Blanchardstown to City Centre Core Bus Corridor Scheme

April 2022

Preliminary Design Report

BUS CONNECTS

SUSTAINABLE TRANSPORT FOR A BETTER CITY.

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List of Acronyms

Acronym	Definition
AC	Asphalt Concrete
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
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
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
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

Acronym	Definition
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
GI	Ground Investigation
GPR	Ground Penetration Radar
GDRCoP	Greater Dublin Regional Code of Practice
GDSDS	Greater Dublin Strategic Drainage Study
HRA	Hot Rolled Asphalt
HGV	Heavy Goods Vehicle
ILP	Institution of Lighting Professionals
IRI	International Roughness Index
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

Acronym	Definition
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
SDCC	South Dublin County Council
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
WCC	Wicklow County Council

Executive Summary

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

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

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

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

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

1 Introduction and Description

1.1 Introduction

BusConnects is the National Transport Authority's (NTA) programme to improve bus and sustainable transport services. It is a key part of the Government's policies 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 Core Bus Corridor (CBC) Infrastructure Works. It comprises an inhouse team including technical and communications resources and external service providers procured from time-to-time to assist the internal team in the planning and design of the twelve Proposed Schemes.

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

Blanchardstown to City Centre Core Bus Corridor of the CBC Infrastructure Works (herein after called the 'Proposed Scheme') measures approximately 10.9 km from end to end.

The Proposed Scheme commences at Junction 3 (Blanchardstown / Mulhuddart) southbound off-slip from the N3. The corridor proceeds along the R121 Blanchardstown Road South into the Blanchardstown Shopping Centre.

From a new terminus to the north-west of Blanchardstown Shopping Centre the Proposed Scheme is routed onto the N3 Navan Road via the Snugborough Road junction and follows the N3 and Navan Road as far as the junction with the Old Cabra Road. From here, the Proposed Scheme is routed along Old Cabra Road, Prussia Street, Manor Street and Stoneybatter to the junction with Brunswick Street North.

The Proposed Scheme is then routed via Blackhall Place as far as the junction with Ellis Quay and Arran Quay, where it joins the prevailing traffic management regime on the North Quays.

At the Stoneybatter / Brunswick Street North junction, cyclists proceed along Brunswick Street North, George's Lane and Queen Street as far as Ellis Quay/Arran Quay.

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

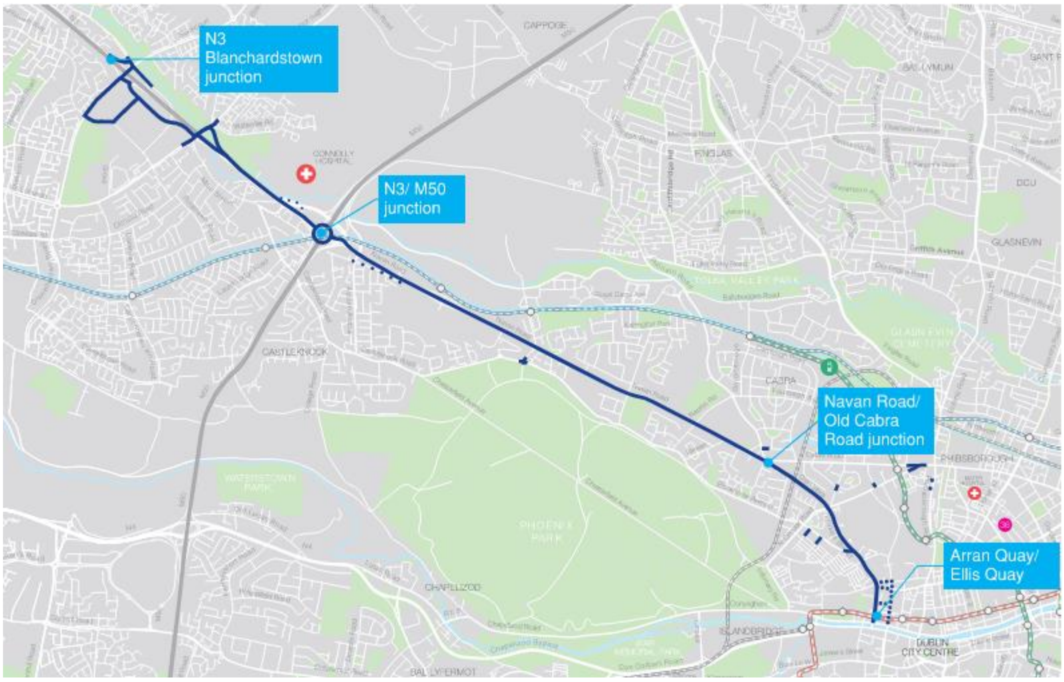


Figure 1.1: Proposed Scheme Route Overview

1.2 Scheme Aims and Objectives

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

The objectives of the CBC Infrastructure Works are to:

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

1.3 Project Background

The Transport Strategy for the Greater Dublin Area 2016 – 2035 sets out a network of the bus corridors forming the “Core Bus Network” for the Dublin region. Sixteen indicative radial CBCs were initially identified for redevelopment. This is shown in Figure 1.2 below (extract from Transport Strategy for the Greater Dublin Area 2016-2035).

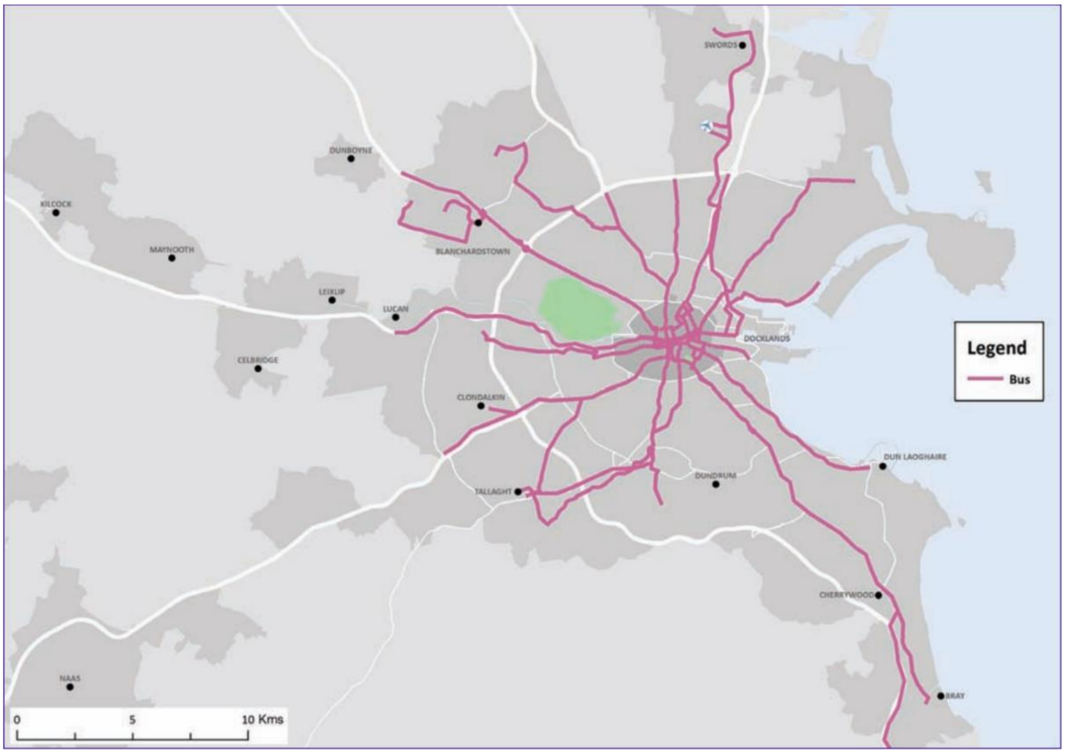


Figure 1.2: 2035 Core Bus Network – Radial Corridors

These corridors currently have dedicated bus lanes along only less than one third of their lengths which means that for most of the journey, buses and cyclists are competing for space with general traffic and are negatively affected by the increasing levels of congestion. This results in delayed buses and unreliable journey times for passengers. Following the completion of feasibility and options studies sixteen radial corridors were taken forward.

In June 2018, the 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 Blanchardstown to City Centre CBC.

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

- Clongriffin to City Centre Core Bus Corridor Scheme;
- Swords to City Centre Core Bus Corridor Scheme;

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

The twelve radial routes that form the CBC Infrastructure works is shown in Figure 1.3.

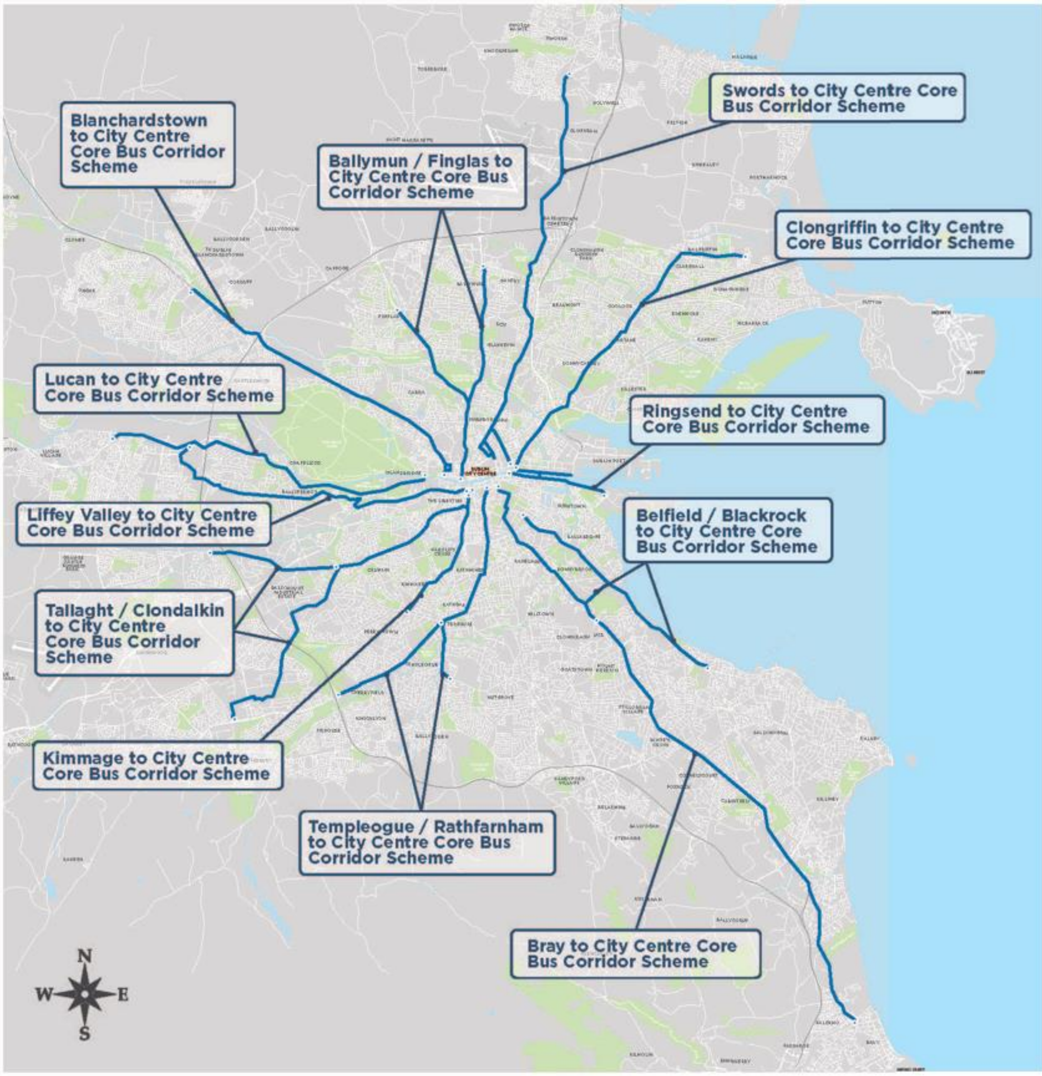


Figure 1.3: BusConnects Radial CBC Network

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 non-statutory public consultation have taken place over the following dates;

- 14 November 2018 to 29 March 2019 - Consultation on Emerging Preferred Route;
- 4 March 2020-17 April 2020 - Consultation on Preferred Route Option; and
- 4 November 2020 - 16 December 2020 - Consultation on Preferred Route Option.

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

Consultation with the principal project stakeholders (i.e. Dublin City Council (DCC), Fingal County Council (FCC), Transport Infrastructure Ireland (TII), An Garda Síochána, Office of Public Works (OPW) and Utility companies) has taken place to date in order to:

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

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

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

- Representative Groups;

- Chartered Landowners (i.e. owners of lands at any specific locations); and
- Directly Impacted landowners.

1.6 Audit of the Existing Situation

A number of audits, surveys and assessments have been carried out, and includes the following:

- Problem Identification Audit;
- Accessibility Audit;
- Route Infrastructure Audit;
- Existing Pavement Inspection Audit;
- Existing Structures Impact Assessment;
- Existing Route Collision Analysis;
- Cellar Survey;
- Private Landings Survey;
- Baseline Tree Survey;
- Arboricultural Impact Assessment;
- Cycle Journey Time Survey;
- Pavement condition;
- Phase 1 Utility Survey;
- Bus Stop Survey including boarding and alighting and AVL;
- Traffic Survey (JTC, pedestrian and cyclists counts);
- Parking survey; and
- Bus Journey Time.

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

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

1.7 Purpose of the Preliminary Design Report

The Preliminary Design Report sets out the preliminary design of the Proposed Scheme, and supports the Compulsory Purchase Order (CPO) documentation and Environmental Impact Assessment Report (EIAR) which form part of the Planning Application to An Bord Pleanála.

During the preparation of the preliminary design, a designer's risk assessment was undertaken, details of these are included in Appendix A.

The purpose of the risk assessment is to identify significant design risks and mitigate them as part of the design process.

1.8 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 five sections of the Proposed Scheme in more detail;
- Chapter 4: Road Geometry – In this chapter, the geometrical alignment and cross-section of the scheme are described, along with an overview of the operational safety process which has been implemented;
- Chapter 5: Junction Layout – 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 Condition – This chapter provides an overview of the ground investigation process and ground conditions;
- Chapter 7: Pavement, Kerbs, Footpaths and Paved Areas– This chapter gives an overview of the existing pavement situation and proposed pavement, kerbs, footpaths and paved areas design for the scheme;
- Chapter 8: Structures – In this chapter an overview of the structures strategy is provided, along with a summary of principal and miscellaneous structures, retaining walls and embankments;
- Chapter 9: Drainage, Hydrology and Flood Risk – This chapter is an overview of the drainage strategy includes descriptions of existing watercourses and culverts alongside a summary of the drainage design for each catchment along the scheme, including the consideration of drainage at structures and the maximisation of SuDS features;
- Chapter 10: Services and Utilities – This chapter shows the Utilities design strategy documents surveys undertaken to date, identifies conflicts and recommends a number of diversions;
- Chapter 11: Waste Quantities – This chapter provides an overview of the waste quantities for the Proposed Scheme;
- Chapter 12: Traffic Signs, Lighting and Communications – In this chapter the design strategy for traffic signs, road markings, lighting and communications equipment is outlined, alongside descriptions of how these elements can be maintained and monitored safety and securely;

- Chapter 13: Land Use and Accommodation Works – This chapter outlines land use and acquisition requirements, affected land and property owners, and proposed accommodation works;
- Chapter 14: Landscape and Urban Realm – This chapter is an overview of the landscape and urban realm design strategy focussing on the existing trees and proposed mitigation;
- Chapter 15: How we are achieving the Objectives – This chapter sets out the manner in which the Proposed Scheme achieves its objectives; and
- Appendices – Various appendices and background information as referenced throughout the report.

1.9 Preliminary Design Drawings

A set of preliminary design drawings have been prepared to convey the scheme design principles for each discipline and should be read in conjunction with this Preliminary Design Report. Table 1.1 provides a description of the drawings and relevant design content displayed in each of the series as applicable for the Scheme. The drawings have been included in Appendix B for reference.
The file naming conventions for the Drawing Series and Volume Codes are as set out in the Building Information Modelling (BIM) Execution Plan (BEP) developed for the CBC Infrastructure Works.

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 Plan (1:2500@A1)	Defines the full extent of the works & planning red line boundary. Outlines the scheme chainage structure and provides context for the locality of adjacent Schemes and other notable locations along the route.
SPW_BW	Fencing and Boundary Treatment (1:500@A1)	To be read in conjunction with the GEO_GA General Arrangement series and GEO_CS typical cross section series. Provides an indication of the locations for the proposed boundary modification works along the route.
GEO_GA	General Arrangement (1:500 @ A1)	Displays information for conveying the overarching scheme design intent, providing information on the proposed pedestrian/cycle/ bus/traffic regime, indicative ultimate tree arrangement (existing trees retained & proposed trees), bus stop/shelter locations, key heritage feature locations, parking and loading arrangements, turn bans, side road treatments in addition to identification of specific items of note to the scheme (structures or significant features which may be further described on other drawing series)

Drawing Series Volume Code	Drawing Series Description/Scale	Design Content
GEO_CS	Typical Cross Sections (1:50 @ A1)	To be read in conjunction with the GEO_GA General Arrangement series. Provides an indication of the proposed cross section works in comparison to the existing road geometry. Indicative pavement/kerbing, boundary treatments and key street furniture are also provided for context.
GEO_HV	Mainline Plan and Profile (1:500@A1)	To be read in conjunction with the GEO_GA General Arrangement series. Provides an indication of the proposed modification works to the mainline vertical alignment with supplementary information on earthworks/retaining walls and other notable structures along the route (as required).
ENV_LA	Landscaping General Arrangement (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 footpath surface finishes, locations of proposed SUDs features and proposed boundary treatment and key street furniture notes.
DNG_RD	Proposed Surface Water Drainage Works (1:500@A1)	Displays information for conveying the design intent for the drainage portion of the works including identification of SuDS measures, requirements for allowable discharge rates to the existing networks (attenuation/detention/flow control) where applicable, catchment assessments and outline design for the proposed drainage discharge strategy along the route.
UTL_UC	Combined Existing Utilities Records (1:500@A1)	Displays information regarding existing Statutory Undertakers records along the length of the scheme with the proposed scheme features shown as background information for context.
UTL_UD	IW Foul Sewer Asset Alterations (1:500@A1)	Provides an indication of the existing trunk foul sewer network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.
UTL_UW	IW Water Asset Alterations (1:500@A1)	Provides an indication of the existing trunk potable water network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.

Drawing Series Volume Code	Drawing Series Description/Scale	Design Content
UTL_UE	ESB Asset Alterations (1:500@A1)	Provides an indication of the existing trunk electrical network (above and below ground) and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.
UTL_UL	Telecommunications Asset Alterations (1:500@A1)	Provides an indication of the existing trunk telecommunications network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.
UTL_UG	GNI Asset Alterations (1:500@A1)	Provides an indication of the existing trunk gas network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.
LHT_RL	Street Lighting (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 lighting column features.
TSM_SJ	Junction Systems Design (1:250@A1)	Provides a more detailed overview of the proposed junction arrangements for pedestrians, cyclists, buses and general traffic with an indication of the proposed junction staging and associated signal head arrangements for key signalised junctions/signalised crossings along the route.
TSM_GA	Traffic Signs and Road Markings (1:500@A1)	Provides an indication of the proposed key signage (information/directional/regulatory) design requirements and the design intent for the proposed lane marking arrangements along the route.
PAV_PV	Pavement Treatment Plans (1:500@A1)	Provides an indication of the proposed pavement treatment works along the length of the route.
STR_GA	Bridges and Major Retaining Structures	Provides details relating to proposed bridge structure/underpass works in addition to structural retaining walls and overhead sign gantries along the route.
BLD_AR	Buildings / Architecture	Provides details relating to proposed Bus Interchange and driver welfare facility including architectural layouts and site elevations and sections.

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

Full details of the compulsory land acquisition required to construct the 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.

2 Policy Context and Design Standards

2.1 Policy Context

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

- Project Ireland 2040;
- 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); and
- Fingal County Council Development Plan (FCC) (2017 – 2023).

For further information on how the Proposed Scheme meets the policies outlined above, refer to Blanchardstown to City Centre Core Bus Corridor Planning Compliance Report.

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), contained in Appendix O; its purpose is to provide guidance for the various design teams involved in CBC Infrastructure Works, to ensure a consistent design approach across the twelve Proposed Schemes.

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 or design guidance, these deviations have been noted within Section 4.17.

3 The Proposed Scheme

3.1 Proposed Scheme Description

The Proposed Scheme is approximately 10.9 km long, commencing at Junction 3 (Blanchardstown/Mulhuddart) eastbound off-slip from the N3 and terminating at the junction of Blackhall Place and Ellis Quay. The General Arrangement drawings and associated Typical Cross Sections drawings in Appendix B show the extent of the infrastructure proposed to deliver the Proposed Scheme. The Proposed Scheme has been broken down into five sections and the works contained within them are described accordingly.

N3 Blanchardstown Junction to Snugborough Road:

The Proposed Scheme commences at Junction 3 (Blanchardstown / Mulhuddart) eastbound off-slip from the N3. It is proposed to alter the existing off-slip road from the N3, from two general traffic lanes to one general traffic lane and one bus lane. At the junction of Blanchardstown Road North / Navan Road, it is proposed to introduce a protected style junction to enhance safety for cyclists. Proposals for the N3 on-slip junction, immediately to the south of this junction, include for the provision of a left turn filter lane with the northbound cycle track being moved to alongside the verge.

In the vicinity of the N3 overbridge, the relocation of cycle tracks to alongside footpaths, which cross adjacent to pedestrian crossings at slip-roads to avoid conflict with vehicular traffic, is proposed.

After crossing the N3 overbridge, a westbound bus lane, alongside a general traffic lane is proposed along Blanchardstown Road South towards the Blanchardstown Shopping Centre via the Blakestown Way junction. The proposal also includes two eastbound general traffic lanes along Blanchardstown Road South. It is proposed to include a cycle track along each side of Blanchardstown Road South. A new retaining wall is proposed between the cycle track / footpath and the shopping centre, extending from the westbound bus stop to the N3 off-slip junction and further south towards the Crowne Plaza hotel. It is also proposed to replace the small retaining wall and railing between Whitestown Grove and Blanchardstown Road South, due to a reduction in footpath levels. The new wall and railing will match existing.

A bus layover ‘layby’ is proposed to be located north of the shopping centre on Blanchardstown Road South, with a proposed driver welfare facility in close proximity to the bus layover.

A new access, in the form of a signalised junction, will be provided from Blanchardstown Road South into the northern car park at Blanchardstown Shopping Centre.

The Blanchardstown Road South / Blakestown Way junction will be converted from a roundabout to a signal-controlled junction. The proposals for the road linking the Blanchardstown Road South / Blakestown Way junction to the western junction of the Bus Interchange include a bus lane and general traffic lane in each direction, with an additional left turn filter lane into the shopping centre. A single cycle track along the eastern side of this road becomes a two-way cycle track on the approach to the shopping centre. The area adjacent to the western junction of the Bus Interchange will facilitate 35 bicycle stands.

The existing roundabouts in the vicinity of the shopping centre are proposed to be converted to signalised junctions.

Within the Blanchardstown Shopping Centre site, it is proposed to upgrade the existing bus laydown area to a more formal Bus Interchange with improved passenger waiting facilities. The new Bus Interchange will include six bays for boarding / alighting and an additional seven alighting bays for buses. The interchange will also include six bus shelters with roof canopies of two different heights providing shelter for external circulation.

An existing entrance (at Chainage F85) into the northern car park at the Shopping Centre will be removed as a result of the proposed Bus Interchange.

A two-way cycle track will continue along the southern side of the interchange as part of the proposals.

The existing northbound bus lane on the northern corner of Blanchardstown Shopping Centre site (adjacent to the Crowne Plaza Hotel) is proposed to be maintained. This will merge with a new northbound bus lane on the N3 off-slip leading to Blanchardstown Road South. It is also proposed to provide a two-way cycle track adjacent to the northbound bus lane.

A new bus stop for inter-urban buses is proposed on the Northbound N3 off-slip adjacent to the Crowne Plaza Hotel.

Between the junction adjacent to the Crowne Plaza Hotel entrance and the Liberty Insurance building, it is proposed that a bus lane and general traffic lane be provided in each direction with a two-way cycle track along the southern edge of the carriageway. Retaining walls are required between the southern footpath and the adjacent car park between chainage A200 and A400 approximately. New bus stops are also proposed in each direction in this area, including modification of an existing bus stop layby to accommodate inter-urban buses.

An existing exit from a bus park at Chainage A415 will be removed to accommodate a proposed bus stop. The bus parking layout will be revised in conjunction with buses exiting using an existing access road at Chainage A390.

Modification of the existing roundabout junction adjacent to the Liberty Insurance Building on the L3020 to a fully signalised crossroads junction is proposed, allowing for bus lanes in both directions each side of this junction. It is also proposed to widen the road between the existing junction and the tie-in with the Snugborough Interchange Upgrade scheme to accommodate improved cycling, pedestrian and bus stop facilities. A new bus layby (for inter-urban buses) is also proposed on the westbound carriageway on the L3020, which will require a short section of retaining wall to be constructed to the rear of the proposed cycle track at this location.

Following this Section, it is intended to route the bus lane through the Snugborough Road junction. The Proposed Scheme will be coordinated with the Snugborough Interchange Upgrade scheme being undertaken by Fingal County Council (FCC). The Snugborough Interchange Upgrade scheme involves the widening of the Snugborough Road bridge and the L3020 to accommodate additional bus lanes and general traffic lanes, and new cycle tracks.

The scheme proposals include for five proposed bus stops with four existing bus stops to be retained and four existing bus stops to be removed along this section of the route. This does not include for the existing bus stops at the location of the proposed Bus Interchange. There is also one existing bus stop layby to be retained and one proposed bus stop layby for inter-urban buses.

Snugborough Road to N3/M50 Junction:

This Section of the Proposed Scheme commences at the tie-in with the Snugborough Junction Upgrade scheme on the N3 citybound slip-road. There is a proposed bus lane along the N3 Snugborough Road junction on-slip and off-slip ramps. It is proposed to construct a bus lane along the extremities of the N3 corridor in both directions. This will result in the widening of the BR01 River Tolka Bridge beneath the N3 off-slip and also BR02 Mill Road Bridge.

An emergency refuge layby and two maintenance laybys are proposed alongside the outbound carriageway and two maintenance laybys are proposed alongside the inbound carriageway of the N3.

On the N3 inbound carriageway, the Scheme proposal includes for relocating the overhead variable messaging sign, modification to an existing overhead sign gantry, provision of a new overhead sign gantry and removal of an existing overhead sign gantry. On the N3 outbound carriageway, it is proposed to provide two new overhead sign gantries.

Additional inbound and outbound bus stops will be provided on the N3 with pedestrian access to and from Mill Road. Access from Mill Road to the new bus stops is proposed via pedestrian ramps and steps. Retaining walls will be constructed to support the pedestrian ramps and steps.

Retaining walls are also required at the back of verge along sections of both the inbound and outbound N3 carriageways. This includes a retaining wall to the rear of a bus stop layby on the inbound carriageway between River Road and the M50 roundabout. A section of new retaining wall is also required between the inbound and outbound N3 carriageways immediately to the west of the M50 roundabout.

Existing noise barriers are also required to be relocated along the outbound carriageway back of verge.

It is proposed to have a speed limit of 60km/h for the inbound and outbound bus lane of the N3 carriageway section.

The inbound bus lane is proposed to be directed onto the Connolly Hospital off-slip road and onto the N3 Navan Road.

The proposals include a bus lane in both the eastbound and westbound directions on the gyratory over the M50 (Junction 6).

The scheme proposals include for four proposed bus stops (one being a layby) with an existing bus stop layby to be removed along this section of the route. There is also one existing bus stop layby to be retained and one proposed bus stop layby for inter-urban buses.

N3/M50 Junction to Navan Road/Ashtown Road Junction:

It is intended to construct a new section of inbound bus lane between the eastern side of the gyratory and the Auburn Avenue junction.

New bus stops are proposed immediately to the east of Auburn Avenue junction with the R147 Navan Road, along both the inbound and outbound carriageways. A short retaining wall is proposed to the rear of the outbound bus stop.

A bus lane is proposed along the existing inner lane of the inbound and outbound R147 Navan Road, with the bus lane terminated on the inbound carriageway between Morgan Place and the Navan Parkway off-slip junction to allow left turners to enter the nearside lane to leave the main carriageway. At the Navan Road Parkway junction, it is proposed that buses be routed off the mainline and along the on and off slip roads (widened to carry bus lanes) to the junction overbridge.

As part of measures to improve road safety, it is proposed to reduce the inbound carriageway cross-section from four general traffic lanes and a bus lane to two general traffic lanes and a bus lane before the existing pedestrian crossing west of Morgan Place. This will reduce potential conflict between vehicle movements, between Morgan Place and the Navan Parkway off-slip junction.

Commensurate with the suburban nature of Navan Road between Auburn Avenue and Phoenix Park Avenue junctions, it is proposed to implement a consistent 60kph speed limit, to reflect the presence of bus stops and pedestrian crossings, and the need for general traffic to carry out merging and weaving actions to access side roads. East of Phoenix Park Avenue junction, Navan Road enters an urbanised environment (including pedestrian crossings) and hence a 50km/h speed limit is proposed, which is consistent with the speed limit on Navan Road east of Ashtown Road. The existing 50km/h speed limit along the Navan Parkway on and off-slip ramps will remain in place, with their proposed extents adjusted slightly.

Due to a proposed change in lane positions on Navan Road between Phoenix Park Avenue and Auburn Avenue, it is proposed to modify the three existing overhead sign gantries on the outbound carriageway of the R147.

New bus stop lay-bys for inter-urban buses are proposed on both the inbound and outbound Navan Parkway off-slip ramps, with a new inline bus stop located on the inbound on-slip ramp, replacing the existing inline bus stop located on the inbound off-slip ramp. A retaining wall is proposed to the rear of the outbound bus stop lay-by. New inbound and outbound bus stop lay-bys and relocated bus stops are also proposed adjacent to Phoenix Park Avenue junction.

The Proposed Scheme has a Quiet Street Treatment proposed for cyclists on Castleknock Manor to integrate with secondary route 4A of the GDA Cycle Network Plan. It is also proposed to modify the Auburn Avenue / Castleknock Manor roundabout to provide enhanced pedestrian and cyclist crossing facilities.

On the scheme corridor between Castleknock Manor and Ashtown Road junction, the proposal includes a two-way cycle track along the outer edge of the westbound (outbound) carriageway, which will provide good connectivity for cyclists from existing and planned residential areas.

At the Ashtown Road junction, it is proposed to terminate the two-way cycle track, west of the junction, and to transition to a one-way cycle track on each side of the Navan Road carriageway east of the junction.

The two left-in / left-out junctions on opposite sides of Navan Road at Phoenix Park Avenue are proposed to be amended to operate as a staggered signal-controlled junction, which will allow left and right turns out of the side roads, left turns into the side roads and right-turns from the west into Phoenix Park Avenue.

The central median between Phoenix Park Avenue junction and Ashtown Road junction will be removed to provide additional space for footpath and cyclist facilities and landscaped verges.

At the Navan Road / Ashtown Road junction, the proposals include for the existing roundabout to be modified to a signal-controlled crossroads, with separate pedestrian and cyclist crossings.

The Blackhorse Avenue / Ashtown Gate Road junction to the south of the core bus corridor is proposed to be signalised to allow improved traffic management, and in particular to minimise use of side roads by through traffic.

The scheme proposals include for five proposed bus stops with three existing bus stops to be retained and two existing bus stops to be removed along this section of the route. There are also four proposed bus stop laybys for inter-urban buses.

Navan Road/Ashtown Road Junction to Navan Road/Old Cabra Road Junction:

From Ashtown Road junction to Old Cabra Road junction (also referred to as Ratoath Road junction), the proposals generally consist of a bus lane and general traffic lane in each direction, with one-way cycle tracks alongside the proposed inbound and outbound bus lanes. Land take is required from a number of residential properties along this section to accommodate these facilities.

The proposals also cater for re-grading of a number of driveways to facilitate the Proposed Scheme alignment. Further details are provided in Chapter 13 ‘Land Use and Accommodation Works’ of this report.

Enhanced cyclist and pedestrian facilities are proposed at each junction along this section of the Proposed Scheme.

Proposed revised junction layouts include the removal of the right turn filter lane from Navan Road (westbound) into Kempton Avenue and Ashtown Grove, although the right turn movement is permitted.

The scheme proposals include for four proposed bus stops with nine existing bus stops to be retained and seven existing bus stops to be removed along this section of the route.

Navan Road/Old Cabra Road Junction to Ellis Quay:

The Proposed Scheme will limit the use of Old Cabra Road to local access traffic, buses, taxis and cyclists as follows:

- No through traffic in the southbound direction at the northern end of Old Cabra Road (at its junction with Navan Road), except for buses, taxis and cyclists, which precludes general traffic from Navan Road travelling to Stoneybatter along Old Cabra Road; and
- No through traffic in the northbound direction except for buses, taxis and cyclists, due to proposed introduction of a Bus Gate at the railway overbridge on the Old Cabra Road, which precludes general traffic from Stoneybatter and the North Circular Road from travelling along Old Cabra Road through to Navan Road. Local traffic in the northbound direction will have access as far as the Bus Gate.

On Old Cabra Road, the extent of the outbound bus lane will be limited to an approximate 110m section just south of the Navan Road junction.

Glenbeigh Road / Old Cabra Road junction is proposed as a signal-controlled junction, with the introduction of toucan crossings on the Old Cabra Road.

It is proposed to include two one-way cycle tracks on each side of Old Cabra Road. The traffic lanes, bicycle infrastructure and footpaths will be accommodated within the existing road bridge width over the Heuston Station / Connolly Station railway line.

To provide an alternative route for general traffic to and from the City Centre (along Cabra Road, North Circular Road, Infirmary Road and Conyngham Road), the design includes a proposed alteration to the Cabra Road / North Circular Road junction. This junction is to be modified to allow right turns from Cabra Road to North Circular Road and left turns from North Circular Road onto Cabra Road.

On Prussia Street, between North Circular Road and the entrance to the Park Shopping Centre, the proposed road layout has one southbound general traffic lane; one northbound ‘straightahead only’ lane for local traffic, taxis and buses travelling to Old Cabra Road; and one left turn lane from Prussia Street to North Circular Road. Right turn movement from Prussia Street to North Circular Road is proposed to be removed.

The proposal for the junction of Prussia Street and North Circular Road is to upgrade the signalised junction to provide separate crossing facilities for cyclists and pedestrians, and to ban right turns from Prussia Street to minimise delay to buses travelling straight ahead (to Old Cabra Road).

Along Prussia Street, a traffic lane in both directions is proposed, carrying buses and local traffic only. It is also proposed to modify St Joseph’s Road to include a one-way section (in an eastbound direction) at its eastern end in order to avoid traffic using this street to avoid the southbound Bus Gate at Prussia Street / Manor Street junction.

A short section of southbound cycle track is proposed on Prussia Street from its junction with North Circular Road before cyclists merge with general traffic just north of Park Shopping Centre. In the northbound direction, the cycle track commences approximately 50m south of the junction with St Joseph's Road.

At the junction of Manor Street / Prussia Street with Aughrim Street, the proposal includes the following:

- In the northbound direction, a Bus Gate is proposed to be located on Prussia Street just north of Aughrim Street junction, such that all northbound general traffic will be required to turn left onto Aughrim Street;
- In the southbound direction, a Bus Gate is proposed to be located on Prussia Street / Manor Street just south of the Aughrim Street junction – and any general traffic travelling southbound on Prussia Street at this location will be required to turn right onto Aughrim Street; and
- Retention of a loading bay outside Kavanagh's Public house.

The proposed junction will be modified to include a signal-controlled cycle crossing, along with public realm improvements. The proposed layout includes a raised junction to assist pedestrians crossing. The proposal also includes a southbound Bus Gate on Aughrim Street, preventing any general traffic from travelling from Aughrim Street onto Manor Street.

South of the Aughrim Street junction with Manor Street and Prussia Street, the proposal includes traffic signal controls at the Manor Street / Kirwan Street / Manor Place staggered junction. The signal-controlled junction also includes a pedestrian crossing of Manor Street. It is also proposed to restrict movements out of Kirwan Street to left turn only, which will remain one-way westbound as at present. At the junction with Manor Street, Manor Place is proposed to be altered to a one-way street (eastbound towards Manor Street), to limit use of Manor Place and Oxmantown Road by through traffic.

On Manor Street and Stoneybatter, the proposal consists of two general traffic lanes and a cycle track in both directions to the junction with Brunswick Street North. The proposed layout includes protected parking bays on both sides of the road, and two loading bays.

In the northbound direction on Blackhall Place, the proposal consists of a bus lane and a single general traffic lane, as far as the junction with King Street North. It is proposed that northbound general traffic wishing to progress onto Manor Street turn right onto King Street North (which will remain one-way eastbound), and then turn left onto George's Lane to travel westbound along Brunswick Street North.

This proposal also allows for signal-controlled priority for buses in the northbound direction at the Stoneybatter / Brunswick Street North junction.

It is also proposed to have a cycle track in each direction along Brunswick Street North.

The proposals include for general traffic exiting Arbour Hill to turn right only at the Stoneybatter junction. General traffic into Arbour Hill is proposed from Manor Street direction or Brunswick Street North only.

A southbound general traffic lane is proposed along Stoneybatter between Brunswick Street North and King Street North, with general traffic being required to turn left into King Street North, as a result of a southbound Bus Gate at Blackhall Place / King Street North junction. It is proposed that buses are permitted to continue travelling straight ahead along a southbound bus lane on Blackhall Place. This matches the current situation.

A loading bay is proposed along the northern side of King Street North.

On Blackhall Place between Blackhall Street and Arran Quay, the proposed carriageway arrangement consists of a bus lane and general traffic lane in each direction.

On Blackhall Street, the proposed road layout has been revised to include one lane for general traffic, a two-way cycle track, and angled parking.

In the proposed layout, George’s Lane is to have one northbound general traffic lane, with proposed new signal controls at the junction of Grangegorman Street Lower and Brunswick Street North.

It is proposed that westbound general traffic from the City Centre on the eastern section of King Street North (east of George’s Lane) be restricted to left turns only, into Queen Street.

On Queen Street, the proposed layout of two southbound general traffic lanes, from King Street North will reduce to one southbound general traffic lane from Blackhall Street to Ellis Quay / Arran Quay, with a two-way cycle track on the eastern side of Queen Street from King Street North to Ellis Quay / Arran Quay.

The scheme proposals include for five proposed bus stops with six existing bus stops to be retained and six existing bus stops to be removed along this section of the core bus corridor. There are also four existing bus stops at the Cabra Road / North Circular Road junction to be retained.

Traffic management measures in the form of sections of one-way street and / or turn bans have been devised to minimise traffic impacts on roads adjacent to the proposed core bus corridor due to any rerouting of traffic (which may occur due to the priority given on the bus corridor scheme to pedestrians, cyclists and buses).

A short one-way northbound section is proposed on Annamoe Road at its junction with Annamoe Terrace and on Charleville Road at its junction with North Circular Road.

No access is proposed from Phisborough Road onto Phibsborough and Monck Place, along with the introduction of right turn bans onto Phibsborough Road.

A short one-way southbound section is also proposed at the northern end of Cowper Street with Aughrim Place becoming one-way southbound. There is also a short one-way westbound section at the western end of Swilly Road.

3.2 Associated Infrastructure Projects and Developments

The Proposed Scheme will interface with the following under construction or proposed developments:

- Snugborough Junction Upgrade Scheme

The Snugborough Interchange Upgrade scheme is being undertaken by Fingal County Council and includes the construction of a second bridge over the N3 national primary route as well as new bus lanes, footpaths, protected cycle tracks and traffic lanes giving improved accessibility to Blanchardstown Shopping Centre and the Dublin Enterprise Zone in Mulhuddart. The scheme has been designed to address network congestion issues and deliver significant improvements for pedestrians, cyclists and bus services.

- Park Shopping Centre redevelopment

The Park Shopping redevelopment proposes the demolition of the existing Park Shopping Centre and construction of a new mixed-use District Centre, Student Residential Housing development. The redevelopment is planned to include a new pedestrian and bicycle street connecting Prussia Street with the emerging Grangegorman SDZ campus.

- Navan Parkway development

This involves the redevelopment of lands to the north and south of the R147 Navan Road at Navan Parkway on a 45.8 hectare site.

3.3 Integration with Ballymun/Finglas to City Centre CBC

The Ballymun/Finglas to City Centre CBC scheme proceeds along the Phisborough Road and interacts with proposed implementation of traffic management measures for the Blanchardstown to City Centre CBC scheme at Monck Place and Phibsborough junctions.

Works proposed to the junctions include the introduction of short one-way sections, kerbline realignment and uncontrolled raised crossings, along with landscaping and a cycle track at Monck Place junction.

The design teams of both schemes have coordinated the respective scheme designs to provide flexibility in the proposals such that construction sequencing and physical works can be coordinated or delivered in sequence should both schemes be implemented.

Figure 3.1 shows the proposed junction layouts as part of the Blanchardstown to City Centre CBC scheme where the scheme ties into the existing Phisborough Road layout. Figure 3.2 shows a coordinated design solution where both schemes are implemented.

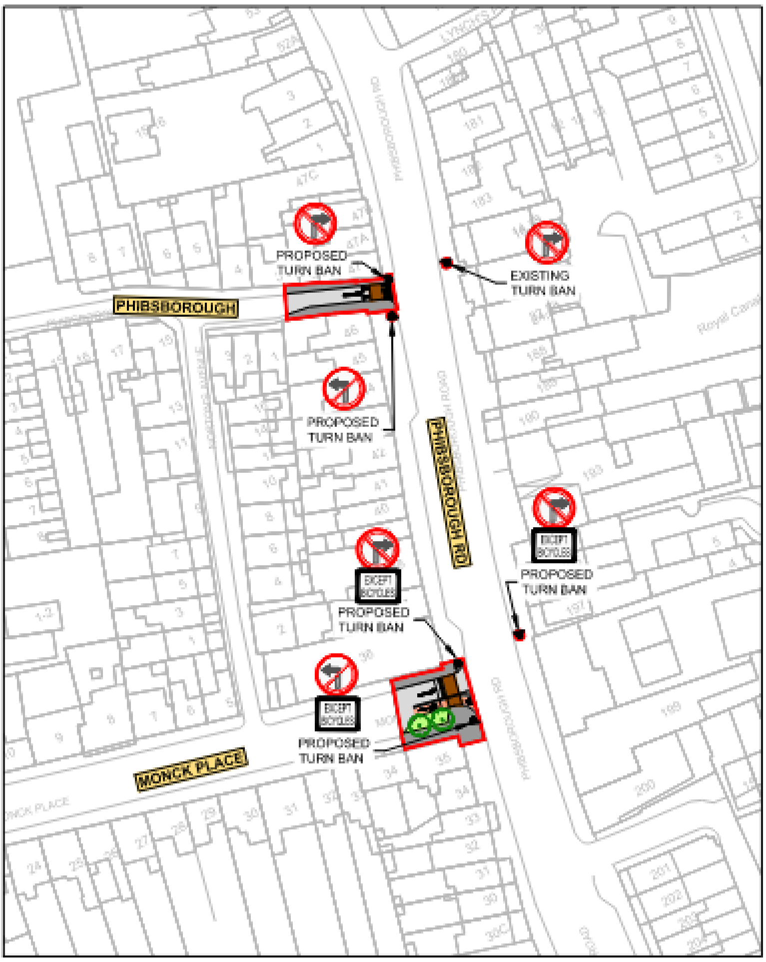


Figure 3.1: Proposed Blanchardstown to City Centre CBC scheme layout at R108 Phisborough Road / Phisborough junction and R108 Phisborough Road / Monck Place junction, tying into the existing Phisborough Road layout.

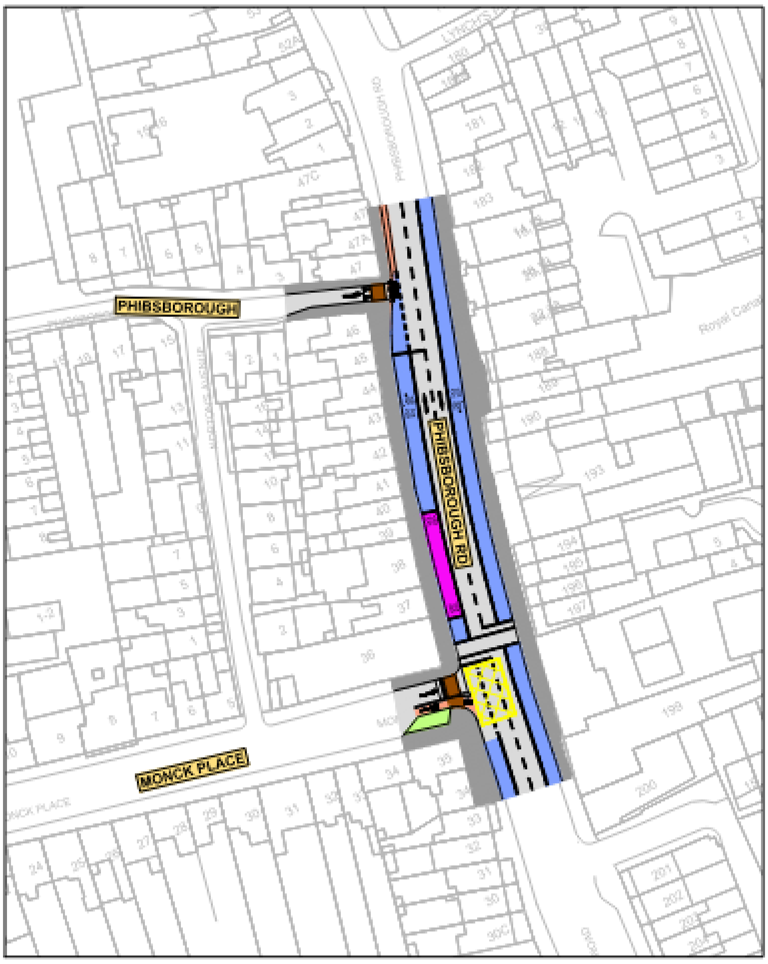


Figure 3.2: Proposed Design solution at R108 Phisborough Road / Phisborough junction and R108 Phisborough Road / Monck Place junction for coordination between Blanchardstown to City Centre CBC scheme and Ballymun/Finglas to City Centre CBC scheme

4 Road Geometry

The following chapter outlines the process by which the geometrical design of the Proposed Scheme was undertaken. This chapter discusses the design speed, cross-section, horizontal and vertical alignment design, stopping sight distance, alignment modelling, active travel provision and corner radii and swept path of the Proposed Scheme.

4.1 Principal Geometric Parameters

The BCPDGB in Appendix O has been used to form the basis of design. Section 2.2 of this PDR lists the standards referenced within the BCPDGB.

The road geometry design of the Proposed Scheme was undertaken in accordance with the Design Manual for Urban Roads and Streets (DMURS) as published by the Department for Transport, Tourism and Sport (DTTAS), with the exception of the N3 Carriageway, the R147 Navan Road (from Auburn Avenue junction to Phoenix Park Avenue junction) and the associated merge/diverge junctions. This section has been designed in accordance with the Transport Infrastructure Ireland (TII) Publications (Standards). In particular, adherence to the following standards forms the basis of the road geometry design:

- DN-GEO-03031 – Rural Road Link Design;
- DN-GEO-03036 – Cross Sections and Headroom;
- DN-GEO-03060 – Geometric Design of Junctions (priority junctions, direct accesses, roundabouts, grade separated, and compact grade separated junctions);
- DN-GEO-03044 – 2009 TII addendum to UK DMRB TD 50/04 – The Geometric Layout of Signal-Controlled Junctions and Signalised Roundabouts; and
- TII Standards Commission Draft Publication (Literature and Scheme Review Note) - Bus Lanes on Dual Carriageways and Motorways.

The Proposed Scheme requires the reconfiguration of the existing carriageway and where practicable the existing geometry has been maintained to respect the existing site constraints. Where the existing road geometry does not meet the above design standards, this has been highlighted within Section 4.17.

Table 4.1 summarises the principal geometric design parameters applicable to all urban roads designed in accordance with DMURS contained within the Proposed Scheme.

Table 4.1: Geometric Design Parameters for Urban Roads designed to DMURS

Road Type	Design Speed (km/h)	Minimum Curve Radius (m) without Superelevation	Minimum Curve Radius (m) with 2.5% Superelevation	Minimum Longitudinal Gradient (%)	Maximum Longitudinal Gradient (%)	Minimum Sag Curve Value (K)	Minimum Crest Curve Value (K)
Urban Road with 30 km/h Speed Limit	30	26	-	0.5	5	2.3	N/A
Urban Road with 50 km/h Speed Limit	50	104	82	0.5	5	6.4	4.7
Urban Road with 60 km/h Speed Limit	60	178	136	0.5	5	9.2	8.2

Table 4.2 summarises the key geometric design parameters applicable to all urban roads designed in accordance with TII Publications contained within the Proposed Scheme.

Table 4.2: **Geometric Design Parameters for roads designed to TII Publications**

Road Type	Design Speed (km/h)	Minimum Curve Radius (m) without Superelevation	Minimum Curve Radius (m) with 5% Superelevation	Minimum Longitudinal Gradient (%)	Maximum Longitudinal Gradient (%)	Minimum Sag Curve Value (K)	Minimum Crest Curve Value (K)
National Road							
N3 Carriageway from Snugborough Junction to River Road Junction	85	1440	510	0.5	3	26	55
N3 Merge and Diverge Slip Roads	60	720	255	0.5	6	13	17
National /Regional Roads							
N3/R147 Navan Road from River Road Junction to Phoenix Park Avenue Junction	70	1020	360	0.5	4	20	30
R147 Navan Parkway Interchange Merge and Diverge Slip Roads	60	720	255	0.5	6	13	17

4.2 Accessibility for Mobility Impaired Users

The proposed CBC Infrastructure Works will include the provision of enhanced walking and cycling infrastructure along the route of the Proposed Scheme.

The design process has included an Accessibility Audit of the existing road corridor environment, which is enclosed in Appendix I. The audit provided a description of the key accessibility features and potential barriers to mobility impaired people based on good practice, and identified the following issues to be addressed in the design process:

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

Measures to address the noted issues are noted in the Accessibility Audit - Designers Response in Appendix I.

The assessment of the existing street infrastructure and its ability to support access for disabled users have been based mainly on the Irish Wheelchair Association [IWA] *'Best Practice Guidelines, Designing Accessible Environments'* and The National Disability Authority's [NDA] *'Building for Everyone: A Universal Design Approach'*.

In addition, the Bus Interchange has been designed in accordance with BS8300:2009 +A1:2010 Design of buildings and their approaches to meet the needs of disabled people – Code of practice.

4.3 Mainline Cross-Section (Lane Widths)

4.3.1 Design Guidance and Requirements

All the roads contained within the Proposed Scheme are urban in location and setting. The proposed road cross sections have been developed based on the guidance outlined in DMURS and DN-GEO-03036. For roads which have not been designed in accordance with TII Publications, traffic lane widths follow 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 ≤ 60 km/h; and
- Traffic lane widths of 2.75m are permissible in DMURS but are not desirable. Reduced lane widths have only been applied on straight road sections with very low HGV traffic and where all desirable minimum widths for footpaths, cycle tracks, parking, bus lanes are not achievable without impact on third-party land.

For roads listed in Table 4.2, traffic lane widths have been based on the standards detailed in DN-GEO-03036 for urban dual carriageways (Table 4.3) and TII's Draft Publication on Bus Lanes on Dual Carriageways and Motorways.

