# Ballymun/Finglas to City Centre Core Bus Corridor Scheme

June 2022

# Preliminary Design Report

BUS CONNECTS

SUSTAINABLE TRANSPORT FOR A BETTER CITY.

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## Appendices

# List of Acronyms

| Acronym | Definition |
|---|---|
| AC | Asphalt Concrete |
| AGI | Above Ground Installation |
| AIAR | Arboricultural Impact Assessment Report |
| ASLs | Advance Stacking Locations |
| AVL | Automatic Vehicle Location |
| AP | Attenuation Ponds |
| AT | Attenuation Tanks |
| AVLS | Automatic Vehicle Location System |
| AlluvMIN | Alluvial(mineral) |
| BCPDGB | BusConnects Preliminary Design Guidance Booklet |
| BEP | Building Information Modelling (BIM) Execution Plan |
| BGL | Below Ground Level |
| BIM | Building Information Modelling |
| BJTR | Bus Journey Time Report |
| BminDW | Deep well drained (Mainly basic) |
| BminPD | Mineral poorly drained (Mainly basic) |
| CBR | California Bearing Ratio |
| CBC | Core Bus Corridor |
| CDETB | City of Dublin Educational and Training Board |
| CSC | Characteristic Skid Coefficient |
| CIRIA | Construction Industry Research and Information Association, |
| CPO | Compulsory Purchase Order |
| CCTV | Close Circuit Television |
| DB 32 | Design Bulletin 32 |
| DSRC | Dedicated Short Range Communications |
| DCC | Dublin City Council |
| DLAM | Dublin Local Area Model |
| DLRCC | Dún Laoghaire-Rathdown County Council |
| DM | Do Minimum |
| DMURS | Design Manual for Urban Roads and Streets |
| DCP | Dynamic Cone Penetrometer |
| DEHLG | Department of Environment, Heritage and Local Government |
| DMRB | TII Design Standards |
| DART | Dublin Area Rapid Transit |
| DTTAS | Department for Transport, Tourism and Sport |
| DS | Do Something |
| ESB | Electricity Supply Bord |
| ED | Engineering Designer |
| EIAR | Environmental Impact Assessment Report |
| EPR | Emerging Preferred Route |
| FTA | Federal Transit Administration |
| FRA | Flood Risk Assessment |
| FD | Filter Drains |
| FCC | Fingal County Council |
| GNI | Gas Networks Ireland |
| GSI | Geological Survey of Ireland |
| GDSDS | Greater Dublin Strategic Drainage Study |
| GDA | Greater Dublin Area |
| GDA Transport Strategy | Transport Strategy for the Greater Dublin Area 2016-2035' |

| Acronym | Definition |
|---|---|
| GI | Ground Investigation |
| GPR | Ground Penetration Radar |
| GDRCoP | Greater Dublin Regional Code of Practice |
| GDSDS | Greater Dublin Strategic Drainage Study |
| BRA | Hot Rolled Asphalt |
| HGV | Heavy Goods Vehicle |
| ILP | Institution of Lighting Professionals |
| IRI | International Roughness Index |
| ITS | Intelligent Transport System |
| IW | Irish Water |
| JTC | Junction Turning Count |
| KFPA | Kerbs, Footways and Paved Areas |
| LEBM | Low Energy Bound Mixtures |
| LOD | Level of Detail |
| LED | Light Emitting Diode |
| LPV | Longitudinal Profile Variance |
| MMaRC | Motorway Maintenance and Renewals Contract |
| Msa | Million standard axles |
| MOVA | Microprocessor Optimise Vehicle Actuation |
| MPD | Mean Profile Depth |
| MCA | Multi-Criteria Assessment |
| MID | Mobility Impaired & Disabled |
| NCM | National Cycle Manual |
| NTA | National Transport Authority |
| NSS | National Spatial Strategy |
| NCDWC | National Construction and Demolition Waste Council |
| NPF | National Planning Framework |
| OPW | Office of Public Works |
| OSI | Ordnance Survey Ireland |
| OD | Ordinance Datum |
| OSP | Oversize pipes |
| PDR | Preliminary Design Report |
| PSCI | Pavement Surface Condition Index |
| PMG | Project Management Guidelines |
| PMC | People Movement Calculator |
| RSES | Regional Spatial and Economic Strategies |
| RC | Rotary Core |
| RMO | Road Maintenance Office |
| RSA | Road Safety Audit |
| RTPI | Real Time Passenger Information |
| SMA | Stone Mastic Asphalt |
| SuDS | Sustainable Urban Drainage Systems |
| SCOOT | Split Cycle Offset Optimisation Technique |
| SCATS | Sydney Coordinated Adaptive Traffic System |
| SSD | Stopping Sight Distance |
| TII | Transport Infrastructure Ireland |
| TSM | Traffic Signs Manual |
| TP | Trial Pit |
| UCD | University College Dublin |
| VMS | Variable Message Signs |

# Executive Summary

This Preliminary Design Report has been prepared for the Ballymun/ Finglas to City Centre Core Bus Corridor Scheme and builds on the previous Feasibility and Options Reports for two Core Bus Corridors (CBCs) – namely the Ballymun to City Centre CBC and the Finglas to Phibsborough CBC that have now been amalgamated into a single Proposed 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 Ballymun / Finglas to City Centre Core Bus Corridor Scheme wholly achieves the Proposed Scheme objectives. In doing so, it fulfils the aim of providing enhanced walking, cycling and bus infrastructure on a key access corridor in the Dublin region, enabling the delivery of efficient, safe, and integrated sustainable transport movement along the corridor.

# 1 Introduction and Description

## 1.1 Introduction

BusConnects is the National Transport Authority's (NTA) programme to improve bus and sustainable transport services. It is a key part of the Governments 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 Ballymun/Finglas to City Centre Core Bus Corridors of the CBC Infrastructure Works (herein after called the 'Proposed Scheme') will be 10.9 km in length. The Proposed Scheme will be comprised of two main alignments in terms of the route it follows, namely from Ballymun to City Centre and from Finglas to Phibsborough as a branch from the Ballymun Alignment

The Ballymun Alignment commences at the R108 Ballymun Road / St Margaret's Road junction and runs along Ballymun Road / St. Mobhi Road / Botanic Road / Prospect Road / Phibsborough Road / Constitution Hill, and Church Street, ending at Ormond Quay.

The Finglas alignment commences at the R135 Finglas Road / St Margaret's Road junction and runs along Finglas Road, ending at Hart's Corner where it intersects the Ballymun Alignment.

Refer to Figure 1-1 overall Route of the Proposed Scheme.

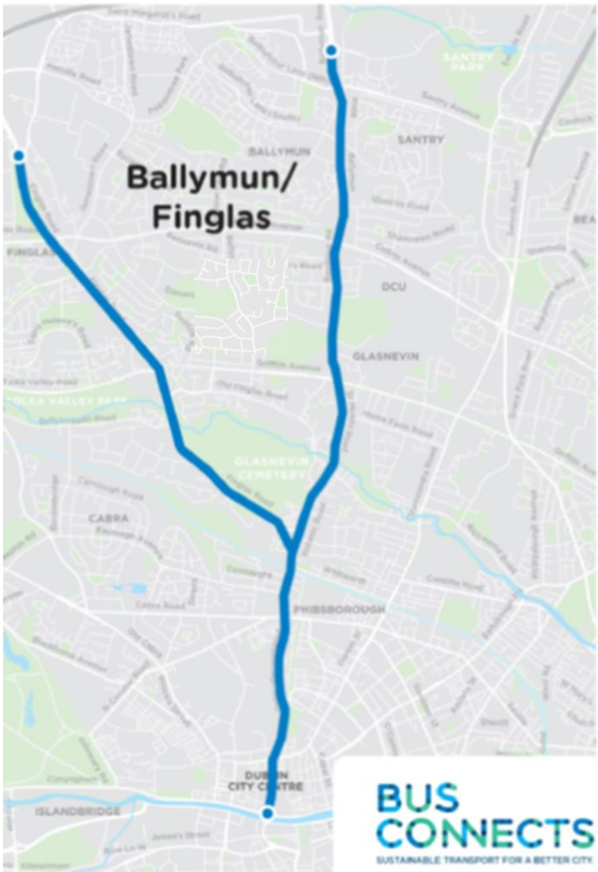



***Figure 1-1: Proposed Scheme Route Overview***

## 1.2 Scheme Aims and Objectives

The aim of the Proposed Scheme is to provide enhanced walking, cycling and bus infrastructure 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 Proposed Scheme 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 2016 – 2035 sets out a network of the bus corridors forming the "Core Bus Network" for the Dublin region. Sixteen indicative radial Core Bus Corridors (CBCs) were initially identified for redevelopment. This is shown in Figure 1-2 (extract from Transport Strategy for the Greater Dublin Area 2016-2035).

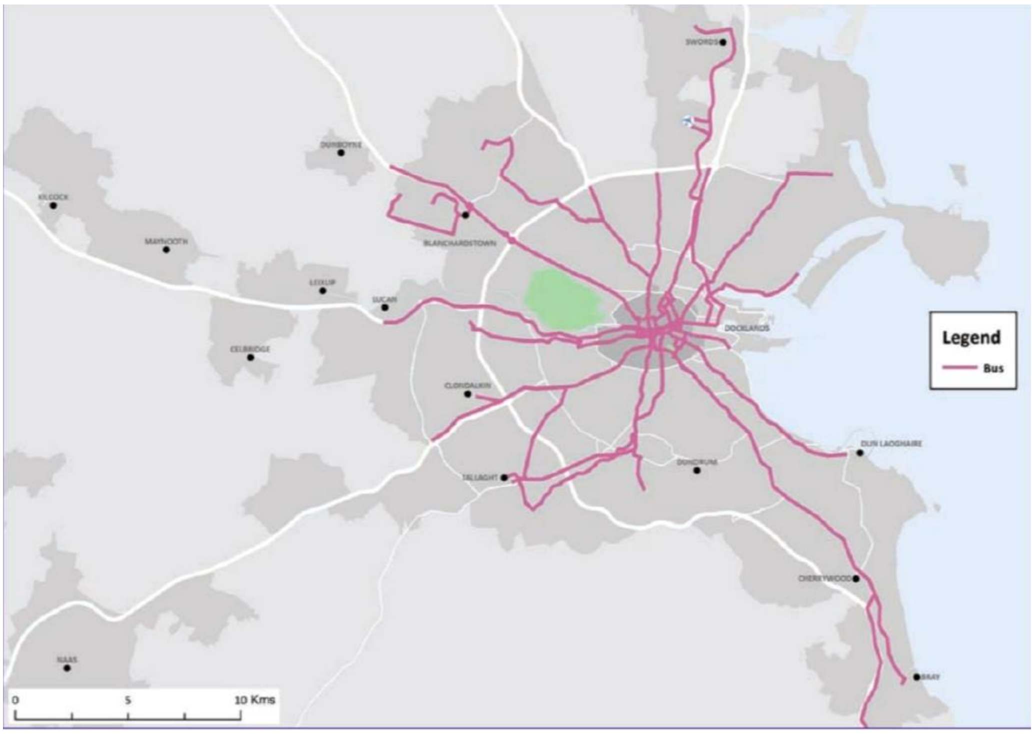



***Figure 1-2: 2035 Core Bus Network – Radial Corridors***

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

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

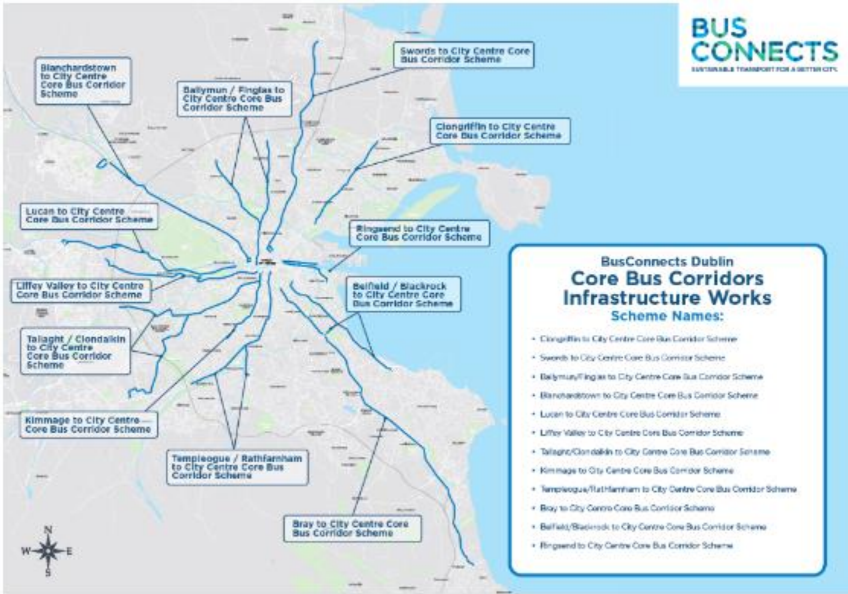



***Figure 1-3 - BusConnects Radial CBC Network***

## 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:

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

Refer to the BusConnects website for the Ballymun to City Centre Core Bus Corridor and Finglas to Phibsborough Core Bus Corridor Consultation Submissions Summary Reports for information on the non-statutory consultations at the links below:

https://busconnects.ie/wp-content/uploads/2022/02/03-ballymun-to-city-centre-report-on-cbc-public-consultation.pdf

https://busconnects.ie/wp-content/uploads/2022/02/04-finglas-to-phibsborough-report-on-cbc-public-consultation.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 Proposed Scheme development process at particular locations;
- Identify constraints and opportunities within the study area, Proposed Scheme corridor and route options considered;
- Further refine the Proposed Scheme objectives;
- Discuss potential mitigation measures and options; and
- Identify planning requirements, conditions, and implications with respect to the Proposed Scheme design measures.

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

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

- Representative Groups;
- Land Owners (i.e. owners of lands at any specific locations);
- Directly Impacted landowners.

## 1.6 Audit of the Existing Situation

The following surveys have been conducted to inform the preliminary design:

- 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 (Automatic Vehicle Location) data
- Traffic Survey (Junction Turn Counts, 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 purpose of the Preliminary Design Report (PDR) is to outline the design intent of the Proposed Scheme. In particular, the PDR outlines the following:

- 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 studies 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 the 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 Proposed Scheme chainage structure and provides context for the locality of adjacent Schemes and other notable locations along the route. (See Appendix B1) |
| **GEO_GA** | General Arrangement Plans (1:500 @ A1) | Displays information for conveying the overarching Proposed 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 Proposed Scheme (structures or significant features which may be further described on other drawing series). (See Appendix B2) |
| **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) |
| **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) |
| **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) |
| **PAV_PV** | Pavement Treatment Plans (1:500@A1) | Provides an indication of the proposed pavement treatment works along the length of the route. |

| Drawing Series Volume Code | Drawing Series Description / Scale | Design Content |
|---|---|---|
| | | (See Appendix B6) |
| **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) |
| **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) |
| **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) |
| **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. (See Appendix B11) |
| **UTL_UD** | Irish Water Fowl Sewer Alteration Plans (1:500@A1) | Provides an indication of the existing trunk fowl sewer network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for Proposed Scheme context. (See Appendix B12) |
| **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 Proposed Scheme context. (See Appendix B13) |
| **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 Proposed Scheme context. (See Appendix B14) |
| **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 Proposed Scheme context. (See Appendix B15) |

| Drawing Series Volume Code | Drawing Series Description / Scale | Design Content |
|---|---|---|
| **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 Proposed Scheme context. (See Appendix B16) |
| **UTL_UC** | Combined Existing Utilities Record Plans (1:500@A1) | Displays information regarding existing Statutory Undertakers records along the length of the Proposed Scheme with the Proposed Scheme features shown as background information for context. (See Appendix B17) |
| **STR_GA** | Bridges and Major Retaining Structures (Varies) | Provides additional details relating to proposed bridge structure/underpass works in addition to structural retaining walls along the route. (See Appendix B18) |

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 Proposed 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 four sections of the Proposed Scheme in more detail
- Chapter 4: Preliminary Design – In this chapter, the geometrical alignment and cross-section of the Proposed 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, proposed pavement design and considerations of the kerbs, footways and paved areas for the Proposed 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 Proposed 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 Works– This chapter outlines land use and acquisition requirements, affected land and property owners, and proposed accommodation works
- Chapter 14: Landscape and Urban Realm – This chapter is an overview of the landscape and urban realm design strategy focussing on the existing trees and proposed mitigation
- Chapter 15: How the Proposed Scheme achieves the Objectives – In this chapter benefits provided by the Proposed 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 (2019)
- Eastern & Midland Regional Assembly, Regional Spatial & Economic Strategy (2019-2031)
- Greater Dublin Area Cycle Network Plan
- Transport Strategy for the Greater Dublin Area (2016-2035)
- Dublin City Council Development Plan (2016-2022)
- Fingal County Council Development Plan (FCC) (2017 – 2023)

## 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 will have an overall length of 10.9 km (kilometres) and is comprised of two main alignments.

The Ballymun Alignment of the Proposed Scheme is 6.7km long and will commence on R108 Ballymun Road at its junction with St. Margaret's Road, just south of M50 Motorway Junction 4, and will be routed along the R108 on Ballymun Road, St. Mobhi Road, Botanic Road, Prospect Road, Phibsborough Road, Constitution Hill and R132 Church Street as far as R148 Arran Quay at the River Liffey on the western edge of Dublin City Centre. A complementary off-line cycle route along quiet streets is proposed along Royal Canal Bank in Phibsborough, which will extend southwards from the Royal Canal to Western Way, parallel to and a short distance to the east of R108 Phibsborough Road, and also through the Markets Area at the southern end of the Proposed Scheme.

The Finglas Alignment of the Proposed Scheme is 4.2km long and will commence on the R135 Finglas Road at the junction with R104 St. Margaret's Road and will be routed along the R135 Finglas Road as far as Hart's Corner in Phibsborough, where it will join the Ballymun Alignment of the Proposed Scheme.

This proposed scheme is described below in the following Sections 1 to 7:

- Section 1 — Ballymun Road from St. Margaret's Road to Griffith Avenue: 3 km,
- Section 2 — St. Mobhi Road and Botanic Road from Griffith Avenue to Hart's Corner: 1.5 km,
- Section 3 — Prospect Road, Phibsborough Road from Hart's Corner to Western Way: 1.2 km,
- Section 4 — Constitution Hill and Church Street from Western Way to Arran Quay: 1 km,
- Section 5 — R104 Finglas Road from St. Margaret's Road to Wellmount Road: 1.1km,
- Section 6 — Finglas Road from Wellmount Road to Ballyboggan Road over 1.6 km,
- Section 7 — Finglas Road from Ballyboggan Road to Hart's Corner at Prospect Road 1.5 km.

The following paragraphs will describe each Proposed Scheme sections in more detail.

### 3.1.1 Section 1 - Ballymun Road from St. Margaret's Road to Griffith Avenue

The Ballymun Alignment starts at the junction of Ballymun Road and St. Margaret's Road and runs south along the Ballymun Road dual carriageway for 3 km in Section 1 to the junction with Griffith Avenue.

The proposed road layout will generally retain the existing one bus lane and two general traffic lanes in each direction, except in two locations as described further below. The tree-lined existing median will be retained. Segregated 2m wide cycle tracks will be provided at the edge on the outer sides of the carriageway and will segregated from the adjoining bus lane by upstand kerbs, with some localised narrowing of the adjoining wide footpaths in places. There are occasional street trees in the footpaths at the road edges, some of which will need to be removed as shown on the Landscaping Drawings in Appendix B5 and replacement planting will be provided where practicable. The existing footpaths are quite wide ranging from 2.5m to 4m. In some locations these footpaths may need to be narrowed by 0.5m to 1m accommodate the proposed cycle tracks, but generally will not be reduced to less than 2.5m wide.

#### *3.1.1.1 St. Margaret's Road to Shangan Road*

In the stretch between St. Margaret's Road and Shangan Road the existing road layout will be modified to provide two 2m wide segregated cycle tracks alongside the existing bus lane and two general traffic lanes on each carriageway. This will be achieved mainly by narrowing of the traffic lanes and modification of the kerbs, which will be moved slightly backwards between 0.5m and 1.0m narrowing the footpaths.

The segregation of the cycle track will be implemented, as for most of Ballymun Road, by installing a raised kerb between the roadway and the cycle track, keeping it at grade and allowing the passage of runoff, thus minimising changes to the existing drainage scheme by just relocating the existing gullies.

The existing median is paved and will be converted to a green landscaped area, retaining most of the existing trees and proposing new ones.

Bus stops will be upgraded to island bus stops, for improved safety of pedestrians and cyclists in the boarding and alighting zone.

The junctions of St. Margaret's Road, Northwood Avenue and Santry Cross will be upgraded to provide bus priority and segregated cycling facilities, such as protected corners, with associated signal staging to minimise conflicts with general traffic.

At the Santry Cross junction left-turn traffic lanes will be provided in both the southbound and northbound directions to enable segregated signal operations between turning traffic and buses and cyclists. These left turn lanes will replace one of the two existing straight-ahead lanes.

#### *3.1.1.2 Ballymun* **Town Centre**

From the Shangan Road junction to Gateway Crescent, through the town centre along Ballymun Main Street, it is proposed to narrow the road from two traffic lanes to a single traffic lane. The space of the removed lane will be used to provide permanent on-street parking spaces at the commercial and civic premises along the street, and improved cycle and pedestrian facilities. The proposed road cross-section on each of the two carriageways will consist of the existing wide footpath, a new cycle track, buffer strip, parking layby, a bus lane and one traffic lane with a slightly narrower landscaped median island in the middle of the street. The cycle track will be segregated from the roadway behind the parking, separated by a 0.75m wide buffer. New high-quality paving and trees will be provided to improve public realm in the town centre. On the western side of the street, the existing high step between the footpath and the road will be reduced to provide a continuous public space. The median will be narrowed by 0.5m on each side to accommodate the provision of cycle tracks along the outer edges of the street. The existing trees are too close to the kerb, and they cannot be retained when the kerbs are moved inwards, so they will be removed and replaced with new trees as shown on the Landscaping Drawings in Appendix B5.


***Figure 3-1: Ballymun Main Street West***

The signal-controlled junctions of Shangan Road and Gateway Crescent will be upgraded to provide bus priority and segregated cycling facilities, such as protected corners, with associated signal staging to minimise conflicts with general traffic. Priority controlled junctions at side streets and entrances will be provided with raised platform crossings along the street edges for pedestrians and cyclists.

#### *3.1.1.3 Ballymun Town Centre to Griffith Avenue*

South of Ballymun Town Centre the existing road layout will be generally retained with one bus lane and two general traffic lanes in each direction. Segregated cycle tracks will be provided in the same manner as further north requiring slight movement of the kerbs and narrowing of the footpaths and verges.

At the Collins Avenue junction left-turn traffic lanes will be provided in both the southbound and northbound directions to enable segregated signal operations between turning traffic and buses and cyclists. These left turn lanes will replace one of the two existing straight-ahead lanes.

On the western side of the road south of Collins Avenue to St. Pappin Road, one northbound traffic lane will be removed to accommodate on-street parking spaces, to serve frequent drop-off activity related to the Our Lady of Victories National School.

The existing signal-controlled junction of St. Pappin Road will be upgraded to provide bus priority and segregated cycling facilities, such as protected corners, with associated signal staging to minimise conflicts with general traffic. At St. Canice's Road traffic signals will be provided, which will provide for easier and safer turning movements. Other priority controlled junctions at side streets and entrances will be provided with raised platform crossings along the street edges for pedestrians and cyclists.

#### *3.1.1.4 Griffith Avenue Junction*

At the gyratory junction of Griffith Avenue, the traffic system will be modified to divert southbound traffic on St. Mobhi Road turning east onto Griffith Avenue. This traffic will instead circulate around the western and southern arms of the triangular road system which will be modified to two-way movement on those arms. Likewise, eastbound traffic from the western section of Griffith Avenue will continue directly along the southern side of the gyratory instead of diverting around the northern end of it. This arrangement will remove a significant traffic conflict at the corner of St. Mobhi Road and Griffith Avenue which will benefit buses and cyclists.

Segregated cycle tracks will be provided through the traffic gyratory, plus a 2-way cycle track along Griffith Avenue on the southern side to facilitate the cycle connection between Griffith Ave and St. Mobhi Road, which is much used by students to and from nearby schools.

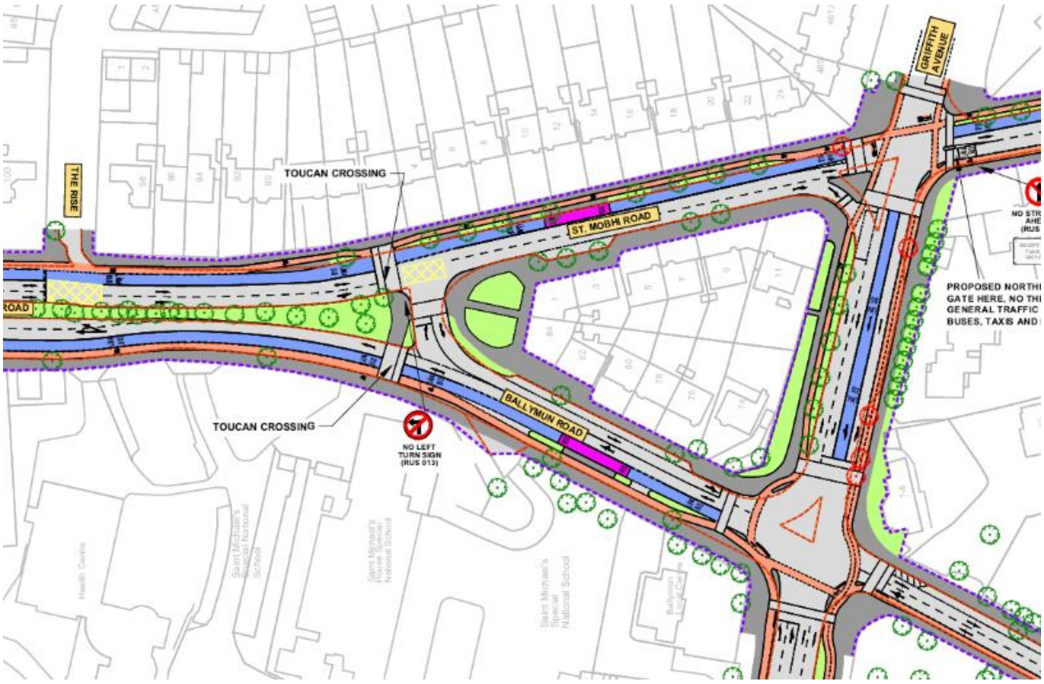



***Figure 3-2: Proposed layout for Griffith Avenue Junction Gyratory***

### 3.1.2 Section 2 – Griffith Avenue to Hart's Corner

#### *3.1.2.1 St. Mobhi Road*

A northbound Bus Gate will be provided at the northern end of St. Mobhi Road to provide appropriate priority for bus services where no bus lane is provided in the northbound direction. The existing 3-lane road layout will be retained with the southbound bus lane and two traffic lanes. In the northbound direction buses will share the traffic lane which will cater for local access traffic during bus gate operating hours.

Segregated cycling facilities will be provided generally with a 1.25m wide cycle track in both directions behind the existing lines of mature trees, all of which will be maintained. There will be localised pinch-points where the cycle tracks will require some narrowing at trees to protect the root systems.

On the eastern side of the road where there is a cluster of schools and sports clubs, there will be land acquisition and widening for a 2-way cycle track of 2.5m and a 2.5m footpath behind the tree line to cater for the increased flow of pedestrians and cyclists.

In the section between St. Mobhi Drive and Botanic Avenue, the road will be widened towards the western side to accommodate segregated cycle tracks while maintaining the existing parking in front of houses without driveways. This arrangement requires the removal of the 5 trees located on the western side, and these will be replaced with new trees.

A traffic restriction is proposed on St. Mobhi Drive to prohibit eastbound traffic from exiting onto St. Mobhi Road at the eastern end of the street where the road will be narrowed locally to a single westbound lane at the junction. This will reduce traffic flows along the narrow street where there is regular on-street parking that causes obstruction for two-way movements.

#### *3.1.2.2 Parallel Traffic Route to the West: Ballymun Road South, Glasnevin Hill, and Botanic Road*

The southern section of Ballymun Road between Griffith Avenue and Glasnevin Hill will be restricted to one-way traffic southbound over a short section from Claremont Avenue to Church Avenue where the street is too narrow for two-way traffic in conjunction with on-street parking at houses without driveways.

At Glasnevin Hill, cycle tracks will be provided in both directions as an upgrade for the existing arrangement so as to provide a feeder cycle route to the main bus corridor on St. Mobhi Road via a section of two-way cycle track alongside the River Tolka at St. Mobhi Drive.

At the junction of Botanic Avenue and Botanic Road, a new Public space is proposed, enlarging the pedestrian space and providing a better public environment at Glasnevin Village centre.


***Figure 3-3: Urban design proposal for Glasnevin Village at Botanic Ave***

#### *3.1.2.3 Botanic Road to Hart's Corner*

On Botanic Road south of the junction with St. Mobhi Road, there is a narrow section of street where bus lanes cannot be accommodated over a length of 230m south of the junction. Instead, signal controlled priority will be provided for buses at the upstream approaches to this section in both directions. To ensure a continuous cycle route though this section segregated cycle tracks will be provided as an upgrade of the existing advisory cycle lanes. Once Botanic Road becomes wider at the former print-works bus lanes will be provided in both directions.

At Hart's Corner (just north of Phibsborough) where Botanic Road intersects Prospect Way, and Finglas Road, the Finglas Alignment joins the Ballymun Alignment. The existing traffic system consists of a set of three one-way streets to circulate the traffic around Hart's Corner. Northbound traffic runs along the western side on the southern end of Finglas Road, which will be widened for bus lanes on both corridors before they branch at the corner of Prospect Way.

Southbound traffic travels along Prospect Road on the eastern side of the one-way system, where there is an existing bus lane beside two traffic lanes. On this section one traffic lane will be removed which will leave a single traffic lane and bus lane and will enable the provision of a segregated 3m wide 2-way cycle track along the eastern side of the street to provide continuity of the cycling route from both Botanic Road and Finglas Road to the Royal Canal on the eastern side of Cross Guns Bridge in Phibsborough. This 2-way cycle track will continue along Prospect Way until Finglas Road, where the cycle traffic is divided with Toucan crossings to separate directions.

### 3.1.3 Section 3 - Hart's Corner to Western Way

#### *3.1.3.1 Hart's Corner to Doyle's Corner*

South of Hart's Corner on Prospect Road to the Royal Canal at Cross Guns Bridge, the existing road layout will be retained with a bus lane and a general traffic lane in both directions. Cycle traffic will run along the 2-way cycle track on the eastern side of the street, with 2 new bridges to cross railway cuttings to the north and south of Whitworth Road. At this point the north-south cycle route will connect to the National Cycle Route N2 at the Royal Canal Greenway.

On Cross Guns Bridge the existing footpath on the western side is too narrow at only 1.6m wide. This will be widened to 4m to provide appropriate capacity for large numbers of pedestrians that will be drawn to and from the railway station just to the north that is proposed as part of both the DART+ West project for the east-west railway line, and for the MetroLink north-south railway in tunnel underneath. To widen this footpath it is proposed to omit a short 40m section of the southbound bus lane on the eastern side of the bridge, and to provide signal controlled priority for the bus lane at the Whitworth Road junction.

From Cross Guns Bridge at the Whitworth Road junction southward through Phibsborough the existing street is too narrow to accommodate segregated facilities for both buses and cyclists. Instead, cycle traffic will be diverted onto a parallel route, through quiet streets along Royal Canal Bank, which was formed when a former canal was infilled. The radial cycle route will depart from the bus corridor at the Royal Canal to follow a separate parallel route along Royal Canal Bank 100m to the east of Phibsborough Road. The cycle route will intersect North Circular Road to the east of Doyle's Corner.

Along the core bus corridor on Phibsborough Road south of the Royal Canal there are existing bus lanes in places, and these will be extended continuous in both directions through to Doyle's Corner at the junction with North Circular Road. This will require some road widening into the car park at Phibsborough Shopping Centre on the western side of the street.

On Phibsborough Road to Connaught Street, the configuration of a bus lane and a general traffic lane will be maintained in each direction. The centre right turn lane will be partially converted to a central green median with additional street trees.

Between Connaught Street and Doyle's Corner at the North Circular Road, it is proposed to widen the street on the western side to introduce an additional southbound bus lane to complement the existing northbound bus lane. This will also increase the public footpath area in front of Phibsborough Shopping Centre, taking part of the existing car park.

Bus Stop No.186 on the eastern side of Prospect Road will be expanded to a double bay to cater for significant interchange movements at the future Railway and Metro Station of Glasnevin. Similar provision is expected to be provided as part of the MetroLink project at the station forecourt on the western side for the northbound bus services.

#### *3.1.3.2 Royal Canal Bank Cycle Route*

The proposed cycle route toward the city will share with the Royal Canal Greenway over a short length of 50m east of Cross Guns Bridge. It will then cross over the Royal Canal on a new steel arch pedestrian and cycle bridge, which is provided with ramps to elevate the crossing for the required navigation clearance over the canal as shown in Figure 3.4.

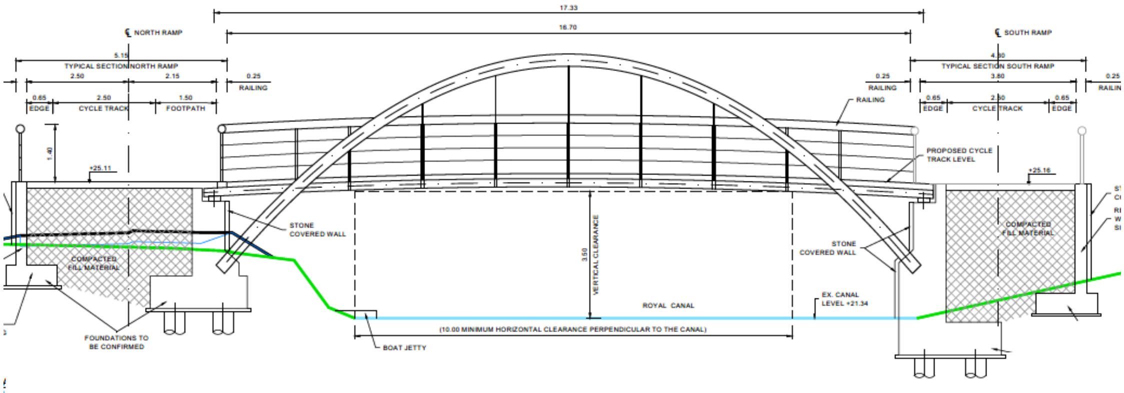



***Figure 3-4: Proposed footbridge for Royal Canal Crossing***

Heading southward from the Royal Canal the cycle route will largely avail of the existing quiet street along Royal Canal Bank. In the section behind Mountjoy Prison, a short length of southbound cycle track will be constructed along the edge of the open green space where the existing street is too narrow for cyclists and contra-flow traffic

The cycle route will pass around the eastern side of Phibsborough library and will then cross underneath North Circular Road where a new bridge will be provided. At this point, historically there was a stone arch bridge, Blaquiere's Bridge, on North Circular Road where it crossed the former Royal Canal Broadstone Branch Line. The bridge was removed after the canal became disused and was filled in to form what is now the linear park of Royal Canal Bank. It is proposed to reinstate the former crossing under North Circular Road to enable the north-south cycle route to pass through without the climb and delay of a traffic signal crossing. This keeps the integrity and continuity of the former canal route and link the southern part of the linear park through to the Phibsborough Library on the northern side. This creates an opportunity to create a Public space with reinstated trees and footpaths as is shown in Figure 3.5. An access ramp will be provided to replace the existing set of steps that links North Circular Road to Royal Canal Bank on the southern side.

***Figure 3-5: Artist's impression for crossing under North Circular Road***

### *3.1.3.3 Doyle's Corner to Western Way*

From Doyle's corner to Western way the road layout will keep the existing kerbs in position with a bus lane and a traffic lane in both directions. The only exceptions are at two localised narrow sections of street:

- In front of St. Peter's Court, 130m south of Doyle's Corner, over a short section of 40m, where there will be a gap in the northbound bus lane and signal controlled priority will be provided for the bus lane where it ends.
- Just north of Western Way the section between retaining walls at Royal Canal Terrace, where the northbound lane will be omitted over a length of 90m, and signal controlled bus priority will be provided.

Additional signal-controlled pedestrian crossings will be provided at various locations along Phibsborough Road to make it easier to cross the busy street at regular intervals. A toucan crossing will be provided at Phibsborough Fire Station to enable cyclists to link from the Royal Canal Bank cycle route via a laneway, and to connect onwards to Monck Place and the neighbourhood to the west of Phibsborough Road.

A small public space will be provided at the triangular area of disused ground adjacent to the Broadstone Station at the southern end of Royal Canal Terrace on the western side of the street.

South of North Circular Road the cycle route follows along Royal Canal Bank, which requires no alteration of the existing local access vehicle circulation. Cyclists heading towards the city centre can branch off at Geraldine Street to connect via Berkley Road and Blessington Street towards O'Connell Street. At the end of Royal Canal Bank, the route crosses Western Way and turns west to meet the core bus corridor again at Broadstone.

### 3.1.4 Section 4 – Western Way to Arran Quay

#### *3.1.4.1 Constitution Hill*

At Constitution Hill, the street layout will be widened slightly on the western side for a bus lane and traffic lane per direction alongside a 2-way segregated cycle track in the front of King's Inns Park on the eastern side from Western way to Coleraine Street. An additional northbound cycle track is provided in the opposite side, whose alignment varies through the retained line of trees.

#### *3.1.4.2 Church Street*

From Coleraine Street the core bus corridor follows along Church Street Upper as far as the junction with King Street North with continuous bus lanes alongside the traffic lanes. Cycle tracks will be provided alongside the bus lanes over this section as far as the King Street junction North.

On Church Street Lower the existing street is considerably narrower and short gaps are required in the bus lanes as follows:

- Southbound from the King Street North junction to Church Avenue West over a length of 190m.
- Northbound from the junction at May Lane for 60m.
- Southbound from the junction at Chancery Street (LUAS Red Line crossing) for 50m.

Signal controlled priority will be provided for buses at the start at each of these gaps in the bus lanes.

Cycle tracks cannot be accommodated alongside the bus lanes on Church Street Lower due to the restricted width of the existing street. Cyclists will therefore share the bus lanes along the 460m length of Church Street Lower. At the short gaps in the bus lanes cycle tracks will be provided instead.

The Ballymun Alignment of the Proposed Scheme ends at the junction of Church Street Lower with Ormond Quay and Arran Quay on the River Liffey.

#### *3.1.4.3 Markets Cycle Route - Alternative*

From Coleraine Street southwards an additional cycle route will divert from the bus corridor to follow quiet streets through the Markets Area over a length of 750m to Ormond Quay on the River Liffey. This route will provide an alternative for cyclists to sharing the bus lanes on Church Street Lower. It can link with a continuation southward across the River Liffey at Winetavern Street as part of the further development of the cycle route network in the city centre

### 3.1.5 Section 5 – Finglas Road from St. Margaret's Road to Wellmount Road

The Finglas Alignment starts at the roundabout on Finglas Road at the junction with St. Margaret's Road. To improve pedestrian connections in the vicinity of the roundabout, additional signal-controlled pedestrian crossings and footpaths are proposed around the roundabout on all sides.

There is an existing bus lane on the southbound carriageway of the Finglas Road where it bypasses Finglas Village centre in this section. However, in the northbound direction the existing bus lane terminates 450m south of the roundabout where there is a merge ramp from Mellowes Road. From the merge ramp northward there are two existing traffic lanes, whereas there is only one traffic lane south of there. For the Proposed scheme it is proposed to convert the left traffic lane to a bus lane from the Mellowes Road merge ramp northward over a length of 450m to the roundabout at St. Margaret's Road. A pair of new bus stops will be provided just south of the roundabout on Finglas Road where there is an existing footbridge over the dual carriageway. New footpath links will be provided to these bus stops from the local streets to the east and west. The proposed new signal-controlled pedestrian crossing between the proposed bus stops and the roundabout will enable bus passengers to cross the dual carriageway road.

There are no existing facilities provided for pedestrians and cyclists along the Finglas Bypass dual carriageway over the 0.75km length north of the Mellowes Road grade-separated junction where there is no frontage access. Instead, pedestrians and cyclists will continue to use the parallel local streets to the east and west of the bypass.

South of the Mellowes Road Bridge there will be a new northbound cycle track along the western side of the Finglas Road, which will follow the existing footpath over a length of 380m from Wellmount Road past the junction with Church Street and along the diverge ramp to Mellowes Road. Between Wellmount Road and Church Street the existing verge on the western side is quite narrow and it will be necessary to remove 4 existing trees to accommodate the proposed cycle track.

In the southbound direction, rather than follow the merge ramp from Mellowes Road, cyclists will be directed along Finglas Main Street for a length of 160m and then turn right (southwest) along Church Street for another 80m to join Finglas Road where a new cycle track will commence on the eastern side of the dual carriageway. A gap will be provided in the existing wall that closes off Church Street where it was bisected by the Finglas Bypass at the existing footbridge. The verge on the eastern side of Finglas Road is wider than on the western side and the proposed 1.5m wide cycle track can be accommodated outside the existing trees that will be retained.

At the junction of Church Street with Finglas Road a pair of new bus stops will be provided just south of the junction where there is an existing footbridge over the dual carriageway. These bus stops will provide direct access to Finglas Village centre from bus services along the Finglas Bypass. New footpath links will be provided to these bus stops from the local streets to the east and west. A proposed new signal-controlled toucan crossing between the proposed bus stops and the Church Street junction will enable bus passengers to cross the dual carriageway road. It will also enable cyclists to cross the road at this point.

