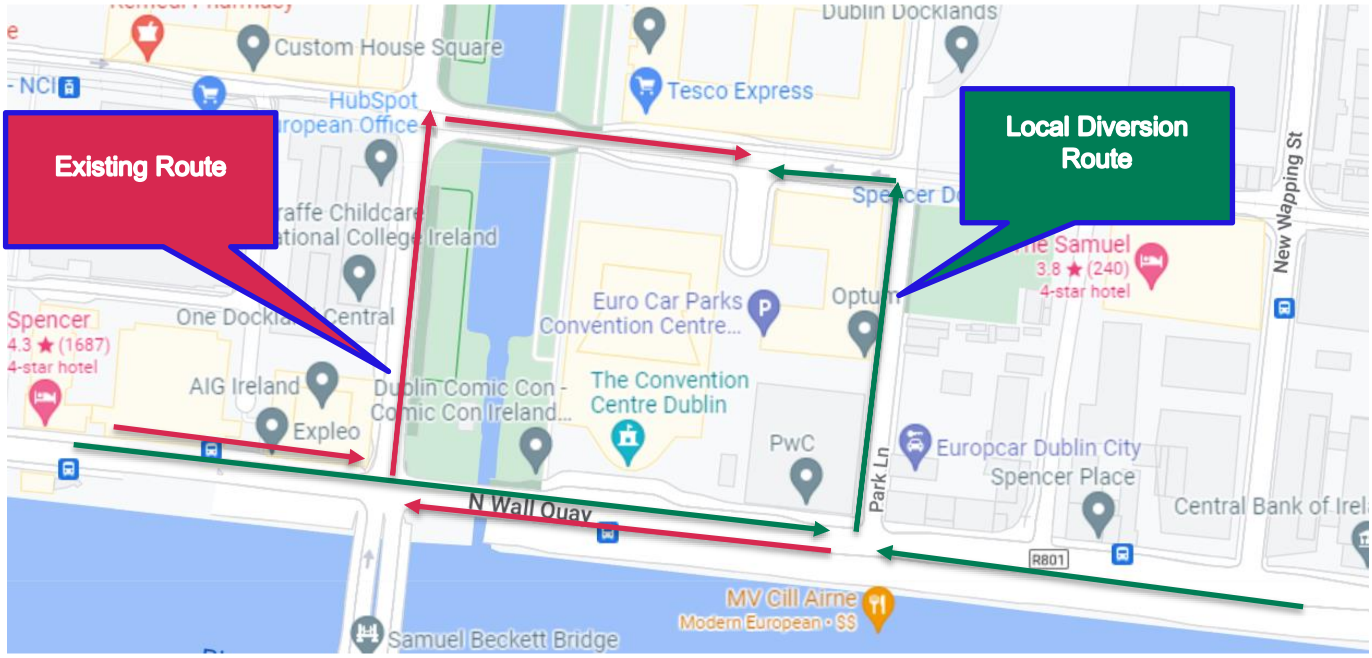


Figure 12.2: Local Diversion Route for Traffic to the CCD Car Park

The proposed turning restrictions at the Samuel Beckett Bridge junction will also impact on the ability of southbound traffic on Guild Street to turn left onto North Wall Quay. It is proposed to provide direction signs for an alternative traffic diversion route as follows and illustrated in Figure 12.3.

- Traffic wishing to access North Wall Quay eastbound from Guild Street will be directed by provision of appropriate signage to turn left to Upper Mayor Street and then right onto Park Lane. .