Table 4.3: Urban All- Purpose Roads – Dimensions of Cross-Section Elements Including: Slip Road, Interchange Links and Loops

	Nearside			Offside		
	Verge (3)	**Hard Strip (2)**	**Carriageway (2)**	**Hard Strip (2)**	**Verge (1,4)**	**Central Reserve (1,4)**
Mainlines						
Single Carriageway Relief Road	Varies	-	6.00 to 7.00	-	-	-
Dual Carriageway Relief Road	Varies	-	7.00	-	-	1.80
Dual 2 Lane	Varies	-	7.30	-	- (4)	1.80
Dual 3 Lane	Varies	-	11.00	-	- (4)	1.80
Slip Roads, Interchange Links and Loops: Merges and Diverges						
1 Lane	Varies	1.50	4.00	0.50	Varies	-
2 Lane	Varies	1.00 (Type 2/3) 5 1.50 (Type 1) 5	7.30	-	Varies	-
Slip Roads: Diverge Only						
2 Lane	Varies	1.00 (Type 2/3) 5 1.50 (Type 1) 5	6.00	-	Varies	-

Notes:

1. *Central reserve dimensions are minimum values: any reduction is a Departure from Standard.*
2. *Carriageway and hard strip dimensions are fixed values: any reduction or increase in the width of these elements is a Departure from Standard, unless the increase results from the requirements for pavement widening on curves as detailed in DN-GEO- 03031.*
3. *Verge width shall be determined to take account of the uses and clearances required.*
4. *For details of offside verges at divided structures, see Table 5.1. of DN-GEO-03036*
5. *The Nearside hard strip on a Type 1 Single and Dual Carriageway shall have a width of 1.50m and on a Type 2 or 3 Single and Dual Carriageway shall have a width of 1.00m.*

6. *For guidance on selection of slip roads and interchange link and loop roads, see DN-GEO-03060 for the design of Grade Separated Junctions.*

7. *All dimensions are in metres.*

8. *For graphic representation of these cross-sections, refer to the appropriate Standard Construction Detail for road type and cross section on the TII Publications website.*

9. *Table 6.1 of DN-GEO-03031 does not apply to Urban Roads. Refer to UK DMRB TA 79 for guidance on assessing the Traffic Capacity of Urban Roads.*

For roads designed to DMURS, bus lanes widths are a minimum of 3m as detailed in the BCPDGB. On roads designed to TII Publications, the proposed bus lane width shall be a minimum of 3.25m. On the N3 Dual Carriageway, between Snugborough junction and River Road junction, a 3.5m bus lane width is proposed with a 0.3m wide separation from adjacent traffic lanes. The separation zone will be formed by road markings.

Figure 4.1 summarises the optimum road cross section, while Table 4.4, Table 4.5 and Table 4.6 present the geometric cross section requirements for roads design to TII Publications and the BCPDGB.

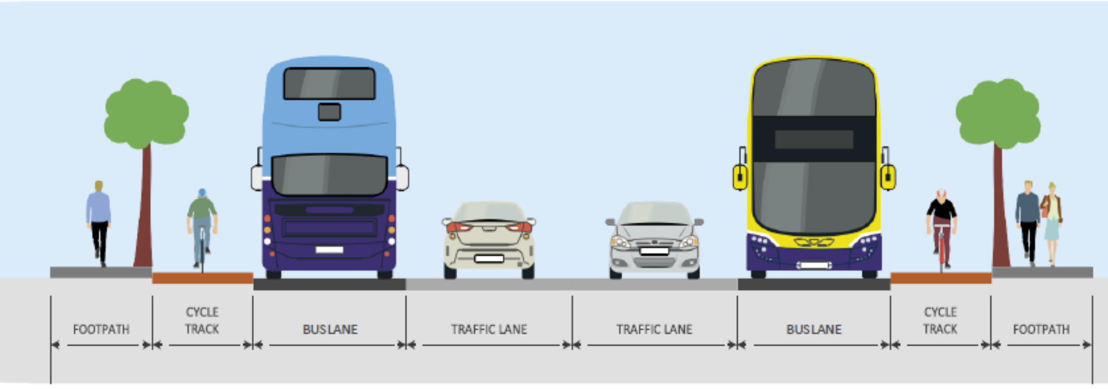


Figure 4.1: **Optimum CBC Infrastructure Works Cross Section for this section comprising a traffic lane, bus lane, cycle track and footpath in each direction**

The National Cycle Manual (NCM) indicates the desirable minimum width for a single-direction, with-flow, raised-adjacent cycle track is 2.0m which includes a 0.25m kerb. This arrangement allows for two-abreast cycling. Based on the NCM Width Calculator this allows for overtaking within the cycle track. The minimum width is 1.5m, which, based on the NCM Width Calculator, allows for single file cycling. Localised narrowing of the cycle track below 1.5m may be necessary over very short distances to cater for local constraints (e.g. mature trees).

The desirable minimum width for a two-way cycle track is 3.25m. In addition to this, a desirable minimum buffer of 0.5m, with an absolute minimum of 0.3m, should be provided between the two-way cycle track and the carriageway. Using the NCM width calculator, reduction of these desirable minimum widths can be considered on a case-by-case basis, with due cognisance of the volume of cyclists anticipated to use the route as well as the level of service required. The preferred arrangement for a two-way cycle track is for cyclists to ‘cycle on the left ‘as it provides improved legibility, and this has been implemented on the Proposed Scheme. Similarly, TII publication DN-GEO-03036 indicates a minimum two-way cycleway width of 3.0m, which has been adopted on the R147 between the Ashtown roundabout and Castleknock Manor. This standard also recommends that a minimum of a 1m grassed verge is provided between the cycleway and carriageway. Refer to Table 4.4 and Table 4.6 for cycle track widths recommended by TII and DMURS.

TII Publications, DMURS and Building for Everyone: A Universal Design Approach indicate a 2m wide footpath as the recommended limit / desirable minimum width. This width should be increased in areas catering for significant pedestrian volumes where space permits. DMURS defines the absolute minimum footway width for road sections as 1.8m based on the width required for two wheelchairs to pass each other. 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 (Figure 4.2). Similarly, this is reflected within DN-PAV-03026. This minimum of 1.2m allows one wheelchair to pass. Refer to Table 4.4 and Table 4.5 for footpath widths recommended by DMURS and TII Publications.

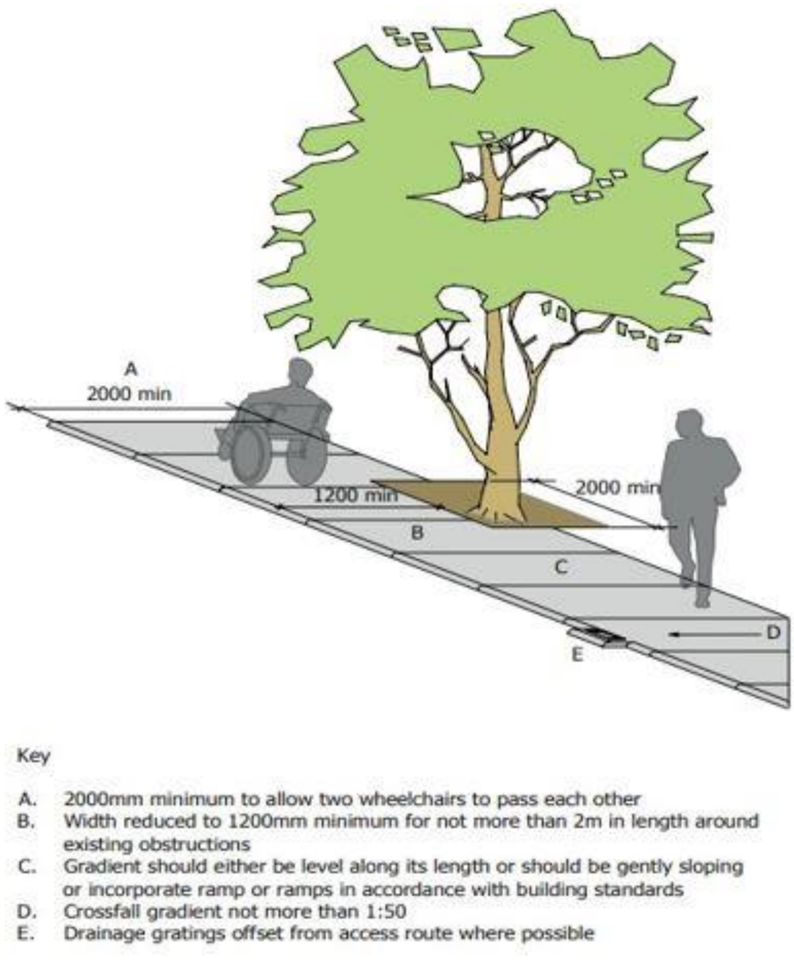


Figure 4.2: Recommended absolute minimum footpath widths allowable over a short section

Table 4.4: BCPDGB Cross-Section Design Parameters

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

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

Table 4.5: TII Publications Cross-Sectional Design Parameters - Footway

Design Element	Recommended limits(m)	Extreme Limits(m)	Design Standard
Footway	2.0	1.3	DN-PAV-03026 - Footway Design Jan 2005

Table 4.6: TII Publications Cross-Section Design Parameters - Cycle tracks and vehicle lanes

Design Element	Desirable min (m)	One step below Desirable min (m)	Design Standard
Cycle Track (two-way high volume)	3.0	2.5	DN-GEO-03036 - Cross Sections and Headroom - May 2019
Bus lane width for motorways and dual carriageways	3.50	N/A	TII Standards Commission - Bus Lanes on Dual Carriageways and Motorways -Literature and Scheme Review Note - Draft
Bus lane width for urban motorways and Dual carriageways	3.25	N/A	TII Standards Commission - Bus Lanes on Dual Carriageways and Motorways -Literature and Scheme Review Note - Draft
Traffic lane (Dual Carriageway Relief Road)	3.5	N/A	DN-GEO-03036 - Cross Sections and Headroom - May 2019

4.3.2 Proposed Design

N3 Blanchardstown Junction to Snugborough Road

The geometric design of this section of the Proposed Scheme has been sub-divided into Alignments A to F and L to account for the 'mainline' alignment string (Alignment A) and various 'side road' alignment strings (Alignments B to F and L).

Main Blanchardstown-Snugborough Link (Alignment A)

The existing carriageway linking the Blanchardstown Town Centre area with the Snugborough Road Junction (Ch. A0+200 to A0+900) will be widened to facilitate a bus lane, 3.0m in width, in each direction linking the Bus Interchange with the N3 dual carriageway. The existing accesses, including those to the Blanchardstown Shopping centre car park, along this section will be retained with a series of intermittent breaks in the bus lanes and right-turn pockets incorporated. Additionally, the cross-section will comprise of a two-way cycle track (3.0m width, 0.5m buffer) along the northbound carriageway with a footpath, 2.0m minimum width, proposed in both directions. The proposed layout will tie-in with the Snugborough Junction upgrade scheme. Traffic lanes along this section of the Proposed Scheme are to be 3.0m wide.

The section of carriageway between the N3 Mulhuddart off slip/Blanchardstown Road South (Ch. A0+000) and Crowne Plaza (Ch. A0+200) will largely remain as existing with bus-only access travelling north via a 3.0m (minimum) wide bus lane and southbound access-only for vehicles exiting the N3 carriageway, as existing. The widening works will incorporate a 3.0m wide two-way cycle track and 2.0m footpath to maintain existing connectivity.

The existing roundabout junctions will be replaced by signalised junctions (Ch. A0+200 & A0+600).

The existing bus stop lay-bys along this section of the route will be retained in addition to the provision of new inline bus stop locations; an exception being the existing bus stop opposite the Crowne Plaza Hotel which will be removed. The existing bus stop lay-bys will be modified with a new layout measuring 3.0m wide and 18m long. A 20m long entry taper and 15m long exit taper will facilitate access and egress from the lay-by.

Blanchardstown South-North (Alignment B)

The existing Blanchardstown Road South (Ch. B0+000 to B0+600) will be revised to accommodate a 2.0m wide cycle track (minimum) and 2.0m wide footpath in both directions.

The main carriageway itself will consist of two eastbound traffic lanes (3.0m wide) to replace the existing 3.0m bus lane and 3.0m traffic lane. In the westbound direction, a traffic lane and bus lane, both 3.0m in width, will be provided similar to the existing. New bus layover spaces incorporated within an overall 115m long x 4m wide lay-by will be provided.

A retaining wall will be required immediately adjacent to the bus layover spaces to minimise land-take. At this location, the footpath will be located alongside the bus lay-by to facilitate bus drivers accessing and egressing buses. Here, the cycle track will increase to 2.4m in width due to the provision of a retaining wall alongside the cycle track.

A new access to the Blanchardstown Centre will be provided at Ch. B0+300 and will require the installation of a signalised junction at this location.

The existing roundabout junction at Ch. B0+100 will be replaced by a new signalised junction. This junction will incorporate a segregated left-turn lane (3.0m minimum width) dedicated for buses travelling from Blanchardstown Road South towards the Bus Interchange.

The revised Blanchardstown Road South layout will tie in to the existing Mulhuddart Overbridge. It is proposed to relocate the existing eastbound cycle lane immediately adjacent to the eastbound footpath. In order to minimise any impact to the existing overbridge structure the carriageway, cycle track and footway widths will be maintained as existing. The resulting eastbound layout will consist of a 2.0m minimum footpath, 2.0m wide cycle track, 3.25m minimum traffic lanes while the westbound layout will consist of a 2.5m minimum footpath, 1.5m minimum cycle lane, a 3.0m wide traffic lane, a 2.75m traffic lane and a 2.5m wide right-turn filter lane.

Mulhuddart (Alignment C) and N3 Inbound Diverge (Alignment L)

The existing junction to the north of the N3 Overbridge will be amended to a protected junction for cyclists.

The existing nearside traffic lane of the N3 inbound diverge at Mulhuddart will be redesignated as a 3.5m wide bus lane. No widening works will be required to facilitate this.

An additional left-turn lane is proposed at the existing N3 citybound on-slip. These works will include an upgrade to the northbound cycle track provision increasing the cycle track width to 2.0m with appropriate uncontrolled crossing facilities provided at the junction.

N3 Outbound Mulhuddart Interchange (Alignment D)

The existing N3 outbound off-slip at Mulhuddart will be modified to facilitate a bus stop at its junction with the main Blanchardstown-Snugborough alignment (Ch. D0+000). At Ch. D0+100, the junction with Mulhuddart will be modified to facilitate a left-turn bus lane. All bus and traffic lane widths will maintain a minimum of 3.0m and tie in with the existing N3 off-slip and on-slip lanes. Along this stretch the existing footpath and cycleway provisions will be improved with a 3.0m wide two-way cycle track and 2.0m wide footpath.

Blanchardstown Road South – Bus Interchange Link (Alignment E)

The existing Blakestown Way carriageway linking Blanchardstown Road South with the Bus Interchange (Ch. E0+000 to E0+380) will largely remain as existing however the proposed cross section will see lane widths reduced to 3.0m traffic lanes and bus lanes. A 2.0m cycle track and 2.0m footpath will be provided in each direction to the toucan crossing (Ch. E0+190).

From Ch. E0+190 to 0+380, a two-way cycle track (3.0m in width and 0.5m buffer) is proposed in the eastbound direction. Cyclists will be accommodated by a toucan crossing point located at Ch. E0+190. A central median of 2.0m will be provided between the carriageways through here and this separation strip will be landscaped similar to existing.

Bus Interchange (Alignment F)

The proposed Bus Interchange will see the existing two-way carriageway layout revised to accommodate a central pedestrianised area, 7.5m minimum in width at the main interchange area. Dedicated bus lanes circulating around the pedestrianised area will facilitate a series of boarding and alighting bus stop locations and provide a terminus point allowing buses to return in the opposite direction along their intended route. To accommodate the bus manoeuvres around the interchange the dedicated bus lanes will be widened from 3.0m on the entry access roads to 7.5m (minimum) through the interchange. A 3.0m minimum width will be provided for traffic lanes, through the interchange area while a two-way cycle track, 3m in width including a 0.5m buffer, and opposing footpaths are proposed, 2.5m minimum on the westbound side and 3.0m eastbound side.

Snugborough Road to N3 / M50 Junction

On the N3 carriageway an additional bus lane in each direction is proposed between Snugborough Road Junction at Ch. 1+140 and River Road Junction at Ch. 1+960. The bus lanes will be 3.5m in width with a 0.3m wide separation from the nearside traffic lane. The separation strip will be formed of road markings. Three traffic lanes in each direction are proposed between the junctions; the traffic lanes on both the eastbound and westbound carriageways are 3.5m in width. A 0.6m offside hard strip will be provided on both the eastbound and westbound carriageways. The existing central reservation will be reduced in width as detailed in Section 4.6 below. The minimum width of the central reservation will be 2.76m at Ch. 1+580.

A bus stop is proposed at Ch. 1+590 on the eastbound carriageway and Ch. 1+650 on the westbound carriageway. The provision of bus stops along a dual carriageway is not an aspect of design covered by TII publications however principles of a 'Type C Lay-by' in accordance with DN-GEO-03046 have been adopted with a 2m wide physical traffic island proposed at the bus stops to provide a higher level of segregation from the adjacent traffic lanes. A 2m wide physical traffic island is proposed at the bus stops to provide a higher level of segregation from the adjacent traffic lanes. The traffic islands will be formed of kerbs with a 0.6m offset to the nearside traffic lane and 0.3m offset to the bus lane.

At the Snugborough Road junction the bus lane from the N3 will continue along the westbound off-slip and the existing mainline lane drop will be retained. An additional auxiliary lane on the slip road will be developed matching the existing provision.

The proposed cross section will tie into the cross section for the Snugborough Interchange design at Ch. 1+020 with minor alterations proposed to the road markings to ensure the bus lane will continue to the stop line at Snugborough Road. On approach to Snugborough Road, additional traffic lanes will be developed on the nearside and offside of the carriageway, resulting in two right turn lanes onto Snugborough Road eastbound, a single left turn lane onto Snugborough Road westbound and a single bus lane and traffic lane for vehicles heading straight through the junction. On the eastbound on-slip to the N3 an additional bus lane is proposed which continues along the N3. The traffic lane on the slip road will merge with the N3 mainline at Ch. 1+350, matching the existing provision.

The bus lane will continue from the N3 along the eastbound diverge. To accommodate the bus lane and minimise the impact on the existing retaining wall structure in the nearside verge, the existing traffic lane will move into the existing offside verge. The slip road will tie into the existing cross section at the junction for Connolly Hospital. The westbound merge at River Road will consist of two 3.5m traffic lanes with the nearside traffic lane merging with the offside traffic lane at Ch. 1+780. A 3.25m bus lane, with a developing 0.3m separation from the traffic lane, will commence at the junction with Navan Road and continue westbound along the N3. A bus layby with two bus stops will be provided at Ch. 1+950.

From the Connolly Hospital - River Road junction, the nearside traffic lane will be redesignated as a 3.5m minimum width bus lane and continue across the N3 Overbridge at River Road. The proposals will see the existing carriageway width widened by a maximum of 1.4m across this bridge in the inbound direction.

A traffic lane will be provided in each direction (minimum width of 3.5m) where carriageway widening will be required to facilitate this at the Connolly Hospital junction. From the River Road Overbridge (Ch. 2+200) the inbound bus lane will continue on to the M50 roundabout (Ch. 2+400) with an additional entry lane created specifically for buses. A segregated left-turn bus lane at the River Road Overbridge signalised junction is proposed while a new bus stop lay-by will be provided at Ch. 2+280. The general traffic lanes leading into the M50 roundabout will consist of 3.5m lanes. Widening to the roundabout entry arm will be required to facilitate the additional bus lane.

In the westbound direction, from the M50 junction (Ch. 2+400) to the N3 westbound merge at River Road (Ch. 2+000), a nearside bus lane of 3.5m minimum width is proposed alongside the existing two-lane carriageway. Due to a number of junctions along this section, right-turn and left-turn traffic lanes will be accommodated in a revised layout. All lanes will have a minimum width of 3.5m.

The two carriageways will be separated by a median of 2.2m minimum width. (including hard strips). Due to a difference in level of the carriageways, a form of retention for the inbound carriageway will be required similar to the existing scenario.

The existing M50 roundabout junction will see the nearside traffic lane redesignated as a 3.5m bus lane with intermittent breaks in the bus lane at the entry and exit points of the roundabout to facilitate general traffic movements.

N3 / M50 Junction to Navan Road / Ashtown Road Junction

Travelling from the M50 Roundabout to Auburn Avenue Junction, a new bus lane with a 3.25m minimum width will be provided from Ch. 2+670 to Auburn Avenue junction, Ch. 2+900. To facilitate the existing traffic lanes and minimise impact on the existing constraints in this area, the proposal will require widening to the existing carriageway running beneath the N3-R147 inbound ramp resulting in a 6.5m carriageway (3.25m traffic lane and 3.25m bus lane) through this stretch where the existing reduced speed limit of 50km/h will be retained. The existing traffic lane will reduce to a minimum of 3.25m in the vicinity of the existing overbridge structure to minimise any resulting widening impacts on the structure. The bus lane will then deviate from the existing carriageway and tie in with the N3 inbound carriageway at the upgraded Auburn Avenue junction. All lane widths at the junction will reduce to a minimum width of 3.25m to facilitate the introduction of the bus lane.

In the outbound direction, travelling from Auburn Avenue Junction to the M50 roundabout an existing traffic lane will be redesignated as a 3.65m bus lane. Widening to the existing roundabout entry width will be required to facilitate an additional bus signal. At both junction locations, lane widths will be reduced to a minimum of 3.5m to minimise impact on existing infrastructure.

Changes to the existing R147 Navan Road between Auburn Avenue Junction and Ashtown Road Junction (Ch. 2+900 to 4+850) will see the provision of dedicated inbound and outbound bus lanes, apart from a short length of the inbound section between Ch. 3+300 and Ch. 3+550. It is proposed to provide 2.0m minimum footpaths along the majority of each side of the carriageway. There is no footpath proposed alongside the R147 westbound carriageway parallel to Castleknock Manor, apart from access to bus stops. Between Auburn Avenue Junction and Ch. 3+400 pedestrians and cyclists will be diverted onto the existing Castleknock Manor. An additional length of footpath will be provided adjacent to the outbound carriageway linking with a new bus stop at Ch. 2+960. Additionally, over a section of footpath in the eastbound direction between Ch. 3+090 and 3+690, the footpath width will be reduced to a minimum of 1.8m to minimise impact on the existing footpath and a 52 m length of boundary along this section, with 1.5m widths on entry to accesses which is as per existing.

A 3.0m two-way cycle track with 0.5m minimum buffer, is proposed along the southern side of the R147 carriageway. The bus lanes, cycle track and footpaths will divert off the main carriageway to the Navan Parkway junction facilitating connectivity to Navan Parkway Railway Station. Hard strips of 0.75m are proposed on the nearside carriageway edge which will, in conjunction with a 0.5m buffer, offer a 1.25m total segregation width for cyclists on the two-way cycle track. On the merge and diverge slip roads of Navan Parkway junction, where the speed limit will be reduced to 50km/h, this hard-strip width will reduce to 0.5m to minimise carriageway widening and hence scheme land take requirements.

General traffic lanes of 3.25m width are proposed along the R147 from Auburn Avenue junction to Phoenix Park Avenue junction at Ch. 4+500. On the inbound carriageway, four lanes merge to two lanes beyond the Auburn Avenue Junction and in advance of the pedestrian crossing at Ch. 3+200. Beyond the Navan Parkway diverge junction, the two-lane carriageway will merge to a single-lane carriageway before merging traffic joins the carriageway from the Navan Parkway eastbound on-slip. The outbound proposal consists of two 3.25m traffic lanes provided from Ch. 4+250 to Auburn Avenue junction. Additional lanes will be provided at the Auburn Avenue junction to facilitate right and left turning movements.

The proposed cross-section represents a reduction in the existing lane widths from 3.65m to 3.25m. In conjunction with this lane width reduction and the provision of a cycle track alongside the outbound carriageway, it is proposed to remove the existing 80km/h zone along a portion of this R147 and extend the 60km/h speed limit zone from Auburn Avenue junction (Ch. 2+890) to Phoenix Park Avenue junction (Ch. 4+500).

At Phoenix Park Avenue, a right turn pocket, 3.0m in width, is provided for right-turning traffic into Phoenix Park Avenue along the inbound carriageway.

Between Phoenix Park Avenue junction and Ashtown Road junction, the existing central median will be removed. A general traffic lane and bus lane is proposed in each direction and lane widths will reduce from 3.25m to 3.0m (lane width reduction is achieved over a 150m length across Phoenix Park Ave junction). A 2.0m footpath will be provided on both sides of the carriageway while a 3.0m wide two-way cycle track (with additional 0.5m buffer) will continue alongside the outbound carriageway.

At the Navan Parkway interchange, the existing Navan Parkway Overbridge structure will remain as existing with three lanes of traffic, 3.25m each with a 1.0m separation strip between opposing lanes. 1.75m cycle tracks with 1.5m minimum footpaths will also be provided in each direction. The bus lane and traffic lane on the Navan Parkway merge and diverge ramps are proposed as 3.25m wide lanes.

The existing Ashtown Roundabout will be replaced with a signalised junction with segregated cyclist and pedestrian crossing facilities.

The Blackhorse Avenue / Ashtown Gate Road junction to the south of the core bus corridor is proposed to be signalised to allow improved traffic management.

Navan Road / Ashtown Road Junction to Navan Road / Old Cabra Road Junction

Commencing at Ashtown Road junction, Ch. 4+900, the cross section comprises of a 3.0m traffic lane, 3.0m bus lane, 2.0m cycle track and 2.0m footpath in each direction. The width of the footpath will vary based on the location and position of existing boundary walls, however a minimum width of 2.0m will generally be achieved. On the eastern approach to Ashtown Road junction an additional 3.0m traffic lane will be developed.

An existing grass verge, with trees, will be maintained between the cycle track and footpath from Ch. 5+190 to Ch.5+420. The footpath width will vary along this section with a minimum width of 1.55m being achieved.

From Ch. 5+450 a 3.0m traffic lane, 3.0m bus lane, 2.0m cycle track and 2.0m footpath is proposed in each direction as far as the junction with Kinvara Avenue/Baggot Road at Ch. 5+900. On the eastern approach to this junction, an additional 3.0m wide traffic lane will be developed for right turning vehicles to match the current junction layout.

To the west of St John Bosco’s School and Our Lady Help of Christians Church at Ch. 6+170, a parking layby will be retained on the eastbound side of Navan Road.

The parking layby is approximately 24m long. Over the length of the layby the cycle track width will reduce to 1.5m and increase to the desirable minimum of 2.0m in advance of the toucan crossing. Due to local constraints, the proposed layout of the cycle track and parking layby is not in accordance with the BCPDGB.

The 3.0m traffic lane, 3.0m bus lane, 2.0m cycle track and 2.0m footpath in each direction will continue to the Hampton Green Junction, Ch. 7+100, where an additional 3.0m lane will be developed for right turning vehicles. Beyond the Hampton Green junction, the additional traffic lane will continue for right turning vehicles into the library and shopping centre at Ch. 7+250, and the existing central reservation will be removed. At the junction at Ch. 7+250m, a traffic island is proposed in the eastbound direction between the traffic lanes and bus lane to accommodate the proposed bus signal which will allow buses to cross from the nearside lane on approach to the junction to the offside lane after the junction.

From the library junction, Ch. 7+250, to the junction with Old Cabra Road, Ch. 7+400, a bus gate is proposed on the offside lane to remove general traffic from accessing Old Cabra Road. A single traffic lane will continue eastbound through the junction along Cabra Road, and an additional traffic lane will be developed at Ch. 7+340 for traffic turning left on to Ratoath Road. Westbound from the junction with Old Cabra Road, Ch. 7+400, to the junction with the library at Ch. 7+300, a 3.0m traffic lane and 3.0m bus lane will continue from Old Cabra Road onto Navan Road. A central reservation is proposed between the eastbound and westbound carriageways, between the noted junctions replicating the existing arrangement.

Traffic management measures are proposed along Swilly Road at the junction with Ratoath Road in the form of junction improvements to promote a short section of one-way, with associated turn bans.

Off-route junction improvement works are also proposed at the North Circular Road and Cabra Road junction to remove the existing turn bans and facilitate all vehicular movements. All lane widths are provided as 3.0m minimum.

Navan Road / Old Cabra Road Junction to Ellis Quay

Commencing at the Navan Road/Old Cabra Road junction, Ch. 7+400, the Proposed Scheme will continue south-east along Old Cabra Road with a 3.0m bus lane in the eastbound direction and a 3.0m traffic lane and 3.0m bus lane in the westbound direction, with the bus lane developing at Ch. 7+550 in advance of the Cabra Junction. At Ch. 7+550, the designated bus lane in the eastbound direction terminates and becomes a 3.0m traffic lane continuing along Old Cabra Road.

In general, a cycle track 2.0m in width and a 2.0m wide footpath will be provided in both directions throughout this section, with exceptions noted below. The footpath will be continuous from Ch. 7+400 to Ch. 9+492 at Ellis Quay.

At a number of locations in both directions along the Old Cabra Road the cycle track widths will be reduced to a minimum of 1.5m in width. Due to existing property boundaries the footpath widths reduce, over a short distance, to a minimum of 1.7m, while at the railway overbridge structure, the footpath width on the western side will reduce locally to 1.3m at each end of the bridge.

At the Old Cabra Road railway overbridge (eastbound direction) it is proposed to amend the existing kerbline. The proposals will see the footpath narrowed locally by a maximum of 0.5 m to facilitate a shared bus stop landing.

This cross section will continue through the junction with Glenbeigh Road to Ch. 7+750. At the railway overbridge, Ch. 7+790, a bus gate will be introduced on the outbound carriageway which will permit access for buses and taxis only.

On the outbound approach to the North Circular Road junction from Prussia Street, a left turn filter lane will be developed at Ch. 8+250. At this point, the inbound cycle lane (1.5m in width) will terminate and cyclists will join the main carriageway. The proposed corridor will consist of an inbound and outbound traffic lane, two footpaths and an outbound cycle track will continue along Prussia Street to Ch 8+550. Cyclists heading outbound along Prussia Street from the Aughrim/Manor Street Junction will merge with general traffic between Ch.8+650 and 8+550.

A raised table is proposed at the Prussia Street/Aughrim Street/ Manor Street junction. The junction layout will divert outbound general traffic (from Stoneybatter) and inbound general traffic (from Prussia Street) onto Aughrim Street. At this location, the outbound cycle track will terminate, and cyclists will re-join the carriageway. A landscaped area is proposed between the traffic lanes and outbound cycle track.

The Proposed Scheme will continue south-east along Manor Street with a 3.0m traffic lane and 2.0m cycle track in each direction through Stoneybatter. Parking bays are proposed on the outbound side of Manor Street between Ch. 8+730 and Ch. 8+780, which includes a disabled parking bay, and between Ch 8+870 and Ch 8+910. Parking bays are also proposed on the inbound side of Manor Street between Ch 8+860 and Ch 8+880 and between Ch 8+925 and Ch 8+950 which includes a disabled parking bay. Existing loading bays on Aughrim Street, close to the Aughrim St /Manor St junction and on the inbound side of Stoneybatter, between Ch 9+060 and Ch 9+078, will be retained, with the latter loading bay proposed to be extended to Ch 9+086. A loading bay on the outbound side of Manor Street at Ch 8+910 is also proposed.

At the junction with Brunswick Street North, Ch. 9+100, the cycle tracks will terminate along the main CBC and will be diverted onto Brunswick Street North, George’s Lane and onwards to Queen Street. Along Blackhall Place, a bus lane is proposed in the inbound direction beyond King Street North with general traffic being diverted onto King Street North. This inbound bus lane will continue to Ellis Quay. A general traffic lane will be reintroduced south of Blackhall Street junction for inbound traffic leading to Ellis Quay. In the outbound direction along Blackhall Place and Stoneybatter, a 3.0m bus lane will be implemented along this full stretch from Ellis Quay to Brunswick Street North, while a 3.0m general traffic lane is proposed as far as the junction with King Street North. General traffic will be diverted onto King Street North with a right-turn lane.

On Brunswick Street North, the proposed cross-section will consist of a one-way 3m wide westbound lane in conjunction with a 1.5m wide cycle track and footpath on each side of the carriageway. The eastbound footpath width will match the existing along Brunswick Street North (1.5m minimum width) and will be reduced below the desirable 2.0m due to the back of footpath tying into existing property frontages.

The cross section of George’s Lane will consist of a single northbound 3.0m wide traffic lane and a 3.25m wide two-way cycle track on the east side of the carriageway. Widening will be applied to the traffic lane on the curve from King Street North and the curve to Brunswick Street North to facilitate the swept path of larger vehicles.

A loading bay is proposed on the east side of the traffic lane to match the existing provision. There is a large area of public realm proposed on the east side of George’s Lane and a minimum 2.0m wide footpath on the west side.

A single eastbound traffic lane will be provided on King Street North from the junction with Blackhall Place which will widen to two 3.0m traffic lanes on approach to the junction with George's Lane and Queen Street. A minimum 2.0m wide footpath, with the introduction of a loading layby will be provided on the north side of King Street North and minimum 2.0m wide footpath will be provided on the south side. Two 3.0m wide inbound traffic lanes are proposed on Queen Street from King Street North as far as Blackhall Street, and the existing King Street North cycle track will be diverted from the westbound carriageway to form a link with a 3.25m wide two-way cycle track along the eastern side of Queen Street. It is also proposed to widen the eastern and western footpaths along Queen Street.

A traffic lane will be dropped on Queen Street at the junction with Blackhall Street and a single 3.5m wide traffic lane will continue alongside the two-way cycle track from Blackhall Street through the Hendrick Street and Benburb Street junctions to Ellis/Arran Quay.

On Blackhall Street, a single 3.0m westbound traffic lane is proposed with parking bays proposed north and south of the traffic lane. A 3.0m wide two-way cycle track is proposed on the north side of the street with varying width footpaths on the north and south sides. The existing loading bay at the west end of Blackhall Street will be retained.

Traffic management measures in the form of sections of one-way street and / or turn bans will be implemented to minimise traffic impacts on roads adjacent to the proposed core bus corridor due to any rerouting of traffic (which may occur due to the priority given on the bus corridor scheme to pedestrians, cyclists and buses).

A short one-way southbound section is proposed on Annamoe Road at its junction with Annamoe Terrace and on Charleville Road at its junction with North Circular Road. At both locations, junction improvements are proposed to facilitate the turning bans with a short length of 2.0m wide cycle track proposed to facilitate cyclist movements through the junction towards the CBC.

Short one-way eastbound sections are also proposed on Phibsborough and Monck Place at its junction with Phibsborough Road, along with the introduction of right turn bans onto Phibsborough Road. Improvements to the junction layout are proposed to facilitate the turning bans and, additionally, a 2.0m wide cycle track provided within the junction bellmouth at Monck Place.

Short one-way southbound sections are also proposed at the northern end of Cowper Street and Aughrim Place. At Cowper Street, junction improvements are proposed to facilitate the turning ban and a short length of 2.0m wide cycle track is proposed to facilitate cyclist movements through the junction towards the CBC.

The cross sections within each section of the Proposed Scheme are summarised in Table 4.7. Where the proposed CBC cross-section parameters do not satisfy the desirable criteria set out within this section this is considered a deviation from standard. Refer to Section 4.17 for details of Deviations from Standard. Cross-section parameters less than the desirable minimum where the Proposed Scheme ties into existing are not included in the Deviations from Standard in Appendix C.

Table 4.7: Proposed Scheme Cross-Section Widths

Location	Westbound/Outbound Carriageway				Eastbound/Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
N3 Blanchardstown Junction to Snugborough Road									
Main Blanchardstown-Snugborough Link (Alignment A) (Design Speed / Speed Limit = 60km/h; unless otherwise stated)									
CH. A0+000 to CH. A0+110	2.0	3.0*	3.0 min**	N/A	3.0 min**	N/A	N/A	N/A	*Two-way cycle track. 3.0m in width with an additional 0.5m buffer. **Local curve widening to facilitate vehicle swept-path.
CH. A0+110 to CH. A0+200	2.0	3.0*	3.0	N/A	2 x 3.0	N/A	N/A	N/A	*Two-way cycle track. 3.0m in width with an additional 0.5m buffer. Design speed / Speed Limit = 50 km/h
CH. A0+200 to CH. A0+600	2.0	3.0*	3.0	3.0	3.0	3.0	N/A	2.0 min	*Two-way cycle track. 3.0m in width with an additional 0.5m buffer. Design speed / Speed Limit = 50 km/h
CH. A0+600 to CH. A0+750	2.0	3.0*	3.0	3.0	3.0	3.0	N/A	2.0	*Two-way cycle track.
Blanchardstown Road South-Blanchardstown Road North (Alignment B) (Design Speed / Speed Limit = 60km/h)									
CH. B0+000 to CH. B0+100	4.0	2.0	3.0**	3.0	3.0*	3.0***	2.0	2.0	*Three lanes introduced at junction. **Bus lane introduced at CH B0+040

Location	Westbound/Outbound Carriageway				Eastbound/Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
									***Bus lane terminates at CH B0+050
CH. B0+100 to CH. B0+200	2.0	2.0*	3.0*	3 x 3.0	2 x 3.0	N/A	2.0	2.0	*Curve widening provided at junction to facilitate vehicle swept path.
CH. B0+200 to CH. B0+320	2.0	2.0	3.0	3.0*	2 x 3.0 **	N/A	2.0	2.0	*Lane width tapering to introduce additional lanes on approach to junction. **Right turn filter lane introduced at junction.
CH. B0+320 to CH. B0+400	2.0	2.0	N/A	2 x 3.0	2 x 3.0	N/A	2.0	2.0 min	
CH. B0+400 to CH. B0+570	2.0	2.4	3.0*	3.0	2 x 3.0	N/A	2.0	2.0	*Bus/coach layover parking provided from Ch. 0+470 to 0+600, 4.0m in width.
CH. B0+570 to CH. B0+660	2.0	2.4	3.0*	2 x 3.0**	2 x 3.0***	N/A	2.0	2.0	* Bus/coach layover parking provided from Ch. 0+470 to 0+600, 4.0m in width. **Two lane merge. ***Two left-turn filter lanes develop on approach to junction.

Location	Westbound/Outbound Carriageway				Eastbound/Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
CH. B0+660 to CH. B0+760 (bridge)	2.0**	1.5	N\A	1 x 2.5* 2 x 2.75 min	3 x 3.25	N/A	2.0	1.8 min**	*Right-turn filter lane on overbridge structure ** Existing
CH. B0+760 to CH. B0+820	2.0	2.0	N/A	2 x 3.0 min	3 x 3.0*	N/A	2.0	2.0	*Additional lane develops at junction.
CH. B0+820 to CH. B0+895	2.0 min***	1.5 min	3.0*	3.0**	2 x 3.25	N/A	1.75	2.0	*Bus lane terminates on approach to junction **Additional lane develops at junction *** reduces to 1.5 m from Ch.0+870 to Ch. 0+895

Location	Northbound / Outbound Carriageway				Southbound / Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
N3 Inbound Diverge (Alignment L) (Design Speed / Speed Limit = 60km/h)									
CH. L0+000 to CH. C0+195	N/A	N/A	N/A	N/A	3.5	3.5	N/A	N/A	Bus lane commences at CH.0+055

Location	Northbound Carriageway				Southbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
Mulhuddart (Alignment C) (Design Speed / Speed Limit = 60km/h)									
CH. C0+000 to CH. C0+120	N/A	2.0**	N/A	2 x 3.0	3.0	N/A	2.0**	2.0*	*As existing ** Cycle track width reduces to 1.5m min. at tie-in.
CH. C0+120 to CH. C0+250	N/A	2.0	N/A	3.0 min.*	3.0 min	N/A	2.0	2.0 min	*Additional lanes develop at junction
CH. C0+250 to CH. C0+270	N/A	2.0	N/A	3.25*	3.0 min	N/A	2.0	2.0	*As existing
CH. C0+270 to CH. C0+340	N/A	2.0	N/A	3.25 min	2 x 3.0	N/A	2.0	2.0	
CH. C0+340 to CH. C0+480	N/A	2.0	N/A	2 x 3.0	2 x 3.25 min.*	N/A	2.0	2.0	**As existing
N3 Outbound Mulhuddart Interchange (Alignment D) (Design Speed / Speed Limit = 60km/h)									
CH. D0-000 to CH. D0+050	2.0	3.0**	3.0	2 x 3.0*	N/A	N/A	N/A	N/A	*As existing **0.5m buffer between cycle track and carriageway
CH. D0+050 to CH. D0+100	2.0	3.0**	3.0	2 x 3.25*	N/A	N/A	N/A	N/A	*Third lane developed on approach to junction **0.5m buffer between cycle track and carriageway

Location	Northbound Carriageway				Southbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
CH. D0+100 to CH. D0+170	2.0	N/A	N/A	2 x 3.65	N/A	N/A	N/A	N/A	

Location	Westbound/Outbound Carriageway				Eastbound/Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
Blakestown Way Link (Alignment E) (Design Speed / Speed Limit = 60km/h)									
CH. E0+000 to CH. E0+100	2.0	2.0	N/A	3.65*	2 x 3.0	N/A	2.0	2.0	*As existing.
CH. E0+100 to CH. E0+190	4.0	2.0	3.0*	2 x 3.0	3.0	3.0	2.0	2.0	*Bus lane terminates on approach to junction allowing traffic to merge.
CH. E0+190 to CH. E0+250	2.0 min	N/A	3.0	3.0	3.0	3.0	3.0*	2.0	*Two-way cycle track. 3.0m in width including a 0.5m buffer.
CH. E0+250 to CH. E0+350	2.0 min	N/A	3.0	3.0	2 x 3.0	3.0	3.0*	2.0	*Two-way cycle track. 3.0m in width including a 0.5m buffer.

Location	Westbound/Outbound Carriageway				Eastbound/Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
Bus Interchange (Alignment F) (Design Speed / Speed Limit = 30km/h)									
CH. F0+000 to CH. F0+150	2.5	3.0*	4.25 min	3.0	3.5	6.0 min	N/A	3.0	*Two-way cycle track. 3.0m in width including a 0.5m buffer.
CH. F0+150 to CH. F0+260	2.5	3.0*	7.5 min	3.0	3.0 min	7.5 min	N/A	3.0	*Two-way cycle track. 3.0m in width including a 0.5m buffer.
CH. F0+260 to CH. F0+350	2.5	3.0*	5.5 min	3.0	3.0	3.5min	N/A	3.0	*Two-way cycle track. 3.0m in width including a 0.5m buffer.
Snugborough Road to N3 / M50 Junction (Design Speed = 70 km/h, Speed Limit = 60km/h; unless otherwise stated)									
N3 merge - Snugborough	N/A	N/A	N/A	N/A	3.5	3.5*	N/A	N/A	*0.3m separation provided between bus lane and traffic lanes.
N3 diverge – Snugborough	N/A	N/A	3.5*	3.5	N/A	N/A	N/A	N/A	*0.3m separation between bus lane and traffic lanes is gradually removed at the tie-in location along the diverge on approach to Snugborough.
N3 Carriageway CH. 1+200 to CH. 1+900	N/A	N/A	3.5*(**)	3 x 3.5	3*3.5	3.5*	N/A	N/A	*0.3m separation provided between bus lane and traffic lanes. This increases to 2.0m at bus stop locations. (**) Bus lane width reduced to 3.25m along N3 merge as it passes properties at Old River Road
N3 merge - River Road	2.0*	N/A	3.25**	2 x 3.5	N/A	N/A	N/A	N/A	*Footpath terminates at bus stop. **0.3m separation provided between bus lane and traffic lanes.

Location	Westbound/Outbound Carriageway				Eastbound/Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
N3 diverge - River Road	N/A	N/A	N/A	3.5*	3.5	3.5 min. **	N/A	2.0***	*Westbound lane terminated at Connolly Hospital junction. **0.3m separation provided between bus lane and traffic lane. *** Footpath terminated at Connolly Hospital junction.
CH. 2+000 to CH. 2+400	2.0	N/A	3.5*	2 x 3.5**	2 x 3.5	3.5*	N/A	2.0	*0.3m separation provided between bus lane and traffic lanes. **Additional lane developed at River Road (left-turn) and River Road Overbridge (right-turn) junctions.
N3 / M50 Junction to Navan Road / Ashtown Road Junction (Design Speed = 70 km/h, Speed Limit = 60km/h; unless otherwise stated)									
M50 Roundabout	N/A	N/A	3. 5	2 x 3. 5	2 x 3. 5	3. 5	N/A	N/A	
N3 Navan Rd CH. 2+600 to CH.2+700	N/A	N/A	3.5 min.	2 x 3.5 min.	4 x 3.5 min.	N/A	N/A	N/A	N3-M50 interchange region. Lane widths represent minimum width provided.
N3 Navan Rd CH. 2+700 to CH.2+900	N/A	N/A	3.5 min.	2 x 3.5 min.	1 x 3.25* 2 x 3.5 min.	3.25	N/A	N/A	N3-M50 interchange region. Lane widths represent minimum width provided. *New River Road / R102 link road.
R147 Navan Rd CH. 2+900 to CH.3+100	N/A*	N/A*	3.25	2 x 3.25**	2 x 3.25**	3.25	N/A	2.0 (1.8 min CH 3+090 to CH 3+100)	*Pedestrians/ cyclists diverted onto Castleknock Manor **Four lanes provided at Auburn Junction Provision of 0.75m and 0.6m hard strips at the nearside verge and central median respectively.

Location	Westbound/Outbound Carriageway				Eastbound/Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
R147 Navan Rd CH.3+100 to CH.3+400	N/A*	N/A*	3.25	2 x 3.25	2 x 3.25	3.25**	N/A	1.8 min	*Diverted onto Castleknock Manor **Bus lane terminates in advance of accesses at Ch. 3+310 allowing traffic to merge. Provision of 0.75m and 0.6m hard strips at the nearside verge and central median respectively.
R147 Navan Rd CH.3+400 to CH.3+550	2.0	3.0*	3.25	2 x 3.25	3 x 3.25	N/A	N/A	1.8min	*Two-way cycle track. 3.0m in width with an additional 0.5m buffer. **Two-lanes merging to a single-lane Provision of 0.75m and 0.6m hard strips at the nearside verge and central median respectively.
R147 Navan Rd CH.3+550 to CH.4+200	N/A	N/A	N/A	2 x 3.25	3.25*	N/A	N/A	N/A	*Two-lanes merging to a single-lane
R147 Navan Parkway Overbridge	1.7*	1.75*	N/A	2 x 3.25	3.25	N/A	1.75*	1.7*	*As existing.
R147 Navan Parkway Interchange (Merges & Diverges)	2.0	3.0*	3.25	3.25	3.25	3.25	N/A	2.0**	*Two-way cycle track. 3.0m in width with an additional 0.5m buffer. **Localised reduction to 1.8m min. (130m in length along inbound diverge). Provision of 0.5m hard strips at the nearside verge.

Location	Westbound/Outbound Carriageway				Eastbound/Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
									(Design Speed = 60 km/h, Speed Limit = 50km/h)
R147 Navan Rd CH.4+200 to CH.4+250	2.0	3.0*	3.25	2 x 3.25	2 x 3.25**	3.25	N/A	2.0	*Two-way cycle track. 3.0m in width with an additional 0.5m buffer. **Lane merging from Navan Parkway Interchange. Provision of 0.75m and 0.6m hard strips at the nearside verge and central median respectively.
R147 Navan Rd CH.4+250 to CH.4+500	2.0 min.	3.0*	3.25	3.25	2x3.25**	3.25	N/A	2.0 min.	*Two-way cycle track. 3.0m in width with an additional 0.5m buffer. **2 traffic lanes merge into 1 at CH 4+290 Provision of 0.75m and 0.6m hard strips at the nearside verge and central median respectively.
R147 Navan Rd CH.4+500 to CH.4+850	2.0 min.	3.0*	3.0	3.0	3.0**	3.0	N/A	2.0 min.	*Two-way cycle track. 3.0m in width with an additional 0.5m buffer. **Additional lane develops on approach to Ashtown Junction. (Design Speed / Speed Limit = 50km/h)

Location	Westbound/Outbound Carriageway				Eastbound/Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
Navan Road / Ashtown Road junction to Navan Road / Old Cabra Road Junction (Design Speed / Speed Limit = 50km/h) (Note: all cycle track widths in this section include a 0.25m kerb/buffer to the carriageway unless otherwise stated)									
Navan Road Ch.4+900 to Ch.5+100	2.0 min.	2.0	3.0	3.0	3.0	3.0	2.0	2.0 min.	Additional 3.0m wide traffic lane developed westbound on approach to Ashtown Junction.
Navan Road Ch.5+100 to Ch.5+190	2.0 min.	2.0	3.0	3.0	3.0	3.0	2.0	2.0 min.	
Navan Road Ch.5+190 to Ch.5+420	1.55 min.	2.0	3.0	3.0	3.0	3.0	2.0	2.0 min.	Verge provided between cycle track and footpath in westbound direction and localised areas in eastbound direction.
Navan Road Ch.5+420 to Ch.5+900	2.0 min.	2.0	3.0	3.0	3.0	3.0	2.0	2.0 min.	
Navan Road Ch.5+900 to Ch.6+170	2.0 min.	2.0	3.0	3.0	3.0	3.0	2.0	2.0 min.	Additional 3.0m wide traffic lane developed westbound on approach to Kinvara Avenue/Baggot Road junction.
Navan Road Ch.6+170 to Ch.6+250	2.0 min.	2.0	3.0	3.0	3.0	3.0	1.5	2.0*	*Localised reduction to 1.9m at Ch 6+210
Navan Road Ch.6+250 to Ch.6+950	2.0 min*	2.0	3.0	3.0	3.0	3.0	2.0	2.0	* Localised reduction to 1.8m from Ch 6+535 to Ch 6+550
Navan Road Ch.6+950 to Ch.7+120	2.0 min.	2.0	3.0	3.0	3.0	3.0	*2.0	2.0 min.	Additional 3.0m wide traffic lane developed eastbound on approach to Hampton Green junction. *Inbound narrowing to a shared bus stop has been extended to 21.5m to

Location	Westbound/Outbound Carriageway				Eastbound/Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
									maintain footpath width at a pinch point
Navan Road Ch.7+120 to Ch.7+260	2.0 min.	2.0	3.0	3.0	3.0	3.0	2.0	2.0 min.	Additional 3.0m wide traffic lane developed eastbound on approach to Cabra Library junction.
Navan Road Ch.7+260 to Ch.7+400	2.0 min.	2.0	3.0	3.0	3.0*	3.0	2.0	2.0 min.	Central island introduced between EB and WB carriageways. *Additional 3.0m wide traffic lane developed eastbound on approach to Old Cabra Road junction.
Navan Road / Old Cabra Road junction to Ellis Quay (Design Speed / Speed Limit = 30km/h) (Note: all cycle track widths in this section include a 0.25m kerb/buffer to the carriageway unless otherwise stated)									
Old Cabra Road Ch.7+400 to Ch.7+500	2.0 min.	2.0	3.0	3.0	N/A	3.0	2.0	2.0 min.	
Old Cabra Road Ch.7+500 to Ch.7+560	2.0 min.	2.0	N/A*	3.0	N/A	3.0	2.0	2.0 min.	*WB Bus lane developed between Ch 7+540 to Ch 7+500
Old Cabra Road Ch.7+560 to Ch.7+620	2.0 min.	2.0	N/A	3.0	3.0	N/A	2.0	2.0 min.	
Old Cabra Road Ch.7+620 to Ch.7+660	1.8 – 2.0	2.0	N/A	3.0	3.0	N/A	1.75	2.0 min.	
Old Cabra Road Ch.7+660 to Ch.7+700	1.8 - 2.0	2.0	N/A	3.0	3.0	N/A	1.5	2.0 min.	
Old Cabra Road Ch.7+700 to Ch.7+840	1.3 - 2.0	1.75	N/A	3.0	3.0	N/A	1.5	2.0 min.	