### 3.1.6 Section 6 - Finglas Road from Wellmount Road to Ballyboggan Road

At the staggered junction between Wellmount Road on the western side and the Finglas Village link on the eastern side there are three southbound traffic lanes at present, comprising two straight ahead lanes and a left-turn lane. The existing left-turn lane will be retained which will enable segregated signal operations between turning traffic and buses and cyclists. The southbound bus lane will be extended by 170m through the staggered junction with one of the two straight ahead traffic lanes converted to a bus lane. In the northbound direction there is no existing left-turn lane and left-turn traffic will continue to share the left lane with buses over a short length of 30m within the junction. Signal segregation will be provided for northbound cyclists at this junction to avoid conflicts with the large volume of left-turning traffic.

Cycle facilities will be extended through this pair of junctions, and corners will be tightened to shorten the road crossing distances for pedestrians. Signal crossings will be provided for pedestrians at the two side streets, as well as an additional pedestrian crossing of the Finglas Road dual carriageway on the southern side for more direct access to the bus stops on each side. A wider opening is proposed in the wall of the car parking area beside this junction on the eastern side with a short ramp to give access for cyclists to the centre of the village.

The northbound bus stop will be moved 30m further north to be closer to the junction which will shorten the walking distance to the road crossing for access towards Finglas Village. It is also proposed to provide an opening in the boundary wall on the western side to enable more direct access from the residential area of Finn Eber Fort to both the core bus corridor, and to Finglas Village. This new access will shorten the walking distance to the bus stops by up to 700m.

The cycle infrastructure along Finglas Road in this section will comprise segregated 2m wide raised cycle tracks between the bus lanes and the grass verges. Careful excavations will be undertaken near trees to avoid damage to the roots where the cycle tracks will overlap by about 0.5m into the verge. Bus stops will be upgraded to island bus stops. A small number of trees will need to be removed in various locations to accommodate the proposed improvements. The existing footpaths between the verges and boundaries will be reconstructed at 2m width where they are in poor condition.

At the Finglas Place junction there will be modifications to provide protected corners and shelter islands for cyclists. The existing left-turn lane will be retained which will enable segregated signal operations between turning traffic and buses and cyclists.

At the Clearwater Shopping Centre, the exit slip lane northbound will be removed to reduce traffic interactions with pedestrians and cyclists. This will provide a larger landscaped area. A northbound left-turn traffic lane will be provided on Finglas Road to replace the existing slip lane and corner island to enable segregated signal operations between turning traffic and cyclists. In the southbound direction there is no existing left-turn lane into Glenhill Road on the eastern side, and there is no space to provide a segregated left-turn lane. The signal operations will be arranged to release the bus lane and cycle tracks in advance of general traffic, followed by a signal stage where the small number of left-turn vehicles will cross the cycle track on a flashing amber and will be required to give way to any cyclist crossing through the junction at the same time. The junction will be provided with protected corners for cyclists and the pedestrian crossings will be shortened.

The Tolka Valley Road junction will be modified with removal of the northbound left-turn slip lane, shortened pedestrian crossings and providing protected corners for cyclists. A northbound left-turn traffic lane will be provided to enable segregated signal operations between turning traffic and buses and cyclists.

Old Finglas Road junction will be modified to provide protected corners and cyclist turning pockets. A southbound left-turn traffic lane will be provided to enable segregated signal operations between turning traffic and buses and cyclists. The existing southbound right-turn lane in the median will be removed to enable provision of the left-turn lane, and a short turning pocket will be provided instead for the Tolka Vale apartments on the western side. The northbound right turn lane will be extended to cater for increased traffic coming from Hart's Corner, which will be directed along this route and onward via Old Finglas Road to continue to north Ballymun. This is a result of the bus gate proposal at St. Mobhi Road north on the Ballymun Alignment.

A Toucan crossing will be provided at the Tolka River bridge, to provide for the proposed future Tolka Valley Cycle Route.

Ballyboggan Road junction will be tightened for shorter pedestrian crossings, with cycle facilities, protected corners and turning pockets. A northbound left-turn traffic lane will be provided on Finglas Road to replace the existing slip lane and corner island to enable segregated signal operations between turning traffic and cyclists.

### 3.1.7 Section 7 - Finglas Road from Ballyboggan Road to Hart's Corner at Prospect Road

South of Ballyboggan Road there are no verges at the road edges, apart from a short section on the eastern side. This narrower cross-section will require a relaxation in the proposed segregated cycle track widths to be 1.5m wide rather than 2m as provided further north, and they will be separated from the adjoining footpaths by a step in level. The existing 2-lane road layout will otherwise be maintained, comprising a bus lane and traffic lane in both directions.

The existing bus stops will be upgraded to island bus stops, requiring some minor land-take at the disused petrol station on the western side just north of the Slaney Road corner.

There are 4 priority-controlled side streets along the western side of Finglas Road in this section at The Willows, Claremont Court, Claremont Lawns, and Tower View Cottages where the corners will be tightened and raised platform crossings provided for pedestrians and cyclists.

South of Claremont Lawns alongside Glasnevin Cemetery the road will be widened for the addition of a northbound bus lane and a southbound cycle track. The existing on-street car parking will be removed and replaced with a new parking facility with the same number of spaces, which will encroach into the open public space at Claremont Lawns.

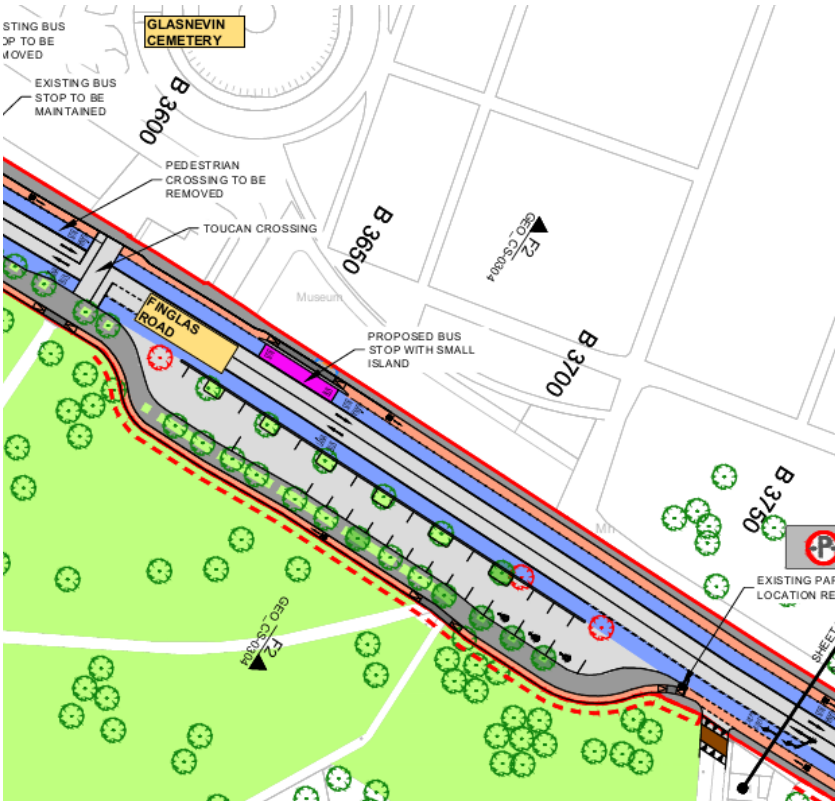



***Figure 3-6: Proposed replacement car park opposite Glasnevin Cemetery***

Opposite the southern end of Glasnevin Cemetery there will need to be road widening with land-take along the front of St. Vincent's School to accommodate an additional bus lane. Replacement planting of trees and shrubs will be provided behind a new boundary railing for the school. To the south of the school the widening and land-take will transition to the eastern side of the street for a short length at the front gardens of 3 houses (No.34, 36 and 38 Bengal Terrace) until the existing road is wide enough to fit bus lanes and cycle tracks in both directions. It will be necessary to remove 5 small street trees in this section, which will be replaced in new positions within the outer edges of the footpaths.

Reaching Hart's corner, the southbound traffic turns left into Prospect Way, which is the northern side of the one-way triangular gyratory traffic system at Hart's Corner. The road carriageway will be narrowed on Prospect Way to accommodate a two-way cycle track along the northern side. There will be no change to the kerbs on the southern side of this street and the existing trees will be retained on both sides.

On the southern end of Finglas Road, which is one-way in the northbound direction, the street layout will be modified within the boundaries to provide a segregated northbound cycle track. It will be necessary to remove 7 street trees in this section, which will be replaced in new positions within the outer edges of the footpaths.

## 3.2 Associated Infrastructure Projects and Developments

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

- MetroLink: a proposed underground railway from Dublin Airport to the City Centre which will be located close to the Ballymun Core Bus Corridor, with 5 stations proposed in order from north to south at Northwood, Ballymun, Collins Avenue, Griffith Park, and Glasnevin (Phibsborough) which will have interfaces with the proposed bus corridor.

- DART+ West: A proposed major upgrade and electrification of the existing suburban railway along the Dublin to Sligo and Docklands railway lines passing east-west through Phibsborough where a new railway station will be provided beside the Proposed Scheme
- National Cycle Route N2 Royal Canal Greenway from Galway to Dublin (and part of International Euro-Velo cycle route EV2) at Phibsborough. The proposed Greenway will be modified as the ramps of the proposed footbridge over the Royal Canal will be constructed over the Greenway layout
- LUAS Green Line future extension at St. Margaret's Road roundabout, at Finglas Road. Scheme design has been provided for coordination.

Various private developments have obtained planning permission along the Proposed Scheme, and the significant ones of relevance to the design of the project are outlined in Table 3-1 below. The planning and design of the Proposed Scheme took these other proposed developments into consideration where relevant. In most cases there was no relevance to the Proposed Scheme. Consultations took place for some of the larger proposed developments, such as at Phibsborough Shopping Centre and at the Botanic Business Centre to exchange information and to arrange compatibility between the proposals:

***Table 3-1:Relevant Development Projects Planned Along the Proposed Scheme***

| Reference No. | Applicant | Description | Location |
|---|---|---|---|
| **BALLYMUN ALIGNMENT** | | | |
| Permission 2709/17 | Phibsborough Shopping Centre Ltd | Demolition of multiple structures | Phibsborough Shopping Centre, and 345-349 North Circular Road, Dublin 7 |
| Permission 3665/15 | IDV Developments Ltd | Demolition of all existing buildings, construct 131 residential houses + Café & Creche | former Printworks/Smurfit site, Botanic Road, Glasnevin, Dublin 9 |
| Permission 2402/14 | Bondford Developments Ltd | Demolition of 2no. 2 storey derelict houses accessed off Phibsborough Road, Construction of a mixed use development of 9no. Apartments + Basement carpark. | 113 Phibsborough Road/Royal Canal Bank, Dublin 7 |
| Permission 3870/18 | Sanderly Holdings Limited | Demolition of existing buildings + construction of residential & retail development, 4559.11sqm | Glasnevin Autos, 54 Glasnevin Hill, Dublin 9 |
| Permission 4267/17 | Scanron Ltd. | Amendment to structure of Houses no.1-19 of residential development 3665/15 | former Printworks/Smurfit site, Botanic Road, Glasnevin, Dublin 9 |
| Permission 4368/17 | Tender Hearts Ltd | installation of pre-fab buildings for child care facility + car parking, bike parking & pedestrian works | Westfield House, Ballymun road, Dublin 9 |
| Permission 4437/18 | Patricia Ryan | Construction of one detached 2-storey dwelling | Side of 180, Home Farm Road, Dublin 9 |
| Permission 2019/21 | Phibsborough Foodie Addicts Limited | Installation of outdoor seating area with associated perimeter glazed partitions , parasol & heaters | Ground Floor, Unit 140, Phibsborough road, Dublin 7 |
| **FINGLAS ALIGNMENT** | | | |
| Permission 2819/15 | Board of Management, St. Vincent's CBS School | Demolition & extension of school building | D11 PA00, Finglas Road, Glasnevin, Dublin 11 |
| Permission 2332/14 | Glasnevin Trust | Widening of vehicle entrance gates to cemetery | Main Cemetery Gates, Glasnevin Cemetery, Finglas Road, Dublin 11 |
| Permission 2458/17 | LDC Developments Ltd | Construction of apartment block (69 apartments), Basement car park over two levels with separate entrance and exit ramps off Finglas road, Communal open space, landscaping, Boundary fencing and paths | Site of the former Royal Oak Public House, Finglas road, Glasnevin, Dublin 11 |

## 3.3 Integration with Other Core Bus Corridor Schemes

As part of the Preliminary Design of the Proposed Scheme, consideration has been given to the potential coordination required in relation to other Proposed Schemes within the BusConnects CBC Infrastructure Works where relevant. This section outlines potential interactions of the Proposed Scheme with adjacent scheme(s) and identifies any procedures within the construction strategies that may be required in order to account for various sequencing scenarios in the construction of the schemes.

The Proposed Scheme will only interact with the Blanchardstown to City Centre CBC Scheme.

The BCID Infrastructure Team has coordinated the Proposed Schemes designs to ensure a holistic design has been achieved, so that each scheme can be implemented, and integrated, regardless of the sequencing of their construction.

In the Blanchardstown to City Centre CBC Scheme a bus gate is proposed at Old Cabra Road, which will require traffic to and from City Centre to use alternative routes. Some of this traffic may be diverted to the east along Cabra Road to North Circular Road at Phibsborough, where it would turn west towards Infirmary Road and Conyngham Road to reach the River Liffey quays. This will require some alterations to the junction at St Peter's Church to allow traffic turns between Cabra Road and North Circular Road.

To prevent this traffic from heading to Phibsborough Road by turning at Avondale Road, and the opposite movement too, the Blanchardstown to City Centre CBC Scheme proposes some traffic management alterations at the junctions of Phibsborough Road with Monck's Place and Phibsborough. The proposals will be as follows:

- Ban right turn from Phibsborough onto Phibsborough Road Southbound
- Ban right turn from Phibsborough Road Southbound onto Phibsborough (existing)
- Ban left turn from Phibsborough Road Northbound onto Phibsborough
- Ban right turn from Monck Place onto Phibsborough Road Southbound, except for cyclists
- Ban right turn from Phibsborough Road Southbound onto Monck Place, except for cyclists
- Ban left turn from Phibsborough Road Northbound onto Monck Place, except for cyclists

The proposed traffic management measures require minor works for traffic signs and reduction of the road width at the entrance to Monck Place for one-way traffic, and contraflow cycle traffic.

If the Blanchardstown to City Centre CBC Scheme proceeds before the Proposed Scheme construction, these modifications on Phibsborough Road would be already in place. Similarly, should the Proposed Scheme proceed before the Blanchardstown to City Centre CBC Scheme, the traffic management measures can readily be integrated with the Proposed Scheme as constructed.

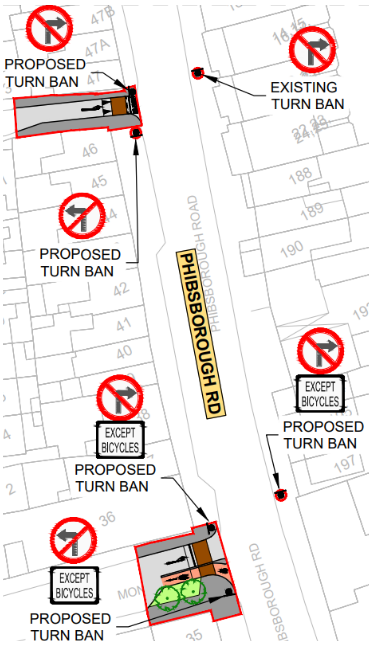



***Figure 3-7- Proposed design in Blanchardstown Scheme without the Proposed Scheme constructed***

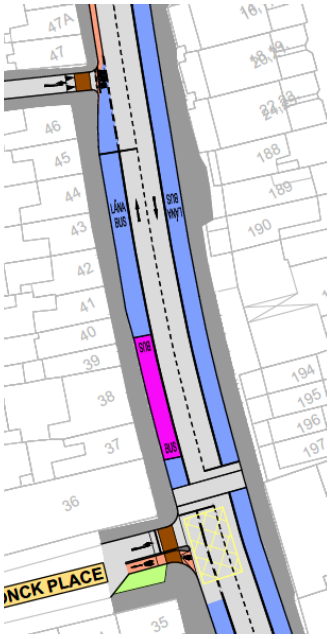


***Figure 3-8 - Proposed design in Blanchardstown Scheme tie-in with the Proposed Ballymun/Finglas Scheme***

# 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<br>• 1.8m minimum nominal width (low pedestrian activity area or localised restrictions)<br>• 1.2m absolute minimum width at pinch points (e.g. trees over 2m length) | NDA[1] (Section 1.5.1)<br>DMURS (Figure 4.34) |
| | | Nominal footway widths in moderate – high pedestrian activity areas | | • 2.5m-3m desirable width (moderate to high pedestrian activity area)<br>• 3m-4m desirable width (high pedestrian activity area) | NDA[1] (Section 1.5.1)<br>DMURS (Figure 4.34) |
| | Footway Longitudinal Gradient | New road sections or new offline footpaths | | • 0.5% (1 in 200) absolute minimum<br>• 3% (1 in 33) desirable maximum<br>• 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<br>• Desirable max gradient 1 in 20 with 0.45m max rise over 9m length between landings | NDA[1] (Section 1.5.2) |

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

| Cross Section Element | Design Parameter | Description | Design Speed (km/h) | Adopted Design Parameter(s) | Reference(s) |
|---|---|---|---|---|---|
| | | Ramp gradients – Bridge Structures | | • Desirable max gradient 1 in 20 with 2.5m max rise between landings<br>• Absolute max 1 in 15 – 1 in 12 with 0.65m max rise between landings where 1 in 20 is not practical) | DN-STR-03005 (Section 6.9, 6.14, 6.15) |
| | Footway Crossfall Gradient | Fully reconstructed road sections or new offline footpaths | | • 1 in 50 nominal gradient | NDA[1] (Section 1.5.1.1) |
| | | Existing footpaths with localised adjustments | | • Generally in line with existing site constraints to a maximum of 3.3% (1 in 33) gradient with no less than 1.5% (1 in 65) | DN-PAV-03026 (Table 2.3) |
| Cycle Track | Cycle Track Width | Optimum cycle track width (two abreast cycling): single-direction, with-flow, raised-adjacent cycle track | | • 2m desirable minimum width | NCM / BCPDG (Section 5) |
| | | Minimum cycle track (single file cycling): single-direction, with-flow, raised-adjacent cycle | | • 1.5m minimum width<br>• 1m absolute minimum width at constrained island bus stop locations | NCM / 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 | NCM / 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)<br>• 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) |

| Cross Section Element | Design Parameter | Description | Design Speed (km/h) | Adopted Design Parameter(s) | Reference(s) |
|---|---|---|---|---|---|
| | | Nominal deflection – Island Bus Stops | | • 1 in 1.5 horizontal taper at Island Bus Stops | BCPDG (Figure 34) |
| | Longitudinal Gradient | Acceptable gradient range | | • 0.5% to 5.0% (1:200 to 1:20) | NCM 5.2.3.4 |
| | Ramps | Transition to cycle track to carriageway | | • 60mm drop at 1:20 gradient (2.4m long) | NCM 4.10 |
| | | Transition from carriageway to Pedestrian Priority Zone | | • 120mm at 1:20 gradient (4.8m long) | NCM 4.10 |
| | | Transition from cycle track to Pedestrian Priority Zone | | • 60mm rise at 1:20 gradient (2.4m long) | NCM 4.10 |
| | Crossfall Gradient | Acceptable gradient range | | • 1.25% to 2.5% (1:80 to 1:40) | NCM 5.2.3.4 |
| Bus Lane | Shared Bus/Cycle Lane | Lane widths (collector/link roads – low speed) in constrained environments | 50 km/h | • 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)<br>• 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 | TMG Table 9.2<br>BCPDG (Section 5.1) |
| | | | 60 km/h | • 3.25m min width | |

| Cross Section Element | Design Parameter | Description | Design Speed (km/h) | Adopted Design Parameter(s) | Reference(s) |
|---|---|---|---|---|---|
| | 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) |
| | Longitudinal Gradient | Longitudinal gradient | | • 0.5% minimum grade<br>• 5% desirable maximum grade<br>• 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 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<br>• 45m SSD (cars & smaller vehicles)<br>• 49m SSD (HGV/Buses) | DMURS (Figure 4.63)<br>DMURS (Figure 4.63 / Para 4.4.5) |
| | | Visibility to primary traffic signals | 50 km/h | • 70m desirable min<br>• 50m absolute min | TSM (Table 9.1) |
| | Corner Radii | Few larger vehicles (local streets) | | • 1m -3m radius (subject to vehicle tracking assessment & balance of junction form/function) | DMURS (Section 4.4.3) |

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

| Cross Section Element | Design Parameter | Description | Design Speed (km/h) | Adopted Design Parameter(s) | Reference(s) |
|---|---|---|---|---|---|
| | | Perpendicular parking | | • 4.8m – 5m x 2.4m desirable minimum.<br>• Buffer zone (0.3m minimum) | DMURS (Section 4.4.9) |
| | | Loading Bay (Parallel) | | • 6m x 2.8m (large vans)<br>• 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 with 1 m being a minimum width at pinch points specially in St. Mobhi Road. 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.

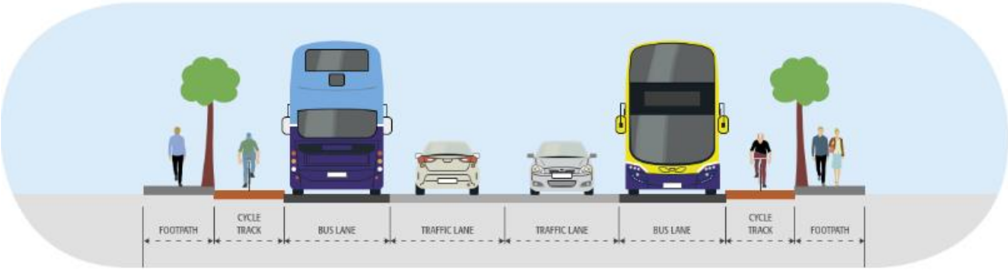



***Figure 4-1: Typical CBC Cross Section***

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: Ballymun Alignment.

- Section 1 — Ballymun Road from St. Margaret’s Road to Griffith Avenue: CH A0000 to CH 3050
- Section 2 — St. Mobhi Road and Botanic Road from Griffith Avenue to Phibsborough to Hart’s Corner: CH A3050 to CH 4400
- Section 3 — Prospect Road, Phibsborough Road from Hart’s Corner to Western Way: CH A4400 to CH A5850
- Section 4 – Constitution Hill and Church Street to Arran Quay: CH A5850 to CH A6380

Alignment B: The Finglas Alignment. Sections 5 to 7

- Section 5: R104 Finglas Road from St. Margaret's Road to Wellmount Road: CH B0000 to CH B1150
- Section 6: Finglas Road from Wellmount Road to Ballyboggan Road: CH B1150 to CH B2700
- Section 7 – Finglas Road from Ballyboggan Road to Hart's Corner at Prospect Road: CH B2700 to CH B4124

***Table 4-2 Proposed Scheme vs Existing Nominal Cross Section Widths***

| Location | Existing Northbound/Outbound Carriageway | | | | Existing Southbound/Inbound Carriageway | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | Proposed Northbound/Outbound Carriageway | | | | Proposed Southbound/Inbound Carriageway | | | | |
| | **Footpath Width (m)** | **Cycle Width (m)** | **Bus Lane Width (m)** | **Traffic Width (m)** | **Traffic Width (m)** | **Bus Lane Width (m)** | **Cycle Width (m)** | **Footpath Width (m)** | **General note:** The asterisks (*) shown in the section elements are links to these notes, where further information of the elements dimensions is provided |
| **(Alignment A) Ballymun Road -St. Margaret's Road Junction** | | | | | | | | | |
| CH. A0000 to CH. A0005 | 2.83 | 2.5 | N/A | 1x3.45 + 2x3.75 | 1 x 3.25<br>2 x 3.65<br>1 x 3.9 | N/A | 2 | 2.25* | * var. up to 2.45m<br>3.6m central median |
| CH. A0000 to CH. A0005 | 2.83 | 2.5 | N/A | 1x3.45 + 2x3.75 | 1x3.25 +<br>2x3.65 +<br>1x3.9 | N/A | 2 | 2.25* | * var. up to 2.45m<br>3.6m central median |
| **(Alignment A) Ballymun Road - St. Margaret's Road Junction to Northwood Avenue** | | | | | | | | | |
| CH. A0005 to CH. A0160 | 3 | 2 | N/A | 3x3.5 | 3x3.5 | N/A | 2 | 2.45 | |
| CH. A0005 to CH. A0100 | 2 | 2 | 3 | 3x3 | 3x3 | N/A | 2 | 2.8 | Left-turn lane approaching junction<br>6.90m central median |
| CH. A0100 to CH. A0130 | 2 | 2 | 3 | 2x3 | 3x3 | N/A | 2 | 2.9 | 6.90m central median |
| CH. A0130 to CH. A0160 | 2.65 | 2 | 3 | 2x3 | 3x3 | N/A | 2 | 3.10* | * var. Up to 6.60m<br>6.90m central median |
| **(Alignment A) Ballymun Road - Northwood Avenue to Santry Avenue** | | | | | | | | | |
| CH. A0160 to CH. A0480 | 2 | 2 | N/A | 3x3.5 | 3x3.5 | N/A | 2 | 3 | up to 7.90m central median |
| CH. A0160 to CH. A0290 | 2 | 2 | 3 | 4+ 2x3.5 | 2x3 | 3 | 2 | 3 | Northbound right-turn lane at median<br>5m central median |
| CH. A0290 to CH. A0350 | 2 | 2 | 3 | 2x3 | 2x3 | 3 | 2 | 3 | 5m to 7.90m central median taper |
| CH. A0350 to CH. A0400 | 3.4 | 2 | 3 | 2x3 | 2x3 | 3 | 2 | 3 | 7.90m central median |
| CH. A0400 to CH. A0480 | 2 | 2 | 3 | 2x3 | 32x3 | 3 | 2 | 2 | Southbound right turn lane at median<br>4.0m central median |
| **(Alignment A) Ballymun Road - Santry Avenue to Balbutcher Lane** | | | | | | | | | |
| CH. A0480 to CH. A0970 | 4 | (1.25)* | 4* | 2x3 | 2x3 | 4* | (1.25)* | 4 | *Advisory cycle lane within bus lane<br>up to 5.7m central median |
| CH. A0480 to CH. A0590 | 4 | 2 | 3 | 2x3 | 2x3 | 3 | 2 | 4 | Northbound right-turn lane at median<br>4.0m central median |

| Location | Existing Northbound/Outbound Carriageway | | | | Existing Southbound/Inbound Carriageway | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | Proposed Northbound/Outbound Carriageway | | | | Proposed Southbound/Inbound Carriageway | | | | |
| | Footpath Width (m) | Cycle Width (m) | Bus Lane Width (m) | Traffic Width (m) | Traffic Width (m) | Bus Lane Width (m) | Cycle Width (m) | Footpath Width (m) | **General note:** The asterisks (*) shown in the section elements are links to these notes, where further information of the elements dimensions is provided |
| CH. A0590 to CH. A0940 | 4 | 2 | 3 | 2x3 | 2x3 | 3 | 2 | 4 | NB taper from 1 to 2 traffic lanes at CH. A9040<br>5.7m central median |
| CH. A0940 to CH. A0970 | 4 | 2 | 3 | 1x3 | 2x3 | 3 | 2 | 4 | 2.7m central median<br>2.2m parking bay plus 0.80 buffer on NB side |
| **(Alignment A) Ballymun Main Street from Balbutcher Lane to Gateway Crescent** | | | | | | | | | |
| CH. A0970 to CH. A01250 | 4 | (1.25)* | 4* | 2x3 | 2x3 | 4* | (1.25)* | 4 | *Advisory cycle lane within bus lane<br>5.7m median |
| CH. A0970 to CH. A01250 | 4 | 2 | 3 | 1x3 | 1x3* | 3 | 2 | 4 | *plus SB right-turn lane at junction<br>4.7m median except at junction<br>2.2m parking bay plus 0.80 buffer on both sides |
| **(Alignment A) Ballymun Road - Gateway Crescent to Gateway Avenue** | | | | | | | | | |
| CH. A1250 to CH. A1390 | 4 | (1.25)* | 4* | 2x3 | 2x3 | 4* | (1.25)* | 4.5 | *Advisory cycle lane within bus lane<br>up to 5.9m central median |
| CH. A1250 to CH. A1390 | 4 | 2 | 3 | 1x3 | 1x3 | 3 | 2 | 4.5 | 4.7m median |
| **(Alignment A) Ballymun Road - Gateway Avenue to Collins Avenue** | | | | | | | | | |
| CH. A1390 to CH. A1840 | 3.5 | (1.25)* | 4* | 2x3 | 2x3 | 4* | (1.25)* | 2.5 | *Advisory cycle lane within bus lane<br>up to 9m central median<br>up to 7m verge on SB side<br>SB Right-turn lane at Collins Avenue |
| CH. A1390 to CH. A1840 | 2.5 | 2 | 3 | 2x3* | 2x3 | 3 | 2 | 2.5 | *Only 1 NB lane at Collins Avenue for wider 4m median<br>up to 9m central median<br>up to 6m verge on SB side |
| **(Alignment A) Ballymun Road - Collins Avenue to Albert College Drive** | | | | | | | | | |
| CH. A1840 to CH. A2050 | 3 | (1.25)* | 4* | 2x3 | 2x3 | (1.25)* | 4* | 3** | *Advisory cycle lane within bus lane<br>up to 4.2m central median<br>** Var. up to 5m |
| CH. A1860 to CH. A1940 | 2 | 2 | 3 | 3x3 | 2x3* | 3 | 2 | 2.5 | *Only 1 SB lane at Collins Avenue for wider 4m median |
| CH. A1940 to CH. A1980 | 2 | 2 | 3 | 2x3 | 2x3* | 3 | 2 | 2.5 | |
| CH. A1980 to CH. A2050 | 2 | 2 | 3 | 1x3* | 2x3 | 3 | 2 | 2** | *2.2m parking plus 0.80 buffer on NB side<br>** up to 4m<br>4.2m central median |
| **(Alignment A) Ballymun Road - Albert College Drive to St. Pappin Road** | | | | | | | | | |

| Location | Existing Northbound/Outbound Carriageway / Proposed Northbound/Outbound Carriageway | | | | Existing Southbound/Inbound Carriageway / Proposed Southbound/Inbound Carriageway | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | Footpath Width (m) | Cycle Width (m) | Bus Lane Width (m) | Traffic Width (m) | Traffic Width (m) | Bus Lane Width (m) | Cycle Width (m) | Footpath Width (m) | **General note:** The asterisks (*) shown in the section elements are links to these notes, where further information of the elements dimensions is provided |
| CH. A2050 to CH. A2200 | 2.2* | (1.25) | 4 | 2x3** | 2x3** | 4 | (1.25) | 2.2*** | * Var. up to 4m<br>** + Right-turn lanes for junctions<br>1.8m central median<br>*** Var. up to 3m |
| CH. A2050 to CH. A2150 | 2.2 | 2 | 3 | 1x3 | 2x3 | 3 | 2 | 3 | *2.2m parking plus 0.80 buffer on NB side |
| CH. A2150 to CH. A2200 | 2.5 | 2 | 3 | 2x3 | 3x3 | 3 | 2 | 2.2 | 1.8m central median |
| **(Alignment A) Ballymun Road - St. Pappin Road to St. Canice's Road** | | | | | | | | | |
| CH. A2200 to CH. A2550 | 3 | (1.25)* | 4* | 2x3.5 | 2x3.5 | 4* | (1.25)* | 2.2 | * advisory cycle lane in bus lane<br>4.2m central median |
| CH. A2200 to CH. A2550 | 3 | 2 | 3 | 2x3 | 2x3 | 3 | 2 | 2.2 | |
| **(Alignment A) Ballymun Road - St. Canice's Road to Hampstead Avenue** | | | | | | | | | |
| CH. A2550 to CH. A2680 | 2.5 | (1.25)* | 4* | 2x3.5 | 2x3.5 | 4* | (1.25)* | 2.2 | * advisory cycle lane in bus lane<br>4.2m central median |
| CH. A2550 to CH. A2680 | 2.5 | 2 | 3 | 2x3 | 2x3 | 3 | 2 | 2.2 | 4.2m central median |
| **(Alignment A) Ballymun Road - Hampstead Avenue to DCU Sportsgrounds** | | | | | | | | | |
| CH. A2680 to CH. A2730 | 2.5 | (1.25)* | 4 | 3 x 3.25* | 2 x 3 | 4 | (1.25)* | 3.3 | * advisory cycle lane in bus lane<br>**Northbound right-turn lane<br>1.2m central median |
| CH. A2680 to CH. A2730 | 2.5 | 2 | 3 | 3 x 3 | 2 x 3 | 3 | 2 | 2.3 | |
| **(Alignment A) Ballymun Road - DCU Sportsgrounds to St. Mobhi Road** | | | | | | | | | |
| CH. A2730 to CH. A2890 | 2.5 | 1.5 | 3 | 2x3.3 | 2x3 | 4* | (1.25)* | 3.75 | * advisory cycle lane in bus lane<br>* 4.1m central median<br>** Var. up to 4.9m |
| CH. A2730 to CH. A2830 | 2.5 | 2 | 3 | 2x3 | 2x3 | 3 | 2 | 2.75 | 4.1m central median |
| CH. A2830 to CH. A2890 | 2.8 | 2 | 3 | 1x3 | 2x3 | 3 | 2 | 2.5 | |
| **(Alignment C) Ballymun Road to Griffith Avenue** | | | | | | | | | |

| Location | Existing Northbound/Outbound Carriageway | | | | Existing Southbound/Inbound Carriageway | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | Proposed Northbound/Outbound Carriageway | | | | Proposed Southbound/Inbound Carriageway | | | | |
| | Footpath Width (m) | Cycle Width (m) | Bus Lane Width (m) | Traffic Width (m) | Traffic Width (m) | Bus Lane Width (m) | Cycle Width (m) | Footpath Width (m) | **General note:** The asterisks (*) shown in the section elements are links to these notes, where further information of the elements dimensions is provided |
| CH. C0 to CH. C100 | 3.5 | 1.5 | N/A | 3x3.7 | N/A | N/A | N/A | 4.8* | one-way northbound<br>* with parking bay indent |
| CH. C0 to CH. C100 | 3.5 | 2 (+1.5)* | 3 | 1x3 | 1x3** | N/A | 1.5 | 4.8 | * separator island outside cycle track<br>** contraflow southbound lane |
| **(Alignment C) Griffith Avenue - Ballymun Road to St. Mobhi Road** | | | | | | | | | |
| CH. C110 to CH. C200 | 5.8* south | 2.0** | N/A | 4x3** | N/A | N/A | 2** | 5.4* north | one-way westbound<br>* with parking bay indent / verge<br>** temporary cycle tracks installed in 2021 with reduction to 2 traffic lanes |
| CH. C110 to CH. C200 | 2.5 | 2.5* | 3 | 2x3 | 3** | N/A | 2 | 3.5 | * two-way cycle track and parking removed<br>** contraflow southbound lane |
| **(Alignment A) St. Mobhi Road – Griffith Avenue to Scoil Chaitríona** | | | | | | | | | |
| CH. A3040 to CH. A3360 | 2.8 (+1.7) | 0 | N/A | 1x3 | 1x3 | 3 | 0 | 2.8 (+1.7)* | * Footpath + verge |
| CH. A3040 to CH. A3130 | 2.5 | 2.0 | N/A | 1x3 | 1x3 | 3 | 1.25 | 1.8 (1.5)* | * Footpath + verge |
| CH. A3130 to CH. A3360 | 1.8 (1.45)* | 1.25 | N/A | 1x3** | 1x3 | 3 | 1.25 | 1.8 (1.5)* | * Footpath + verge |
| **(Alignment A) St. Mobhi Road - Scoil Chaitríona to St. Mobhi Drive** | | | | | | | | | |
| CH. A3360 to CH. A3690 | 2.8 (+1.7) | 0 | N/A | 1x3 | 1x3 | 3 | 0 | 2.8 (+1.7)* | * Footpath + verge |
| CH. A3360 to CH. A3690 | 1.8 (1.5)* | 1.25 | N/A | 1x3 | 1x3 | 3 | 2.5** | 2.5 (2.0)* | * Footpath + verge<br>** two way cycle track |
| **(Alignment A) St. Mobhi Road - St. Mobhi Drive to Botanic Avenue** | | | | | | | | | |
| CH. A3690 to CH. A3800 | 2 (+1.5)* | 1.5 | N/A | 1x3 | 1x3 | 3 | N/A | 2.3 (+2)* | * Footpath + verge / parking |
| CH. A3690 to CH. A3800 | 2 (+1.5)* | 1.5 | N/A | 1x3 | 1x3 | 3** | 1.5 | 2.3 (+2)* | * Footpath + verge / parking |
| **(Alignment A) St. Mobhi Road - Botanic Avenue to Fairfield Road** | | | | | | | | | |
| CH. A3800 to CH. A4010 | 2.4 (+2.1)* | N/A | N/A | 1x3.75 | 1x3.75 | N/A | 1.5 | 2.4 (+2.1)* | * Footpath + verge |
| CH. A3800 to CH. A4010 | 1.9 (+1.2)* | 1.4 | N/A | 1x3 | 1x3 | 3 | 1.4 | 1.9 (+1.2)* | * Footpath + verge |
| **(Alignment A) Botanic Road - Fairfield Road to Prospect Way** | | | | | | | | | |

| Location | Existing Northbound/Outbound Carriageway | | | | Existing Southbound/Inbound Carriageway | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | Proposed Northbound/Outbound Carriageway | | | | Proposed Southbound/Inbound Carriageway | | | | |
| | Footpath Width (m) | Cycle Width (m) | Bus Lane Width (m) | Traffic Width (m) | Traffic Width (m) | Bus Lane Width (m) | Cycle Width (m) | Footpath Width (m) | **General note:** The asterisks (*) shown in the section elements are links to these notes, where further information of the elements dimensions is provided |
| CH. A4010 to CH. A4430 | 3 | 1.5* | N/A | 1x3 | 1x3 | N/A | 1.5* | 2.6 | * Advisory cycle lane |
| CH. A4050 to CH. A4270 | 3 | 1.5* | N/A | 1x3 | 1x3 | N/A | 1.5* | 2.6 | * Cycle track |
| CH. A4270 to CH. A4430 | 2 | 1.5 | 3 | 1x3 | 1x3 | 3 | 1.5 | 2 | |
| **(Alignment A) Botanic Road - Prospect Way to Finglas Road (Hart's Corner) one-way southbound** | | | | | | | | | |
| CH. A4430 to CH. A4590 | 2.5 | N/A | N/A | N/A | 2x3 | 3 | N/A | 2.2 | |
| CH. A4430 to CH. A4590 | 2.5 | N/A | N/A | N/A | 1x3 | 3 | 3* | 2.2 | * two way cycle track |
| **(Alignment A) Prospect Road - Finglas Road to Whitworth Road** | | | | | | | | | |
| CH. A4590 to CH. A4690 | 3 | N/A | 3 | 1x3 | 1x3 | 3 | N/A | 2 | |
| CH. A4590 to CH. A4690 | 3 | N/A | 3 | 1x3 | 1x3 | 3 | 3* | 2.5 + 3** | * two way cycle track<br>** Footpath at island bus stop |
| **(Alignment A) Phibsborough Road - Whitworth Road to Royal Canal Bank on Cross Guns Bridge** | | | | | | | | | |
| CH. A4690 to CH. A4750 | 1.6 | N/A | 3 | 1x3 | 2x3 | N/A | N/A | 4 | |
| CH. A4690 to CH. A4750 | 3.35 | N/A | 3 | 1x3 | 1x3 | N/A | 1.25* | 4 | * short cycle lane link to bus lane downstream |
| **(Alignment A) Phibsborough Road - Royal Canal Bank to Connaught Street** | | | | | | | | | |
| CH. A4750 to CH. A4930 | 3.4 | N/A | 3 | 1x3 | 2x3* | 3 | N/A | 4 | * right-turn lane |
| CH. A4750 to CH. A4930 | 3.4 | N/A | 3 | 1x3 | 2x3* | 3 | N/A | 4 | 3m central median /shorter right-turn lane |
| **(Alignment A) Phibsborough Road - Connaught Street to North Circular Road** | | | | | | | | | |
| CH. A4930 to CH. A5130 | 3.5 | N/A | 3 | 1x3 | 2x3 | N/A | N/A | 3.5* | * varies up to 5.7m at parking / loading bay |
| CH. A4930 to CH. A5130 | 3.5 | N/A | 3 | 1x3 | 1x3 | 3 | N/A | 3.5 | * varies up to 5.7m at parking / loading bay |
| **(Alignment A) Phibsborough Road - North Circular Road to Phibsborough** | | | | | | | | | |