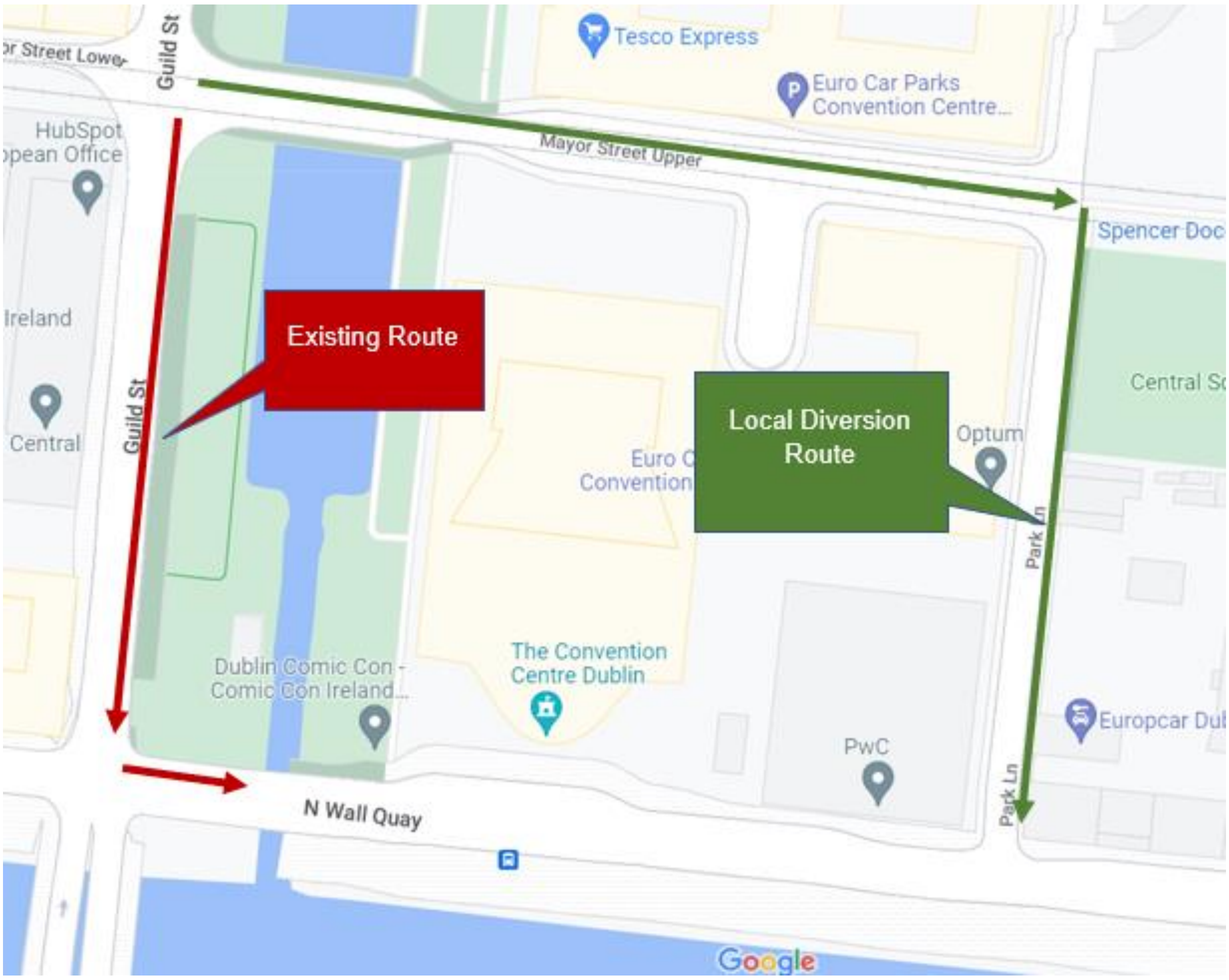


Figure 12.3: Local Diversion Route for Southbound Traffic on Guild Street onto North Quay

It is proposed to restrict left turns onto Guild Street for traffic heading east on North Wall Quay. It is also proposed to prevent right turns onto Samuel Beckett Bridge for traffic heading east (except for buses) on North Wall Quay. Direction signs will be provided for an alternative traffic diversion route as follows and illustrated in Figure 12.4.

- Eastbound traffic on North Wall Quay will be diverted left onto Commons Street, then right onto Lower Mayor Street and right onto Guild Street.
- The same diversion as referred to above will apply, i.e. eastbound traffic on North Wall Quay will be diverted left onto Commons Street, then right onto Lower Mayor Street and right onto Guild Street. This diversion will not apply to buses.

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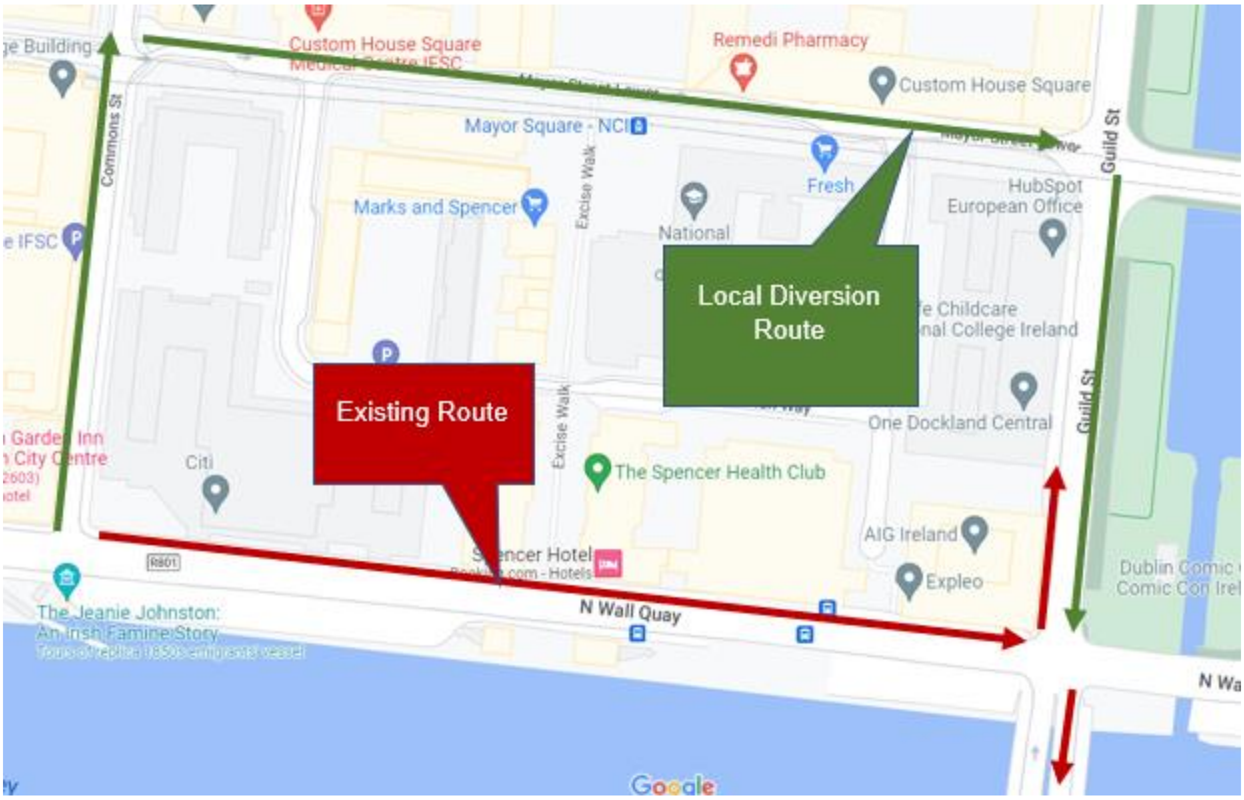

Figure 12.4: Local Diversion Route for Eastbound Traffic at Samuel Beckett Bridge

It is proposed to restrict various right turn movements for westbound traffic on North Wall Quay onto the following:

- North Wall Avenue
- Castleforbes Road
  - -Guild Street
  - -Commons Street

Direction signs will be provided for alternative traffic diversion route as follows and illustrated in Figure 12.5.