Location	Westbound/Outbound Carriageway				Eastbound/Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
Old Cabra Road Ch.7+840 to Ch.7+990	2.0	2.0	N/A	3.0	3.0	N/A	2.0	2.0 min.	
Old Cabra Road Ch.7+990 to Ch.8+200	1.7 - 2.0min*	1.5	N/A	3.0	3.0	N/A	1.5	1.7 - 2.0 min*	* Localised reduction to 1.7m min at existing property boundary walls

Location	Northbound/Outbound				Southbound/Inbound				
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track width (m)	Footpath Width (m)	Notes
Prussia Street Ch. 8+200 to Ch. 8+250	2.0 min.	2.0	N/A	2 x 3.0*	3.0 min.	N/A	1.5**	2.0 min.	*Straight ahead lane and left-only lane. **Cycle track terminates at bus stop.
Prussia Street Ch. 8+250 to Ch. 8+530	2.0 min.	2.0	N/A	3.0	3.0	N/A	N/A	2.0 min.	
Prussia Street Ch. 8+530 to Ch. 8+660	2.0 min.	N/A	N/A	3.0	3.0	N/A	N/A	2.0 min.	
Prussia Street Ch. 8+660 to Ch. 8+680	2.0 min.	2.0	N/A	3.0	3.0	N/A	N/A	2.0 min.	
Prussia Street Ch. 8+680 to Ch. 8+700	2.0 min.	2.0	3.0	N/A	3.0	N/A	N/A	2.0 min.	
Manor Street Ch. 8+700 to Ch. 8+720	2.0 min.	2.0*	N/A	3.0	3.0 min**	3.0	N/A	2.0 min.	*Cycle track is remote from carriageway and separated with grass verge **Right turn lane only.

Location	Northbound/Outbound				Southbound/Inbound				
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track width (m)	Footpath Width (m)	Notes
Manor Street Ch. 8+720 to Ch. 8+950	2.0 min.	2.0	N/A	3.0	3.0	N/A	2.0	2.0 min.	
Manor Street/ Stoneybatter Ch. 8+950 to Ch. 9+050	2.0 min.	2.0	N/A	3.25*	3.25*	N/A	2.0	2.0 min.	*Curve widening to facilitate vehicle swept-path.
Stoneybatter Ch. 9+050 to Ch. 9+100	2.0 min.	2.0	N/A	3.0	3.0	N/A	1.75	2.0 min.	
Stoneybatter Ch. 9+090 to Ch. 9+150	2.0 min.	N/A	3.0 min.	N/A	3.0 min.	N/A	N/A	2.0	
Blackhall Place Ch. 9+150 to Ch. 9+310	2.0 min.	N/A	3.0	3.0	N/A	3.0	N/A	2.0 min.	
Blackhall Place Ch. 9+310 to Ch. 9+490	2.0 min.	N/A	3.0	3.0	3.0	3.0	N/A	2.0 min.	
Queen Street Ch. G 0 + 000 to Ch. G 0+200	2.2 min	N/A	N/A	N/A	3.5	N/A	3.25*	2.5 min	*Two-way cycle track. 3.25m in width with an additional a 0.5m buffer.
Queen Street Ch. G 0 + 200 to Ch. G 0+330	2.2 min	N/A	N/A	N/A	2 x 3.0	N/A	3.25*	2.5 min	*Two-way cycle track. 3.25m in width with an additional a 0.5m buffer.
Queen Street Ch. Ch. G 0+330 to G 0+380	N/A	N/A	N/A	N/A	3.5	N/A	N/A	3.0 min	
George's Ln Ch. K 0+000 to Ch. K 0+080	2.5 min	N/A	N/A	3.5 min	N/A	N/A	3.25*	4.2 min	* Two-way cycle track 3.25m in width with an additional 1m buffer to adjacent on-street loading bay. In

Location	Northbound/Outbound				Southbound/Inbound				
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track width (m)	Footpath Width (m)	Notes
									addition, localised areas of cycle track are remote from carriageway and separated with grass verge.

Location	Westbound/Outbound Carriageway				Eastbound/Inbound Carriageway				
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track width (m)	Footpath Width (m)	Notes
Brunswick Street North Ch H 0+000 to Ch. H 0+170	1.4 min	1.5	N/A	3.0	N/A	N/A	1.5	2.0 min	
Blackhall Street Ch. J 0+000 to Ch. J 0+140	1.5 min	3.0*	N/A	3.5	N/A	N/A	N/A	2.5 min	*Two-way cycle track. 3.0m in width with an additional 1m buffer to adjacent on-street parking. Provision of on-street parking on both the right and left of the traffic lane.

Location	Westbound/Outbound Carriageway				Eastbound/Inbound Carriageway				
	Footpath Width (m)	Cycle Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track width (m)	Footpath Width (m)	Notes
King Street North Ch.G 0+380 to Ch. G 0+420	2.2 min	N/A	N/A	N/A	2 x 3.0	N/A	N/A	3.0 min	
King Street North Ch.G 0+420 to Ch. G 0+490	2.2 min	N/A	N/A	N/A	4.0 min	N/A	N/A	2.4 min	

4.4 Design Speed and Speed Limit

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'*. Therefore, the design speed proposed for urban roads is aligned with the proposed speed limit. For most cases along the urban CBC network, the existing speed limits will be retained with the exception of the Bus Interchange at Blanchardstown, and the Navan Road / Old Cabra Road junction to Ellis Quay section of the CBC, with a proposed speed limit of 30 km/h in each location. A 350m section of the R147 from Phoenix Park Avenue junction to Ashtown junction will also see a reduction in speed limit to 50 km/h from 60 km/h in conjunction with a change in road classification from urban dual to urban single carriageway.

Over the length of the R147 (from Auburn Avenue junction to Phoenix Park Avenue junction) and N3 carriageway, the design speed is higher than the proposed speed limit as indicated in Table 4.8. The proposed speed limit on the section of N3 Carriageway, between River Road junction and Snugborough Road junction, of the CBC will see an 80km/h limit imposed for general traffic lanes with a separate 60km/h speed limit imposed for the bus lane. For the adjoining N3 link roads (River Road to Auburn Avenue) the existing speed limits will be maintained. The proposed speed limits largely represent a retention of the existing speed limits in this area with the exception of the R147 (from Auburn Avenue junction to Phoenix Park Avenue junction), where the existing section of 80 km/h will be reduced to 60km/h to facilitate a change in carriageway cross-section as outlined in Section 4.3.2. The design speeds are therefore determined to be 85 km/h on the N3 Dual Carriageway and 70 km/h on the adjoining N3 link roads and R147, from Auburn Avenue junction to Phoenix Park Avenue junction. In accordance with DN-GEO-03060, a design speed of 60 km/h has been assigned to the slip roads of the grade-separated junctions along the route: Navan Parkway interchange along the R147 in addition to N3 junctions at Mulhuddart, Snugborough and River Road.

The design speeds used for the proposed mandatory speed limits are detailed in Table 4.8.

Table 4.8: Maximum Design Speeds for Mandatory Speed Limits

Speed Limit km/h	Design Speed km/h	Design Standard
30	30	DMURS
50	50	DMURS
60	60	DMURS
50	60	DN-GEO-03031
60	70	DN-GEO-03031
80	85	DN-GEO-03031

All slip roads have been designed in accordance with design speeds specified in DN-GEO-03060 Table 7.6 Connector Road Design Speed. An Urban Type 1 Dual Carriageway with a design speed of 85km/h specifies a 60km/h design speed for slip roads. Table 4.9 indicates the speeds limits proposed for all roads within the Proposed Scheme.

Table 4.9:: Proposed Scheme speed limits and design speeds

Road Name	**Road Type**	**Design Speed (km/h)**	**Proposed Speed Limit (km/h)**	**Existing Speed Limit (km/h)**	**Reason for speed limit change**
Blanchardstown Road South-North	Urban Arterial	60	60	60	n/a
Blanchardstown Road South/Crowne Plaza to Snugborough Link	Urban Arterial	60	60 (part) 50 (part)	60 (part) 50 (part)	n/a
Bus Interchange	Urban Arterial	30	30	60	To provide a safe area for buses to manoeuvre and turn in and out of the interchange.
Blakestown Way	Urban Arterial	60	60	60	n/a
Mulhuddart (Alignment C)	Urban Arterial	60	60	60	n/a
N3 Dual Carriageway	National	85	80	80	n/a
N3 Snugborough & Mulhuddart slip roads	National	60	60	60	n/a
N3 River Road/M50 Interchange (slip roads)	National	60	60 (merge) 50 (diverge)	60 (merge) 50 (diverge)	n/a
N3 - River Road to M50 Roundabout	National	70	60	60	n/a
N3 - M50 Roundabout to Auburn Ave Junction	National	70	60	60	n/a

Road Name	Road Type	Design Speed (km/h)	Proposed Speed Limit (km/h)	Existing Speed Limit (km/h)	Reason for speed limit change
Auburn Ave Junction to Phoenix Park Ave Junction	Regional	70	60	80 (part) 60 (part)	To provide a consistent speed limit along this section and to improve safety for side road access and weaving.
Navan Parkway Merge and Diverge Ramps	Regional	60	50	50	Extent of proposed speed limit amended to standardise extents on all four merge/diverge arms and to facilitate new bus stop layby on outbound diverge.
Phoenix Park Ave Junction to Ashtown Road Junction	Urban Arterial	50	50	60	To reflect the urban nature of this section (with signal junctions and pedestrian crossings)
Ashtown Road Junction to Old Cabra Road Junction	Urban Arterial	50	50	50	n/a
Old Cabra Road	Urban Arterial	30	30	50	To reflect the relatively constrained corridor width and hence to provide safe conditions for cyclists in particular.
Prussia Street	Urban Arterial	30	30	50	To reflect the relatively constrained corridor width and hence to provide safe conditions for cyclists in particular.
Manor Street and Stoneybatter	Urban Arterial	30	30	50	To reflect the relatively constrained corridor width and

Road Name	Road Type	Design Speed (km/h)	Proposed Speed Limit (km/h)	Existing Speed Limit (km/h)	Reason for speed limit change
					hence to provide safe conditions for cyclists in particular.
Blackhall Place	Urban Arterial	30	30	30	n/a
Brunswick Street North	Urban Link	30	30	30	n/a
King Street North	Urban Link	30	30	30	n/a
Blackhall Street	Urban Link	30	30	30	n/a
Hendrick Street	Urban Link	30	30	30	n/a
George’s Lane	Urban Link	30	30	30	n/a
Queen Street	Urban Link	30	30	30	n/a

4.5 Alignment Modelling Strategy

As part of preliminary design, the 3D road alignment design has been developed on the principles of the Preferred Route Option. The proposed alignment has also taken into consideration public consultation, traffic impact and environmental impact assessments, in addition to a peer review exercise in collaboration with the other Engineering Designers (EDs), for the Proposed Scheme.

The 3D highway design, including the horizontal and vertical alignments, 3D modelling corridors and the associated highways related design features required for all roads included in this preliminary design, has been developed using Civil 3D software. In collaboration with the other EDs for the other CBC schemes, the 3D models have been produced in accordance with the BusConnects BEP.

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. For the purposes of the alignment and modelling design process, it has been necessary to develop a separate set of 3D alignments, which differ from that of the global alignment used as a reference for the general arrangement layout of the preliminary design.

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 any impact to existing road network and develop the proposed carriageway levels as close to existing as practicable. In most circumstances however, due to a change in cross-section, due consideration is given to the resulting level difference at the outer extents of the carriageway, particularly through urban areas where a difference in existing and proposed footpath levels will require additional temporary land-take to facilitate tie-in.

Existing ground levels have been obtained using a triangulated surface (the existing ground model) produced from the topographical survey covering the route. This existing ground model is used to inform the differences in levels between the proposed and existing ground while at the scheme boundary it is also used to ensure an appropriate means of tie-in to existing levels. Furthermore, at junctions linking to existing side roads, the existing ground model is 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.

4.6 Summary of Horizontal Alignment

The Proposed Scheme commences at Junction 3 (Blanchardstown/Mulhuddart) eastbound off-slip from the N3 and continues east towards the City Centre terminating at Ellis Quay. The horizontal alignment of the Proposed Scheme will generally follow the existing carriageways with any amendments to the alignment as described below.

Generally, all carriageways have been designed in camber with a fall of 2.5% from the centreline of the road. Superelevation has been applied where the proposed curve radius is below the minimum values specified in Section 4.10.

In a number of locations crossfalls/superelevation have been implemented to match the existing scenario where the geometry allows, to minimise the impact of the Proposed Scheme on the existing corridor.

In the sections from Ashtown Road junction to Blackhall Place, the existing road crossfalls will be maintained as far as practicable to minimise the impact on adjacent properties, driveways and existing drainage and utility apparatus.

The following section summaries the horizontal geometry of the carriageways associated with the CBC. All horizontal alignments have been designed using the appropriate set of design guidelines/standards as outlined in Section 4.10. In instances where the desirable minimum parameters defined by the appropriate guidance have not been met, these locations have been detailed within Section 4.17**,** Deviations from Standard.

This section should be read in conjunction with the Mainline Plan and Profile drawings in Appendix B.

N3 Blanchardstown Junction to Snugborough Road

The proposal through this section of the Proposed Scheme will upgrade a number of existing routes around the Blanchardstown Shopping Centre area providing bus, cyclist and pedestrian linkage from the Mulhuddart Interchange and Blanchardstown Shopping Centre areas to Snugborough Junction and onwards towards Dublin City Centre.

The alignment will generally maintain a similar geometry to the existing with a design speed of 60km/h, with the exception of the Bus Interchange area where the design speed is reduced 30km/h to reflect the speed limit. However, to facilitate widening and cross-sectional changes at certain locations, the horizontal geometry will deviate from that of the existing, particularly where the roundabout junctions are to be replaced with signalised junctions. Specific changes to the existing geometry are outlined in the following paragraphs.

Main Blanchardstown-Snugborough Link (Alignment A)

The horizontal alignment of the main Blanchardstown-Snugborough Link Road will largely maintain a similar geometry to existing. However, the carriageway centreline will shift approximately 2.0m west from Ch. A0+200 to facilitate carriageway widening consisting of a two-way cycle track. A series of superelevated horizontal curves (R=230m and R=255m at approximate Ch. 0+500 to 0+620 and Ch. 0+660 to Ch. 0+760 respectively) are proposed through the current roundabout junction on approach to the tie-in with the Snugborough Junction design.

Blanchardstown South-North (Alignment B)

The proposed horizontal alignment of the main Blanchardstown South and North roads will deviate slightly from the existing through Ch. B0+060 to B0+500 to account for the additional cross-section widening. The principles of the geometric parameters however will remain similar with two R=1020m right-hand curves separated 55m apart beyond the altered junction at Ch. 0+100.

The alignment over the Mulhuddart N3 Overbridge structure will remain unchanged, so as not to impact on the structure.

Bus Interchange (Alignment F)

The proposed layout of the Bus Interchange will see this area widened towards the existing shopping centre car park. To facilitate the proposals, the main through-route for traffic heading westbound will be similar to existing. An additional alignment will be created for the eastbound traffic lane and westbound bus-lane, which will tie into the main through-route alignment at each end. The existing roundabouts at either end of the proposed Bus Interchange will be replaced with signalised junctions.

Snugborough Road to N3 / M50 Junction

The section commences at Snugborough Road overbridge, and joins the N3 for a short distance before following the River Road slip roads, terminating at the M50 Junction 6 roundabout. The proposed horizontal alignment of the N3, and the proposed slip roads and link roads between the N3 and the M50 Junction 6 Roundabout, will generally follow the horizontal alignment of the existing carriageways.

The horizontal alignment of the N3 dual carriageway has been developed in accordance with the geometric standards applicable to a design speed of 85 km/h urban dual carriageway as identified in Section 4.1. The cross section for this section of road is described in Section 4.3.2.

The alignments of the westbound and eastbound carriageways of the N3 are proposed to be amended to move a section of both carriageways into the existing central reservation. The width of the central reserve is proposed to be reduced from approximately 8.8m to 2.7m at its narrowest point at Ch. 1+580. The westbound edge of carriageway (offside) moves north a maximum of 5.1m at Ch. 1+580 with the eastbound edge of carriageway (offside) moving south a maximum of 3.1m at Ch. 1+440. The current alignment will be amended, and the central reserve width will be reduced in order to minimise the impact of the provision of additional bus lanes, bus stops and pedestrian ramps and steps on Millstead Estate, the properties at Herbert Road and the existing River Tolka culvert structure, adjacent to BR02 Mill Road Bridge.

The proposed alignment of the N3 eastbound merge slip road and N3 westbound diverge slip road will follow the existing alignment. Both slip roads have been developed to a design speed of 60 km/h as noted in Section 4.4. The cross section for this section of road is described in Section 4.3.2. The slip roads have been designed to tie into the horizontal alignment of the revised slip roads proposed as part of the Snugborough Interchange Upgrade Scheme. The eastbound merge slip road will tie in with the Snugborough Interchange slip road at side road chainage 0+000. The westbound diverge slip road will tie in with the Snugborough Interchange slip road at Ch. 1+020.

The proposed alignment of the N3 eastbound diverge slip road, including beyond the Connolly Hospital Junction and across the River Road Overbridge, and the N3 westbound merge slip road will follow the existing alignment. Both slip roads have been developed to a design speed of 60 km/h as noted in Section 4.4. The cross section for this section of road is described in Section 4.3.

The geometry of the existing carriageway linking the N3 merge and diverges to the M50 roundabout junction will remain largely unaltered. The additional bus lane provision will involve offside and nearside widening, however due to the extent of changes between River Road overbridge (Ch. 2+200) and the M50 roundabout, a relocation of the central median will be required resulting in a maximum shift to the north of approximately 1.6m shift. This length of central median will also reduce in width to a minimum of 2.2m (including hard strips) to accommodate the additional provisions.

N3 / M50 Junction to Navan Road / Ashtown Road Junction

The Proposed Scheme continues along the roundabout of the M50 junction where sections of the existing nearside traffic lane will be redesignated as a bus lane with no proposed alignment changes.

Beyond the roundabout junction, the Proposed Scheme will continue to Auburn Avenue junction and along the existing R147 Navan Road. The creation of an inbound bus lane will involve a new stand-alone alignment commencing at the widened M50 roundabout exit arm and tying into Auburn Avenue junction. Due to the existing constraints of the M50-N3 interchange and associated structures, this proposed alignment will include a series of sub-standard superelevated horizontal curves (R=45m S=5.0%, R=80m S=2.5%). The proposed incorporation of the westbound/outbound bus lane along this stretch will involve the redesignation of an existing traffic lane, therefore no changes in horizontal alignment will be required.

Beyond Auburn Avenue junction, between chainages Ch. 2+900 and Ch. 4+250, the existing alignment of the R147 will be retained with online widening to both nearside and offside, accounting for the additional bus and cyclist provisions proposed. The carriageway widening proposed along this section of the CBC will be an extension of the existing carriageway crossfalls. Similarly, this principle will apply to the alignments along the slip roads of the Navan Parkway Interchange.

From Ch. 4+500, as the Proposed Scheme passes through the constrained corridor on approach to the Ashtown Road junction, the proposed layout will see the central median of the existing carriageway removed and the road will change to single carriageway classification in conjunction with a speed limit reduction from 60km/h to 50km/h beyond Phoenix Park Avenue junction towards the city centre. Lane widths will be also reduced as outlined in Section 4.2. Subsequently, the applicable design speed between Ch. 4+500 to the Ashtown Road junction will be 50km/h and DMURS will apply. The proposed alignment will tie into the new layout proposed at Ashtown Road junction, which will replace the existing roundabout.

Navan Road / Ashtown Road Junction to Navan Road / Old Cabra Road Junction

This section generally follows the existing horizontal alignment of the R147 Navan Road commencing at Ashtown Road junction and terminating at the Navan Road/Old Cabra Road junction. Where the proposed horizontal alignment of the R147 Navan Road deviates from the existing road alignment, the horizontal geometry has been developed in accordance with the geometric standards applicable to a design speed of 50 km/h identified in Section 4.1. The cross section for this section of road is described in Section 4.3.2.

From Ch. 6+450 to Ch. 6+600m, west of Nephin Road junction, the proposed alignment of Navan Road deviates from the existing by moving 2m north to allow for the increased road width. The change in alignment is accommodated by the provision of reverse 510m radius curves and a large radius 4,420m curve to gradually reduce the deviation from the existing alignment. A 250m radius reverse curve is then adapted to tie the alignment into existing.

Navan Road / Old Cabra Road junction to Ellis Quay

This section generally follows the existing horizontal alignment starting at Old Cabra Road and continuing on to Prussia Street, Manor Street, Stoneybatter and Blackhall Place where the Proposed Scheme terminates at Ellis Quay. There is a parallel side road alignment running from King Street North to Queen Street which terminates at Arran Quay. There are additional proposed side road alignments connecting Blackhall Place and Queen Street at Blackhall Street and Brunswick Street North. Where the proposed horizontal alignment deviates from the existing road alignment, the horizontal geometry has been developed in accordance with the geometric standards applicable to a design speed of 50 km/h noted in Section 4.4. The cross section for this section of road is described in Section 4.3.2.

At Old Cabra Road, from Ch.7+400 to Ch. 7+550 the alignment of the road is proposed to be moved south, with the existing central reserve being removed, to provide bus lanes in each direction. The proposed alignment ties into the existing centreline of Old Cabra Road at Ch. 7+600. Although the alignment of the road will change through this area, the boundary of the road will remain unchanged.

At Manor Street / Stoneybatter from Ch. 8+770 to Ch. 9+000, it is proposed to alter the existing alignment to accommodate the proposed on-street parking, bus stops and cycle tracks. The curve radius through this section has been reduced which moves the alignment to the north with the alignment gradually tying back into the existing centreline at Ch. 9+000.

4.7 Summary of Vertical Alignment

The following section summaries the vertical geometry of the carriageways associated with the CBC. All vertical alignments have been designed using the appropriate set of design guidelines/standards as outlined in Section 4.1

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

In instances where the desirable minimum parameters defined by the appropriate guidance have not been met, these locations have been detailed within Section 4.17 Deviations from Standard.

This section should be read in conjunction with the Mainline Plan and Profile drawings in Appendix B.

N3 Blanchardstown Junction to Snugborough Road

The layout of this section of the route will involve reconstruction of the existing carriageways with online widening required at certain locations. To facilitate this the proposed vertical alignments have been developed to match existing. This will ensure, so far as is reasonably practicable, that much of the existing carriageway can be incorporated into the works. This will also minimise level difference between the existing and proposed levels, and in doing so reduce impact on adjacent land.

The design generally falls from a level of 57.8m AOD at the Mulhuddart Interchange (East) to the tie-in with the proposed Snugborough Junction realignment at a level of 55.8m AOD. At the N3 Mulhuddart interchange overbridge, the existing levels will be replicated, in order to mitigate any impact on the existing structure.

The proposed works to the Bus Interchange, and particularly the creation of the central pedestrian area, where crossfalls are restricted to 2-3%, will see minor deviations in the vertical alignment from existing, to achieve the desired crossfalls. This will result in an increase in levels through this area, However the portion of the interchange widened towards the existing car park will see the level difference minimised and graded out to the existing levels in the car park area.

There are no locations in this section where the K value for sag and crest curves fall below the minimum values specified by DMURS.

Snugborough Road to N3 / M50 Junction

The vertical alignment in this section will generally match the existing road level to minimise impact on adjacent properties and existing structures. The vertical geometry for the N3 mainline has been developed in accordance with the geometric standards applicable to a design speed of 85 km/h, and the merge and diverge slip roads for the N3 have been developed to a design speed of 60 km/h as identified in Section 4.4. The cross section for this section of road is described in Section 4.3.2.

The proposed level on the N3 at its western end commences at an elevation of 52.3m AOD, rising to an elevation of 52.8m AOD before reducing to an elevation of 50.3m AOD at its eastern end. The vertical alignment of the N3 westbound carriageway complies with the minimum requirements identified in Table 4.2. The vertical alignment of the N3 eastbound carriageway includes a crest curve with a K value of 30 at the eastern tie-in with the existing N3 alignment. This is a one-step relaxation from the requirement outlined in Table 4.2.

The proposed vertical alignment of the N3 westbound diverge and N3 eastbound merge slip roads will follow the existing vertical alignment. The N3 westbound diverge will rise from the N3 mainline to tie into the proposed design for the Snugborough Interchange.

The N3 eastbound merge will fall from the Snugborough Interchange to tie in with the proposed level of the mainline N3 eastbound carriageway. The vertical alignment of the slip roads will comply with the minimum requirements identified in Table 4.2**.**

The proposed vertical alignment of the N3 eastbound diverge slip road follows the existing alignment, tying in with the existing junction to Connolly Hospital. The existing levels will be retained to minimise the impact on the retaining wall in the nearside verge and to minimise alterations to the existing junction. Continuing along the eastbound diverge the existing levels and sub-standard vertical geometry (concurrent crest curves of k value 15 and 13) will be retained to minimise impact on the existing overbridge at River Road. The N3 westbound merge slip road will follow the existing vertical alignment to minimise the impact on the residential properties at Old River Road. The vertical alignment of the slip roads will comply with the minimum requirements identified in Table 4.2.

The proposed vertical alignment of the M50 roundabout entry and exit arms will also follow the existing to ensure appropriate tie-in with the existing roundabout.

N3 / M50 Junction to Navan Road / Ashtown Road Junction

To minimise impact on the existing road network, and due to the nature of the additional widening works required to facilitate the Proposed Scheme, the proposed vertical alignment through this section will also generally match the existing.

The sections of both northbound and southbound carriageway running from M50 roundabout through Auburn Avenue junction and on to Ashtown Road junction will largely remain as per existing with online widening accounting for the majority of the construction works. The proposed level of this section will fall from an elevation of 57.2m AOD at the M50 roundabout to 51.6m AOD at the Ashtown Road junction.

At the west end of this section, the vertical alignment of the M50 roundabout will remain unaltered, similarly Auburn Avenue junction will remain at approximately 53.3m AOD. Changes to the Auburn Avenue junction layout will accommodate the widened section of carriageway on the entry arms. It is proposed to largely maintain the existing vertical geometry of the carriageways around the Auburn Avenue junction with minor variations required to achieve tie-in at the intersection of the widened carriageway edges.

The proposed vertical alignment of the new section of bus lane in the inbound direction, linking the M50 roundabout with Auburn Avenue junction will tie into the existing roundabout exit arm at the north end (51.2m AOD), and Auburn Avenue junction at the south end (53.3m AOD). To facilitate the vertical tie-in over a relatively short alignment, a series of sub-standard vertical crest (minimum K value of 10) and sag (minimum K value of 9) curves are proposed.

The Proposed Scheme along the R147 Navan Road will fall from an elevation of 53.3m AOD at Auburn Avenue junction to 51.6m AOD at the Ashtown Road junction.

The proposed vertical alignment of the Navan Parkway interchange will remain largely as per existing with all levels on the overbridge structure remaining as per existing. At this location, the level of the mainline R147 carriageway is 48.9m AOD while the overbridge carriageway level is 55.8m AOD.

Navan Road / Ashtown Road Junction to Navan Road / Old Cabra Road Junction

The vertical alignment in this section will generally match the existing road profile/level to minimise the impact on adjacent properties. The vertical geometry has been developed in accordance with the geometric standards applicable to a design speed of 50 km/h identified in Section 4.1. The cross section for this section of road is described in Table 4.7.

The proposed level in this section will fall from 51.5m AOD at Ashtown Road junction to 40.5m AOD at Old Cabra Road junction. There are no locations in this section where the K value for sag and crest curves will fall below the minimum values specified by DMURS. However, there are six locations where the minimum gradient will be below 0.5%. The vertical alignment in this section will generally follow the existing vertical alignment, therefore the gradients proposed in the design are similar to existing gradients. There is limited opportunity to increase the gradients due to proximity of adjacent properties and driveways where any significant change to the existing level would affect access. Lowering of the existing levels to increase the gradients to a minimum of 0.5% would result in additional full depth pavement reconstruction and impact on utility apparatus, resulting in additional protection measures or utility diversions. To ensure that the areas where the gradient falls below 0.5% drain effectively, a minimum of 2% crossfall has been applied to the carriageway to ensure surface water reaches the proposed drainage system. There are no locations in this section where the K value for sag and crest curves fall below the minimum values specified by DMURS.

Navan Road / Old Cabra Road Junction to Ellis Quay

The vertical alignment in this section will generally match the existing road level to minimise the impact on adjacent properties. The vertical geometry has been developed in accordance with the geometric standards applicable to a design speed of 30 km/h identified in Section 4.1.The cross section for this section of road is described in Table 4.7.

The proposed level in this section will fall from 40.5m AOD at Old Cabra Road to 3.45m AOD at the tie-in point at Ellis Quay with the proposed gradients replicating the existing. There are no locations in this section where the K value for sag and crest curves will fall below the minimum values specified by DMURS.

4.8 Forward Visibility

Forward visibility (or Stopping Sight Distance, SSD) has been assessed along the extent of the proposed route against the criteria outlined within the relevant applicable standards of DMURS and TII DN-GEO-03031 for the design speeds listed in Section 4.4

The desirable minimum forward visibility requirements have been achieved across the majority of the Proposed Scheme. Where the desirable minimum forward visibility requirements will not be achieved, details are provided in Deviations from Standard, refer to Section 4.17. A summary of the locations that will have a reduction in forward visibility is noted within Appendix C.

Table 4.10 and Table 4.11 summarise the key geometric design parameters applicable to all urban roads designed in accordance with DMURS and those roads designed in accordance with TII Publications respectively.

Table 4.10: Forward Visibility/SSD Parameters for roads designed to DMURS

Road Type	Design Speed (km/h)	Forward visibility (m)	Forward visibility on Bus Routes (m)
Urban Road with 30 km/h Speed Limit	30	2.3	N/A
Urban Road with 50 km/h Speed Limit	50	6.4	4.7
Urban Road with 60 km/h Speed Limit	60	9.2	8.2

Table 4.11: Forward Visibility/SSD Parameters for roads designed to TII Publications

Road Type	Design Speed (km/h)	Desirable min. SSD (m)	One step below desirable min. SSD (m)
National Roads			
N3 Dual Carriageway from Snugborough Junction to River Road Junction	85	160	120
N3 Merge and Diverge Slip Roads	60	90	70
National / Regional Roads			
N3/R147 Navan Road from River Road Junction to the Phoenix Park Avenue Junction	70	120	90
R147 Navan Parkway Interchange Merge and Diverge Slip Roads	60	90	70

4.8.1 Junction Visibility

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

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

Details and locations where the desirable minimum junction visibility will not be achieved are available within the Deviations from Standards in Appendix C.

4.8.2 Junction Intervisibility

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

As many of the junctions along the Proposed Scheme will involve retrofitting of the existing layout in an urban environment to provide additional NMU provisions in addition to the requirements to facilitate vehicle swept-paths, junction intervisibility will be impacted. Details and locations where the junction intervisibility do not meet the requirements of DN-GEO-03044 for those roads designed to TII Publications are noted in Appendix C.

4.9 Corner Radii and Swept Path

Generally, on junctions along the Proposed Scheme, corner radii of between 6m and 10m will be implemented. This will generally accommodate the swept-path of the design vehicles along the route without the swept-path crossing the centre line of the intersecting road. However, where swept-path analysis has identified constrained areas and larger vehicles are anticipated to make up a higher portion of the usage (i.e. bus lanes, HGV service areas etc.) a combination of localised carriageway widening, and increased corner radii has been provided to facilitate this.

Although swept-path analysis is used to inform the junction design, it is not the determining factor. There are a number of additional factors relating to the junction design which are considered in the overall methodology including junction intervisibility, speed of turning vehicles and in particular pedestrian safety. Corner radii along the route will be less than 6m at some locations in order to lower the speed at which vehicles can turn corners and increase inter-visibility between users e.g. Fingall Place (see DMURS Section 4.3). Reduced corner radii will also assist in the creation of more compact junctions, which align crossing points with desire lines and reduce crossing distances.

It is accepted that at minor type junctions and residential accesses, larger vehicles may have to cross the centreline; however, usage is expected to be infrequent.

A summary of the vehicles used as part of the overall Swept Path Analysis are outlined below:

- (Design Bulletin) DB32 Private Car – Analysis undertaken at private residential properties;
- 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 including Blackhall Place/Queen Street, Stoneybatter and the Proposed Scheme around Blanchardstown area; and
- FTA Design Articulated Vehicle (1998) – Analysis undertaken ensuring the vehicle can access the CBC from side roads between the start of the scheme at N3 Blanchardstown junction to M50 junction. From the M50 junction to the North Circular Road junction, this vehicle has been used to auto-track the CBC only. Between the M50 junction and North Circular Road, the Ashtown Road junction & Kinvara Avenue/Baggot Road junction were tracked to ensure they were suitable for this design vehicle.

Section 4.16 of this report details areas of turning bans along the Proposed Scheme.

4.10 Kerbing

The kerbing type selected along the Proposed Scheme is primarily dependent upon the presence of a cycle track alongside the carriageway. Where cycle tracks will be present adjacent to the carriageway, the cycle track will be separated by the typical 250mm wide BusConnects kerb, which will have a 120mm upstand to the carriageway and a 60mm upstand to the cycle track (120mm upstand where cycle track is not raised) as shown in Figure 4.3.

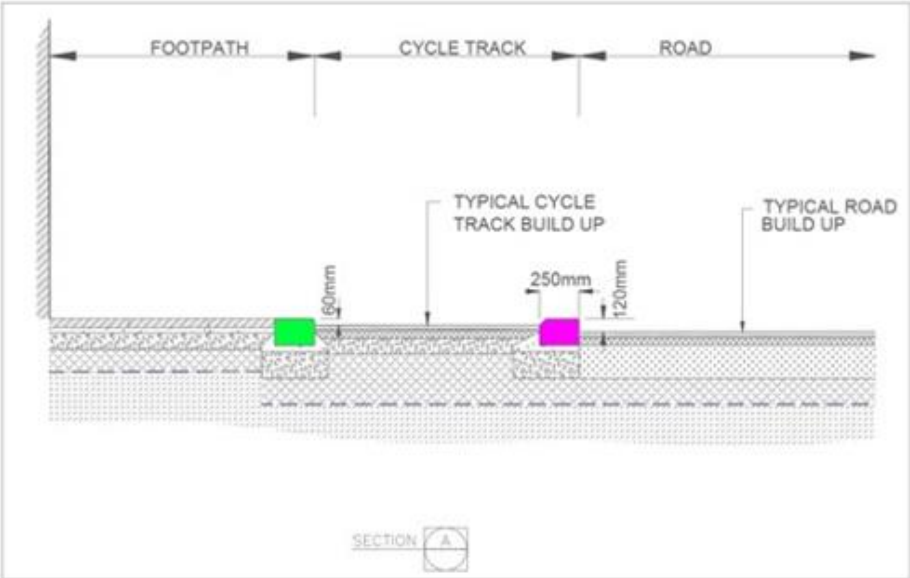


Figure 4.3: Typical Kerb Arrangement

Where this kerb will cross at an uncontrolled junction and at direct accesses, the Raised Table Priority Junction Treatment (Figure 4.4) will be implemented at the majority of locations. At these locations, the kerb will be lowered to a 60mm upstand while the cycle track will be raised throughout. At some locations, where it is necessary to retain the cycle track at carriageway level (e.g. due to cobblestone heritage feature), the kerb will transition to carriageway level and/or terminate as required.

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

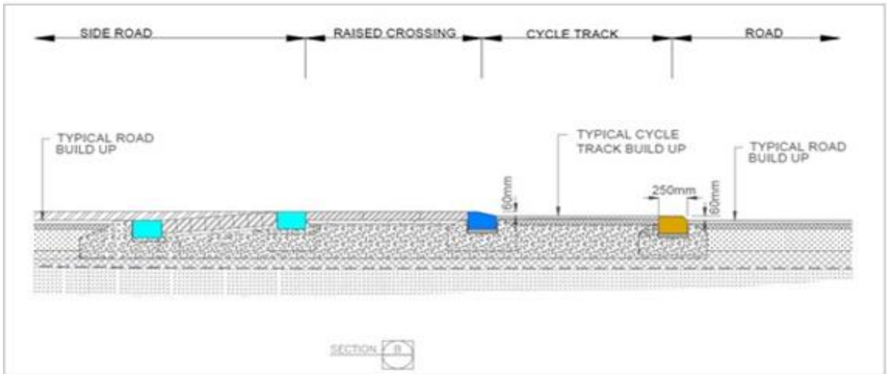


Figure 4.4: Kerb Treatment at Raised Table Priority Junction

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

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

At locations along the N3 and the R147, where kerbs are proposed and where a cycle track and footpath are not proposed adjacent to the carriageway, kerbs with a maximum upstand of 80mm are proposed.

Where levels and proposed carriageway cross-sections will not change across major overbridge structures along the Proposed Scheme, it is proposed to retain the existing kerb provisions, (including N3 Mulhuddart Overbridge and Navan Parkway Overbridge).

At the existing N3 overbridge structure on River Road (inbound direction) it is proposed to use a trief kerb due to carriageway widening, in order to minimise the extent of change to footpath crossfall.

4.11 Bus Provision

One of the main objectives of the Proposed Scheme is 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.

The proposed bus provision is shown on the General Arrangement drawings within Appendix B. This provision will increase the bus priority along the Proposed Scheme and is shown below as a percentage of the overall scheme length (10.9km)

- 10% Existing bus priority (outbound) *(10% physical);*
- 40% Existing bus priority (inbound) *(40% physical);*
- 97% Proposed bus priority (outbound) *(83% physical – 14% virtual);* and
- 98% Proposed bus priority (inbound) *(84% physical – 14% virtual).*

This increased bus priority will enhance the capacity and potential of the public transport system meeting one of the main objectives of this Proposed Scheme.

4.11.1 Full Bus Priority

Full Bus Priority uses a dedicated lane within the carriageway for the bus to travel unhindered from the general traffic. For full priority the provision will continue through junctions and remain unbroken for left turning traffic. Over the majority of the route, as per the guidance for traffic lane widths outlined in DMURS, a 3m lane will be provided for bus use only, apart from the section between Snugborough Road and Phoenix Park Avenue junction. Increased lane widths have been designed where the swept path of the bus requires a greater width to undertake the manoeuvre.

Where continuous bus lanes will not be provided due to constraints, measures such as signal controlled priority and bus gates are proposed to be introduced where feasible.

4.11.2 Signal Controlled Bus Priority

Signal Controlled Bus 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.

Locations where signal-controlled bus priority have been provided on the Proposed Scheme are noted in Table 4.12.

Table 4.12: Signal-controlled bus priority locations

Location	Reason for Mitigation
Stoneybatter/ Brunswick St North junction (Outbound)	To provide priority for buses in the Stoneybatter Village area, while providing wider footpaths, cycle tracks and reducing overall general traffic in this area.

4.11.3 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 is directed by signage to divert away to other roads before they arrive at the Bus Gate. Locations where 24-hour bus gates are proposed are summarised within Table 4.13.

Table 4.13: Proposed Scheme bus gate locations

Location	Reason for Mitigation
Navan Road at junction with Ratoath Road / Cabra Road / Old Cabra Road (inbound)	This is to restrict inbound general traffic from using the Old Cabra Road as a through-route.
Railway overbridge at Old Cabra Road (outbound)	This is to restrict outbound general traffic from using the Old Cabra Road as a through-route.
Manor St at junction with Prussia St and Aughrim St (inbound and outbound)	This is to restrict inbound and outbound traffic from travelling between Prussia Street and Manor Street and hence, to discourage general traffic from travelling through Stoneybatter Village.
Aughrim Street at junction with Prussia St and Manor St (inbound)	This is to restrict inbound general traffic from travelling from Aughrim Street on to Manor Street to discourage general traffic from travelling through Stoneybatter Village.
Blackhall Place at junction with King Street North (outbound)	This is to discourage outbound general traffic from using Manor Street as a through-route.

Location	Reason for Mitigation
Stoneybatter at junction with King Street North (inbound)	This is to restrict inbound general traffic from using Blackhall Place as a through-route. This is retention of an existing bus gate.

4.12 Cycling Provision

One of the core objectives of the Proposed Scheme is to enhance the potential for cycling by providing safe infrastructure for cycling, segregated from general traffic wherever practicable. Physical segregation ensures that cyclists are protected from motorised traffic as well as being independent of vehicular congestion, thus improving cyclist safety and reliability of journey times for cyclists. Physical segregation can be provided in the form of vertical segregation, (e.g. raised kerbs), horizontal segregation, (e.g. parking/verge protected cycle tracks), or both.

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

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

The desirable minimum width for a single-direction, with-flow, raised-adjacent cycle track is 2.0m. This arrangement allows for two-abreast cycling. Based on the NCM Width Calculator, this allows for overtaking within the cycle track. The minimum width is 1.5m, which based on the NCM Width Calculator, allows for single file cycling.

Localised narrowing of the cycle track below 1.5m may be necessary over very short distances to cater for local constraints (e.g. mature trees).

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

The Proposed Scheme is approximately 10.9km long from end to end. The General Arrangement drawings included within Appendix B show the improved extent of cycle provision, which is summarised below:

- 48% Existing cycle priority (outbound) (14% mandatory cycle lane, 23% advisory, 11% cycle-track);
- 38% Existing cycle priority (inbound) (15% mandatory cycle lane, 16% advisory, 7% cycle-track);
- 80% Proposed cycle priority (outbound) (80% cycle track); and
- 77% Proposed cycle priority (inbound) (77% cycle track).

Details of the proposed cycle tracks and cycle lanes throughout the extent of the Proposed Scheme are provided below.

4.12.1 Segregated Cycle Track

A segregated cycle track is a cycle track which is physically segregated from the adjacent traffic lane and/or bus lane horizontally and/or vertically, as shown in Figure 4.5, taken from the BCPDGB.

To reduce impact on a number of driveways, between Ashtown Road junction and Skreen Road junction, and direct accesses (e.g. cobblestone heritage feature), it is proposed to lower the cycle track to align with carriageway level.

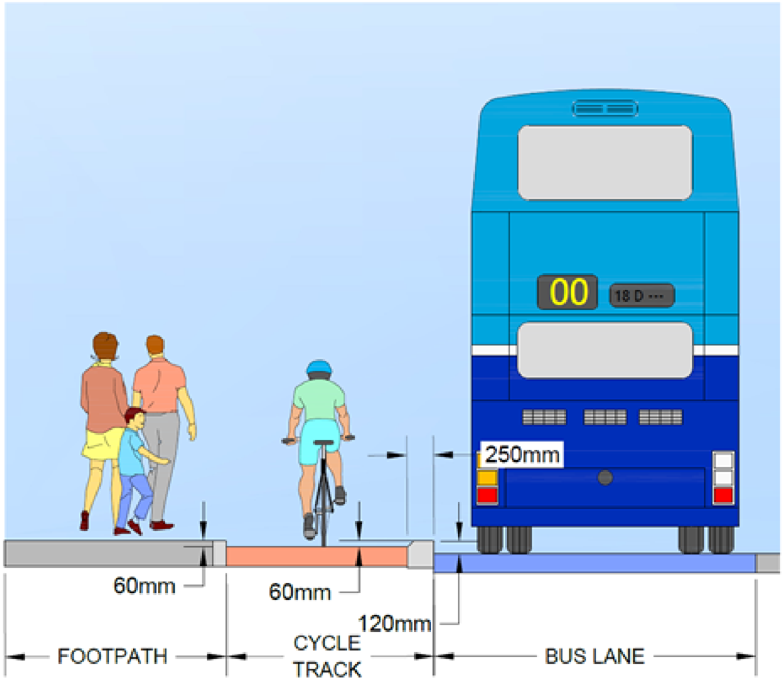


Figure 4.5: Fully Segregated Cycle Track

A full height 120mm upstand kerb between the carriageway and the cycle track is proposed. This will result in a 120mm kerb height on the bus lane side and 60mm kerb height on the cycle track side (120mm kerb height where cycle track is not raised). This provides increased protection of the cycle track as well as allowing for side entry drainage systems where applicable. The 60mm high minimum vertical kerb is required on the footpath side of the cycle track to ensure that the kerb is properly detectable by visually impaired pedestrians using the footpath.

Cycle track construction guidance is given in Section 5.6 of the NCM. The use of machine laid asphalt for cycle tracks has proven to be an effective way of providing a high level of service with a safe, smooth and continuous surface.

Existing bridge deck details necessitate the use of industry-standard cycle lane separators (‘Armadillos’) instead of the segregated kerbs at:

- N3 Overbridge at Mulhuddart; and
- Old Cabra Road Railway overbridge

A short section of cycle lane is proposed on approach to bus stop southbound at Rathdown Square / Prussia Street junction. Inbound cyclists share the carriageway beyond this point.

4.12.2 Offline Cycle Track

There are no cycle tracks routed away from the road edge in the form of a segregated offline route.

4.12.3 Quiet Street Treatment

Offline options may include directing cyclists along streets with minimal general traffic other than car users who live on the street. They are called Quiet Streets due to the low volume of general traffic and are deemed suitable for cyclists sharing the roadway with the general traffic without the need to construct segregated cycle tracks or painted cycle lanes. The Quiet Street Treatment would involve appropriate advisory signage for both the general road users and cyclists.

A quiet street cycle route is proposed along Castleknock Manor which connects to the two-way cycle track on the R147 Navan Road. This links directly with the GDA Cycle Network Plan Secondary Route 4A, while reducing the need for landtake and removal of trees.

4.12.4 Treatment of Constrained Areas

At some locations along the Proposed Scheme, desirable minimum width of cycle tracks cannot be achieved, and localised narrowing will be required. All locations where desirable minimum widths will not be achieved are recorded and presented in Appendix C.

Due to the width available, cyclists share the carriageway at the following locations along the Proposed Scheme:

- Prussia Street (inbound Ch. 8+250 to Ch. 8+700 and outbound Ch. 8+670 to Ch. 8+550); and
- Manor Street (inbound Ch. 8+700 to Ch. 8+730).

4.12.5 N3 Dual Carriageway

The Proposed Scheme along the main N3 dual carriageway from Auburn Avenue to Snugborough Road will not include cyclist facilities. Cyclists will instead be routed via Castleknock Manor and Blanchardstown Main Street, routes 4A and 5 of the GDA Cycle Network Plan.

4.12.6 Queen Street

A two-way cycle track is proposed on Queen Street, which is parallel to the bus corridor along Blackhall Place. This routing via Queen Street will provide a high-quality route for cyclists and will align with the GDA Cycle Network Plan, route 4D. The two-way cycle track will link in with the Liffey Cycle Route Scheme.

4.12.7 Cycle Parking Provision

Cycle stands will be provided, where practicable, at island bus stops and key additional locations as noted in the Landscaping General Arrangement Drawings, in Appendix B.

4.13 Pedestrian Provision

Footpath widths will be a standard 2.0m wide where practicable. It is recorded in Appendix C where this will not be achieved.

Pedestrian crossings have been designed to accommodate a moderate flow of foot traffic along the mainline desire line where practicable, with a minimum width of 2.4m at both signalised junctions and zebra crossings.

Pedestrians will share their movements with cyclists when using toucan crossings, which will be provided at signalised junctions which cannot accommodate segregated cycle crossings. Mid-block toucan crossings are also proposed at certain locations along the Proposed Scheme.

To facilitate road users who cannot cross in a reasonable time, the desirable maximum crossing length without providing a refuge island is 19m. Where this is not possible, refuge islands a minimum of 4m wide are proposed to allow those who cannot cross in a reasonable time to make the journey in two phases. Louvres will be added on green far-side pedestrian aspect if necessary to avoid potential ‘see through’ by pedestrians waiting to cross the nearside crossing.

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

Formal crossing points are proposed at bus stop islands, consisting of an on-demand signalised pedestrian crossing with appropriate tactile paving, push button units and LED warning studs.

4.13.1 Footpath Crossfall

Crossfalls have generally been assigned to footpaths in accordance with *DN-PAV-03026, Table 2.3* (extract inserted as Table 4.14) which recommends a crossfall of 2%-3.3%. This gradient will allow the footpath to suitably drain without affecting the ability of mobility-impaired people to move safely along the corridor.

In certain circumstances dictated by the constraints of existing land boundaries and (particularly at existing residential accesses) to minimise impacts to adjacent properties it has been necessary to deviate from these values in the proposed design. In most cases the maximum crossfall applied to footpath design is 4.0% over a short distance.

Table 4.14: Geometric Parameters for Footpaths

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.

Table 2.3 Geometric Parameters for Footways

4.13.2 Longitudinal Gradient

The longitudinal gradient of the footpaths along the Proposed Scheme is constrained by the longitudinal gradient of the proposed carriageway. *DN-PAV-03026*, *Table 2.3* recommends a longitudinal gradient along footpaths of 1.25%-5%. However, in all scenarios of the Proposed Scheme, the footpath gradient is dictated by that of the main carriageway. Similar to the crossfall, the longitudinal fall in the road has been designed to ensure it can suitably drain without affecting the ability of mobility-impaired people to move safely along the corridor.

4.14 Bus Stops

This section of the report presents a summary of the Bus Stop Review process.

The purpose of the review is to assess the location of the existing Dublin Bus stops to determine whether a stop should be removed, relocated, or remain where it is currently located. This exercise has been 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 are sufficiently covered within the catchment of bus stops.

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

4.14.1 Methodology

The methodology followed as part of this review is set out in the 'Bus Stop Review Methodology Report' which is appended to the Bus Stop Review Report in Appendix H. It outlines the methodology to be followed for the bus stop reviews, the various considerations required when assessing a stop location, and the background reasoning for those considerations.

The main principles considered as part of the review were as follows:

- Aim to achieve a bus stop spacing of 400m in suburban locations, and 250m in urban centres;
- Locate bus stop as close as possible to nearest junction/pedestrian crossing;
- Locate bus stop downstream of junction rather than upstream;
- Consider space requirements to provide bus stop including shelter, waiting area, cycle lane and footpath provision and information displays;
- Review existing and proposed boarding and alighting volumes to determine the usage of the bus stop; and
- Consider the potential for interchange with orbital bus services proposed as part of the New Dublin Area Bus Network.

The above principles were considered to determine whether a bus stop should remain where it is, be relocated or be removed.

Following the review of bus stop locations, the catchment analysis was run to review the impact of the changes on the bus network. The proposed catchments are presented in Figure 4.6 and Figure 4.7 with population numbers presented in Table 4.15 to Table 4.18.