| Location | Existing Northbound/Outbound Carriageway / Proposed Northbound/Outbound Carriageway | | | | Existing Southbound/Inbound Carriageway / Proposed Southbound/Inbound Carriageway | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | Footpath Width (m) | Cycle Width (m) | Bus Lane Width (m) | Traffic Width (m) | Traffic Width (m) | Bus Lane Width (m) | Cycle Width (m) | Footpath Width (m) | **General note:** The asterisks (*) shown in the section elements are links to these notes, where further information of the elements dimensions is provided |
| CH. A5130 to CH. A5290 | 2.4 | N/A | N/A | 2x3 | 1x3 | N/A | 1.2 | 2.8 | |
| CH. A5130 to CH. A5250 | 2.4 | N/A | 3 | 1x3 | 1x3 | 3 | N/A | 2.8 | |
| CH. A5250 to CH. A5290 | 2.15 | 1.25 | N/A | 1x3 | 1x3 | 3 | N/A | 2.8 | |
| **(Alignment A) Phibsborough Road - Phibsborough to White's Lane North** | | | | | | | | | |
| CH. A5290 to CH. A5710 | 3 | N/A | 3 | 1x3 | 1x3.3 to 5 | N/A | 1.2 | 2.8 | 2.2m parking (50+60+30)m east side<br>2.2m parking (30m) west side |
| CH. A5290 to CH. A5710 | 3 | N/A | 3 | 1x3 | 1x3 | 3 | N/A | 2.8 | Parking retained |
| **(Alignment A) Phibsborough Road - White's Lane North to Western Way** | | | | | | | | | |
| CH. A5710 to CH. A5840 | 2 | N/A | 3 | 1x3 | 1x4.8* | N/A | 1.3 | 2.1 | * flares to 2 lanes at southern end |
| CH. A5710 to CH. A5770 | 2 | 1.7 | N/A | 1x3 | 1x3 | 3 | N/A | 2.1 | |
| CH. A5770 to CH. A5840 | 2 | N/A | 3 | 1x3 | 1x3 | 3 | N/A | 2.1 | |
| **(Alignment A) Constitution Hill to Church Street Upper** | | | | | | | | | |
| CH. A5880 to CH. A6150 | 2 | 1.5 | 3 | 1x3 | 1x3 | N/A | 1.5 | 2.2* | * variable buffer zone at cycle track |
| CH. A5880 to CH. A6150 | 2 | 1.5 | 3 | 1x3 | 1x3 | 3 | 3* | 2.2 | * two way cycle track |
| **(Alignment A) Church Street Upper to King Street North** | | | | | | | | | |
| CH. A6150 to CH. A6370 | 2.6 | 2.4 | 3 | 3 | 2x3 | 3 | N/A | 2.7 | 2.7m central median complete length |
| CH. A6150 to CH. A6370 | 2.6 | 1.5* | 3 | 3 | 2x3 | 3 | 1.4 | 2 | * island bus stop outside cycle track<br>Median reduced to 2m |
| **(Alignment A) Church Street Lower - King Street North to May Lane** | | | | | | | | | |
| CH. A6370 to CH. A6580 | 2 | 1.5 | N/A | 4.25 | 4.25 | N/A | 1.5 | 2.2 | |
| CH. A6370 to CH. A6520 | 2 | N/A | 3 | 3 | 3 | N/A | 1.5 | 2.2 | |
| CH. A6520 to CH. A6550 | 2.8 | 1.5 | N/A | 3 | 3 | N/A | 1.5 | 2.5 | |

| Location | Existing Northbound/Outbound Carriageway<br>Proposed Northbound/Outbound Carriageway | | | | Existing Southbound/Inbound Carriageway<br>Proposed Southbound/Inbound Carriageway | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | Footpath Width (m) | Cycle Width (m) | Bus Lane Width (m) | Traffic Width (m) | Traffic Width (m) | Bus Lane Width (m) | Cycle Width (m) | Footpath Width (m) | **General note:** The asterisks (*) shown in the section elements are links to these notes, where further information of the elements dimensions is provided |
| CH. A6550 to CH. A6580 | 3 | 1.5 | N/A | 3 | 3 | 3 | N/A | 2.4 | |
| **(Alignment A) Church Street Lower - May Lane to Chancery Street** | | | | | | | | | |
| CH. A6580 to CH. A6690 | 3 | 1.3 | N/A | 2x2.9 | 2x3.25 + 5 parking | N/A | N/A | 3 | |
| CH. A6580 to CH. A6690 | 3 | N/A | 3 | 3 | 3 | 3 | N/A | 3 | Parking bay / Bus Stop layby retained |
| **(Alignment A) Church Street Lower - Chancery Street to Inns Quay** | | | | | | | | | |
| CH. A6690 to CH. A6830 | 2 | 1.5 | N/A | 4.8 | 1 to 3 x 3 | N/A | 1.5 | 2.5 to 4 | |
| CH. A6690 to CH. A6750 | 2 | N/A | 3 | 3 | 3 | N/A | 1.5 | 2.5 | |
| CH. A6750 to CH. A6830 | 2.5 | N/A | 3 | 3 | 2x3* | 3 | N/A | 3 | * left-turn lane inside bus lane |

| Location | Existing Northbound/Outbound Carriageway<br>Proposed Northbound/Outbound Carriageway | | | | Existing Southbound/Inbound Carriageway<br>Proposed Southbound/Inbound Carriageway | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | Footpath Width (m) | Cycle Width (m) | Bus Lane Width (m) | Traffic Width (m) | Traffic Width (m) | Bus Lane Width (m) | Cycle Width (m) | Footpath Width (m) | |
| **(Alignment B) Finglas Road from St Margaret’s Road to Church Street** | | | | | | | | | |
| CH. B40 to CH. B500 | | N/A | N/A | 2x3.75* | 3.75 | 3.75 | N/A | | 4m central median |
| CH. B40 to CH. B500 | 2 | N/A | 3.75 | 3.75 | 3.75 | 3.75 | N/A | 2 | 4m central median |
| | | | | | | | | | |
| CH. B500 to CH. B940 | | N/A | 3.75 | 3.75 | 3.75 | 3.75 | N/A | * | 4m central median |
| CH. B500 to CH. B940 | | N/A | 3.75 | 3.75 | 3.75 | 3.75 | N/A | * | 4m central median |
| CH. B940 to CH. B1020 | | N/A | 3.75 | 3.75 | 3.75 | 3.75 | N/A | * | 4m central median |

| Location | Existing Northbound/Outbound Carriageway | | | | Existing Southbound/Inbound Carriageway | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | Proposed Northbound/Outbound Carriageway | | | | Proposed Southbound/Inbound Carriageway | | | | |
| | Footpath Width (m) | Cycle Width (m) | Bus Lane Width (m) | Traffic Width (m) | Traffic Width (m) | Bus Lane Width (m) | Cycle Width (m) | Footpath Width (m) | |
| CH. B940 to CH. B1020 | | 1.5 | 3.75 | 3.75 | 3.75 | 3.75 | N/A | * | 4m central median |
| **(Alignment B) Finglas Road from Church Street to Wellmount Road** | | | | | | | | | |
| CH. B1000 to CH. B1120 | 2* | N/A | N/A | 2x3.6 | 3.75 | 3.75 | N/A | 2* | * 2m west verge / 2.5m east verge<br>4m central median |
| CH. B1000 to CH. B1120 | 3.2 | 2 | N/A | 2x3 | 3 | 3 | 1.5 | 2* | 2.5m east verge<br>4m central median |
| **(Alignment B) Finglas Road from Wellmount Road to Finglas Place** | | | | | | | | | |
| CH. B1120 to CH B1220 | 2* | | N/A | 2x4 | 3x3.7 | N/A | N/A | 1.8* | * 2m west verge / 2.5m east verge<br>3.5m central median |
| CH. B1120 to CH B1220 | 2* | 2 | N/A | 2x3 | 2x3 | 3 | 2 | 1.8* | * 2m west verge / 2.5m east verge<br>3.5m central median |
| CH. B1220 to CH B1250 | 2* | | 3.75 | 2x3.75 | 2x3.75 | 3 | N/A | 2* | * 2m west verge / 2.5m east verge<br>1.5m central median |
| CH. B1220 to CH B1250 | 2* | 1.5 | 3 | 2x3 | 3 | 3 | 2 | 2* | * 2m west verge / 2.5m east verge<br>4m central median |
| CH. B1250 to CH B1350 | 2* | | 3.75 | 3.75 | 3.75 | 3.75 | N/A | 2* | * 2m west verge / 2.5m east verge<br>4m central median |
| CH. B1250 to CH B1350 | 2* | 1.5 / 2 | 3 | 3 | 3 | 3 | 2 | 2* | * 2m west verge / 2.5m east verge<br>4m central median |
| CH. B1350 to CH B1400 | 2* | | 3.75 | 3.75 | 3.75 | 3.75 | N/A | 2* | * 2m west verge / 2.5m east verge<br>4m central median |
| CH. B1350 to CH B1400 | 2* | 2 | 3 | 3 | 2x3** | 3 | 2 | 2* | * 2m west verge / 2.5m east verge<br>** left-turn lane inside bus lane<br>4m central median |
| **(Alignment B) Finglas Road from Finglas Place to Glenhill Road** | | | | | | | | | |
| CH. B1440 to CH B1580 | 2* | | 3.75 | 3.75 + 3** | 3.75 + 3** | 3.75 | 2* | | * 2m west verge / 2.5m east verge<br>** right-turn lanes at junctions<br>4m central median reduces to 1.5m for turning lanes |
| CH. B1440 to CH B1580 | 2* | 1.5 / 2 | 3 | 3 + 3** | 3 + 3** | 3 | 2 | 2* | * 2m west verge / 2.5m east verge<br>** right-turn lanes at junctions<br>4m central median |

| Location | Existing Northbound/Outbound Carriageway | | | | Existing Southbound/Inbound Carriageway | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | Proposed Northbound/Outbound Carriageway | | | | Proposed Southbound/Inbound Carriageway | | | | |
| | Footpath Width (m) | Cycle Width (m) | Bus Lane Width (m) | Traffic Width (m) | Traffic Width (m) | Bus Lane Width (m) | Cycle Width (m) | Footpath Width (m) | |
| **(Alignment B) Finglas Road from Glenhill Road to Tolka Valley Road** | | | | | | | | | |
| CH. B1580 to CH B2230 | 2* | | 3.75 | 3.75 + 3** | 3.75 + 3** | 3.75 | 2* | | * 2.5m west verge / 1.5m east verge<br>** right-turn lanes at junctions<br>4m central median reduces to 1.5m for turning lanes |
| CH. B1580 to CH B2230 | 2* | 2 | 3 | 3 + 3** | 3 + 3** | 3 | 1.5 | 2* | * 2.5m west verge / 1.5m east verge<br>** right-turn lanes at junctions<br>4m central median |
| **(Alignment B) Finglas Road from Tolka Valley Road to Old Finglas Road** | | | | | | | | | |
| CH. B2230 to CH B2450 | 1.5* | 1.25 | 3.75 | 3.75 + 3** | 3.75 + 3** | 3.75 | 1.25 | 1.5* | * 2m west verge / 2.5m east verge<br>** right-turn lanes at junctions<br>4m central median reduces to 1.5m for turning lanes |
| CH. B2230 to CH B2450 | 2* | 2 | 3 | 3 + 3** | 3 + 3** | 3 | 1.5 | 2* | * 2m west verge / 2.5m east verge<br>** left-turn lanes at junctions<br>4m central median |
| **(Alignment B) Finglas Road from Old Finglas Road to Ballyboggan Road** | | | | | | | | | |
| CH. B2450 to CH B2680 | 1.8 | 1.5 | N/A | 2x3.75 + 3* | 3.75 + 3* | 3.75 | 1.5 | 1.8 | * right-turn lanes at junctions<br>4m central median reduces |
| CH. B2450 to CH B2680 | 2 | 2 | 3 | 3 + 3* | 3 + 3* | 3 | 2 | 2 | * right left-turn lanes at junctions<br>4m central median reduces to 2m for turning lanes |
| **(Alignment B) Finglas Road from Ballyboggan Road to Slaney Road** | | | | | | | | | |
| CH. B2680 to CH B3080 | 1.8 | 1.5 | 3.75 | 3.75 | 3.75 + 3* | 3.75 | 1.5 | 1.8** | * right-turn lane at junction<br>** verge up to 4.5m over 80m length<br>4m central median reduces to 1.5m for turning lane |
| CH. B2680 to CH B3080 | 2 | 2 | 3 | 3 + 3* | 3 + 3* | 3 | 2 | 2* | * right left-turn lanes at junctions<br>** verge up to 4.5m over 80m length<br>4m central median reduces to 1.5m for turning lane |
| **(Alignment B) Finglas Road from Slaney Road to Claremont Court** | | | | | | | | | |
| CH. B3080 to CH B3390 | 1.8 | 1.5 | 3.75 | 3.75 | 3.75 + 3* | 3.75 | 1.5** | 1.8 | * right-turn lane at junction<br>** cycle track ends 30m before junction and changes to advisory cycle lane in the wider bus lane<br>4m central median reduces to 1.5m for turning lane |
| CH. B3080 to CH B3390 | 2 | 2 | 3 | 3 | 3 + 3* | 3 | 2 | 2 | * right left-turn lanes at junctions<br>4m central median reduces to 1.5m for turning lane |

| Location | Existing Northbound/Outbound Carriageway / Proposed Northbound/Outbound Carriageway | | | | Existing Southbound/Inbound Carriageway / Proposed Southbound/Inbound Carriageway | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | Footpath Width (m) | Cycle Width (m) | Bus Lane Width (m) | Traffic Width (m) | Traffic Width (m) | Bus Lane Width (m) | Cycle Width (m) | Footpath Width (m) | |
| **(Alignment B) Finglas Road from Claremont Court to Claremont Lawns** | | | | | | | | | |
| CH. B3080 to CH B3390 | 1.8* | 1.5 | 3.75 | 3.75 | 3.75 | 4** | (1.5)** | 2.8 | * verge up to 4m<br>** advisory cycle lane in bus lane<br>4m central median tapers out over 65m |
| CH. B3080 to CH B3390 | 2* | 2 | 3 | 3 | 3 | 3 | 2 | 2 | * verge up to 4m<br>4m central median tapers out over 65m |
| **(Alignment B) Finglas Road from Claremont Lawns to Towerview Cottages** | | | | | | | | | |
| CH. B3390 to CH B3750 | 2* | 1.5 (+0.5 buffer) | N/A | 3.5 | 3 | 4** | (1.5)** | 2.8 | * parking area 5m<br>** advisory cycle lane in bus lane |
| CH. B3390 to CH B3750 | 2* | 2 | 3 | 3 | 3 | 3 | 2 | 2 | * parking area 9m |
| **(Alignment B) Finglas Road from Towerview Cottages to St. Philomena's Road** | | | | | | | | | |
| CH. B3750 to CH. B3990 | 1.8 | 1.5 | N/A | 3.5 | 3 | 4* | (1.25)* | 2.5 | * advisory cycle lane in bus lane |
| CH. B3750 to CH. B3990 | 2 | 2 / 1.5 | N/A | 3.5 | 3 | 3 | 2/ 1.5 | 2 | |
| **(Alignment B) Finglas Road / Prospect Way from St. Philomena's Road to Prospect Way** | | | | | | | | | |
| CH. B3990 to CH. B4010 | 2.8 | 1.5 | N/A | 3 | 3.75 | 3.75 | (1.25)* | 3 | * advisory cycle lane in bus lane |
| CH. B3990 to CH. B4010 | 2.8 | 1.5 | N/A | 3 | 3 | 3.5** | 2.7* | 3 | * two-way cycle track on eastern side<br>** bus lane widened on sharp bend |
| **(Alignment B) Prospect Way (one-way eastbound)** | | | | | | | | | |
| CH. B4010 to CH. B4120 | 2.2 | N/A | N/A | N/A | 2 x 3.9 | 4 | N/A | 1.8 | |
| CH. B4010 to CH. B4120 | 2.2 | N/A | N/A | N/A | 2 x 3 | 3 | 2.75* | 1.8 | * two-way cycle track on northern side |
| **(Alignment A) Finglas Road - Prospect Way to Prospect Road at Hart's Corner (one-way northbound)** | | | | | | | | | |
| CH. A4400 to CH. A4550 | 3.7 | (1.25)* | 3.5** | 4 + 3 | N/A | N/A | N/A | 3.5 | * advisory cycle lane in traffic lane<br>** bus lane in centre of road for right turn to Prospect Way |
| CH. A4400 to CH. A4550 | 3.7 | 1.5 | 3* | 3 + 3 | N/A | N/A | N/A | 3.5 | * bus lane in centre of road for right turn to Prospect Way |

## 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 | CENTRE | N'HOOD | SUBURBAN | BUSINESS/ INDUSTRIAL | RURAL FRINGE |
|---|---|---|---|---|---|
| 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 |

CONTEXT

***Figure 4-2: DMURS Design Speed Selection Matrix***

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

Lower 30 km/h speed limits are proposed in the following sections of the Proposed Scheme:

- **Ballymun Main Street - Shangan Road to Gateway Avenue (CH A900 to A-1400):** This sections corresponds to Ballymun town centre with intense pedestrian activity and closely spaced crossings. In this area, in the context of the town centre character it is proposed to narrow the road to single traffic lanes in each direction. In line with the DMURS guidance statement that the speed limit should relate to the place context and movement function of a town centre street, a reduction to 30km/h is proposed.

- **Phibsborough Road: Connaught Street to Monck Place (CH A4900 to A5350):** This section passes through Phibsborough Village with intense pedestrian activity and closely spaced crossings. Local cycle traffic will be required to share the bus lane through this section. This proposal is in line with the DMURS guidance that the speed limit should relate to the place context and movement function of a town centre street and to suit shared use of the bus lanes by cyclists.

***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) |
|---|---|---|---|---|---|---|
| **A - Ballymun Alignment** | | | | | | |
| A-0 to A-300 | St. Margaret's Road to south of Northwood Avenue | Arterial - dual | Suburban | 60 | 60 | 60 |
| A-300 to A-900 | Northwood to Shangan Road | Arterial - dual | Suburban | 50 | 50 | 50 |
| A-900 to A-1400 | Ballymun Main Street: Shangan Road to Gateway Avenue | Arterial: narrowed to dual single lanes | Centre | 50 | 50 | **30** |
| A-1400 to A-3050 | Ballymun Road from Gateway Ave. to Griffith Ave. | Arterial - dual | Suburban | 50 | 50 | 50 |
| A-3050 to A-4900 | Griffith Avenue to Connaught Street | Arterial | Suburban | 50 | 50 | 50 |
| A-4900 to A-5350 | Phibsborough Village: Connaught St. to Monck Place | Arterial | Centre | 50 | 50 | **30** |
| A-5350 to A-6850 | Phibsborough Road south of Monck Place, Constitution Hill, Church Street | Arterial | Urban | 50 | 50 | 50 |
| **B - Finglas Alignment** | | | | | | |
| B-0 to B-1000 | Finglas Bypass from St. Margaret's Road to Church Street | Arterial (Dual) | Suburban | 60 | 60 | 60 |
| B-1000 to 3400 | Finglas Road Church Street to Claremont Court | Arteria (Dual) | Suburban | 60 | 60 | 60 |
| B-3400 to 4130 | Claremont Court to Prospect Road | Arterial (Single) | Suburban | 50 | 50 | 50 |
| C 0 to 200 | Ballymun Road to Griffith Avenue | Link | Suburban | 50 | 50 | 50 |
| D 0 to 2060 | Ballymun Road To Botanic Road | Link | Suburban | 60 | 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.

The Proposed Scheme commences, for the Ballymun Alignment, at the St Margaret's Road junction with Ballymun Road, ending at the Ormond Way. Being an essentially urban corridor, all along this section, the main alignment consists of tangents, joined with radius circles, without transition curves or superelevation, consistent with the urban character of the Scheme. The existing alignment has been retained

The Finglas Alignment starts at the St Margaret's Road roundabout junction with Finglas Road. The alignment runs southbound in generally straight alignment, with tangents similar arrangement to the Ballymun Alignment. The proposed design has been proposed over the existing horizontal alignment.

## 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.

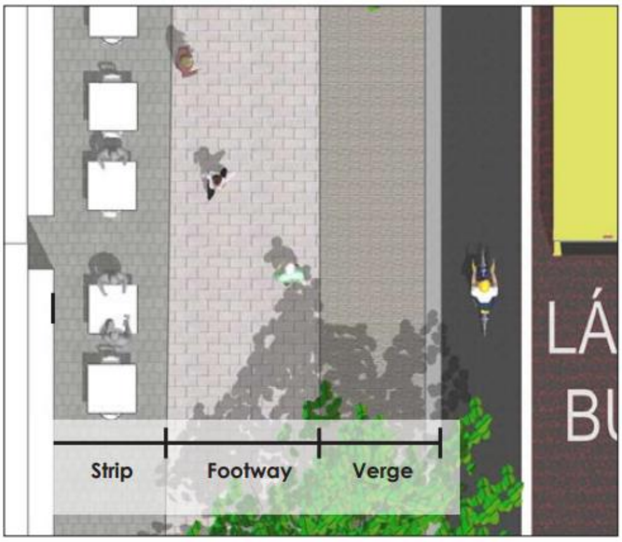



***Figure 4-4: Key components of the footpath***

### 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 most of the Proposed Scheme generally where pedestrian numbers are low, the existing footway widths of 2.0m or wider will be retained, 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. Along most of Finglas Road the footpaths are separated from the road edge by a grass verge with trees that are desirable to be retained. These footpaths are generally less than 1.8m wide and may be as low as 1.2m in places. However, pedestrian numbers are very low along these sections of the road where there is no active frontage, and it is not proposed to widen the footpaths which could endanger the retention of the existing mature trees. In busier town centre locations, such as Ballymun Main Street and in Phibsborough Village the existing footpaths are typically 3m or 4m wide, which will be retained, or widened a little for consistency where appropriate. 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. Geometric Parameters for Footways***

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

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

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

### 4.9.3 Longitudinal Gradient

The adopted footway design longitudinal grading parameters have been provided in Table 4-1. The footpath longitudinal gradient follows the gradient of the proposed carriageway. DN-PAV-03026, Table 2.3 shown in Table 4-5 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 a retrofit context it may not be possible to meet this requirement and slightly longer crossings may be necessary. On the Finglas Road dual carriageway for example, at two junctions the direct crossing distance is 21m or 24m, but the median island is only 3m wide, which is too narrow to provide a suitable staggered crossing with a clear 2m space between signal poles and guard rails. In that context direct crossings are preferable for pedestrian comfort and safety, even if this exceeds the desirable maximum distance and slightly longer signal times are necessary and can be accommodated within the overall traffic capacity of the junctions.

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

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, with-flow, raised-adjacent cycle track is 2.0m. This arrangement allows for two-abreast cycling. Based on the NCM Width Calculator, this allows for overtaking within the cycle track. The minimum width is 1.5m, which based on the NCM Width Calculator, allows for single file cycling. Localised narrowing of the cycle track below 1.5m may be necessary over very short distances to cater for local constraints (e.g. mature trees).

The desirable 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 on St. Mobhi Road, Botanic Road and Prospect Way.

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

***Table 4-6: Cycle Facilities Provision Southbound***

| | **Road Length (m)** | **Existing Length (m)** | | **Existing Segregated %** | **Proposed Length (m)** | **%** |
|---|---|---|---|---|---|---|
| **Southbound** | | Segregated | Non-Segregated | | Segregated | |
| Ballymun Road | 2.950 | 500 | 830 | 17% | 2.950 | 100% |
| St. Mobhi Road | 1.130 | 0 | 220 | 0% | 1.000 | 100% |
| Botanic Road | 530 | 0 | 220 | 0% | 530 | 100% |
| Prospect Road | 140 | 0 | 0 | 0% | 140 | 100% |
| Royal Canal Bank | 1070 | 260 | 440 | 24% | 1.200 | 100% |
| Constitution Hill* | 300 | 300 | 0 | 100% | 300 | 100% |
| Church Street / Markets route * | 670 | 520 | 0 | 78% | 670 | 100% |
| Finglas Road St. Margaret's Road to Church Street | 1.100 | 0 | | 0% | 0 | 0% |
| Finglas Road Church Street to Slaney Road | 2.100 | 1.700 | 295 | 81% | 2.100 | 100% |
| Finglas Road Slaney Road to Prospect Way | 1.100 | 270 | 630 | 25% | 1.100 | 100% |
| **Total** | **11,090** | **3,550** | **2,635** | **32%** | **9,990** | **90%** |

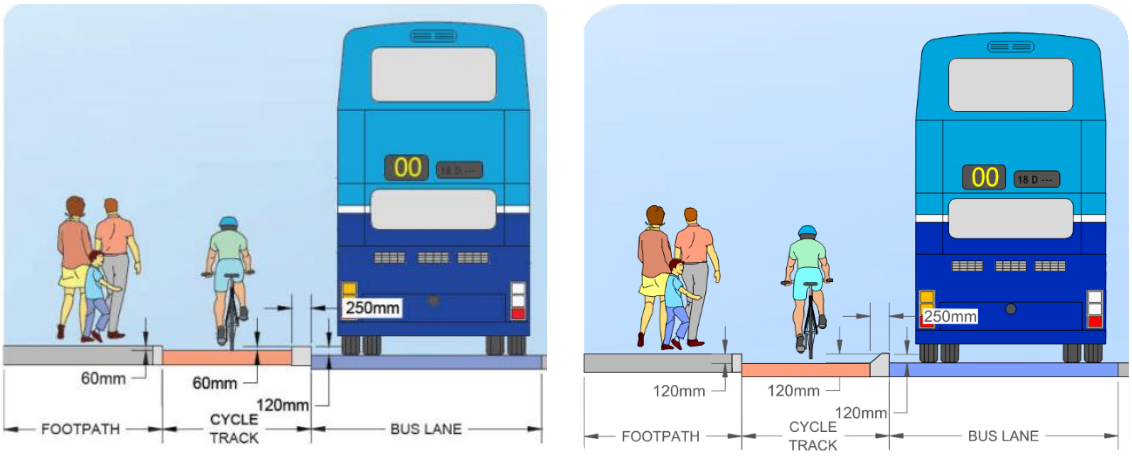
***Table 4-7: Cycle Facilities Provision Northbound***

| | **Road Length (m)** | **Existing Length (m)** | | **Existing Segregated %** | **Proposed Length (m)** | **%** |
|---|---|---|---|---|---|---|
| **Northbound** | | Segregated | Non-Segregated | | Segregated | |
| Church Street / Markets route * | 670 | 670 | 0 | 100% | 670 | 100% |
| Constitution Hill * | 300 | 300 | 0 | 100% | 300 | 100% |
| Royal Canal Bank | 1070 | 0 | 0 | 0% | 1.200 | 100% |
| Prospect Road / Finglas Road / Prospect Way | 440 | 0 | 0 | 0% | 300 | 100% |
| Botanic Road | 380 | 0 | 380 | 0% | 380 | 100% |
| St. Mobhi Road | 1.000 | 470 | 0 | 47% | 1.000 | 100% |
| Griffith Avenue (westbound) | 90 | 0 | 0 | 0% | 90 | 100% |
| Ballymun Road | 3.050 | 500 | 2.550 | 16% | 3.050 | 100% |
| Finglas Road Hart's Corner to Slaney Road | 1.030 | 660 | 370 | 64% | 1.030 | 100% |
| Finglas Road Slaney Road to Mellowes Road | 2.150 | 1.450 | 560 | 67% | 2.150 | 100% |
| Finglas Road Mellowes Road to St. Margaret Road | 1.000 | 0 | 0 | 0% | 0 | 0% |
| **Total** | **11,180** | **4,050** | **2,930** | **36%** | **10,170** | **91%** |

* Note: Some cycling lanes were improved in 2021 with provision of bollards and intermittent raised kerbs for segregation from traffic as part of emergency works during the COVID-19 pandemic.

### 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 BCPDGB.




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

***Figure 4-5: Fully Segregated Cycle Track Options***

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

- Ballymun Road to Prospect Road, from Ch A 0 to Ch A 4700 at the tie in with Royal Canal Bank. Northbound and Southbound
- Western Way to King Street North, from Ch A 6400 to Ch A 5900, Northbound.
- Western Way to Church Avenue West from Ch A 5900 to Ch 6550 Southbound
- Finglas Road from Mellowes Road to Botanic Road, Ch B 800 to Ch B 4127, Southbound,
- Botanic Road to Finglas Road with Church Street, Ch B 4127 to Ch B 1050, Northbound

### 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. Offline sections of cycle track are included in a few locations in the Proposed Scheme as follows:

- Along the River Tolka Greenway at St. Mobi Drive.
- Crossing the Royal Canal at Phibsborough to connect from the Royal Canal Greenway to the Royal Canal Bank cycle route.
- At the crossing of North Circular Road in Phibsborough on the Royal Canal Bank cycle route.

### 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 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.

Quiet street cycle routes are proposed along Royal Canal Bank as an alternative to Phibsborough Road where cycle tracks cannot be accommodated alongside bus lanes, and on Coleraine Street, King Street North, Anne Street North, George´s Hill, St. Michan´s St, Ormond Square and Charles Street, as an alternative attractive route for cyclists away from Church Street where cycle tracks cannot be accommodated alongside bus lanes along large lengths of the street.

### 4.11.5 Cycling Facilities at Constrained 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:

- St. Mobhi Road
- Botanic Road
- Prospect Road
- Phibsborough Road for short sections of cycle track linking between bus lanes
- Church Street Upper and Lower
- Finglas Road in various places to retain existing street trees and not encroach into footpaths at busy locations.
- Prospect Way to retain existing street trees.

### 4.11.6 Cycling 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 each of the 65 bus stops along the route when they are upgraded to give a total of 455 cycle stands with capacity for 910 parked bicycles

## 4.12 Bus Provision

The Proposed Scheme is approximately 6.7 km long from end to end on the Ballymun Alignment and 4.2 km along the Finglas Alignment. 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 Summary***

| BALLYMUN ALIGNMENT | | | | | |
|---|---|---|---|---|---|
| | **Road Length (m)** | **Existing Length** | **%** | **Proposed Length** | **%** |
| **Bus Lanes – Southbound to City Centre** | | | | | |
| Ballymun Road | 2,950 | 2,160 | 73% | 2,950 | 100% |
| St. Mobhi Road | 1,000 | 760 | 76% | 1,000 | 100% |
| Botanic Road | 530 | 190 | 36% | 290 | 55% |
| Prospect Road | 140 | 70 | 50% | 140 | 100% |
| Phibsborough Road | 1,070 | 140 | 13% | 1,070 | 100% |
| Constitution Hill | 300 | 0 | 0% | 300 | 100% |
| Church Street | 670 | 0 | 0% | 440 | 66% |
| **Total** | **6,660** | **3,320** | **50%** | **6,330** | **95%** |
| **Bus Lanes – Northbound from City Centre** | | | | | |
| Church Street | 670 | 0 | 0% | 590 | 88% |
| Constitution Hill | 300 | 0 | 0% | 300 | 100% |
| Phibsborough Road | 1,070 | 625 | 58% | 925 | 86% |
| Prospect Road / Finglas Road | 340 | 135 | 40% | 340 | 100% |
| Prospect Way | 130 | 75 | 58% | 105 | 81% |
| Botanic Road | 380 | 0 | 0% | 120 | 32% |
| St. Mobhi Road | 1,000 | 0 | 0% | 0 | 0% |
| Griffith Avenue (westbound) | 90 | 0 | 0% | 60 | 67% |
| Ballymun Road | 2,950 | 2,090 | 71% | 2,950 | 100% |
| **Total** | **6,930** | **2,925** | **42%** | **5,390** | **78%** |
| **FINGLAS ALIGNMENT** | | | | | |
| | **Road Length (m)** | **Existing Length** | **%** | **Proposed Length** | **%** |
| **Bus Lanes – Southbound to City Centre** | | | | | |
| Finglas Road: St. Margaret's Road to Slaney Road | 3,100 | 2,300 | 74% | 3,100 | 100% |
| Finglas Road: Slaney Road to Prospect Way | 1,100 | 990 | 90% | 1,100 | 100% |
| **Total** | **4,200** | **3,290** | **78%** | **4,200** | **100%** |
| **Bus Lanes – Northbound from City Centre** | | | | | |
| Finglas Road: St. Margaret's Road to Slaney Road | 3,100 | 1,835 | 59% | 700 | 100% |
| Finglas Road: Slaney Road to Prospect Way | 1,100 | 445 | 40% | 1,100 | 100% |
| **Total** | **4,200** | **2,280** | **54%** | **4,200** | **100%** |
| **Overall Route Sections Combined - Southbound** | **10,860** | **5,600** | **51%** | **10,530** | **97%** |
| **Overall Route Sections Combined - Northbound** | **11,130** | **5,205** | **47%** | **9,590** | **86%** |

### 4.12.1 Bus Priority

Bus priority for the Proposed Scheme is based on provision of a dedicated lane within the carriageway for the bus to travel unhindered by the general traffic along the road corridors between junctions. At junctions, bus lane provision can be provided up to the stop line wherein adaptive signalling solutions 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 8 locations listed in Table 4-9.

***Table 4-9: Signal Controlled Priority for Buses Summary***

| Location | Direction | Reason |
|---|---|---|
| A-4,000: St. Mobhi Road / Botanic Road junction | Southbound | No bus lane downstream of the junction for 230m where the street is too narrow. |
| A-4,280: Botanic Road | Northbound | No bus lane downstream for 230m where the street is too narrow. |
| B-4,140: Botanic Road / Prospect Way | Northbound | No bus lane downstream for 30m around corner through junction where the street is too narrow. |
| A-4,685: Prospect Road / Whitworth Road junction | Southbound | No bus lane downstream of the junction for 40m where it is proposed to widen footpaths on Cross Guns Bridge to improve conditions for pedestrians on the western side. |
| A-5,320: Phibsborough Road | Northbound | No bus lane downstream for 40m where the street is too narrow. |
| A-5,800: Phibsborough Road | Northbound | No bus lane downstream for 90m where the street is too narrow between existing retaining walls. |
| A-6,330: Church St. Upper / King St. North | Southbound | No bus lane downstream of the junction for 190m where the street is too narrow. |
| A-6,600: Church St. / May Lane | Northbound | No bus lane downstream of the junction for 60m where the street is too narrow. |
| A-6,680: Church St. / Chancery St. | Southbound | No bus lane downstream of the junction for 50m where the street is too narrow. |

### 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.

A northbound Bus Gate has been proposed at the northern end of St. Mobhi Road to provide appropriate priority for bus services where no bus lane is provided in the northbound direction. The existing 3-lane road layout will be retained with the southbound bus lane and two traffic lanes. In the northbound direction buses will share the traffic lane which will cater for local access traffic during bus gate operating hours, which are 16:00 – 20:00h. Northbound through traffic along the Proposed Scheme will use alternative routes during the Bus Gate operation hours.

An alternative regional route is proposed along R135 Finglas Road from Hart's Corner, and then along Old Finglas Road, Tolka Estate and Griffith Avenue, as shown in Figure 4-6.

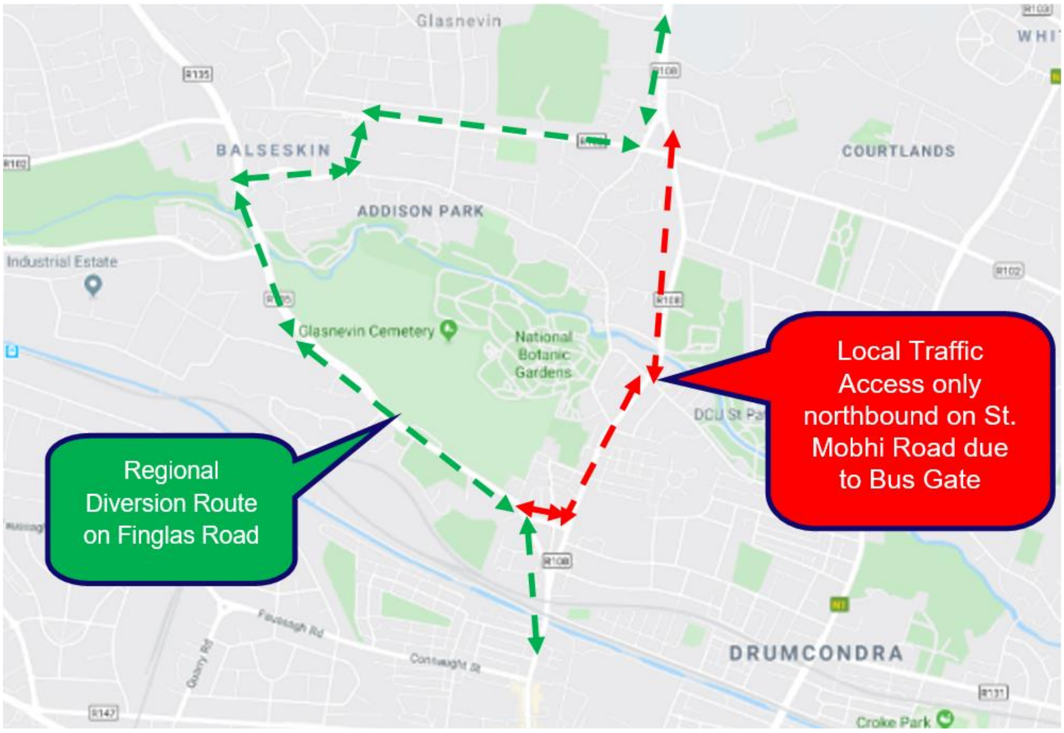



*Figure 4-6 - Alternative Regional Route for Northbound Traffic at Glasnevin*

Local northbound traffic may to Botanic Road, Glasnevin Hill, Old Finglas Road. Cremore Villas and Griffith Avenue as shown in Figure 4-7.

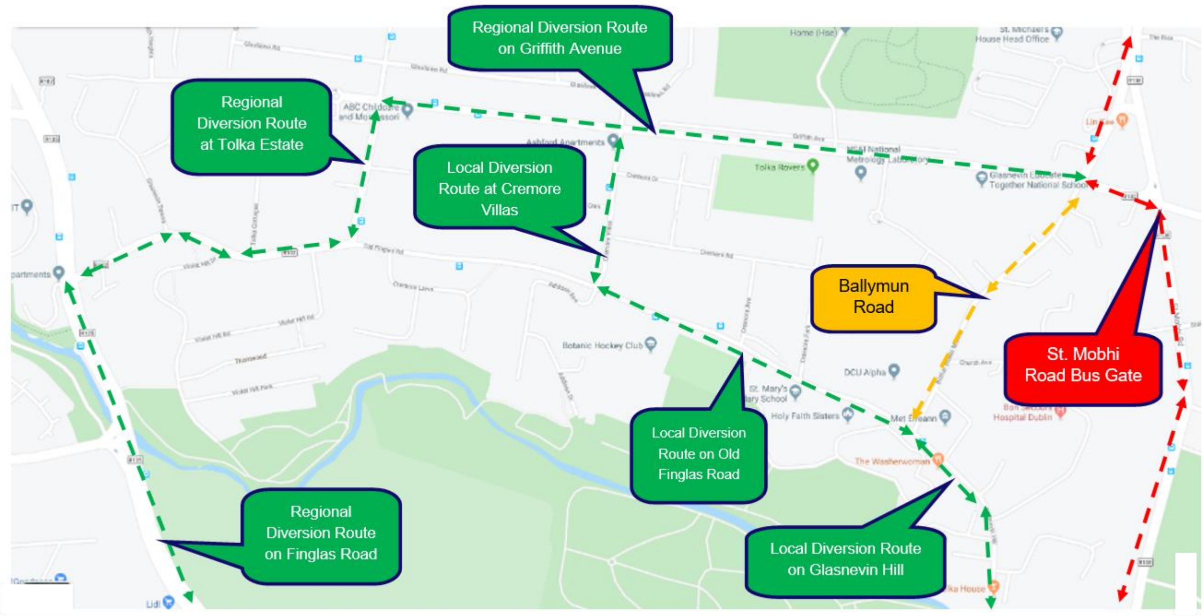



***Figure 4-7: Alternative Regional & Local Traffic Diversion Routes at Glasnevin***

## 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 4-8.

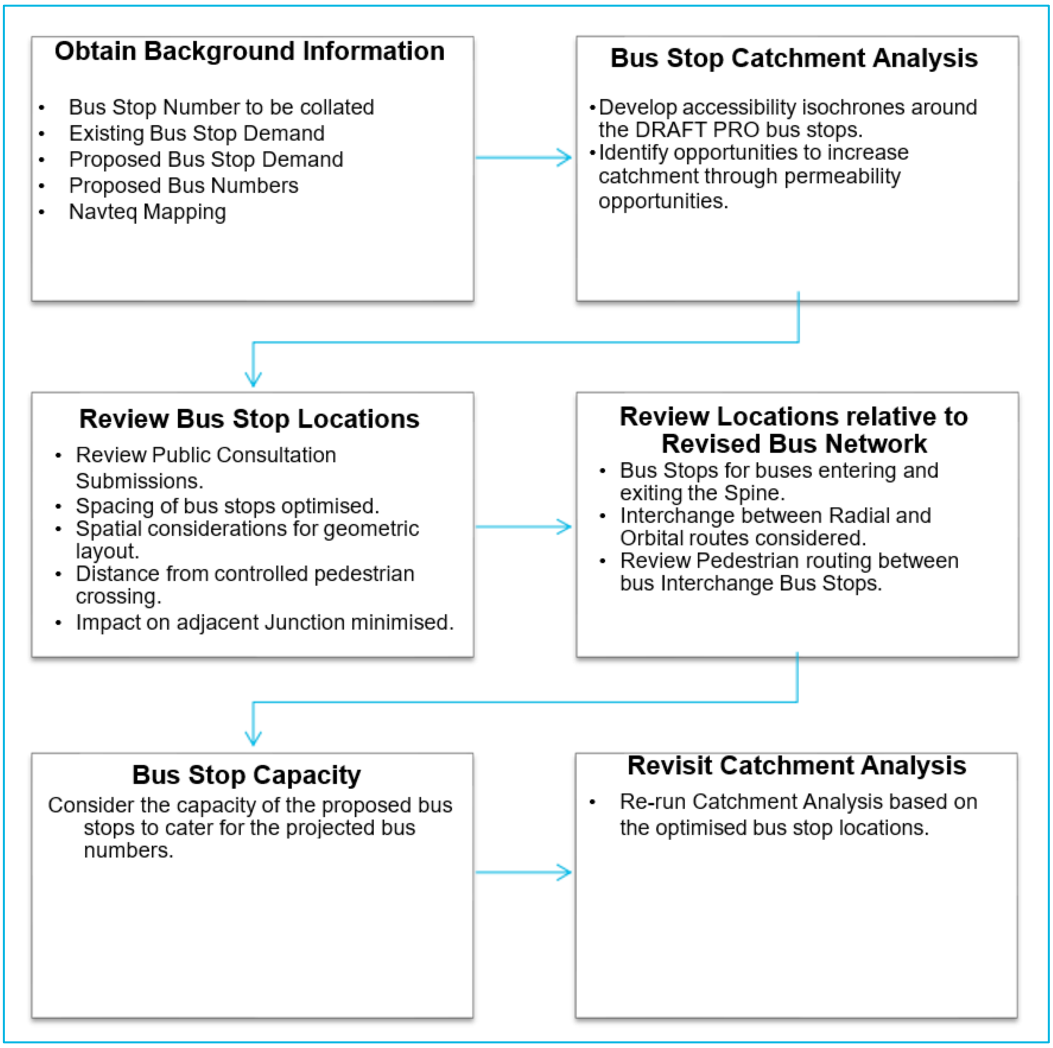



***Figure 4-8: Bus Stop Location Assessment Process***

The procedure for the assessment undertaken was set out in the Bus Stop Review Methodology document provided in Appendix 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 64 bus stops, of which 3 are proposed new stops.
    - Island bus stops: 29
    - Shared landing bus stops: 22
    - Inline bus stops: 13
- 4 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 4-9.