- At the northern end of Tom Clarke Bridge, traffic wishing to turn left onto North Wall Quay and intending to make the above right turn movements will be diverted northwards onto East Wall Road and then left onto Upper Sheriff Street from which all necessary access will be available.

Figure 12.5: Local Diversion Routes for Westbound Traffic Right Turn Movements off North Wall Quay

12.1.3 Gantry Signage

No gantry signage exists along the route, and the original concept design and its development through preliminary design did not identify the requirement for any new gantry signage.

12.2 Road Markings

A preliminary design of road markings has been undertaken in accordance with TSM Chapter 7. Refer to the preliminary design drawings contained within Appendix A.2 for details. This exercise also included the preliminary road marking design of the following items:

- Bus lanes are provided along the Proposed Scheme and will be marked accordingly.
- Cycle tracks have been provided along the majority of the Proposed Scheme. These will be marked according to the Traffic Signs Manual and the National Cycle Manual with particular attention given to junctions.

12.3 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 scheme, as shown on the preliminary design drawings within Appendix B9

12.3.1 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 CBC. 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 conflicts with pedestrians, where possible, and the existing removed once the new facility is operational.

Where significant alterations are proposed to the existing carriageways, the existing public lighting arrangement shall be reviewed 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:

On Custom House Quay, some heritage light columns shall be relocated as a consequence of the carriageway widening. In addition, the uplighters located on the proposed cycle lane along the river side shall be removed. Along North Wall Quay, new public lighting columns shall be installed on both sides of the road.

Two lighting columns will need to be relocated at the Samuel Beckett Bridge / Sir John Rogerson's Quay junction due to a footpath modification. Similar to the north side, the uplighters located along the proposed cycle along the river side shall be removed.

To illuminate the proposed Dodder Public Transport Opening Bridge, it is proposed to install light poles on the bridge footpath. In the green areas next to the bridge, new light poles are proposed. At the intersection between the East Link Toll Plaza and Tom Clarke Bridge, it is proposed to install additional public lighting to optimise light levels at the pedestrian crossing.

Bat friendly lighting will be installed through Ringsend Park and along the green areas adjacent to Strand Street and Pembroke Street. The light level should be less than 3 lux in order to avoid disturbing the species present in these areas.

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;
- Ensuring that the electrical installation is compliant.

12.3.2 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;
- Institution of Lighting Professionals "GN01 Guidance Notes for Reduction of Obtrusive Light"

All new lighting shall minimise the effects 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).

12.3.3 Lighting at Bus 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).

12.4 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.

12.4.1 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.

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, the design will assume that the post will be mounted in a NAL-type post socket installed at footpath level. This will provide for easier installation as well as replacement, for example where the pole has been damaged and structurally compromised.

12.4.2 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.

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.

12.4.3 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.

12.4.4 Data Communications

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.

12.4.5 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 100 metres 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 100 metres.

12.5 Real Time Passenger Information

The design for the Proposed Scheme assumes the provision of real-time passenger information (RTPI) at all of the bus stops. This will comprise a “live” display identifying the estimated arrival time of each bus at the stop.

Initial discussions have determined a requirement for a flag-type display on a dedicated mounting post, as illustrated in Figure 12-6.

Figure 12-6: Flag Type Display

12.5.1 RTPI Display Positioning and Mounting

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

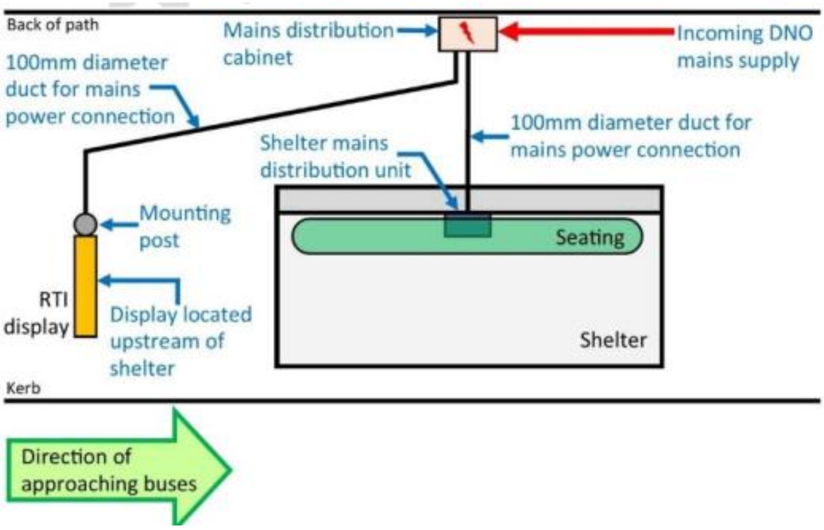

Figure 12-7: Typical Layout for Bus stop with RTPI Display

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 footpath, other street furniture, walls and buildings) may also influence the exact location of the display at each stop.

Design of the above, for both location of an RTPI display and connectivity requirements for mains power, will therefore require an understanding of each detailed bus stop layout, in particular where the shelter is to be located and whether the requirements of other facilities need to be taken into consideration. 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 footpath 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.

The specification provided for the mounting post illustrates a fixed post design so it has been assumed for design purposes that a tilt-down post, as described for the cameras, will not be required for the RTPI display. However, if such a design is needed then it can be accommodated by the NAL-type socket.

12.5.2 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 12-7 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 12-7.

12.5.3 Data Communications for RTPI Display

The majority of RTPI systems currently in operation now use the mobile phone (GPRS/3G/4G) 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 Ringsend to City Centre Core Bus Corridor, 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.

12.6 Roadside Variable Message Signs

Consideration was also given to the inclusion of roadside Variable Message Signs (VMS) to provide traffic information to road users. However, it has been confirmed that VMS is not considered a requirement for this route and therefore such signage is not currently included in the design for the Proposed Scheme.