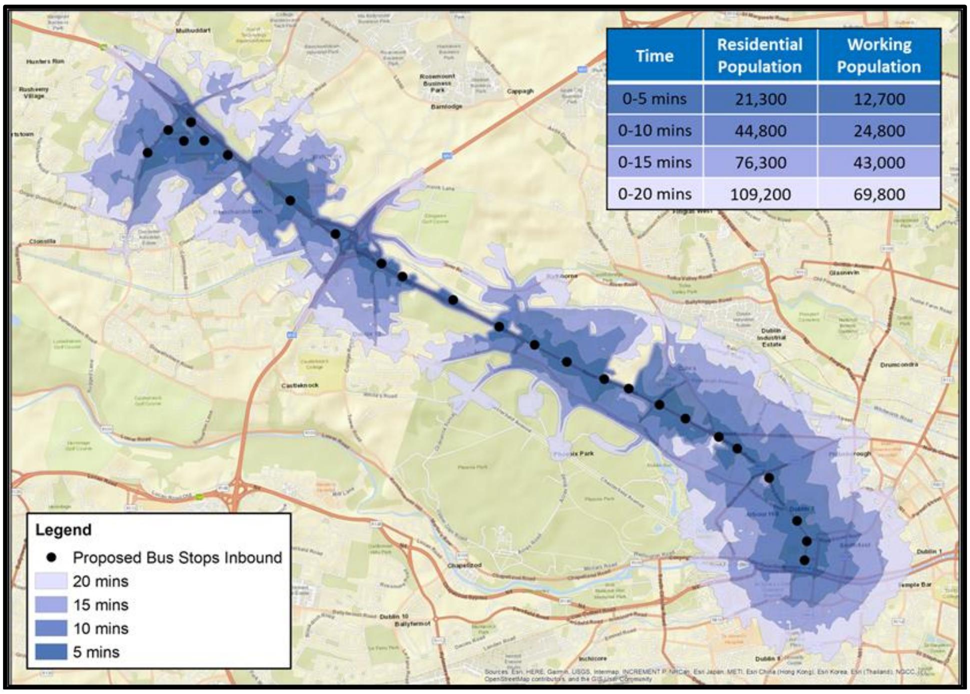


Figure 4.6: Proposed Inbound Bus Stop Catchments

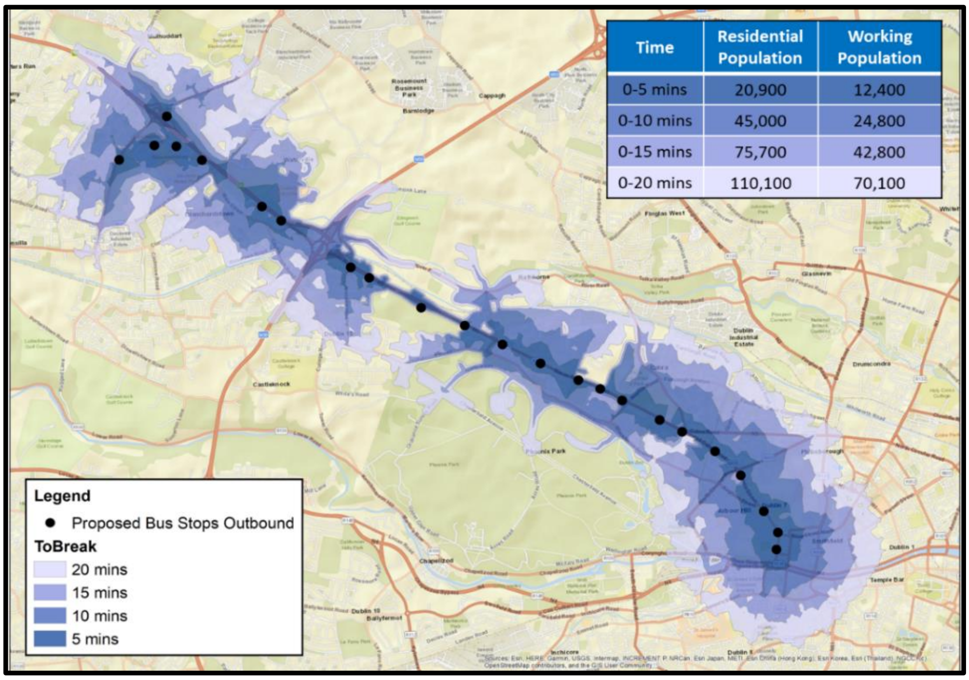


Figure 4.7: Proposed Outbound Bus Stop Catchments

Table 4.15: Inbound Residential Catchment Populations

Catchment	Existing	Proposed	Difference
0-5	21600	22700	1100
0-10	46800	48400	1600
0-15	80900	82200	1300
0-20	117500	118100	600

Table 4.16: Inbound Workplace Catchment Populations

Catchment	Existing	Proposed	Difference
0-5	12500	13000	500
0-10	24700	25400	700
0-15	43600	44200	600
0-20	71800	71800	0

Table 4.17: Outbound Residential Catchment Populations

Catchment	Existing	Proposed	Difference
0-5	23100	23100	0
0-10	49000	49300	300
0-15	81600	82100	500
0-20	119100	119400	300

Table 4.18: Outbound Workplace Catchment Populations

Catchment	Existing	Proposed	Difference
0-5	13000	13000	0
0-10	24500	24500	0
0-15	42800	42900	100
0-20	70100	70100	0

From the tables above, it is noted that the proposed bus stop locations result in an increase in both residential and workplace catchments for the inbound and outbound directions. The residential population increases more than the workplace populations, which is likely due to the largely suburban nature of the area through which the route passes.

Each of the study components and proposed bus stops are discussed in more detail in the Bus Stop Review Report in Appendix H.

4.14.2 Route Summary

Table 4.19 and Table 4.20 below presents a summary of the outcome of the bus stop review process.

Table 4.19: Blanchardstown to City Centre Inbound Route Summary

Number of Existing Stops	26
Number of Stops Moved	8
Number of Stops Removed	4
Number of Stops Added	6

Table 4.20: Blanchardstown to City Centre Outbound Route Summary

Number of Existing Stops	23
Number of Stops Moved	9
Number of Stops Removed	4
Number of Stops Added	8

4.14.3 Bus Shelter

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 will be 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 are presented on the General Arrangement drawing series in Appendix B. The optimum configuration that provides maximum comfort and protection from the elements to the travelling public is the 3-Bay Reliance 'mark' configuration with full width roof. This shelter is a relatively new arrangement which has been developed by JCDecaux in conjunction with the NTA. The shelter consists mainly of a stainless-steel structure with toughened safety glass and extruded aluminium roof beams. Figure 4.8 below provides an example image of the preferred full end panel shelter arrangement. The desirable minimum footpath/island widths required to accommodate the full end panel shelter is 3.3m with an absolute minimum width of 3m to facilitate a minimum 1.2m clearance at the end panel for pedestrians. Alternative arrangements for more constrained footpath widths are considered below.

Figure 4.8: Example of a 3-Bay Reliance full end panel bus shelter (Source: JCDecaux)

The cantilever shelter using full width roof and half end panel arrangement provides a second alternative solution for bus shelters in constrained footpath locations. Figure 4.9 below provides an example of this type of shelter. Advertising panels in this arrangement are normally located on the back façade of the shelter compared to the full end panel arrangement. The desirable minimum footpath/island widths required to accommodate the full end panel shelter is 2.75m with an absolute minimum width of 2.4m to facilitate a minimum 1.2m clearance at the end panels for pedestrians.

Figure 4.9: Example of a 3-Bay Reliance Cantilever Shelter with full width roof and half end panels (Source: JCDecaux)

Two alternative narrow roof shelter configurations (Figure 4.10) 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. The desirable minimum footpath widths for the narrow roof configuration are 2.75m (with end panel) and 2.1m (no end panel). The absolute minimum footpath widths for these shelters are 2.4m (with end panel) and 1.8m (no end panel) to allow for boarding and alighting passengers in consideration of wheelchair, pram, luggage and other such similar spatial requirements.

Figure 4.10: Example of a 3-Bay Reliance Cantilever shelter with narrow roof configuration with and without half end panels (Source: JCDecaux)

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

Figure 4.11, Figure 4.12 and Figure 4.13 illustrate each of these scenarios.

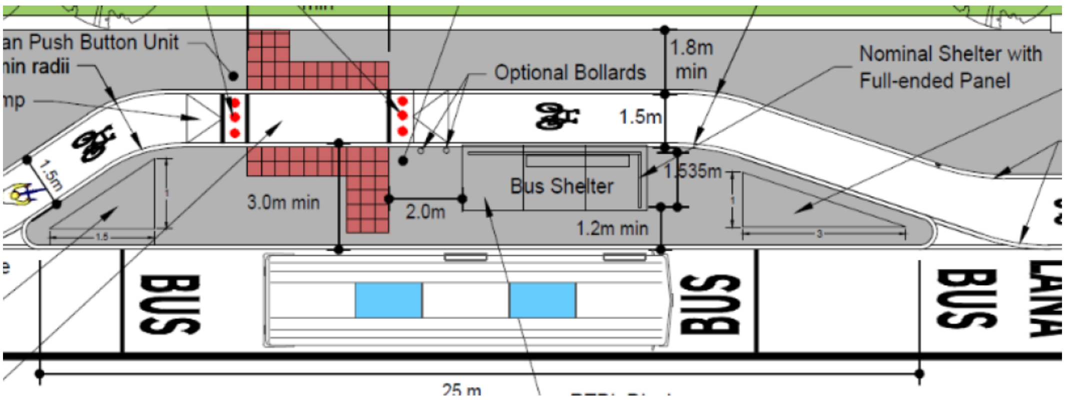


Figure 4.11: Preferred Shelter Location (on island)

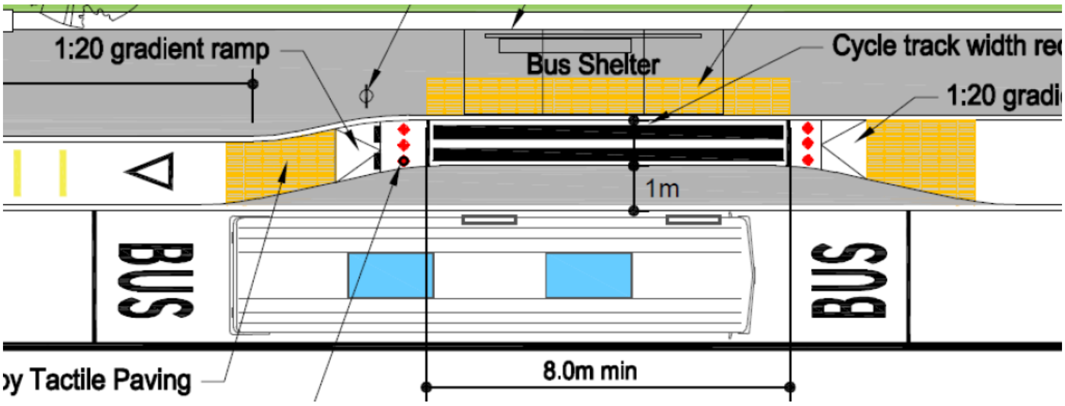


Figure 4.12: Alternative Shelter Location back of footpath (narrow island with adequate footpath widths)

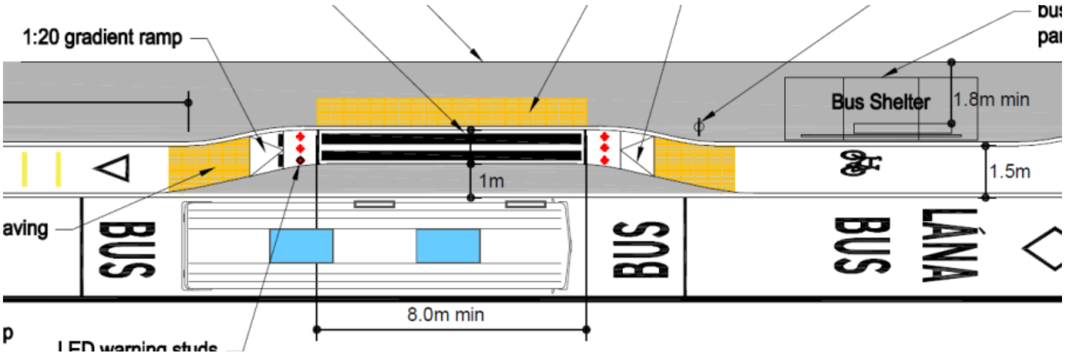


Figure 4.13: Alternative Shelter Location downstream of island (narrow island with narrow footpath widths at landing area)

4.14.4 Island Bus Stops

Where sufficient space is available, Island Bus Stops have been proposed, which will help to reduce the conflict between users departing the bus and cyclists. The two types of island bus stops which accommodate for one way and two cycle lanes are shown within Figure 4.14 and Figure 4.15 respectively. The following features reduce conflict between pedestrians and cyclists while addressing accessibility for mobility impaired users:

- To address the pedestrian/cyclist conflict, a pedestrian priority crossing point will be provided for pedestrians accessing the bus stop area. Part-time signals will enable controlled crossing when required. Visually impaired pedestrians may call for a fixed green signal when necessary and the cycle signal will change to red;
- The cycle track should be deflected behind the bus stop sufficiently to reduce cycling speed for safety through the crossing area so cyclists can give way to pedestrians crossing to the bus stop area. The cycle track will rise in level to meet the footpath level. (Yellow bar markings could also be provided to alert approaching cyclists but the narrowing and deflection should suffice when the approaching cycle track is the nominal 2m width);
- Appropriate signage and lighting will be provided at these locations to ensure that all road users are aware of the potential conflicts in this area; and
- The cycle track will narrow from 2.0m to 1.5m for single file cycling through the bus stop, as overtaking is not required in this area.

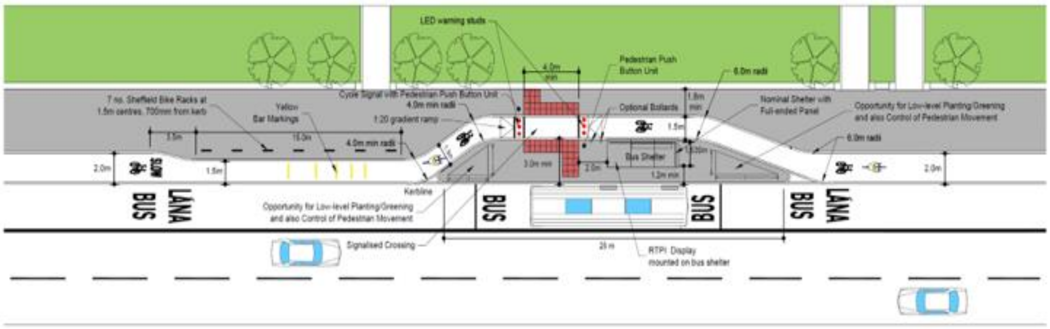


Figure 4.14: Island Bus Stop Arrangement

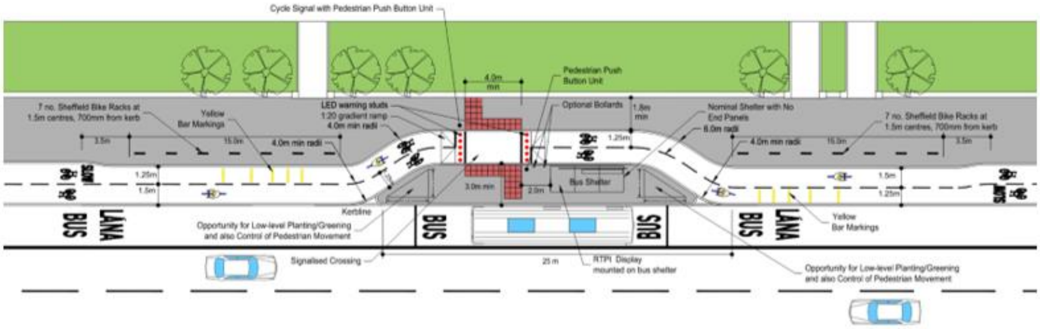


Figure 4.15:: Island Bus Stop Arrangement with 2-way cycle-track

The island bus stops and their locations are listed within Table 4.21 below.

Table 4.21: Island Bus Stops

Stop Number	Stop Name	Inbound / Outbound	Chainage	Bus Shelter	Reason for moving stop
7475	Blanchardstown Road South	Inbound	B450	Yes	To be moved 40m north to facilitate the left turn manoeuvre into the service yard downstream, and to tie-in to new infrastructure for bus layover.
1906	Cabra Cross	Inbound	A7475	Yes	Not Applicable.
1713	Stanhope Street Convent	Inbound	A8890	Yes	Not Applicable.
1649	Aughrim Street	Outbound	A8800	Yes	Moving 20m north, this location facilitates the provision of a toucan crossing at the location of the existing stop.
1660	Nephin Road	Outbound	A6560	Yes	Not Applicable.
1807	Phoenix Pk Avenue	Outbound	A4440	Yes	Moved 150m East. This location better serves the catchment at Phoenix Park Avenue side road.
7167	Parkway Station	Outbound	A3920	Yes	Not Applicable.
New Stop	New stop - Blanchardstown Town Centre	Outbound	A420	Yes	New Stop

4.14.5 Shared Bus Stop Landing Zone

Shared landing zones, as shown in Figure 4.16 are used where there is insufficient space to provide an island bus stop. The cycle track width will be reduced to 1.0m on the approach to slow cyclists and a 1.0m island will be provided for bus users arriving and departing; this is to prevent bus users stepping directly into the cycle track. Appropriate tactile kerbing will be provided to ensure that visually impaired users are aware of crossing areas. The proposed Shared Bus Stop Landing Zone locations are indicated within Table 4.22.

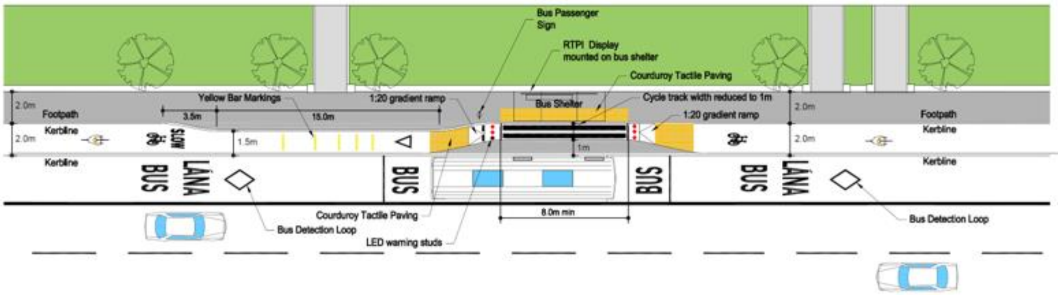


Figure 4.16: Shared Bus Stop Landing Zone Arrangement

Table 4.22: Shared Bus Stop Landing Zones

Stop Number	Stop Name	Inbound / Outbound	Chainage	Bus Shelter	Reason for moving stop
unknown	Old Navan Road (Slip Rd Eastbound)	Inbound	C250	Yes	Not Applicable.
4362	Blanchardstown Road South	Inbound	B50	Yes	Not Applicable.
1696	Ashtown Roundabout	Inbound	A5010	Yes	Not Applicable.
1698	Ashtown Grove	Inbound	A5485	Yes	Not Applicable.
1700	Kinvara Avenue	Inbound	A5970	Yes	Moved 20m East to facilitate the bus stop design layout (while minimising conflict with driveways)
1701	Our Lady's Church	Inbound	A6270	Yes	Not Applicable.
1703	Nephin Road	Inbound	A6700	Yes	Not Applicable.
1905	Skreen Road	Inbound	A7040	Yes	Not Applicable.
1907	Railway Bridge	Inbound	A7750	Yes	Not Applicable.
1909	North Circular Road	Inbound	A8250	Yes	Move 30m south. This location allows for more space for waiting passengers to congregate
1911	Drumalee	Outbound	A8280	Yes	Not Applicable.
1914	Glenbeigh Road	Outbound	A7820	Yes	Move 150m south. This location serves as a replacement for both stops 1913 and 1914
1805	Dunard	Outbound	A7350	Yes	Move 85m west. This location brings

Stop Number	Stop Name	Inbound / Outbound	Chainage	Bus Shelter	Reason for moving stop
					the stop after the junction, and closer to the pedestrian crossing
1806	Hampton Green	Outbound	A7070	Yes	Not Applicable.
1661	Our Lady's Church	Outbound	A6300	Yes	Moving 20m east, relocated further from toucan crossing stop line to provide sufficient visibility for approaching drivers of traffic signals, when bus stationary. Addresses issue raised in road safety audit.
1662	Kinvara Ave	Outbound	A6000	Yes	Move 40m east. This location avoids the left turn slip, moving this stop ahead of the junction was unpopular during consultation
1664	Ashtown Grove	Outbound	A5500	Yes	Not Applicable.
1666	Ashtown Roundabout	Outbound	A4980	Yes	Not Applicable.
1882	Blanchardstown Road South	Outbound	B000	Yes	Not Applicable.

4.14.6 Inline Bus Stops

Where no cycle tracks are proposed, inline bus stops will be used, where the users departing the bus exit straight on to the footpath. Locations where inline bus stop are proposed are noted in Table 4.23.

Table 4.23: Inline Bus Stops

Stop Number	Stop Name	Inbound / Outbound	Chainage	Bus Shelter	Reason for moving stop
2960	Blanchardstown Town Centre	Inbound	A360	Yes	Moving 30m south, the existing layby bus stop will be used as an inter-urban stop.
1545	Westend Office Park	Inbound	A660	Yes	Not Applicable.
New Stop	New stop - Mill Road	Inbound	A1590	Yes	New Stop
7374	Blanchardstown Bypass	Inbound	A2300	Yes	Moving 30m east, the existing layby bus stop will be

Stop Number	Stop Name	Inbound / Outbound	Chainage	Bus Shelter	Reason for moving stop
					used as an inter urban bus stop.
New Stop	New stop - Auburn Avenue	Inbound	A2950	Yes	New Stop
1845	Morgan's Place	Inbound	A3270	Yes	Not Applicable.
7166	Parkway Station	Inbound	A3920	Yes	Move 100m east. Moving the stop after the junction improves the operation of the bus route
1847	Phoenix Pk Avenue	Inbound	A4550	Yes	Move 160m west. This location better serves the catchment at Phoenix Park Avenue
1714	Brunswick Street	Inbound	A9175	Yes	Move 100m south. Under the proposed design, there is reasonable space in this location, and it places the stop after the junction, where the road becomes bus-only.
1715	Blackhall Street	Inbound	A9400	Yes	Not Applicable.
1647	Law Society	Outbound	A9350	Yes	Not Applicable.
1648	Arbour Place	Outbound	A9125	Yes	Move 115m south. In this location, there is more space created due to the new road layout. This location also achieves better spacing from the next stop
1808	Peck's Lane	Outbound	A3200	Yes	Not Applicable.
New Stop	New stop - Auburn Avenue	Outbound	A2975	Yes	New Stop
New Stop	New stop - Mill Road	Outbound	A1650	Yes	New Stop
661	Westend Office Park	Outbound	A675	Yes	Moving 65m west, this location brings the stop closer to the junction to the west.
New Stop	Crowne Plaza Off-slip	Outbound	D000	Yes	New Stop

4.14.7 Lay- By Bus Stops

Consideration has been given to locations where private coaches may be required to stop along the Proposed Scheme, which could require longer dwell time to allow passengers to load/unload their luggage. In these cases, and where space has permitted, a separate lay-by bus stop is proposed as shown in Figure 4.17.

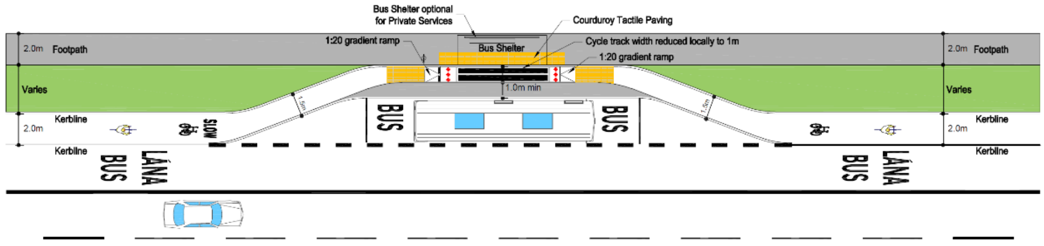


Figure 4.17: Lay-by Bus Stop Landing Zone Arrangement (Private Service Coaches)

Lay-by Bus Stops are proposed at a number of locations, as shown in Table 4.24.

Table 4.24: Lay-by Bus Stops

Stop Number	Stop Name	Inbound / Outbound	Chainage	Bus Shelter	Reason for moving stop
New Stop	New Stop – adjacent to stop 2960 - Blanchardstown Town Centre	Inbound	A340	Yes	Not Applicable.
New Stop (adjacent to existing stop 7374)	Junction 6	Inbound	A2250	Yes	New Stop
New Stop	Navan Road Parkway Station	Inbound	A3790	Yes	New Stop
New Stop	Phoenix Park Avenue	Inbound	A4400	Yes	New Stop
New Stop	Phoenix Park Avenue	Outbound	A4550	Yes	New Stop
New Stop	Navan Road Parkway Station	Outbound	A3950	Yes	New Stop
7389	Navan Road	Outbound	A1925	Yes	Move 60m east. This location is closer to the connection to Old River Road
New Stop	New Stop - Navan Road (adjacent to existing stop 7389)	Outbound	A1925	Yes	New Stop
New Stop	Westend Office Park	Outbound	A700	Yes	New Stop

4.15 Parking and Loading

With the Proposed Scheme infrastructure in place, the impacts of the change on on-street parking have been considered and are summarised below. Refer to Figure 4.18 and Table 4.25.

This considers the parking impact on the corridor in the context of parking supply on the CBC and on adjacent streets close-by (within 200m). The associated mitigation effects of the Proposed Scheme and other measures are also summarised.

Navan Road: The change in parking will involve removal of approximately 19 unregulated spaces, and retention of approximately 4 of an existing 5 spaces (on Navan Road between Ashtown Road and Nephin Road). Aspects of the Proposed Scheme and network proposals are expected to mitigate the reduction in parking by reducing reliance on private cars due to availability of an improved bus network with journey reliability, by availability of improved cycling infrastructure, and by continued and managed use of private off-street parking at, for example, local churches and schools.

Similarly, most houses have driveways and residents should be encouraged to utilise their available off-road space for parking (rather than seek to park on-street). It is concluded that the overall impact of loss of parking space on Navan Road is limited and will be largely offset by the cumulative effect of mitigations.

Aughrim Street / Prussia Street / Manor Street / Stoneybatter: The parking impact assessment indicates that although all 10 parking spaces (only available from 10am onwards during the day) will be removed on Prussia Street, on-street parking on adjacent side streets will continue to provide a parking supply for local use. Along Manor Street, Stoneybatter, Manor Place and Aughrim Street, there will be a reduction of 53 spaces. The reduction in parking spaces along this section of the corridor is 19% including side streets, for both residential and commercial parking activity. Aspects of the Proposed Scheme and network proposals are expected to mitigate the reduction in parking by reducing reliance on private cars due to availability of an improved bus network with journey reliability, and by availability of improved cycling infrastructure. Improved compliance with parking and loading bay regulations, and management of loading activities will also assist in offsetting the reduction in on-street parking spaces. It is concluded that the overall impact of loss of parking spaces on Prussia Street and Manor Street is limited and will be largely offset by the cumulative effect of mitigations.

Blackhall Place: The parking impact assessment indicates that this section of the Proposed Scheme and its surrounding areas will lose approximately 6% of parking spaces for both residential and commercial usage. Aspects of the Proposed Scheme and network proposals are expected to mitigate the reduction in parking by reducing reliance on private cars due to availability of an improved bus network with journey reliability, and by availability of improved cycling infrastructure. Improved compliance with parking and loading bay regulations, and management of loading activities will also assist in offsetting the reduction in on-street parking spaces. It is concluded that the overall impact of loss of parking space on the Blackhall Place corridor section is limited and will be largely offset by the cumulative effect of mitigations.

Other issues and design considerations will also have an impact on parking availability and usage:

- Commercial premises will need to consider adapting their loading arrangements – for example by loading at night-time or early morning (and also considering using smaller vans in Paid-for spaces); and
- Cycle parking is included in the Proposed Scheme – which will enhance the ability of residents to cycle instead of driving and parking a car to use local services.

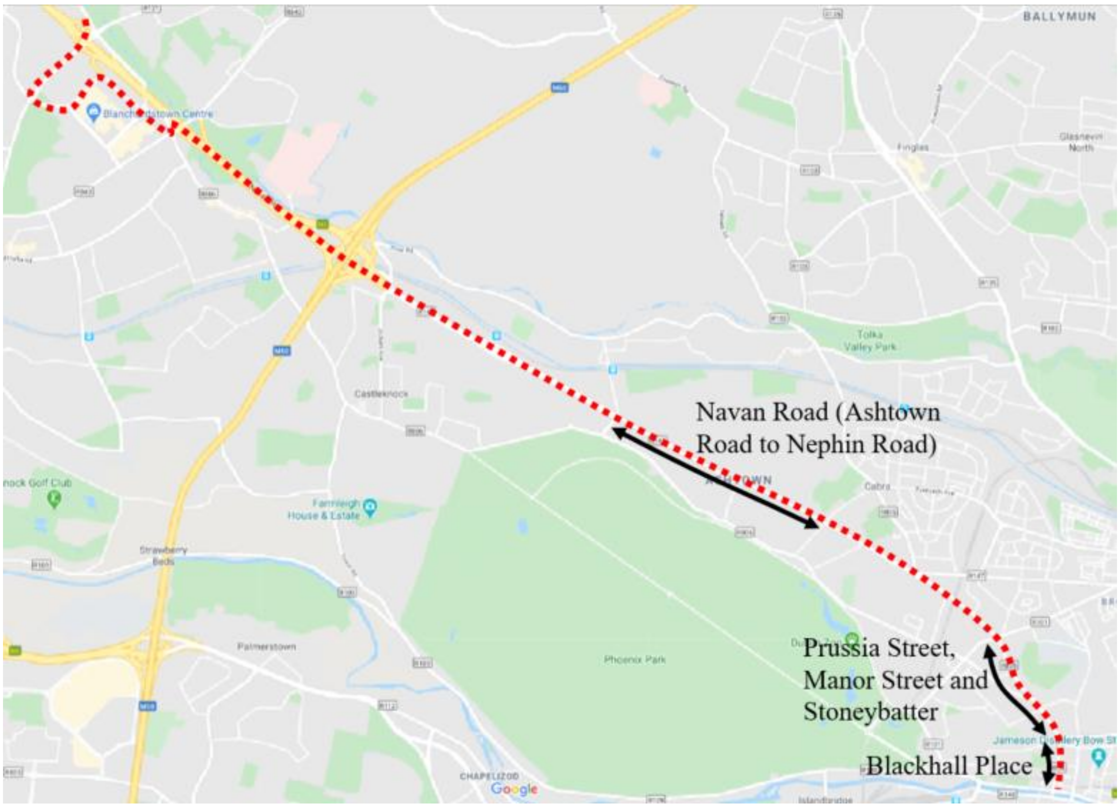


Figure 4.18: Proposed preliminary Parking Survey Study Areas

4.15.1 Summary of Parking Changes

With the Proposed Scheme infrastructure in place, there will be an associated need to remove some parking spaces to provide improved facilities for pedestrians, cyclists, and buses – which inevitably requires some reallocation of parking road space. The proposed changes in parking provision are summarised in Table 4.25, Table 4.26 and Table 4.27**.** To ensure disabled parking bays required as part of the Proposed Scheme are accessible, all disabled parking bay have been designed to Chapter 7 of the Traffic Signs Manual. Typical disabled parking bays layouts are indicated in Figure 4.19.

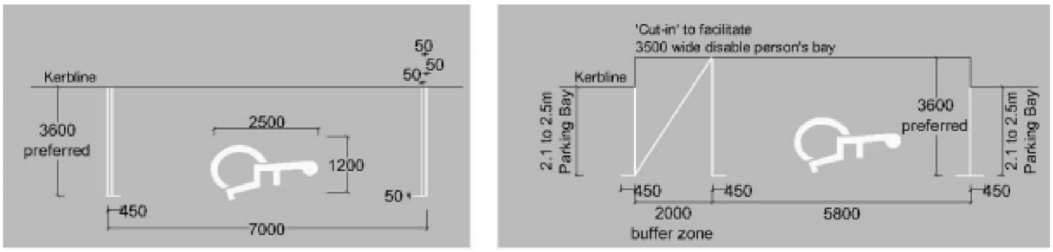


Figure 4.19: Typical disabled parking layout

Refer to Parking summary from the Parking Survey Report in Appendix G.

Table 4.25: On-Street Parking Spaces Change Impact Summary (Navan Road) Ashtown Road to Old Cabra Road

Ashtown Road to Old Cabra Road			
Existing Parking Facilities	**Baseline**	**Scheme**	**Proposed Change**
Informal Parking Spaces	24	4	-20
Total Change	24	4	-20

Table 4.26: On-Street Parking Spaces Change Impact Summary (Prussia Street, Manor Street, Stoneybatter, Manor Place and Aughrim Street)

Prussia Street, Manor Street, Stoneybatter and Aughrim Street			
Existing Parking Facilities	**Baseline**	**Scheme**	**Proposed Change**
Designated Paid & Permit Parking Spaces	80	16	-64
Disabled Permit Parking Spaces	2	2	0
Loading / Unloading Spaces (in Designated Loading Bays)	6	7	+1
Total Change	88	25	-63

Table 4.27: On-Street Parking Spaces Change Impact Summary (Blackhall Place and adjacent streets)

(Blackhall Place and adjacent streets)			
Existing Parking Facilities	**Baseline**	**Scheme**	**Change**
Designated Paid & Permit Parking Spaces	54	42	-12
Loading / Unloading Spaces (in Designated Loading Bays)	3	4	+1
Total Change	57	46	-11

4.16 Turning Bans and Traffic Management Measures

Turning bans and other traffic management measures will be implemented on the route to direct traffic away from either the Proposed Scheme corridor (to maximise bus journey time reliability) or to limit use of side streets as a short-cut route by through traffic. All these measures are shown on the General Arrangement Drawings, and are listed in Table 4.28 and Table 4.29. Existing turn bans and traffic management measures are not included in these two tables.

Table 4.28: Core bus corridor traffic management measures and turning bans

Location	TM measure implemented	Reason for Mitigation	Impact of Mitigation
New shopping centre entrance on Blanchardstown Road South	New signalised junction	To reduce car park traffic movement in the vicinity of the new Bus Interchange	Improved reliability for bus journey times in and out of the Bus Interchange.
Eastern approach to Blanchardstown Bus Interchange	No right turn movement allowed for general traffic into Bus Interchange from the east	To allow access to buses only	Improved reliability for bus journey times along this section of the corridor.
Blanchardstown car park entrance to east of Bus Interchange	No right turn movement from car park access	To allow for bus priority	Improved reliability for bus journey times along this section of the corridor.
Eastern approach to Blanchardstown Bus Interchange	Bus Priority Signal	To allow for bus priority	Improved reliability for bus journey times along this section of the corridor.
R147 Outbound / Auburn Avenue Junction	Bus Priority Signal	To allow for bus priority	Improved reliability for bus journey times along this section of the corridor.
R147 Outbound / Ashtown Business Centre / Phoenix Industrial Park Junction	No right turn movement allowed from R147 Navan Road into Ashtown Business Centre / Phoenix Industrial Park	To allow for bus priority	Improved reliability for bus journey times along this section of the corridor.
Navan Road Inbound / Cabra Library Junction	Bus Priority Signal	To allow for bus priority	Improved reliability for bus journey times along this section of the corridor.
Navan Road/Old Cabra Road junction	Bus Gate: No turning movement allowed for general traffic from Navan Road / Ratoath Road / Cabra Road on to Old Cabra Road	To allow for bus priority on Old Cabra Road	Inbound general traffic is redirected on to Cabra Road.
Old Cabra Road	Bus Gate: No straight-ahead general traffic movement allowed on Old Cabra Road at Railway Bridge (outbound). Right turn movements from Cabra Drive also restricted for northbound through-traffic.	To allow for bus priority on Old Cabra Road	Outbound through-movements of general traffic will be removed from Old Cabra Road.

Location	TM measure implemented	Reason for Mitigation	Impact of Mitigation
Prussia Street / North Circular Road junction	No right-turn movement allowed for general traffic from Prussia Street on to North Circular Road and outbound onto Old Cabra Road restricted to access only.	To provide bus priority through the junction	General traffic will not block outbound bus movements
St. Joseph's Road / Prussia Street junction	No turning movement allowed for vehicular traffic from Prussia Street on to St. Joseph’s Road	To discourage through movements of general traffic on St. Joseph's Road	General traffic level on St. Joseph’s Road will be minimised.
Prussia Street / Manor Street junction	Bus Gate: No straight-ahead inbound general traffic movement allowed from Prussia Street on to Manor Street	To allow bus priority on Manor Street	General traffic is discouraged from travelling southbound on Prussia St, unless destination is on Prussia Street (e.g. Park Shopping Centre), to ensure buses have reliable journey times.
Manor Street / Prussia Street junction	Bus Gate: No straight-ahead outbound general traffic movement allowed from Manor Street on to Prussia Street	To improve bus priority on Prussia Street	General traffic will be diverted onto Aughrim Street to ensure buses have reliable journey times.
Aughrim Street / Manor Street junction	Bus Gate: No straight-ahead inbound general traffic movement allowed from Aughrim Street on to Manor Street	To improve bus priority on Manor Street	General traffic is unable to travel from Aughrim Street to Manor Street, to ensure buses have reliable journey times.
Aughrim Street / Manor Street junction	Access road and parking between Aughrim Street and Prussia Street (in front of Kavanagh’s Pub) removed	To provide enhanced public realm at this location	Minimal impact on general traffic movements as this road is used for access to parking only. Parking spaces are provided within the Proposed Scheme on Manor Street and will continue to be available on Aughrim Street.
Manor Street / Kirwan Street junction	No right turn from Kirwan Street onto Manor Street	To stop through general traffic from using this route	General traffic is unable to travel from Kirwan Street northbound onto Manor Street, to ensure buses have reliable journey times.
Manor Street / Manor Place junction	No turning movement allowed for vehicular traffic from Manor Street on to Manor Place	To discourage general through traffic from using this route	To minimise general traffic levels on local side streets.

Location	TM measure implemented	Reason for Mitigation	Impact of Mitigation
Blackhall Place / King Street North / George's Lane / Brunswick Street North	Brunswick Street North modified to be one-way westbound, buses only on outbound section of Stoneybatter north of King Street North	To discourage general traffic through movements in Stoneybatter	Outbound general traffic will be redirected to King Street North / George's Lane / Brunswick Street North.
King Street North / George's Lane	Westbound general traffic from on the eastern section of King Street North (east of George's Lane) to be restricted to left turns only, into Queen Street.	To discourage general traffic through movements from King Street North (east of George's Lane) towards and through Stoneybatter.	Westbound general traffic on King Street North (east of George's Lane) wishing to travel north will have to travel south on Queen Street - but then can travel northwards via Blackhall Street / Blackhall Place.
Stoneybatter / Arbour Hill junction	No left-turn movement allowed from Arbour Hill on to Blackhall Place	To discourage general traffic through movements in Stoneybatter	General traffic is discouraged from travelling northbound on Manor Street, and hence to ensure buses have reliable journey times.
Stoneybatter / Brunswick Street North junction (outbound)	Signal Controlled Priority	To allow for bus priority along Stoneybatter / Manor Street	General traffic is discouraged from travelling northbound on Manor Street, and hence to ensure buses have reliable journey times.
Blackhall Place / King Street North junction (outbound)	Bus Gate: No straight-ahead outbound general traffic movement allowed beyond this junction. Right turn only for general traffic at this point.	To discourage general traffic through movements in Stoneybatter	Outbound general traffic will be redirected to King Street North / George's Lane / Brunswick Street North.
Stanley Street / Brunswick Street North junction	No left turn movement from Stanley Street onto Brunswick Street North.	Brunswick Street North is westbound only.	To facilitate two one-way cycle tracks and maintain one traffic lane.

Table 4.29: Turning bans offline from main Core Bus Corridor

Location	TM measure implemented	Reason for Mitigation	Impact of Mitigation
Ratoath Road / Swilly Road junction	No turning movement allowed for vehicular traffic from Ratoath Road on to Swilly Road	To discourage general through traffic from using this route.	To minimise general traffic levels on local side streets
Cowper Street (between Lucky Lane	No access from Cowper Street onto Aughrim Street	To discourage general through	To minimise general traffic levels on local side streets

Location	TM measure implemented	Reason for Mitigation	Impact of Mitigation
and Aughrim Street)		traffic from using this route.	
Aughrim Place (between Lucky Lane and Aughrim Street)	One-way southbound only	To discourage general through traffic from using this route.	To minimise general traffic levels on local side streets
Annamoe Road / Annamoe Terrace junction	One-way northbound only for vehicular traffic at Annamoe Road / Annamoe Terrace junction.	To discourage general traffic travelling through the Annamoe Estate as a means of bypassing Old Cabra Road	To minimise general traffic levels on local side streets
Charleville Road	Northbound movement only for vehicular traffic on Charleville Road between Annamoe Parade and North Circular Road	To discourage general traffic travelling through Charleville Road as a means of bypassing Old Cabra Road	To minimise general traffic levels on local side streets
Cabra Road /North Circular Road junction	New right turn from Cabra Road to North Circular Road and new left turn from North Circular Riad to Cabra Road to be introduced	To provide a route for general traffic from Navan Road to the Quays (and thus avoiding Old Cabra Road & Stoneybatter)	Provides an access route for local general traffic between Cabra and the Quays.
Cabra Road /North Circular Road junction	New left turn from North Circular Road to Cabra Road to be introduced	To provide a route for general traffic from the Quays to Navan Road (and thus avoiding Stoneybatter and Old Cabra Road)	Provides an access route for local general traffic between the Quays and Cabra.
Phibsborough	No access for general traffic from Phisborough Road on to Phisborough (existing right turn ban from northern approach being retained)	To discourage general traffic travelling through Phibsborough from Phibsborough Road	To minimise general traffic levels on local side streets
Phibsborough	No right-turn on to Phibsborough Road	To discourage general traffic travelling through Phibsborough from North Circular Road	To minimise general traffic levels on local side streets

Location	TM measure implemented	Reason for Mitigation	Impact of Mitigation
Monck Place	No access for general traffic from Phisborough Road on to Monck Place	To discourage general traffic travelling through Monck Place from Phibsborough Road	To minimise general traffic levels on local side streets
Monck Place	No right-turn on to Phibsborough Road	To discourage general traffic travelling through Monck Place from North Circular Road	To minimise general traffic levels on local side streets
Castleknock Road / Blackhorse Avenue junction	No through road from Castleknock Road to Blackhorse Avenue	To discourage general traffic using Blackhorse Avenue as an alternative to the Navan Road / Old Cabra Road.	To minimise general traffic levels on local side streets
North Circular Road / Oxmantown Road junction	No left-turn for vehicular traffic from North Circular Road on to Oxmantown Road	To discourage general traffic travelling through Oxmantown Road from North Circular Road	To minimise general traffic levels on local side streets

4.17 Deviations from Standard

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

A schedule of deviations from BCPDGB and departures and relaxations from TII Design Standards, relating to the individual aspects of Road Geometry is included within Appendix C.

4.18 Road Safety and Road User Audit

The TII Publication ‘GE-STY-01024 Road Safety Audit’ document provides an outline of the typical stages for road safety audits and are 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); and

• Stage 4: Early operation at 2 to 4 months' post road opening with live traffic.

Part 2 of a Stage F Road Safety Audit (RSA) was carried out at EPR stage (i.e. once the option had been chosen). A Stage 1 RSA, including a supplementary road safety audit, has been undertaken on the preliminary design, and designer's responses and appropriate changes made.

Both RSA's considered matters that have an adverse effect on road safety and considered the perspective of all road users.

Refer to RSA reports in Appendix M.

5 Junction Layout

5.1 Overview of Transport Modelling Strategy

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

The design for each junction within the Proposed Scheme was developed to meet the objectives of the scheme and to align with the geometric parameters set out in Section 4.1, in conjunction with the junction operation principles described in the BCPDGB. Various traffic modelling tools were used to assess the impact of the proposals on a local, corridor and surrounding road network level which is further described in Section 5.4.

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

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

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. The final junction design flows 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 BCPDGB;

- Integration of pedestrian and cycle movements at junctions;
- Geometrical junction design for optimal layouts for pedestrians, cyclists and bus priority whilst minimising general traffic dispersion where practical;
- People Movement Calculator (PMC) to inform junction staging and design development;
- LINSIG junction modelling to assess junction design performance and refinement;
- Micro-Sim modelling to assess and refine bus priority designs; 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 will be 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 wraparound pedestrian signal stage at the start of the cycle. In some instances, this will not be feasible i.e. due to crossing distances and the associated intergreen time for pedestrians to safely clear the junction. A "walk with traffic" system is therefore proposed at certain junctions, in particular where refuge islands have been introduced for a two-stage pedestrian crossing. At these locations, controlled crossings for pedestrians are provided across part of the junction, whilst some of the traffic movements that are now in conflict with the pedestrian movement, are allowed to run at the same time. This facility has the advantage of allowing pedestrians to cross during the cycle whilst having less effect on traffic capacity.

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 will remove any uncontrolled conflict between pedestrians and cyclists, assigning clear priority to all users at different stages within a traffic signal 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 will 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 will be typically ramped down to carriageway level on approach to the junction and will proceed 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 will also place 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; and
- Cyclist and pedestrian crossings will be kept as close as possible to the mainline desire line. However pedestrian and cyclist crossings will be separated where feasible; in these instances, 2-3m separation should be provided between crossings. This is to ensure motorists infer a clear differentiation between a cycle lane crossing through the junction and a pedestrian crossing across the same arm.

In some junction locations, constraints in respect of physical space and junction configuration have meant that deflection of cycle tracks with kerbed corner islands is not feasible. In these cases, the cycle track will be aligned alongside the adjacent traffic lane on a straight-through path, with box-turns provided for right turning cyclists where appropriate.

5.3.3 Bus Priority

The Proposed Scheme design at junctions is based on typical layouts described in the BCPDGB document, which sets out four different types of junctions, referred to as Junction Types 1-4 (in Section 7.4 Signalised Junction Operation of BCPDGB). The following subsections provide an overview of the context and principles for applying all or part of the junction type layouts for the Proposed Scheme design.

5.3.3.1 Junction Type 1

Junction Type 1 (Section 7.4.1 of BCPDGB) comprises a dedicated bus lane on both inbound and outbound directions which will continue up to the junction stop line. Due to space constraints, general traffic travelling both straight ahead and turning left will be 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 will proceed with the bus phase. The bus lane gets red, allowing the general traffic lane to proceed. If the volume of turning vehicles is greater than 150 PCUs, then the cyclists should also be held on red. If the volume of left turners is approx. 100 – 150 PCUs, left turners will be controlled by a flashing amber arrow and cyclists should receive an early start.

A full Junction Type 1 has not been applied to the Proposed Scheme, however the Proposed Scheme has a number of ‘hybrid’ junctions, which comprise of a Junction Type 1 and another junction type, as shown in Figure 5.1 below.

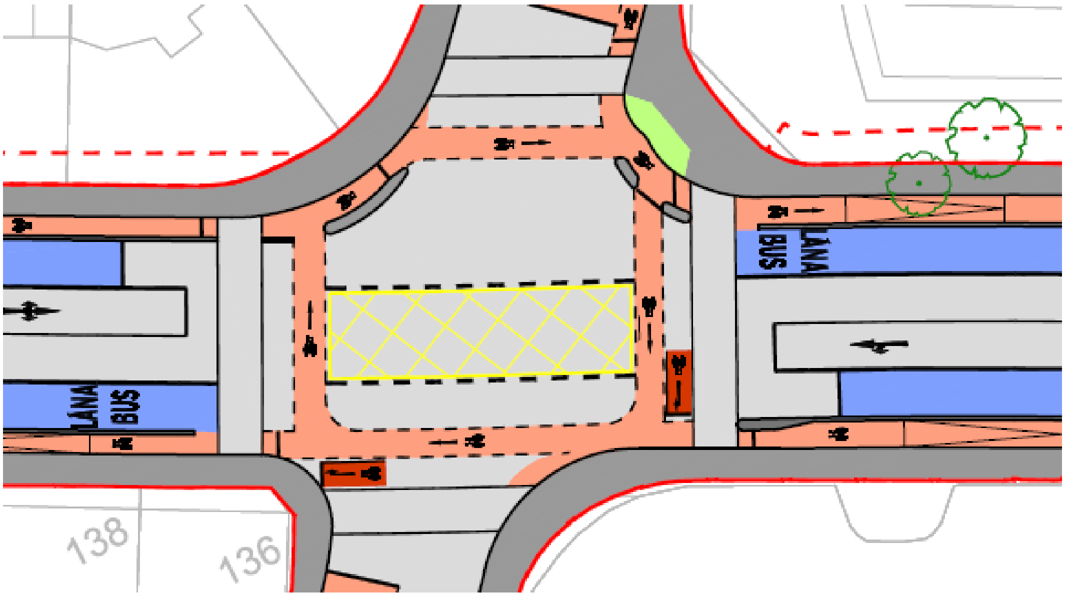


Figure 5.1: Junction Type 1

5.3.3.2 Junction Type 2

Junction Type 2 (Section 7.4.2 of BCPDGB) comprises a signalised junction in a suburban context where there is room for additional lanes, as shown in Figure 5.2. A dedicated bus lane in both inbound and outbound directions will continue up to the junction stop line. On the bus lane approach to the junction a yellow box will be provided to allow left turners to cross the bus lane to enter a dedicated left turn pocket, where space permits. Junction Type 2 has been chosen for the following reasons:

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

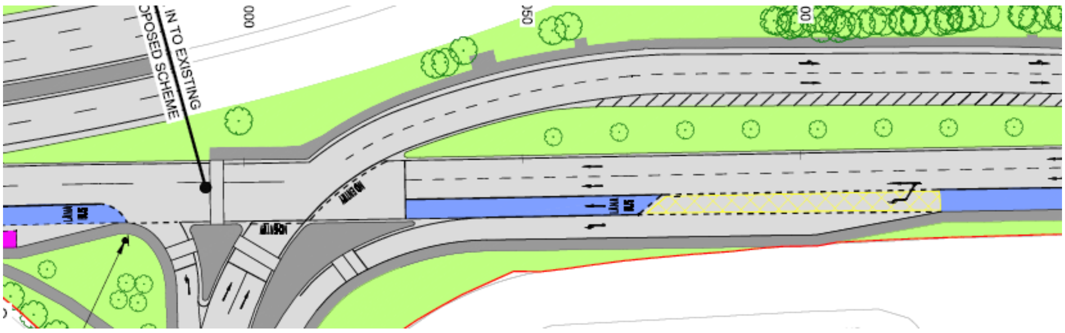


Figure 5.2: Junction Type 2

5.3.3.3 Junction Type 3

Junction Type 3 (Section 7.4.3 of BCPDGB) shown in

Figure **5.3** illustrates a signalised junction where the inbound and outbound bus lane will terminate just short of the junction to allow left turners to turn left from a short left turn pocket in front of the bus lane. Buses can continue straight ahead from this pocket where a receiving bus lane is proposed. A Junction Type 3 is chosen for the following reasons:

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

In this instance, mainline buses and general traffic (including left turners) will proceed together, but before they do, mainline cyclists will be 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 traffic volumes are less than 150 PCUs per hour. Left turning vehicles from the left turn pocket will be given a flashing amber.

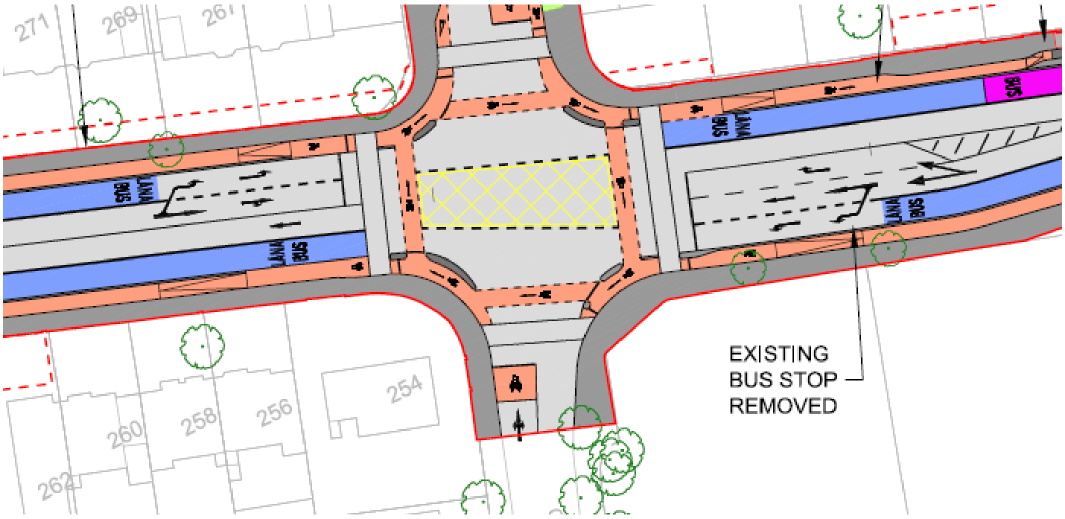


Figure 5.3: Junction Type 3

5.3.3.4 Junction Type 4

Junction Type 4 (Section 7.4.4 of BCPDGB) (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, as shown in Figure 5.4). Pedestrian crossing distances will be 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. Other key design features are that left turning cyclists can effectively bypass the junction, while giving way to pedestrians crossing as well as cyclists already on the orbital cycle track, and 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; and
- Appropriate space at junction corners to provide cycle tracks and pedestrian corner islands.

There are no Type 4 junctions within the Proposed Scheme.