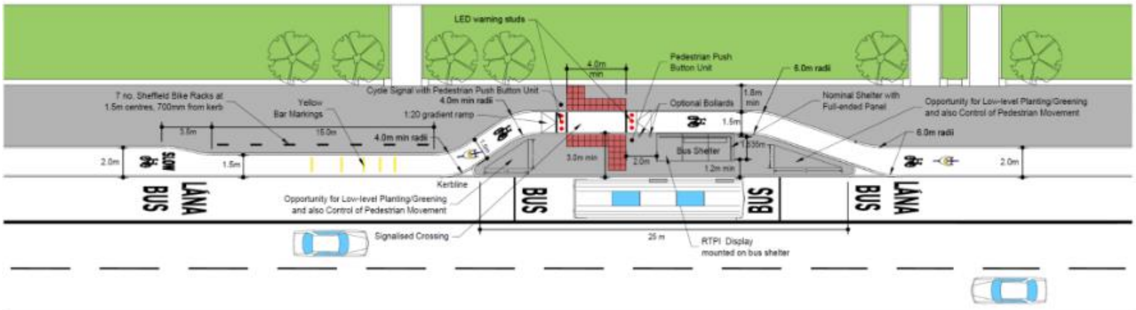



***Figure 4-9: Example of an Island Bus Stop***

This arrangement will reduce the potential for conflict between pedestrians, cyclists and stopping buses by deflecting cyclists behind the bus stop, thus creating an island area for boarding and alighting passengers. On approach to the bus stop island the cycle track is intentionally narrowed with yellow bar markings also used to promote a low speed single file cycling arrangement on approach to the bus stop. Similarly a 1 in 1.5 typical cycle track deflection is implemented on the approach to the island to reduce speeds for cyclists on approach to the controlled pedestrian crossing point on the island. To address the pedestrian/cyclist conflict, a pedestrian priority crossing point is provided for pedestrians accessing the bus stop island area. At these locations a 'nested Pelican' sequence similar to what has been provided on the Grand Canal Cycle Route is introduced so that visually impaired or partially sighted pedestrians may call for a fixed green signal when necessary and the cycle signal will change to red. Where the pedestrian call button has not been actuated the cyclists will be given a flashing amber signal to enforce the requirement to give way to passing pedestrians. A schematic outline of the nested pelican sequence is provided in Figure 4-10. Audible tactile units will also be a featured at the crossing points.

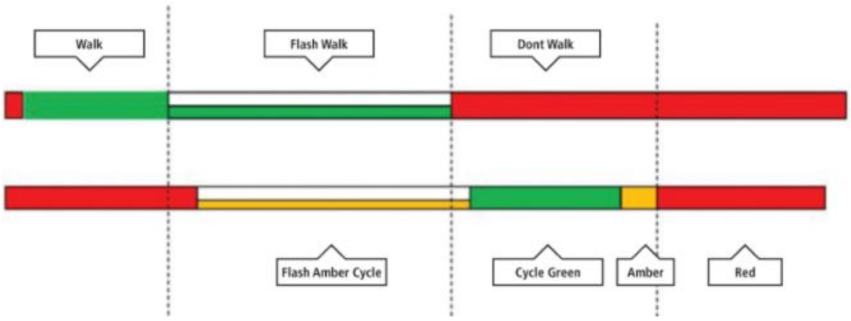



***Figure 4-10: Example of nested pelican sequence***

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 the gradual transition to the cycle track.

The desired minimum island width of 3m has been developed to accommodate the provision of a full end panel shelter and nominal length of 25m to accommodate a 19m typical bus cage arrangement and adjusted to suit the site constraints (e.g. between driveway entrances). The residual bus stop triangular island arrangements can also be used for areas of planting or SUDS as these areas are not intended for pedestrian circulation and will also help promote directing pedestrians towards the designated crossing point in addition to improving the passenger waiting area environment. Bike racks should also be located in the immediate vicinity as shown in Figure 4-11 to promote the use sustainable mode interchange at bus stops for longer distance trips.


***Figure 4-11: Example landscaping arrangement at island bus stops on Oxford Road Manchester (source: Google Street-View 2021)***

Table 4-10 provides a summary of the proposed island bus stop locations.

***Table 4-10: List of Island Bus Stops***

| Stop Number | Stop Name | Existing Chainage | Proposed Chainage | Reason for Moving Stop | Shelter? |
|---|---|---|---|---|---|
| **BALLYMUN ALIGNMENT** | | | | | |
| **Southbound** | | | | | |
| 7113 | Northwood Avenue | A-310 | | Not applicable | Yes |
| 127 | Nursing Home | A-730 | | Not applicable | Yes |
| 112 | Ballymun Civic Centre | A-1065 | | Not applicable | Yes |
| 113 | Trinity Comprehensive School | A-1500 | | Not applicable | Yes |
| 114 | Ballymun Road | A-1600 | | Stop removed as only 100m from previous stop. | N/A |
| 115 | Ballymun Road Church | A-1990 | | Not applicable | Yes |
| 37 | DCU Ballymun Road | A-2270 | | Not applicable | Yes |
| 186(b) | Lindsay Grove (New) | A-4670 | | Not applicable | Yes |
| **Northbound** | | | | | |
| 1618 | Church Street Upper | A-6255 | | Not applicable | Yes |
| 148 | St. Mobhi Road | A-3980 | | Not applicable | Yes |
| 27 | Ballymun Road | A-2925 | | Not applicable | Yes |
| 91 | Ballymun Road National School | A-1940 | | Not applicable | Yes |
| 90 | Ballymun Library | A-1770 | n/a | Stop removed as only 160m from previous stop and 270m from next stop | n/a |
| 93 | Gateway Avenue | A-1490 | | Not applicable | Yes |
| 94 | Civic Centre | A-1070 | | Not applicable | Yes |
| 126 | Ballymun Nursing Home | A-740 | | Not applicable | Yes |
| 6182 | Santry Cross | A-365 | A-455 | Moved closer to Santry Cross for better stop spacing | Yes |
| 322 | Gulliver's Retail Park | A-150 | | Not applicable | Yes |
| **FINGLAS ALIGNMENT** | | | | | |
| **Northbound** | | | | | |
| 1507 | St. Vincent's School | B-3865 | | Not applicable | Yes |
| 1508 | Glasnevin Cemetery | B-3564 | | Not applicable | Yes |
| 1509 | Slaney Road | B-3048 | | Not applicable | Yes |
| 1511 | Tolka Vale | B-2401 | | Not applicable | Yes |
| 1512 | Prospect Hill | B-1856 | | Not applicable | Yes |
| 1538 | Clearwater Shopping Centre | B-1535 | | Not applicable | Yes |
| 100891 | Bottom of the Hill | B-1285 | B-1245 | Moved 40m north closer to pedestrian crossing at junction | Yes |
| **Southbound** | | | | | |
| 4542 | Finglas Village | B-1246 | | Not applicable | Yes |
| 1531 | Clearwater Shopping Centre | B-1656 | | Not applicable | Yes |
| 1532 | Prospect Hill | A-1952 | | Not applicable | Yes |
| 1533 | Tolka Valley | B-2322 | | Not applicable | Yes |
| 1534 | Ballyboggan Road | B-2600 | B-2745 | Moved 145m north to fit island bus stop and to align with NB stop and access route to housing to the east | Yes |
| 1535 | The Willows | B-3185 | | Not applicable | Yes |

### 4.13.3 Shared Landing Area Bus Stops

Where space constraints do not allow for an island bus stop, an option consisting of a shared bus stop landing zone will be considered. The use of corduroy tactile paving on the cycle track is additional in this arrangement to help facilitate awareness and reduce speeds in lieu of the 1:1.5 deflection provision for the island bus stop. The cycle track will also be narrowed when level to the footpath and tactile paving provided to prevent pedestrian/cyclist conflict. Shared landing area bus stops were required in a number of locations along the CBC route due to localised space constraints. See Table 4-11 for the locations of bus stops of this type. An example of a shared landing area bus stop is shown in Figure 4-12.

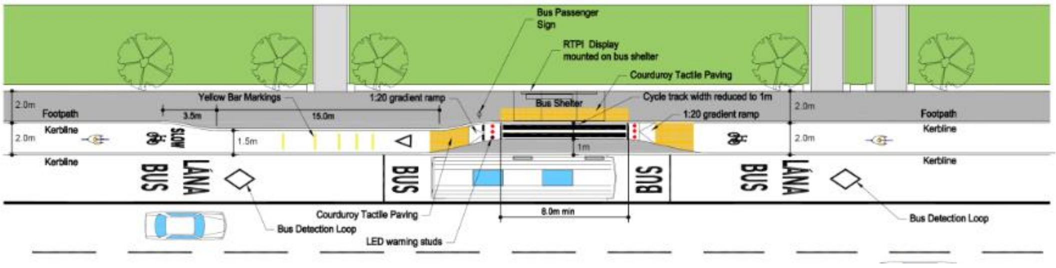



*Figure 4-12: Example of a Shared Landing Area Bus Stop*

*Table 4-11: List of Shared Landing Area Bus Stops*

| Stop Number | Stop Name | Existing Chainage | Proposed Chainage | Reason for Moving Stop | Shelter ? |
|---|---|---|---|---|---|
| | | | BALLYMUN ALIGNMENT | | |
| **Southbound** | | | | | |
| 38 | Hampstead Avenue | A-2625 | A-2650 | Moved 25m south to fit shared landing | Yes |
| 39 | The Rise | A-2830 | A-2940 | Moved 110m south to fit shared landing | Yes |
| 40 | Stella Avenue | A-3260 | A-3140 | Moved 120m north for better spacing | Yes |
| 146 | Na Fianna GAA Club | A-3420 | | Not applicable | Yes |
| 147 | Tolka Bridge | A-3730 | A-3630 | Moved 100m north to fit shared landing | Yes |
| 184 | Botanic Road | A-4105 | A-4060 | Moved 45m north to fit shared landing | Yes |
| 185 | St. Teresa's Place | A-4300 | | Not applicable | Yes |
| 186(a) | Lindsay Grove | A-4620 | | Not applicable | Yes |
| 1614 | Church Street Upper | A-6225 | | Not applicable | Yes |
| **Northbound** | | | | | |
| 1619 | Constitution Hill | A-6030 | | Not applicable | Yes |
| 1506 | Finglas Road / Dalcassian Downs | A-4105 | | Not applicable | Yes |
| 201 | Botanic Road | A-4280 | | Not applicable | Yes |
| 149 | Tolka Bridge | A-3650 | | Not applicable | Yes |
| 150 | Na Fianna GAA Club | A-3365 | A-3400 | Moved 35m south away from pedestrian crossing for safety reasons | Yes |
| 27 | Ballymun Road | A-2925 | | Not applicable | Yes |
| 28 | Hampstead Avenue | A-2700 | | Not applicable | Yes |
| 29 | Albert College Park | A-2490 | n/a | Stop removed as only 210m from previous stop and 250m from next stop | n/a |
| 4680 | DCU (Set-Down only). | A-2310 | A-2240 | Moved 70m north to also serve St. Pappin Road | Yes |
| 90 | Albert College Court | A-2160 | n/a | Stop removed as only 80m from previous stop and 220m from next stop | n/a |
| | | | FINGLAS ALIGNMENT | | |
| | | | Southbound | | |
| 1536 | Glasnevin Cemetery | B-3665 | | Not applicable | Yes |
| 1537 | St. Vincent's School | B-3955 | B-3975 | Moved 45m north to fit shared landing | Yes |
| | | | Northbound | | |
| 1510 | Ballyboggan Road | B-2550 | B-2600 | Moved 50m closer to Ballyboggan Road | Yes |
| new | Church Street Junction | B-1076 | | Not applicable | Yes |

### 4.13.4 Inline Bus Stop

Inline bus stops are generally only provided in areas of low-medium flow or where no cycle tracks are provided, cyclists will generally have to yield when a bus is stationary at the stop to avoid collisions with the bus as it pulls away.

***Table 4-12: List of Inline Bus Stops***

| Stop Number | Stop Name / Location | Chainage | Type | Note |
|---|---|---|---|---|
| **BALLYMUN ALIGNMENT** | | | | |
| **Southbound** | | | | |
| 187 | Phibsborough Road (at Connaught Street) | A-4920 | Inline | Alternative quiet street cycle route on Royal Canal Bank parallel to the east |
| 188 | North Circular Road (on Phibsborough Road south of Doyle's Corner) | A-5210 | Inline | |
| 189 | Fire Station (Phibsborough Road) | A-5545 | Inline | |
| 190 | Broadstone (Phibsborough Road) | A-5775 | Inline | |
| **Northbound** | | | | |
| 1616 | St. Michan's Church (Church Street Lower) | A-6665 | Inline | Alternative quiet street cycle route through Markets Area parallel to the east |
| 195 | Broadstone (Phibsborough Road) | A-5790 | Inline | Alternative quiet street cycle route on Royal Canal Bank parallel to the east |
| 196 | Fire Station (Phibsborough Road) | A-5575 | Inline | |
| 197 | Monck Place (Phibsborough Road) | A-5340 | Inline | |
| 198 | Phibsborough Shopping Centre (Phibsborough Road) | A-5040 | Inline | |
| 199 | Munster Street (Phibsborough Road) | A-4825 | Inline | |
| **FINGLAS ALIGNMENT** | | | | |
| **Northbound** | | | | |
| new | New bus stop at St. Margaret's Road Junction | B-84 | Inline | Alternative cycle routes on local roads parallel on both sides |
| **Southbound** | | | | |
| new | New bus stop at St. Margaret's Road Junction | B-83 | Inline | Alternative cycle routes on local roads parallel on both sides |
| new | New Bus Stop at Church Street Junction, Finglas | B-980 | Inline | |

In all of the locations listed above there are no cycle tracks proposed parallel to the bus lanes, and there is an alternative route nearby. Any cyclists who choose to follow the bus corridor instead of the alternative cycle route may use the bus lane to bypass the bus stops and will be required to wait behind a stopped bus, such that they would not interact with bus passengers as they board or alight.

### 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 Preliminary Design Guidance Booklet for BusConnects; urban area bus stop laybys 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 in Figure 4-13.

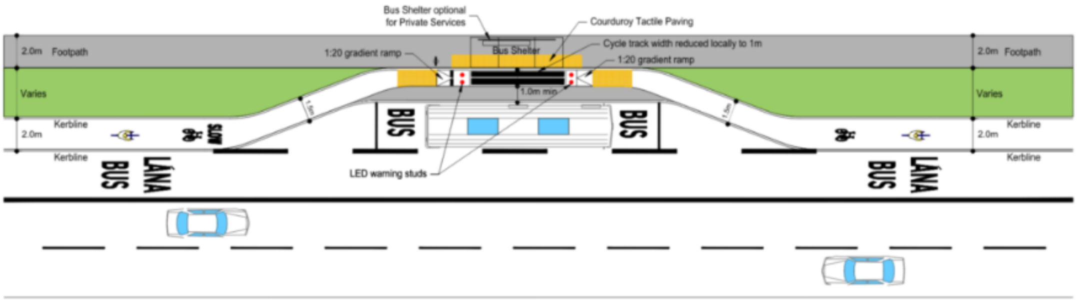



*Figure 4-13: Example of a Layby Bus Stop*

Layby bus stops are used at the locations along the Proposed Scheme listed in able 4-13.

*Table 4-13: List of Layby Bus Stops*

| Stop Number | Stop Name / Location | Chainage | Type |
|---|---|---|---|
| **Northbound** | | | |
| 1615 | Church Street Lower (at Mary's Lane) | 6615 | Existing Layby retained |
| **Northbound** | | | |
| 200 | Prospect Way | 4400 | Existing Layby retained |

### 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 4-14 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 4-14: Example of a 3-Bay Reliance full end panel bus shelter (Source: JCDecaux)*

The cantilever shelter using full width roof and half end panel arrangement provides a second alternative solution for bus shelters in constrained footpath locations. Figure 4-15 below provides an example of this type of shelter. Advertising panels in this arrangement are normally located on the back façade of the shelter compared to the full end panel arrangement. The desirable minimum footpath/island widths required to accommodate the full end panel shelter is 2.75m with an absolute minimum width of 2.4m to facilitate a min. 1.2m clearance at the end panels for pedestrians.


***Figure 4-15: Example of a 3-Bay Reliance Cantilever Shelter with full width roof and half end panels (Source: JCDecaux)***

Two alternative narrow roof shelter configurations are also available which offer reduced protection against the elements compared to the full width roof arrangements. These shelter configurations are not preferred but do provide an alternative solution for particularly constrained locations where cycle track narrowing to 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 4-16: Example of a 3-Bay Reliance Cantilever shelter with narrow roof configuration with and without half end panels (Source: JCDecaux)***

The siting of bus shelters also requires due consideration on a case by case basis. Ideally bus shelters should be located on the island bus stop boarding/alighting area where space permits. Where this is not feasible, the shelters should be located 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.

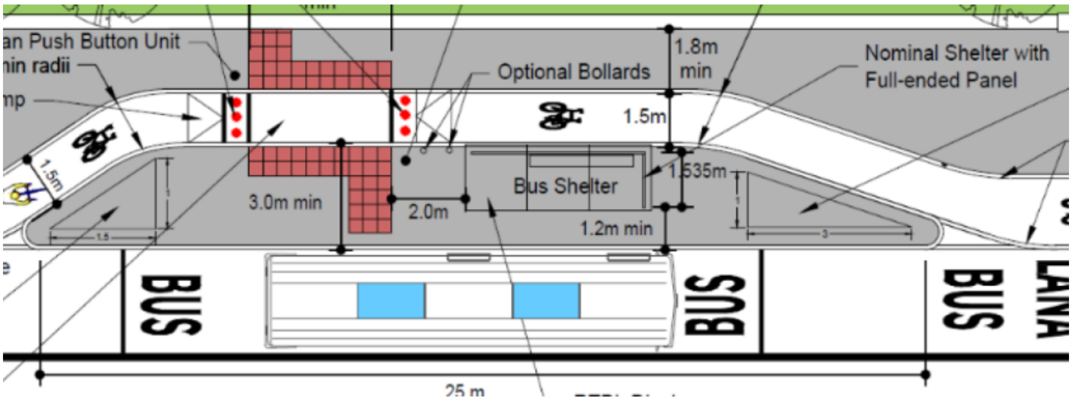



***Figure 4-17: Preferred Shelter Location (on island)***

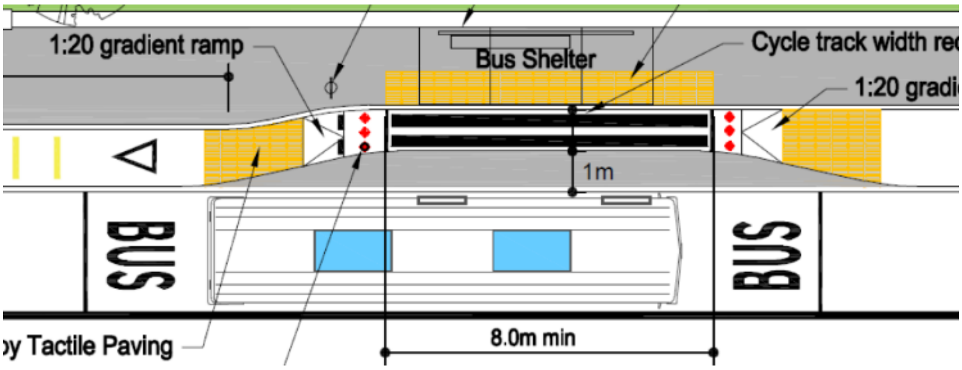



***Figure 4-18: Alternative Shelter Location back of footpath (narrow island with adequate footpath widths)***

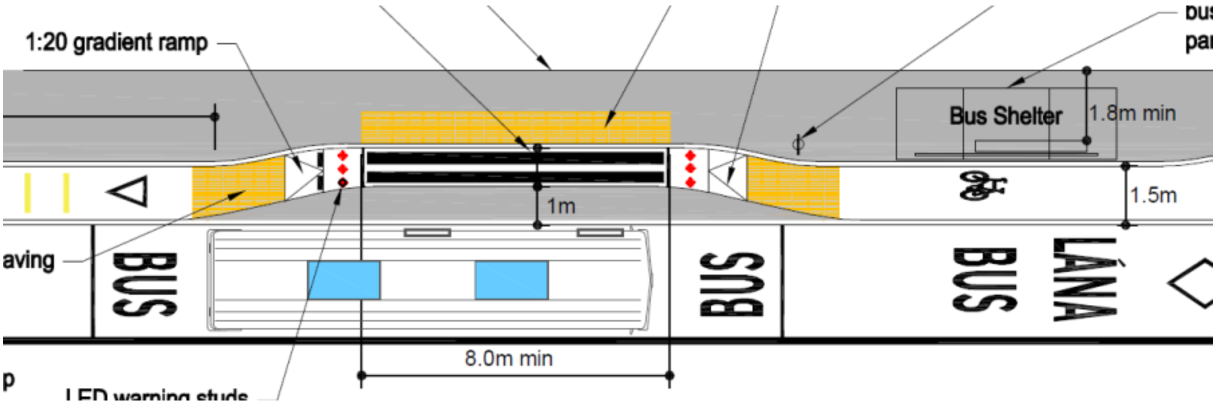



***Figure 4-19: Alternative Shelter Location downstream of island (narrow island with narrow footpath widths at landing area)***

## 4.14 Parking and Loading

As part of the ongoing assessment of existing conditions to support the development of the engineering design along the Proposed Scheme, a parking survey assessment was undertaken to assess the existing loading and parking arrangements and potential alternatives along the Proposed Scheme. Appendix G provides the details of the Parking 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 4-14.

***Table 4-14: Summary of Proposed Parking Amendments***

| Section | Location | Type | Part Time / Full Time | Loading / Other | Disabled | Existing Parking | Proposed | Change | Section change |
|---|---|---|---|---|---|---|---|---|---|
| **B1** | **Santry Cross** | | | | | | | | |
| B1.1 | Ballymun Road, east - *Aprile* takeaway. 65 m south of Santry Cross | Layby - not restricted | FT | | | 3 | 0 | -3 | |
| B1.2 | Ballymun Road, west - Maguires outlet: 50 m south of Santry Cross | Loading / Parking | FT | 3 | | | 0 | -3 | -11 |
| B1.3 | Ballymun Road, east - Spelman Callaghan Solicitors: 130m m south of Santry Cross | Layby - not restricted | FT | | | 3 | 0 | -3 | |
| B1.4 | Ballymun Road, west: 130m m south of Santry Cross | Layby - not restricted | FT | | | 2 | 0 | -2 | |
| **B2** | **Ballymun Main Street** | | | | | | | | |
| B2.1 | Ballymun Road, East | Pay & Display | PT | | | 14 | 25 | 11 | |
| | Ballymun Road, East | Disabled | PT | | 3 | | 3 | 0 | 36 |
| B2.2 | Ballymun Road, West | Pay & Display | PT | | | 0 | 25 | 25 | |
| **B3** | **Collins Avenue to Griffith Avenue** | | | | | | | | |
| B3.1 | Ballymun Road, west - school to Pappin Road | New | | | | 0 | 11 | 11 | |
| B3.2 | Ballymun Road, Albert Collage Park south of DCU Entrance | Informal | FT | | | 10 | 0 | -10 | |
| B3.3 | St. Mobhi Road, west side, outside barber shop | Free - 1 hr max | FT | | | 3 | 3 | 0 | -3 |
| B3.4 | Ballymun Road at Griffith Avenue, shops | Free - 1 hr max | FT | | | 8 | 8 | 0 | |
| B3.5 | Griffith Avenue Link, south | Free | FT | | | 4 | 0 | -4 | |
| **B4** | **Ballymun Road / Glasnevin Hill / Botanic Road** | | | | | | | | |
| B4.1 | Ballymun Road South, north of Claremont | Informal | FT | | | 18 | 25 | 7 | |
| B4.2 | Ballymun Road South, south of Claremont | Informal | FT | | | 17 | 17 | 0 | 7 |
| B4.3 | Glasnevin Hill, northern side | Informal | FT | | | 10 | 10 | 0 | |
| B4.3a | Glasnevin Hill, northern side | Disabled | PT | | 1 | | 1 | 0 | |
| B4.4 | Glasnevin Hill, southern side, outside Tolka House | Informal | FT | | | 14 | 14 | 0 | |
| B4.4a | Bothar Gharraithe Na Lus | Loading | PT | 1 | | | 1 | 0 | |
| B4.4b | Bothar Gharraithe Na Lus | Pay & Display | PT | | | 14 | 14 | 0 | |
| **B5** | **St. Mobhi Road** | | | | | | | | |

| Section | Location | Type | Part Time / Full Time | Loading / Other | Disabled | Existing Parking | Proposed | Change | Section change |
|---|---|---|---|---|---|---|---|---|---|
| B5.1 | St. Mobhi Road, south of Whitehall College | Informal | FT | | | 5 | 5 | 0 | 0 |
| B5.2 | St. Mobhi Drive | Informal | FT | | | 20 | 20 | 0 | |
| **B6** | **Phibsborough Village** | | | | | | | | |
| B6.1 | Phibsborough Road, outside Euro-Giant & Woodstock Café | Loading Bay | FT | 7 | | | 4 | -3 | -71 |
| B6.2 | Phibsborough Shopping Centre | Pay & Display (Private) | FT | | | 59 | 25 | -34 | |
| | | | | | | | | | |
| B6.3 | Phibsborough Road: NCR to Monck Place, east | Night parking | PT | | | 29 | 0 | -29 | |
| B6.4 | Phibsborough Road, north of Monck Place, west opposite tattoo shop | Loading Bay | FT | 2 | | | 0 | -2 | |
| | | Pay & Display | FT | | | 3 | 0 | -3 | |
| **B7** | **Phibsborough Road South** | | | | | | | | |
| B7.1 | Phibsborough Road, outside church, west side | Pay & Display | PT | | | 10 | 0 | -10 | -22 |
| B7.2 | Phibsborough Road, outside church, east side | Pay & Display | FT | | | 9 | 9 | 0 | |
| B7.3 | Phibsborough Road, opposite Phibsborough Fire Station, east side | Pay & Display | FT | | | 7 | 7 | 0 | |
| B7.4 | Phibsborough Road, south of Fire station, west side | Pay & Display | PT | | | 3 | 0 | -3 | |
| B7.5 | Phibsborough Road, outside McGowan's Pub, west | Taxi Rank | PT | | | 2 | 0 | -2 | |
| B7.6 | Phibsborough Road, north of White Lane, east | Loading Bay/Pay & Display | FT | 2 | | 2 | 11 | 7 | |
| B7.7 | Phibsborough Road south of McGowan's pub, west | Taxi Rank | | | | 4 | 0 | -4 | |
| B7.8 | Phibsborough Road south of McGowan's pub, west | Pay & Display | PT | | | 10 | 0 | -10 | |
| **B8** | **Church Street** | | | | | | | | |
| B8.1 | Church Street, outside The King's Building | Loading Bay | FT | 1 | | | 0 | -1 | -1 |
| B8.2 | Church Street, outside LIV student accommodation | Permit - Police for the Courts | FT | | | 12 | 12 | 0 | |
| **F** | **Finglas Road** | | | | | | | | |
| F1 | Finglas Road at Hart's Corner | Time Limit | FT | | | 4 | 3 | -1 | -1 |
| F2 | Finglas Road at Glasnevin Cemetery | | | 2 | 1 | 30 | 33 | 0 | |
| | **Totals** | | | **18** | **5** | **329** | **286** | **-66** | |

### 4.14.2 Summary of Parking Changes

With the Proposed Scheme in place, the main changes in on-street parking as shown in Table 4-14 are summarised as follows:

- 36 additional parking spaces in Ballymun Main Street.
- 11 additional parking spaces on Ballymun Road south of Collins Avenue on the western side.
- 10 parking spaces removed on Ballymun Road at Albert College Park on the eastern side.
- 7 additional spaces on Ballymun Road south of Griffith Avenue.
- 71 fewer parking spaces in Phibsborough Village of which half will be from the shopping centre car park and the remainder on-street.
- 22 fewer parking spaces on Phibsborough Road south of Doyle's Corner.
- A net reduction of 1 parking space at the southern end (Hart's Corner).
- A net reduction of 66 parking spaces overall, 19% of the total, along the route.

## 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 4-15.

***Table 4-15: Summary of Proposed Turning Bans and Traffic Management Measures***

| Chainage | Major Road | Minor Road | Measure | Reason | Impact |
|---|---|---|---|---|---|
| A-1300 | Ballymun Road | Shangan Road (South) | No right turn onto major road | Existing | Not applicable |
| A-2060 | Ballymun Road | Albert College Court | No right turn onto major road | Existing | Not applicable |
| A-2680 | Ballymun Road | Hampstead Avenue | No right turn onto major road | Existing | Not applicable |
| A-3020 | Saint Mobhi Road | Griffith Avenue | No southbound left turn from St. Mobhi Road onto Griffith Avenue | To remove conflict with buses and cyclists. Traffic rerouted around the western and southern side of the traffic gyratory system. | Improved journey time reliability for buses.<br>Better safety for cyclists. |
| A-3055 | Saint Mobhi Road | Griffith Avenue | Northbound Bus Gate on St. Mobhi Road (16-20h, 7 days) | To minimise delay for buses in the PM peak period. | Through traffic diverted to other routes. |
| A-3200 | Saint Mobhi Road | Stella Avenue | Local Access Only notice sign – No Right Turn | To alert drivers of the bus gate at Griffith Avenue during operational hours. | Limit traffic approaching bus gate |
| A-3200 | Saint Mobhi Road | Mobhi Bóithrín | Local Access Only notice sign – No Left Turn | To alert drivers of the bus gate at Griffith Avenue during operational hours. | Limit traffic approaching bus gate |
| A-3190 | Saint Mobhi Road | Stella Avenue | No right turn onto minor road | Existing | Not applicable |
| A-3310 | Saint Mobhi Road | Home Farm Road | No right turn onto minor road | Existing | Not applicable |
| A-3310 | Saint Mobhi Road | Home Farm Road | Local Access Only notice sign – No Right Turn | To alert drivers of the bus gate at Griffith Avenue during operational hours. | Limit traffic approaching bus gate |
| A-3700 | Saint Mobhi Road | Whitehall College | Local Access Only notice sign – No Right Turn | To alert drivers of the bus gate at Griffith Avenue during operational hours. | Limit traffic approaching bus gate |
| A-3810 | Saint Mobhi Road | Botanic Avenue | No northbound right turn from St. Mobhi Road into Botanic Avenue | To avoid lane blocking on northbound shared lane with buses. Traffic may divert a | Improved journey time reliability for buses . |

| Chainage | Major Road | Minor Road | Measure | Reason | Impact |
|---|---|---|---|---|---|
| | | | | short distance to the west via Botanic Road. | |
| A-3810 | Saint Mobhi Road | Botanic Avenue | Local Access Only notice sign – No Right Turn & No Left Turn | To alert drivers of the bus gate at Griffith Avenue during operational hours. | Limit traffic approaching bus gate |
| A-4000 | Saint Mobhi Road | Botanic Road | No left turn onto major road | Existing | Not applicable |
| A-4000 | Saint Mobhi Road | Botanic Road | Local Access Only notice sign – No Left Turn | To alert drivers of the bus gate at Griffith Avenue during operational hours. | Limit traffic approaching bus gate |
| A-4000 | Saint Mobhi Road | Fairfield Road | Local Access Only notice sign – No Right Turn | To alert drivers of the bus gate at Griffith Avenue during operational hours. | Limit traffic approaching bus gate |
| A-4710 | Phibsborough Road | Whitworth Road | No right turn onto minor road | Existing | Not applicable |
| A-4750 | Phibsborough Road | Royal Canal Bank | No right turn onto major road (at peak hours) | Existing | Not applicable |
| A-4865 | Phibsborough Road | Munster Street | No right turn onto major road | Existing | Not applicable |
| A-5120 | Phibsborough Road | North Circular Road | No right turns in all directions | Existing | Not applicable |
| A-5300 | Phibsborough Road | Phibsborough | No right turn onto minor road | Existing | Not applicable |
| A-5300 | Phibsborough Road | Phibsborough | No right turn onto major road | To restrict through traffic at residential area. | Traffic diverted onto North Circular Road |

## 4.16 Relaxations Departures & 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 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 relevant geometric parameters 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 0.

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
- DoSomething – 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 of 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 practicable;

- 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; and
- Cyclist quantification

## 5.3 Junction Geometry Design

### 5.3.1 Pedestrians

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

The preferred arrangement for pedestrians at junctions is to have a wrap-around pedestrian signal stage at the start of the cycle. In some instances, this hasn't been feasible i.e. due to crossing distances and the associated inter-green time for pedestrians to safely clear the junction. A "walk with traffic" system is therefore proposed at certain junctions, in particular where refuge islands have been introduced for a two-stage pedestrian crossing. At these locations, controlled crossing for pedestrians is provided across part of the junction, whilst some of the traffic movements that are now in conflict with the pedestrian movement, are allowed to run at the same time. This facility has the advantage 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 |
| **Ballymun Alignment** | | | | |
| 1. | St. Margaret's Road / Ballymun Road | 75 | 120 | 110 |
| 2. | Northwood Avenue / Ballymun Road | 90 | 120 | 110 |
| 3. | Santry Cross: Ballymun Road / Santry Ave. | 120 | 120 | 120 |
| 4. | Shangan Road / Ballymun Road | 120 | 120 | 120 |
| 5. | Gateway Crescent / Ballymun Road | 90 | 120 | 120 |
| 6. | Collins Avenue / Ballymun Road | 125 | 120 | 105 |
| 7. | St. Pappin Road / Ballymun Road | 150 | 120 | 115 |
| 8. | St. Canice's Road / Ballymun Road | Unsignalised | 90 | 85 |
| 9. | Griffith Avenue / Ballymun Road | 122 | 120 | 120 |
| 10. | St. Mobhi road /Ballymun Road | 65 | 60 | 60 |
| 11. | Griffith Avenue / St. Mobhi Road | 117 | 120 | 120 |
| 12. | Botanic Avenue / St. Mobhi Road | 110 | 110 | 120 |
| 13. | Botanic Road / St. Mobhi Road | 133 | 110 | 120 |

| No. | Junction Name | Cycle Time (Seconds) | | |
|---|---|---|---|---|
| | | Do Minimum | Do Some-thing AM | Do Something PM |
| 14. | Prospect Way / Botanic Road | 120 | 105 | 105 |
| 15. | Botanic Road / Finglas Road | 120 | 105 | 105 |
| 16. | Prospect Way / Finglas Road | 110 | 105 | 105 |
| 17. | Whitworth Road / Prospect Road | 120 | 110 | 115 |
| 18. | Connaught Street / Phibsborough Road | 128 | 110 | 110 |
| 19. | Doyle's Corner | 110 | 120 | 120 |
| 20. | Phibsborough Road / Western Way (LUAS crossing) | 66 | 90 | 90 |
| 21. | North Brunswick Street / Church Street | 120 | 60 | 60 |
| 22. | North King Street / Church Street | 120 | 120 | 120 |
| 23. | Church Street Lower / May Lane | No change to existing | | |
| 24. | Church Street Lower / Chancery Street (LUAS crossing) | No change to existing | | |
| **Finglas Alignment** | | | | |
| 25. | Church Street / Finglas Road | Unsignalised | 120 | 120 |
| 26. | Wellmount Road / Finglas Road | 135 | 120 | 120 |
| 27. | Finglas Place / Finglas Road | Unsignalised | 120 | 120 |
| 28. | Glenhill Road / Finglas Road | 124 | 120 | 120 |
| 29. | The Griffith / Finglas Road | 120 | 120 | 120 |
| 30. | Tolka Valley Road / Finglas Road | 122 | 120 | 120 |
| 31. | Old Finglas Road / Finglas Road | 105 | 120 | 120 |
| 32. | Ballyboggan Road / Finglas Road | 103 | 120 | 120 |
| 33. | Slaney Road / Finglas Road | 144 | 120 | 120 |
| 34. | Claremont Court / Finglas Road | 132 | 120 | 120 |

### 5.3.2 Cyclists

The provision for cyclists at junctions is a critical factor in managing conflict and providing safe junctions for all road users. The primary conflict for cyclists is with left turning traffic.

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

- The traffic signal arrangement removes any uncontrolled conflict between pedestrians and cyclists, assigning clear priority to all users at different stages within a traffic cycle;
- Kerbed corner islands should be provided to force turning vehicles into a wide turn and remove the risk of vehicles cutting into the cycle route at the corner, which is a cause of serious accidents at junctions. The raised islands create a protective ring for cyclists navigating the junction, improving safety for right turning cyclists
- Cycle tracks that are protected behind parking or loading bays return to run along the edge of the carriageway approaching the junction. Consideration has been given to remove any parking or loading located immediately at junctions to enhance visibility between motorists and cyclists;
- The cycle track is typically ramped down to carriageway level on approach to the junction and proceeds to a forward stop line.  A secondary cycle stop line is also proposed at an advanced location to the vehicular stop line at a number of junctions to cater for right turning cyclists, 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 as Junction Types 1-4. Junction Type 1 is mainly proposed on the Proposed Scheme with some Junction Type 2 provided where left-turn movements are high enough to need a dedicated turning lane. The following is a description of the four junction layout types.

#### *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

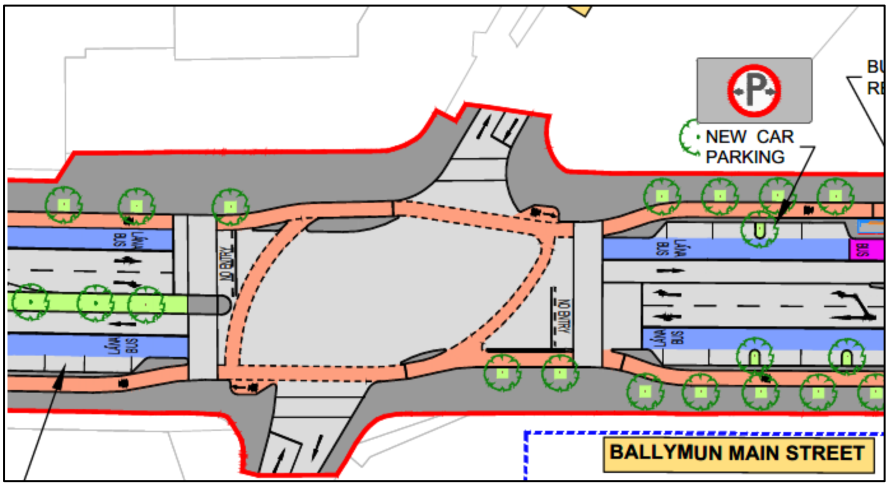



***Figure 5-1: Junction Type 1 Proposed Shangan Road Junction***

#### *5.3.3.2* Junction Type 2

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

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

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

A full Junction Type 2 has not been applied to the Proposed Scheme, however the Proposed Scheme has a number of ‘hybrid’ junctions, which comprise of a Junction Type 2 and another junction type, as shown in Figure 5-2 below. In this instance, a left turn pocket is provided in the Outbound direction due to high demand for this manoeuvre, as the Junction Type 2 layout, while the Inbound direction, without such a left turning lane, follows a Junction Type 1 layout.

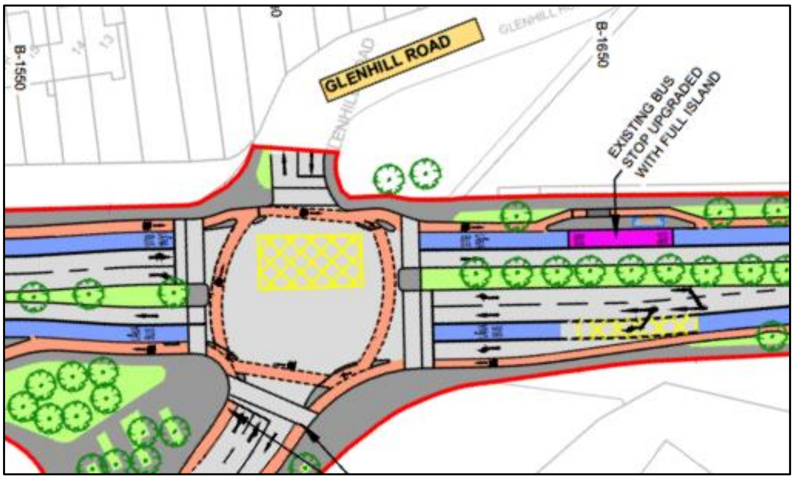



***Figure 5-2: Junction Type 2 Proposed Glenhill Road Junction***

#### *5.3.3.3 Junction Type 3*

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

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

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

*Figure 5-3 - - Example of Junction Type 3 from BCPDG*

Junctions Type 3 has not been applied to the Proposed Scheme

#### *5.3.3.4 Junction Type 4*

Junction Type 4, described at BCPDG Section 7.4.4, is a signalised junction with an inbound and outbound bus lane, but also positions the pedestrian crossings on the inside of the cycle lanes across the arms of the junction. Pedestrian crossing distances are minimised as a result. Signalised pedestrian crossings are proposed across the cycle tracks to allow pedestrians to cross from the footpath to the pedestrian crossing landing areas, thus avoiding uncontrolled pedestrian – cyclist conflict. The key design features and considerations relating to this junction type are as follows:

- An orbital cycle track is provided, with controlled crossing points to allow pedestrians to cross to large islands within a central signal controlled area
- Left turning cyclists can effectively bypass the junction, while giving way to pedestrians crossing as well as cyclists already on the orbital cycle track
- Pedestrians and cyclists can cross at the same time due to the segregated and non-conflicting crossings;
- Signal controlled pedestrian crossing distances are reduced when compared to traditional junction layouts, due to the face that pedestrians cross the cycle track in a separate signalised movement. Pedestrian crossings are also close to the pedestrian desire line. However the number of crossings for pedestrians is increased as pedestrians must cross the cycle track to access the central signal controlled area.