12.7 Traffic Signals

12.7.1 Above Ground Infrastructure

12.7.1.1 Traffic Signal Poles

All traffic signal equipment is designed in accordance with Chapter 9 (Traffic Signals) of the Department of Transport Traffic Signs Manual. 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 Traffic Signs Manual 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.

12.7.1.2 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.

12.7.1.3 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
- 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 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.

12.7.2 Under Ground Infrastructure

12.7.2.1 Ducts

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

- **Power Cables** – installed equipment will require a power supply to function, this is facilitated by a ducting connection between the electricity supply point and equipment location. This connection is normally a single power supply duct.
- **Communication Cables** – to facilitate the provision of fibre optic cable along the Proposed Scheme it may 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.
- **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.

Where practicable the Proposed Scheme shall utilise existing ducting and chambers to provide the required communications continuity.

12.7.2.2 Chambers

Chamber 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 for extensive traffic and pedestrian management.

Individual chambers will be designed and sized with consideration given to the number of ducts and cables that will be routed through the chamber, and the need to provide maintenance loops of cables within the chambers. Unless prior agreement is in place, chambers will not be shared between users.

12.7.2.3 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. Cabinets 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.

12.7.3 Signal Controlled Priority

12.7.3.1 Overview

It proposed to provide specific detection for buses located a sufficient distance from the junction to allow the traffic signal junctions to respond safely and efficiently to the requested bus priority request. There would 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 would 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.

Signal controlled priority for buses providing queue relocation is proposed in areas where physical constraints cannot be overcome, and physical bus priority cannot be provided through the delivery of a bus lane such as village centre areas where the built form is close to the carriageway edge. Bus Priority Traffic Signals allow the bus to achieve virtual priority through a section where the bus shares a lane with general traffic through the management of queues within this section and providing priority to the bus on approach.

Figure 12-8: Signal Controlled Bus Priority Schematic Operation

The scenarios in which signal-controlled priority for buses can operate effectively requires assessment on a case-by-case basis, however designers should consider the following factors:

- The corridor length through which the bus will share the lane with general traffic should be reasonably clear from potential disruption. A bus priority traffic signal is not likely to operate effectively over a long distance with a large number of accesses for instance, or where a major junction is contained within this area.
- The availability and appropriateness of stacking space for traffic upstream should be considered as queues will be relocated to this area.
- Downstream queue detection will be used to ensure a clear route for the bus through the section without a bus lane.

The system provided can interface with all of the junctions along the corridor, and where required other parts of the network. This will require an AVL system that communicates both with the Central Dublin SCATS system, in an updated version of the DPTIM SCATS centralised priority system, other local authority SCOOT systems and direct interfaces with local traffic signals where these typically run MOVA. Options for local control include direct from optical sensors or using an AVL system interface.

The intention is that 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 would 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 would 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 predominately comprise Junction Type 1. These junction types facilitate general traffic and bus through movements travelling in unison. This therefore gives a high degree of flexibility regarding the level of bus priority applied at the respective junctions along the Proposed Scheme.

12.7.3.2 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. Dublin City Council use Sydney Coordinated Adaptive Traffic System (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.
- 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.

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

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

12.7.4 Communications Network

Communications will be used to connect on-street devices with the appropriate traffic control rooms. The communications will take the form of:

- Fibre Optic Cable network:
- Where appropriate the existing fibre optic cable networks may be extended in the Proposed Scheme to provide high bandwidth/low latency communication to Traffic Signal Controllers, CCTV Cameras, and other apparatus deployed on the Proposed Scheme.
- Fibre breakout cabinets will be provided at each Traffic Signal Controller, or CCTV camera.
- 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 Variable Messages Signs (VMS).

12.8 Safety and Security

12.8.1 CCTV

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:

- 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

- Bus shelters will be generally provided at Bus Stops to provide rest facilities and weather protection for users where space permits, unless there are particular local constraints that preclude provision of a shelter. Details were listed earlier in the tables of bus stop locations.

12.9 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
- 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 over the full length of the proposed route. A full table of the list of land to be acquired is shown below.

The land use along the Proposed Scheme comprises a mix of residential and commercial properties. The extent of the impact due to the Proposed Scheme on a landowner's holding is shown on the Protected Road Order Deposit Maps.

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 'Compulsory Purchase Order (CPO) Documents' prepared as part of the planning application.

In total approximately (4.3) Hectares of land will be required to be permanently acquired, of which a sizeable proportion is currently in Dublin City Council ownership, with remainder consisting of open space and other smaller land ownerships to construct to Proposed Scheme.

There will also be an additional (0.6) Hectares of Temporary land required to allow for construction of boundary treatment and surface tie in work. This temporary requirement also consists of Dublin City Council ownership and various other land owners.

13.3 Summary of affected landowners/ properties

In order to understand what existing landowners/properties would be affected by the Proposed Scheme a desktop study was carried out. This desktop study has highlighted any property within 5m of the works area, whether they would be affected by the works or not. This list was then reduced to landowners/properties being impacted by the Proposed Scheme on the basis of the preliminary design. These landowners/properties then received notification via mail of the potential impact on their property/land.

The locations for proposed land take are summarised in Table 13-1.