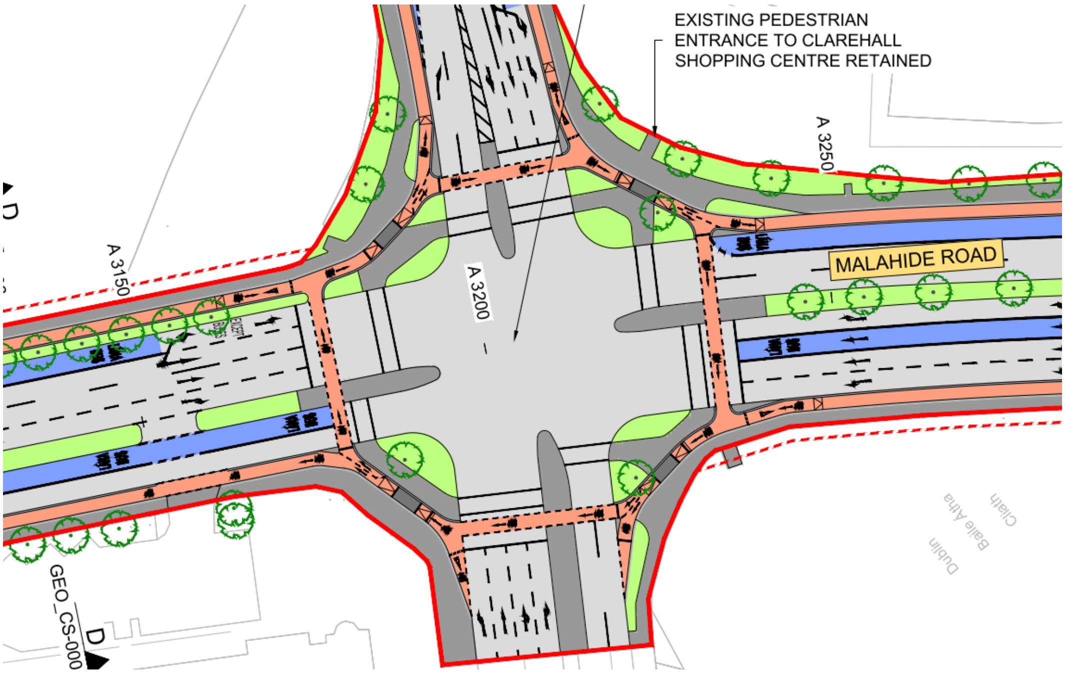


Figure 5.4: Junction Type 4

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, 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

A detailed junction assessment has been undertaken in line with the principles described in Section 5.3. The following summary tables provide an overview of the key design principles adopted at each junction location. More detailed information for each junction location can be found in the Junction Design Report in Appendix L.

The traffic signal junctions considered as having 'major' changes are listed in Table 5.1. This categorisation is based upon the size of the junction; the extent of physical work required to establish them; and the degree of change compared to the existing layout.

Table 5.1: Major Signalised Junctions

Drawing	Name	Summary
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0003	Crowne Plaza / N3 off-slip	The junction is based on a Junction Type 1 layout and is proposed to be modified to provide signal priority for buses entering the slip road from the side road, and a short bus lane is also proposed to be provided on the slip road.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0003	Blanchardstown Road South / Shopping Centre car park	A new signal-controlled access junction (based on a Junction Type 3 layout) will be provided to Blanchardstown Shopping Centre's northern car park – in order to divert car park traffic away from the existing entrance (which will tend to reduce congestion and allow buses to travel freely in and out of the Bus Interchange). The junction will operate as a three-stage signal junction. Left turning vehicles on the mainline will cross the bus lane path on Blanchardstown Road South, 20m from the junction and will operate in the same stage as buses. Crossings of Blanchardstown Road South for pedestrians and cyclists will be provided within the signal staging.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0004	Blanchardstown Road South / Blakestown Way	The roundabout junction of the Blanchardstown Road South and Blakestown Way is proposed to be modified to a four - arm signal - controlled junction (based on a Junction Type 3 layout). Left turning vehicles will cross the outbound bus lane path on Blakestown Way (south), 20m from the junction. A segregated left turn lane and separate bus lane are to be provided for the movement from Blanchardstown Road South heading south towards the Bus Interchange / Shopping Centre.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0004	Bus Interchange Western Access	The roundabout junction immediately to the west of the Bus Interchange is proposed to be modified to a four-arm signal-controlled junction (based on a Junction Type 1 layout). Bus lanes will be provided on the access road to the west of the junction. A two-way cycle track will be set adjacent to the inbound bus lane. Shared areas will be provided at toucan crossing points for both cyclists and pedestrians to use.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0005	Bus Interchange Eastern Access	The existing car park access junction will be upgraded to a signal-controlled junction which will incorporate bus lanes in and out of the proposed Bus Interchange (based on a Junction

Drawing	Name	Summary
		Type 1 layout). Pedestrian crossings to the interchange will also be provided.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0005	Crowne Plaza	The junction adjacent to the access to Crowne Plaza hotel is proposed to be modified to a four-arm signal-controlled junction. A bus lane to the stop line will be provided on the approach arm from the L3020 / Liberty Insurance junction (based on a Junction Type 1 layout). The bus lane on the interchange access road will be curtailed 20m prior to the junction to manage capacity at the junction (based on a Junction Type 3 layout). Cycle facilities will be provided by a dedicated off-road two-way cycle track which comes from the Bus Interchange area and heads towards Snugborough Road junction. Shared space will be provided at the crossing areas for pedestrians and cyclists.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0007	L3020 / Liberty Insurance	The junction adjacent to the Liberty Insurance Building is proposed to be modified to a four-arm signal-controlled junction (based on a Junction Type 3 layout). Bus lanes will be provided on the eastern and western approaches to the junction, which will be curtailed 20m prior to the junction to manage capacity at the junction. A two-way cycle track will be provided along the southern side of the road. The side roads will be provided with cycle lanes to lead users in / out of the main cycle track, via the toucan crossings.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0020	Navan Road / Phoenix Park Avenue	The Phoenix Park Avenue staggered junction with the Ashtown Business Centre access is proposed to be signalised as per a Junction Type 3 layout (instead of the present left-in / left-out junction). Signalisation will allow right turns out of the side roads, and into Phoenix Park Avenue, but will prevent right-turn movements into Ashtown Business Centre from Navan Road. Bus lanes will be provided on both Navan Road approaches and will be curtailed 20m from the junction. Cyclist facilities will be provided via a two-way cycle track to the south of Navan Road.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0021	Navan Road / Ashtown Road	The existing roundabout is proposed to be converted to a signalised junction (based on a Junction Type 3 layout). Bus lanes are proposed on the Navan Road approaches; these will be curtailed 20m from the junction to allow for left turning movement. A shared area will be provided on the southwest corner where the two way cycle track (from the west) will split to

Drawing	Name	Summary
		become a one-way track on the east side of the junction.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0029	Old Cabra Rd / Glenbeigh Road	The Old Cabra Road / Glenbeigh Road T-junction will be signalised to enable side road traffic entering from Glenbeigh Road to be controlled and limited in volume (by use of short green times), as per a Junction Type 1 layout. Cycle turning will be provided by toucan crossings here rather than through specific cycle crossing points.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0033	Manor Street / Aughrim Street	It is proposed to modify the junction to include signal control and introduce a Bus Gate, with a Junction Type 1 approach, which will require all southbound and northbound general traffic to divert onto Aughrim Street. Only buses, taxis and cycles will be permitted to head south from Prussia Street to Manor Street and north from Manor Street to Prussia Street. A Bus Gate will also be introduced for buses arriving (and travelling south) on Aughrim Street; thus will effectively stop general traffic from travelling south from Aughrim Street to Manor Street.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0033	Manor Street / Kirwan Street	This junction is proposed to be signalised to allow traffic entering from Kirwan Street and Manor Place to be controlled thereby limiting short-cutting traffic along side streets. A no-right turn ban will be introduced on Kirwan Street, and access to Manor Place from Manor Street will be restricted– to limit traffic using side roads as short cut routes. The junction layout does not include bus lane priority, as traffic management measures and bus gates to the north and south of Manor Street will reduce general traffic movements at this location.

There are a number of junctions where the proposed changes are moderate – and are mainly reallocations of space to provide the bus and cyclist facilities, where the overall physical layout will remain largely the same. Table 5.2 summarises these junctions.

Table 5.2: Moderate Junctions

Drawing	Name	Summary
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0001	Old Navan Road / Mulhuddart Slip Road	The signal-controlled junction where the N3 off-slip meets Old Navan Road will be modified to reallocate the left lane as a bus lane, with a separate bus lane signal stage (based on a Junction Type 1 layout)
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0001	Blanchardstown Road North / Old Navan Road	The existing signal-controlled junction will be modified by removing the left-turn slip lane from Old Navan Road, while retaining the segregated left-turn lane from Blanchardstown Road North towards the N3 slip road on Old Navan Road. Realigned cycle track crossings will be provided, with signal-controlled crossings across the left-turn slip roads. Maintaining the flow of buses through the junction will be achieved by the presence of a bus lane on the Blanchardstown Road North approach, a bus lane on the access from Blanchardstown Bus Interchange past the Crowne Plaza Hotel, and allowing buses from the west (on Old Navan Road) to turn right from the straight-ahead traffic lane.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0003	Blanchardstown Road South / N3 off-slip	The existing signal-controlled junction will be modified to include a left-turn bus lane on the approach from the Crowne Plaza / N3 westbound off-slip – connecting directly to the bus layover layby (as per a Junction Type 1 layout). Nearside cycle tracks will be provided through the junction on both directions on Blanchardstown Road South.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0012	N3 eastbound off -slip / Connolly Hospital Access	The existing signal-controlled junction will be modified to provide an additional lane for buses on the nearside of the N3 off-slip road, on the approach and exit carriageway (based on a Junction Type 1 layout)
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0012	Navan Road / Old Navan Road	The existing signal-controlled junction has a proposed additional outbound bus lane on the nearside of the outbound carriageway. A pedestrian footpath will be provided on the south side of the N3 to provide access on foot to the bus stop east of the Connolly Hospital access junction. A left-turn lane on the outbound approach to the junction will be retained outside the new bus lane – accessed by general traffic crossing the bus lane east of the junction (as per a Junction Type 2 layout).

Drawing	Name	Summary
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0012	Navan Road / N3 Eastbound off-slip	The existing signal-controlled junction will be modified by addition of a left-turn bus lane on the nearside of the hospital access road, and an outbound bus lane (as an additional lane alongside three general traffic lanes) on the nearside of the outbound N3 carriageway (based on a Junction Type 1 layout). A signal-controlled pedestrian crossing of the N3 will be provided to improve pedestrian access to the inbound bus stop from areas to the south.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0013	Navan Road / M50 Junction 6	The existing gyratory interchange is signal-controlled. Bus lanes are proposed as additional lanes on the nearside of outbound and inbound roundabout entry junctions from Navan Road to the east and west, with bus lanes to the stop line (based on a Junction Type 1 layout). On the gyratory carriageway, one of the three existing lanes will be allocated for use as a bus lane.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0014/0015	Navan Road / Auburn Avenue	The existing signal-controlled junction is proposed to be modified by provision of an additional lane for buses in the inbound direction, and to replace the existing left-turn lane with a bus lane in the outbound direction (based on a Junction Type 1 layout). Pedestrian crossing facilities are proposed across Navan Road on the east side of the junction.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0018	R147 Eastbound off-slip / Parkway Bridge (northern junction)	The existing signal-controlled junction is proposed to be modified by extending the bus lane on the eastbound off-slip road to the stop line (based on a Junction Type 1 layout). An inline bus stop and a bus stop layby is proposed (for long distance buses) each side of the junction.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0018	R147 Westbound off-slip / Parkway Bridge (southern junction)	The existing signal-controlled junction is proposed to be modified by extending the bus lane on the westbound off-slip road to the stop line (based on a Junction Type 1 layout). An inline bus stop and separate bus stop layby (for long distance buses) is proposed on the slip road approach to the junction.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0022	Navan Road / Kempton Avenue	Nearside bus lanes will be provided in both directions through the junction, with the inbound bus lane curtailed 20m from the junction to allow for left turn traffic (based on a Junction Type 3 layout). Cyclist and pedestrian crossing facilities will be provided, and an advanced stop line for cyclists will be provided on the side road.

Drawing	Name	Summary
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0023	Navan Road / Ashtown Grove	Nearside bus lanes will be provided in both directions through the junction, with the inbound bus lane curtailed 20m from the junction to allow for left turn traffic (based on a Junction Type 1 layout). Cyclist and pedestrian crossing facilities will be provided, and an advanced stop line for cyclists will be provided on the side road.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0024	Navan Road / Baggot Road	Nearside bus lanes will be provided in both directions through the junction, with the inbound bus lane curtailed 20m from the junction to allow for left turn traffic (based on a Junction Type 1 layout). Cyclist and pedestrian crossing facilities will be provided, and an advanced stop line for cyclists will be provided on the side roads due to space constraints. A right-turn pocket will be provided on Navan Road for traffic turning in to Kinvara Avenue.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0026	Navan Road / Nephin Road	The existing signal-controlled junction is proposed be modified by extending existing nearside bus lanes in both directions up to the stop line (based on a Junction Type 3 layout). Right turns from Navan Road (east) will be banned (as existing). The constrained junction location will require the use of right turn bays and non-protected kerbed cycle lanes on the southern side of the junction in order to maintain the consistent cycle route throughout. An advanced stop line will be provided for cyclists on each arm of Nephin Road.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0027	Navan Road / Skreen Road	This existing T-junction is proposed to be signal-controlled – with nearside bus lanes being provided in both directions (up to the stop line, as per a Junction Type 1 layout). Cycle tracks will be provided adjacent to bus lanes, with separate cycle and pedestrian crossing facilities proposed.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0028	Navan Road / Hampton Green	This existing signal-controlled junction will be modified to provide nearside bus lanes in both directions, with the inbound bus lane brought to the junction stop line (as per a Junction Type 3 layout) and the outbound bus lane curtailed 20m to provide for left turn movements (as per a Junction Type 3 layout). Cycle tracks will be provided adjacent to bus lanes, with separate cycle and pedestrian crossing facilities proposed.
BCIDC-ARP-GEO_GA-0005_XX_0	Navan Road / Cabra Library	This existing signal-controlled junction will be modified to provide nearside bus lanes in both directions, with the inbound lane brought to the junction stop line (as per a Junction Type 3 layout) and the outbound curtailed 20m short of the stop line to provide for left turn movements

Drawing	Name	Summary
0-DR-CR-0028		(as per a Junction Type 3 layout). Cycle tracks will be provided adjacent to bus lanes, with separate cyclist and pedestrian crossing facilities proposed.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0028	Navan Road / Old Cabra Road	The existing signal-controlled junction will be modified to include a ban on general traffic turning from Navan Road into Old Cabra Road. An outbound bus lane will be provided from Old Cabra Road to Navan Road (as per a Junction Type 1 layout). One way cycle tracks will be provided north and south of the junction with a two-way crossing proposed across the junction. Toucan crossings will be provided alongside shared space areas to enable pedestrians and cyclists to cross together.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0031	Prussia Street / North Circular Road	The existing signal-controlled junction will be modified to provide more space for cyclist and pedestrian crossing facilities. General traffic movement from Prussia Street will be banned from turning right to ensure buses travelling to Old Cabra Road are not delayed.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0034	Stoneybatter / Brunswick Street North	The existing junction will be signal-controlled. An outbound bus lane is proposed on approach to the junction (as per a Junction Type 1 layout). Traffic from Brunswick Street North will turn left towards Blackhall Place or right towards Manor Street (but will be restricted by short green times to minimise through traffic on Manor Street). Segregated cycle lanes will be provided on either side of Manor Street and Stoneybatter leading to Brunswick Street North.
BCI BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0034	Blackhall Place / King Street North	The existing signal-controlled junction is proposed to be altered to provide an outbound bus lane, and an inbound bus lane on the Blackhall Place (south) exit (as per a Junction Type 1 layout). All outbound general traffic from Blackhall Place will turn right into King Street North. All inbound general traffic from Stoneybatter will turn left into King Street North.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0034	Brunswick Street North / Grangegorman Lower	The existing signal-controlled junction is proposed to be modified such that Brunswick Street North is an exit only for one-way traffic (westbound) and with added cycle track provision from Brunswick Street North to George’s Lane and improved crossings for cyclists and pedestrians.

Drawing	Name	Summary
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0034	King Street North / Queen Street	The existing signal-controlled junction is proposed to be modified to remove the turning movement for general traffic from King Street North to George's Lane. A proposed two-way cycle track will connect through the junction to Queen Street.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0035	Blackhall Place / Blackhall Street	The existing junction is proposed to be altered by realignment of the bellmouth from Blackhall Street to remove the existing central splitter island. The junction will continue to operate as a signal-controlled junction (as per a Junction Type 1 layout), with pedestrian crossings proposed on all arms of the junction.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0035	Queen Street / Blackhall Street	The existing junction is proposed to be altered by replacement of a traffic lane with a two-way cycle track on the eastern side of Queen Street. Access to the Blackhall Street cycle route will be via a Toucan crossing.
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0036	Blackhall Place / Benburb Street	The existing signal-controlled junction is proposed to be modified by provision of a northbound bus lane (in addition to the existing southbound bus lane), as per a Junction Type 1 layout
BCIDC-ARP-GEO_GA-0005_XX_00-DR-CR-0036	Queen Street / Benburb Street	The existing signal-controlled junction is proposed to be modified by removal of two (of three) southbound traffic lanes on Queen Street and will be replaced by a two-way cycle track and wider footpaths.

5.3.6 Minor and Priority Junctions

There is a total of 34 (not including access points for properties) minor junctions without signal control proposed across the Scheme. These are shown in the General Arrangement drawings series in Appendix B.

5.3.7 Roundabouts

The N3 / M50 Junction 6 / Navan Road is included in Table 5.2 as part of the junction operation and modelling summaries and will operate as a signal-controlled gyratory.

5.4 Junction Modelling

5.4.1 LinSig Modelling

Junction modelling using industry standard LinSig software (version 3.2.40) was undertaken to assist the junction design process, as follows:

- To formulate appropriate signal staging for all movements at signal-controlled junctions;
- To understand delays / capacity characteristics for bus movements; and
- To ensure that appropriate timings are included within the signal cycle to accommodate the necessary pedestrian and cyclist crossing times.

The LinSig analyses and junction layout design were undertaken on an iterative basis – with each junction subject to a design development process to achieve bus priority and enhanced provision for walking / cycling movements. In respect of general traffic, LinSig analysis was used to ensure that traffic movements could be practically accommodated within the junction signal staging, but without seeking to minimise delays to traffic.

The following assumptions were generally applied in the LinSig modelling:

- Cycle Time of 120s;
- Minimum Pedestrian Green Time 6s;
- Pedestrian Intergreen based on a walking speed of 1.2m per second plus a 2 second safety buffer;
- Cyclist Cruise Speed 15km/h; and
- Cyclist Early Start 5s on the majority main CBC arms, with 3s minimum. On the side roads of junctions, 3s cyclist early start.

Table 5.3 provides an overview of the LinSig junction analysis results. The Junction Design Report in Appendix L provides details of LinSig junction modelling outputs. It is noted that the LinSig models produced provide a basis for finalising junction designs, but that implementation of the proposed junctions will require detailed signal controller specifications and associated phasing plans to be produced.

Table 5.3: Proposed Scheme Signalised Junctions

Junction Name	Proposed Cycle Time (Seconds)	Practical Reserve Capacity (%)	
		AM peak Hour	PM Peak Hour
Old Navan Road / Mulhuddart Slip Road	120	276%	331%
Blanchardstown Road North / Old Navan Road	120	28%	68%
Blanchardstown Road North / N3 off-slip	120	52%	26%
Blanchardstown Road South / Shopping Centre car park	120	80%	120%
Blanchardstown Road South / Blakestown Way	120	-3%	24%
Bus Interchange Western Access	120	285%	142%
Bus Interchange Eastern Access	120	196%	144%
Crowne Plaza	120	193%	139%
Crowne Plaza / N3 off-slip	120	210%	225%

Junction Name	Proposed Cycle Time (Seconds)	Practical Reserve Capacity (%)	
		AM peak Hour	PM Peak Hour
L3020 / Liberty Insurance	120	25%	85%
Snugborough Road / L3020*	120	-33%	-4%
Snugborough Road / N3 (Southbound on-ramp) *	120	60%	61%
Snugborough Road / Waterville Road*	120	-10%	-25%
N3 Eastbound off-slip / Connolly Hospital Access	120	101%	67%
Navan Road / Old Navan Road	120	99%	67%
Navan Road / N3 Eastbound off-slip	120	105%	67%
Navan Road / M50 Junction 6	90	58%	77%
Navan Road / Auburn Avenue	120	-26%	-1%
R147 Westbound off-slip / Parkway Bridge	120	112%	130%
R147 Eastbound off-slip / Parkway Bridge	120	109%	130%
Navan Road / Phoenix Park Avenue	120	17%	28%
Navan Road / Ashtown Road	120	-5%	-8%
Navan Road / Kempton Avenue	120	43%	4%
Navan Road / Ashtown Grove	120	17%	10%
Navan Road / Baggot Road	120	21%	24%
Navan Road / Nephin Road	120	7%	43%
Navan Road / Skreen Road	120	24%	10%
Navan Road / Hampton Green	120	117%	93%
Navan Road / Cabra Library	120	27%	42%
Navan Road / Old Cabra Road	120	31%	36%
Old Cabra Road / Glenbeigh Road	90	383%	452%
Prussia Street / North Circular Road	90	13%	50%
Manor Street / Aughrim Street	90	893%	585%
Manor Street / Kirwan Street	90	231%	286%
Stoneybatter / Brunswick Street North	90	96%	60%
Brunswick Street North / Grangegorman Lower	90	139%	198%
Blackhall Place / King Street North	90	94%	128%
King Street North / Queen Street	90	104%	72%
Blackhall Place / Blackhall Street	90	88%	23%
Queen Street / Blackhall Street	90	131%	69%
Blackhall Place / Benburb Street	90	132%	188%
Queen Street / Benburb Street	90	104%	125%

*Junction is part of the Snugborough Interchange being implemented by Fingal County Council

Overall, the junction analyses show that all junctions along the corridor have feasible and functional signal staging plans which will ensure that buses will be able to proceed along the corridor with delays minimised, and that high quality crossing facilities are provided for cyclists and pedestrians. Locations where some overcapacity issues are noted are:

- Snugborough Road / L3020: This junction is being upgraded by Fingal County Council, and for forecast flows does show some approach arms as overcapacity – but delays to buses are minimised, and provision for cyclists and pedestrians are much improved.
- Navan Road / Auburn Avenue Junction: The junction analysis indicates overcapacity on some approach arms in the AM peak. However, it is noted that the signal cycle includes for a right-turn signal phase from Navan Road to Dunsink Lane will only operate occasionally on a vehicle-actuated detection basis (as the forecast movement is less than 10 vehicles per hour). When this right-turn phase is not 'called' the overcapacity effects at the junction are much reduced.

5.4.2 Forecast Traffic Flow Data for Junction Modelling

The EIA process for the Proposed Scheme included a traffic and transport assessment based on strategic area-wide modelling, utilising a Local Area Model (LAM) for the CBC corridor, which was a subset model of the NTA's Eastern Regional Model (ERM). The LAM outputs provide projected traffic flows for the situation with the Proposed CBC Scheme in place (the 'Do Something' scenario), which were input to the LinSig junction models for purposes of refining junction designs. An iterative process was followed in which successive draft outputs from LinSig junction modelling (in respect of staging plans and timings) were coded into the LAM and the resultant LAM forecast traffic flow outputs were inputted to the LinSig models (for the AM and PM peak periods for the projected year of opening in 2028).

The Junction Design Report in Appendix L provides summaries of LinSig junction modelling outputs. The LinSig outputs show that the Proposed Scheme junction designs will operate effectively for the forecast flow scenarios with buses not subject to delay, and with appropriate provision within the signal operation for crossing movement of pedestrians and cyclists.

The EIA investigations also included development of a microsimulation model developed for the Proposed Scheme corridor. The LinSig outputs (in respect of staging plans and timings) were inputted to the corridor micro simulation model, which also assisted in assessing and optimising the junction designs and traffic control strategies. Figure 5.5 provides an overview of the LinSig and transport modelling processes for the proposed scheme.

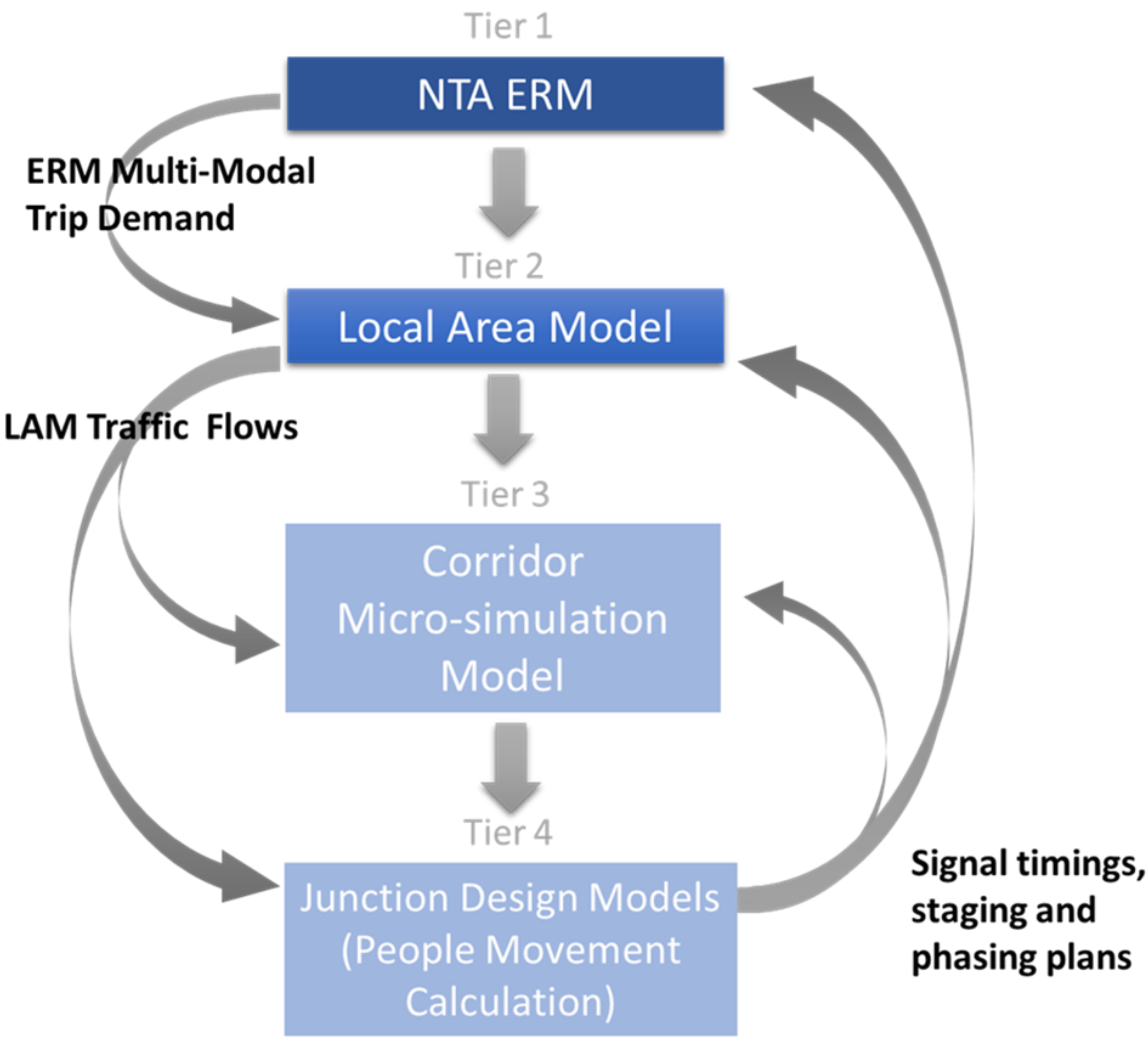


Figure 5.5: Scheme Transport Modelling Hierarchy

5.4.3 People Movement through Junctions

The design process for junctions has included assessments of the potential people movement throughput at each junction on the Proposed Scheme. For this purpose, a bespoke People Movement Calculation tool was developed, in which the number of people that can theoretically be carried through each junction by each mode was assessed, based on the signal green times allocated to each movement and the person-capacity of the car and bus motorised modes. This approach represents a policy-led influence on design iterations, and ensured that the focus of design was to maximise the number of people able to travel through each junction (rather than cars), with priority given in the design process to sustainable modes i.e. walking, cycling and bus – with a lesser priority given to general traffic movements by car.

The information used for the purposes of People Movement Calculation includes the following:

- Number of buses planned to travel on the corridor (informed by the BusConnects network design proposals);

- Estimated cycling demand (from the ERM), with consideration also to a higher policy-based cycle mode share;
- Pedestrian crossing width and resultant crossing timing requirements; and
- Vehicular capacity at each junction (derived by LinSig).

The Junction Design Report in Appendix L provides summaries of total theoretical movement capacity by each mode at each junction.

6 Ground Investigation and Ground Condition

6.1 Ground Investigation Overview

Following a review of the proposed alignment, a desk study was undertaken along the proposed route. A Ground Investigation (GI) was scoped and designed based on the findings of the desk study review. The following sections outline the desk study sources, the anticipated ground conditions, the scoped GI, the GI results and their interpretation. A separate section presents hydrogeological information. The last section presents the geotechnical considerations relevant to the proposed structures along the route.

Refer also to Ground Investigation Report contained in Appendix E.

6.2 Desk Study

The site setting and geotechnical information for the site were obtained from publicly available information. The publicly available sources of information reviewed are as follows:

- 1836 – 1842 Historic map 6 inch (Geohive);
- 1888 – 1913 Historic map 25 inch (Geohive);
- 1830 – 1930 Historic map 6 inch – Cassini (Geohive);
- Contour map (EPA);
- Geological Survey of Ireland (GSI);
- Quaternary Sediments and Geomorphology map (GSI);
- Teagasc Soils map (GSI);
- Unconsolidated Sediments map (GSI);
- Bedrock, Geology100k map (GSI);
- Karst Features map (GSI);
- Depth to Bedrock map (GSI);
- Groundwater Aquifer map (GSI);
- Groundwater Vulnerability map (GSI);
- Groundwater Wells and Springs map (GSI);
- Groundwater Recharge map (GSI);
- Subsoil Permeability map (GSI);
- Active and Historic Pits and Quarries map (GSI);
- Mineral localities map (GSI);
- Historic Ground Investigations map (GSI);
- In-house Ground Investigations database; and
- Rivers of Dublin (C.L. Sweeney, 1991).

6.2.1 Existing Ground Conditions

The EPA contour map shows that the alignment drops from approximately 60m OD at Blanchardstown Road down to 40m OD at Old Cabra Road. From there, the elevation continues dropping up to 10m OD close to River Liffey.

The GSI Quaternary Geomorphology map shows a number of glacial features the majority of which are noted at the northern part of the Proposed Scheme. A glaciofluvial terrace is present under the N3 at Blanchardstown, immediately north and south of Junction 3. A historic meltwater channel underlies the River Tolka. Hummocky sands and gravels intersect the Proposed Scheme at the Junction of Blanchardstown Road South and Blakestown Way to the west of Blanchardstown Shopping Centre. Another glaciofluvial terrace intersects the Proposed Scheme at Junction 2 of the N3 and extends east and west underlying the Tolka River Valley Park and the green urban area northeast of Main Street in Blanchardstown. A localised pocket of hummocky sands and gravels is recorded underlying the N3 at Talbot Court, south of the N3/M50 Junction. Going further south a glaciofluvial terrace is present east of the N3/M50 Junction underlying New River Road to River Road. The last glacial feature (glaciofluvial terrace) intersects the Proposed Scheme along the R805 between King Street North and Blackhall Court.

The GSI Quaternary Subsoil map shows that the alignment is underlain mainly by Till derived from Limestone with localised areas of Gravels derived from Limestone and Alluvium. Along the River Tolka pockets of Gravels derived from Limestone, Alluvial deposits and Bedrock subcrop/outcrop are noted. Gravels derived from Limestone intersect the Proposed Scheme west of Blanchardstown Shopping Centre, at St. Brigid’s Church Blanchardstown, at Talbot Court south of the N3/M50 Junction and on the eastern side of the N3/M50 Junction. There is a large pocket of Alluvium which intersects the Proposed Scheme west of Nephin Road, Cabra. Moving further south towards the city centre, Gravels derived from Limestone are recorded along King Street North. A pocket of Alluvium intercepts the Proposed Scheme at Hendrick Street to Ellis Quay and also the area underlying Croppies Arce Memorial Park. Urban fill is recorded from King Street North to the River Liffey.

The GSI bedrock- geology 100k map states that the rock type along the examined Route is calcareous shale of Tober Colleen Formation and Limestone of Lucan Formation (locally known as Calp Limestone). The Tober Colleen Formation is shown at two locations along the proposed route. The first location is northeast of Blanchardstown Shopping Centre. The second location extends from approximately Mill Road underpass to N3/M50 Junction. The Lucan Formation is shown to be present along the remaining part of the proposed route. The GSI bedrock- geology 100k map shows two faults crossing the examined route. The former is noted close to Blanchardstown Shopping Centre and the latter at M50 Junction. An anticline fold structure is shown to intersect the Proposed Scheme adjacent to Talbot Court south of the Navan Road.

The GSI Depth to Bedrock map presents rockhead to typically range from 0 to 10m BGL apart from the northern and southern ends of the alignment where it increases up to 15 and 20m BGL, respectively.

6.3 Summary of Ground Investigation

6.3.1 Field Investigation

Following a review of the alignment and the findings of the desk study, a GI was specified. The initial GI scope for the Proposed Scheme included the following field investigation:

- 10 No. Trial Pits (TPs) to a maximum depth of 3m BGL;
- 6 No. Rotary Coring (RC) boreholes to a maximum depth of 13m;
- In situ testing (i.e. standard penetration test (SPT)); and
- 2 No. standpipe installations with groundwater monitoring.

The initial GI scope was reviewed and updated. The final GI scope comprised:

- 13 No. Trial Pits (TPs) to a maximum depth of 2.2m BGL;
- 6 No. Rotary Coring (RC) boreholes (BH) to a maximum depth of 17.3m;
- 4 No. Cable Percussion (CP) with follow-on rotary boreholes to a maximum depth of 35.2m;
- In situ testing (i.e. SPTs); and
- 2 No. standpipe installations with groundwater monitoring.

6.3.2 Geotechnical Laboratory Testing

Scheduled geotechnical and geo-environmental laboratory testing laboratory tests for the Proposed Scheme included the following:

- 9 No. Moisture content;
- 7 No. Particle size distribution;
- 7 No. Atterberg limits;
- 2 No. Organic matter content;
- 22 No. Geo-Environmental testing (Waste Acceptance Criteria (WAC) assessment);
- 11 No. Unconfined compressive strength;
- 22 No. Point Load; and
- A geotechnical factual report.

6.4 Ground Summary and Material Properties

According to the available TP and BH logs the stratigraphy comprised Topsoil and/or Made Ground over Cohesive Deposits. The RC logs recorded Mudstone and/or Limestone as the underlying rock type. Table 6.1 presents the encountered stratigraphy along the Proposed Scheme.

Table 6.1: Summary of GI Results

Stratum	Description	Depth (m BGL)	Thickness (m)
Topsoil	Brown to greyish brown to dark greyish brown slightly sandy slightly gravelly Topsoil with occasional to frequent rootlets	0.0	0.0 to 0.2
Made Ground	Brown to greyish brown to brownish grey to grey slightly sandy slightly gravelly to gravelly Clay with some angular to subangular cobbles, occasional boulders, occasional rootlets. Occasional fragments of plastic, rope, concrete, wood, cloth, tarmacadam, brick and organic matter noted in a few exploratory locations OR Brown gravelly clayey fine to coarse Sand with occasional angular to subrounded cobbles, rootlets and occasional fragments of metal, plastic and red brick Grey to light grey to dark grey sandy GRAVEL with occasional rootlets	0.0 to 0.2	0.0 to 5.0
Cohesive Deposits	Firm to stiff to very stiff brown to greyish brown to grey slightly sandy slightly gravelly to gravelly CLAY with occasional cobbles	0.0 to 5.0	0.0 to 9.2**
Granular Deposits	Dense grey angular to subangular fine to coarse GRAVEL with some angular to subangular cobbles OR Dark brown fine to coarse SAND***	2.0 to 8.2	0.0 to 4.3**
Weathered Rock	Brown to brownish grey sandy clayey GRAVEL with some cobbles	0.0 to 8.05	0.0 to 0.7
Bedrock	Grey fine-grained argillaceous LIMESTONE OR Dark grey fine-grained calcareous Mudstone	0.7 to 8.5**	N/A

* At the top 2.8m of R05-CP05 the layer is described as soft to very soft.

** At R05-CP05 the thickness of the overburden is significantly greater than anywhere else. BH completed at 35.2m BGL without encountering rockhead.

*** Granular Deposits are only encountered at one Rotary Coring borehole (R05-RC01) and at one follow-on rotary borehole (R05-CP05). In most of the cases the recovery is poor. The recovered material is likely not to be representative of the actual in situ layer.

6.4.1 Contaminated Land

The works will mostly be carried out in made ground since most of the alignment is classified as discontinuous urban fabric, with sections being described as industrial-commercial units and green urban areas.

Also, there are multiple historic quarries and pits close to the alignment and made ground is mentioned in the recent and historical boreholes.

In the recent ground investigation carried out from October 2020 to March 2021 by GII Ltd. (Project No:9754-07-20 R5, Rev D, 18 June 2021), geoenvironmental testing was undertaken on 22 No. samples, in natural ground and made ground, from eight ground investigation locations. No signs of contamination were noted on borehole, trial pit and slit trench logs and all environmental test results suggest an ‘Inert’ WAC classification.

However, the ground investigations do not cover the whole alignment and contamination is a possibility. Potential sources are listed in the Ground Investigation Report (GIR) in Appendix E.

6.4.2 Summary of Ground Investigation Report

As stated earlier the GI along the examined route encountered Topsoil, Made Ground, Cohesive Deposits, Weathered Rock and Limestone/Mudstone.

6.4.2.1 Topsoil

No interpretation is required for Topsoil. Wherever encountered, it will be excavated and removed.

6.4.2.2 Made Ground

No interpretation is required for Made Ground. Wherever encountered it will be excavated and removed. However, in cases where the Made Ground does not include waste materials and the engineering properties, such as strength and stiffness, are acceptable then Made Ground could be left in place.

6.4.2.3 Cohesive Deposits

Cohesive deposits are encountered in the majority of the exploratory locations. The laboratory classification tests, and the soil descriptions as included in the logs indicate that this material is predominantly a low plasticity brown to grey clay with silt, sand, gravel and boulder content. At R05-CP01 the cohesive deposits show a higher percentage of silt content.

The cohesive deposits described above are known as Dublin Boulder Clay which is a subdivision of till derived from limestone.

The following parameters will be provided for the Dublin Boulder Clay. It should be noted that these parameters correspond to stiff to very stiff Dublin Boulder Clay. Very soft to soft material will be excavated and removed. Testing will be undertaken to confirm the formation is acceptable.

Weight density

In the absence of laboratory testing which could measure the weight density (γ) directly or indirectly reference is made to BS8002: 2015. According to this document a clay with high to very high undrained shear strength, like the one examined herein, has a weight density which typically varies from 18 to 24kN/m3. A value of 21kN/m3 is adopted.

In situ stress

No in-situ testing or laboratory testing in which K0 is directly or indirectly measured was carried out as part of the GI. Long & Menkiti (2007) recommended a K0 value in the range of 1.0 to 1.5 for design. Taking the above into account, a value of 1.5 is chosen.

Total strength

The soil descriptions in the logs at the geotechnical report are in accordance with BS5930:2015. The logs describe the stiffness of the Boulder Clay primarily as stiff to very stiff. A stiff to very stiff clay, according to BS5930:2015, has a cu value which varies from 75 to 300kPa. The recorded SPTs values shown at the borehole logs range from 28 to refusal. A value of SPT N equal to 35 is selected. The classification testing carried out at samples taken from this stratum showed a PI varying from 17% to 23%. Based on Stroud and Butler graph (1975) such PI values correspond to an f1 value of around 5.5. The cu can be calculated as “SPT N x f1” which will lead to 192kPa. Taking the above into account a cu value of 190kPa is chosen for design.

Effective strength

No effective stress shear strength laboratory testing was carried out on samples of Dublin Boulder Clay as part of this GI. Long and Menkiti (2007) report a value of 44° for the peak compressive angle of shearing resistance (φ´p) for all formations of the Dublin Boulder Clay. Long and Mentiki (2007) also report a value of 36° for the critical state angle of shearing resistance (φ´cs). This value of φ´cs compares favourably with the findings of Lehane and Faulkner (1998) and Farrell and Wall (1990) who report values of 34°±1° and 35° respectively. In all cases a c´= 0kPa is recommended. Taking the above into account a value of φ´p = φ´cs = 34° is chosen for design.

Stiffness

For stiff consolidated clays, the soil undrained stiffness (Eu) can be calculated based on the relationship with undrained shear strength. Published data suggests a value of Eu between 500 cu and 1000 cu. In the examined case the Eu will be calculated as follows:

Eu = 500 x cu = 95MPa

The drained stiffness (E´) can be approximated by taking 80% of this value which leads to a value of approximately 76MPa.

6.4.2.4 Granular Deposits

Granular Deposits are only recorded at two drillholes. The logs state that the recovery is poor, and the layer descriptions are based on driller's notes. Considering the above, the layer descriptions are likely not be totally accurate. Furthermore, the recovered material is not representative of the actual in situ conditions. Thus, laboratory testing could not provide meaningful results.

The following parameters will be provided for the Granular Deposits.

Weight density

Based on the available GI results this stratum is typically described as gravel or sand below groundwater level. Most of the SPT N values are above 30 which, according to BS5930, corresponds to a dense layer. This leads to a γ value ranging between 19 to 23kN/m3 (BS8002: 2015). A value of 20kN/m3 is adopted.

In-situ stress

As described in previous sections the K0 will be calculated as a function of φ.

K0 = 1 - sinφ = 0.40*

*φ value is presented below as φ´cv,k

Effective strength

Peck et al established a relationship between the SPT N and φ´cv,k for coarse-grained soils. Following from that, a graph was introduced corelating the above parameters. Several SPT tests were completed within the Granular Deposits. The results ranged from 19 to above 50 (refusal). The geotechnical report mentions that the lower values occurred due to blowing conditions. Thus, they will be ignored. The remaining SPT N values vary from 29 to above 50 with the majority of them exceeding a value of 35. This value is selected for the design. An SPT N value of 35, according to the graph mentioned above, corresponds to a φ´cv,k of approximately 37°.

The approach presented in BS8002: 2015 cannot be applied in the examined case as the soil recovery is poor and most likely does not realistically represent the ground conditions. A φ´cv,k value of 37° is selected. Due to the nature of this layer (coarse-grained) c´= 0kPa.

Stiffness

For the estimation of the stiffness the following empirical relationship will be used:

E´ = 1.5 SPT N (in MPa) which leads to an E´ of 52.5MPa.

6.4.2.5 Weathered Rock

Weathered Rock is recorded above competent Limestone/Mudstone in a few exploratory locations. The logs typically describe it as Gravel. The properties and the behaviour of the Weathered Rock is expected to be similar to a gravel layer.

The following parameters will be provided for the Weathered Rock.

Weight density

Based on the available GI results this stratum is described as dense Gravel. It is not clear if it is encountered above or below the groundwater table. This leads to a γ value ranging between 18 to 23kN/m3 (BS8002: 2015). A value of 21kN/m3 is adopted.

In-situ stress

As described in previous sections the K0 will be calculated as a function of φ.

$K0 = 1 - \sin\varphi = 0.41$*

*φ value is presented below as φ´cv,k

Effective strength

An SPT test was carried out within the examined stratum and an SPT N value of 50 was recorded. This value, according to the Peck et al graph mentioned in a previous section, corresponds to an angle of shearing resistance (φ´cv, k) of approximately 41°.

An alternative approach of calculating φ´cv, k is presented in BS8002: 2015. According to it φ´cv, k could be calculated by the following relationship:

$\varphi'_{cv,k} = 30° + \varphi'_{ang} + \varphi'_{PSD}$

where

φ´ang is contribution to φ´cv,k from the angularity of the particles

φ´PSD is contribution to φ´cv,k from the soil's particle size distribution.

The angularity of the stratum is described as angular to sub-angular which corresponds to a φ´ang value of 3°. No PSD test was carried out at samples taken from the examined layer therefore φ´PSD will be considered as 0°. Taking the above into account a φ´cv,k value of 36° is selected.

Stiffness

For the estimation of the stiffness the following empirical relationship will be used:

E´ = 1.5 SPT N (in MPa) which leads to an E´ of 75MPa. This value is based on a single SPT test. Therefore, a slightly reduced value of E´ equal to 60MPa will be adopted.

6.4.2.6 Bedrock

All the drillholes, apart from R05-CP05, recorded Bedrock. The Bedrock is mainly described as medium strong to strong grey/dark grey fine to medium grained laminated Limestone locally interbedded with weak black fine grained laminated Mudstone or Clay and weak to medium strong thinly laminated dark grey fine grained calcareous Mudstone.

Bedrock parameters except weight density, were determined based on the Generalized Hoek-Brown Criterion presented in "Practical Rock Engineering" by Evert Hoek.

Weight density

11 No Unconfined Compressive Strength tests were carried out on rock samples and Bulk Density were measured for each sample as a part of the test.

Based on the available GI results γ value ranging between 26 to 28kN/m3, a value of 26kN/m3 is adopted.

Hoek Brown Classification

Intact Uniaxial Compressive strength (σ_{ci})

11 no. of Unconfined Compressive Strength tests (UCD) and 22 no. of Point Load tests were carried out on rock samples.

UCS test result range is between 15MPa to 59MPa.

Point Load Testing (Is (50)) was determined on axial and dimetral samples. The relationship UCS = f* Is (50) (MPa), where f = 20 (although may range between 20 and 24) is commonly used for Dublin Basin (Lucan Formation) Limestones. Point load test results (Is (50)) are ranging between 0.8 to 8 (UCS=16MPa to 160 MPa).

A value of 20MPa is adopted for Intact Uniaxial Compressive Strength.

Geological Strength Index (GSI)

Based on core photos and rock descriptions, surface condition of the rock adopted as Fair to Good, and structure adopted as Very Block to Blocky to be conservative. Based on surface condition and structure, Geological Strength Index (by Hoek) value was determined to be between 35 to 75. A value of 35 is adopted.

Hoek-Brown Constant (mi) and Disturbance Factor

Hoek Brown Constant is adopted based on rock type. The bedrock is mainly described as Limestone and Mudstone. A value of 4 is adopted for Hoek Brown Constant for mudstone to be conservative.

Rock assumed to be excavated with an excavator and disturbance to rock expected to be minimal. Based on this assumption, disturbance factor is adopted as 0.

Intact Modulus

Intact modulus (Ei) was estimated by using the following relationship:

Ei=MR*σci

A value of 250 is adopted for Modulus Ratio (MR). A value of 5000MPa is adopted for Intact modulus.

Rock Mass Parameters

Effective strength

Effective strength parameter was determined by using Mohr Coulomb fitting by using RocLab (Version 1.032).

Cohesion value is adopted as 80kPa and 50° is adopted as friction angle. These parameters are only related with rock mass. Strength along discontinuities and joints should be reviewed to confirm if it is suitable for its intended use.

Stiffness

For the estimation of the stiffness the following empirical relationship will be used:

Erm (MPa) = Ei*((0.02+(1-D/2) /(1+e((60+15D-GSI)/11))

A value of 550MPa is adopted.

6.4.2.7 Geotechnical parameters

Table 6.2 summarises the geotechnical parameters for the strata encountered during the GI for the examined route.

Table 6.2: Geotechnical parameters

Stratum	γ (kN/m3)	K0	cu (kPa)	φ (°)	c´ (kPa)	UCS (MPa)	Eu (MPa)	E´ (MPa)
Topsoil	No geotechnical parameters will be provided for these layers							
Made Ground								
Dublin Boulder Clay*	21	1.5	190	34	0	N/A	95	76
Granular Deposits	20	0.40	N/A	37	0	N/A	N/A	52.5
Weathered Rock	21	0.41	N/A	36	0	N/A	N/A	60
Limestone/Mudstone	26		N/A	50	80	20	N/A	550

*Parameters correspond to stiff to very stiff layer

6.5 Overview of Soil and Bedrock Classification

The ground conditions along the Proposed Scheme are as follows:

- Topsoil and/or made ground is expected to be present along examined route;
- Granular Deposits are expected to be encountered mainly at the northern part of the proposed alignment;
- Dublin Boulder Clay is expected to be present below Topsoil, Made Ground and/or Granular Deposits along the majority of the proposed route;
- Weathered Rock is expected be sporadically recorded along examined route; and
- Limestone and/or Mudstone is expected to be present along the proposed route.

6.6 Groundwater

2 No. standpipe installations was carried out during the ground investigation. Groundwaters were measured only one tie per borehole. Measured groundwater depts are listed as follows:

- R05-RC01 5.7m below ground level
- R05-RC04 3m below ground level

Groundwater was only encountered at R05-CP03 during the drilling of boreholes and excavation of trial pits. Groundwater was encountered at 3m below ground level at R05-CP03.

6.7 Hydrogeology

The GSI Groundwater Aquifer map states that the proposed alignment is mainly underlain by a locally important aquifer described as Bedrock which is moderately productive only in local zones. The northern part of the proposed alignment is also underlain by a poor aquifer where Bedrock is generally unproductive except for local zones. A fault crosses the proposed route between Snugborough and Blanchardstown Road. According to the relevant GSI map the groundwater vulnerability varies highly. The groundwater vulnerability is classified as low at the southern section of the proposed alignment changing to moderate at approximately the corner of Cabra Road and Old Cabra Road. North to Ashtown roundabout it appears as high. Extreme groundwater vulnerability is noted northwest to Phoenix Park Avenue, at M50 Roundabout, around Mill Road, close to Snugborough Road and at the northern section of the proposed route. Areas where rock at or near surface are sporadically presented at the northern part of the proposed alignment. Based on the relevant GSI map the subsoil permeability is typically classified as low. High subsoil permeability is noted in a localised area between M50 Roundabout and Snugborough Road. It is noted that the permeability has not been mapped/assessed for parts of the central and northern section. The GSI Wells and Springs map shows a feature (borehole) approximately 350m east to Stoneybatter. Another well, also presented as a borehole, is noted around 850m south to the M50 roundabout.

6.8 Geotechnical Input to Structures

The Proposed Scheme includes widening of existing carriageway and construction of new footpath and cycle track pavements. In the absence of in-situ testing such as California Bearing Ratio (CBR) tests, the CBR values will be estimated taking into account the existing GI results. The anticipated CBR values are expected to typically range from 2.5 to 3.0%. These values will be confirmed at detailed design stage.

The Proposed Scheme also includes the construction of four gantries, the modification of four gantries, the construction of five retaining walls and the widening of two bridges. The following sections present in detail each structure and the geotechnical input at the corresponding locations, where GI is available. A preliminary bearing capacity is provided for each retaining wall and bridge. The preliminary bearing capacity will require to be updated during detailed design stage.

6.8.1 Gantries

As part of the Proposed Scheme, new overhead sign gantries will be modified or installed along the N3 and R147 sections. Refer to Figure 6.1.