Junction Type 4 is chosen for the following reasons:

- High incidence of HGV movements e.g. at industrial estates or where two major regional roads meet;
- Suburban setting and lower pedestrian volumes.

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

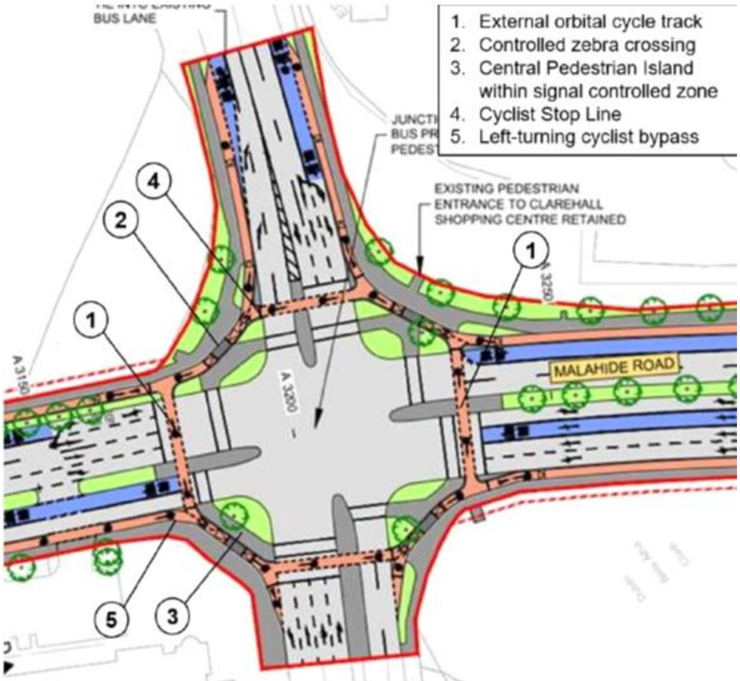



***Figure 5-4 - Example of Junction Type 4 from BCPDG***

Junctions Type 4 has not been applied to the Proposed Scheme.

### 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 the Appendix L

*Table 5-2: Major Junctions*

| No. | Junction Location | Type | Summary |
|---|---|---|---|
| 1 | Santry Cross: Ballymun Road / Santry Ave. | 1 | Pedestrian crossings shortened on the east and west arms.<br>New pedestrian crossing on north arm.<br>Protected cycle tracks.<br>Bus lanes to stop lines. |
| 2 | Collins Avenue / Ballymun Road | 2 | Left-slip lanes removed on east side.<br>Bus lanes to stop lines.<br>Segregated left-turn lanes on Ballymun Road.<br>Protected cycle tracks. |
| 3 | Griffith Avenue Gyratory:<br>St. Mobhi Road / Ballymun Road | 1 | New southbound right-turn to the western side of the traffic gyratory system. |
| 4 | Griffith Avenue Gyratory:<br>St. Mobhi Road / Griffith Avenue | 1 | No left-turn southbound. Traffic diverted around the western and southern sides of the traffic gyratory system.<br>Proposed northbound bus gate here, no through general traffic except buses, taxis and bicycles.<br>Two-way east-west cycle route. |
| 5 | Griffith Avenue Gyratory:<br>Griffith Avenue / Ballymun Road | 1 | New southbound entry on north arm.<br>New eastbound exit on east arm.<br>Bus lane outbound on east arm.<br>Two-way east-west cycle route with protected corners. |
| 6 | Botanic Road / St. Mobhi Road | 1 | Southbound signal controlled priority for bus.<br>New pedestrian crossing on south arm.<br>Left slip lane removed at SW corner and shorter pedestrian crossing.<br>Protected cycle tracks. |
| 7 | Hart's Corner<br>Botanic Road / Prospect Way | 1 | Existing pedestrian crossings moved from the central island and replaced with direct crossings on each entry arm.<br>Two-way cycle route from Botanic Road (south) to Prospect Way (west).<br>Northbound signal controlled priority for bus. |
| 8 | Hart's Corner<br>Finglas Road / Prospect Way | 1 | Two-way cycle route from Prospect Way (east) to Finglas Road (north). |
| 9 | Hart's Corner<br>Botanic Road / Finglas Road | 1 | Northbound bus lane extended along Finglas Road.<br>New pedestrian crossings on northern arms of junction.<br>Two-way cycle route on eastern side. |
| 10 | Whitworth Road / Prospect Road / Phibsborough Road | 1 | Bus lanes to stop line on Prospect Road and Phibsborough Road.<br>New pedestrian crossing on Prospect Road (north arm).<br>Two-way cycle route on eastern side with toucan crossing on Whitworth Road.<br>Southbound signal controlled priority for bus. |
| 11 | Doyle's Corner:<br>Phibsborough Road / North Circular Road | 1 | Bus lanes to stop lines on Phibsborough Road |
| 12/13 | Phibsborough Road / Western Way / Constitution Hill / Broadstone | 1 | Closely spaced pair of tee-junctions on either side of LUAS Green Line crossing of Constitution Hill.<br>Bus lanes to stop lines on Phibsborough Road<br>Additional pedestrian crossing between the LUAS crossing and Broadstone. |
| 14 | North King Street / Church Street | 1 | Bus lane to stop lines on Church Street.<br>Direct crossings for pedestrians on all arms of the junction<br>Cycle lanes on all arms of the junction with protected corners.<br>Southbound signal controlled priority for bus. |
| 15 | Church Street Lower / Arran Quay | 2 | Southbound bus lane to stop line with left-turn lane on inside. |

| No. | Junction Location | Type | Summary |
|---|---|---|---|
| 16 | Wellmount Road / Finglas Village | 2 | Southbound bus lane extended through pair of tee-junctions.<br>Left-turn lanes for traffic.<br>New pedestrian crossing signals on south, east and west arms.<br>New cycle tracks through junction with protected corners. |
| 17 | Tolka Valley Road / Finglas Road | 2 | Northbound left-turn traffic lane.<br>New cycleway facilities on Tolka Valley Road |
| 18 | Old Finglas Road / Finglas Road | 2 | Southbound left-turn traffic lane.<br>Additional pedestrian crossings on east and south arms |
| 19 | Ballyboggan Road / Finglas Road | 2 | Northbound left-turn traffic lane and left-slip lane removed.<br>Shorter and simpler pedestrian crossings |

***Table 5-3: Moderate Junctions***

| No. | Junction | Type | Summary |
|---|---|---|---|
| 1 | St. Margaret's Road / Ballymun Road | 1 | Northbound bus lane with left-turn to St. Margaret's Road.<br>Left-slip lanes removed, and pedestrian crossings shortened.<br>Cycle tracks through the junction. |
| 2 | Northwood Avenue / Ballymun Road | 1 | Southbound bus lane starts downstream of the junction.<br>Left-slip lanes removed, and pedestrian crossings shortened.<br>Additional pedestrian crossing on northern arm.<br>Cycle tracks through the junction. |
| 3 | Shangan Road / Ballymun Road | 1 | General traffic reduced from 2 through lanes to 1 on Ballymun Road.<br>Pedestrian crossings shortened.<br>Bus lanes to the stop lines.<br>Cycle tracks through the junction. |
| 4 | Botanic Avenue / St. Mobhi Road | 1 | Southbound bus lane to the stop line.<br>Cycle tracks through the junction. |
| 5 | North Brunswick Street / Church Street | 1 | Dedicated pedestrian and cycle crossings<br>Bus priority inbound and outbound proposed |
| 6 | Finglas Place / Finglas Road | 2 | Proposed new traffic signals.<br>Southbound left-turn lane.<br>New cycle and pedestrian crossing facilities. |
| 7 | Glenhill Road / Finglas Road / Clearwater Shopping Centre | 2 | Slip lanes and corner islands removed for shorter pedestrian crossings.<br>Segregated southbound bus lane to the stop line not shared with left-turn traffic.<br>Segregated northbound bus lane to the stop line with a separate left-turn lane on the inside. Left-turn traffic segregated from bus and cyclist traffic.<br>4 pedestrian and cyclist crossings where there are 2 at present.<br>Protected corners and turning facilities for cyclists. |
| 8 | Slaney Road / Finglas Road | 1 | Pedestrian crossing distance shortened at east arm. |

***Table 5-4: Minor Junctions***

| No. | Junction | Type | Summary |
|---|---|---|---|
| 1 | Gateway Crescent / Ballymun Road | 1 | General traffic reduced from 2 through lanes to 1 on Ballymun Road.<br>Pedestrian crossings shortened.<br>Bus lanes to the stop lines.<br>Cycle tracks through the junction. |
| 2 | St. Pappin Road / Ballymun Road | 1 | Ballymun Road pedestrian crossing moved from north to south arm. |
| 3 | St. Canice's Road / Ballymun Road | 1 | New traffic signals. |
| 4 | Connaught Street / Phibsborough Road | 1 | Northbound bus lane to the stop line.<br>New southbound bus lane downstream.<br>Additional pedestrian crossing on northern arm.<br>Pedestrian staging islands removed and wrap-around stage. |
| 5 | Church Street Lower / May Lane / Mary's Lane | 1 | Bus lanes to the stop lines in both directions.<br>Signal controlled priority for Northbound buses. |
| 6 | Church Street Lower / Chancery Street / LUAS Red Line crossing | 1 | Bus lanes to the stop lines in both directions.<br>Signal controlled priority for southbound buses. |
| 7 | Finglas Road / Church Street (West) | 1 | Left-in / left-out junction on the western side only.<br>Northbound bus lane provided through the junction.<br>Northbound cycle track provided through the junction.<br>Signal toucan crossing provided on the southern side across the Finglas Road.<br>Signal pedestrian crossing provided on the eastern Church Street arm. |
| 8 | The Griffith / Finglas Road | 1 | Pedestrian crossing on Finglas Road straightened with stagger removed. |
| 9 | Claremont Court / Finglas Road | 1 | Pedestrian crossing on Finglas Road straightened with stagger removed. |

#### *5.3.5.1* Roundabouts

There is only one existing roundabout on this Proposed Scheme at the northern end of the Finglas Alignment and no new roundabouts are proposed.

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

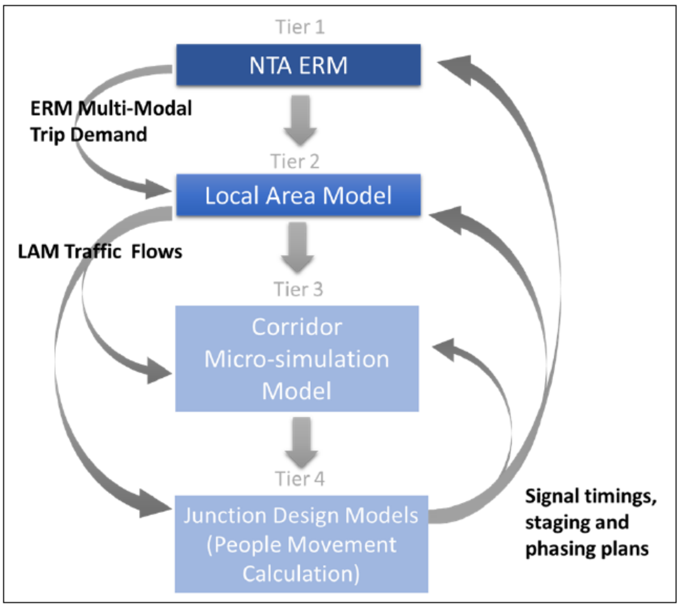



***Figure 5-5: Proposed Scheme Traffic Modelling Hierarchy***

### 5.4.2 People Movement

An assessment has been carried out to determine the potential people movement the Proposed Scheme will generate. This adopts a policy led approach to the design of junctions, which prioritises the people movement and maximisation of sustainable modes i.e. walking, cycling and bus in advance of the consideration and management of general traffic movements at junctions. The outputs of the calculator provide an estimate of people movement per mode per junction and the respective percentage mode share. Figure 5-6 illustrates the People Movement Formulae.

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

***Figure 5-6: 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 5-7 illustrates an initial 2028 AM distribution plot, whilst Figure 5-8 illustrates a final iterated distribution plot. Figure 5-7 illustrates more significant traffic dispersion onto the surrounding road network, whilst the refined Figure 5-8 demonstrates a more optimised Proposed Scheme, where traffic dispersion has been minimised without compromising the sustainable modes.

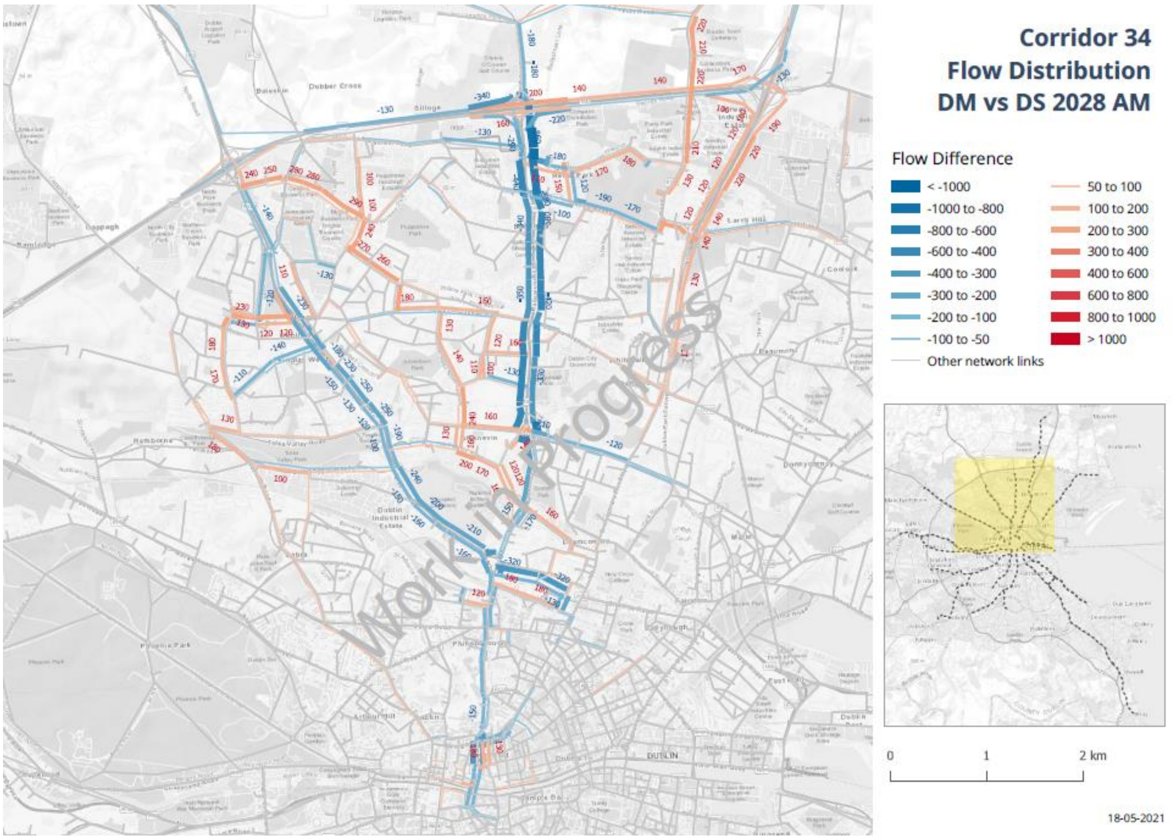



*Figure 5-7: An initial 2028 AM Peak DLAM Distribution Plot*

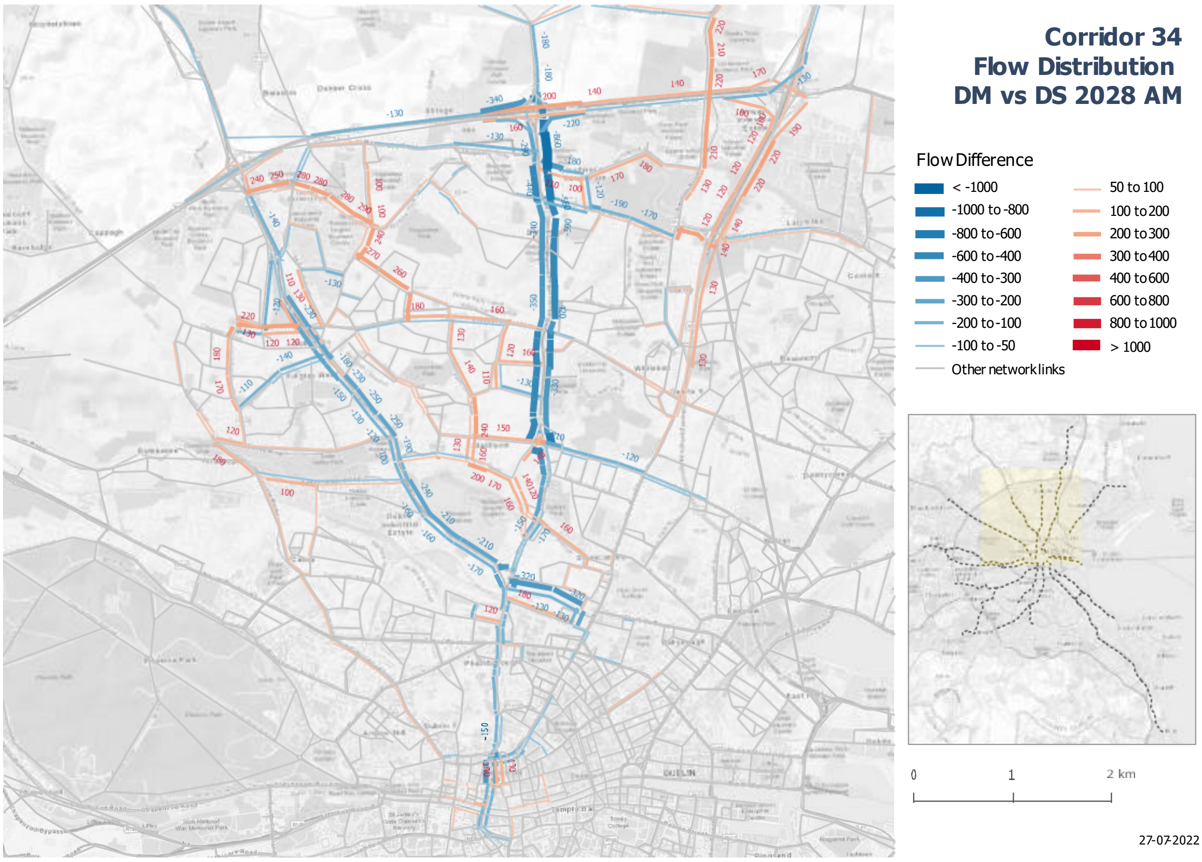



*Figure 5-8: Optimised and Iterated 2028 AM Peak DLAM Distribution Plot*

### 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 |
| St. Margaret's Road / Ballymun Road | 383 | 423 | 381 | 401 |
| Northwood Avenue / Ballymun Road | 410 | 420 | 419 | 429 |
| Santry Cross: Ballymun Road / Santry Ave. | 649 | 709 | 613 | 703 |
| Shangan Road / Ballymun Road | 598 | 668 | 568 | 658 |
| Gateway Crescent / Ballymun Road | 445 | 447 | 420 | 424 |
| Collins Avenue / Ballymun Road | 546 | 559 | 513 | 551 |
| St. Pappin Road / Ballymun Road | 458 | 478 | 436 | 476 |
| St. Canice's Road / Ballymun Road | 455 | 465 | 449 | 469 |
| St. Mobhi Road / Griffith Avenue | 546 | 578 | 542 | 576 |
| Griffith Avenue / Ballymun Road | 385 | 410 | 376 | 427 |
| Botanic Avenue / St. Mobhi Road | 508 | 578 | 544 | 588 |
| Botanic Road / St. Mobhi Road | 484 | 561 | 503 | 573 |
| Botanic Road / Prospect Way | 839 | 840 | 734 | 744 |
| Finglas Road / Prospect Way | 876 | 900 | 842 | 862 |
| Botanic Road / Finglas Road | 1162 | 1179 | 1118 | 1143 |
| Whitworth Road / Prospect Road | 1127 | 1132 | 1076 | 1082 |
| North Brunswick Street / Church Street | 389 | 412 | 355 | 362 |
| North King Street / Church Street | 542 | 580 | 523 | 549 |
| Wellmount Road / Finglas Village | 502 | 512 | 418 | 438 |
| Finglas Place / Finglas Road | 463 | 483 | 432 | 452 |
| Glenhill Road / Finglas Road / Clearwater Shopping Centre | 446 | 490 | 435 | 506 |
| The Griffith / Finglas Road | 440 | 523 | 440 | 540 |
| Tolka Valley Road / Finglas Road | 518 | 588 | 488 | 568 |
| Old Finglas Road / Finglas Road | 614 | 619 | 568 | 590 |
| Ballyboggan Road / Finglas Road | 600 | 602 | 552 | 553 |
| Slaney Road / Finglas Road | 487 | 493 | 474 | 488 |
| Claremont Court / Finglas Road | 490 | 511 | 472 | 486 |

#### *5.4.4.3* LINSIG Results

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

***Table 5-6: Signalised Junctions Analysis***

| No | Junction Name | Cycle Time (Seconds) | | | Practical Reserve Capacity (%) | |
|---|---|---|---|---|---|---|
| | | Do Minimum | Do-Something AM | Do-Something PM | AM Peak Hour | PM Peak Hour |
| **BALYMUN ALIGNMENT** | | | | | | |
| 1 | St. Margaret's Road / Ballymun Road | 75 | 120 | 110 | 1.6 | 2.3 |
| 2 | Northwood Avenue / Ballymun Road | 90 | 120 | 110 | 4.5 | 1.5 |
| 3 | Santry Cross: Ballymun Road / Santry Ave. | 120 | 120 | 120 | 1.5 | -31.1 |
| 4 | Shangan Road / Ballymun Road | 120 | 120 | 120 | 0.3 | 3.1 |
| 5 | Gateway Crescent / Ballymun Road | 90 | 120 | 120 | 2 | 19.9 |
| 6 | Collins Avenue / Ballymun Road | 120 | 120 | 105 | -3.0 | 5.2 |
| 7 | St. Pappin Road / Ballymun Road | 120 | 120 | 115 | 16.7 | 24.6 |
| 8 | St. Canice's Road / Ballymun Road | Unsignalised | 120 | 115 | 8.4 | 6.7 |
| 9 | Griffith Avenue Gyratory/ Ballymun Road | 120 / 60 / 120 | 120 / 60 / 120 | 120 / 60 / 120 | 5.6 | 12.6 |
| 10 | Botanic Avenue / St. Mobhi Road | 110 | 115 | 120 | 3.3 | -57.8 |
| 11 | Botanic Road / St. Mobhi Road | 120 | 110 | 120 | 18.6 | 0.4 |
| 12 | Hart's Corner Gyratory – 3 junctions | 120 | 105 | 105 | 7.3 | 5.5 |
| 13 | Whitworth Road / Prospect Road | 120 | 110 | 115 | 5.9 | 0.8 |
| 14 | Connaught Street / Phibsborough Road | 120 | 110 | 110 | 0.3 | 14.9 |
| 15 | Doyle's Corner | 110 | 120 | 120 | 13.5 | 1.2 |
| 16 | Phibsborough Road / Western Way | 66 | 90 | 90 | 1.8 | 4.8 |
| 17 | North Brunswick Street / Church Street | 120 | 70 | 60 | 1.0 | 9.4 |
| 18 | North King Street / Church Street | 120 | 120 | 120 | 1.5 | 6.7 |
| **FINGLAS ALIGNMENT** | | | | | | |
| 20 | Wellmount Road / Finglas Road | 120 | 120 | 120 | -21.8 | -22.3 |
| 21 | Finglas Place / Finglas Road | Un-signalised | 120 | 120 | 1.8 | 25.4 |
| 22 | Glenhill Road / Finglas Road | 120 | 120 | 120 | 4.7 | 0.1 |
| 24 | Tolka Valley Road / Finglas Road | 122 | 120 | 120 | -13.9 | 0.6 |
| 25 | Old Finglas Road / Finglas Road | 105 | 120 | 120 | -3.4 | 0.8 |
| 26 | Ballyboggan Road / Finglas Road | 103 | 120 | 120 | 6.5 | 30.8 |
| 27 | Slaney Road / Finglas Road | 120 | 120 | 120 | 1.2 | -5.4 |
| 28 | Claremont Court / Finglas Road | 120 | 120 | 120 | 27 | 0.5 |

# 6 Ground Investigations 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.

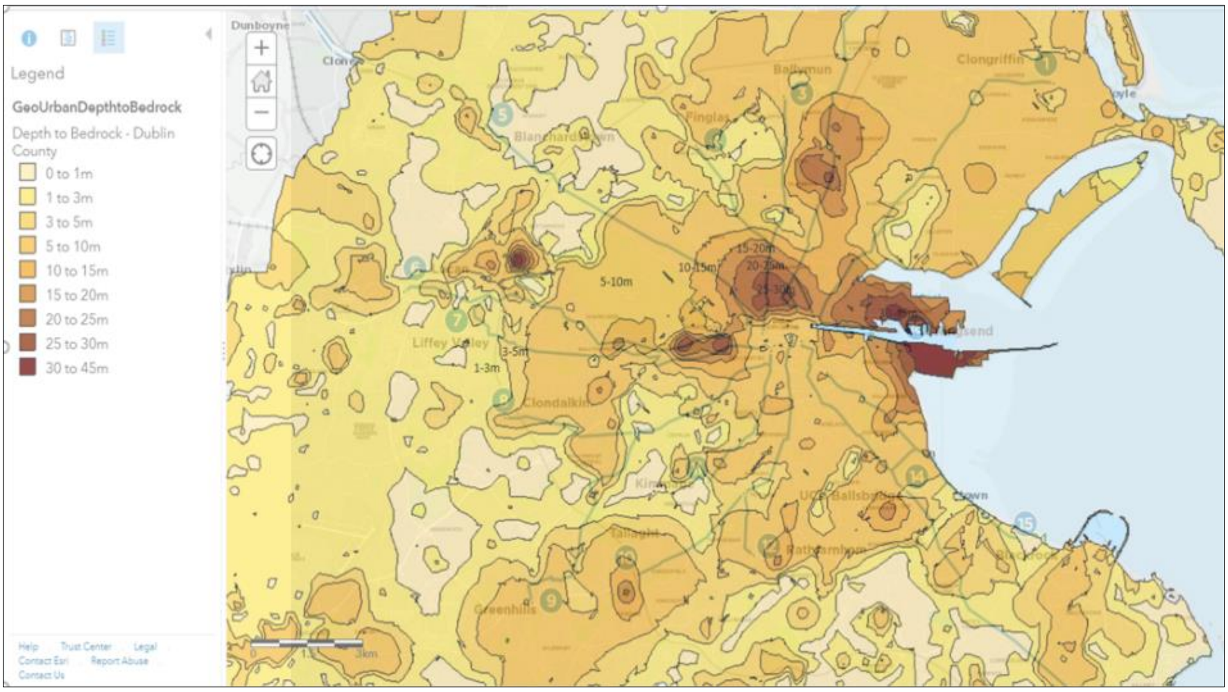



***Figure 6-1: Depth of Bedrock from the Geological Survey Ireland website***

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. | Borehole Depth (m) – Cable Percussion | Borehole Depth (m) – Rotary Core | Notes |
|---|---|---|---|---|
| Ballymun 02 | R3-CP03 | 7.1 | - | |
| Ballymun 03 | R3-CP07 | 6.0 | - | |
| | R3-CP08 | 4.8 | - | Changed to WS03 (Drive-in Windowless Sampler) |
| Ballymun 04 | R3-CP09 | - | 20 | Changed to RC01 |
| | R3-CP10 | - | 20 | Changed to RC02 |
| | R3-CP11 | - | 20 | Changed to RC03 |
| | R3-CP12 | 1.5 | - | Changed to WS01 (hand window sample) |
| | R3-CP13 | 1.0 | - | Changed to WS02 (hand window sample) |
| | R3-CP14 | 9.0 | - | |

In addition, other ground investigation data was obtained from the proposed MetroLink scheme located near this Proposed CBC Scheme at the railway crossings just north of Phibsborough: 4 boreholes.

### 6.3.1 Laboratory Testing

18 disturbed samples were taken at each change of soil consistency or between SPT tests and 1 undisturbed sample (UT100) where ground conditions permit.

Geotechnical testing consisted of 19 moisture content, 8 Atterberg limits and 10 Particle Size Distribution. Soil strength testing consisted of 1 UU Triaxial Test, 2 Vane tests and 2 Shear Box.

Environmental & Chemical testing consisted of 23 Suite E samples and 2 PH and Organic matter content tests.

From Glasnevin and MetroLink Phase 4 GI works, 3No. Inspection Pit, 2 No. Cable Percussion Boreholes followed by Rotary Core Boreholes to a maximum depth of 40m BGL, 2 No. Rotary Core Boreholes to a maximum depth of 35.4m BGL; 40 SPT tests at 1 metre intervals alternating with disturbed samples and 6 GWL recordings.

40 disturbed samples were taken at each change of soil consistency or between SPT tests. Geotechnical testing consisting of 40 moisture content, 25 Atterberg limits and 24 Particle Size Distribution. Soil strength testing consisted of 9 CU Triaxial Tests, 3 CU Triaxial Tests with PWP and 2 Shear Box. Rock strength testing included 12 Unconfined Compressive Strength (UCS) testing, 13 Point Load Tests and 3 Brazilian Tests.

## 6.4 Overview of soil 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 either from the surface or beneath the Topsoil/Surfacing and were present to depths of between 1.40m and 6.50m BGL.

Made ground deposits were described generally as either dark grey / brown, sandy gravelly Clay with occasional cobbles or greyish brown clayey sandy Gravel. In some investigation holes the made ground contained occasional fragments of concrete, ceramic, red brick metal, rubber and wood.

Soil classifies as CLAY of intermediate to high plasticity, with a plasticity index ranging between 17% and 40%.

The Particle Size Distribution tests confirm percentages of sands and gravels ranging between 10% and 42% and 24% and 47%, respectively.

PH and total organic carbon (TOC) were determined at boreholes R03-CP03 and C03-CP08, at 1m and 0.5m depth respectively. Organic matter content (OMC) was estimated from TOC. Average values of PH 7.8, TOC 2.7 % w/w C and OMC 4.6 % w/w were obtained.

Samples R03-WS02 and R03-CP14 showed high values (>6% w/w C) of total organic carbon at Suite E tests. Asbestos was detected at 0.5m depth at borehole R03-CP08.

### 6.4.2 Cohesive deposits

Cohesive deposits were encountered beneath the Made Ground and were described typically as brown sandy gravelly CLAY or grey / dark grey sandy gravelly CLAY with occasional cobbles and boulders.

The strength of the cohesive deposits typically increased with depth. In the majority of the exploratory holes, it was firm below 3.0m BGL, stiff below 5.0m BGL and very stiff below 7.0m BGL

The geotechnical testing carried out on recovered soil samples generally confirm the descriptions on the logs and classified the deposits as CLAY of low, with a plasticity index ranging between 14% and 17%.

The Particle Size Distribution tests confirm generally well-graded deposits with percentages of sands and gravels ranging between 14% and 31% and 20% and 56%, respectively, with average values of 22% of sand and 34% of gravel.

### 6.4.3 Bedrock

The rotary core boreholes recovered weak to medium strong thinly laminated to thickly bedded grey/dark grey fine-grained LIMESTONE locally interbedded with medium strong dark grey fine grained laminated MUDSTONE.

The depth to rock is of 18.5m BGL. RQD values are very poor but presumably because they belong to the upper weather zone.

## 6.5 Summary of Geotechnical Interpretation Report

For the Proposed scheme, the lithology and soil strength properties has been determined based on the GI findings as shown in Table 6-3.

***Table 6-3: Geotechnical Parameters***

| Layer | Depth (m) | SPT | Undrained shear strength, $c_u$ (kPa) |
|---|---|---|---|
| Topsoil | 0 to 0.5 m | - | - |
| Made Ground: Gravel / Brown Clay (possibly UBrBC) / Grey Clay | 0.5 to 4m | 8 | 50 |
| Stiff / Very stiff Grey or Dark Grey Boulder Clay (UBkBC) | 4 to 12.5 | 20-50 | 250 |
| Very stiff Brown Boulder Clay (LBrBC) | 12.5 to 17.5 | 50 | 325 |
| Gravel | 14 to 18.5 | 50 | 325 |
| Limestone | >18.5 | - | - |

- 2 Vane tests at Made Ground layer UBrBC, defined as brown slightly sandy slightly gravelly Clay have shown Peak shear strength values of about 20 KPa.
- 1 undrained triaxial UU test at UBrBC layer, defined as stiff brown slightly sandy gravelly Clay, has given a shear strength of about 80 KPa.
- 2 Shear Box tests at UBkBC layer, defined as slightly sandy slightly gravelly Clay, shown angles of peak shearing resistant between 32 and 36 degrees and effective cohesion between 5 and 15 kPa.

From Glasnevin project 9 triaxial CU tests. Layers of UBkBC and LBrBC shown values between 600 and 700 kPa. Also 1 triaxial CU from Thameslink project on LBrBC showing a value of 800 kPa.

From Metrolink 2 Shear Box tests, one at Made Ground layer showing an angle of peak shearing resistant of 29 degrees and effective cohesion of 6 kPa, and another at the bottom Gravel layer with an angle of peak shearing resistant of 34 degrees and no effective cohesion.

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

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## 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 summarised in Table 6-4:

***Table 6-4: Groundwater levels***

| Date: | 20/4/21 | 16/6/21 |
|---|---|---|
| R3-CP02 | - | 10.03 |
| R3-CP07 | 1.29 | 1.27 |
| R3-CP14 | - | 1.25 |
| | **9/2/18** | **14/2/18** |
| Glasnevin BH01 | 9.80 | 9.80 |
| Glasnevin BH02A | 10.10 | 11.25 |
| | **30/7/20** | **31/7/20** |
| Metrolink GBH01 | 8.97-9.06 | - |
| Metrolink GBH02 | - | 10.47-11.2 |

## 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 6-5.

***Table 6-5: Geotechnical Conclusions for Structures***

| Structure | Permanent loads / Variable loads (KN) | Borehole Ref. | Expected Depth to Bedrock | Depth to encountered Bedrock | Depth to $N_{SPT}$ values of Refusal | Piles estimated length (m) |
|---|---|---|---|---|---|---|
| Ballymun 01 | 454 / 120 | - | 15-20m | - | - | 9.5 |
| Ballymun 02 | 424 / 179 | R3-CP03 | 15-20m | - | 5m | 8.5 |
| Ballymun 03 | 82 / 169 | R3-CP07 | 15-20m | - | 5m | 5.5 |
| | | R3-WS03 | 15-20m | - | 5m | 5.5 |
| Ballymun 04 | 298 / 425 | R3-RC01 | 20-25m | 18.5m | 9.5m | 10.0 |
| | | R3-RC02 | 20-25m | 18.5m | 6.5m | 7.0 |
| | | R3-RC03 | 20-25m | 18.5m | 8m | 8.5 |
| | | R3-WS01 | 20-25m | - | - | - |
| | | R3-WS02 | 20-25m | - | - | - |
| | | R3-CP14 | 20-25m | - | 5m | 6.0 |
| Ballymun 04 | 298 / 425 | R3-RC01 | 20-25m | 18.5m | 9.5m | 14.5 |
| | | R3-RC02 | 20-25m | 18.5m | 6.5m | 12.0 |
| | | R3-RC03 | 20-25m | 18.5m | 8m | 12.0 |
| | | R3-WS01 | 20-25m | - | - | - |
| | | R3-WS02 | 20-25m | - | - | - |
| | | R3-CP14 | 20-25m | - | 5m | 11.0 |

At Ballymun 05 a retaining wall is proposed, for which the geotechnical parameters derived are summarised in Table 6-6.

***Table 6-6: Geotechnical Parameters for Structure Ballymun 05 Retaining Wall***

| Route 3 Ballymun 04 | Depth (m) | Dry weight (KN/m$^3$) | Undrained shear strength, $c_u$ (kPa) | Young's modulus E (MPa) | Undrained Young's modulus (MPa) | Friction angle φ' (º) | Cohesion c' (KPa) | Poisson's coefficient (-) | Earth pressure coefficient at rest $K_0$ (-) | Horizontal spring stiffness (KN/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Made Ground | 0 to 4.5m | - | 50 | 25 | - | 28 | 0 | 0.3 | 1 | 3,500 – 5,000 |
| Grey Boulder Clay (UBkBC) | 4.5 to 12.5 | 22.5 | 250 | 80 | 100 | 30 | 0 | 0.2 | 1.3 | 17,000 – 20,000 |
| Brown Boulder Clay (LBrBC) | 12.5 to 17.5 | - | 325 | - | 120 | 35 | 0 | 0.2 | 1.3 | 20,000 – 25,000 |
| Mudstone | 17.5 to 19.5 | - | 325 | - | - | - | - | - | - | - |
| Limestone | >19.5 | 25 | 500 | 800 | 1000 | 45 | 0 | . | - | 35,000 – 37,500 |

# 7 Pavement, Kerbs, Footways 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.

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 following data sources were available:

- 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.

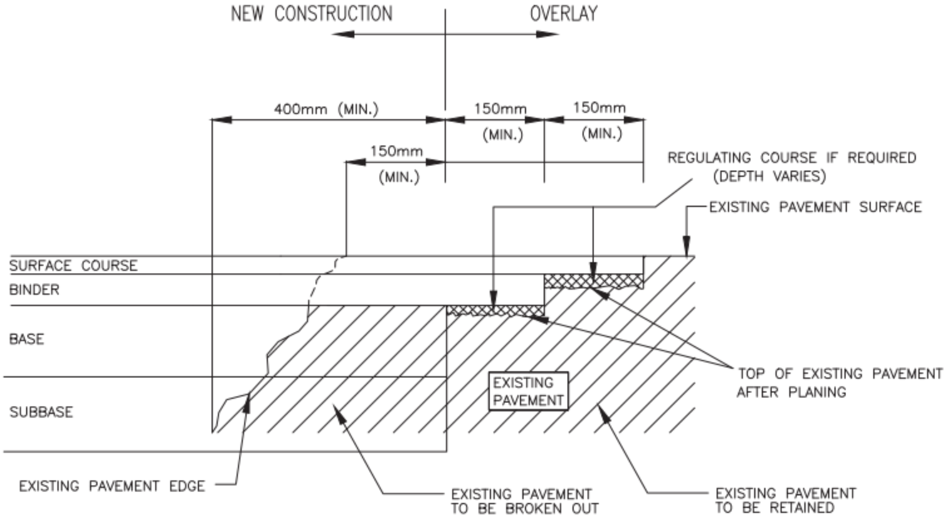


***Figure 7-1 Longitudinal Joint between new construction and existing road as per CC-SCD-00704-02***

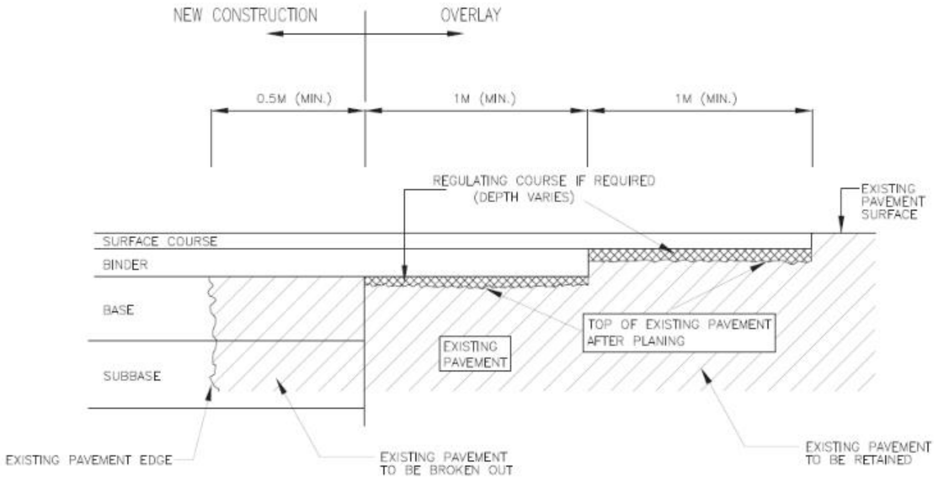


***Figure 7-2 Transversal Joint between new construction and existing road as per CC-SCD-00704-03***

#### *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.

The old concrete roads are understood to extend to the following limits on the Proposed Scheme:

- The Ballymun Alignment: to the Griffith Avenue gyratory and the northern end of St. Mobhi Road.

- Finglas Alignment: To Glasnevin Cemetery at Claremont Lawns where the road widens to a dual carriageway.

#### 7.1.4.3.2 Suburban Areas

As the growth of Dublin accelerated in the 1960's through the 1980's the main roads were mostly widened and reconstructed. Ballymun Road was widened to a dual carriageway north of the Griffith Avenue gyratory over a length of 2 km linking to the new suburb at Ballymun. The Finglas Road, which was part of National Route N2 at the time, was widened to a dual carriageway from Glasnevin Cemetery northward over a distance of 2 km in the 1970's, possibly in phases. Later the dual carriageway was extended through a bypass of Finglas Village over a distance of 1.3 km in the 1990's.


***Figure 7-3 Finglas Road at River Tolka in 1971 prior to the widening to dual carriageway***

Concrete was no longer used for road pavements on main roads from the 1960's onwards, although it remained the normal material for minor roads in residential and industrial areas, and there was a general shift towards flexible pavements as the radial roads were upgraded and widened.

The typical construction of the more modern urban radial routes in suburban areas constructed from the 1980's onwards is understood to be as follows:

- 40mm surface course often in Hot Rolled Asphalt. Some roads may have been resurfaced more recently in Stone Mastic Asphalt.
- 60mm of macadam binder course.
- 200mm thick (or possibly 150mm on lesser routes) Dense Bitumen Macadam road-base.
- 150mm to 300mm Sub-base.
- Capping Layer: possibly in occasional soft spots, but uncommon on the generally strong boulder clay with CBR >15%.