Table 13-1:Locations for Land Take

Address	Permanent Land Take	Temporary Land Take
Public open areas: • Adjacent CHQ building at George's Dock • Along north quays (Campshires) at multiple locations • At corner of Guild Street and North Wall Quay adjacent Spencer Dock • Along City Quay (Campshire) at Lombard Street East junction • Along Sir John Rogerson's Quay (Campshire) between Cardiff Lane and Britain Quay	Yes	No

Address	Permanent Land Take	Temporary Land Take
- Green space adjacent East Link Road - Green space adjacent York Road - Through Ringsend Park - Car park adjacent Strasbourg Terrace - Green Space adjacent Strand Street, Bayview Terrace and Beach Road - Green space adjacent Irishtown Stadium		
St. Patrick’s Rowing Club	Yes	No
University of Dublin Trinity College Stack B Building (George’s Dock)	Yes	Yes
National Convention Centre	No	Yes
Private Road at Mayor Street	Yes	No
Open space at Citi Bank, junction of Custom House Quay and Commons St.	Yes	No
River frontage at DCC Docklands Offices	Yes	Yes
River Bed at North Wall Quay junction of Excise Walk	Yes	No
River Bed between Britain Quay and York Road	Yes	No
River Bed at month of Royal Canal	Yes	No
River Bed at George’s Dock entry channel	Yes	No
River Bed at DCC offices	Yes	No

13.4 Demolition

There is one building proposed to be demolished as part of the Proposed Scheme. The St Patrick’s Rowing Club Clubhouse is proposed to be demolished and replaced adjacent to the proposed Dodder Bridge public transport bridge.

Boundary walls and railings will be removed and replaced as part of the works as listed in Table 13-1 above.

All reasonable precautions to prevent pollution of the site, works and the general environment including streams and waterways to 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
- 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 are consistent with the landholdings to be acquired as shown in Table 13-1 and also shown on the SPW_BW Fencing and Boundary Treatment Plans located in Appendix A.2 .

For boundary treatment requirements the following criteria has been used to calculate the area of temporary land take needed during construction:

- Walls <900mm in height– Typically two metre working room offset for temporary land take.
- Walls> 900mm in height – Typically two metre working room offset for temporary land take.
- Fences – Typically two metre offset for temporary land take.
- Significant retaining walls –There are no significant retaining walls within the Proposed Scheme.
- Specific structures (bridges etc) –Provide enough room for the storage of equipment and materials for the construction process.

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 shall be between 2.5m and 3.6m in width.

Existing gates will be reused where practicable however considerations will be required for the use of bifold gates to mitigate impacts on parking in driveways. All gates will be hung such that they will open inwards onto the property.

14 Landscape and Urban Realm

A Landscape is understood as the result of the interaction of landforms, natural elements (visible and concealed) with man-made features, and human activities over a certain area in time. The specificities of the sites that contains give each landscape a distinct character from others. Landscape is always a cultural construction, but the urban landscapes are those areas where the human actions are preponderant. Urban realm could be understood as publicly accessible spaces within an urban landscape, it encompasses streets, squares, paths, building entrances, lanes and all areas primarily dedicated for pedestrians.

A good urban realm should be safe, functional, appealing for varied users, should provide comfort and protection from distressing elements, should be identifiable and perceivable as distinctive but simultaneously well integrated in the Urban Landscape.

The success of different urban realms settings is also determined by function. Footpaths along a narrow street, for instance, need to provide optimal routes from point A to point B. Assuring pedestrians can move in the most effective, safe, and comfortable way. Large squares on the other hand are also meeting points, places to stay, socialize and rest. People routes needs to be assured but other objectives are also important. These can be met by introducing specific urban furniture elements such as benches, trees, for shading or streetlighting.

Some main policy and strategic documents that have been considered as guidance to develop the landscape and urban realm proposals where:

- Dublin City Development Plan 2022-2028
    - Vol.1: Written statement – 14.8.4
    - Vol.2: Appendix. 3 – Retail strategy/ 3.7 Guidance on the Scale and Location of Development
    - Vol.4: Record of Protected Structures
- Dublin City Tree Strategy 2016-2020
    - Chapter 4.0 Action Plan 2016–2020
- Dublin City Biodiversity Action Plan 2015-2020
    - Theme 1: 1.4 Invasive Species.
    - TGN on Biodiversity for Development Management in Dublin City- Site Design chapter

14.1 Consultation with Local Authority

Periodic consultations were held with local stakeholders throughout the design process, namely local associations, resident groups, and Dublin City Council, including representative experts for local heritage, landscape, and ecology.

14.2 Landscape and Character Analysis

The strategy for the urban realm design was developed comprehensively to achieve coherence between the different Proposed Schemes while enhancing the special character of each segment. It was initially based on a common mapping exercise for Urban Realm Initiatives which provided the general planning framework on which to base site specific designs.

Within the analysis of the existing urban realm, a classification of segments with similar character was carried out. It included heritage features such as particular buildings or groups of buildings, boundaries, existing vegetation, planting, light fixtures. And hardscape materials. It also considered the available space, distance to attraction points or relative position within the city network. The objective was to identify the existing character and perceive how the design proposal may affect it. The result of the analysis was made clear by the identification of areas of opportunities for enhancing the urban realm character or improve what currently exists. These areas were identified and will be analysed in the next chapters of the report. The main activities considered were introducing/ extending planting, upgrading the paving materials, decluttering the streets and general contributions for upgrading zones.

14.3 Arboricultural Survey

14.3.1 Scope of Assessment

An Arboricultural Impact Assessment Report identifies the trees, groups of trees, or hedgerows that may be impacted by the Proposed Scheme. The surveyed trees contained within this report are located within or adjacent to the proposed Bus Connects route. 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 B5.

The assessment was informed by an extensive tree survey prepared by Arbor Care, Professional Consulting Tree Service. Based on the requirements of BS5837:2012 Trees in relation to design demolition and construction – Recommendations (BS5837).

The objective of the Arboricultural Impact Assessment was to identify the areas that contained trees, groups of trees, or hedgerows, and to ensure where practicable that these areas would be retained and to identify the trees that are to be removed to facilitate the development. It includes a report and plans on Arboricultural Impact that identify recommendation for tree works.

The report considers the following:

- Client brief and Methodology.
- General description of trees.
- Guidance for the design team and any key considerations.
- Statutory or non-statutory designations affecting trees within the survey area.
- Schedule of surveyed trees
- Tree protection/constraint plan.

14.4 Hardscape

14.4.1 Design Principles

Landscape design has been directed by a good understanding of the original landscape values, heritage elements and ecological values. An effort has been made to support the enhancement of significant places and the protection of trees and shrubs which are thriving.