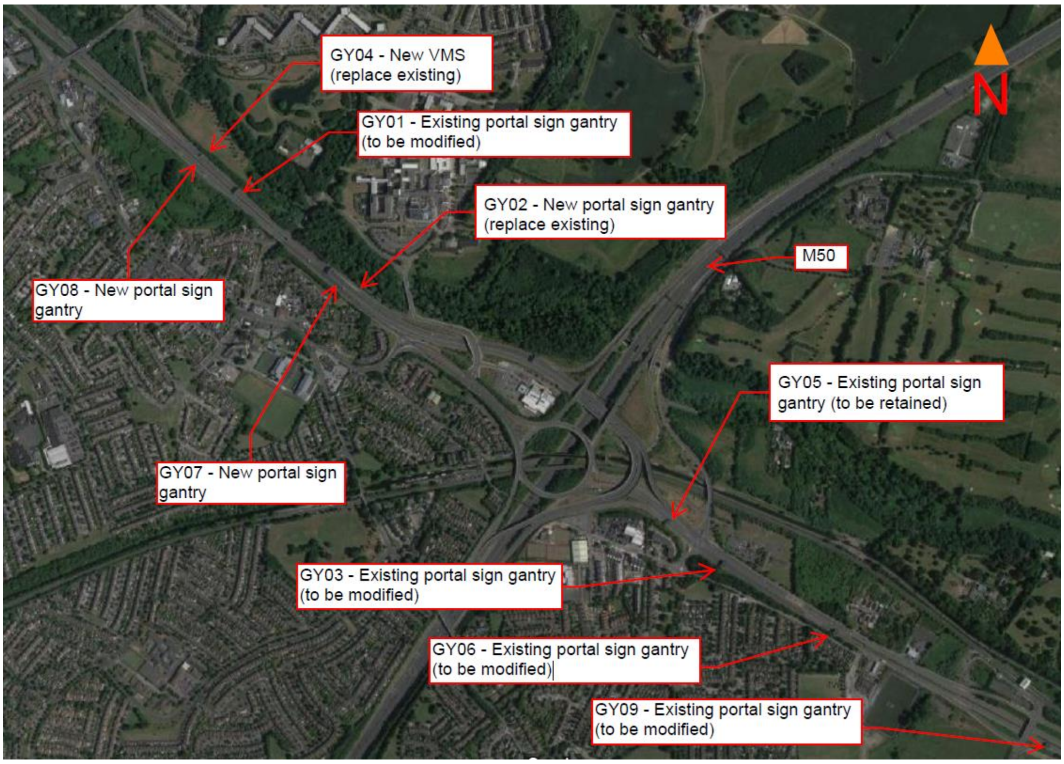


Figure 6.1: Sign Gantries Locations

The GI scope did not include exploratory locations at the proposed gantry areas. Therefore, no geotechnical input is included herein.

The foundation solution of the new sign gantries is expected to be pads. The pads will be founded on Dublin Boulder Clay, Gravel Deposits or Bedrock. If soft/loose material is encountered at founding level, then the excavation will have to extend to deeper depth till a suitable layer is encountered.

One of the next GI stages will have to include exploratory locations adjacent to the proposed gantry locations to confirm that pad foundation will be the most suitable foundation solution.

6.8.1.1 Gantry 01

Gantry 01 will be modified at approximate ITM coordinates 708097:E, 738835:N. According to the desk study the ground conditions comprise Made Ground, Alluvium, Glacial Gravel, Till derived from Limestone and Calcareous Shale. The Bedrock is shown to be shallow. A meltwater channel is noted in the vicinity of the proposed gantry location.

6.8.1.2 Gantry 02

Gantry 02 will be constructed at approximate ITM coordinates 708370:E, 738606:N. Based on the desk study findings the ground conditions consist of Made Ground, Till derived from Limestone and Calcareous Shale. The Bedrock is expected to be shallow.

6.8.1.3 Gantry 03

Gantry 03 will be modified at approximate ITM coordinates 709332:E, 737926:N. The desk study shows Made Ground over till derived from Limestone over Calcareous Shale. The

Bedrock is shown to be shallow. R05-TP08A which was excavated close to the proposed gantry location verified the overburden stratigraphy.

6.8.1.4 Gantry 04

Gantry 04 will be constructed at approximate ITM coordinates 707995:E, 738915:N. The desk study noted presence of Made Ground, Alluvium, Glacial Gravel, Till derived from Limestone, Limestone and Calcareous Shale. A fault and a meltwater channel is noted in the vicinity of the proposed gantry location.

6.8.1.5 Gantry 05

Gantry 05 will be retained at approximate ITM coordinates 709188:E, 738025:N. According to the desk study the ground conditions comprise Made Ground, Till derived from Limestone and Calcareous Shale. The Bedrock is expected to be shallow.

6.8.1.6 Gantry 06

Gantry 06 will be modified at approximate ITM coordinates 709613:E, 737762:N. Based on the desk study findings the ground conditions consist of Made Ground, Till derived from Limestone and Calcareous Shale. The Bedrock is expected to be shallow.

6.8.1.7 Gantry 07

Gantry 07 will be constructed at approximate ITM coordinates 708360:E, 738585:N. The desk study shows made ground overlying Till derived from Limestone over Calcareous Shale. The Bedrock is shown to be shallow. A meltwater channel is noted in the vicinity of the proposed gantry location.

6.8.1.8 Gantry 08

Gantry 08 will be constructed at approximate ITM coordinates 707902:E, 738964:N. The desk study shows Made Ground. Alluvium, Glacial Gravel and Till derived from Limestone overlying Limestone and Calcareous Shale. The Bedrock is shown to be shallow. A meltwater channel and a fault are noted in the vicinity of the proposed gantry location.

6.8.1.9 Gantry 09

Gantry 09 will be modified at approximate ITM coordinates 710091:E, 737523:N.

The desk study shows Topsoil, Alluvium, and Till derived from Limestone overlying Limestone and Calcareous Shale. The Bedrock is shown to be shallow.

R05-CP03 which was drilled close to the proposed gantry location verified the overburden stratigraphy, Alluvium was not noted in this exploratory hole. R05-CP03 is drilled at the top of the existing embankment and Alluvium shall be excavated and replaced during the construction of the embankment.

6.8.2 Retaining Walls

The Proposed Scheme includes the construction of five retaining walls, with an earth retaining height greater than 1.5m. Refer to Figure 6.2.

Figure 6.2: Retaining Walls Locations

Taking into account the ground conditions at each retaining wall and the height of the proposed retaining walls, a slope of 1:2 is proposed for the initial calculations of the land take.

In case localised softer material is encountered during construction works this material will have to be excavated and replaced with a granular fill material (i.e. Class 6N fill).

6.8.2.1 Retaining Wall 01 (RW01)

RW01 will be constructed adjacent to Blanchardstown Road South at approximate ITM coordinates 706861:E, 739684:N. Based on the desk study the ground conditions comprise Made Ground over Till derived from Limestone over Limestone. The two closest exploratory locations, namely R05-TP01 and R05-CP01, verify this stratigraphy. The thickness of Made Ground varies from approximately 1.3m to 3.4m. Based on the log descriptions the Made Ground is likely to be reworked Boulder Clay. The SPT tests show that the Made Ground is very stiff. The thickness of Dublin Boulder Clay ranges from around 0.3m to 1.6m. The proposed retaining wall is expected to be founded on Dublin Boulder Clay or reworked Dublin Boulder Clay. Table 6.3 summarises the geotechnical input to RW01.

Table 6.3: Geotechnical input parameters – RW01

Stratum	γ (kN/m3)	K0	cu (kPa)	c (kPa)	φ (°)	Eu (MPa)	E´ (MPa)
Dublin Boulder Clay OR reworked Dublin Boulder Clay	21	1.5	190	0	34	95	76

Based on the above geotechnical parameters a preliminary bearing capacity of 250kPa is selected.

6.8.2.2 Retaining Wall 03 (RW03)

RW03 will be constructed adjacent to Navan Road, close to Auburn Avenue at approximate ITM coordinates 709301:E, 737937:N. Based on the findings of the desk study the local stratigraphy comprises Made Ground over Till derived from Limestone over Limestone. As part of the site specific GI two trial pits, namely R05-TP08A and 09, were excavated close to the proposed RW03 location.

The GI results verify the stratigraphy of the overburden (rockhead and rock type was not verified). The logs present Topsoil (0.2m thick) over Made Ground (0.6m to 1.2m thick) over Till derived from Limestone (Dublin Boulder Clay, 0.0m to 1.4m thick). The nature of the Made Ground varies highly. R05-TP08A encountered granular Made Ground while R05-TP09 recorded cohesive material which is likely to be reworked Made Ground. The proposed retaining wall is expected to be soil nail wall with a 20-degree inclination to the vertical. Table 6.4 introduces the geotechnical input to RW03.

Table 6.4: Geotechnical input parameters – RW03

Stratum	γ (kN/m3)	K0	cu (kPa)	c (kPa)	φ (°)	Eu (MPa)	E´ (MPa)
Dublin Boulder Clay	21	1.5	100	0	34	50	40

6.8.2.3 Retaining Walls 07A & B (RW07A, 07B)

The retaining walls will be constructed close to Mill Road Bridge. RW07A and B will be located at approximate coordinates 708209:E, 738697:N and 708206:E, 738752:N, respectively. The desk study shows that the ground conditions at the proposed locations consist of Made Ground over Till derived from Limestone over Mudstone. The desk study also presents areas where Bedrock outcrops. R05-TP05B and TP06 were excavated close to the proposed structures. The TPs encountered Topsoil and Made Ground or Till derived from Limestone. Both TPs were completed at shallow depth due to possibly presence of bedrock. The two drillholes verified that Bedrock is shallow.

The proposed retaining walls are expected to be founded on existing embankment material and Mudstone.

Table 6.5: Geotechnical input parameters – RW07A & B

Stratum	γ (kN/m3)	c (kPa)	φ (°)	UCS (MPa)	E' (MPa)
Mudstone	26	80	50	20	550

Bearing Resistance calculated with the table above is cross referenced with BS 8004. The preliminary bearing capacity is chosen as 500kPa from BS8004.

6.8.2.4 Retaining Wall 09 (RW09)

RW09 will be constructed adjacent to Navan Road at approximate ITM coordinates 708752:E, 738337:N. No GI was scoped at or close to the proposed location of RW09. Based on the desk study the local ground conditions consist of Made Ground over Glacial Gravel over Limestone.

It is likely that Dublin Boulder Clay will also be present. Rockhead is shown to be shallow. The proposed retaining wall is expected to be founded on Glacial Gravel, Dublin Boulder Clay or Limestone. No geotechnical input will be provided for the examined structure due to absence of GI. A preliminary bearing capacity of 150kPa is selected for the anticipated overburden and 250kPa for the underlying bedrock.

6.8.3 Bridges and Bridge Sized Culverts

The locations are shown in Figure 6.3.

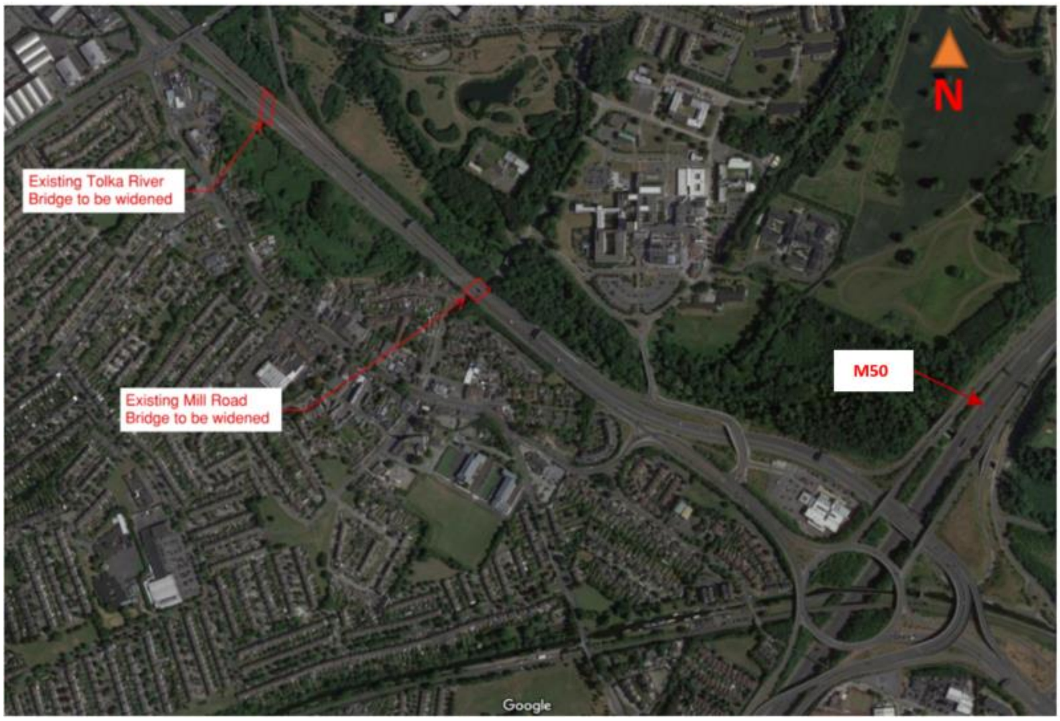


Figure 6.3: Bridge & Bridge sized culvert Locations

6.8.3.1 Tolka River Bridge Widening (BR01)

The desk study indicates that the ground conditions at the area of the Tolka River Bridge consists of Made Ground, Alluvial, Glacial Gravel and Till derived from Limestone over Limestone. The desk study also presents a geological feature (meltwater channel) crossing that area. R05-CP05 which was drilled in the vicinity of the Tolka River Bridge recorded soft cohesive deposits, Dublin Boulder Clay, Glacial Gravel and Sand. This borehole did not encounter Bedrock although its completion depth was around 35m BGL. Based on the above, it is very likely that the R05-CP05 encountered the meltwater channel.

The existing bridge is founded on shallow pad foundations. It is likely that the pads are founded on very stiff Dublin Boulder Clay, similar to the layer R05-CP05 recorded at approximately 43.3m OD. The widening of Tolka River Bridge will increase the loads which will have to be transmitted from the foundation to the ground. For the preliminary design stage, the foundation solution is considered to be piled foundation for abutment walls and spread pad foundation for retaining walls and wingwalls. Table 6.6 summarises the geotechnical input to BR01.

Table 6.6: Geotechnical input parameters – BR01

Stratum	γ (kN/m3)	K0	cu (kPa)	c (kPa)	φ (°)	Eu (MPa)	E´ (MPa)
Dublin Boulder Clay OR reworked Dublin Boulder Clay	21	1.5	190	0	34	95	76

Based on the above geotechnical parameters a preliminary bearing capacity of 250kPa is selected.

Due to the very likely presence of the meltwater channel the rockhead could be highly variable. As a result, there is a risk of high differential settlements between the pads. Additional GI will be required as part of the detailed design.

6.8.3.2 Mill Road Bridge Widening (BR02)

The examined structure is in the vicinity of RW07A & B. The stratigraphy is presented in detail in the RW07A & B section. The existing bridge is founded on pads. Considering the results of the nearby drillholes, it is assumed that the pads are founded on Bedrock.

The widening of Mill Road Bridge will increase the loads which will have to be transmitted from the foundation to the ground. For the preliminary design stage, the foundation solution is considered to be the spread pad foundation.

The following table summarises the geotechnical input to BR02.

Table 6.7: Geotechnical input parameters – BR02

Stratum	γ (kN/m3)	c (kPa)	φ (°)	UCS (MPa)	Eu (MPa)
Mudstone	26	800	27	20	1000

Bearing Resistance calculated with the table above is cross referenced with BS 8004. The preliminary bearing capacity is chosen as 500kPa from BS8004.

7 Pavement, Kerbs, Footways and Paved Areas

7.1 Pavement

7.1.1 Overview of Pavement

This section covers the preliminary design for the following pavement assets:

- General traffic lanes;
- Bus lanes;
- Cycle lanes; and
- Other specific trafficked areas (e.g. off-line bus stops, bus terminals, off-line parking and loading bays).

For the Proposed Scheme, two pavement networks are being considered, the primary and the secondary networks. The primary network refers to the bus corridor under consideration, while the secondary network refers to the roads impacted by the re-routing of existing traffic from the Proposed Scheme to the nearby road network.

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

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

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

This section should be read in conjunction with the Pavement Treatment Plans in <u>Appendix B.</u>

The different pavement assets are designed taking consideration of:

- Traffic loads;
- Changes in road geometry;

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

7.1.2 Design Constraints

7.1.2.1 Traffic Loading Considerations

Use of current Traffic Count data (Traffic Count Data 2019-2020) has been made available to understand the current traffic loads and how they link with the existing pavement construction build-up. A representation of traffic counts along the Proposed Scheme is shown in Figure 7.1 below.

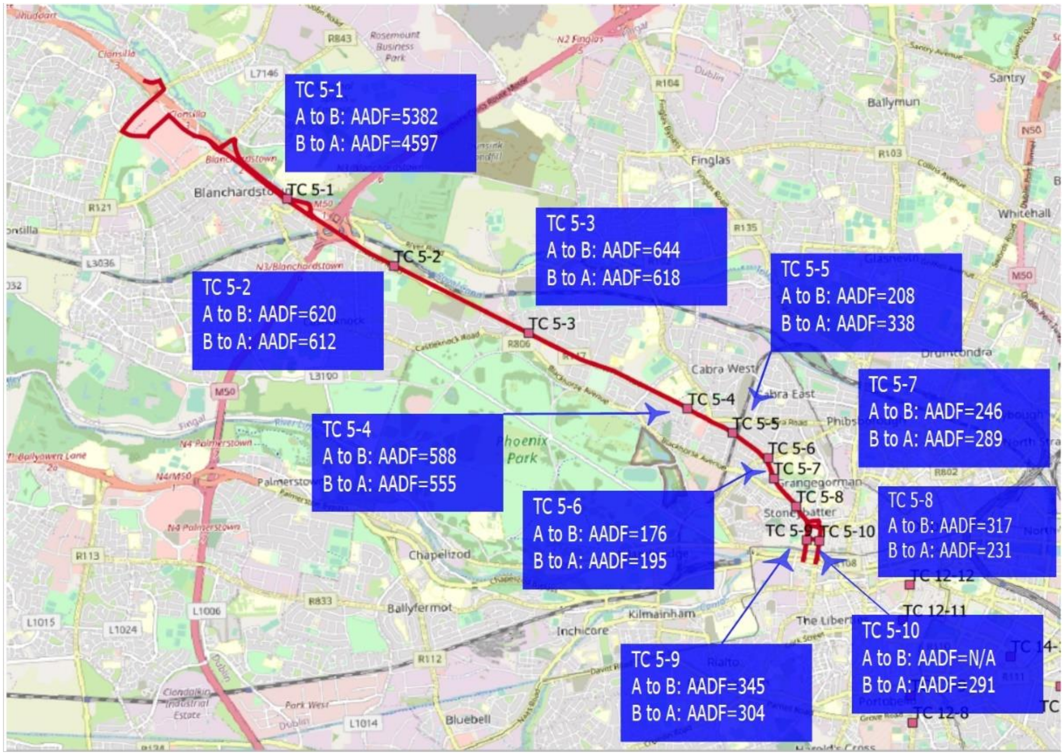


Figure 7.1: 2019-2020 AADF over extent of Proposed Scheme

Assuming that all routes were built for 20-, 30- or 40-year Design Life, the following Design Traffics are estimated in Table 7.1.

Table 7.1: Estimated Design Traffic ranges for the Proposed Scheme

Design Life		
20 Years	**30 Years**	**40 Years**
1.5 to 5 msa (40 msa on N3)	2 to 7 msa (59 msa on N3)	3 to 9.5 msa (79 msa on N3)
Note: “msa” stands for million standard axles.		

The Design Traffic ranges displayed in Table 7.1 above are to be read in conjunction with the Construction data given in Section 7.1.2.3.1 of this report. Analysis of those two sets of data will allow the pavement designer to assess the probability of an existing pavement being fit for current purpose or not.

BusConnects bus traffic data (Revised Network Frequencies) has been used to design bus only permitted lanes. This traffic data does not account for other commercial vehicle use such as non-BusConnects buses.

Traffic Designs have initially been calculated for four different Design Lives: 20 years, 30 years and 40 years and “long life”.

The Growth Factor for BusConnects buses has been assumed to be 1.

Table 7.2: BusConnects Buses only Traffic Design in Million Standard Axles (msa)

BusConnects Buses only Traffic Design (msa)			
20-year Design Life	**30-year Design Life**	**40-year Design Life**	**“Long life”**
9 to 11	13.5 to 16.5	18 to 22	80+

Specific loading areas will be identified and characterised along the Proposed Scheme:

- Bus stops (on- and off-line);
- Terminus;
- Loading / Unloading areas for delivery vehicles;
- Off-line parking areas; and
- Traffic calming features.

7.1.2.2 Geometry Considerations

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

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

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

7.1.2.2.1 Widening

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

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

7.1.2.2.2 Narrowing

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

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

7.1.2.2.3 Horizontal Realignment

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

7.1.2.2.4 Increase in Vertical Alignment

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

7.1.2.2.5 Decrease in Vertical Alignment

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

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

7.1.2.2.6 Relocation of Traffic Islands

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

7.1.2.3 Existing Pavement Considerations

7.1.2.3.1 Construction

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

For the sections of the Proposed Scheme running on the N3 national route, carriageway depth data is available from TII's 2013 GPR survey as shown in Table 7.3. It provides overall depth of bituminous materials (upper pavement) as well as overall depth of underlying unbound granular materials (foundation). It is important to note that the survey does not give any additional information on either the bituminous or the unbound granular materials (e.g. number of layers and associated thickness, specific type of materials, bond between layers, condition of the materials). Educated assumptions are therefore required to identify the pavement types. The age of the pavement structure and its structural maintenance history are also unknown, making it impossible at this stage to estimate how much life is left in each pavement asset. In addition, no information about tar contaminated material was made available.

Table 7.3: Expected Pavement Construction Build-ups on the N3

Route	TII Chainage (km)	Thickness of Bituminous Materials (mm)	Thickness of Granular Materials (mm)	Likely Pavement Type
N3 – Navan Road	0.0 to 1.0	313 to 376 (346 average)	182 to 450 (371 average)	"long life" fully flexible pavement
	1.0 to 2.2	242 to 298 (270 average)	222 to 434 (357 average)	Possibly a 20 msa fully flexible pavement
	2.2 to 2.6	264 to 335 (308 average)	206 to 396 (295 average)	Possibly a 50-60 msa fully flexible pavement
	2.6 to 4.0	258 to 271 (265 average)	384 to 604 (442 average)	Possibly a 15 msa fully flexible pavement

For the sections of the Proposed Scheme running on non-national routes, limited construction data is available on the Road Maintenance Office (RMO) portal:

- "Surface Inventory Material Type": this provides information on which type of surface material or treatment is present;
- "Completed Pavement Interventions": this provides the location of where the carriageway has been resealed, surface restored, structurally overlaid, fully reconstructed or if a different treatment has been applied as per below; and

- "Planned Pavement Interventions": this provides the location of where the carriageway is planned to undergo routine maintenance, surface restoration or full depth reconstruction as per Table 7.4 below.

Table 7.4: Lengths of Completed and Planned Interventions on Local Authorities' networks

Pavement Interventions (in linear metres)	
Completed	**Planned**
Surface restoration: 1760 in 2015, and 2200 in 2017.	Surface restoration: 1400 for 2020, and 1080 for 2021.

The surface materials and treatments recorded on the Proposed Scheme are a mix of Hot Rolled Asphalt (HRA) and Stone Mastic Asphalt (SMA) with some localised Surface Dressing (SD).

It is therefore proposed for a Ground Penetration Radar (GPR) survey to be procured. Cores will be taken at regular intervals to allow for the calibration of the GPR. Such survey would generate the following datasets essential for the pavement design:

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

Local Pavement Asset Managers have also been contacted to mitigate the risk of encountering tar contaminated materials during construction. The likelihood of tar presence along the Proposed Scheme has been requested with answers provided in Table 7.5.

Table 7.5: Local Authorities' knowledge on presence of tar contaminated materials

Local Authorities	Likelihood for tar contaminated material presence
Fingal County Council Dublin City Council	No response Unknown

The age of the pavement structure of the N3 carriageway, and its structural maintenance history are unknown, making it impossible at this stage to estimate how much life is left in each pavement asset.

7.1.2.3.2 Condition

For the sections of the Proposed Scheme running on the N3 national route, various pavement related data sets are available from TII's Pavement Asset Management System (PAMS). Strip maps were provided by TII for chainages 0.4 (southern end of red line) to 3.6 (km) (northern end of the red line) of the N3 northbound carriageway as per Figure 7.2 below:

- **RSP data (July 2019):** International Roughness Index (IRI), Mean Profile Depth (MPD), Rutting, Longitudinal Profile Variance at 3 and 10 metres (LPV3 and LPV10) and geometry parameters (grade, crossfall land radius);
- **LCMS data (Sept. 2017):** Alligator, Longitudinal and Transverse cracking, Ravelling; and
- **SCRIM data (Aug. 2019):** Characteristic Skid Coefficient (CSC).

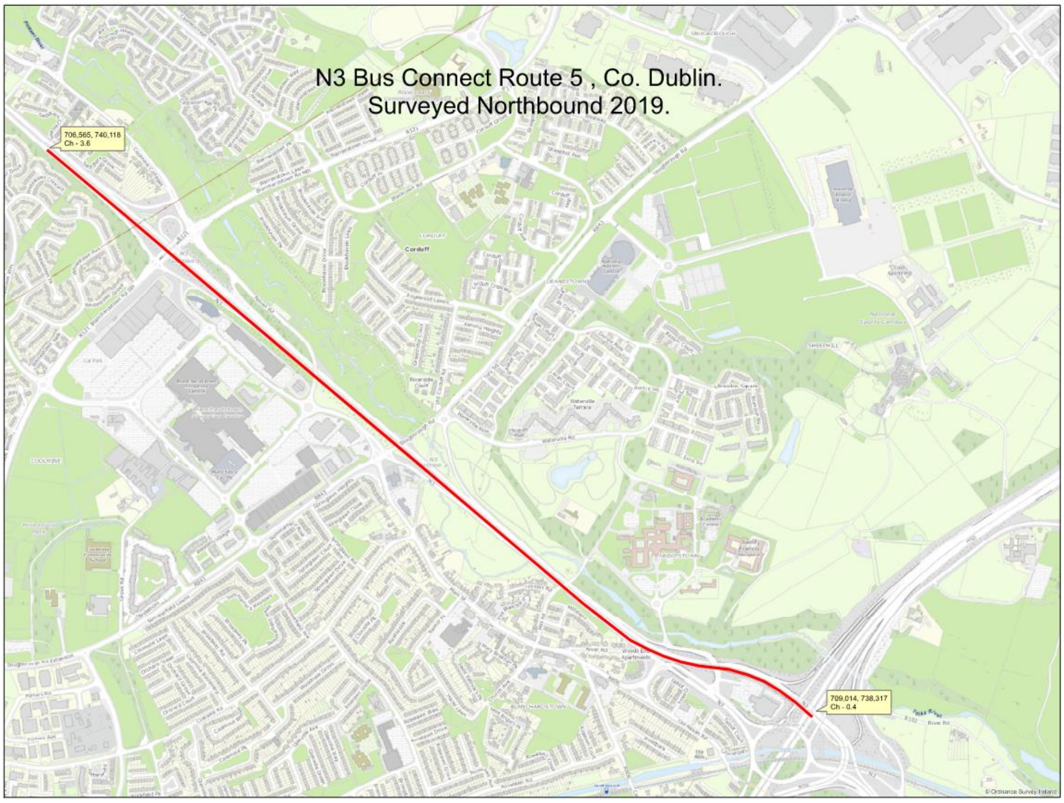


Figure 7.2: Extent of TII Pavement Condition data provided for the N3 (X-ITM 709,014 / Y-ITM 738,317 to X-ITM 706,565 / Y-ITM 740,118)

Pavement Surface Condition:

Surface condition data for the N3 southbound carriageway has not been made available. Therefore, data for the N3 Northbound carriageway was analysed.

From a skid resistance perspective, the only 300 metre long area of the N3 that would require further investigation is located 100 metres north of the junction with the M50. This is because the low speed, dry weather skid resistance of the pavement is low (Characteristic SCRIM Coefficient CSC less than 0.40).

On the first 800 metres north of the junction of the N3 with the M50, the amount of ravelling appears to be very limited. On the following 2.4 km, consistent ravelling of less than 2m2 per 100m was reported. This could explain the relatively high texture depth reported on that section of road (>1.5mm).

Very little rutting issues are being reported along the 3.2 km length of road shown on Figure 7.2. Some rutting is reported in the right wheel path for about 300 metres, 1.1 km north of M50 junction 6 and for approximately 100 metres, 2.4 km north of M50 junction 6.

Pavement Structural Condition:

In 2017, no alligator cracking was observed along the 3.2 km length of road. Extensive longitudinal and/or transversal cracking was however observed in that year, for approximately 2.3 km, 800 metres north of M50 junction 6. Those cracks may be a sign of structural failure or may simply be a record of an opened longitudinal joint between traffic lanes. Such information cannot be correlated with the IRI and LPV3 datasets as the survey dates are two years apart. Rehabilitation works may have been undertaken in the interim period.

The longitudinal profile of the 3.2 km length of road in terms of IRI and LPV3 is very inhomogeneous which could be a sign of structural instability.

Because of the uncertain structural condition of the pavement and the limited amount of information made available, further investigation will be undertaken at Specimen Design stage (Visual Condition Survey) and recommendations made for the Detailed Design stage.

For the sections of the Proposed Scheme running on the network of non-national routes, access to the Road Maintenance Office (RMO) datasets was granted. Available datasets include:

- SCRIM data: Characteristic Skid Coefficient (CSC);
- RCI Scanner (DCC area only): Road Condition Index giving an idea of general pavement condition from the analysis of surface observed defects (covering the Proposed Scheme from the roundabout at Ashtown Road to Dublin city centre at Ellis Quay);
- PSCI: Pavement Surface Condition Index giving an idea of general pavement condition from the analysis of surface observed defects; and
- RSP data: International Roughness Index (IRI), Mean Profile Depth (MPD), Rutting Depth and Longitudinal Profile Variance (LPV).

From a general pavement condition perspective, Figure 7.3 gives the following PSCI breakdown for the Proposed Scheme, Table 7.6 the currency of the data:

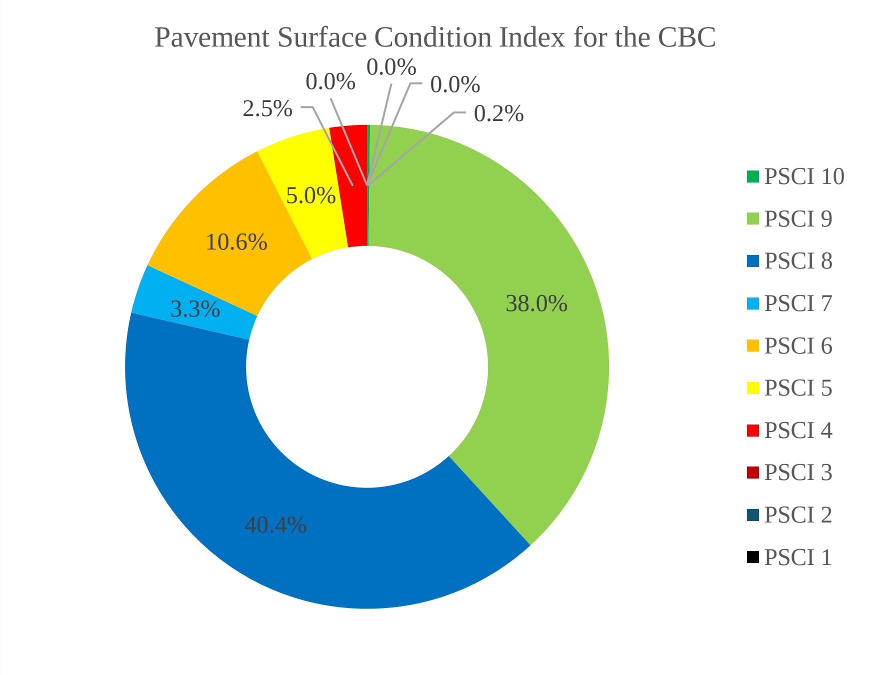


Figure 7.3: Pavement Surface Condition Index (PSCI)

Table 7.6: Currency of PSCI data

Route	5
Currency of PSCI data (Years of survey)	2011 2014 2015 2018 2020

For fully flexible pavements, sections of roads with a score of 9 or 10 require routine maintenance, a score of 7 or 8 could trigger resealing and/or restoration of skid resistance works, scores of 5 or 6 surface restoration works, scores of 3 or 4 structural overlay or inlay works, while scores of 1 or 2 require a full depth reconstruction of the road. (As per "Urban Flexible Roads Manual - Pavement Surface Condition Index" - Volume 2 of 3 -DTTAS – RMO).

For rigid pavements, no maintenance is required for scores of 9 or 10, routine maintenance is required at scores of 7 or 8, surface restoration is needed for scores of 5 or 6, scores of 3 or 4 would trigger a structural rehabilitation, while full depth reconstruction of the road is required at scores of 1 or 2. (As per "Urban Concrete Roads Manual - Pavement Surface Condition Index" - Volume 3 of 3 -DTTAS – RMO)

The PSCI provides a good indication of the general pavement condition by assessing defects recorded at the surface of the pavement structure. Adopting this method, the pavement surface condition is directly assessed while the pavement structural condition is indirectly estimated. A PSCI score on its own is not sufficient to design and specify a pavement rehabilitation.

The proportion of the Proposed Scheme per PSCI score shown in Figure 7.3 is a reflection of the overall pavement condition at a point in time.

The percentages are expected to remain constant over the following years, as long as the Local Authorities' pavement maintenance strategies remain unchanged. The geographical distribution of sections with various PSCI will evolve between now and the commencement of the Proposed Scheme. This is because pavement assets deteriorate over time and the Local Authorities have already and are expected to continue maintenance of those roads in the interim period.

The other pavement condition indicators are as noted in Figure 7.4.

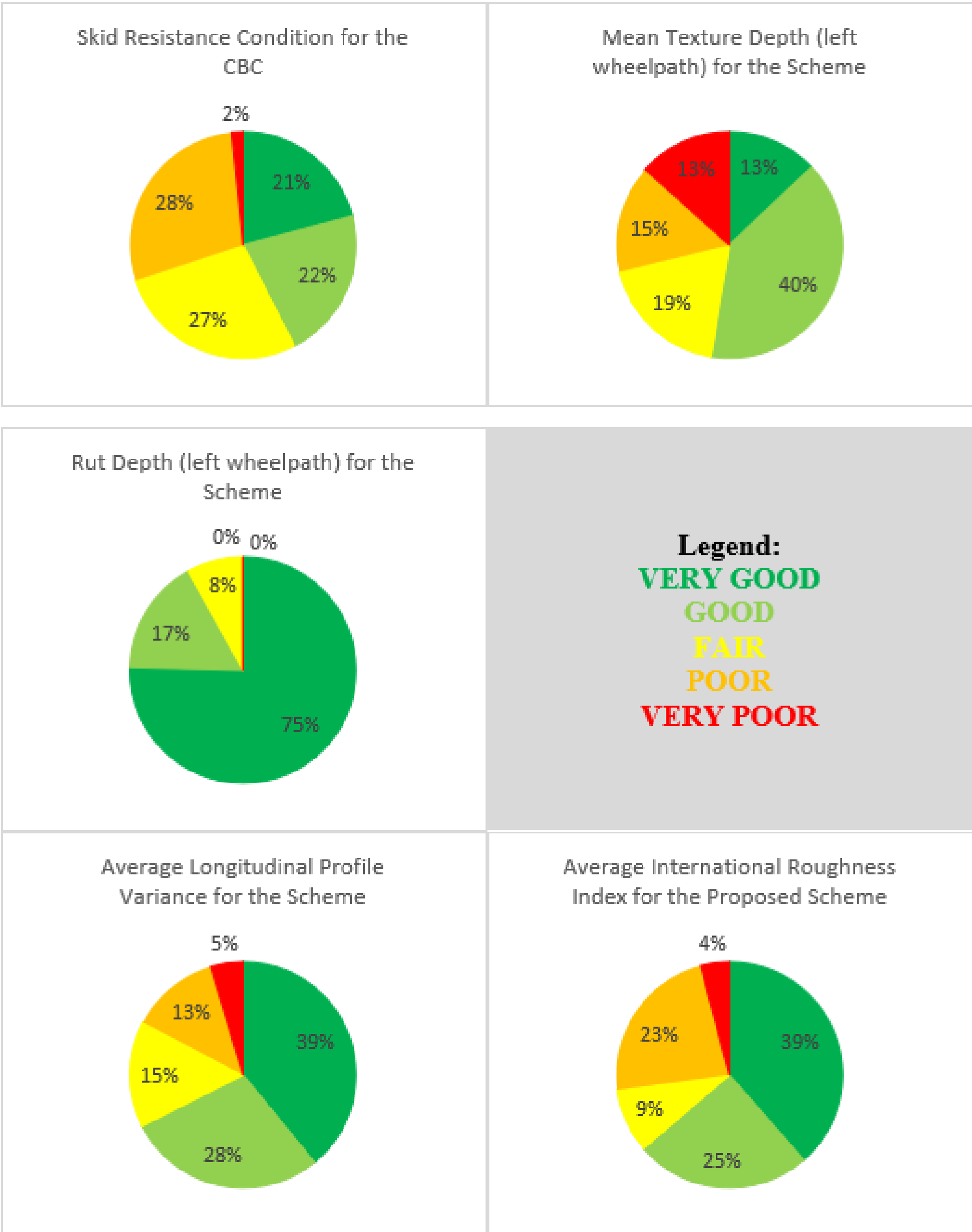


Figure 7.4: Pavement Condition through five Pavement Indicators Pavement Surface Condition:

Both the SCRIM and texture depth indicators reflect the skid resistance of the pavement when a road user brakes or turns. On one hand, the SCRIM indicator measures the skid resistance provided by the micro-texture of the pavement surface and is a proxy for skid resistance at low speed and/or in dry weather conditions. On the other hand, the texture depth indicator is a direct measurement of the macro-texture of the pavement surface and is a proxy for skid resistance at higher speeds and/or in wet weather conditions.

30% of the Proposed Scheme is in a poor to very poor condition while more than 55% of the Proposed Scheme is in a fair or worse SCRIM condition.

In terms of texture depth, at least 45% of the Proposed Scheme is in a fair or worse condition.

Poor skid resistance of the pavement surface may become an issue for vulnerable road users such as pedestrians and cyclists, especially where motorised and non-motorised traffic interact.

The rut depth indicator is showing that about 90% of the Proposed Scheme is in good or very good condition. From a pavement surface perspective, this is positive as little to no transversal surface irregularities are expected and little to no water is expected to be ponding in the ruts.

Pavement Structural Condition:

The structural condition of the pavement can only be reported on and assessed from indirect condition indicators taken from the surface of the pavement: rut depth, International Roughness Index (IRI) and Longitudinal Profile Variance (LPV).

The rut depth being at approximately 90% in the good or very good categories, thus no structural issue can be identified through this indicator. It does not however mean that there are no structural issues.

Both the IRI and LPV indicators are a reflection of the ride quality of the road, in other words, how smooth the road surface is. Those indicators are in most part influenced by surface defects such as potholes, large cracks or networks of cracks, open joints, poor or failing reinstatements, depression that can originate from the surface or the pavement structure below. Features like gullies, manhole covers or other ironworks and if not filtered out of the survey data, ramps, can also influence the IRI and LPV indicators.

Where high levels of profile variance are observed over long sections of road, it is likely for structural failure to have occurred.

Less than 20% of the Proposed Scheme is displaying poor or very poor LPV condition while less than 30% of the Proposed Scheme is displaying poor or very poor IRI condition.

Every effort should be made to address, at the source, all structural failures along the Proposed Scheme in order to guarantee a high-quality ride for all bus passengers, cyclists and other road users.

Subgrade Condition:

Whatever the network, no information about the subgrade is made available in terms of bearing capacity (California Bearing Ratio – CBR).

The foundation for all widening and full depth reconstruction pavement structures is designed on the assumption that the Design CBR is the minimum permitted in Clause 3.23 of DN-PAV-03021 (Dec. 2010): 2.5%.

Additional condition data is expected to become available at Specimen Design stage in the form of core logs taken as part of the GPR survey (Ground Penetrating Survey).

The delivery of the Proposed Scheme is expected to commence in 2022/2023. The condition of all pavements is therefore expected to change, deteriorate in most cases and improve where Local Authorities' interventions occur.

7.1.2.3.3 Required Complementary Surveys

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

7.1.3 Pavement Design

7.1.3.1 Pavement Materials

At Specimen Design stage, the selection of appropriate pavement materials will be made with the following considerations:

- Which pavement structure is the most appropriate and compatible with the existing pavement? (i.e. Fully flexible vs. Flexible Composite vs. Rigid pavement);
- Which materials are most appropriate from a noise, permeability, colour, texture, etc. perspective?; and
- Which materials, from a lifecycle perspective, provide the best value in terms of environmental impact, durability, maintainability, repairability, recyclability, cost, etc.?

Specific materials will be selected for specific loading areas.

Where pavement material is excavated, it is envisaged that the contractor will seek to reuse or recycle it, where practicable, within the Proposed Scheme.

The choice of surfacing materials will be discussed with the Landscape Architect.

7.1.3.2 Pavement Strategy

7.1.3.2.1 New Pavement and Bus Interchange Strategy

A Bus Interchange is proposed at the Blanchardstown shopping centre (N3 junction 3). Such location will be trafficked by a large volume of buses. Slow moving, stationary, vibrating and manoeuvring buses are extremely damaging to both the pavement surface and the pavement structure.

Fully flexible (bituminous mixtures) and flexible composite (bituminous mixtures on a hydraulically bound base) pavement structure are unlikely to provide a durable and low maintenance option for this location. It is therefore proposed for the pavement to be rigid (concrete) at that location.

Rigid pavements do not rut, are highly resistant to scuffing and oil dropping, requiring limited maintenance (e.g. joints).

A new section of carriageway is proposed on the east side of the N3/M50 interchange. This new road is a bus lane linking the interchange roundabout to Navan Road eastbound. Providing that the pavement structure of the existing link between the interchange roundabout and the R147 is suitable for the forecasted bus traffic, it is anticipated that the pavement structure of the new road will be of similar depth and make-up.

7.1.3.2.2 Pavement Rehabilitation Strategy

At Specimen Design stage, different pavement strategies will be developed for:

- Areas to be widened or fully reconstructed
- Areas to be rehabilitated (do minimum, intermediary strategies, fully reconstruct)

Additional testing requirements in line with AM-PAV-06050 will be specified to complete the Pavement Design.

The risk of tar contaminated material presence in the existing pavement is expected to be mitigated at Specimen Design stage with the delivery of the GPR survey through the testing of the calibrating cores for tar.

In order to estimate the waste quantities and the carbon emissions from the Proposed Scheme pavement works, the following assumptions were made:

- Where full depth reconstruction is anticipated (e.g. widening, traffic island relocation…), a conservative fully flexible pavement design is assumed: 350mm of bituminous mixtures on top of 150mm of subbase material and 400mm of capping material;
- Where the existing pavement is anticipated to only require rehabilitation, the assumed materials and associated depths depend on the PSCI for the pavement design:
- Fully Flexible Carriageway;
- PSCI ≥ 7: no works;
- PSCI = 5 or 6: 50mm Bituminous Inlay;
- PSCI = 3 or 4: 200mm Bituminous Inlay;
- PSCI = 1 or 2: 350mm Bituminous Inlay + 150mm Subbase Inlay + 400mm Capping Inlay;
- Rigid Carriageway;
- PSCI ≥ 5: no works; and
- PSCI ≤ 4: 200mm Concrete Inlay.

7.1.3.3 Opportunities for Innovation

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

7.1.3.4 Reuse and Recycling Considerations

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

Current opportunities include but are not limited to:

- 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.

7.2 Kerbs, Footways and Paved Areas

7.2.1 Overview of Kerbs, Footways and Paved Areas

This section covers the preliminary design for the kerbs, footways and paved areas (KFPA) assets:

- Kerbs;
- Footways (concrete, bituminous and paved); and
- Cycle tracks.

For the Proposed Scheme, two pavement networks are being considered, the primary and the secondary networks. The primary network refers to the bus corridor under consideration while the secondary network refers to the roads impacted by the re-routing of existing traffic from the Proposed Scheme to the nearby road network.

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

- DN-PAV-03021 (Dec. 2010) – Pavement and Foundation Design;
- DN-PAV-03026 (Jan. 2005) – Footway Design;
- Construction Standards for Road and Street Works in Dublin City Council (May 2016) – Revision 1;
- PE-SMG-02002 (Dec. 2010) – Traffic Assessment;
- CC-SPW-00600 (Mar. 2013) – Specification for Road Works Series 600 – Earthworks;
- CC-SPW-00700 (Jan. 2016) – Specification for Road Works Series 700 – Road Pavements – General;
- CC-SPW-00800 (Mar. 2013) – Specification for Road Works Series 800 – Road Pavements – Unbound and Cement Bound Mixtures;
- CC-SPW-00900 (Sep. 2017) – Specification for Road Works Series 900 – Road Pavements – Bituminous Materials;
- CC-SPW-01000 (Mar. 2013) – Specification for Road Works Series 1000 – Road Pavements – Concrete Materials;
- CC-SPW-01100 (Feb. 2012) – Specification for Road Works Series 1100 – Kerbs, Footways and Paved Areas; and
- BS 7533 series of standards (1999 – 2021) – Pavement Constructed with Clay, Natural Stone or Concrete Pavers;

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

This section should be read in conjunction with the Pavement Treatment Plans in Appendix B.

The different KFPA assets are designed taking consideration of:

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

7.2.2 Design Constraints

7.2.2.1 Traffic Loading Considerations

Depending on the expected traffic characteristics (volumes, pedestrian vs. vehicular) and the proposed surface material, the Design Traffic may be categorised slightly differently as illustrated in Figure 7.5.

For bituminous footways and cycle tracks, the Design Traffic will be calculated in accordance with PE-SMG-02002 (Dec. 2010) and categorised as per DN-PAV-03026 (Jan. 2005), if the Design Traffic is below 50,000 standard axles over their lifetime (40 years).

For concrete footways, the Design Traffic will be calculated in accordance with PE-SMG-02002 (Dec. 2010) for a 40-year design life.

And for paved footways, the Design Traffic will be calculated in accordance with PE-SMG-02002 (Dec. 2010) and categorised as per BS 7533 series.

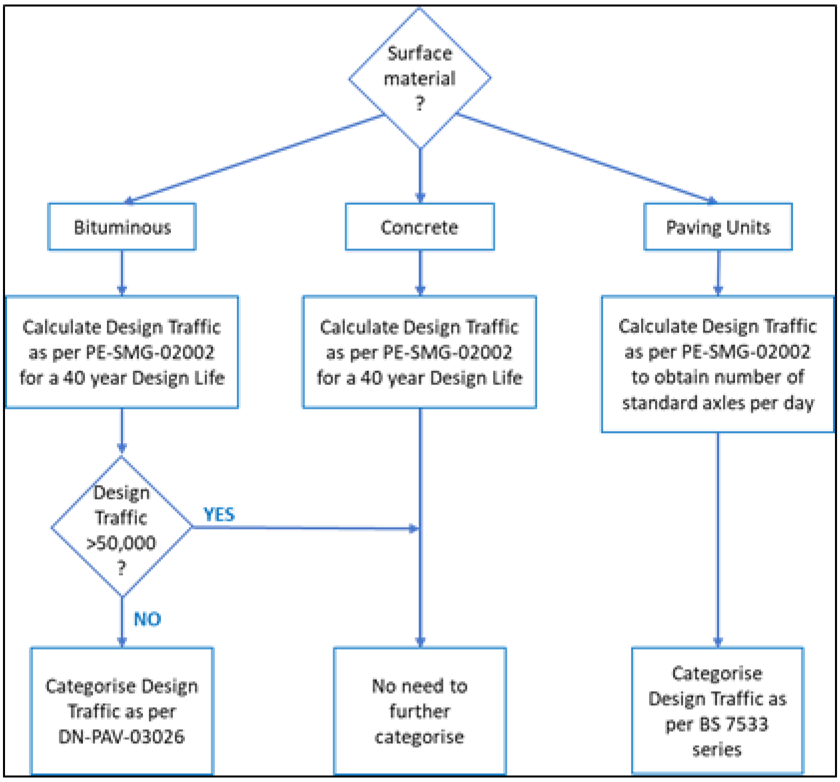


Figure 7.5: Traffic Design and Categorisation for KFPA

7.2.2.2 Geometry Considerations

At Specimen Design stage, the 3D geometry model will be further analysed to identify footways and cycle tracks requiring full depth reconstruction and those that can be maintained in place.

The current assumption for footpaths and cycle tracks is for full depth reconstruction.

7.2.2.3 Existing Pavement Condition Considerations

For the footways and cycle tracks that will be fully reconstructed, the design of the foundation will be based on an assumed Design CBR of 2.5%, the minimum permitted value as per Clause 3.23 of DN-PAV-03021 (Dec. 2010).

If some existing footways and cycle tracks are proposed to be maintained, their condition will be assessed visually before proposing any potential rehabilitation works.

7.2.3 Pavement Design

7.2.3.1 Pavement Materials

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

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

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

Specific materials will be selected for specific loading areas.

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

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

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

As per Section 5.5 of the BCPDGB, in order to provide a visual differentiation between the carriageway and cycle tracks and cycle lanes, it is proposed that all cycle tracks and cycle lanes are to have red coloured epoxy resin type surfacing, or red coloured HRA, or similar in accordance with the National Cycle Manual.

7.2.3.2 Pavement Structures

The appropriate pavement structures for footways and cycle tracks will be defined at Specimen Design stage.

7.2.3.3 Opportunities for Innovation

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

7.2.3.4 Reuse and Recycling Considerations

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

Current opportunities include but are not limited to:

- Excavated capping layer material could be reused as new capping material if compliant with current standards;
- Excavated subbase layer material could be reused as new subbase material if compliant with current standards;
- Up to 50% of capping and subbase materials could be substituted with Reclaimed Asphalt;
- Concrete base to paved areas could make use of Recycled Aggregate, Recycled Concrete Aggregate and more sustainable hydraulic binders (e.g. CEM III/A);

- Concrete footways could also make use of more sustainable hydraulic binders;
- Jointing and bedding mortars used in the construction of paved areas could contain recycled materials; and
- Aggregate for base/binder layer for cycle tracks could be 100% Reclaimed Asphalt (Low Energy Bound Material – LEBM).

8 Structures

8.1 Overview of Structures Strategy

The Proposed Scheme impacts on a number of existing structures and also requires new structures at various locations along the Proposed Scheme. The sections below summarises where existing structures are impacted and where new structures are required.

A separate Preliminary Design Report for the structures has been prepared, following the guidance set out in TII publication DN-STR-03001 (Technical Acceptance of Road Structures on Motorways and Other National Roads). These are included in Appendix J of this report.

8.2 Summary of Existing Structures

Table 8.1 below lists the existing structures along the Proposed Scheme and identifies those that are being impacted. Refer to the Existing Structures Impact Assessment Report in Appendix F for further details.