#### 7.1.4.3.3 Road Pavement Condition Assessment

***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.

Below, the results of those condition pavement surveys are assessed and detailed.

***RMO Pavement Survey***

Access to RMO dataset was granted with the information mentioned above. 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 Figures 7-4 and 7-5.

**Visual Inspections**

A visual inspection was undertaken along the length of the Proposed Scheme to provide an assessment for the condition of the pavements in addition to the recorded pavement condition data.

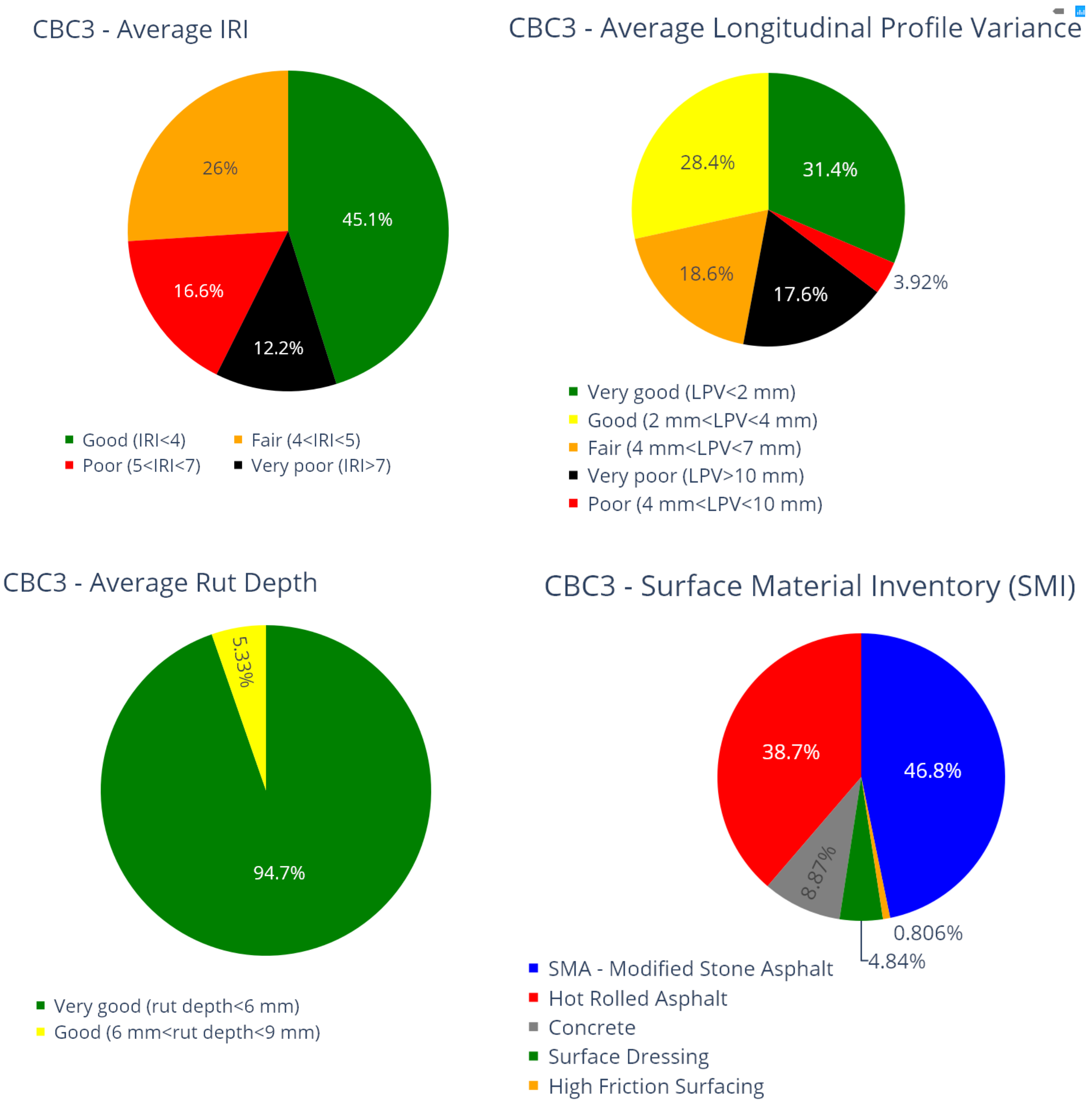


***Figure 7-4 Ballymun Alignment IRI, LPV, Rut depth and SMI. Source: RMO dataset***

Summarising, around 50% IRI and LPV range of 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 and Stone Mastic Asphalt (SMA).

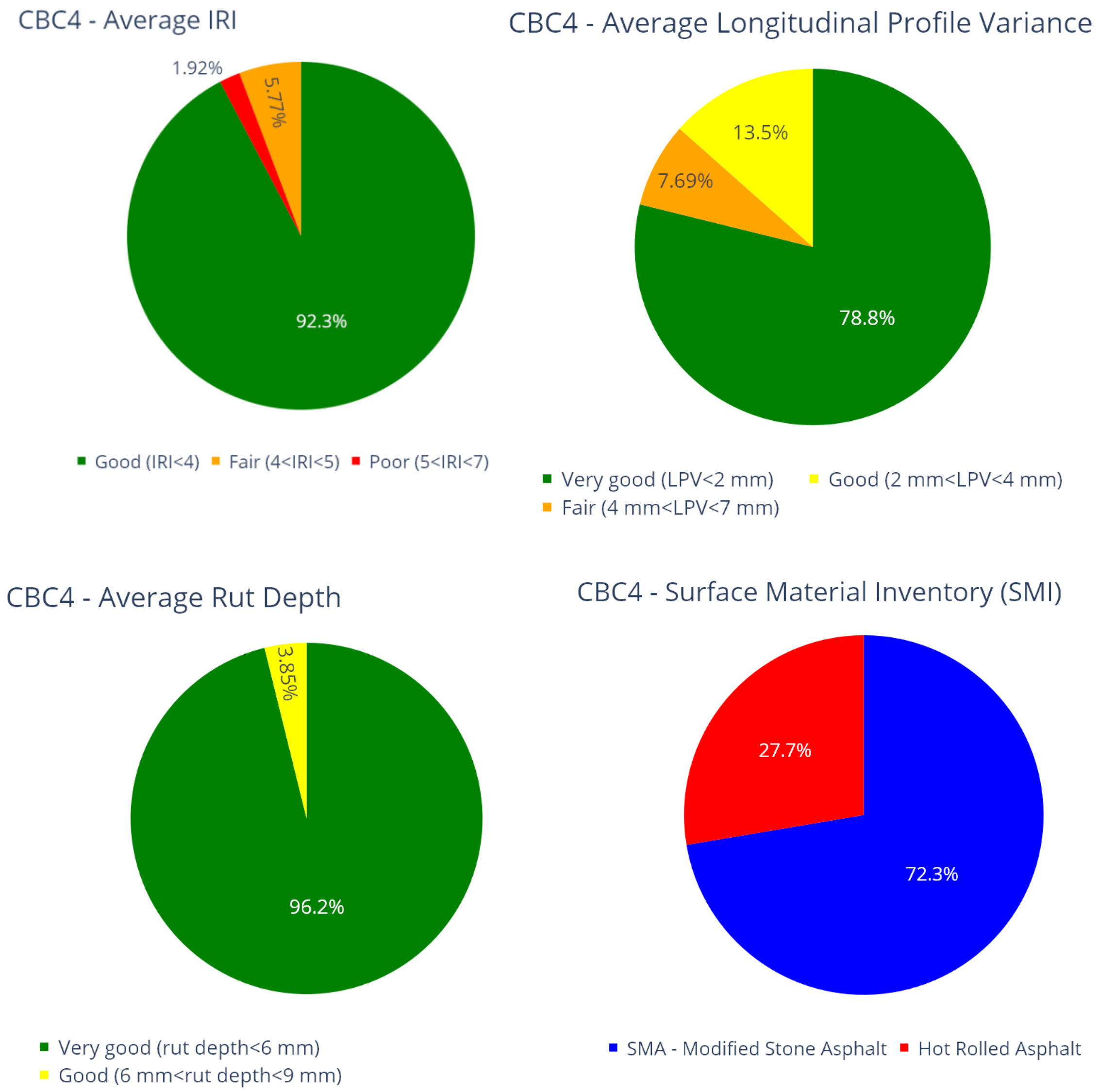


***Figure 7-5 Finglas Alignment IRI, LPV, Rut depth and SMI***

On the Finglas Alignment more than 90% 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 (28%) and Stone Mastic Asphalt (72%).

***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 7-6 CSC investigatory level depending on Site Category. Source: TII AM-PAV-06045***

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 each route:

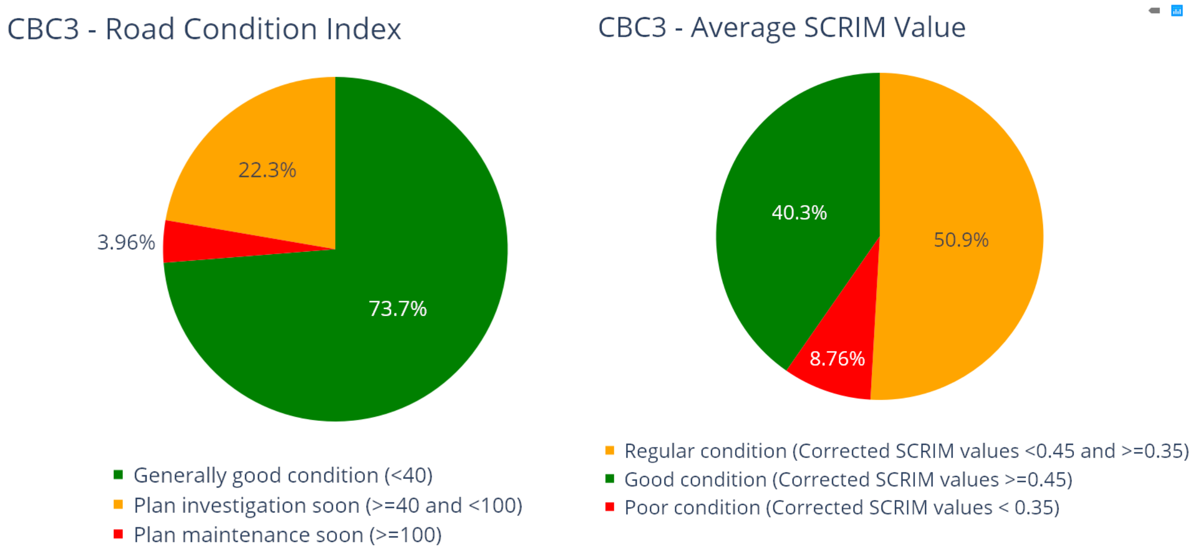


***Figure 7-7 Ballymun Alignment RCI and SCRIM condition***

The RCI survey along the Ballymun route indicates that the pavement is generally in good condition, around 74% are green, 22% amber and only 4% are in red. There are localised areas of poor condition, mainly near at major junctions, as Ballymun Road approaching Griffith Avenue, St. Mobhi Road from River Tolka to Botanic Avenue and Church Street south approaching Brunswick Street.

The SCRIM assessment indicates that the 50% of the road shows regular and poor condition. This means the surface restoration is required along Ballymun Road section (from Collins Avenue to Griffith Avenue), Botanic Road, Prospect Road, Phibsborough Road, Constitution Hill and Church Street.

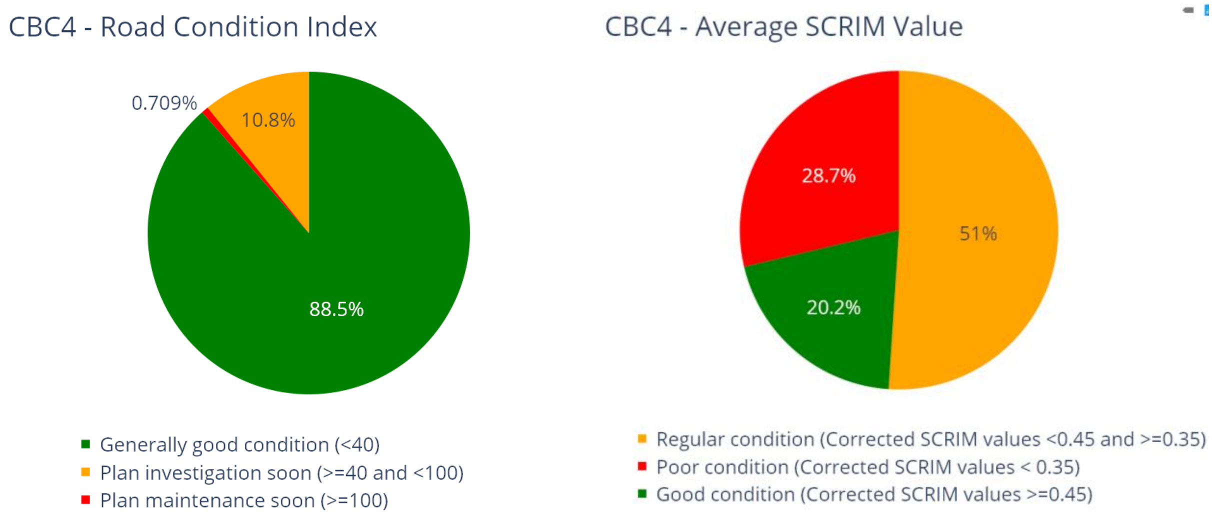


***Figure 7-8 Finglas Alignment RCI and SCRIM condition***

The RCI assessment indicates the good condition of the pavement along the Finglas Alignment, with few localised areas of poor condition, mainly near junctions with Church Street, Wellmount Road, Old Finglas Road and Ballyboggan Road. In contrast, SCRIM assessment indicates almost 80% of Finglas Road shows regular and poor condition in terms of skid resistance, except in the section between Church Street and Old Finglas Road, due to 2016 and 2019 pavement interventions to restore surface characteristics. (There has been some recent resurfacing in these areas since the times of the previous surveys).

***Subgrade condition***

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 Rehabilitation Strategy

### *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 7-11 Ballymun Alignment. Pavement Design Thickness for a range of different bus frequencies. The associated pavement thicknesses are shown in Figure 7- and Figure 7- in accordance with the relevant design standard for a 40 Year Design Life.

**ROAD PAVEMENT DESIGN** **Dublin Bus Connects**

ROD ROUGHAN & O'DONOVAN TYPSA

**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: | Ballymun | | | Status: | | | |
| Design by | SMG | | **Design Life:** | 40 | **years** | 365 | Year |

| **Bus Traffic** | Per Hour | Hours / day | AADT Bus |
|---|---|---|---|
| | 15 | 18 | 270 |

| **Traffic Data (AADT)** | Year | AADT | |
|---|---|---|---|
| Opening Year | 2024 | 270 | one-way |
| HCV Content | 100.0% | | |
| Growht factor: | 1.19 | | |

Total Cumulative HCV traffic **4,690,980**

**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 | **4,690,980** | **2.6** | **12.2** |

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

| | | | |
|---|---|---|---|
| Total Traffic in lane | million standard axles | 12.20 | msa |
| % in left hand lane (Refer to Figure 2.5 of HD 24/06) | | 100% | |
| **Design Traffic Loading** | | 12 | msa |

**Design Thickness for Flexible Pavement:**
Ref: Figure 4.2 of DN-PAV-03021 (formerlyDMRB Vol 7 TD 25-26)

| | | | | |
|---|---|---|---|---|
| Asphalt Concrete | 70/100 Pen | **300** | **mm** | |
| Asphalt Concrete | 40/60 Pen | **260** | **mm** | Selected |

***Figure 7-9 Ballymun Alignment. Design Traffic Loading***

**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: | **Finglas** | Status: | | | |
| Design by | SMG | **Design Life:** | **40** | **years** | 365 Year |

| | | | |
|---|---|---|---|
| **Traffic Data (AADT)** | Year | AADT | |
| Opening Year | 2024 | **270** | one-way |
| HCV Content | 100.0% | | |
| Growht factor: | 1.19 | | |

| **Bus Traffic** | Per Hour | Hours / day | AADT Bus |
|---|---|---|---|
| | **15** | 18 | 270 |

Total Cumulative HCV traffic **4,690,980**

**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 | **4,690,980** | **2.6** | **12.2** |

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

| | | | |
|---|---|---|---|
| Total Traffic in lane | million standard axles | 12.20 | msa |
| % in left hand lane (Refer to Figure 2.5 of HD 24/06) | | 100% | |
| **Design Traffic Loading** | | **12** | msa |

**Design Thickness for Flexible Pavement:**
Ref: Figure 4.2 of DN-PAV-03021 (formerlyDMRB Vol 7 TD 25-26)

| | | | | |
|---|---|---|---|---|
| Asphalt Concrete | 70/100 Pen | **300** | **mm** | |
| Asphalt Concrete | 40/60 Pen | **260** | **mm** | Selected |

***Figure 7-10 Finglas Alignment. 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 shown as red lines overlaid on Figure 4.2 of DN-PAV-03021.

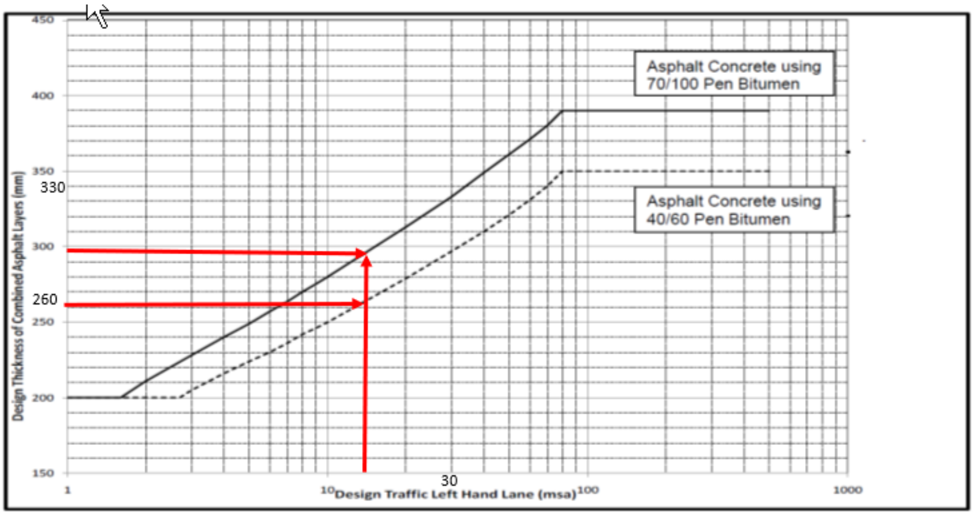


***Figure 7-11 Ballymun Alignment. Pavement Design Thickness***

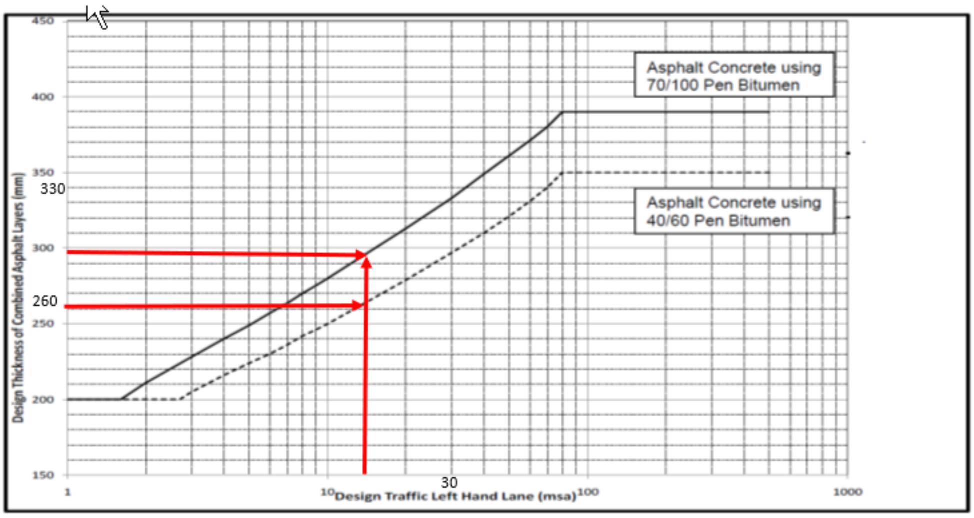


***Figure 7-12 Finglas Alignment. Pavement Design Thickness***

***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 7-3:

***Table 7-3 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 |

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.

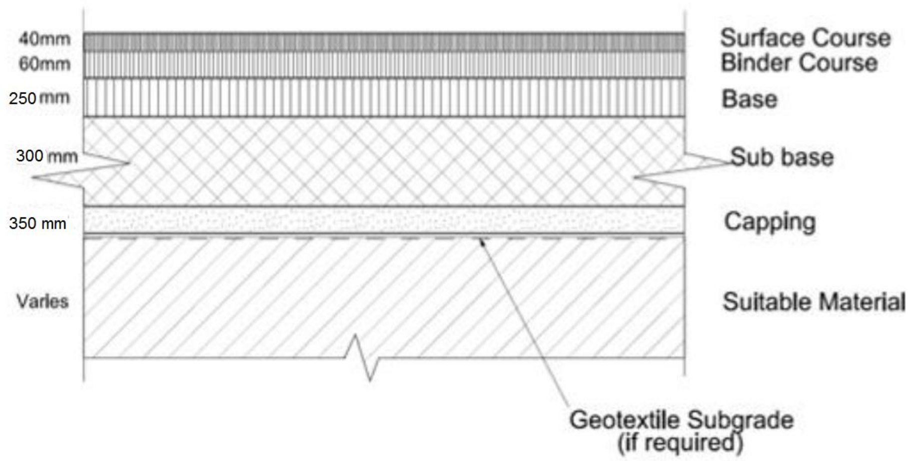


***Figure 7-13 Pavement Structure for Full Depth Construction***

##### 7.2.1.1.1 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 7-4 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 | New surface overlay | 40 mm PSMA wearing course |
| RCI<40 and SCRIM <0.35 | New surface overlay | 40 mm PSMA wearing course |
| 40 ≤RCI<100 | New surface and binder course | 40 mm PSMA wearing course+110 mm binder course |
| RCI ≥100 | New surface, binder, base and subbase course | 40 mm PSMA wearing course+110 mm binder course + 150 mm base course+ 300 mm subbase |

***Table 7-5 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. |

#### *7.2.1.2* Reuse and Recycling Considerations

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, Footways 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

Footway 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 necessary to consider the pedestrian and vehicular which the footway may to support.

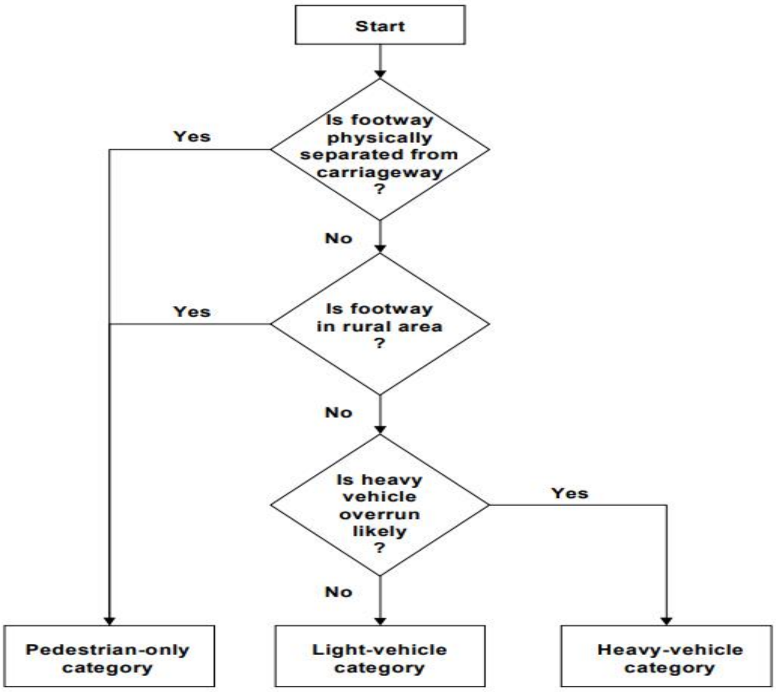


***Figure 7-14 Flowchart for Selection of Footway Category. Source: DN-PAV-03026. Footway Design***

- 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 footway is adjacent to a busy road and overrun is not prevented by some physical means, then the footway should be designed to sustain heavy vehicle overrun. For this category of footway 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 footway) But, in areas when see a significant amount of delivery or maintenance vehicles, pavement design shall be carried out according in TII HD 26 (7.2.3.2).

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

Off road cycleways will be constructed adjacent footways 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 footway geometry are the result of realignment of kerbs and changes in the configuration of junctions.

#### *7.3.1.3* Existing Pavement Condition Considerations

The footpath pavement conditions are quite mixed along the Proposed Scheme as described in the following sections.

##### 7.3.1.3.1 Ballymun Alignment

Starting in the northern area around St. Margaret's Road to Shangan Road there is predominantly an asphalt surface with some poured concrete areas. The conditions are moderate with some defects. The concrete kerbs show some separation from the pavement and weeds tend to grow in those areas. Through Ballymun Town Centre the footpaths and median are paved with small rectangular concrete pavers in different tones of grey. The kerbs are in granite stone. The pavement in this area is in very good condition.

***Figure 7-14 Asphalt and Concrete Footpath***

***Figure 7-15 Concrete Paved Median***

Further to the south there is mostly poured concrete surfaces. Most areas are in good condition, but there are patches in different types of materials. In some median crossings there are interlocking concrete pavers (0.10x0.20m) in herringbone patterns which do not integrate into the overall aesthetic of the general pavement design.

In Phibsborough Village some repaving works are needed, while some heritage pavers should be saved and reused.

Recent changes along the existing cycleway provided bollards to improve the segregation for the cycle lanes which have a red resin based surface treatment. These are along sections of Phibsborough Road southbound south of Doyle's Corner and along Church Street as shown in Figure 7-17.

***Figure 7-16 Surface treatment in existing cycle lanes***

##### 7.3.1.3.2 Finglas Alignment

Most of this route has poured concrete footpaths with asphalt patches where trenches have been repaired. The concrete is cracked in places. Most of the cycle lanes have lost the red wearing course and show the asphalt below. Around Hart's Corner the many kerbs are not high enough to provide adequate protection from traffic, and the extensive footpath repairs are required.

### 7.3.2 Pavement Design for Footways and Cycleways

#### *7.3.2.1* Pavement Materials

For areas outside city centres and commercial zones, poured concrete surfaces are proposed as the main pavement material.

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* Footway and Paved Areas

The primary concept of the landscape proposal regarding pavement design for village and conservation areas will provide high-quality paving materials. The more extensive peripheral areas will feature poured concrete footways since these are more cost-effective and low-maintenance surfaces. Examples of the various footway paving types are presented in the Figure 7-18.

***Asphalt Footway***

***. Concrete Paving Footway***

***Granite Flagstone Footway***

***. Concrete Footway***

***Figure 7-18: Footway Paving Types***

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

- For concrete footways, 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 footways 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 indicates 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: Principal existing structures in Proposed Scheme***

| | ID | Name | Inventory Code * | Typology | Obstacle | Approx. Station | Expected structural Works? |
|---|---|---|---|---|---|---|---|
| Ballymun Alignment | **CBC03-01** | Dean Swift Bridge | - | Concrete solid slab | Tolka river | 3+760 | NO |
| | **CBC03-02** | - | OBO 11 | Concrete solid slab | Railway | 4+700 | Ballymun 01 adjoining |
| | **CBC03-03** | - | OBD 222 | Arch + concrete solid slab | Railway | 4+750 | Ballymun 02 adjoining |
| | **CBC03-04** | Cross Guns Bridge | PB- XX-008.00 | Steel girder / Solid slab bridge | Royal Canal | 4+770 | NO |
| Finglas Alignment | **CBC04-01** | Footbridge | - | Concrete slab | Finglas Road | 0+060 | NO |
| | **CBC04-02** | - | - | Concrete solid slab | Finglas Road | 0+780 | NO |
| | **CBC04-03** | Footbridge | - | Steel truss | Finglas Road | 1+025 | NO |
| | **CBC04-04** | - | - | Retaining wall and concrete solid slab | Tolka River | 2+660 | NO |

## 8.3 Summary of Principal Structures

There are 5 new structures required for the Proposed Scheme:

Ballymun 01: Railway Bridge at Prospect Road for Cyclists and Pedestrians

Ballymun 02: Railway Bridge at Whitworth Road for Cyclists and Pedestrians

Ballymun 03: Canal Bridge at Royal Canal for Cyclists and Pedestrians

Ballymun 04: Underpass at North Circular Road for Cyclists and Pedestrians

Ballymun 05: Retaining Wall at St. Mobhi Road

Specific Preliminary Design Reports are provided for each proposed structure in Appendix J.

### 8.3.1 Pedestrian/ Cyclist Bridge Ballymun 01 over Railway at Prospect Road

The proposed bridge Ballymun 01 will cross over the Midlands & Great Western Railway Line from Dublin to Sligo at Prospect Road just to the north of Phibsborough. It will be a single span, fully integral portal bridge, next to the existing bridge over the railway (OBO11). The proposed bridge is longer (17.44 m) than the existing one (span of 8.32 m). In addition, the bridge structure type is different to the existing structure, thus both structures will be two independent bridges, separated by a longitudinal joint between them.

The plan view of the proposed bridge and the existing bridge is shown in Figure 8-1. The bridge is skewed in plan as the abutments are parallel to the direction of the railway tracks.

**Figure 8-1: Plan View of Bridge Ballymun 01**

The elevation of both proposed and existing bridges are shown in Figure 8-2, where the difference of spans highlighted above is clearly illustrated.

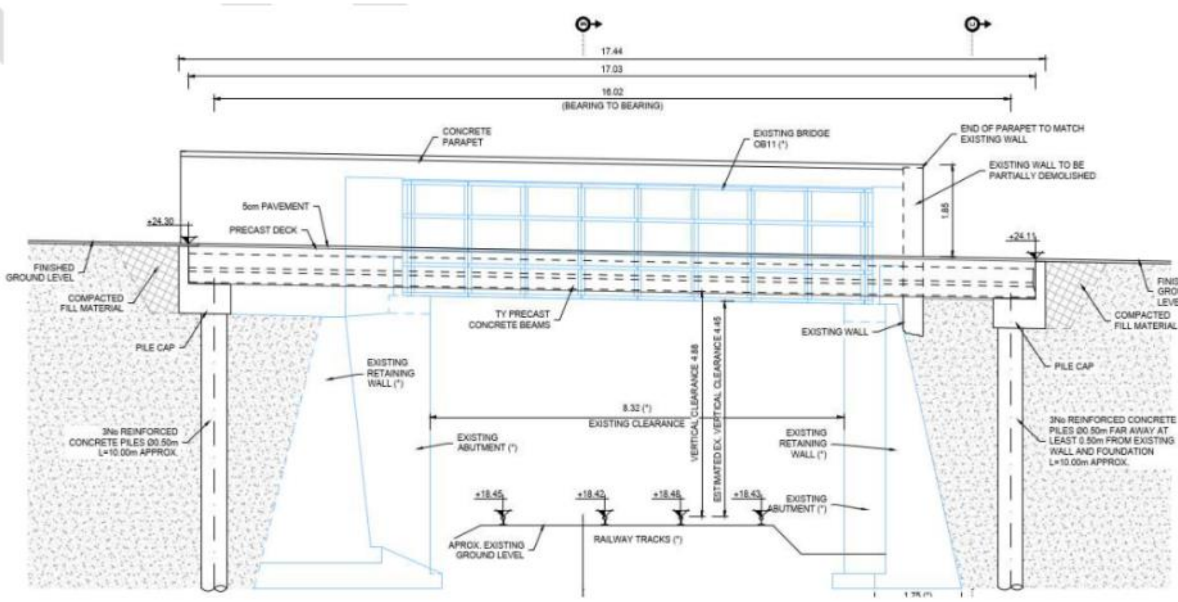


**Figure 8-2 Elevation View of Bridge Ballymun 01**

The difference in length between proposed and existing structures is due to the proposed bridge abutment layout, situated at the rear of the existing retaining walls. This layout ensures the proposed structure will not structurally affect the existing retaining walls.

A typical section of the bridge, 6.25m wide, consists of 8No. precast prestressed concrete beams, 6No. type TY and 2No. type TYE, and a cast in-situ reinforced concrete slab. The precast beams are to be lifted in place in close proximity, such that formwork is not required for slab construction. The proposed beams have a depth of 0.60m and the in-situ slab has a depth of 0.15m. The total structural depth of the deck will be therefore 0.75m. The proposed bridge has a smaller overall depth than the adjacent existing structure, so the vertical clearance beneath the proposed structure will not be reduced. The clearance of the proposed bridge is 4.90m, where the existing bridge clearance is 4.45m (to be confirmed).

The proposed bridge will carry a proposed cycle lane and footpath, both 3.00m wide. The barrier is a concrete parapet with a 1850 mm restrained height, in accordance with the DN-REQ-03034, "The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridges". The typical section of the deck is shown in the following Figure 8-3

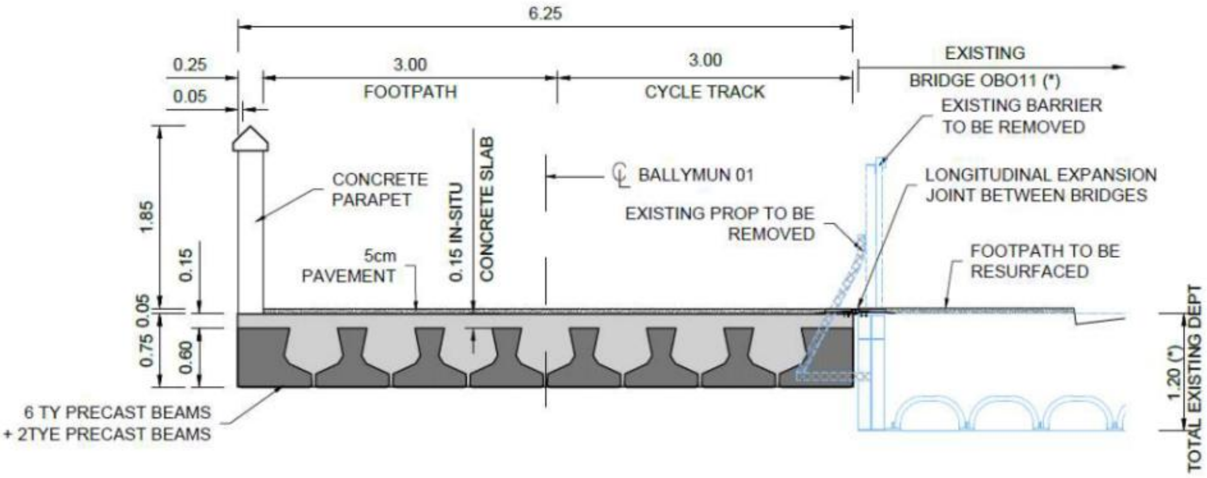


***Figure 8-3 Deck Section at Bridge Ballymun 01***

The bridge will be supported on piled foundations. The foundations consist of 3No. 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 10.0m (to be confirmed in subsequent 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 is integral, expansion joints are not needed consequently. The typical section of the abutments is shown in Figure 8-4

The proposed bridge will be immediately adjacent to the existing railway overbridge OBO11, but without structural connection between them. There will be between both bridges a traffic durable longitudinal expansion joint. The solution proposed consists of a couple of metallic profiles attached to each bridge with an elastomeric profile, to allow the differential movement; foam chord and water recuperation duct, to offer a waterproof joint. The joint will accommodate differential movement between the proposed and existing bridge.

With regard to the existing bridge and walls, details from the original drawings (provided by Iarnród Éireann) have been included in the preliminary drawings of the proposed bridge for information only. As the original drawings are dated, some data has not been updated nor is it representative of the current bridge's conditions. Consequently, for the detailed design of the proposed bridge, additional investigation is required to determine the geometry of the existing walls and their foundations.

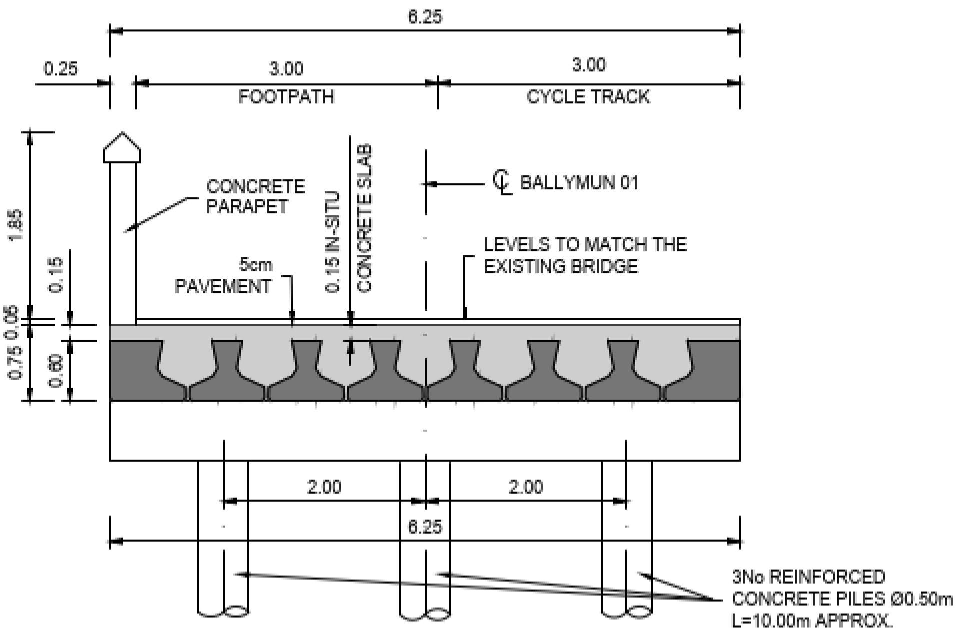


***Figure 8-4 Abutment Section at Bridge Ballymun 01***

### 8.3.2 Pedestrian/Cycle Bridge Ballymun 02 over Railway at Whitworth Road

Bridge Ballymun 02 is located a short distance further south of Ballymun 01. This is a proposed cycle bridge and pedestrian bridge, which spans over the Docklands Railway line. An air gap will separate the proposed structure from the existing bridge (OBD222).

The plan view of the proposed bridge is shown in Figure 8-5 The bridge is slightly skewed in plan due to the abutments are parallel to the direction of the railway tracks.


***Figure 8-5 Plan View of Bridge Ballymun 02***

The elevation view of the bridge is shown in Figure 8-6. The adjacent bridge and tunnel's sections are superimposed in blue and red respectively for information.

The proposed structure is a single span, fully integral portal bridge, 13.32m long between bearings centre line, with the aim to place the piled foundations behind the existing walls. The 10.63 m wide section carries a cycle and pedestrian lane 3.0 m wide at the centre of the bridge, crossing skewed to the deck.

A typical section of the bridge consists of 14No. precast prestressed concrete beams, 12No. type TY and 2No. type TYE, and a cast in-situ reinforced concrete slab. The precast beams are to be lifted in place in close proximity, such that formwork is not required for slab construction. The proposed beams have a depth of 0.55m and in-situ slab has a depth of 0.15m. Total structural depth of the deck will be therefore 0.70m.

The vertical clearance of the proposed structure is slightly lower than the existing adjacent bridge. However, the existing arch tunnel over the railway tracks provides further reduced clearance; therefore, the proposed structure is not expected to hinder the normal operation of the railway tracks. The vertical clearance of the proposed bridge is estimated to be 4.99m (but there is not topographical information of the railway tracks to confirm this), while the existing vertical clearance beneath the tunnel is 4.66m.

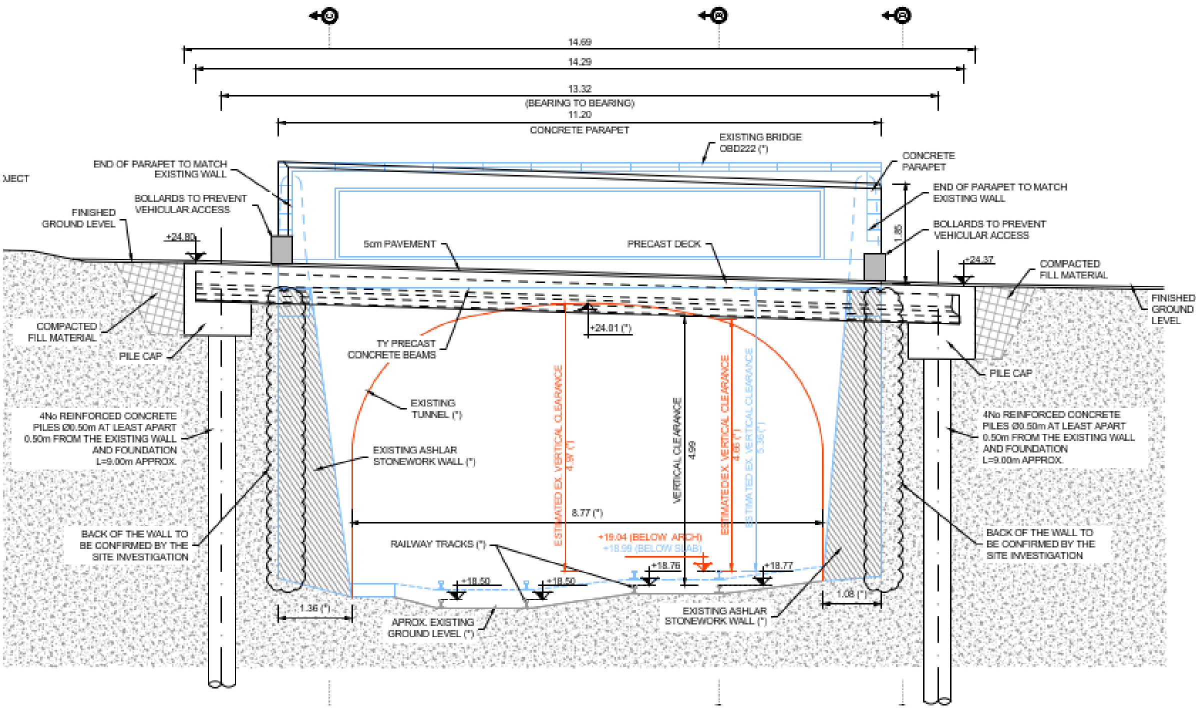

*Figure 8-6 Elevation View of Bridge Ballymun 02*

A typical section of the deck is shown in Figure 8-7. The adjacent bridge and tunnel's sections are also included for information in blue and red respectively.