The main elements that have been considered are:

- Building typologies, uses, scale, pedestrian environment, landmarks, landscape character and any other relevant place attributes.
- Assessment of the general route proposals and impacts to the local conditions that require mitigation for the risk of being detrimental for some public space users.
- Development of strategic public realm proposals that provide compensation of detrimental effects of the general proposal.

- Development of public realm design proposals for each section following both the vision of BusConnects Dublin Infrastructure Works and the specificities of the sites that relate to identity and character

14.4.2 Typical Material Typologies

A palette of proposed materials was put forward to create a consistent design response for various sections of the route. The proposed materials were based on the existing elements, landscape character, function, and durability.

The material employed in the preliminary design are:

- **Poured in situ concrete pavement**. – Used extensively on existing footpaths and in areas to reinstate according to existing. Sometimes these are laid without kerbs but in some locations, they have concrete or stone curbs. These pavements are durable, resistant, and non-slippery, but are impermeable. With time and weathering they frequently present cracks and a non-homogeneous colouring. If utility works are needed the patches will be visible.
- **Natural stone. –** Used in high quality urban realm areas, mostly in city centre locations or around heritage buildings. This typology includes stone surface treatments such as granite used to create enhanced public spaces.
- **Precast concrete pavers**. – Includes concrete paving slabs or concrete blocks, 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 public realm enhancements for commercial areas where large slabs are included.
- **Stone setts**. – Proposed for distinguishing pedestrian crossing points and special locations of road traffic in high quality urban areas (footpath or road level).
- **Self-binding gravel** – Proposed for pedestrian and cycle paths with less traffic. Used for areas parks areas or pocket garden setbacks from roads or streets.
- **No change**. – There were also areas where no change in materials would is required. For example, where pavement has recently been laid and is in good condition or is not new but is in perfect conditions.

Other design responses also include in certain areas:

- **Tree pit insertion** larger tree pits should be included whenever possible. In some cases, it was also necessary to construct tree pits to accommodate trees that were formerly within green areas that are now hardscape areas.
- **Street furniture** is mostly confined to replacing or relocating existing furniture, there is opportunity at key locations to provide additional street **furniture** where it would most enhance the communal spaces.

14.5 Softscape

14.5.1 Tree Protection and Mitigation

One of the landscape design main concerns is to protect existing trees along the route following recommendations from the arboricultural report. The information gathered from the arboricultural survey was overlaid in the designs and reviewed iteratively with the main objective of keeping the trees that are in good condition in the proposal even if special protection to those specimens should be required during works or alternative methods to keep them should be taken.

14.5.2 Tree Loss and Mitigation

Some less important trees are to be removed along North Wall Quay; however replacement planting is proposed to suit the new road layout. Despite the best efforts to retain trees in the design, 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 135 trees lost, refer to Table 14-1 below. This loss has been addressed through mitigation and replanting efforts as outlined in the planting strategy (section 14.5.3) below, resulting in a net loss of 4 trees along the Proposed Scheme.

Table 14-1: Summary of Trees Retained, Removed and Proposed as part of the Bus Connects Route.

Retained Trees	Removed Trees	Proposed Trees	Total Trees in Development
Total retained in development	Total identified tree numbers lost	Street trees planted	Proposed Scheme
312	**135**	**+131**	**443**

14.5.3 Planting Strategy

It has been developed according to the Dublin City Tree Strategy and the Dublin Biodiversity Action Plan. To have an influence on the local environment to improve air quality; stormwater runoff; health and well-being; and habitat provision.

- Green corridors and new green areas have been kept and enhanced to promote biodiversity in urban areas.
- Street trees are proposed throughout following the principles of the Dublin City Tree Strategy.
- Support for the role of SuDS opportunities within the Proposed Scheme in coordination with the drainage engineers. (Refer the Drainage, Hydrology and Flood Risk section of this report).
- The biodiversity 10-20-30 rule (no more than 10% of any one species, 20% of any one genus, or 30% of any family) to reduce the risk of catastrophic tree loss due to pests was taken into consideration for the selected tree palette

14.5.4 Typical Planting Typologies

Several typologies were implemented to address the issues discussed before.

- **New Trees in Footpaths** – Medium to large canopy trees planted in large urban tree pit systems to allow for protection of the soil structure and good root development.

Figure14-1: Semi Mature Street Trees

Figure 14-2: Semi Mature Street Trees

- **New trees to Fill Tree Screens in Areas Affected by Works** – The existing green verges that border high traffic roads such as East Link Road and York Road are very important since they constitute a green screen that shelters the residential buildings from high vehicular traffic. These areas will receive new tree planting to mitigate trees loss by the implementation of the future River Dodder bridge pedestrian area. The new tree planting will also give continuity to the small new park to be installed in that zone.

Figure14-3: Existing Trees in Green Verge

Figure 14-4: Existing Trees in Green Verge

14.6 Proposed Urban Realm Design

The landscaping design proposal (see Appendix B5) is presented at scale 1:500 and it includes the identification of relevant existing vegetation and paving surfaces to be retained and proposed paving types. These are stone, concrete, asphalt, stone/concrete sett paving and self-binding gravel. As proposed vegetation there are trees, hedgerows, native planting grass verges and amenity areas and rich grass land. Sustainable Urban Drainage systems (SuDs) planting areas are also included to manage the run-off close to the surfaces where rainfall lands. The designs also provide indications of removed vegetation and trees. The notes include information for proposed tree species with reference to purchase dimensions.

Vegetation areas in good condition are to be kept in parks and verges while the medians throughout most of the north part of the route provide a good opportunity for natural wildflowers, shrubs, and hedgerows to be installed thus contributing to increased biodiversity and ecological resilience. A great variety of green spaces, mostly flushed planter areas, are to be included throughout the design, thus allowing for a more coherent corridor and better natural connectivity. The new enlarged pedestrian areas will feature new green ornamental planting and urban furniture while some areas will include also a more differentiated design with different paving materials.