Table 8.1: Summary of Existing Structures

Structure Ref.	Structure Type	Name/ Description	Jurisdiction	Impact
5.01	Retaining Wall	N3 Junction 3 Southbound off-slip - retaining wall at ESB pylon.	FCC	No impact
5.02	Bridge	N3 - R121 Overbridge	FCC	No impact
5.03	Retaining Wall	Retaining wall between northern edge of R121 and Whitestown estate	FCC	Structure impacted
5.04	Embank-ment	Embankment to the N3 from the L3020 Blanchardstown	FCC	Structure impacted
5.05	Embank-ment & Retaining Wall	Embankment and retaining wall adjacent to the L3020 at the Ebay building	FCC	Structure impacted

Structure Ref.	Structure Type	Name/ Description	Jurisdiction	Impact
5.06	Pedestrian Underpass	Pedestrian underpass under N3 and westbound N3 offramp	FCC	No impact
5.07	Culvert	Tolka River Culvert under N3	FCC	Structure impacted
5.08	Cantilever Gantry	Navan Road N3	FCC	Structure impacted
5.09	Portal Gantry	Navan Road N3 Gantry SG-057	FCC	Structure impacted
5.10	Culvert	Tolka River Culvert under N3 (James Connolly Bridge	FCC	No impact
5.11	Bridge	Mill Road Bridge	FCC	Structure impacted
5.12	Portal Gantry	Navan Road N3 Gantry SG-059	FCC	Structure impacted
5.13	Retaining Wall	Retaining wall at N3 eastbound off-slip (adjacent to Connolly Hospital)	FCC	No impact
5.14	Bridge	Bridge over Tolka River at Connolly Hospital access	FCC	No impact
5.15	Retaining Wall	Retaining wall at N3 eastbound off-slip	FCC	Structure impacted
5.16	Bridge	N3 Overbridge at eastbound off-slip	FCC	Structure impacted

Structure Ref.	Structure Type	Name/ Description	Jurisdiction	Impact
5.17	Retaining Wall	Retaining wall between northbound and southbound carriageway	FCC	Structure impacted
5.18	Bridge	N3 outbound - M50 interchange - Royal Canal Bridge	FCC	No impact
5.19	Bridge	N3 outbound - M50 interchange - M50 Bridge	FCC	No impact
5.20	Bridge	N3 inbound - M50 interchange - M50 Bridge	FCC	No impact
5.21	Bridge	N3 inbound - M50 interchange - Royal Canal Bridge	FCC	No impact
5.22	Bridge	M50 interchange, Bridge over N3	FCC	No impact
5.23	Bridge	M50 interchange Bridge	FCC	Structure impacted
5.24	Portal Gantry	Navan Road N3 Gantry SG-060	FCC	No impact
5.25	Portal Gantry	Navan Road N3 Gantry SG-061	FCC	Structure impacted
5.26	Portal Gantry	Navan Road R147 Gantry SG-062	FCC	Structure impacted
5.27	Bridge	Bridge- Ashtown Train Station	FCC	No impact

Structure Ref.	Structure Type	Name/ Description	Jurisdiction	Impact
5.28	Portal Gantry	Navan Road R147 Gantry SG-063	FCC	Structure impacted
5.29	Bridge	R805 Old Cabra Road - Railway Bridge	Irish Rail	No impact
5.30	Retaining Wall	Retaining wall to low courtyard, 42 Manor Street	Private	No impact
5.31	Retaining Wall	Retaining wall to low courtyard, 32-37 Manor Street	Private	No impact
5.32	Retaining Wall	Retaining wall to low courtyard, Blackhall Court	Private	No impact
5.33	Retaining Wall	Retaining wall to low courtyard, 69-70 Queen Street	Private	No impact
5.34	Retaining Wall	Retaining wall to low courtyard, 72a Queen Street	Private	No Impact
5.35	Retaining Wall	Retaining wall to Phoenix Industrial Park / Gowan Motors Retail Group	Private	No impact
5.36	Retaining Wall	Retaining wall to Ashtown Gate	Private	No impact
5.37	Retaining Wall	Retaining wall between 1-5 Herbert Road and N3 westbound carriageway	Private / FCC	No impact

8.3 Summary of Principal Structures

Principal Structures are defined as those that require technical approval following the processes outlined in TII Publication DN-STR-03001.

8.3.1 Bridges and Bridge Sized Culverts

There are two existing bridge structures impacted by this Proposed Scheme. Both require widening as a result of the proposed carriageway works;

Figure 8.1 indicates the structure locations.

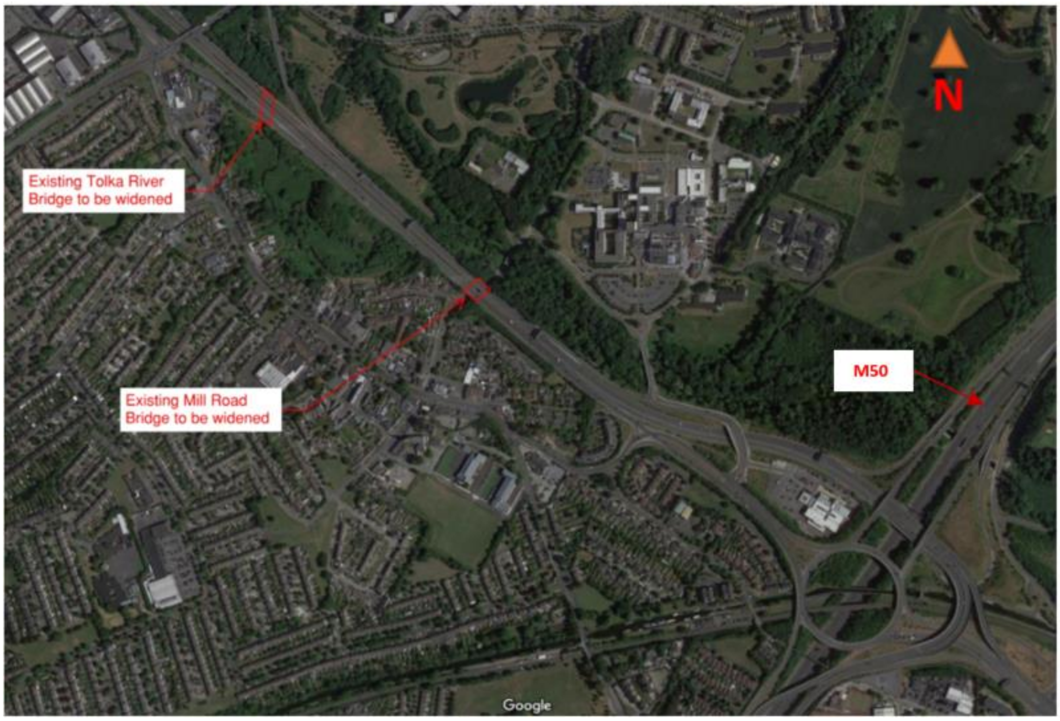


Figure 8.1: Bridge & Bridge sized culvert Locations

8.3.2 Existing Tolka River Bridge (FG-N03-008.00) to be widened:

The existing bridge is located at the northern crossing of the Tolka River beneath the N3 (Alignment A, Ch 1110.00m). The structure comprises a corrugated steel arch culvert, which has subsequently been widened using precast concrete girders. The proposed widening of the N3 to accommodate the Proposed Scheme requires this bridge to be widened further at its southern end. A similar approach is proposed, whereby the bridge will be widened by approximately 2 m using TYE beams and a cast in-situ deck slab. The abutments will be extended to suit.

Refer to the Preliminary Design Report - Tolka River Bridge in Appendix J for further information.

8.3.3 Existing Mill Road Bridge (FG-N03-010.00) to be widened

Twin bridges carry the eastbound and westbound carriageways of the N3 over Mill Road at this location (Alignment A, Ch 1605.00m). The bridge requires widening to accommodate works associated with the Proposed Scheme.

The existing bridge will be widened along both its southern and northern sides as well as closing up of the opening within the central median. It is proposed to extend the structure using a cast in-situ arrangement, similar in form to the existing structure.

Refer to the Preliminary Design Report – Mill Road Bridge in Appendix J for further information.

8.3.4 Retaining Walls

Retaining walls with a retained height greater than 1.5 m are classed as principal structures and are summarised in Figure 8.2 and described within Table 8.2.

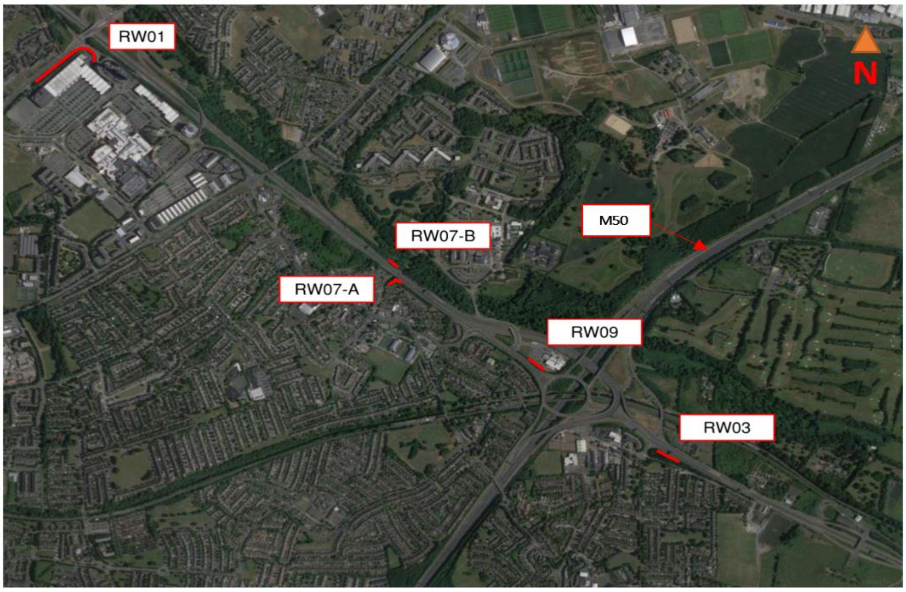


Figure 8.2: Retaining wall locations

Table 8.2: Summary of Principal Retaining Walls

Ref.	Structure Type	Chainage Start - Chainage End (m)	Length (m)	Max Retained Height (m)	Comment
N3 Blanchardstown Junction to Snugborough Road					
RW01	Spreadfoot cantilever wall	Blanchardstown Road South Ch 453.00 to Alignment A – Ch 40.00	270 m	3.0 m	Retains vegetated berm adjacent Blanchardstown Road South.
Snugborough Road to N3 / M50 Junction					
RW07-A	Spreadfoot cantilever wall	Alignment A Ch 1604.00m – 1653.00	100 m	1.5 m	To service bus stop on southern side of N3. Includes ramp and stair access.
RW07-B	Spreadfoot cantilever wall	Alignment A Ch 1540.00-1609.00	250 m	3.0 m	To service bus stop on northern side of N3. Includes ramp and stair access.
RW09	Spreadfoot cantilever wall	Alignment A Ch 2219.00-Ch 2305.00	90 m	4.0 m	Retains N3 embankment adjacent Junction 6 Castleknock health & leisure village.
N3 / M50 Junction to Navan Road / Ashtown Road Junction					
RW03	Soil nail wall	Alignment A Ch 2926.00m-Ch 3027.00	100 m	4.0 m	Retain cut slope to accommodate widening for bus stop.

These walls range from 1.5 m in retained height up to approximately 4.0 m. Refer to the Preliminary Design Report – Retaining Walls in Appendix J for further information

8.3.5 Sign Gantries

There are a number of existing gantries being impacted along the Proposed Scheme, as well as two new gantries required. Refer to Figure 8.3 and Table 8.3 which identifies the various gantries along the Proposed Scheme.

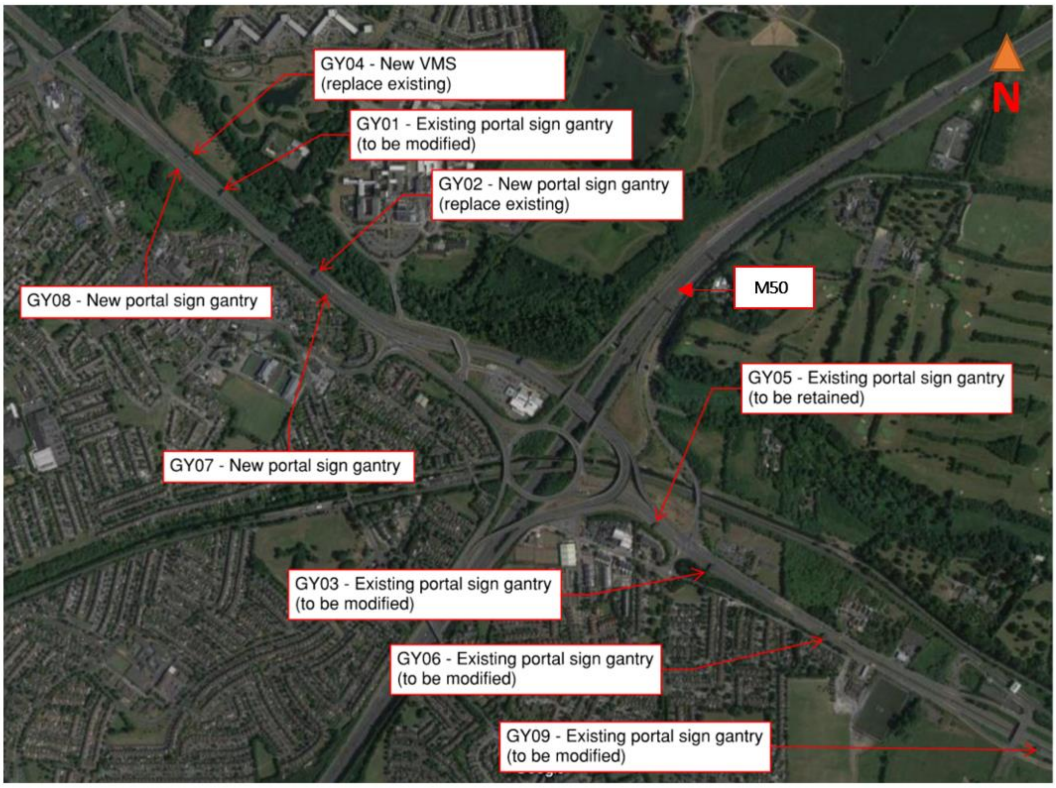


Figure 8.3: Sign Gantries locations

No modification is required to the structure of gantry GY05 located on the northbound carriageway of the N3. At this location the overall carriageway width beneath the gantry is being maintained while the lane widths are unchanged. Changes to traffic signs faces are required, but it is assumed that the cumulative area of the sign faces will remain unchanged. The gantries locations are indicated on the General Arrangement drawing set within Appendix B.

Refer to the Preliminary Design Report – Sign Gantries in Appendix J for further information.

Table 8.3: Summary of Sign Gantries

Ref.	Gantry Type	Existing / New	Chainage (m)	Carriageway & Span Length
Snugborough Road to N3 / M50 Junction				
GY01	Group 6 Sign Gantry	Modify/Replace existing	Alignment A Ch 1439.00	N3 Eastbound – 19.0 m
GY02	Group 6 Sign Gantry	Replace existing	Existing location Alignment A Ch 1745.00 Proposed location Alignment A Ch 1799.00	N3 Eastbound – 23.3 m
GY04	VMS	Replace existing	Alignment A Ch 1316.00	N3 Eastbound – 9.5 m
GY07	Group 6 Sign Gantry	New	Alignment A Ch 1765.00	N3 Westbound – 22.4 m
GY08	Group 6 Sign Gantry	New	Alignment A Ch 1311.00	N3 Westbound – 20.8 m
N3 / M50 Junction to Navan Road / Ashtown Road Junction				
GY05	Group 6 Sign Gantry	Existing – retain	Alignment A Ch 2818.00	N3 Westbound – 21.6 m
GY03	Group 6 Sign Gantry	Modify/Replace existing	Alignment A Ch 2988.00	R147 Outbound – 22.6 m
GY06	Group 6 Sign Gantry	Modify/Replace existing	Alignment A Ch 3316.00	R147 Outbound – 18.1 m
GY09	Group 6 Sign Gantry	Modify/Replace existing	Alignment A Ch 3916.00	R147 Outbound – 20.0 m

8.4 Summary of Miscellaneous Structures

8.4.1 Retaining Walls (<1.5m)

Figure 8.4 and Figure 8.5 indicate the locations of proposed retaining walls less than 1.5m high. Further details about each retaining wall are summarised within Table 8.4. In addition, a number of residential properties, where boundary walls are being relocated, are likely to incorporate retention of private gardens / frontages.

Figure 8.4: Retaining Walls RW10 to RW18 <1.5m - locations

Figure 8.5: Retaining Wall RW19 to RW21 <1.5m - locations

Table 8.4: Summary of Retaining Walls <1.5m

Ref.	Location	Chainage Start/ Chainage End	Length (m)	Max Retained Height (m)
N3 Blanchardstown Junction to Snugborough Road				
RW10	Blanchardstown Road South adjacent to Whitestown Grove	Blanchardstown Road South Ch 304.00- Ch 543.00	241	0.3
RW11	West of Crowne Plaza Junction	Alignment A Ch 140.00- Ch 156.00	16	0.3
RW12-1	Westbound Approach to Crowne Plaza Junction	Alignment A Ch 229.00 – Ch 255.00	27	0.5
RW 12-2		Alignment A Ch 269.00 – Ch 293.00	24	0.6
RW 12-3		Alignment A Ch 302.00 – Ch 326.00	25	0.6
RW 12-4		Alignment A Ch 339.00 – Ch375.00	36	0.4
RW 13	L3020 adjacent to Ben Dunne Gym, Blanchardstown, Dublin, Ireland	Alignment A Ch 703.00- Ch 741.00	36	0.9
Snugborough Road to N3 / M50 Junction				
RW 14	N3 eastbound verge connecting to Mill Road Northern Pedestrian Ramp	Alignment A Ch 1475.00-Ch 1545.00	66	0.7
RW 15	N3 eastbound verge at location of proposed overhead sign gantry	Alignment A Ch 1793.00 – Ch. 1801.00	8	0.5
RW 16	N3 adjacent to 3 Catherine's Well, Old River Road	Alignment A Ch 1854.00- Ch 1880.00	26	0.4

Ref.	Location	Chainage Start/ Chainage End	Length (m)	Max Retained Height (m)
RW 17	Between N3 westbound carriageway and N3 eastbound approach to M50/N3 Interchange	Alignment A Ch 2205.00- Ch 2310.00	107	0.9
RW 18	N3 eastbound verge on approach to M50/N3 Interchange	Alignment A Ch 2308.00- Ch 2342.00	34	1.3
N3 / M50 Junction to Navan Road / Ashtown Road Junction				
RW 19	Off ramp at Navan Road Parkway Westbound	Alignment A Ch 3939.00 – Ch 3979.00	41	1.3
Navan Road / Ashtown Road Junction to Navan Road / Old Cabra Road Junction				
RW 20	Between footpath and cycle track adjacent to pedestrian access to Aura De Paul swimming pool	Alignment A Ch 5542.00 - Ch 5548.00	6	0.3
RW 21	To rear of footpath at Cabra Garda Station	Alignment A Ch 6658.00 – Ch 6693.00	35	0.5

8.4.2 Bus Interchange Canopies

The proposed Bus Interchange at Blanchardstown Shopping Centre will provide six new covered waiting areas adjacent to the bus stops, accessed from a central pedestrian area to replace the current system of two individual bus shelters serving nine bus routes on either side of the four lane public road. Roof canopies of two heights will provide shelter for external circulation. Up-lighting on the canopies will be provided to create a safe environment for members of the public. The Bus Interchange bisects the shopping centre from the main shopping centre car park; at this intersection seating-height planters are proposed.

The canopies comprise of a concrete clad steel frame supported on circular columns. Drainage off each roof will be directed through the columns to a below ground rainwater drainage system, eased by the presence of green roofs incorporated into the roof of each canopy.

Refer to Bus Interchange Design Statement in Appendix P and Buildings / Architecture drawing series in Appendix B for further information.

8.4.3 Bus Interchange - Bus driver welfare facility

A bus driver welfare facility is to be located in proximity to the Blanchardstown Bus Interchange. This facility is proposed adjacent to the proposed bus layover spaces on Blanchardstown Road South, next to the retail park delivery access. This building will be a single storey pitched roof structure with canteen, shower and bathroom facilities.

Refer to Buildings / Architecture drawing series in Appendix B for further information.

8.4.4 Noise Barriers

Existing noises barriers located on the N3 westbound carriageway adjacent to Old River Road and Herbert Road are affected by the proposed works. These barriers will be relocated to back of proposed verge to accommodate the Proposed Scheme, while their existing length, height and coverage will be maintained to buildings they screen from the carriageway. Refer to Fencing and Boundary Treatment drawing series in Appendix B for their current location.

8.4.5 Digipoles/Digipanels

As part of the Proposed Scheme, road widening is required at locations where digital advertising panels are currently placed. The following panels or poles will be appropriately relocated to the adjacent footpath as part of the works:

- Navan Road - Belvedere sports ground - Outbound footpath; and
- Navan Road - Cabra Garda Station – Inbound footpath.

Refer to General Arrangement drawing series in Appendix B for details of their proposed locations.

9 Drainage, Hydrology and Flood Risk

9.1 Overview of Drainage Strategy

The drainage preliminary design was developed following consultation with the relevant Local Authorities and Irish Water, where applicable. The strategy and design parameters to be adopted throughout the Proposed Scheme is summarised in the Drainage Design Basis Statement Doc. No BCIDX_ARP-PMG_PS-0000_XX_00-SD-ZZ-0002 included in Appendix K. The design basis statement was developed taking account of the 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 practice, 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 Proposed Scheme and maintain the existing standard of service;
- To maintain existing run-off rates from existing and newly paved surfaces using Sustainable Urban Drainage Systems (SuDS); and
- To minimise the impact of the runoff from the carriageway on the surrounding environment using SuDS and/or silt traps.

No drainage features like gullies or manholes will be located at, or any ponding will be allowed to occur at, pedestrian cross-walk locations or at bus-stop locations. Where any such drainage features currently exist at such locations, they will be relocated. Drainage of newly paved areas includes SuDS measures to treat and attenuate any additional run-off. These measures ensure that there is:

- No increase in existing run-off rates from newly paved areas; and
- Appropriate treatment to ensure run-off 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 the Drainage Design Basis Statement in Appendix K.

9.2 Existing Watercourses and Culverts

All watercourse and crossing details in the vicinity of the Proposed Scheme have been identified as shown in Table 9.1 below. A Stage 1 Flood Risk Assessment (FRA) has been completed on the Preliminary Design and is summarised in Section 9.7. The Stage 1 FRA is contained in Appendix N.

The location of existing watercourses and culverts has been identified using OS Mapping (www.osi.ie) and EPA blue line network. The Proposed Scheme crosses the following watercourses:

Table 9.1: Location of Existing Watercourses

Watercourse	Chainage	Crossing Detail
River Tolka	A 1+115	Bridge
	A 1+485	Bridge
Royal Canal	A 2+500	Bridge

9.3 Existing Drainage Description

The Proposed Scheme extends from the N3/R121 intersection to Ellis Quay. Based on the information received from Irish Water / TII / Fingal County Council (1992) / MMaRC, the Proposed Scheme is serviced by surface water and combined drainage networks. The surface water drainage system is managed by the Local Authority, whilst combined sewer systems are managed by Irish Water. Flows are typically collected in standard gully grates and routed via a gravity network to outfall points. There are no SuDS/attenuation measures on the existing drainage networks to treat or attenuate run-off from the existing carriageway.

The existing drainage network along the scheme can be split into 21 catchment areas based on topography and the existing pipe network supplied by Irish Water / TII / Fingal CC (1992) / MMaRC. The approximate catchment areas, existing sewer networks, outfalls and watercourses are shown on the existing catchment drawings within the Proposed Surface Water Drainage Works drawing series in Appendix B. The catchments are summarised in Table 9.2.

Table 9.2: Summary of Existing Catchments

Existing Catchment Reference	Chainage	Approx. Drainage Catchment Area (km2)	Existing Network Type	Existing Outfalls
Catchment 1	A0+000 – A0+160, B0+000 – B0+660, E0+000 – E0+355	0.0979	Surface Water (Storm)	Network outfalls to the River Tolka
Catchment 2	A0+160 – A0+600, F0+000 – F0+352	0.3456	Surface Water (Storm)	Network outfalls to the River Tolka
Catchment 3	B0+660 – B0+895, C0+300 – C0+450, L0+095 – L0+195, A0+000 – A0+050 (left)	0.0846	Surface Water (Storm)	Network outfalls to the River Tolka
Catchment 4	C0+000 – C+300	0.0109	Surface Water (Storm)	Network outfalls to the River Tolka

Existing Catchment Reference	Chainage	Approx. Drainage Catchment Area (km2)	Existing Network Type	Existing Outfalls
Catchment 5	A0+600 – A1+025, A1+025 – A1+100 (Right)	0.0477	Surface Water (Storm)	Network outfalls to the River Tolka
Catchment 6	A1+025 – A1+100 (Left), A1+100 – A1+325, A1+325 – A1+390 (Right)	0.0189	Surface Water (Storm)	Network outfalls to the River Tolka
Catchment 7	A1+325 – A1+390 (Left) & A1+390 – A1+580	0.0101	Surface Water (Storm)	Network outfalls to the River Tolka
Catchment 8	A1+580 – A2+400	0.0875	Surface Water (Storm)	Network outfalls to the River Tolka
Catchment 9	A2+400 – A2+550 (left)	0.1147	Surface Water (Storm)	Network outfalls to the River Tolka
Catchment 10	A2+400 – A2+550 (right)	0.0550	Surface Water (Storm)	Network outfalls to the River Tolka
Catchment 11	A2+550 – A3+125 & Auburn Park Roundabout	0.0712	Surface Water (Storm)	Network outfalls to the River Tolka
Catchment 12	A3+125 – A4+830	0.0864	Surface Water (Storm)	Network outfalls to the Royal Canal
Catchment 13	A4+830 – A4+920, A4+920 – A5+020 (Left)	0.0059	Surface Water (Storm)	Network outfalls to the Royal Canal
Catchment 14	A4+920 – A5+020 (Right), A5+020 – A5+070	0.0486	Surface Water (Storm)	Network outfalls to the Royal Canal
Catchment 15	A5+070 - A5+460, A5+460 – A5+550 (Right),	0.0288	Surface Water (Storm)	Network discharging to surface water pipe that discharges to the existing pond/lake in Dublin Zoo. The outfall from the lake finally discharges to a combined sewer that flows to the Main Lift Pump House and partially discharges to the river Liffey through overflow pipes
Catchment 16	A5+460 – A5+550 (left),	0.1656	Surface Water	Network discharging to surface water pipe that discharges to the existing pond/lake in

Existing Catchment Reference	Chainage	Approx. Drainage Catchment Area (km2)	Existing Network Type	Existing Outfalls
	A5+550 - A6+390		(Storm) & Combined	Dublin Zoo. The outfall from the lake finally discharges to a combined sewer that flows to the Main Lift Pump House and partially discharges to the river Liffey through overflow pipes
Catchment 17	A6+390 – A6+745	0.0974	Surface Water (Storm)	Surface water network discharges to a combined which outfalls to Ringsend Main Lift Pumphouse which discharges to Ringsend Treatment Works with overflows to River Liffey
Catchment 18	A6+745 – A7+400	0.0747	Surface Water (Storm) & Combined	Network outfalls to Ringsend Main Lift Pumphouse which discharges to Ringsend Treatment Works with overflows to River Liffey
Catchment 19	A7+400 – A9+100, H0+014 – H0+173	0.6913	Surface Water (Storm) & Combined	Network outfalls to Ringsend Main Lift Pumphouse which discharges to Ringsend Treatment Works
Catchment 20	K0+000 – K0+070	0.0591	Surface Water (Storm) & Combined	Network outfalls to the River Liffey
Catchment 21	A9+100 – A9+492, G0+000 – G0+496 & J0+000 – J0+147	0.1572	Combined	Network outfalls to Ringsend Main Lift Pumphouse which discharges to Ringsend Treatment Works with overflows to River Liffey

9.4 Overview of Impacts of Proposed Works on Drainage/Runoff

Whilst in some areas the Proposed Scheme increases the impermeable areas, additional permeable areas are also provided by the softening of public realm along the route. The drainage design aims to sustain flow levels within the existing pipe network after a rainfall event by controlling discharge rates within each catchment. Flows are being controlled by the implementation of SuDS techniques. One of the principal objectives of the road drainage system is to minimise the impact of the run-off from the carriageway on the surrounding environment via the positioning of: filter drains, swales, bio retention areas, tree pits, silt traps and attenuation features if necessary. The welfare of pedestrians and cyclists is a high priority in the consideration of the drainage system design.

The proposed surface water drainage works are shown on drawings BCIDC-ARP-DNG_RD-0005_XX_00-DR-CD-0001 to DNG_RD-0005_XX_00-DR-CD-0040 in Appendix B.

Table 9.3 provides information on the proposed additional catchments (new paved areas) and the proposed permeable areas (current paved areas to become grassed).

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

Table 9.3: Summary of Increased Permeable and Impermeable Areas

Existing Catchment Reference	Chainage	Road Corridor Area (m2)	Change of use to Impermeable areas (m2)	Change of use to Permeable areas (m2)	Net Change (m2)	Percentage Change (%)
Catchment 1	A0+000 - A0+160, B0+000 – B0+660, E0+000 – E0+355	30257	6928	521	6407	21.2
Catchment 2	A0+160 – A0+600, F0+000 – F0+352	24763	6593	1252	5341	21.6
Catchment 3	B0+660 – B0+895, C0+300 – C0+450, L0+095 – L0+195, A0+000 – A0+050 (left)	15475	6	0	6	0.0
Catchment 4	C0+000 – C0+300	6250	388	202	186	3.0
Catchment 5	A0+600 – A1+025, A1+025 – A1+100 (Right)	7165	2295	347	1948	27.2
Catchment 6	A1+025 – A1+100 (Left), A1+100 – A1+325, A1+325 – A1+390 (Right)	16595	609	246	363	2.2

Existing Catchment Reference	Chainage	Road Corridor Area (m2)	Change of use to Impermeable areas (m2)	Change of use to Permeable areas (m2)	Net Change (m2)	Percentage Change (%)
Catchment 7	A1+325 – A1+390 (Left) & A1+390 – A1+580	9766	3144	139	3005	30.8
Catchment 8	A1+580 – A2+400	51934	3951	493	3458	6.7
Catchment 9	A2+400 – A2+550 (left)	2424	0	0	0	0.0
Catchment 10	A2+400 – A2+550 (right)	3738	0	0	0	0.0
Catchment 11	A2+550 – A3+125 & Auburn Park Roundabout	42656	2382	838	1544	3.6
Catchment 12	A3+125 – A4+830	80353	6361	3247	3114	3.9
Catchment 13	A4+830 – A4+920, A4+920 – A5+020 (left)	5998	1074	552	522	8.7
Catchment 14	A4+920 – A5+020 (right), A5+020 – A5+070	5504	309	0	309	5.6
Catchment 15	A5+070 - A5+460, A5+460 – A5+550 (right),	9957	970	0	970	9.7
Catchment 16	A5+460 – A5+550 (left), A5+550 - A6+390	18431	1710	0	1710	9.3
Catchment 17	A6+390 – A6+745	7605	458	39	419	5.5
Catchment 18	A6+745 – A7+400	17924	224	633	-409	-2.3
Catchment 19	A7+400 – A9+100, H0+014 – H0+173	41200	54	739	-685	-1.7
Catchment 20	K0+000 – K0+070	3651	0	299	-299	-8.2

Existing Catchment Reference	Chainage	Road Corridor Area (m2)	Change of use to Impermeable areas (m2)	Change of use to Permeable areas (m2)	Net Change (m2)	Percentage Change (%)
Catchment 21	A9+100 – A9+492, G0+000 – G0+496 & J0+000 – J0+147	18037	0	48	-48	-0.3

9.5 Preliminary Drainage Design

The existing drainage network is being maintained and used as the main discharge point for the new drainage system. The design aims to replicate the existing situation. Where new multiple gully connections discharging to a combined sewer are required, a new surface water pipe will be provided where practicable and connected to the combined sewer as per Irish Water requirements.

The following drainage systems were considered for the Proposed Scheme where new paved areas are proposed:

- **Sealed drainage (SD)** comprises gullies and sealed pipes. They collect, convey and discharge run-off. The gullies will be located within the kerbline mostly between the cycle track and bus lane, and/or the footpath and the cycle track, depending on the carriageway profile. Their location will also depend on the bicycle and/or bus wheel-track in consideration of the cycling safety and ride-quality.
- **Grass Surface Water Channels, Swales and bio-retention areas/rain gardens (SW/RG)** will be provided as road edge/footpath edge drainage collection systems. They will provide treatment and will provide attenuation if required. A filter drain can be laid under the bio-retention areas to keep them dry during low return period rainfall events.
- **Filter Drains (FD)** will be provided as road edge channels. These comprise a perforated pipe with granular surround and are designed to convey, attenuate and treat run-off prior to discharge.
- **Tree pits** will be provided in close proximity to the carriageway, where practicable. These receive flows from the sealed pipe network and from footpaths, and are designed to convey, attenuate and treat run-off prior to discharge.
- **Green Roofs (GR)** will be provided on the Bus Interchange roof canopy. These will discharge to downpipes located on the columns and outfall to the surface water network. The green roofs will provide a reduction in surface water runoff and also include visual benefit and ecological value.
- **Attenuation Tanks/oversize pipes (AT/OSP)** Where there is insufficient attenuation volume provided by the proposed SuDS drainage measures, hard attenuation measures such as concrete attenuation tanks and/or oversize pipes will be provided to meet the required attenuation volume.

9.5.1 Summary of Surface Water Drainage

The proposed drainage types for Blanchardstown to City Centre Scheme are listed on Table 9.4.

Table 9.4: Summary of Proposed Surface Water Infrastructure

Catchment	Chainage	Drainage Type
Asset Owner/Location: Fingal County Council		
Catchment 1	A0+000 to 0+050 (left)	Bio retention areas/rain gardens with underground storage & sealed pipe network
Catchment 2	A0+200 to 0+390 (both sides)	Tree pits, filter drain, sealed pipe network & oversized pipe
Catchment 2	A0+390 to 0+490 (both sides)	Tree pits, filter drain, sealed pipe network
Catchment 2	A0+490 to 0+600 (both sides)	Tree pits, filter drain, sealed pipe network & oversized pipe
Catchment 2	A0+575 to 0+600 (right)	Bio retention areas/rain gardens with underground storage
Catchment 4	C0+000 to C0+120 (left)	Filter drain
Catchment 4	C0+225 to C0+300 (both sides)	Bio retention areas/rain gardens
Catchment 5	A0+600 to 0+620 (right)	Bio retention areas/rain gardens with underground storage
Catchment 5	A0+600 (left)	Bio retention areas/rain gardens
Catchment 5	A0+620 to 0+747 (right)	Bio retention areas/rain gardens, oversized pipe
Catchment 5	A1+040 to 1+100 (right)	Filter drain
Catchment 6	A1+080 to 1+325 (left)	Bio retention areas/rain gardens, filter drain & sealed pipe network
Catchment 6	A1+160 to 1+390 (right)	Permeable paving
Catchment 7	A1+325 to 1+445 (left)	Permeable paving, bio retention areas/rain gardens & filter drain
Catchment 7	A1+390 to 1+485 (right)	Permeable paving, bio retention areas/rain gardens & filter drain
Catchment 7	A1+485 to 1+600 (right)	Oversized pipe
Catchment 7	A1+520 to 1+630 (left)	Permeable paving, bio retention areas/rain gardens, filter drain & oversized pipe
Catchment 8	A1+600 to 1+720 (right)	Permeable paving, bio retention areas/rain gardens & filter drain
Catchment 8	A1+700 to 1+800 (left)	Permeable paving
Catchment 8	A1+800 to 2+000 (left)	Sealed pipe network
Catchment 8	A1+910 to 2+000 (right)	Bio retention areas/rain gardens with underground storage & sealed pipe network
Catchment 8	A2+020 to 2+100 (right)	Bio retention areas/rain gardens with underground storage
Catchment 8	M0+000 to 0+150 (both sides)	Filter drain & sealed pipe network
Catchment 8	A2+100 to 2+300 (right)	Filter drain
Catchment 8	A2+220 to 2+320 (left)	Sealed pipe network & oversized pipe
Catchment 8	A2+320 to 2+400 (left)	Sealed pipe network
Catchment 11	A2+590 to 2+670 (both)	Bio retention areas/rain gardens & filter drain

Catchment	Chainage	Drainage Type
Catchment 11	A2+730 to 2+782 (Navan 1 -both sides)	Swale, filter drain & sealed pipe network
Catchment 11	A2+782 to 2+880 (Bus lane -both sides)	Swale, filter drain & sealed pipe network
Catchment 11	Auburn Park roundabout (Old Navan Road Castleknock Manor (both sides))	Bio retention areas/rain gardens & sealed pipe network
Catchment 11	A2+880 to 3+050 (right)	Filter drain
Catchment 12	A3+470 to 3+675 (right)	Bio retention areas/rain gardens, filter drain & oversized pipe
Catchment 12	A3+675 to 3+855 (right)	Filter drain
Catchment 12	A3+855 to 4+070 (left)	Filter drain
Catchment 12	A3+855 to 4+100 (right)	Oversized pipe
Catchment 12	A4+100 to 4+210 (right)	Sealed pipe network & oversized pipe
Catchment 12	A4+140 to 4+470 (left)	Tree pits, sealed pipe network & oversized pipe
Catchment 12	A4+210 to 4+505 (right)	Sealed pipe network & oversized pipe
Catchment 12	A4+470 to 4+660 (left)	Tree pits, filter drains & sealed pipe network
Catchment 12	A4+660 to 4+830 (both)	Tree pits, filter drain, bio retention areas/rain gardens & sealed pipe network
Catchment 1	B0+000 to 0+115 (both)	Permeable paving, tree pits, filter drain & sealed pipe network
Catchment 1	B0+115 to 0+280 (both)	Tree pits, filter drain, Bio retention areas/rain gardens & oversized pipe
Catchment 1	B0+280 to 0+450 (both)	Bio retention area/rain garden & oversized pipe
Catchment 1	B0+450 to 0+610 (both)	Bio retention area/rain garden, tree pits, filter drain & oversized pipe
Catchment 1	D0+000 to 0+100 (left)	Bio retention areas/rain gardens, filter drain, sealed pipe network & oversized pipe
Catchment 1	E0+000 to 0+080 (left)	Bio retention areas/rain gardens & sealed pipe network
Catchment 1	E0+030 to 0+080 (right)	Bio retention areas/rain gardens & sealed pipe network
Catchment 1	E0+080 to 0+230 (right)	Permeable paving, Tree pits, filter drain
Catchment 1	E0+080 to 0+230 (left)	Tree pits, filter drain
Catchment 1	E0+230 to 0+360 (left)	Tree pits, filter drain & sealed pipe network
Catchment 2	F0+000 to 0+334 (both sides)	Green roof, bio retention area/rain garden, tree pits, filter drain, sealed pipe network & oversized pipes
Asset Owner/Location: Dublin City Council		
Catchment 13	A4+830 to 4+870 (right)	Bio retention areas/rain gardens, tree pits & filter drain
Catchment 13	A4+830 to 4+850 (left)	Bio retention areas/rain gardens, tree pits & filter drains

Catchment	Chainage	Drainage Type
Catchment 13	A4+850 to 5+020 (left)	Bio retention areas/rain gardens, tree pits, filter drains & sealed pipe network
Catchment 13	A4+870 to 4+920 (right)	Bio retention areas/rain gardens & tree pits
Catchment 14	A4+990 to 5+020 (right)	Sealed pipe network
Catchment 14	A5+020 to 5+070 (right)	Sealed pipe network
Catchment 14	A5+020 to 5+070 (left)	Bio retention areas/rain gardens, filter drain & sealed pipe network
Catchment 15	A5+070 to 5+450 (left)	Bio retention areas/rain gardens, filter drain, sealed pipe network & oversized pipe
Catchment 15	A5+070 to 5+230 (right)	Sealed pipe network
Catchment 15	A5+450 to 5+550 (right)	Sealed pipe network
Catchment 16	A5+550 to 5+700 (right)	Sealed pipe network
Catchment 16	A5+450 to 5+620 (left)	Sealed pipe network
Catchment 16	A5+620 to 5+760 (left)	Tree pits & filter drain
Catchment 16	A5+760 to 5+890 (left)	Tree pits & filter drain
Catchment 16	A5+920 to 6+135 (right)	Tree pits & filter drain
Catchment 16	A6+260 to 6+374 (right)	Oversized pipe
Catchment 17	A6+374 to 6+488 (right)	Sealed pipe network
Catchment 17	A6+465 to 6+642 (left)	Tree pits, filter drain & sealed pipe network
Catchment 17	A6+642 to 6+745 (left)	Sealed pipe network
Catchment 18	A6+745 to 6+900 (both sides)	Sealed pipe network
Catchment 18	A7+075 to 7+260 (right)	Sealed pipe network & oversized pipe
Catchment 18	A7+280 to 7+400 (left)	Bio retention area/rain garden
Asset Owner/Location: Irish Water/ Dublin County Council		
Catchment 19	A7+400 to 7+560 (left)	Bio retention area/rain garden
Catchment 19	A7+560 to 7+720 (left)	Sealed pipe network
Catchment 19	A8+040 to 8+080 (left)	Sealed pipe network
Catchment 19	A8+210 to 8+285 (both sides)	Bio retention areas/rain gardens & sealed pipe network
Catchment 19	A8+285 to 8+400 (both sides)	Sealed pipe network

Catchment	Chainage	Drainage Type
Catchment 19	A8+400 to 8+685 (both sides)	Bio retention areas/rain gardens & sealed pipe network
Catchment 19	A8+685 to 8+730 (left)	Sealed pipe network
Catchment 19	A8+685 to 8+730 (right)	Bio retention areas/rain gardens & sealed pipe network
Catchment 19	A8+730 to 9+000 (right)	Tree pits, filter drain, bio retention areas/rain gardens & sealed pipe network
Catchment 19	A9+000 to 9+100 (both sides)	Sealed pipe network
Catchment 21	A9+140 to 9+290 (both sides)	Sealed pipe network
Catchment 21	A9+290 to 9+360 (right)	Sealed pipe network
Catchment 21	A9+380 to 9+440 (right)	Sealed pipe network
Catchment 21	G0+000 to 0+060 (both sides)	Sealed pipe network
Catchment 21	G0+390 to G0+495 (King Street North - both sides)	Bio retention areas/rain gardens, sealed pipe network
Catchment 19	H0+030 to 0+150 (Brunswick Street North - both sides)	Sealed pipe network
Catchment 20	George’s Lane (both sides)	Bio retention areas/rain gardens

9.5.2 Summary of Attenuation Features, SuDS and Outfalls

Where practicable, and in new areas of public realm gained as part of the design, a sustainable drainage system is considered in the form of rain gardens, bioretention areas, filter drains, swales, tree pits, permeable paving etc. SuDS is also considered in existing areas, where practicable.

The attenuation measures from the Proposed Scheme are summarised for each catchment. Refer to Table 9.5. Chainage locations not shown in Table 9.5 below do not require attenuation or SuDS.

Table 9.5: Summary of Proposed Attenuation Features, SuDS & Outfalls

Chainage	Existing Catchment Reference (Refer to Table 9.2)	Approx. Impermeable Surface Area		Permitted Discharge (l/s)	Possible SuDS solution/ attenuation measure	Catchment Outfall
		Existing (m2)	Change (m2)			
Asset owner/Location: Fingal County Council						
A0+000 to 0+050 (left)	Catchment 1	406	454	5.7	RG with underground storage 11m3	Existing SW, Ch A0+015
A0+200 to 0+390 (both sides)	Catchment 2	1890	1479	26.6	Tree Pits, 201m of 225mm FD,	Existing SW, Ch A0+390

Chainage	Existing Catchment Reference (Refer to Table 9.2)	Approx. Impermeable Surface Area		Permitted Discharge (l/s)	Possible SuDS solution/ attenuation measure	Catchment Outfall
		Existing (m2)	Change (m2)			
					31m of 225mm SW 58m of 300mm OSP 92m of 375mm OSP	
A0+390 to 0+490 (both sides)	Catchment 2	1724	607	24.1	Tree Pits, 85m of 225mm FD, 175m of 225mm SW	Existing SW, Ch A0+495
A0+490 to 0+600 (both sides)	Catchment 2	1108	802	15.6	Tree Pits, 124m of 225mm FD, 16m of 225mm SW, 47m of 300mm OSP	Existing SW, Ch A0+590
A0+575 to 0+600 (right)	Catchment 2	428	286	6	RG with underground storage 3.1m3	Existing SW, Ch A0+590
A0+600 to 0+620 (right)	Catchment 5	719	117	10	RG with underground storage 4m3	Existing SW, Ch A0+650
A0+620 to 0+747 (right)	Catchment 5	1226	1232	17.3	33m of 450mm OSP 49m of 600mm OSP	Existing SW, Ch A0+735
A1+040 to 1+100 (right)	Catchment 5	402	228	5.6	50m of 225mm FD	Existing SW, Ch A1+090
A1+080 to 1+325 (left)	Catchment 6	2901	249	40.4	215m of 300mm FD	Existing SW, Ch A1+880
A1+325 to 1+445 (left)	Catchment 7	826	105811 03	11.1	103m of 300mm FD RG with underground storage 8m3	Existing SW, Ch A1+445
A1+390 to 1+485 (right)	Catchment 7	1245	458	17.4	67m of 300mm FD	Existing SW, Ch A1+455
A1+485 to 1+600 (right)	Catchment 7	1379	391	18.3	94m of 300mm OSP	Existing SW, Ch A1+564
A1+520 to 1+630 (left)	Catchment 7	732	1050	9.6	44m of 375mm FD 26m of 525mm OSP	Existing SW, Ch A1+615
A1+600 to 1+720 (right)	Catchment 8	1532	1375	21.6	92m of 375mm FD	Existing SW, Ch A1+720

Chainage	Existing Catchment Reference (Refer to Table 9.2)	Approx. Impermeable Surface Area Existing (m2)	Change (m2)	Permitted Discharge (l/s)	Possible SuDS solution/ attenuation measure	Catchment Outfall
					RG with underground storage 12m3	
A1+800 to 2+000 (left)	Catchment 8	1280	242	17.8	131m of 225mm SW	Existing SW, Ch A1+914
A1+910 to 2+000 (right)	Catchment 8	677	193	9.5	RG with underground storage 12.4m3	Existing SW, Ch A1+940
M0+000 to 0+150 (both sides)	Catchment 8	1823	98	25.3	31m of 300mm FD 35m of 375mm FD	Existing SW, Ch A1+990
A2+020 to 2+100 (right)	Catchment 8	2350	290	32.7	RG with underground storage 25.6m3	Existing SW, Ch A2+080
A2+100 to 2+300 (right)	Catchment 8	2305	365	32.1	58m of 225mm FD 38m of 375mm FD 41m of 450mm FD	Existing SW, Ch A2+140
A2+220 to 2+320 (left)	Catchment 8	701	390	9.8	42m of 300mm OSP 38m of 225mm SW	Existing SW, Ch A2+220
A2+320 to 2+400 (left)	Catchment 8	745	76	10.5	51m of 225mm SW	Existing SW, Ch A2+330
A2+590 to 2+670 Navan 1 (both)	Catchment 11	1032	486	14.4	52m of 225mm FD RG with underground storage 11m3	Existing SW, Ch A2+670
A2+730 to 2+782 Navan 1 (both)	Catchment 11	482	252	6.8	45m of 225mm FD, Swale 15m3	Existing SW, Ch A2+740
A2+782 to 2+880 Bus Lane (both)	Catchment 11		150	2.0	27m of 225mm FD	Existing SW, Ch A2+785
	Catchment 11		421	2.0	12m of 225mm FD	Existing SW, Ch A2+865
Old Navan Road (right)	Catchment 11	124	114	2.0	RG 2m3	Existing SW, Ch A2+900
Old Navan Rod (left)	Catchment 11	125	125	2.0	RG 1m3	Existing SW, Ch A2+900

Chainage	Existing Catchment Reference (Refer to Table 9.2)	Approx. Impermeable Surface Area		Permitted Discharge (l/s)	Possible SuDS solution/ attenuation measure	Catchment Outfall
		Existing (m2)	Change (m2)			
& Auburn Ave (both)						
Castle-knock Manor (both)	Catchment 11	184	196	2.0	RG 4m3	Existing SW, Ch A2+900
A2+880 to 3+050 (right)	Catchment 11	2179	148	30.3	124m of 300mm FD	Existing SW, Ch A3+050
A3+470 to 3+675 (right)	Catchment 12	3471	585	48.3	Tree Pits, 65m of 225mm FD 60m of 300mm FD 73m of 300mm OSP	Existing SW, Ch A3+675
A3+675 to 3+855 (right)	Catchment 12	955	364	13.3	72m of 450mm FD	Existing SW, Ch A3+769
A3+855 to 4+100 (right)	Catchment 12	1279	769	17.9	75m of 450mm OSP 32m of 525mm OSP	Existing SW, Ch A3+982
A3+855 to 4+070 (left)	Catchment 12	1874	243	26.1	100m of 225mm FD 27m of 450mm FD 42m of 525mm FD	Existing SW, Ch A4+042
A4+100 to 4+210 (right)	Catchment 12	1961	359	27.3	71m of 225mm SW 39m of 300mm OSP	Existing SW, Ch A4+100
A4+140 to 4+470 (left)	Catchment 12	2096	1158	29.4	Tree Pits, 32m of 225mm SW 200m of 300mm OSP	Existing SW, Ch A4+230
A4+210 to 4+505 (right)	Catchment 12	3425	136	47.648.2	128m of 225mm SW 86m of 300mm OSP	Existing SW, Ch A4+210
A4+470 to 4+660 (left)	Catchment 12	887	478	12.4	Tree Pits, 69m of 225mm FD 63m of 300mm FD	Existing SW, Ch A4+522
A4+660 to 4+830 (both)	Catchment 12	3162	467	44.0	Tree Pits, 105m of 300mm FD	Existing SW, Ch A4+650

Chainage	Existing Catchment Reference (Refer to Table 9.2)	Approx. Impermeable Surface Area		Permitted Discharge (l/s)	Possible SuDS solution/ attenuation measure	Catchment Outfall
		Existing (m2)	Change (m2)			
					207m of 225mm SW 20m of 300mm SW	
B0+000 to 0+115 (both)	Catchment 1	1971	416	27.5	Tree Pits, 78m of 375mm FD	Existing SW, Ch E0+092
B0+115 to 0+280 (both)	Catchment 1	3931	260	54.7	Tree Pits, 74m of 375mm FD 24m of 275mm SW	Existing SW, Ch B0+245
B0+280 to 0+450 (both)	Catchment 1	3429	1569	47.9	146m of 600mm OSP	Existing SW, Ch B0+440
B0+450 to 0+610 (both)	Catchment 1	2846	979	39.1	Tree Pits, 95m of 225mm FD 65m of 375mm OSP 42m of 300mm FD	Existing SW, Ch B0+600
C0+000 to 0+120 (left)	Catchment 4	307	94	8.9	68m of 300mm FD	Existing SW, Ch C0+015
D0+000 to 0+100 (left)	Catchment 1	2070	816	28.9	Tree Pits, 15m of 225mm SW 27m of 300mm FD 28m of 300mm OSP 19m of 375mm OSP 18m of 450mm OSP	Existing SW, Ch A0+015
E0+030 to 0+080 (right)	Catchment 1	190	270	2.0	RG with underground storage 5.3m3	Existing SW, Ch E 0+080
E0+080 to 0+230 (right)	Catchment 1	1275	725	17.9	107m of 300mm FD	Existing SW, Ch E 0+225
E0+080 to 0+230 (left)	Catchment 1	1508	372	21.0	Tree Pits, 45m of 225mm FD 47m of 300mm FD	Existing SW, Ch E0+220
E0+230 to 0+360 (left)	Catchment 1	1706	272	23.8	Tree Pits, 45m of 225mm FD 48m of 225mm SW 23m of 300mm FD	Existing SW, Ch E0+220

Chainage	Existing Catchment Reference (Refer to Table 9.2)	Approx. Impermeable Surface Area		Permitted Discharge (l/s)	Possible SuDS solution/ attenuation measure	Catchment Outfall
		Existing (m2)	Change (m2)			
F0+000 to 0+334 (both)	Catchment 2	12800	2502	143.5	Tree Pits, 230m of 225mm FD 26m of 225mm SW 89m of 300mm FD 120m of 300mm OSP 121m of 375mm FD 430m of 375mm OSP	Existing SW, Ch F0+320
Asset owner/Location: Dublin City Council						
A4+830 to 4+850 (left)	Catchment 13	340	290	4.8	Tree Pits, RG with underground storage 4.4m3	Existing SW, Ch A4+850
A4+830 to 4+870 (right)	Catchment 13	728	140	10.2	Tree Pits, RG with underground storage 3m3	Existing SW, Ch A4+855
A4+850 to 5+020 (left)	Catchment 13	1820	170	25.4	Tree Pits, 39m of 225mm FD 117m of 225mm SW	Existing SW, Ch A4+860
A4+990 to 5+020 (right)	Catchment 14	365	75	5.1	33m of 225mm FD	Existing SW, Ch A5+020
A5+020 to 5+070 (right)	Catchment 14	517	73	7.2	46m of 225mm SW	Existing SW, Ch A5+020
A5+020 to 5+070 (left)	Catchment 14	371	84	5.2	Raingarden with storage area 1m3	Existing SW, Ch A5+040
A5+070 to 5+230 (right)	Catchment 15	1445	272	20.1	139m of 225mm SW	New SW, Ch5+210
A5+070 to 5+450 (left)	Catchment 15	3962	576	55	20m of 225mm FD 21m of 225mm SW 90m of 300mm OSP 240m of 450mm OSP	Existing SW, Ch A5+460

Chainage	Existing Catchment Reference (Refer to Table 9.2)	Approx. Impermeable Surface Area		Permitted Discharge (l/s)	Possible SuDS solution/ attenuation measure	Catchment Outfall
		Existing (m2)	Change (m2)			
A5+450 to 5+550 (right)	Catchment 15	804	126	11.2	78m of 225mm SW	Existing SW, Ch A5+540
A5+450 to 5+620 (left)	Catchment 16	1541	359	20.9	154m of 225mm SW	Existing SW, Ch A5+615
A5+550 to 5+700 (right)	Catchment 16	1385	185	19.3	141m of 225mm SW	Existing SW, Ch A5+700
A5+620 to 5+760 (left)	Catchment 16	1957	313	27.2	Tree Pits, 112m of 300mm FD	Existing SW, Ch A5+760
A5+760 to 5+890 (left)	Catchment 16	1544	356	21.5	Tree Pits, 96m of 300mm FD	Existing SW, Ch A5+860
A5+920 to 6+135 (right)	Catchment 16	2897	534	40.3	Tree Pits, 62m of 225mm FD 127m of 300mm FD	Existing SW, Ch A6+135
A6+260 to 6+374 (right)	Catchment 16	2079	121	28.9	88m of 300mm SW	Existing SW, Ch A6+260
A6+374 to 6+488 (right)	Catchment 17	1084	63	15.1	52m of 225mm SW	Existing SW, Ch A6+488
A6+465 to 6+642 (left)	Catchment 17	1330	260	18.5	Tree Pits, 128m of 225mm FD 5m of 300mm SW	Existing SW, Ch A6+575
A6+642 to 6+745 (left)	Catchment 17	1968	108	27.4	50m of 225mm SW	Existing SW, Ch A6+562
A6+745 to 6+900 (left)	Catchment 18	1278	112	17.8	121m of 225mm SW	Existing SW, Ch A6+900
A7+075 to 7+260 (right)	Catchment 18	2196	224	30.6	96m of 225mm SW 64m of 300mm OSP	Existing SW, Ch A7+270

9.6 Drainage at New Bridge Structures

The Proposed Scheme is inclusive of a new bus stop for Connolly Hospital on the N3. The walkway access structures are surrounded by thick vegetation and are located on an embankment down to Mill Road. It is therefore not practicable to provide SuDS features to attenuate for these additional impermeable areas. Over the edge drainage is therefore being proposed for these structures.