The proposed bridge will carry a proposed cycle lane and pedestrian footpath. The barrier is a concrete parapet with a 1850 mm restrained height, in accordance with the DN-REQ-03034, "The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridges". Traffic loads are therefore not expected over this bridge.

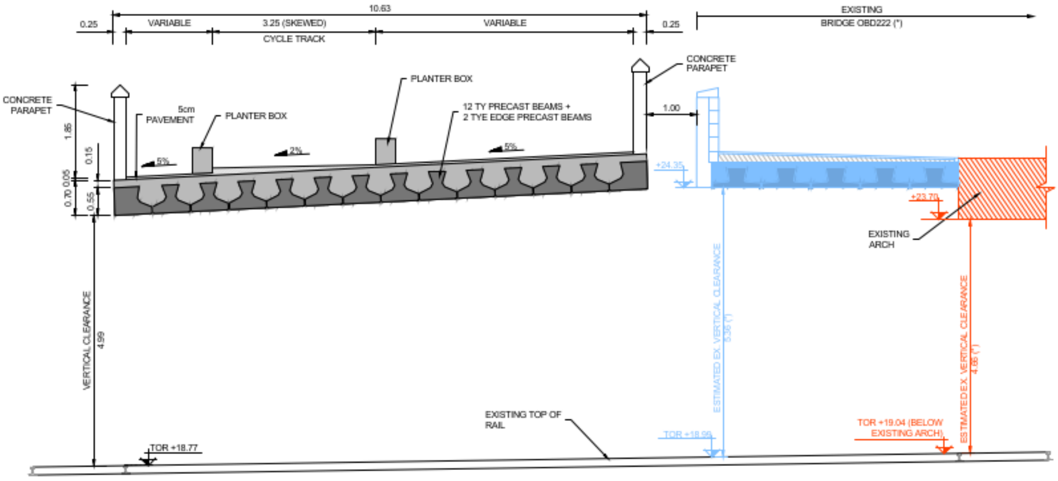


*Figure 8-7: Deck Section at Bridge Ballymun 02*

The bridge will be supported on piled foundations. The foundations consist of 4No. reinforced concrete piles of 0.50m 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 circa 9.0m (to be confirmed in subsequent design stages). The integral connection between the deck and the substructure is to be made at the pile cap. Due to the bridge being integral, expansion joints are not needed consequently. The typical section of the abutments is shown in Figure 8-8 With regard to the existing bridge and walls, details from the original drawings (provided by Iarnród Éireann) have been included in the preliminary drawings of the proposed bridge for information only. The original drawings are dated, some data has not been updated nor is it representative of the current bridge's conditions. Consequently, for the detailed design of the proposed bridge, additional investigation is required to determine the geometry of the existing walls and their foundations.

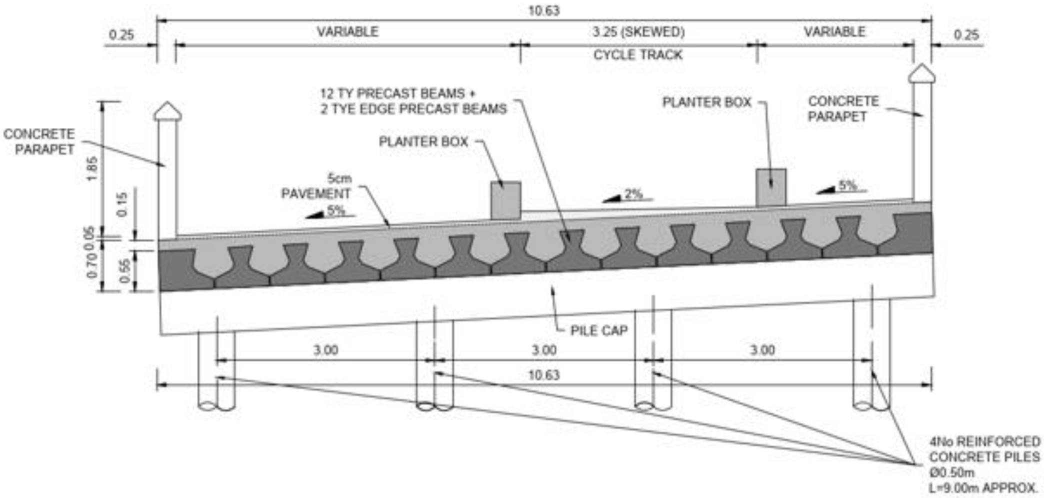


*Figure 8-8: Abutment Section at Bridge Ballymun 02*

### 8.3.3 Pedestrian/Cycle Bridge Ballymun 03 over Royal Canal

The section of the cycle path in Ballymun crosses over the Royal Canal for which an arch bridge is projected to span over the canal. The arch bridge has an overall length of 16.7m as shown in Figure 8-9.

***Figure 8-9: Artist impression of Bridge Ballymun 03 over the Royal Canal***

The main factors and conditions that influenced the proposed arrangement of this bridge are as follows:

- The bridge should serve as a connection for the cycle path of the Ballymun corridor, providing a link between north and south canal banks.
- Canal navigation must be maintained with vertical and horizontal navigation clearances as required by Waterways Ireland.
- The existing access ramp to the canal jetty will be relocated away from the proposed bridge.
- The northern ramp must fit between the railway tracks retaining wall and the canal and the only available space is on the existing towpath which will be realigned vertically to suit the levels at the end of the proposed bridge.
- The southern ramp must fit between the road and the canal, where the space available is very tight and therefore the ramp structure will intrude slightly into the canal water outside of the navigation channel.

The plan of this proposed structure is shown in Figure 8-10:

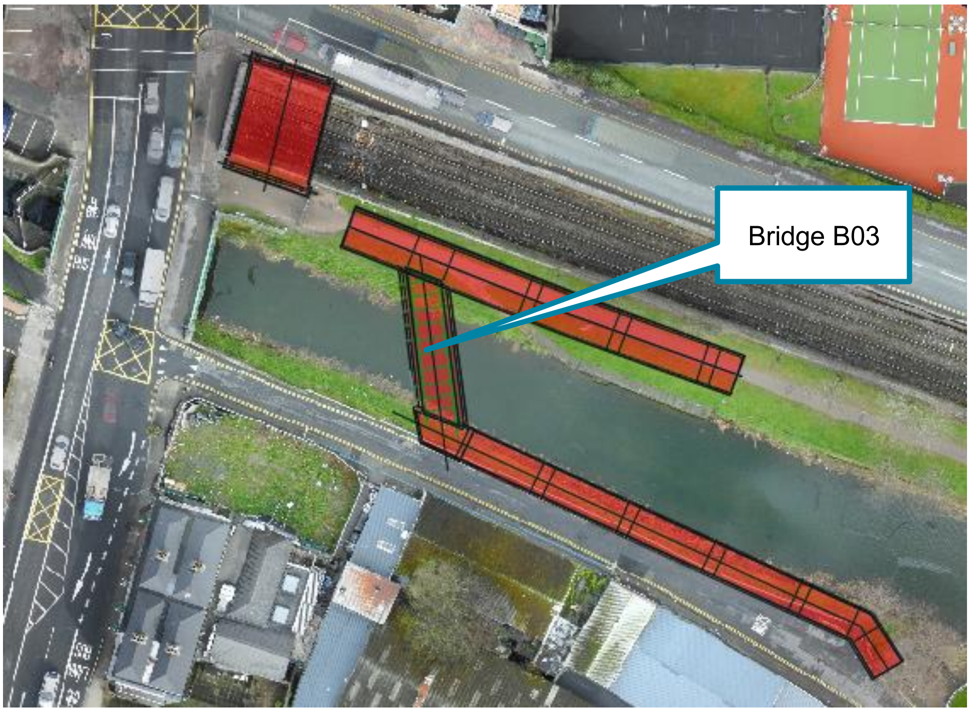


*Figure 8-10: Plan View of Bridge Ballymun 03*

The required clearances for Royal Canal navigation, as agreed with Waterways Ireland, are a vertical clearance of 3.50m and a horizontal clearance of 10.0m. These requirements impact on both ramps, increasing their overall length, as the finished level rises above the existing ground level considerably. The ramps are designed with a gradient of 5% (1:20) at 10.0m long intervals with 1.50m horizontal landings between the slopes, complying with accessibility requirements. The elevation of the bridge is shown in Figure 8-11.

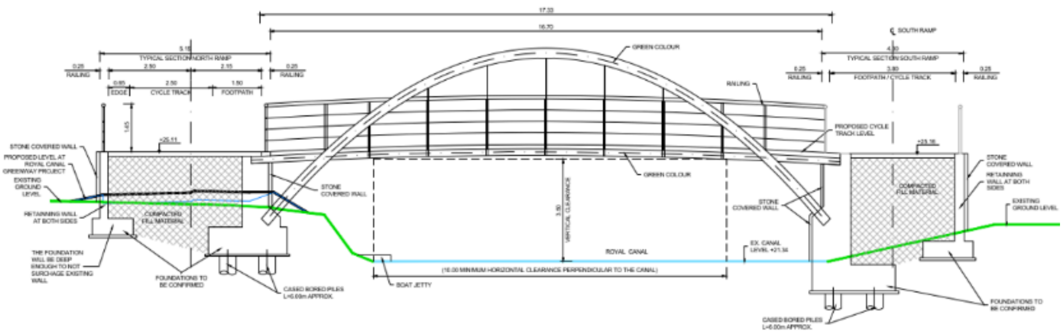

*Figure 8-11: Elevation View of Bridge Ballymun 03*

The bridge will be supported on piled foundations. The bridge's foundation consists of 4No. reinforced concrete encased piles of 0.50m diameter per abutment, a reinforced concrete pile cap at the top of the piles and a reinforced concrete abutment wall. The length of the piles has been estimated to be circa 6.0m (to be confirmed in subsequent design stages). The U-shape ramp retaining walls will be shallow foundations. The finishes of the ramp walls will be covered with stone, as per the visual requirement by the EIR team. The elevation of the north ramp and the transversal section of the south ramp are shown in Figure 8-12 and Figure 8-13 respectively.

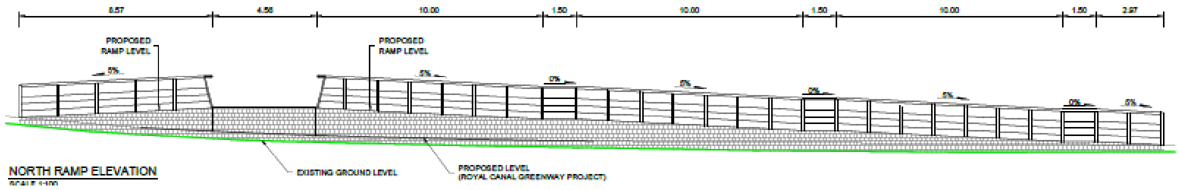


***Figure 8-12: Elevation of Northern Ramp at Bridge Ballymun 03***

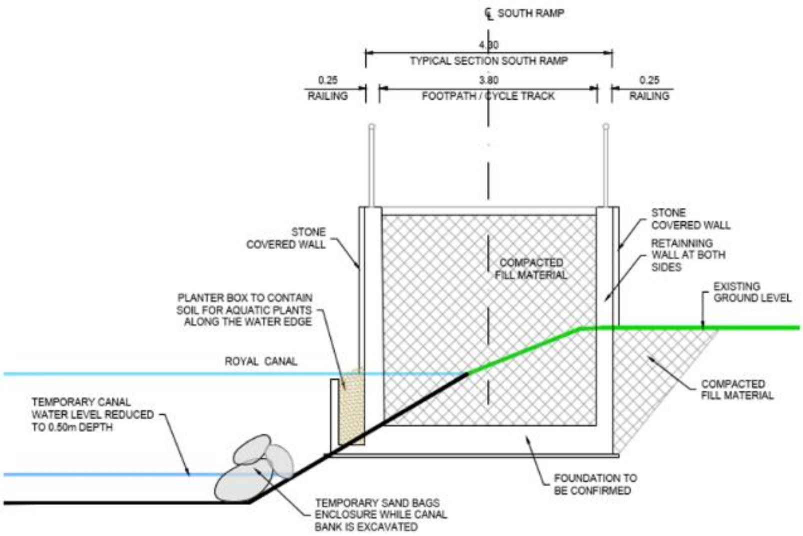


***Figure 8-13: Cross Section of Southern Ramp at Bridge Ballymun 03***

The proposed structure carries the proposed cycle lane. The overall width of the arch bridge will be 6.0m. The total width of the bridge deck will be 5.15m, including the railings, and providing a clearance width of 4.0m for the cycle lane. The restraint system will be “as transparent as possible”, as per the client’s requirements. The north ramp provides continuity with the Royal Canal Greenway Project. The transversal section of the bridge is shown in Figure 8-14.

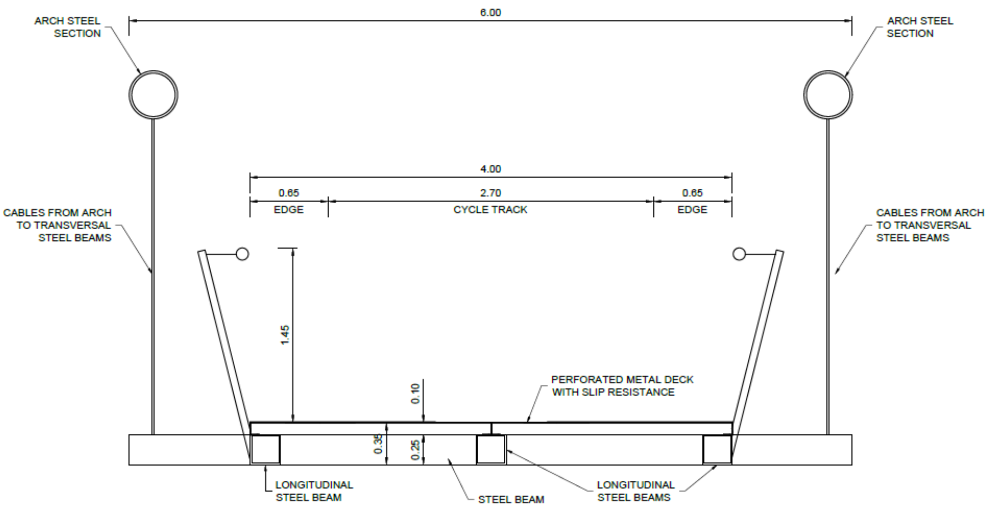


***Figure 8-14: Deck Section at Bridge Ballymun 03***

The bridge superstructure consists of two arches, located outside of the deck, with cables supporting the deck. The suspension cables are spaced approximately 1.66m apart. The arches and the deck will be constructed from steel. The arch sections consist of Circular Hollow Sections (CHS) and the deck surface will employ perforated steel sheets, to provide water-permeable surfaces.

### 8.3.4 Bridge Ballymun 04 at North Circular Road

A proposed underpass, Bridge Ballymun 04, is proposed at North Circular Road. The objective of the proposed underpass is to allow the unimpeded north-south passage of the cycle and pedestrian route under the road. The intention is to provide a wide and bright, with strong visual continuity of the linear park at Royal Canal Bank linking towards the Library. The overall length of the underpass is 16.70m long and 19.20m wide. The plan view of the proposed underpass is shown in Figure 8-15.

***Figure 8-15: Plan View of Bridge Ballymun 04***

As there are existing buildings in direct vicinity to the proposed structure, construction of contiguous reinforced concrete piled walls at this location are proposed to retain the existing ground. Additional investigations of existing buildings and their foundations will need to be carried out in subsequent design stages.

The elevation view of the underpass is shown in Figure 8-16 where the location of the TBM tunnel studied for Metrolink Project is also shown for information.

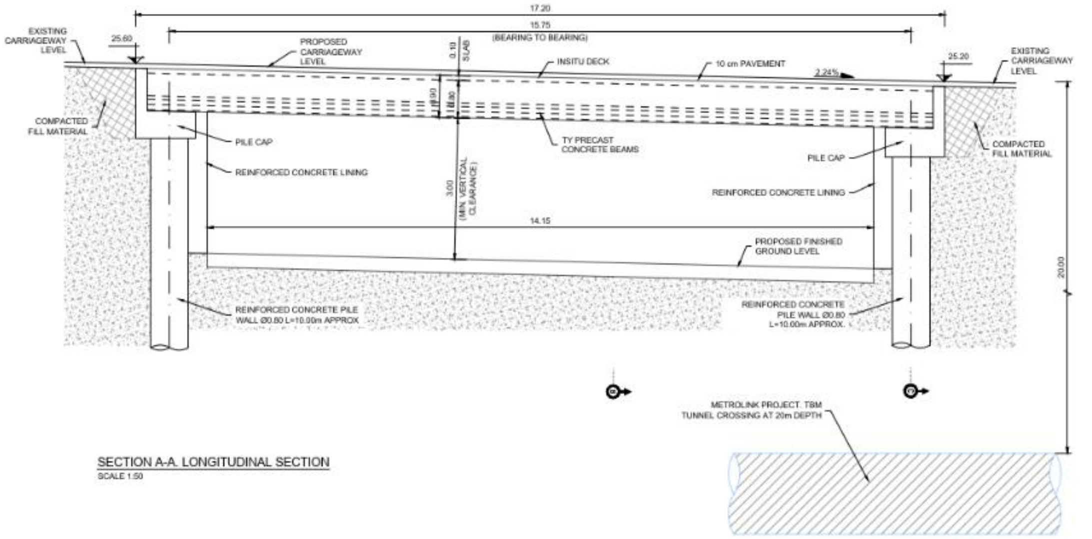


***Figure 8-16: Elevation View of Bridge Ballymun 04***

The proposed structure is a single span, fully integral portal underbridge. The bridge deck is a solid slab construction with 25No. precast prestressed concrete beams, 23No. type TY and 2No. type TYE, and a cast in-situ reinforced concrete slab. The depth of the beams is 0.65m and 0.15m for the slab, providing a total structural depth of 0.80m. Should the provision for utilities be required, adequate space has been provided for these utilities at the bridge footpaths. The beams are to be lifted in place adjacent to one another, such that no formwork is required for the slab construction. A typical section of the deck is shown in Figure 8-17.

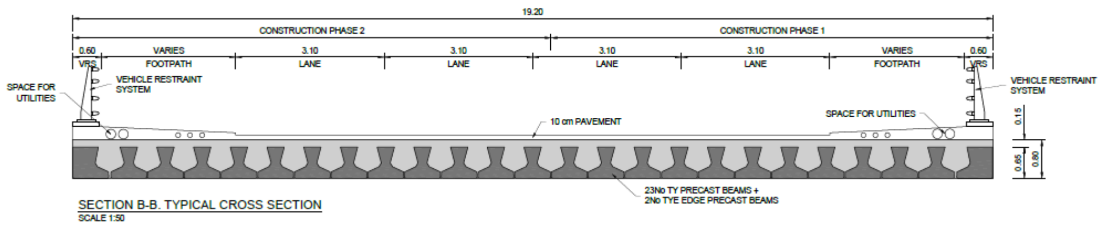


***Figure 8-17: Deck Section at Bridge Ballymun 04***

Due to its urban environment, reinforced concrete contiguous retaining walls are proposed at both ends of the proposed bridge to serve as a temporary support for the construction excavation in the area. The proposed bridge abutment walls will be covered by a concrete lining that incorporates architectural finishes to improve its visual appearance.

In the current design iteration, the underpass has a clearance span of 14.15m and a vertical clearance of 3.0m.

The substructure comprises of embedded foundations, formed by bored in-situ reinforced concrete piles and in-situ reinforced concrete pile cap, where the precast beams will be supported. The piles are to be 12 No. per abutment and 0.8m diameter, with an embedment depth of 10.0m (to be confirmed at subsequent design stages). The integral connection is to be made at the pile cap to provide the fully integral portal structure. The substructure is also to be the retaining structure. A preliminary arrangement is shown in Figure 8-18.

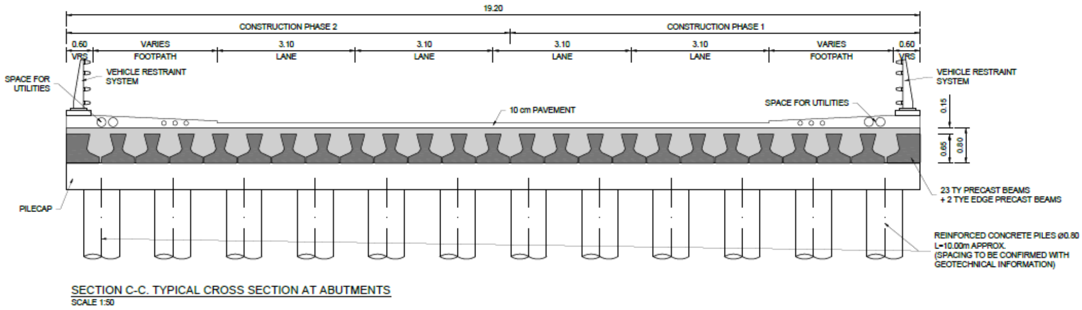


*Figure 8-18 Abutment Section at Bridge Ballymun 04*

## 8.4 Summary of Minor Structures

There are no minor structures proposed on the Ballymun / Finglas to City Centre Core Bus Corridor route.

## 8.5 Summary of Retaining Walls

### 8.5.1 Structure Ballymun 05: Retaining Wall at St. Mobhi Road

A proposed retaining wall is proposed along St. Mobhi Road, parallel to the road on the eastern side, to retain the proposed road layout. A structural retaining wall is proposed instead of building an earth embankment in that area. This wall is required to accommodate the Proposed Scheme road layout with a bus lane, cycle lane and pedestrian footpath on the referred eastern side of the road.

The retaining wall has an overall length of approximately 148.0 m and its height varies between 1,25 m and 4,00 m. Figure 8-19 shows the extents of the wall in plan. It will be located immediately at the back of the footpath on the eastern side, and the foundation will extend eastwards by approximately 1m behind the rear of the wall.

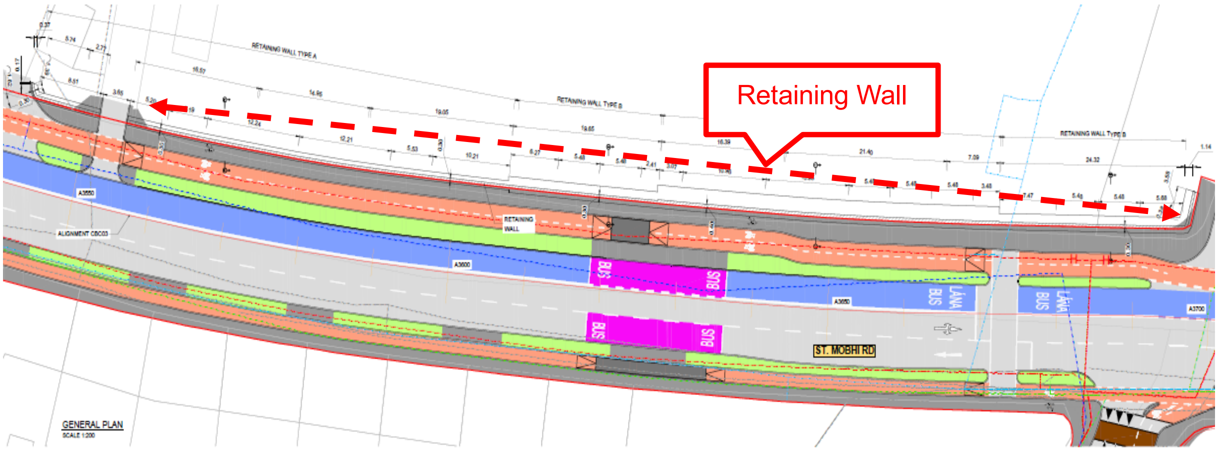


*Figure 8-19: Plan View of Structure Ballymun 05 Retaining wall*

The wall is designed as reinforced concrete cantilevered retaining wall with three types of sections depending on its retained height.

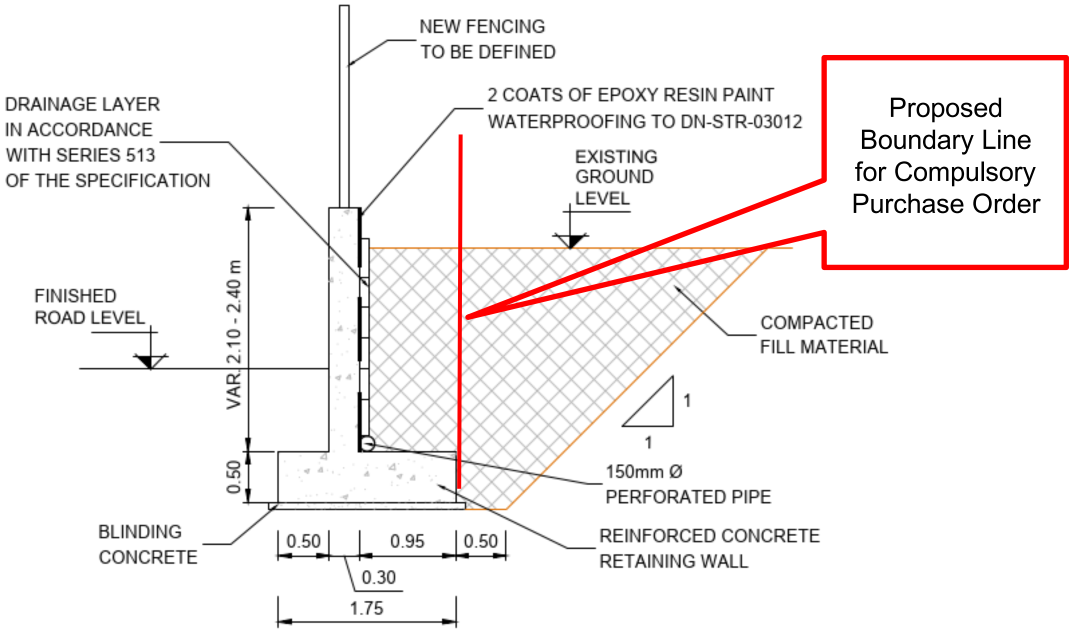


***Figure 8-20: Section at Structure Ballymun 05 Retaining wall***

# 9 Drainage, Hydrology and Flood Risk

## 9.1 Overview of Drainage Strategy

The drainage preliminary design was developed following Consultation with the relevant Local Authority and Irish Water where applicable. The strategy and design parameters to be adopted throughout Dublin BusConnects 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. Except for one case (the footbridge with code Ballymun 03), there are no proposed new culverts or bridges at any of these watercourses due to the BCC works

***Table 9-1: Existing Watercourses***

| Location | Watercourse | Chainage | Crossing type |
|---|---|---|---|
| Glasnevin | Tolka River | 3+710 | Existing bridge |
| Glasnevin | Tolka River | 0+720 | Existing bridge |
| Phibsborough | Royal Canal | 4+725 | Proposed footbridge (Ballymun 03, single span) |
| Finglas | Bachelor’s Stream | Parallel to Finglas Road | Exiting culvert |
| Finglas / Glasnevin | Tolka River | 2+670 | Existing bridge |

In the case of the footbridge with code Ballymun 03, it is located in the Ballymun Alignment and crosses the Royal Canal by means of a single arch. The finishing of the bridge deck allows the water to percolate through it (permeable deck) and therefore there is no need for any positive drainage. Accordingly, no new outfall to the Royal Canal is expected.

In the rest of the cases, there are not additional outfalls proposed to any watercourses. The existing drainage network will be maintained and used as the main discharge point for the new drainage system and therefore the runoff from the proposed scheme will reach the water body at the same location as in the current situation.

Additionally, the Santry river runs at the north of the northern end of the Ballymun corridor (outside the limits of the project). At the current stage with the available information, it is not expected that this watercourse will receive runoff from the BCC corridor. In the same way, the Liffey River runs at the southern end of the Ballymun corridor (outside the limit of the project). At the current stage, it is not expected that this watercourse will receive runoff from the BCC corridor, with the available information.

## 9.3 Existing Drainage Description

The Ballymun Alignment extends from North Ballymun to south city centre, while The Finglas Alignment extends from Mellowes Park to Botanic Road. The developments comprise widening and/or adjustment of the existing corridors to accommodate segregated cycle and bus lanes, in addition to provision for pedestrians and other traffic.

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

The existing drainage networks along the schemes can be split into 21 catchment areas based on topography and the existing pipe network supplied by Irish Water. For more details regarding the approximate catchment areas, existing sewer networks, outfalls and watercourses refer to drawings BCIDD-ROT-DNG_RD-0003_XX_00-M2-CD-0001 and BCIDD-ROT-DNG_RD-0003_XX_00-M2-CD-0001. The catchments are summarised below:

***Table 9-2: Summary of Existing Catchments***

| Existing Catchment Reference | Approx. Drainage Catchment Area ($km^2$) | Existing Network Type | Existing Outfalls |
|---|---|---|---|
| Catchment BS_01 | 0.532 | Surface Water (Storm) | Network outfalls to Bachelor's Stream |
| Catchment BS_02 | 0.150 | Surface Water (Storm) | Network outfalls to Bachelor's Stream |
| Catchment BS_03 | 0.018 | Surface Water (Storm) | Network outfalls to Bachelor's Stream |
| Catchment BS_04 | 0.235 | Surface Water (Storm) | Network outfalls to Bachelor's Stream |
| Catchment BS_05 | 1.291 | Surface Water (Storm) | Network outfalls to Bachelor's Stream |
| Catchment BS_06 | 0.112 | Surface Water (Storm) | Network outfalls to Bachelor's Stream |
| Catchment TR_01 | 3.641 | Surface Water (Storm) | Network outfalls to Tolka river |
| Catchment TR_02 | 0.041 | Surface Water (Storm) | Network outfalls to Tolka river |
| Catchment TR_03 | 0.490 | Surface Water (Storm) | Network outfalls to Tolka river |
| Catchment TR_04 | 0.003 | Surface Water (Storm) | Network outfalls to Tolka river |
| Catchment TR_05 | 0.764 | Surface Water (Storm) / Combined | Network outfalls to Tolka river |
| Catchment TR_06 | 0.059 | Surface Water (Storm) / Combined | Network outfalls to Tolka river |
| Catchment TR_07 | 0.144 | Surface Water (Storm) | Network outfalls to Tolka river |
| Catchment TR_08 | 0.061 | Surface Water (Storm) | Network outfalls to Tolka river |
| Catchment TR_09 | 0.083 | Surface Water (Storm) | Network outfalls to Tolka river |
| Catchment TR_10 | 0.012 | Surface Water (Storm) | Network outfalls to Tolka river |
| Catchment TR_11 | 1.121 | Surface Water (Storm) | Network outfalls to Tolka river |
| Catchment RSTBC_01 | 0.707 | Combined | Network outfalls to Ringsend Wastewater Treatment Plant |
| Catchment RSTBC_02 | 5.052 | Combined | Network outfalls to Ringsend Wastewater Treatment Plant |
| Catchment RSTBC_03 | 0.039 | Combined | Network outfalls to Ringsend Wastewater Treatment Plant |
| Catchment RSTBC_04 | 0.019 | Combined | Network outfalls to Ringsend Wastewater Treatment Plant |

## 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 two separate tables for Ballymun Alignment and Finglas Alignment.

The following tables contain a column entitled “Net change” which take account of the change of use from impermeable to permeable areas and vice versa.

***Table 9-3: Summary of Increased Permeable and Impermeable Areas***

| Route | 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 (%) |
|---|---|---|---|---|---|---|---|
| BALLYMUN ALIGNMENT | D3_01 - TR_01 | A0000 - A 3720 | 127,349 | 2,275 | 5,320 | -3,045 | -2.4% |
| | D3_02 - TR_02 | A1840 - A 1870 | 277 | 0 | 77 | -77 | -27.7% |
| | D3_03 - TR_03 | A2745 - A 3660 | 23,431 | 509 | 92 | 417 | 1.8% |
| | D3_04 - TR_04 | A0660 - A 0740 Glasnevin | 1,392 | 0 | 0 | 0 | 0.0% |
| | D3_05 - TR_06 | A3660 - A 3950 | 5,583 | 239 | 35 | 204 | 3.6% |
| | D3_06 - TR_05 | A3660 - A 4685 | 19,841 | 296 | 250 | 46 | 0.2% |
| | D3_07 - RSTBC_01 | A4685 - A 6005 | 47,533 | 1,010 | 374 | 636 | 1.3% |
| | D3_08 - RSTBC_02 | A6150 - A 6840 | 21,079 | 161 | 179 | -18 | -0.1% |
| | D3_09 - RSTBC_03 | A6005 - A 6350 | 8,604 | 432 | 5 | 428 | 5.0% |
| | D3_10 - RSTBC_04 | A6350 - A 6610 | 3,001 | 0 | 0 | 0 | 0.0% |
| FINGLAS ALIGNMENT | *D4_01 - BS_01* | B-070 - B090 | *6,079* | *543* | *0* | *543* | *8.9%* |
| | *D4_02 - BS_02* | B030 - B 0100 | *1,048* | *53* | *0* | *53* | *5.0%* |
| | *D4_03 - BS_03* | B030 - B 0295 | *4,926* | *184* | *0* | *184* | *3.7%* |
| | *D4_04 - BS_04* | B295 - B 0500 | *5,048* | *0* | *0* | *0* | *0.0%* |
| | *D4_05 - BS_05* | B500 - B 2030 | *43,493* | *1,845* | *370* | *1,475* | *3.4%* |
| | *D4_06 - BS_06* | B1815 - B 2425 | *16,341* | *348* | *434* | *-86* | *-0.5%* |
| | *D4_07 - TR_09* | B2425 - B 2525 | *3,361* | *40* | *23* | *16* | *0.5%* |
| | *D4_08 - TR_10* | B2525 - B 2640 | *3,018* | *106* | *0* | *106* | *3.5%* |
| | *D4_09 - TR_08* | B2640 - B 2690 | *892* | *6* | *0* | *6* | *0.7%* |

| Route | 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 (%) |
|---|---|---|---|---|---|---|---|
| | *D4_10 - TR_11* | B2690 - B 2770 | *2,721* | *0* | *0* | *0* | *0.0%* |
| | *D4_11 - TR_07* | B2770 - B 3200 | *12,820* | *44* | *42* | *2* | *0.0%* |
| | *D4_12 - TR_05* | *B3200 - B4127* | *25,039* | *1,596* | *85* | *1,511* | *6.0%* |

## 9.5 Preliminary Drainage Design

The following drainage types are proposed for Ballymun and Finglas Alignments 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 highway 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. These receive flows from the sealed pipe network and are designed to convey, attenuate and treat runoff prior to discharge.
- **Attenuation Tanks** – Where there is insufficient attenuation volume provided by the proposed SuDS drainage measures, an attenuation tank is required to provide the required volume.
- **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 Proposed Surface Water Infrastructure***

| Route | Catchment | Chainage | Local Authority | Drainage Type |
|---|---|---|---|---|
| BALLYMUN ALIGNMENT | D3_01 - TR_01 | A0000 - A 3720 | DCC | Existing drainage retained, bioretention (18) |
| | D3_02 - TR_02 | A1840 - A 1870 | DCC | Existing drainage retained |
| | D3_03 - TR_03 | A2745 - A 3660 | DCC | Existing drainage retained, bioretention (5) |
| | D3_04 - TR_04 | A0660 - A 0740 Glasnevin | DCC | Existing drainage retained |
| | D3_05 - TR_06 | A3660 - A 3950 | DCC | Existing drainage retained, bioretention (4) |
| | D3_06 - TR_05 | A3660 - A 4685 | DCC | Existing drainage retained, bioretention (3), oversize pipe (1) |
| | D3_07 - RSTBC_01 | A4685 - A 6005 | DCC | Existing drainage retained, bioretention (2), oversize pipe (1) |
| | D3_08 - RSTBC_02 | A6150 - A 6840 | DCC | Existing drainage retained |
| | D3_09 - RSTBC_03 | A6005 - A 6350 | DCC | Existing drainage retained, bioretention (1), oversize pipe (1) |
| | D3_10 - RSTBC_04 | A6350 - A 6610 | DCC | Existing drainage retained |
| FINGLAS ALIGNMENT | D4_01 - BS_01 | B-070 - B090 | DCC | Existing drainage retained, bioretention (2) |
| | D4_02 - BS_02 | B030 - B 0100 | DCC | Existing drainage retained |
| | D4_03 - BS_03 | B030 - B 0295 | DCC | Existing drainage retained, bioretention (1) |
| | D4_04 - BS_04 | B295 - B 0500 | DCC | Existing drainage retained |
| | D4_05 - BS_05 | B500 - B 2030 | DCC | Existing drainage retained, bioretention (13) |
| | D4_06 - BS_06 | B1815 - B 2425 | DCC | Existing drainage retained, bioretention (6) |
| | D4_07 - TR_09 | B2425 - B 2525 | DCC | Existing drainage retained, bioretention (1) |
| | D4_08 - TR_10 | B2525 - B 2640 | DCC | Existing drainage retained |
| | D4_09 - TR_08 | B2640 - B 2690 | DCC | Existing drainage retained |
| | D4_10 - TR_11 | B2690 - B 2770 | DCC | Existing drainage retained |
| | D4_11 - TR_07 | B2770 - B 3200 | DCC | Existing drainage retained, oversize pipe (1) |
| | D4_12 - TR_05 | B3200 - B 4127 | DCC | Existing drainage retained, bioretention (2), permeable pavement |

### 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 footway. 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 runoff 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: from 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: Summary of Proposed Attenuation Features, SuDS & Outfalls***

| Route | Chainage | Existing Catchment Reference (Table 9-2) | Approx. Impermeable Surface Area | | SuDS Measures Existing | Permitted Discharge (l/s) | SuDS Measures Proposed | Catchment Outfall |
|---|---|---|---|---|---|---|---|---|
| | | | Existing* (m2) | Proposed (m2) | | | | |
| BALLYMUN ALIGNMENT | A0000 to A3720 | D3_01 - TR_01 | 113,772 | 110,727 | No | 4.22 | 19.9 $m^3$ bioretention capacity | New drainage to discharge to the existing stormwater network via SuDS measures. Existing stormwater network outfalls to the Tolka River |
| | A1840 to A1870 | D3_02 - TR_02 | 277 | 200 | No | As existing | None | Existing Surface Water Network SW DCC |
| | A2745 to A3660 | D3_03 - TR_03 | 21,266 | 21,683 | No | 1.96 | 7.9 $m^3$ bioretention capacity | New drainage to discharge to the existing stormwater network via SuDS measures. Existing stormwater network outfalls to the Tolka River |
| | A0660 to A0740 Glasnevin | D3_04 - TR_04 | 1,392 | 1,392 | No | As existing | None | Existing Surface Water Network SW DCC |
| | A3660 to A3950 | D3_05 - TR_06 | 4,955 | 5,159 | No | 0.74 | 3.3 $m^3$ bioretention capacity | New drainage to discharge to the existing stormwater network via SuDS measures. Existing stormwater and combined network outfalls to the Tolka River |
| | A3660 to A4685 | D3_06 - TR_05 | 19,508 | 19,554 | No | 2.5 | 2.4 $m^3$ bioretention capacity<br><br>1.2 m3 oversize pipe capacity | New drainage to discharge to the existing stormwater network via SuDS measures. Existing stormwater and combined network outfalls to the Tolka River |
| | A4685 to A6005 | D3_07 - RSTBC_01 | 44,518 | 45,154 | No | 2.22 | 2.6 $m^3$ bioretention capacity<br><br>1.2 m3 oversize pipe capacity | New drainage to discharge to the existing stormwater network via SuDS measures. Existing combined network outfalls to the Ringsend Wastewater Treatment Plant |
| | A6150 to A6840 | D3_08 - RSTBC_02 | 20,854 | 20,836 | | As existing | None | Existing Surface Water Network SW DCC |
| | A6005 to A6350 | D3_09 - RSTBC_03 | 7,395 | 7,822 | | 0.52 | 0.8 m3 bioretention capacity<br><br>1.4 m3 oversize pipe capacity | New drainage to discharge to the existing stormwater network via SuDS measures. Existing stormwater and combined network outfalls to the Ringsend Wastewater Treatment Plant |
| | A6350 to A6610 | D3_10 - RSTBC_04 | 3,001 | 3,001 | | As existing | None | Existing Combined DCC |

| Route | Chainage | Existing Catchment Reference (Table 9-2) | Approx. Impermeable Surface Area | | SuDS Measures Existing | Permitted Discharge (l/s) | SuDS Measures Proposed | Catchment Outfall |
|---|---|---|---|---|---|---|---|---|
| | | | Existing* (m2) | Proposed (m2) | | | | |
| FINGLAS ALIGNMENT | B-070 to B090 | D4_01 - BS_01 | 3,356 | 3,898 | Yes | 2.3 | 7.8 $m^3$ bioretention capacity | New drainage to discharge to the existing stormwater network via SuDS measures. Existing stormwater network outfalls to the Bachelor's Stream |
| | B030 to B100 | D4_02 - BS_02 | 995 | 1,048 | No | As existing | None | Existing Surface Water Network SW DCC |
| | B030 to B295 | D4_03 - BS_03 | 3,664 | 3,848 | Yes | 0.8 | 1.9 $m^3$ bioretention capacity | New drainage to discharge to the existing stormwater network via SuDS measures. Existing stormwater network outfalls to the Bachelor's Stream |
| | B295 to B500 | D4_04 - BS_04 | 4,263 | 4,263 | No | As existing | None | Existing Surface Water Network SW DCC |
| | B500 to B2030 | D4_05 - BS_05 | 34,715 | 36,190 | Yes | 4.9 | 25.4 $m^3$ bioretention capacity | New drainage to discharge to the existing stormwater network via SuDS measures. Existing stormwater network outfalls to the Bachelor's Stream |
| | B1815 to B2425 | D4_06 - BS_06 | 13,313 | 13,227 | Yes | 1.4 | 8.0 $m^3$ bioretention capacity | New drainage to discharge to the existing stormwater network via SuDS measures. Existing stormwater network outfalls to the Bachelor's Stream |
| | B2425 to B2525 | D4_07 - TR_09 | 3,158 | 3,174 | Yes | 0.3 | 2.2 $m^3$ bioretention capacity | New drainage to discharge to the existing stormwater network via SuDS measures. Existing stormwater network outfalls to the Tolka River |
| | B2525 to B2640 | D4_08 - TR_10 | 2,662 | 2,768 | No | As existing | None | Existing Surface Water Network SW DCC |
| | B2640 to B2690 | D4_09 - TR_08 | 837 | 844 | No | As existing | None | Existing Surface Water Network SW DCC |
| | B2690 to B2770 | D4_10 - TR_11 | 2,463 | 2,463 | No | As existing | None | Existing Surface Water Network SW DCC |
| | B2770 to B3200 | D4_11 - TR_07 | 11,189 | 11,190 | Yes | 0.3 | 3.2 m3 oversize pipe capacity | New drainage to discharge to the existing stormwater network via SuDS measures. Existing stormwater network outfalls to the Tolka River |
| | B3200 to B4127 | D4_12 - TR_05 | 22,401 | 23,912 | Yes | 2.7 | 6.9 $m^3$ bioretention capacity<br>21.0 m3 permeable pavement capacity | New drainage to discharge to the existing stormwater network via SuDS measures. Existing stormwater network outfalls to the Tolka River |

## 9.6 Drainage at New Bridge Structures

Along the Ballymun Alignment of the Proposed Scheme there are four new bridges, due to the development of the Proposed Scheme. These are summarized in Table 9-6.