As a preliminary plant listing of trees/shrubs the following can be considered (Native flower species and more trees to be found in annexes):

Table 14-2: Preliminary plant listing of trees/shrubs

Scientific name	Common names in English – Irish
Alnus glutinosa	Alder – Fearnóg
Arbutus unedo	Arbutus – Caithne
Betula pubescens / Betula pendula	Birch – Downy – Beith chlúmhach / Silver – Beith gheal
Corylus avellana	Hazel – Coll

Scientific name	Common names in English – Irish
Crataegus monogyna	Hawthorn – Sceach gheal
Cytisus scoparius	Broom – Giolcach sléibhe
Euonymous europaeus	Spindle – Feoras
Fraxinus excelsior	Ash – Fuinseóg
Hedera helix	Ivy – Eidhneán
Ilex aquifolium	Holly – Cuileann
Juniperus communis	Juniper – Aiteal
Lonicera periclymenum	Honeysuckle – Féithleann
Malus sylvestris	Crab Apple – Crann fia-úll
Pinus sylvestris	Scots Pine – Péine albanach
Populus tremula	Aspen – Crann creathach
Prunus avium	Wild Cherry or Gean – Crann silín fiáin
Prunus padus	Bird Cherry – Donnroisc
Prunus spinosa	Blackthorn – Draighean
Quercus petraea	Sessile Oak – Dair ghaelach
Quercus robur	Pedunculate Oak – Dair ghallda
Rhamnus cathartic	Buckthorn – Paide bréan
Rosa canina	Dog Rose – Feirdhris
Rubus fructicosus	Bramble – Dris
Salix spp	Willows – Saileach
Sambucus nigra	Elder – Tromán
Sorbus aucuparia	Rowan – Caorthann
Sorbus spp	Whitebeam – Fionncholl
Taxus baccata 'fastigata	Irish yew
Tilia cordata	Small leaved lime
Ulex europaeus and Ulex gallii	Gorse – Aiteann
Ulmus glabra	Wych Elm – Leamhán sléibhe
Viburnum opulus	Guelder Rose – Caorchon

14.6.1 Scherzer bridge relocation area in George's dock

This location represents an opportunity to implement significant improvements to pedestrian and bicycle circulation. The special character of the area is to be maintained by using the same pavement materials that currently exist : large granite stone blocks and cobble sets. Some trees need to be removed eastbound for the implementation of a bus stop and the cycle path, but new trees will be planted to the east reinforcing the triple tree alignment which gives character to the quays.

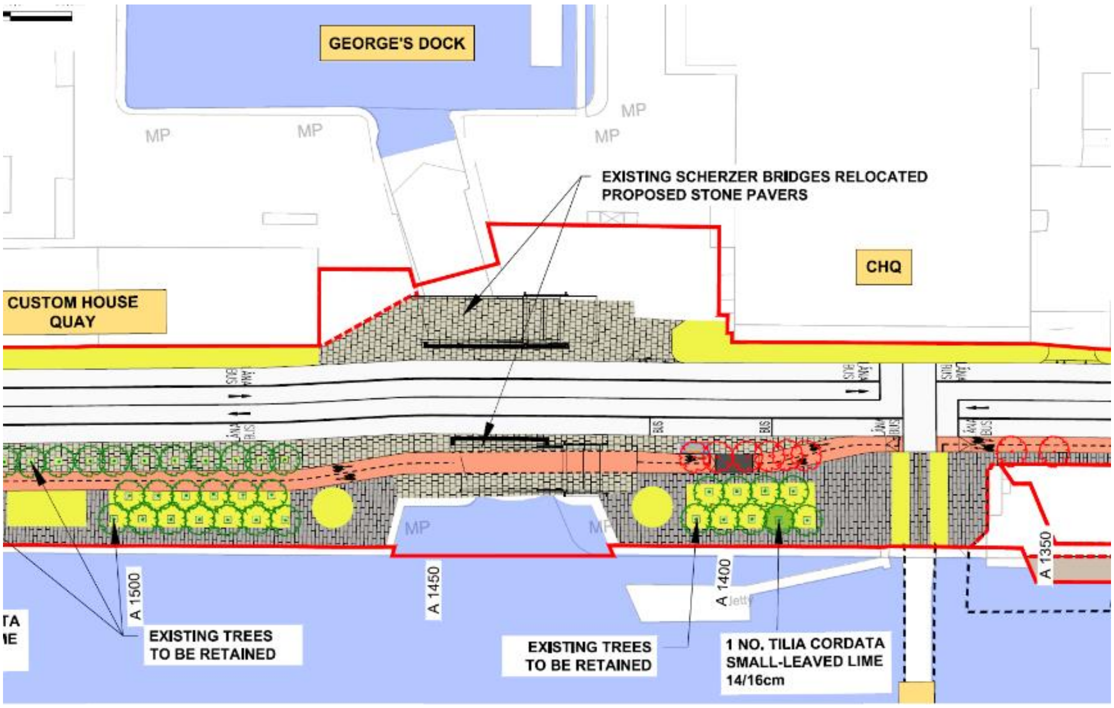

Figure 14-5: Ringsend – Scherzer bridge Hot Spot

14.6.2 Excise Walk Riverfront

The restaurant buildings on the campshires at the junction with Excise Walk constrain the available width for pedestrian and cycle facilities. The road also needs to be widened at this location to achieve the required width for two bus lanes and two traffic lanes. It is therefore proposed to construct a boardwalk outside the restaurants to increase the available space for pedestrians. This in turn will allow the construction of a two-way cycle route between the restaurants and the road. The pedestrian route along the river will align with the other interventions proposed upstream and downstream. The proposed structure comprises a steel substructure supporting a wooden deck to match the existing Liffey Boardwalk further west. Figure 14-6 below refers.