***Table 9-6: Route 03 Ballymun - Drainage at new structures***

| Structure code | Proposed works | Drainage strategy | Comment |
|---|---|---|---|
| Ballymun 01 | Road bridge widening (over railway track) | Runoff to be collected by current road drainage. Additional catchment to be attenuated by means of oversized pipe | Catchment area currently draining directly to the railway. This area will not reach the track level in the post development stage |
| Ballymun 02 | New cycle bridge (over railway track) | Runoff draining according to deck gradient, towards pedestrian area at southern abutment. Pedestrian area graded in order to allow over the edge discharge into the Royal Canal. Some planting to be provided in this area to enhance water quality | Catchment area currently draining directly to the railway. This area will not reach the track level in the post development stage |
| Ballymun 03 | New cycle bridge (over the Royal Canal) | Permeable deck: rainfall and diffuse runoff to cross the structure at multiple locations (suitable deck finishing to be provided) | No changes in contributing area. Rainfall will keep arriving to the Royal Canal as currently does |
| Ballymun 04 | New underpass (under North Circular Road) | Deck draining to the abutments, where runoff will be collected by the existing road drainage (combined) | No changes in catchment area. Pedestrian paths to be graded towards green areas. |

# 9.7 Flood Risk

## 9.7.1 Flood Risk Assessment

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

***Table 9-7: Flood Risk Summary***

| Flood Risk Source | Level of Risk | Notes |
|---|---|---|
| Fluvial & Sea Level Rises / Coastal | Low - Medium | Ballymun Alignment is in close proximity to the Liffey and Tolka rivers. Finglas Alignment is only in close proximity to Tolka River.<br>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 no new proposed culverts/bridges or modifications proposed to existing culverts/bridges that cross watercourses along the Proposed Scheme. Section 50 consent is therefore not required for the Proposed Scheme.

# 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 highways 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. 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, 3-7 & 12-19, 23-30 & 32-37 TBC by utility provider. | 15/10/2019 |
| Medium Pressure (MP) Gas | Partial | No network present for sheets 5-8, 14-17, 24 & 25 | 15/10/2019 |
| Low Pressure (LP) Gas | Yes | No network present for sheet 1 | 15/10/2019 |
| Telecommunications Duct | Yes | EIR - No network present for sheets 12, 14, 15, & 34-37<br>Virgin Media - Data is available for all sheets 32 & 35<br>ENET - No network present for sheets 1-12 & 15-22<br>VDF - No network present for all sheets | 15/10/2019, 05/08/2020, 23/01/2020, 07/08/2020 |
| Foul Sewer (FS) | Yes | No network present for sheet 15 | 15/10/2019, 26/03/2020 |
| HV Electricity | Yes | No network present for sheets 3, 9-11 & 17-22 TBC by utility provider. | 15/10/2019 |
| MV Electricity | Yes | No network present for sheet 7 & 24 TBC by utility provider. | 15/10/2019 |
| LV Electricity | Yes | Data is available for all sheets | 15/10/2019 |
| IW Water Network (WN) | Yes | Data is available for all sheets | 15/10/2019, 26/03/2020 |
| IW Abandoned Lines | Yes | No network present for all sheets | 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 Required Works

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 identified 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.

Table 10-2 outlines the required works for existing ESB services.

***Table 10-2: ESB Asset Works***

| Reference No. | Chainage | Asset | Description of Works |
|---|---|---|---|
| R03-UG-MV-029 | A4960 - 4980 LHS | Medium Voltage | 20m Localised Diversion |
| R03-UG-LV-059 | 4960 - 4980 LHS | Low Voltage | 20m Localised Diversion |
| R03-UG-MV-037 | A5155 - 5180 LHS | Medium Voltage | 65m Localised Diversion |
| R03-UG-MV-030 | A5270 - 5320 LHS | Medium Voltage | 55m Localised Diversion |
| R03-UG-MV-031 | A5320 - 5380 LHS | Medium Voltage | 30m Localised Diversion |
| R03-UG-MV-039 | A5925 - 5960 RHS | Medium Voltage | 67m Localised Diversion |
| R03-UG-MV-042A | A5960 - 5990 RHS | Medium Voltage | 67m Localised Diversion |
| R03-UG-MV-032 | A6050 - 6190 RHS | Medium Voltage | 130m Localised Diversion |
| R03-UG-MV-040 | A6250 - 6280 RHS | Medium Voltage | 25m Localised Diversion |
| R03-UG-MV-041 | A6710 - 6760 RHS | Medium Voltage | 17m Localised Diversion |
| R03-UG-MV-042 | A6770 - 6775 LHS | Medium Voltage | 46m Localised Diversion |
| R04-UG-MV-010 | B1030 - 1130 RHS | Medium Voltage | 75m Localised Diversion |
| R04-UG-MV-039 | B1075 - B1095 RHS | Medium Voltage | 20m Localised Diversion |
| R04-UG-HV-025 | B3335 - 3950 LHS | High Voltage | 670m Localised Diversion |
| R04-UG-HV-033 | B4000 - RHS | Medium Voltage | 120m Localised Diversion |

### 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.

Table 10.3 outlines required works.

***Table 10.3 - GNI Asset Works***

| Reference No. | Chainage | Asset | Description of Works |
|---|---|---|---|
| R03-UG-LP-028 | SR2 770 - 800 RHS | Low Pressure gas | 34m Localised Diversion |
| R03-UG-LP-024 | A3960 - 3985 RHS | Low Pressure gas | 25m Localised Diversion |
| R03-UG-LP-030 | A4955 - 5075 RHS | Low Pressure gas | 126m Localised Diversion |

### 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.

Table10-4 outlines the required works.

***Table 10-4: – Irish Water Watermain Works***

| Reference No. | Chainage | Asset | Description of Works |
|---|---|---|---|
| R03-UW-002 | SR2 960 - 1000 LHS | DN 229mm CI | 40m Localised Diversion |
| R03-UW-010 | A5300 - 5360 LHS | DN 152mm CI | 114m Localised Diversion |
| R03-UW--016 | A5150 - 5200 LHS | DN 150mm DI | 28m Localised Diversion |
| R03-UW-013 | A6050 - 6160 RHS | DN 203mm CI | 107m Localised Diversion |
| R04-UW--003 | B1070 - 1100 RHS | DN 152mm CI | 26m Localised Diversion |
| R04-UW-005 | B3755 - 3880 RHS | DN1 02mm AC | 136m Localised Diversion |
| R04-UW-006 | B3950 - 3980 LHS | DN 76mm CI | 30m Localised Diversion |
| R04-UW-007 | B4020 - LHS | DN 152mm CI | 90m Localised Diversion |

### 10.3.4 Eir

Consultation took place with telecommunications providers regarding the impact of the Proposed Schemes on their assets for incorporation within the design. Drawings of the Proposed Scheme with telecommunications assets overlaid is included within Appendix B.16. Table 10-5 outlines the required works for telecommunications services.

***Table 10-5: – Telecommunications Asset Works***

| Reference No. | Chainage | Asset | Description of Works |
|---|---|---|---|
| R03-UG-007 | A670 - 690 LHS | EIR Ducting | 28m Localised Diversion |
| R03-UG-009 | A1060 - 1105 RHS | EIR Ducting | 39m Localised Diversion |
| R03-UG-017 | A1475 - 1510 LHS | EIR Ducting | 32m Localised Diversion |
| R03-UG-020 | A1710 - 1770 LHs | EIR Ducting | 65m Localised Diversion |
| R03-UG-025 | A2225 - 2350 RHS | EIR Ducting | 121m Localised Diversion |
| R03-UG-032 | A3745 - 3775 RHS | EIR Ducting | 22m Localised Diversion |
| R04-UG-005 | B1070 - 1130 RHS | EIR Ducting | 58m Localised Diversion |

# 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.

***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 (eg 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<br>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<br>15kg per traffic signal head<br>Assumed 2 heads per pole | *Source: Siemens Helios General Handbook Issue 18.*<br><br>Nominal assumed average scenario per signal over Proposed Scheme length |
| | Plastic | 9 kg | |
| Traffic Signs | Metal | 20kg/ 3m pole<br>0.75 m sign height<br>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.<br>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-source/publications/national-code-of-practice.pdf (Accessed on 6 May 2021) |

| Item | Material | Assumed nominal weight | Notes |
|---|---|---|---|
| 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)<br><br>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)<br>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)<br>Greater Dublin Region (2012) *Greater Dublin Regional Code of Practice for Drainage works.* Available online: (https://www.sdcc.ie/en/download-it/guidelines/greater- |

| Item | Material | Assumed nominal weight | Notes |
|---|---|---|---|
| | | | 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)<br>Greater Dublin Region (2012) *Greater Dublin Regional Code of Practice for Drainage works.* Available online: https://www.sdcc.ie/en/download-it/guidelines/greater-dublin-regional-code-of-practice-for-drainage.pdf (Accessed on 6 May 2021) |

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

| Material | Densities (tonnes/m3) | Notes |
|---|---|---|
| Soil | 2.2 | Professional judgement (Dublin boulder clay), laboratory testing - Nominal assumed average scenario over 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)<br>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 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) |
| 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) |

| Asset type | Assumed nominal average trench width (m) | Assumed material spec. (TII) | Assumed nominal average trench depth under pavement layer (m) | Notes |
|---|---|---|---|---|
| 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 subbase layer of footpath) | 0.5 | Class 2/4/U1 Cohesive subgrade material | 0.56 | South Dublin County Council (2016) *Public Lighting Specification.* Available online: https://www.sdcc.ie/en/services/transport/public-lighting/sdcc-public-lighting-specification.pdf (Accessed on 6 May 2021) |
| Gas Excavation Assessment (assumed at 0.6m cover i.e obvert at 0.4m under subbase layer of footpath) | 0.45 | Class 2/4/U1 Cohesive subgrade material | 0.7 | Gas Network Ireland (2018) *Guidelines for Designers and Builders- Industrial and Commercial (Non-domestic) Sites. Available online: https://www.gasnetworks.ie/Guidelines-for-Designers-and-Builders-Industrial-and-Commercial-Sites.pdf (Accessed 6 May 2021)* |

***Table 11-4: Footpath and Verge Widening Excavation Assumptions***

| Layer | Assumed Layer thickness (m) | Assumed material spec. (TII) |
|---|---|---|
| Footpath surface treatment due to all works (remove and replace) | 0.1 | Concrete |
| 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 91,000 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) |
|---|---|
| Soil and stone | 44,000 |
| Concrete, bricks, tiles and similar | 19,000 |
| Bituminous mixtures | 28,000 |
| **Total** | **91,000** |

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 footways & 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 footways 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 footway 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

In conjunction with the proposed northbound bus gate on St. Mobhi Road it is proposed to provide direction signs for two alternative traffic diversion routes as follows and as illustrated in Figures 12-1 and 12-2:

A. Regional traffic diversion from Hart's Corner in the northwest direction along the R135 Finglas Road to the Old Finglas Road, then eastwards via Tolka Estate and Griffith Avenue to re-join R108 Ballymun Road.

B. Local traffic diversion along Botanic Road, Glasnevin Hill, Old Finglas Road, Cremore Villas and Griffith Avenue.

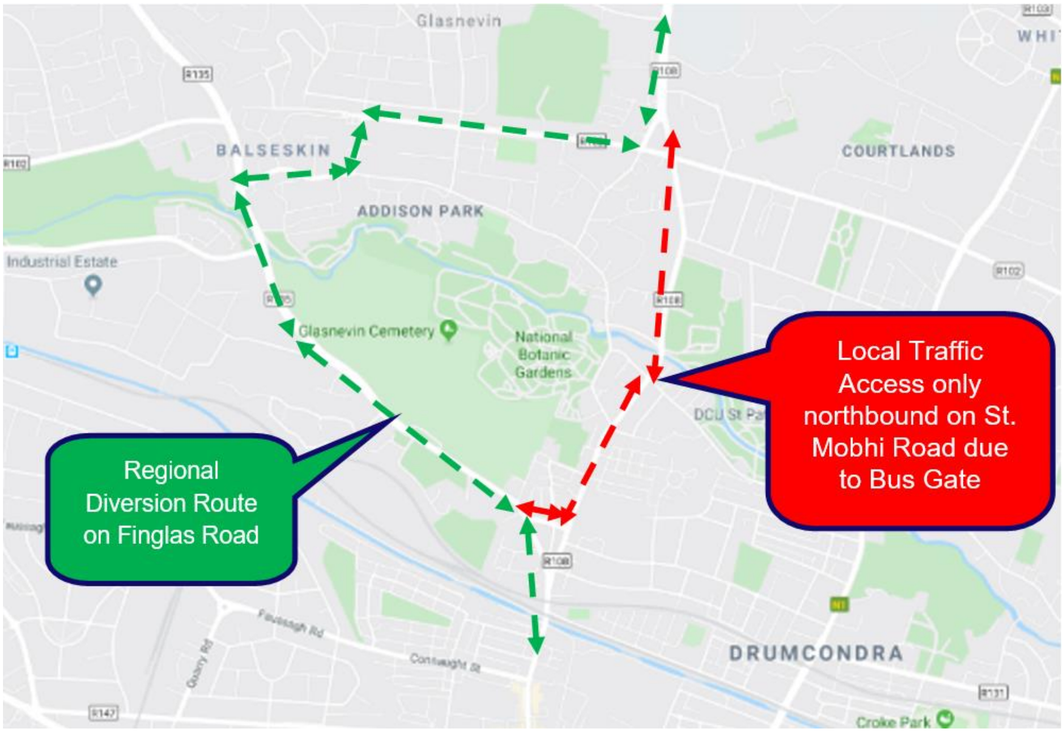


*Figure 12-1 – Diversion Route A - Regional Route for Northbound Traffic at Glasnevin*

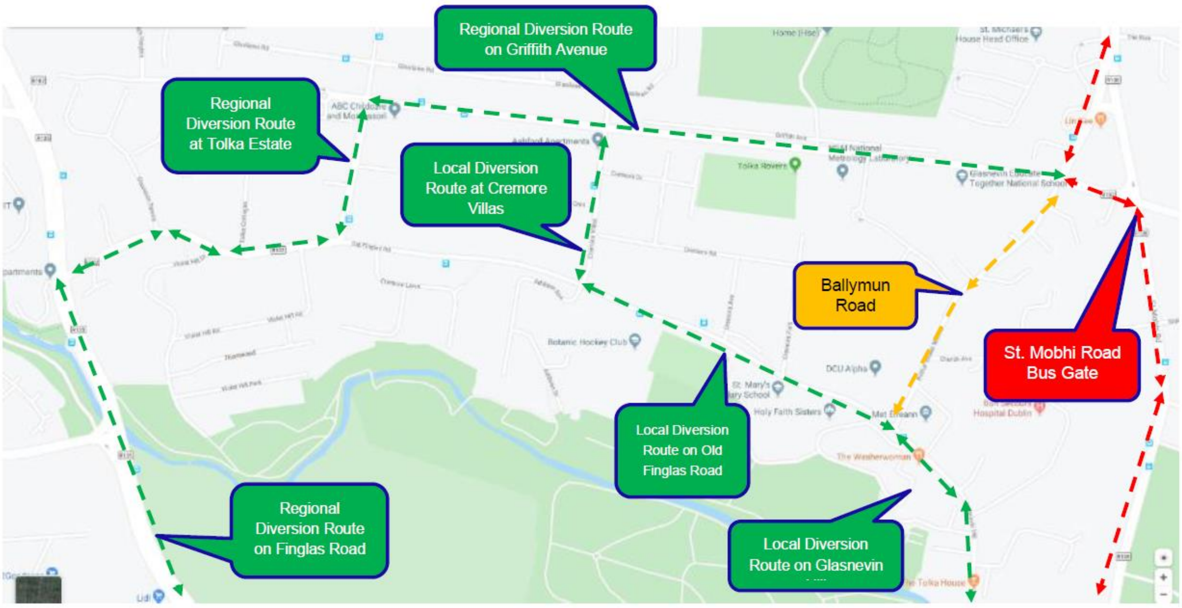


*Figure 12-2: Diversion Route B – Northbound Local Traffic Diversion Routes for Bus Gate at St. Mobhi Road*

### 12.1.3 Gantry Signage

No gantry signage exists along the route, and no new gantry signs are proposed.

## 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 as shown in Appendix B8. This exercise also included the preliminary road marking design of the following items:

- Bus lanes are provided along the full length of 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 Proposed 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 Proposed Scheme. This shall include, but not exclusively, luminaires supplied by underground and overhead cable installations and those located on ESB Infrastructure.

In locations where road widening and/or additional space in the road margin is required, it is proposed that the public lighting columns shall be replaced and relocated to the rear of the footpath, where practicable, 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. 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;

### 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 aim to 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 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 stations 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 footway floor level. This will provide for easier installation as well as replacement, for example where the pole has been damaged and structurally compromised.

### 12.4.2 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.

It was therefore considered appropriate to assume the installation of a separate cabinet for camera equipment from that of the traffic signal control equipment. However, at each traffic signal junction where a camera is installed, consideration will be given to providing a duct between the traffic signal control cabinet and the camera equipment/comms cabinet to allow the connection of the traffic signal control equipment to the data communications network (further details of which are provided below). This would avoid the need for installation of a dedicated comms cabinet for the traffic signal control equipment.

There are sections of the Proposed Scheme where camera locations at or between junctions may be closely spaced. In such cases consideration will be given to using one camera equipment/comms cabinet to serve both camera locations in order to reduce installation costs and minimize the presence of street furniture. This may require positioning the cabinet (and its power supply) between junctions or running ducting from one junction to another. The exact requirement for this will be investigated on a location-specific basis at detailed design stage.

### 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 Figurer 12-3.

***Figure12-3: 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.

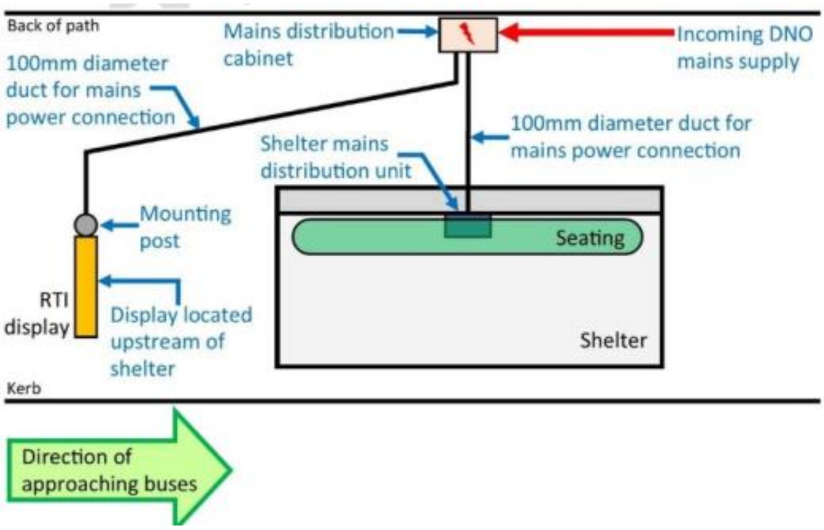


***Figure12-4: Typical Layout for Bus stop with RTPI Display***

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

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 post socket installed at footway floor level. As for the cameras, this will provide for easier installation as well as replacement, for example where the pole has been damaged and structurally compromised.

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 Figure12-4 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 Figure12-4**.**

### 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 the Ballymun / Finglas to City Centre Core Bus Corridor Scheme, with the mains power for the display - as described above – also providing power for this comms device. In this case no ducting will be required for data comms at the bus stop and the only physical connection to the display (i.e. ducting and cabling) will therefore be as described above for mains power.

## 12.6 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.

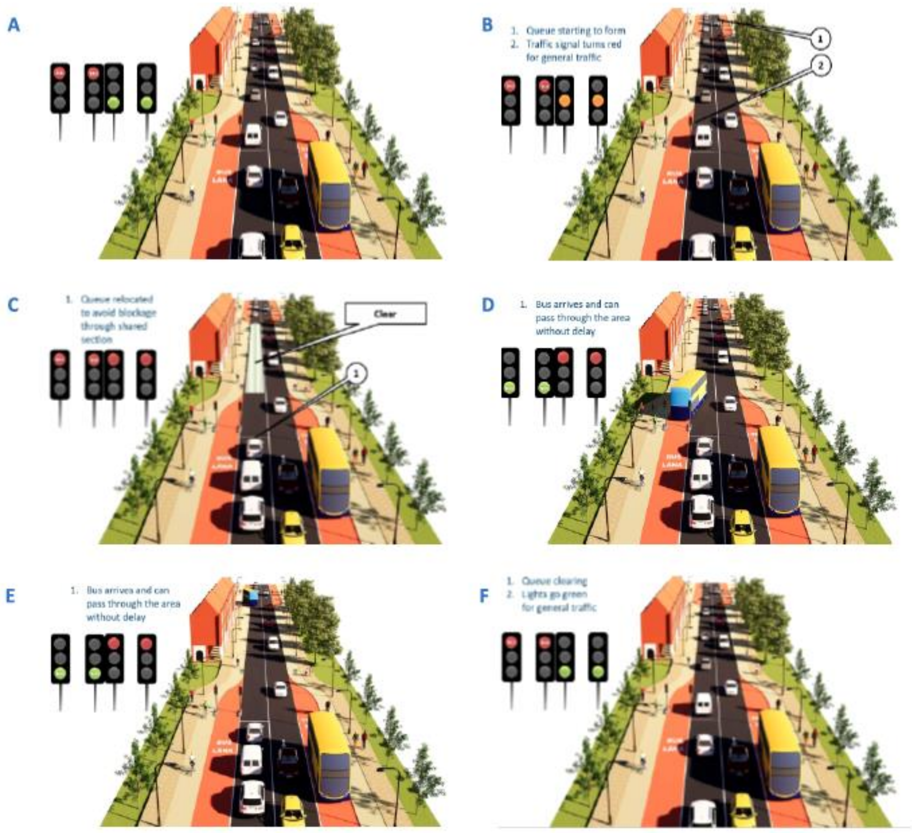


***Figure 12-5: Signal Controlled Bus Priority Schematic Operation***

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.<br>Bonus green compensation for all truncated phases during following cycle, where appropriate.<br>Phase extensions for buses arriving at the end of green. |
| **High** | Truncation of the non-priority stage to minimum value.<br>Immediate insertion of bus priority stage.<br>Bonus green compensation for all truncated phases during following cycle, where appropriate.<br>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 Communication

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.
- 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

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. The total area that lies within the proposed road development boundary is approximately 25ha. including the existing roads and footpaths.

## 13.2 Summary of Compulsory Land Acquisition

From the outset of the design of the Proposed Scheme every effort was made to avoid compulsory land acquisition. However, there are a number of public and private lands that are necessary for the construction of the proposed road development and to secure the many benefits for the Proposed Scheme.

Reference should be made to the 'Compulsory Purchase Order (CPO) Documents' prepared as part of the planning application.

In total approximately 2.5ha. of land will be required to be permanently acquired, of which approximately 1.5ha is currently in Dublin City Council ownership, to construct the Proposed Scheme. There will also be an additional 0.7Ha of Temporary land required to allow for construction of boundary treatment and surface tie in work. This includes approximately 0.5ha currently in Dublin City Council ownership.

## 13.3 Summary of effected 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:<br>• along Ballymun Road at 6 locations<br>• Entrance to Arthur Griffith Park on St. Mobhi Road, Glasnevin<br>• St. Mobhi Drive, Glasnevin<br>• Eglington Terrace, Royal Canal Bank, Phibsborough<br>• Garden at Phibsborough Library<br>• Public park at North Circular Road / Royal Canal Bank, Phibsborough<br>• Broadstone, Phibsborough Road<br>• Yard at Constitution Hill flats<br>• Mellowes Park, Finglas<br>• North Road, Finglas<br>• Finglas Place, Finglas<br>• Claremont Lawns, Finglas Road, Glasnevin | Yes | Yes |

| Address | Permanent Land Take | Temporary Land Take |
|---|---|---|
| St. Mobhi Road, Glasnevin at schools and sports clubs:<br>• Scoil Chaitríona<br>• Na Fianna GAA Club<br>• Home Farm Football Club<br>• Whitehall College | Yes | Yes |
| No.163 to 169 St. Mobhi Road, Glasnevin | Yes | Yes |
| Botanic Business Centre, Botanic Road, Glasnevin | Yes | Yes |
| Daneswell, Botanic Road, Glasnevin | Yes | Yes |
| 21/22 Prospect Road & Bernard Shaw pub, Glasnevin | Yes | No |
| Phibsborough Shopping Centre | Yes | Yes |
| Former service station at corner of Finglas Road and Slaney Road, Glasnevin | Yes | Yes |
| St. Vincent's School, Finglas Road | Yes | Yes |
| 32, 34 & 36 Bengal Terrace, Finglas Road, Glasnevin | Yes | Yes |

## 13.4 Demolition

There are no buildings proposed to be demolished as part of this Proposed Scheme.

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 have been provided in Table 13-1 and also shown on the Boundary Treatment Plans located in Appendix B7.

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 this Proposed Scheme.

- Specific structures (bridges etc) –There are no specific structures within this Proposed Scheme that require temporary land take.

To maintain the character and setting of the Proposed Scheme, the approach to undertaking the new boundary treatment works along the corridor is replacement on a 'like for like' basis in terms of material selection and general aesthetics unless otherwise noted on the drawings.

Modifications to driveways and entrances will be in line with DCC's *Parking Cars in Front Gardens Advisory Booklet.* The basic dimensions to accommodate the footprint of a car in the front garden are 3m x 5m and a vehicular opening 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 2016-2022
    - Vol.1: Written statement - 14.8.4 District Centres – Zone Z4 (Ballymun, Finglas Village and Phibsborough) and 15.1.1.2 SDRA 2 Ballymun
    - 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
- Local Area Plans for each scheme.
    - LAP Ballymun (2017)
    - LAP Phibsborough Mountjoy (2008)

## 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.

The Proposed Scheme is particularly rich in urban trees in some areas such as St. Mobhi Road, in and around the main parks, in the vicinity of the Tolka river and the botanical gardens. A tree survey showing the existing species location shape and size of the canopies, and root systems as proven essential to be able to adapt the road and urban realm design in areas where these natural values should be specially protected.

## 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 CMK Horticulture & Arboriculture Ltd. Project No. TBAL001, TFIN001. 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

The most critical area regarding arboricultural impact would be Ballymun city centre where many small trees in the central median will be substituted and Mobhi Road regarding the protection of large trees while implementing the Proposed Scheme. In CLG Na Fianna the removal of a row of trees is required by the works of moving the existing fence to create space for the future metro station.

## 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 recollected 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.

The following key areas were identified as potential conflicts and the road was layout was reconfigured to preserve the trees.

- **Ballymun Road A1950 – A2900**
  Construction of the proposed cycle path and pedestrian footpaths on the eastern and western side of Ballymun Road will result in the loss of some early mature trees, but importantly the central median will be preserved and will be providing additional substantial tree planting to enhance the quality of the area.
- **St. Mobhi Road A3300 – A3800**
  Most of the existing mature trees will be retained but it will be necessary to remove 5 trees on the western side just to the south of the River Tolka bridge for provision of a cycle track on the eastern side.
- **Finglas Road B1200 – B1300**
  Construction of roadway will result in the loss of some group of young trees in the central median, however, the locations of the pedestrian footpaths and cycleways will be routed to avoid the loss of tree lines located on both sides of Finglas Road.
- **Finglas Road B2300 – B2450**
  Road widening will result in the loss of grass verge in the central median with a group of young trees of Sycamore and Hornbeam, but importantly the tree line with early mature trees on the western side of the Finglas Road and north of the Old Finglas Road junction will be preserve.
- **Finglas Road B2500 – B2700**
  Tree loss will be inevitable in the central median north of the Tolka River bridge, but the same central median will have new geometry and in addition, substantial tree planting as future mitigation will be undertaken to enhance the quality of the area.

### 14.5.2 Tree Loss and Mitigation

Despite the best efforts to protect trees, especially trees of a mature and significant stature there will be inevitable impacts on local trees. In total it is estimated that there will be 276 trees lost, refer to Table 14-1. This loss has been addressed through mitigation and replanting efforts as outlined in the planting strategy (section 14.6.3) below.

***Table 14-1: Summary of trees protected, lost and planted 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 |
| **831** | **-276** | **512** | **1343** |

### 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*

- **Central Median Planting** - Combination of tree and shrub planting to reduce head light glare where appropriate and add a corridor of planting with ecological benefits.

*Figure 14-3: Finglas Road existing dense planting to median*

- **Replacement of Planting in Medians** - Direct replacement of trees and hedgerows lost to road widening or hardscape implementation. New species to be planted are native, well adapted to local climate and soil conditions and should enhance biodiversity.

***Figure 14-4: Introduction of hedgerows to soften fence lines (for example Ballymun Civic Centre)***

- **Ornamental Planting -** Small landscape interventions at local community spaces provide opportunities for a combination of street trees, seating, and more formal planting arrangements. These exist at certain intervals (example bellow) and are often picked up as 'Focal Points'.

***Figures 14-5 & 14-6: Examples of existing ornamental planting and zone at Finglas.***

- **Residential Boundary Planting -** The existing private gardens that border the streets are very important to form a green continuum and contribute to a functional green infrastructure. These areas must be particularly care for and reinstated (like for like) if affected during works.

***Figure 14-7 Residential boundaries replaced with like for like hedgerows***

- **Commercial Boundary Planting -** In Many commercial areas, especially those developed some decades ago there was no concern to include planting or any form of urban integration but only to maximize space for their own activities. Those became unattractive areas that do not contribute to the green network. In some cases, there is enough space available to introduce planting.


***Figure 14-8: Commercial boundaries provide opportunities for new tree planting***

## 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*** | Birch - Downy - Beith chlúmhach / Silver - Beith |
| ***Corylus avellana*** | Hazel - Coll |
| ***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 Section 1 – Ballymun Civic Centre

More street trees will be provided along Ballymun Main Street through removal of one traffic lane on each side to accommodate some on-street parking indented within new lines of trees on each side of the street.


*Figure 14-9: Ballymun Main Street*


*Figure 14-10: Ballymun Main Street*

### 14.6.2 Section 2 – St. Mobhi Road. / Botanic Road

At the scale of the neighbourhood this small commercial area junction should be upgraded to include the concrete pavers that are indicative of a commercial zone. New trees, planters, benches, and bins will be introduced while the large trees are to be kept in good conditions. The scope of this urban realm refurbishment also includes the bank corner in Fairfield rd.


*Figure 14-11: Ballymun - St. Mobhi Road. / Botanic Road Focal Point*

### 14.6.3 Section 2 – Glasnevin Village

By changing the existing junction to feature smaller turning radii, at a lower speed provided by a raised table, the opportunity for refurbishing the existing public realm and creating a new plaza-like centrality came up. The landscape design proposal in this area is developed around making the best of the difference in levels near the existing shops to create a customized wall bench and planter with small trees towards the commercial areas west facing façades. New benches, trees a planter and concrete pavers will be included


*Figure 14-12: Ballymun - Glasnevin Village Focal Point*

### 14.6.4 Section 3 – New Royal Canal Cycle Bridge

This area is expected to be transformed extensively in the coming years since a new metro station is being built nearby. The full proposal of this project includes the design of 3 bridges to accommodate cycle and pedestrian flows through Phibsborough village centre in the back of the main commercial streets. The landscaping design proposal additionally includes an upgrade of the paving material to stone blocks, reflecting the historical importance of the Cross Guns bridge, the planting of a new median and a canal embankment.


*Figure 14-13: Ballymun - New Royal Canal Cycle Bridge Focal Point*

### 14.6.5 Section 3 – Phibsborough Village


***Figure 14-14: Phibsborough Village Focal Point***

It corresponds to the central commercial area of the village and is identifiable by the large concrete building with a Tesco supermarket and some other local shops it extends to the Doyle's corner area where some interesting historical buildings stand. The proposal includes the introduction of street trees, a small planting pocket zone, but mainly and extensive paving material upgrade to include large concrete pavers that mark commercial areas. In Doyle's corner Stone sett cobblers in the junction carriageway accentuate the historical importance of the buildings and area

***Figure 14-15: Ballymun – Doyle's Corner***

### 14.6.6 Section 3 – Phibsborough Library Underpass

To give continuity to the cycle lanes and quiet streets around the village centre an underpass has been proposed for the library area. This will require a detailed landscape design to assure visual continuity beneath the structure, an adequate use of vegetation to conceal walls or cover slopes and seamlessly integrate the landscape from the canal road park up until the historical library building. The landscape proposal includes the use of stone cobble setts for mixed use areas, the relocation of the Phibsborough volunteer statue to the park below, and cycle and pedestrian paths.


***Figure 14-16: Ballymun - Phibsborough Library Underpass Focal Point***

### 14.6.7 Section 3 – Constitution hill/ Broadstone Pocket Garden

There is a small triangular area near the Broadstone Gate BUS depot and historical building offices that has the potential to be reused as a small plaza in relation to the large, monumental area in front of the building above and all Constitution hill new public squares to the south. The main idea was to provide a small plaza-garden with benches that would serve as a meeting point for residents of the area and the students from the building in the opposite side of the street. The choice of using self-binding gravel, and concrete paver materials for the central zone and granite stone cobbles is related both to the character of the Broadstone gate landscaping and to the objective of providing a multi purposed relaxed area for the users. The medium-large existing trees are to be kept and possibly scenically enhanced by installing ornamental up lights.

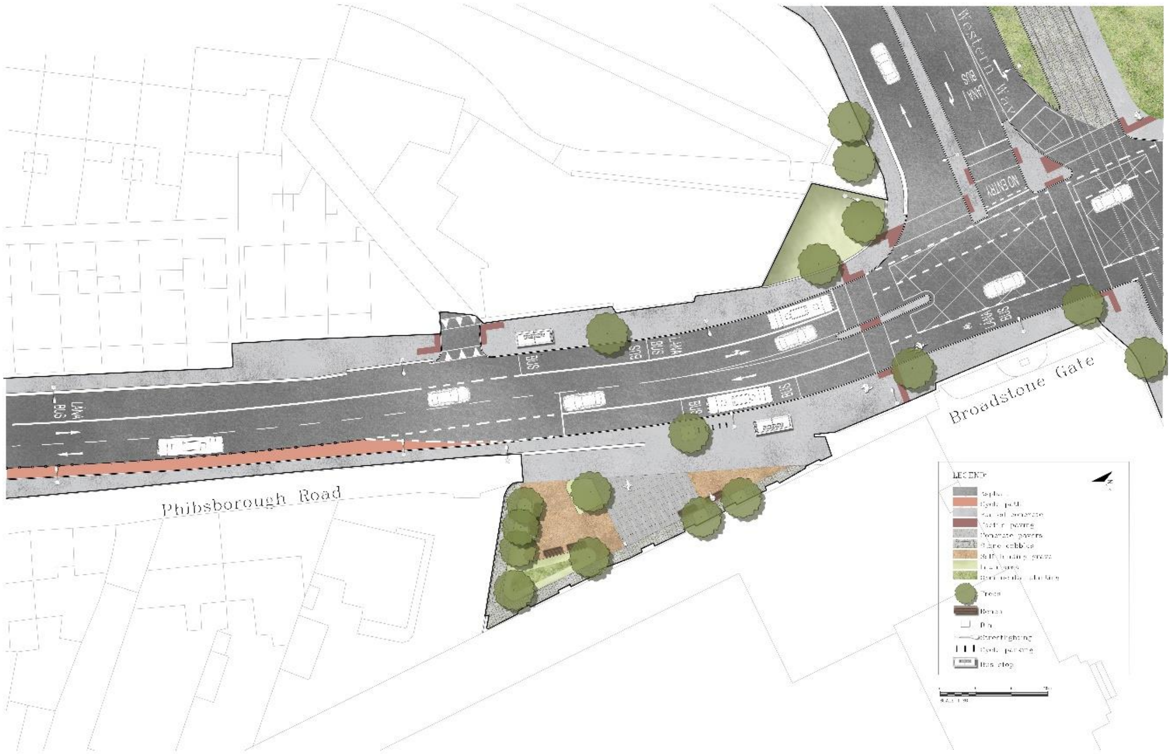


*Figure 14-17: Ballymun – Constitution hill / Broadstone Pocket Garden Focal Point*

### 14.6.8 Section 5 – Finglas Village St. Canice's Church

This small area provides the opportunity to draw attention to a heritage value, the old Celtic cemetery, and ruins of St. Canice's which are located very close by but are hidden by the footbridge and roadside buildings. The proposed design for this area is focused on providing a carefully designed small garden that signals a path to the heritage buildings above in Church St.


*Figure 14-18: Finglas – St. Canice´s Church Focal Point*

### 14.6.9 Section 6 - Clearwater Shopping Centre

The removal of the left turn slip lane in the former junction, allows for the creation of a generous public realm area that is proposed to be shaped into a small plaza area with urban furniture and planters. This will improve the experience of pedestrians reaching this point, also enhancing accessibility in conjunction with the new access route to the bus shelter.


***Figure 14-19: Finglas – Clearwater Shopping Centre Focal Point***

### 14.6.10 Section 7 - Glasnevin Cemetery

The car parking area in front of the Cemetery on the western side of Finglas Road will be relocated. All existing trees along the road edge and in the adjoining public space will be retained around the relocated car parking.


***Figure 14-20: Finglas – Glasnevin Cemetery Focal Point***

# 15 How the Proposed Scheme Achieves the Objectives

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

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 51% of the route inbound and 47% outbound, of which significant portions of the route are shared with cyclists and or parking lanes.

Issues related to frequency, reliability and a complex network have persisted for many years and will continue to do so without further intervention. There are a number of planned high frequency public bus services along the route which will be improved by the Proposed Scheme including the E1, E2, F1, F2. F3 and 19,23 and 24 bus routes, as well as multiple orbital routes including N2 and,N6. In addition to this there are multiple other bus services which run along this corridor intermittently, providing interchange opportunities with other bus services. The Proposed Scheme interventions will seek to make these services more reliable, particularly in peak times, thus providing a more attractive and sustainable alternative mode of transport. The introduction of segregated cycle and parking facilities will facilitate optimum bus speeds to improve on the punctuality and reliability of the bus service. Similarly, the use of active bus signalling measures will improve continuity of bus journey times through junctions.

Without the interventions of the Proposed Scheme there would likely be an exacerbation of the issues which informed the need for the Proposed Scheme itself. The capacity and potential of the public transport system would remain restricted by the existing deficient and inconsistent provision of bus lanes and the resulting sub-standard levels of bus priority and journey-time reliability. Thus, the unreliability of bus services would continue. As such the Proposed Scheme is actively enhancing the capacity and potential of the public transport system, and supports the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets.

A key objective of the Proposed Scheme is to enhance the potential for cycling along the route. Without the provision of safe cycling infrastructure, intended as part of the Proposed Scheme, there would continue to be an insufficient level of safe, segregated provision for cyclists who currently, or in the future would be attracted to use the route of the Proposed Scheme.

In terms of the need to improve facilities for cyclists along the route of the Proposed Scheme, the design intent is that segregated facilities should be provided where practicable to do so. Within the extents of the Proposed Scheme there are mandatory cycle lanes or cycle tracks provided on approximately 32% of the route inbound and 36% outbound on the Proposed Scheme. Advisory cycle lanes are provided on approximately 24% of the inbound route and 26% of the outbound route. The remaining extents have no dedicated cycle provision or cyclists must cycle within the bus lanes where provided, or within the general traffic lane.

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 amenities, village and urban centres which will be enhanced as part of the proposed works. In order to improve accessibility to jobs, education and other social and economic opportunities through the provision of an integrated sustainable transport system, there needs to be a high quality pedestrian environment, including specifically along the route of the Proposed Scheme. There are a number of uncontrolled crossings along the route of the Proposed Scheme, particularly at side roads which are generally of poor standard, including lack of provision for the mobility and visually impaired. There are multiple incidences of ‘patch repairs’ along footpaths that in some instance has led to undulating, uneven surfaces caused by settlement of patch repair material. This is often a hazard to pedestrians, particularly the mobility impaired. A number of submissions were also received as part of the non-statutory consultation in which members of the public indicated specific locations where the existing provision is unsafe for pedestrians – many of which are proposed to be addressed by the Proposed Scheme.

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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*Building Ireland's Future*