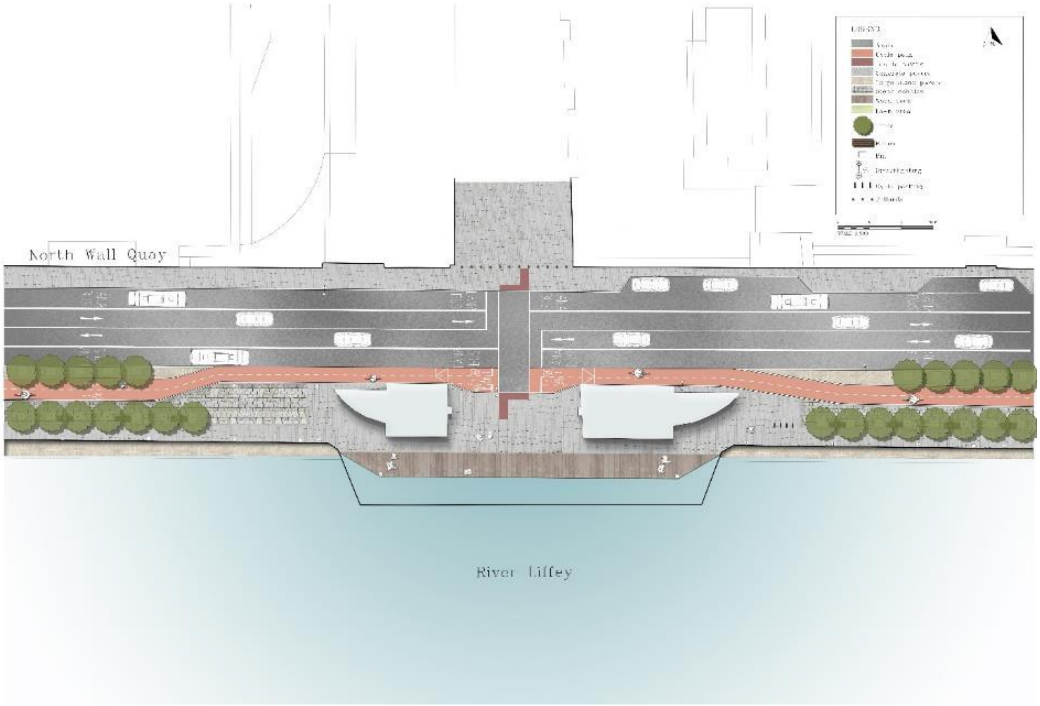

Figure 14-6: Ringsend – Excise Walk Riverfront Hot Spot

14.6.3 Sir Rogerson's Quay South Footpath Near the River Dodder

In Sir Rogerson's quay, between Benson Street and the river Dodder, changes in existing road alignment will result in footpath enlarging. The new area for pedestrians will be wide enough to incorporate two new planted areas with trees and ornamental shrubs/ groundcover plants that will connect with the 4 trees existing alignment to the east. This proposal to incorporate more vegetation in this urban setting will provide shelter from the prevailing winds while partly reconciling the large scale differences between the existing buildings and the surrounding landscape.

14.6.4 Small Park East of the Future River Dodder Bridge

This area includes the design of a small park area with pedestrian and cycle paths, two small plazas and a staircase access from the river Dodder near York Road (to the west). The design is subject to the development of the new bridge and incorporates a connection to a future pedestrian and cycle bridge to the north, crossing the Liffey. For this area, the design proposal has considered new poured concrete footpaths, stone paving along the bridge and through the future rowing club area as well as small central plazas with self-binding gravel and concrete paving. The proposed vegetation includes grass surfaces, ornamental shrub planting in the bridge and hedgerows to frame the small electrical substation building. The new trees will be mostly flowering species such as judas trees, ornamental pears, or red horse chestnut trees to enhance ornamental and ecological value of the zone. To the east, some of the vegetation screen trees such as birches or willows will be used to assure continuity with the existing trees. The area will be fully accessible from the south and west and will have permeable views all around assuring safety for all users. The overall feel will benefit from the sensible use of different paving materials and contrasting tree species. Figure 14-7 below refers.

Figure 14-5: Ringsend – Dodder Bridge small park

15 How the Proposed Scheme Achieves the Objectives

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

1) 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;
2) Enhance the potential for cycling by providing safe infrastructure for cycling, segregated from general traffic wherever practicable;
3) Support the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland’s emission reduction targets;
4) 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;
5) 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
6) 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 29% and 38% of route outbound and inbound respectively of which significant portions of the route are shared with cyclists. This will be increased to 100% coverage in each direction along the north quays, and 59% and 25% coverage of inbound and outbound respectively along the south quays. Overall, coverages of 80% inbound and 63% outbound are provided by the Proposed Scheme.

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 G1, G2 and 60, 71,72 and 91 bus routes, as well as multiple orbital routes including O and N4. At the western end of the scheme, Routes on the D Spine, as well as Radial Routes 22, 23, and 24 will cross Talbot Memorial Bridge, benefiting from the redesigned junction with Custom House Quay. 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 make these services more reliable, particularly in peak times, thus providing a more attractive and sustainable alternative mode of transport. The introduction of segregated cycle facilities and relocation of 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 there are mandatory cycle lanes currently provided on only approximately 63% and 74% 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 will increase this to 100% priority along segregated facilities in both directions. The Proposed Scheme is implementing safe, segregated. infrastructure throughout and as such is greatly enhancing the potential for cycling.

Within the extents of the Proposed Scheme there are a number of public realm areas 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, as highlighted in the Accessibility Audit. 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.

Along with these interventions, the proposals include significant improvements to the pedestrian environment, both along links and at both signalised and priority junctions and crossings. As such the Proposed 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 local authorities and stakeholders. The proposals have been developed alongside the other technical teams so that the preliminary landscape design is integrated into the overall Proposed Scheme design.

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, 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.

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