9.7 Flood Risk

A Flood Risk Assessment (FRA) has been prepared as part of the planning application for the Proposed Scheme.

The Stage 1 FRA is a high-level study of the scheme to identify flood risks to the Proposed Scheme and any potential flooding issues arising due to the scheme. The FRA informs the planning process and identifies whether a further Stage 2 FRA is required.

The FRA includes the following:

- Confirmation of the sources of flooding which may affect the site;
- A qualitative assessment of the risk of flooding to the site and to adjacent sites as a result of construction of the proposed development;
- Review of the availability and adequacy of existing information;
- Identification of possible measures which could mitigate the flood risk to acceptable levels; and
- Areas for further investigation (Stage 2 FRA) if required.

Section 9.7.1 summarises the Stage 1 FRA which is included in Appendix N.

9.7.1 Flood Risk Assessment

The FRA has been carried out as part of the Planning Application for the Proposed Scheme.

There are a number of historic flood events at different locations along or near to the Proposed Scheme. The Proposed Scheme is largely on existing carriageways and results in minimal additional paved areas.

Therefore, the Proposed Scheme does not increase the risk of these events reoccurring compared to the current scenario.

The route lies in an area at low risk of flooding from surrounding rivers, such as the Rivers Tolka and Liffey.

The nearest distance of the Proposed Scheme to the coastal boundary, located at Ellis Quay, measures approximately 1km, and is elevated above sea level. There is therefore no risk of coastal flooding to the Proposed Scheme in the present, or future climate change scenario.

The OPW Preliminary Flood Risk Assessments Groundwater Flooding Report concludes that groundwater flooding is largely confined to the West Coast of Ireland due to the hydrogeology of the area. The proposed works do not involve any deep excavations, significant changes in levels or basement construction. As the Proposed Scheme is on existing roads with no known flooding specifically due to groundwater, it is not expected that this risk will increase to the site or surrounding areas due to the construction of the Proposed Scheme. The risk of groundwater flooding to the site is therefore considered low.

The risk of pluvial flooding along the majority of the proposed route is high, however this risk exists in the current scenario and will be reduced as a result of the Proposed Scheme.

All new surface water pipelines provided as part of the Proposed Scheme will be designed so that no flooding will occur for a return period up to 30 years. This is an improvement when compared to some of the existing historical drainage infrastructure to be replaced and will reduce the risk of pluvial flooding. Also, as part of the Proposed Scheme, new drainage infrastructure is being provided which includes new Sustainable (Urban) Drainage Systems (SuDS) such as rain gardens, swales and bio retention tree pits. These SuDS features provide some surface water storage and thus reduce the risk of pluvial flooding.

As the proposed route from Blanchardstown to City Centre lies within Flood Zone C, a ‘Justification Test’ is not required and it is necessary only to identify mitigation measures for any residual risks, which has been undertaken as part of this flood risk assessment. From the assessment no residual risks have been identified.

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 scheme. Some areas of conflict were designed out at this stage; however, some remain and will be accommodated within the overall scheme design.

10.1.1 Record Information

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

- Irish Water
- Gas Networks Ireland (GNI)
- Electricity Supply Bord (ESB)
- Eir
- Virgin Media
- BT
- Vodafone
- Enet
- Fingal County Council
- Dublin City Council

10.1.2 Phase 1 Utility Survey

A targeted utility survey to *British Standards Institution (BSI) PAS 128A, Specification for underground utility detection, verification and location* including Ground Penetrating Radar (GPR), was commissioned by the NTA to investigate areas where there is risk identified to existing high value assets such as high voltage ESB cables, high pressure gas mains and trunk water mains due to the proposed carriageway alignment. Some areas where there is a high concentration of utility diversions proposed were also surveyed to ensure that adequate spacing is available for relocation of assets. The results of the utility survey have been reviewed to confirm the adequacy of design provisions made with respect to diversion proposals. Additionally, a more extensive utility survey will be completed to inform the detailed design phase of the scheme.

10.1.3 Consultation with Utility Service Providers

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

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

10.2 Overview of Service Diversions

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

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

The principal statutory and other service providers affected are:

- ESB;
- Irish Water (Water & Public Sewer);
- GNI; and
- Telecommunication Services – Eir, Virgin Media, eNet & BT.

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

The services conflicts and the associated diversions will need to be considered in the design and construction of the 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. In addition to chambers identified as Eir assets on the topographical survey that are identified as requiring modification, there are other chambers that might contain telecommunications asset that are impacted by the Proposed Scheme. Further investigation is required to confirm at the construction design stage.

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

The service diversions required for the Proposed Scheme are discussed in the following paragraphs and are summarised in Tables 10.1 to 10.5.

The locations of all known services from records provided from the service providers are shown on Combined Existing Utilities Records Drawings in Appendix B.

10.3 Summary of Recommended Diversions

10.3.1 Gas Networks Ireland

No impacts to high pressure gas mains have been identified. There are five locations where GNI medium pressure gas mains will require a diversion. There are six locations where GNI low pressure gas mains will require a diversion. Table 10.1 outlines potential diversions of Gas Networks Ireland services and are illustrated on drawing series BCIDC-ARP-UTL_UG-0005__XX_00-DR-CU-0001 to 0040 in Appendix B.

Table 10.1: GNI Asset Diversions

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R05-UG-MP-001	GNI	F0+040 – F0+210 RHS	Medium pressure gas main	Proposed diversion length of 177m for GNI utility.
R05-UG-MP-002	GNI	A0+210 – A0+230 RHS	Medium pressure gas main	Proposed diversion length of 20m for GNI utility.
R05-UG-MP-003	GNI	A0+550 – A0+570 RHS	Medium pressure gas main on L3020	Proposed diversion length of 30m for GNI utility.
R05-UG-LP-004	GNI	A2+075 – A2+120 RHS	Low pressure gas main along the N3.	Proposed diversion length of 45m for GNI utility.
R05-UG-LP-005	GNI	A2+240 – A2+250 LHS	Low pressure gas mains	Proposed diversion around retaining wall to be constructed.
R05-UG-LP-006	GNI	A4+560 – A4+610 LHS	Low pressure gas main along Navan Road.	Proposed diversion length of 51m for GNI utility.
R05-UG-MP-007	GNI	A4+560 – A4+610 LHS	Medium pressure gas main on Navan Rd.	Proposed diversion length of 46m for GNI utility.
R05-UG-LP-008	GNI	A4+800 – A4+855 LHS	Low pressure gas main on Navan Rd.	Proposed diversion length of 35m for GNI utility.
R05-UG-LP-009	GNI	A5+625 – A5+850 LHS	Low pressure gas main along Navan Road.	Proposed diversion length of 227m for GNI utility.
R05-UG-MP-010	GNI	A5+970 – A6+250 RHS	Medium pressure gas main along Navan Road.	Proposed diversion length of 158m for GNI utility.
R05-UG-LP-011	GNI	A6+490 – A6+580 LHS	Low pressure gas main along Navan Road.	Proposed diversion length of 94m for GNI utility.

10.3.2 ESB

No impacts to high voltage cables have been identified. There are seventeen sections of medium voltage underground cabling which will require diversions along the route. There are five sections of low voltage underground cabling which will require diversions along the route. Table 10.2 outlines several potential diversions for ESB services and are illustrated on drawing series BCIDC-ARP-UTL_UE-0005_XX_00-DR-CU-0001 to 0040 in Appendix B.

Table 10.2: ESB Asset Diversions

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R0-UE-MV-001	ESB	E0+075 – F0+210 LHS	Medium voltage ducting	Proposed diversion length of 4 x 490m for ESB utility.
R05-UE-MV-002	ESB	B0+020 – E0+130 RHS	Medium voltage ducting	Proposed diversion length of 110m for ESB utility.
R05-UE-MV-003	ESB	F0+045 – F0+085 RHS	Medium voltage ducting	Proposed diversion length of 39m for ESB utility.
R05-UE-MV-004	ESB	D0+000 – D0+100 LHS	Medium voltage ducting	Proposed diversion length of 3 x 136m for ESB utility.
R05-UE-MV-005	ESB	A0+200 – A0+230 LHS	Medium voltage ducting	Proposed diversion length of 67m for ESB utility.
R05-UE-MV-006	ESB	A0+550 – A0+580 RHS	Medium voltage ducting	Proposed diversion length of 80m for ESB utility.
R05-UE-MV-007	ESB	A1+460 – A1+605 LHS	Medium voltage ducting along the N3.	Proposed diversion length of 146m for ESB utility.
R05-UE-MV-008	ESB	A1+620 – A1+725 RHS	Medium voltage ducting along the N3.	Proposed diversion length of 2 x 50m for ESB utility.
R05-UE-MV-009	ESB	A1+900 – A1+945 RHS	Medium voltage ducting along the N3.	Proposed diversion length of 52m for ESB utility.
R05-UE-MV-010	ESB	A2+020 – A2+110 RHS	Medium voltage ducting along the N3.	Proposed diversion length of 93m for ESB utility.
R05-UE-MV-011	ESB	A2+210 – A2+310 LHS	Medium voltage ducting along the N3.	Proposed diversion length of 100m for ESB utility.
R05-UE-MV-012	ESB	A2+950 – A3+000 LHS	Medium voltage ducting along Navan Road.	Proposed diversion length of 2 x 51m for ESB utility.
R05-UE-MV-013	ESB	A4+190 – A4+750 LHS	Medium voltage ducting along Navan Road.	Proposed diversion length of 540m for ESB utility.
R05-UE-MV-014	ESB	A4+750 – A4+870 LHS	Medium voltage ducting along Navan Road.	Proposed diversion length of 145m for ESB utility.

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R05-UE-LV-015	ESB	A4+730 – A4+860 LHS	Low voltage ducting along Navan Road.	Proposed diversion length of 120m for ESB utility.
R05-UE-LV–016	ESB	A5+630 – A5+900 LHS	Low voltage cable along Navan Road.	Proposed diversion length of 260m for ESB utility.
R05-UE-MV-017	ESB	A5+660 – A5+900 LHS	Medium voltage ducting along Navan Road.	Proposed diversion length of 243m for ESB utility.
R05-UE-LV–018	ESB	A6+435 – A6+630 LHS	Low voltage cable along Navan Road.	Proposed diversion length of 165m for ESB utility.
R05-UE-MV-019	ESB	A6+480 – A6+565 LHS	Medium voltage ducting along Navan Road.	Proposed diversion length of 87m for ESB utility.
R05-UE-LV–020	ESB	A8+270 – A8+320 LHS	Low voltage ducting along Prussia Street.	Proposed diversion length of 52m for ESB utility.
R05-UE-MV/LV-021	ESB	A8+680 – A8+720 LHS	Medium and low voltage ducting along Manor Street.	Proposed diversion length of 2 x 40m for ESB utility.
R05-UE-LV-022	ESB	H0+015 – H0+045 LHS	Low voltage cable crossing George’s Lane junction.	Proposed diversion length of 33m for ESB utility.

10.3.3 Irish Water – Watermains

There are eighteen sections of watermains which will require diversions along the route. Table 10.3 outlines several potential diversions for watermain services and are illustrated on drawing series BCIDC-ARP-UTL_UW-0005_XX_00-DR-CU-0001 to 0040 in Appendix B.

Table 10.3: Irish Water – Watermain Asset Diversions

Reference No.	Utility Provider	Chainage	Asset/Apparatus Impacted	Description of Works
R05-UW-001	Irish Water	F0+045 – F0+210 RHS	300mm dia. D.I watermain	Proposed diversion length of 170m for watermain utility.
R05-UW-002	Irish Water	A0+200 – A0+230 LHS	Watermain	Proposed diversion length of 65m for watermain utility.
R05-UW-003	Irish Water	A0+550 – A0+570 RHS	300mm dia. D.I watermain	Proposed diversion length of 35m for watermain utility.
R05-UW-004	Irish Water	A1+590 – A1+700 RHS	Watermain located along the N3.	Proposed diversion length of 124m for watermain utility.
R05-UW-005	Irish Water	A1+900 – A1+950 RHS	Watermain located along the N3.	Proposed diversion length of 48m for watermain utility.

Reference No.	Utility Provider	Chainage	Asset/Apparatus Impacted	Description of Works
R05-UW-006	Irish Water	A3+940 – A3+965 RHS	Watermain located along the Navan Road.	Proposed diversion length of 34m for watermain utility.
R05-UW-007	Irish Water	A4+500 – A4+580 LHS	Watermain located along the Navan Road.	Proposed diversion length of 83m for watermain utility.
R05-UW-008	Irish Water	A4+550 – A4+560 RHS	Watermain located along the southern side of Navan Road.	Proposed diversion length of 22m for watermain utility.
R05-UW-009	Irish Water	A4+790 – A4+850 LHS	Watermain located along the Navan Road.	Proposed diversion length of 58m for watermain utility.
R05-UW-010	Irish Water	A4+875 – A4+940 RHS	Watermain located along the Navan Road.	Proposed diversion length of 75m for watermain utility.
R05-UW-011	Irish Water	A5+460 – A5+475 LHS	Watermain located along the Navan Road.	Proposed diversion length of 17m for watermain utility.
R05-UW-012	Irish Water	A5+460 – A5+475 LHS	Watermain located along the Navan Road.	Proposed diversion length of 17m for watermain utility.
R05-UW-013	Irish Water	A5+720 – A5+880 LHS	Watermain located along the Navan Road.	Proposed diversion length of 168m for watermain utility.
R05-UW-014	Irish Water	A5+965 – A5+980 LHS	Watermain located along the Navan Road.	Proposed diversion length of 16m for watermain utility.
R05-UW-015	Irish Water	A5+970 – A6+250 RHS	Watermain located along the Navan Road.	Proposed diversion length of 267m for watermain utility.
R05-UW-016	Irish Water	A6+260 – A6+275 LHS	Watermain located along the Navan Road.	Proposed diversion length of 15m for watermain utility.
R05-UW-017	Irish Water	A7+030 – A7+040 LHS	Watermain located along the Navan Road	Proposed diversion length of 14m for watermain utility.
R05-UW-018	Irish Water	n/a	Watermain located along the North Circular Road.	Proposed diversion length of 14m for watermain utility.

10.3.4 Irish Water – Foul Sewers

There is one foul sewer main which will require diversion along the route. There are two foul sewer main manhole cover adjustments which will also be required along the route. Table 10.4 outlines potential diversions for foul sewer services and are illustrated on drawing series BCIDC-ARP-UTL_UD-0005_XX_00-DR-CU-0001 to 0040 in Appendix B.

Table 10.4: Irish Water-Foul Sewer Asset Diversions

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R05-UD-001	Irish Water	A1+580 LHS	375mm foul sewer crossing N3.	Proposed diversion length of 6m for foul sewer to avoid clash with proposed new ramp structure.
R05-UD-002	Irish Water	A5+410 RHS	Foul sewer located along the Navan Road.	Proposed manhole cover adjustment to avoid clash with new kerbline.
R05-UD-003	Irish Water	A7+850 RHS	Foul sewer located along the Old Cabra Road.	Proposed manhole cover adjustment to avoid clash with new kerbline.

10.3.5 Telecommunications

There are fifty-seven locations along the route where conflicts with telecommunications infrastructure occur, and diversions or relocations will be required. In addition to chambers identified as Eir assets on the topographical survey that are identified as requiring modification, there are other chambers that might contain telecommunications asset that are impacted by the Proposed Scheme. Further investigation is required to confirm at the construction design stage.

Table 10.5 outlines several potential diversions for telecommunication services and are illustrated on drawing series BCIDC-ARP-UTL_UL-0005_XX_00-DR-CU-0001 in Appendix B.

Table 10.5: Telecoms Asset Diversions

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R05-UT-001	EIR	C0+360 RHS	Eir chamber located along Old Navan Road	Proposed chamber relocation for telecom utility.
R05-UT-002	EIR	B0+320 LHS	Eir chamber located along Blanchardstown Road South.	Proposed chamber relocation for telecom utility.
R05-UT-003	EIR	B0+340 LHS	Eir chamber located along Blanchardstown Road South.	Proposed chamber relocation for telecom utility.
R05-UT-004	EIR	B0+580 – B0+655 RHS	Eir ducting located along Blanchardstown Road South.	Proposed diversion length of 129m for telecom utility.
R05-UT-005	EIR	B0+560 LHS	Eir chamber on Blanchardstown Road South	Proposed chamber relocation for telecom utility.
R05-UT-006	EIR	B0+650 RHS	Eir chamber on Blanchardstown Road South.	Proposed chamber relocation for telecom utility.
R05-UT-007	EIR	B0+610 RHS	Eir chamber.	Proposed chamber relocation for telecom utility.

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R05-UT-008	EIR	B0+610 RHS	Eir chamber	Proposed chamber relocation for telecom utility.
R05-UT-009	EIR	B0+100 LHS	Eir chamber	Proposed chamber relocation for telecom utility.
R05-UT-010	EIR	E0+105 LHS	Eir chamber	Proposed chamber relocation for telecom utility.
R05-UT-011	EIR	E0+170 LHS	Eir chamber	Proposed chamber relocation for telecom utility.
R05-UT-012	EIR	B0+070 LHS	Eir chamber	Proposed chamber relocation for telecom utility.
R05-UT-013	EIR	F0+040 – F0+150 RHS	Eir ducting north of Blanchardstown Centre	Proposed diversion length of 116m for telecom utility.
R05-UT-014	EIR	F0+020 – F0+210 LHS	Eir ducting north of Blanchardstown Centre.	Proposed diversion length of 191m for telecom utility.
R05-UT-015	EIR	F0+185 LHS	Telecoms kiosk	Proposed kiosk relocation for telecom utility.
R05-UT-016	EIR	F0+225 – F0+255 RHS	Eir ducting north of Blanchardstown Centre	Proposed diversion length of 31m for telecom utility.
R05-UT-017	EIR	A0+210 – A0+565 RHS	Eir ducting east of Blanchardstown Centre	Proposed diversion length of 255m for telecom utility.
R05-UT-018	EIR	A0+380 RHS	Eir chamber	Proposed chamber relocation for telecom utility.
R05-UT-019	EIR	A0+400 RHS	Eir chamber	Proposed chamber relocation for telecom utility.
R05-UT-020	EIR	A0+450 RHS	Eir chamber	Proposed chamber relocation for telecom utility.
R05-UT-021	EIR	A0+475 RHS	Eir chamber	Proposed chamber relocation for telecom utility.
R05-UT-022	Virgin Media	A0+400 – A0+570 RHS	Virgin Media ducting east of Blanchardstown Centre	Proposed diversion length of 185m for telecom utility.
R05-UT-023	EIR	A0+480 – A0+570 RHS	Eir ducting east of Blanchardstown Centre	Proposed diversion length of 86m (x2) for telecom utility.
R05-UT-024	EIR	A0+540 RHS	Eir chamber	Proposed chamber relocation for telecom utility.

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R05-UT-025	ENET	A0+620 – A0+655 LHS	ENet ducting north of Blanchardstown Centre.	Proposed diversion length of 40m for telecom utility.
R05-UT-026	EIR	A1+970 LHS	Eir chamber	Proposed chamber relocation for telecom utility.
R05-UT-027	EIR	A3+575 RHS	Eir chamber on Navan Road	Proposed chamber relocation for telecom utility.
R05-UT-028	EIR	A3+580 RHS	Eir chamber on Navan Road	Proposed chamber relocation for telecom utility.
R05-UT-029	EIR	A4+620 – A4+670 LHS	Eir ducting along Navan Road.	Proposed diversion length of 53m for telecom utility.
R05-UT-030	EIR	A4+655 LHS	Eir chamber on Navan Road	Proposed chamber relocation for telecom utility.
R05-UT-031	EIR	A4+920 RHS	Eir chamber on Navan Road	Proposed chamber relocation for telecom utility.
R05-UT-032	EIR	A4+910 – A4+955 RHS	Eir ducting along Navan Road.	Proposed diversion length of 53m for telecom utility.
R05-UT-033	EIR	A4+905 – A5+070 RHS	Eir ducting along Navan Road.	Proposed diversion length of 170m for telecom utility.
R05-UT-034	EIR	A4+925 RHS	Eir chamber on Navan Road	Proposed chamber relocation for telecom utility.
R05-UT-035	EIR	A4+975 RHS	Eir chamber on Navan Road	Proposed chamber relocation for telecom utility.
R05-UT-036	EIR	A5+055 LHS	Eir chamber on Navan Road	Proposed chamber relocation for telecom utility.
R05-UT-037	EIR	A5+160 – A5+220 RHS	Eir ducting along Navan Road.	Proposed diversion length of 60m for telecom utility.
R05-UT-038	EIR	A5+465 LHS	Eir chamber on Navan Road.	Proposed chamber relocation for telecom utility.
R05-UT-039	EIR	A5+465 – A5+865 LHS	Eir ducting along Navan Road.	Proposed diversion length of 396m for telecom utility.
R05-UT-040	EIR	A5+565 LHS	Eir chamber on Navan Road	Proposed chamber relocation for telecom utility.
R05-UT-041	EIR	A5+720 – A5+890 LHS	Eir ducting along Navan Road.	Proposed diversion length of 180m for telecom utility.

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R05-UT-042	EIR	A5+920 RHS	Eir chamber on Navan Road.	Proposed chamber relocation for telecom utility.
R05-UT-043	EIR	A5+920 LHS	Eir chamber on Navan Road.	Proposed chamber relocation for telecom utility.
R05-UT-044	EIR	A5+915 – A6+675 RHS	Eir ducting along Navan Road.	Proposed diversion length of 1000m for telecom utility.
R05-UT-045	EIR	A6+530 – A6+570 LHS	Eir ducting along Navan Road.	Proposed diversion length of 55m for three telecom utilities.
R05-UT-046	EIR	A6+950 RHS	Eir chamber on Navan Road.	Proposed chamber relocation for telecom utility.
R05-UT-047	Virgin Media	A7+140 – A7+170 RHS	Virgin Media ducting along Navan Road.	Proposed diversion length of 36m for telecom utility.
R05-UT-048	EIR	A7+130 – A7+210 RHS	Eir ducting along Navan Road.	Proposed diversion length of 84m for telecom utility.
R05-UT-049	EIR	A7+430 LHS	Eir chamber on Navan Road.	Proposed chamber relocation for telecom utility.
R05-UT-050	EIR	A8+300 LHS	Eir chamber on Prussia Street.	Proposed chamber relocation for telecom utility.
R05-UT-051	EIR	A8+310 LHS	Eir chamber on Prussia Street	Proposed chamber relocation for telecom utility.
R05-UT-052	EIR	A8+300 – A8+320 LHS	Eir ducting along Prussia Street.	Proposed diversion length of 22m for telecom utility.
R05-UT-053	EIR	A8+310 LHS	Eir chamber on Prussia Street.	Proposed chamber relocation for telecom utility.
R05-UT-054	Virgin Media	A8+680 – A8705 LHS	Virgin Media ducting along Prussia Street.	Proposed diversion length of 25m for telecom utility.
R05-UT-055	EIR	A8+850 RHS	Eir chamber on Manor Street.	Proposed chamber relocation for telecom utility.
R05-UT-056	EIR	H0+040 LHS	Eir chamber on Brunswick Street.	Proposed chamber relocation for telecom utility.
R05-UT-057	EIR	N/A	Eir chamber located on Dalymount Road.	Proposed chamber relocation for telecom utility.

11 Waste Quantities

11.1 Introduction

The majority of the waste arisings from the construction of the Proposed Scheme will accumulate from excavation related activities and demolition works due 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.

Excavation waste will arise from the following activities:

- Excavation of existing pavements and carriageways;
- Removal of existing structures including bridges and overhead gantries;
- Construction and reconstitution of cycle tracks, footpaths, road widening and urban realm improvements;
- Alteration of roundabouts to signalised junctions; and
- Utility diversions and / or protections.

Waste material resulting from these activities will include concrete (waste code 17 01 01), bitumen/ asphalt (waste code 17 06 02), and soil and stones (waste code 17 05 04). The waste quantities associated with the excavation of soil and stones have been further broken down into the likely TII material specification to establish an understanding of the volume of materials that could potentially be reused/recycled.

Demolition waste will arise from the following activities:

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

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

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

11.2 Waste Calculation Assumptions

The following tables provide an overview of the various material weights and densities that have been applied to calculate the overall material 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 scheme length.
Vegetation (eg hedges, shrubs, leaves and branches)	Organic	N/A	Organic material from hedges, shrubs, leaves and branches have not been quantified.
Walls	Masonry/ Bricks	1.5m height 0.3m width	Nominal assumed dimensions for purposes of assessment
Gates	Metal	100 kg/unit	Nominal assumed average weight per gate over scheme
Metal railings	Metal	15 kg/m	Nominal assumed average weight per railing over scheme
Fencing	Metal	40 kg/m	Nominal assumed average weight per railing over scheme
Traffic Signals	Metal	68 kg per 4m pole 15kg per traffic signal head Assumed 2 heads per pole	*Source: Siemens Helios General Handbook Issue 18.* Nominal assumed average scenario per signal over scheme length
Traffic Signs	Metal	20kg per 3m pole 0.75 m sign height 0.01 m sign thickness	Nominal assumed average scenario per traffic sign over scheme length
Lighting poles	Metal	100 kg per 8m pole	Nominal assumed average scenario over scheme length
ESB/EIR poles	Timber/wood	250 kg per 9m pole	Nominal assumed average scenario over scheme length
Bus stops	Plastic	365 kg per bus stop	JCDecaux and NTA (2017) *Reliance Bus Shelter information*
	Metal	2400 kg per bus stop	JCDecaux and NTA (2017) *Reliance Bus Shelter information*
	Glass	54 kg per bus stop	JCDecaux and NTA (2017) *Reliance Bus Shelter information*
Litter bins	Metal	60 kg per bin	Omos specification. Nominal assumed average scenario over scheme length
Safety barrier	Metal	20 kg/m	Nominal assumed average scenario over scheme length
Cabinets	Metal	85 kg	ESB (2008). *National Code of Practice for Customer Interface 4th Edition.* Available online: https://www.esbnetworks.ie/doc

Item	Material	Assumed nominal weight	Notes
			s/default-source/publications/national-code-of-practice.pdf (Accessed on 6 May 2021)
Benches	Metal	32kg	Lost Art (2016). *Benches: Product information operation and maintenance instructions.* Available online: https://www.lostart.co.uk/pdf/lost-art-limited-product-information.pdf (Accessed on 6 May 2021)
	Wood	8kg	
Cameras	Metal	35 kg	2b Security Systems (2021) *PTZ-7000 Long range IP PTZ camera*. Available online: https://www.2bsecurity.com/product/long-range-ptz-camera/ (Accessed on 6 May 2021)
Overhead Gantry (steel)	Metal	27.9 kg per m width of road	TII (nb). *CC- SCD- 01804-02*. Available online:https://www.tiipublications.ie/library/CC-SCD-01804-02.pdf (Accessed on 6 May 2021) TII (nb). *CC- SCD- 0180-02*. Available online:https://www.tiipublications.ie/library/CC-SCD-01805-02.pdf (Accessed on 6 May 2021)
Cast Iron Bollard	Metal	50 kg	Furnitubes (2013) *Cast Iron Bollards: Product Brochure.* Available online: https://www.furnitubes.com/uploads/assets/brochures-2013/furnitubes-e-008-01-13-cast-iron-bollard-brochure.pdf (Accessed on 6 May 2021)
Non Assigned Bollard	Metal	40kg	Furnitubes (2013) *Cast Iron Bollards: Product Brochure.* Available online: https://www.furnitubes.com/uploads/assets/brochures-2013/furnitubes-e-008-01-13-cast-iron-bollard-brochure.pdf (Accessed on 6 May 2021)

Item	Material	Assumed nominal weight	Notes
Stainless Steel Bollard	Metal	30kg	Furnitubes (2013) *Cast Iron Bollards: Product Brochure.* Available online: https://www.furnitubes.com/uploads/assets/brochures-2013/furnitubes-e-008-01-13-cast-iron-bollard-brochure.pdf (Accessed on 6 May 2021)
Vehicle Restraint Bollard	Metal	130 kg	Furnitubes (2013) *Cast Iron Bollards: Product Brochure.* Available online: https://www.furnitubes.com/uploads/assets/brochures-2013/furnitubes-e-008-01-13-cast-iron-bollard-brochure.pdf (Accessed on 6 May 2021)
Bike Railings/ handrails	Metal	16 kg	Dublin City Council (2016) *Construction Standards for Road and Street Works in Dublin City Council*
Gully grates	Metal	40 kg	Pam Saint- Gobain (2016). *Ductile Iron Access Covers and Gratings: Product selection and specification guide*. Available online: https://www.saint-gobain-pam.co.uk/sites/pamline_uk/files/access_covers_and_gratings_product_guide_0.pdf (Accessed on 6 May 2021) Greater Dublin Region (2012) *Greater Dublin Regional Code of Practice for Drainage works.* Available online: (https://www.sdcc.ie/en/download-it/guidelines/greater-dublin-regional-code-of-practice-for-drainage.pdf (Accessed on 6 May 2021)
Chamber covers and frame	Metal	50kg	Pam Saint- Gobain (2016). *Ductile Iron Access Covers and Gratings: Product selection and specification guide*. Available online: https://www.saint-gobain-pam.co.uk/sites/pamline_uk/files/access_covers_and_gratings_product_guide_0.pdf (Accessed on 6 May 2021) Greater Dublin Region (2012) *Greater Dublin Regional Code of Practice for Drainage works.*

Item	Material	Assumed nominal weight	Notes
			Available online: (https://www.sdcc.ie/en/download-it/guidelines/greater-dublin-regional-code-of-practice-for-drainage.pdf (Accessed on 6 May 2021)
Manholes	Metal	50kg	Pam Saint- Gobain (2016). *Ductile Iron Access Covers and Gratings: Product selection and specification guide*. Available online: https://www.saint-gobain-pam.co.uk/sites/pamline_uk/files/access_covers_and_gratings_product_guide_0.pdf (Accessed on 6 May 2021) Greater Dublin Region (2012) *Greater Dublin Regional Code of Practice for Drainage works.* Available online: https://www.sdcc.ie/en/download-it/guidelines/greater-dublin-regional-code-of-practice-for-drainage.pdf (Accessed on 6 May 2021)

Table 11.2: In-Situ Pavement and Earthworks Densities

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

Table 11.3: Utilities Material Excavation Assumptions

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

Asset type	Assumed nominal average trench width (m)	Assumed material spec. (TII)	Assumed nominal average trench depth under pavement layer (m)	Notes
allowances e.g transverse trenching)				https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)
		Class 1/2 Granular Subbase material	0.3	Irish Water (2020) *Water Infrastructure Standard Details: Connections and Developer Services.* Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)
		Class 6 Granular Capping material	0.2	Irish Water (2020) *Water Infrastructure Standard Details: Connections and Developer Services.* Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)
Electric /Power bedding excavation Assessment (assumed at 0.75m cover under footpath i.e obvert at 0.55m under subbase layer of footpath/ cycletrack)	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-

Asset type	Assumed nominal average trench width (m)	Assumed material spec. (TII)	Assumed nominal average trench depth under pavement layer (m)	Notes
				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	0.45	Class 2/4/U1 Cohesive subgrade material	0.7	Gas Network Ireland (2018) *Guidelines for Designers and Builders- Industrial and Commercial*

Asset type	Assumed nominal average trench width (m)	Assumed material spec. (TII)	Assumed nominal average trench depth under pavement layer (m)	Notes
0.4m under subbase layer of footpath)				*(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
Footpath sub-layer excavation due to Full Depth Construction (FDC) widening (material under footpath)	0.1	Granular material- Class 1/2 Granular Subbase material
	0.75	Soil and stones- Class 2/4/U1 Cohesive subgrade material
Verge and sub-layer excavation due to FDC widening (material under verge)	0.3	Soil and stones- Class 5 Topsoil material
	0.55	Soil and stones- Class 4/U1 Cohesive subgrade material
Verge and sub-layer excavation due to footpath widening (material under verge)	0.3	Soil and stones- Class 5 Topsoil material
	0	Soil and stones- Class 4/U1 Cohesive subgrade material
Road surface treatment due to road markings and utilities trench reinstatement (mill & re-sheet)	0.05	Bitumen containing material - Bitumen (surface)
Road sub-layer excavation due to FDC (material under road)	0.3	Bitumen containing material - Bitumen (binder and base)
	0.3	Class 1/2 Granular Subbase material
	0.2	Granular material - Class 6 Granular Capping material
	0	Soil and stones- Class 2/4/U1 Cohesive subgrade material

11.3 Waste Estimate Summary

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

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

- Where feasible, naturally occurring excavated material will be reused within construction in the Proposed Scheme in accordance with Article 2 of the Waste Directive Regulations, Waste Framework Directive and Section 3 of the Waste Management Act 1996, as amended;
- Where possible, excavation material will be used as engineering and landscaping material within the Proposed Scheme where practicable and on other projects requiring the types of materials generated. Reuse of topsoil and excavated material within the Proposed Scheme is proposed where possible. The material will also be subject to testing to ensure it is suitable for its proposed end use;
- Article 28 (End-of-Waste) (EPA 2020) criteria may be met by the excavation material, should such facilities become available by the time of commencement of construction of the Proposed Scheme, ensuring that the material will meet the acceptance criteria set out in Article 28 of the Waste Directive Regulations;
- All excavation wastes requiring removal from site for recycling or recovery will be delivered to facilities which are authorised under the Waste Management Act 1996 (i.e. which hold a Certificate of Registration, Waste Facility Permit or EPA Licence). Examples of recycling / recovery activities for excavation material may include:
    - Processing of stone to produce construction aggregate;
    - Backfilling of quarries; and
    - Raising land for site improvement or development.
- There is no crushing and screening of material planned for the Proposed Scheme;
- All wastes removed from site will be delivered to recovery or disposal facilities holding a Certificate of Registration, Waste Facility Permit or EPA Waste Licence; and
- All wastes removed from site will be transported by the holder of the appropriate waste collection permit, granted in accordance with S.I. No. 820/2007 - Waste Management (Collection Permit) Regulations 2007.

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

11.3.1 Demolition

Table 11.5 shows the estimated quantity and type of waste that will be generated by demolition activities in connection with the Proposed Scheme along with how much of this material could potentially be reused or recovered.

Table 11.5: Estimated Demolition Waste Types and Quantities

Waste Type	Approximate Waste and Material Quantity (tonnes)	Potential Recoverable/ Reusable Material	Recoverable/ Reusable Quantities (tonnes)
Concrete, bricks, tiles and similar	1,900	100%	1,900
Metals	620	100%	620
Segregated wood, glass and plastic	80	100%	80
Total	**2,600**		**2,600**

Potentially 100% of material generated from the demolition phase of the Proposed Scheme could be considered for reuse for construction within the Proposed Scheme or in other construction projects in accordance with Article 27 of the Waste Directive Regulations. It will be the responsibility of the appointed contractor to review feasibility of reuse of materials and ensure that the necessary testing is undertaken to demonstrate compliance with Article 27, as appropriate.

Where feasible, street and roadside infrastructure such as bus stops, lighting poles, traffic signals, and signs will be reused within the Proposed Scheme and will not become a waste. The appointed contractor will be responsible for ensuring compliance with all relevant legislation.

Materials will require on-site segregation by waste classification and if not suitable for onsite or offsite reuse, will be delivered to an authorised recycling or recovery facility. Where street furniture is a waste, it may be necessary to separate elements at source such as lightbulbs from luminaires and metals from other components and deliver these separately to suitable authorised recycling or recovery facilities.

Where metal railings and gates are removed, typically these have inherent value due to their metal content. These will be source-segregated and delivered for metal recycling to an authorised waste facility. Some example facilities which are currently authorised to accept metal and electronic waste include:

- Irish Lamp Recycling Co. Ltd, Woodstock Industrial Estate, Kilkenny Road, Athy, Co. Kildare; and
- Hammond Lane Metal Company, Pigeon House Road, Dublin 4, Dublin

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

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

11.3.2 Excavation

Table 11.6 shows the estimated quantity and type of waste that will be generated by the excavation activities of the Proposed Scheme.

Table 11.6: Summary of Excavation Material Type and Quantities

Waste Type	Approximate Waste and Material quantity (tonnes)
Bituminous mixtures	56,000
Concrete, bricks, tiles and similar	11,000
Class 1/2 Granular Subbase material from footway and road	26,000
Class 6 Granular Capping material from road widening	11,000
Class 2/4/U1 Cohesive subgrade material (made ground material under footpath/road	44,000
Class 4/U1 Cohesive subgrade fill material (made ground material under verge)	8,000
Class 5 topsoil material (surface material from verge)	9,000
Total	**165,000**

It is estimated that a total of 165,000 Tonnes of material will be excavated as part of the construction works. Due to the nature of the works in an urban environment there are limited opportunities to achieve a cut/fill balance of materials that could be more readily accommodated on a greenfield project where earthworks embankments/ bunds are more common.

Where material is excavated, it is envisaged that the contractor will seek to reuse or recycle it, where practicable, within the Proposed Scheme through implementation of the measures set out below for each waste type identified within Table 11.6. To further establish an understanding of how soil and stone waste materials could potentially be reused/recovered, they have been further broken down into the likely TII material specification and class.

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

- capping, subbase, bituminous and concrete materials could be reused or recycled in fill and capping materials (e.g. 6A, 6B, 6C, 6F, 6G, 6H ,6I, 6M, 6N) providing they comply with the Specification for Road Works Series 600 – Earthworks (CC-SPW-00600);
- subbase, bituminous and concrete materials could be reused or recycled in subbase or base materials (e.g. Granular Material Type A to Clause 803) providing they comply with the Specification for Road Works Series 800 – Unbound and Cement Bound Mixtures (CC-SPW-00800); and
- subbase and bituminous materials could be recycled in base or binder materials (e.g. Asphalt Concrete base and binder products to Clause 3 or Low Energy Bound Mixtures to Clause 8.1) providing they comply with Road Pavements – Bituminous Materials (CC-SPW-00900).

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

Excavated cohesive subgrade material is likely to be unacceptable for direct reuse for pavement construction, however, this material can be tested for quality and contamination and could potentially be reused as Class 2 general fill or Class 4 landscape fill under the provisions of Article 27. Material which meets the necessary acceptance criteria may be delivered to an authorised soil recovery facility. Material which requires recycling will be sent to an authorised waste facility and may be used in accordance with Article 28 of the European Communities (Waste Directive) Regulations 2011 - S.I. 126 of 2011 as amended. Article 28 sets the criteria which must be complied with and the EPA must use to determine, when a waste reaches “end of waste” status and becomes a material. Large quantities of this type of material are unlikely to be reused on site due to the nature of the works in an urban environment with limited embankments / earthworks bunds being constructed. Therefore, excavated cohesive subgrade material may be recovered and used on future projects in the industry.

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

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

11.3.3 Municipal Waste

It is anticipated that there will be approximately 250, up to 300 at peak, construction staff employed over the Construction Phase of the Proposed Scheme. Small volumes of general municipal wastes will be generated by construction staff during the Construction Phase (e.g., from offices and welfare facilities). Segregation facilities will be provided on the construction site to ensure that recovery and recycling of such wastes is maximised.

11.3.4 Operational Phase

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

It is envisaged that bitumen containing material will be reused within new carriageway construction as far as practicable and in accordance with all applicable legislation. Bitumen containing materials which are not incorporated into the Proposed Scheme are likely to be reused where feasible off-site as a by-product in accordance with Article 27, of the Waste

Framework Directive. Bitumen containing materials may be recycled in accordance with the provisions of an Article 28 (End of Waste) decision by the EPA (EPA 2020).

The quantity of bitumen containing material generated, over the assumed lifetime of the Proposed Scheme (60 years), will decrease by approximately 4,550 tonnes. Therefore, there will be a decrease in maintenance needs during operation of the Proposed Scheme, in comparison to required maintenance of the existing carriageway. This is due to an overall narrowing of the carriageway.

12 Traffic Signs, Lighting and Communications

12.1 Introduction

The existing signage and road markings along the extents of the Proposed Scheme will be modified to clearly communicate information, regulatory and safety messages to the corridor's users. In addition, the existing lighting and communication equipment along the Proposed Scheme has been reviewed and proposals developed to upgrade where necessary.

12.2 Traffic Signage Strategy

A preliminary traffic signage design has been undertaken to identify the requirements of the Proposed Scheme. A combination of Information, Regulatory and Warning signs have been assessed taking consideration of key destinations/centres; intersections/decision points; built and natural environment. In line with DMURS, the signage proposals have been kept to the minimum requirements of the Traffic Signs Manual (TSM) to avoid sign congestion within the Proposed Scheme corridor.

A review of the existing regulatory and warning signs in the vicinity of the Proposed Scheme 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.

On review, the following design changes proposed between the intersection of Cabra Road/Navan Road and Ellis Quay will alter the traffic patterns in this area:

- New left turn from North Circular Road to Cabra Road;
- New right turn from Cabra Road to North Circular Road;
- Southbound bus gate from Aughrim Street to Manor Street;
- Northbound & Southbound bus gate at the intersection of Manor Street, Prussia Street and Aughrim Street;
- Southbound bus gate at the intersection of Navan Road/Old Cabra Road and Cabra Road and a northbound bus gate on Old Cabra Road, at the railway overbridge, to the south of Glenbeigh Road junction; and
- Northbound Bus Gate at Blackhall Place / King Street North junction, with a new right turn for northbound general traffic at this junction.

Traffic management measures in the form of sections of one-way street and / or turn bans have also been devised to minimise traffic impacts on roads adjacent to the proposed core bus corridor due to any rerouting of traffic (which may occur due to the priority given on the bus corridor scheme to pedestrians, cyclists and buses).

Turning bans and other traffic management measures will also be implemented on the route to direct traffic away from either the Proposed Scheme corridor (to maximise bus journey time reliability) or to limit use of side streets as a short-cut route by through traffic. Refer to Section 4.16 for further information.

These changes are outlined within the Traffic Signs and Road Markings drawing series in Appendix B, which outlines the associated signage requirements.

12.3 Traffic Signage and Road Markings

12.3.1 Traffic Signage General

A preliminary assessment was undertaken which involved an assessment of major road traffic signage, including requirements for all information signs (TSM Chapter 2), regulatory signs (TSM Chapter 5), warning signs (TSM Chapter 6), and road markings (TSM Chapter 7).

On review of the existing traffic signage, it is determined that the main changes to regulatory signage will be the proposed introduction of turning bans from or to the Proposed Scheme as indicated within the Traffic Signs and Road Markings drawing series in Appendix B.

Additional directional signs are proposed at the junction of North Circular Road and Cabra Road to direct road users to the M50 via North Circular Road, reducing the vehicular traffic within the Proposed Scheme.

In addition to the signs identified above, the existing signs within the Proposed Scheme are being revised to accommodate the change in road cross-section communicating the following:

- Information Signs to include geographical information signs, signs indicating facilities, road layout signs, traffic calming signs and cycle network signs;
- Regulatory signage –e.g. parking regulation signs, bus lanes, pedestrian and cycle facilities; and
- Warning signs – e.g. Stop and Yield Ahead.

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

12.3.2 Gantry Signage

Gantries which are affected by the Proposed Scheme have been highlighted within section 8.3.5. It is proposed to provide two new overhead sign gantries on the N3 westbound (GY07 & GY08) with suitable lane designations and directional signage. Sign faces on existing, relocated and modified gantries will be updated to indicate the new lane destinations and directional signage installed as part of this scheme.

12.3.3 Road Markings

A preliminary design of road markings has been undertaken in accordance with TSM Chapter 7. Refer to the Traffic Signs and Road Markings drawing series contained within Appendix B for details. This exercise includes the preliminary road marking design of the following items:

- Bus lanes;

- Cycle tracks: The pavement will be marked according to best practice guidelines such as DMURS and the National Cycle Manual with particular attention given to junctions. Advance Stacking Locations (ASLs) have been designed, where practicable, to provide a safer passage for cyclists at signal-controlled junctions for straight-ahead or right turn movements; and
- Pedestrian crossings will be incorporated to connect the network of proposed and existing footpaths. Wider pedestrian crossings will be provided in locations expected to accommodate a high number of pedestrians.

12.4 Public Lighting

12.4.1 Existing Lighting

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

The lighting design involves works on functional, heritage and contemporary lighting installations, on a broad spectrum of lighting infrastructure along the Proposed Scheme. This will 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 be replaced and relocated to the rear of the footpath, and the existing lighting columns removed once the new facility is operational. This will eliminate conflict with pedestrians.

Where significant alterations are proposed to the existing carriageways, the preliminary street lighting design ensures that the current standard of public lighting is maintained or improved.

Refer to Street Lighting drawings in Appendix B for proposed location of all lighting columns.

For existing columns that have specific aesthetic requirements, the intent for the replacement of such columns will include:

- Replacing the existing heritage columns and brackets with identical replica columns and brackets;
- Replacing existing luminaires with approved LED heritage luminaires; and
- Ensuring that the electrical installation is compliant with the latest version of the *National Rules for Electrical Installations, IS 10101*.

12.4.2 New Lighting

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

- Local Authority Guidance Specifications;
- EN 13201: 2014 Road Lighting (all sections);
- ET211:2003 ‘Code of Practice for Public Lighting Installations in Residential Areas’;

- BS 5489-1 'Code of practice for the design of road lighting';
- TII Publications: Specification for Road Works, Series 1300 & 1400;
- TII Publications Standard Construction Details, Series 1300 & 1400;
- IS EN 40 – Lighting Columns; and
- Institution of Lighting Professionals "GN01 Guidance Notes for Reduction of Obtrusive Light".

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

12.4.3 Lighting at Stops

The design will include for the provision of lighting in covered areas, open areas and passenger waiting areas.

The location of the lighting columns will be dictated by the output from the fitting to adhere to the required uniformity and illuminance required for the specific lighting class for the associated road. The columns positioned at bus stops will ensure adequate clearances from moving vehicles.

12.5 Traffic Signals

12.5.1 Above Ground Infrastructure

The Preliminary design shows the proposed locations of above ground infrastructure. This is included in the Junction Systems Design drawings in Appendix B.

Above ground infrastructure will include:

Traffic Signal Poles

All traffic signal equipment has been designed in accordance with Chapter 9 of the Department of Transport's Traffic Signs Manual. The Traffic Signs Manual clearly defines the requirements and positioning of traffic signal heads, detection equipment, and associated traffic signal poles.

The Traffic signal modelling, including LinSig models, has been used to determine the signal head configuration to achieve the required phasing and staging of the traffic signals. This contributed to the determination of the design and positioning of the traffic signal heads.

Single height Traffic Signal poles typically 3m (as measured from the ground) have predominantly been proposed to mount traffic signal heads, push button units, and other equipment. Double height poles, (typically 6m) have been proposed at locations where additional visibility of the signals is required by the motorist, e.g. high-speed approaches.

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.

Roadside Cabinets

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

- Traffic Signal Control Cabinets;
- Fibre Breakout Cabinets; and
- Electricity supply Metering, Mini and Micro pillars.

Cabinets will be positioned to allow for ease of access by maintenance personnel and to minimise their impact on the receiving environment. When accessing cabinets, maintenance personnel will require a clear view of the associated equipment and of approaching vehicles, pedestrians, and cyclists. Cabinets will be positioned at the back of footpaths, to minimise the impact on the effective width of the footpath. They will be 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.

In all cases the consideration of the siting of such roadside equipment will prioritise the access for pedestrians and cyclists in the area and balance the aesthetics of the urban realm with maintenance requirements.

12.5.2 Underground Infrastructure

The Proposed Scheme includes for a continuous underground ducting network to provide the necessary communications for devices including traffic signals and CCTV. Where practicable the Proposed Scheme shall utilise existing ducting and chambers to provide this continuity. Below ground infrastructure will include:

Ducts

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

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

Chambers

Chambers will be required at the termination points of ducts, at regular intervals along ducts (180m), at changes in direction, and at breakout points for devices.

The position of chambers will be designed to be away from carriageways, pedestrian and cycle desire lines, and tactile paving. It is important when positioning chambers that they can be accessed 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.

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 as high CCTV masts, bespoke mass concrete foundations will be designed for incorporation into the works.

Cabinet mountings will be designed and constructed in accordance with the manufacturer’s and local authorities’ standard details, including the incorporation of required vaults, chambers, earthing rods and mats.

12.5.3 Traffic Signal Priority

Public transport priority will be provided through a number of passive and active means. The means of passive priority are discussed elsewhere in this document 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. Fingal County Council use TR2500 type Controllers that feature Split Cycle Offset Optimisation Technique

(SCOOT) for adaptive control. The TR2500 type controllers also feature a Microprocessor Optimise Vehicle Actuation (MOVA) mode of operation.

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. These embedded induction detectors will require ducting, chambers, and carriageway loop pots, to route the cables associated with the detector to the traffic signal controller.
- Specialised induction detectors – these can be utilised to detect cyclists on particular approaches to junctions. These detectors use a concentrated induction pattern to detect the passage of cyclists.

Above ground detection, including:

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

Additional inputs from 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.

12.6 Communications

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.
- All local authorities operate fibre optic cable networks. It is envisaged that each of these networks will be extended along the length of the Proposed Scheme to provide high bandwidth/low latency communication to Traffic Signal Controllers, CCTV Cameras, and

other apparatus deployed on the Proposed Scheme. Longitudinal ducting, provisionally two communications ducts, is required along the length of the Proposed Scheme with access chambers at 180m centres.

- Fibre breakout cabinets will be provided at each Traffic Signal Controller, or CCTV camera.
- Microwave Wireless Point-to-Point Links - Where it is not practicable to install ducting for fibre optic cable, or there is a need to provide a high bandwidth/low latency communication to a remote site or cell, point-to-point microwave communications will be provided to facilitate the communications link.
- Cellular Subscriber Networks (3G/4G/5G) - Cellular communications will be provided to low bandwidth devices such as RTPI and Variable Messages Signs (VMS).

12.7 Traffic Monitoring

The preliminary design proposes a comprehensive CCTV camera deployment along the length of the Proposed Scheme at key locations including junctions. 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.

High-definition cameras with a fibre-optic based communications network for the transmission of video will be provided at each of the proposed CCTV locations. Additionally, a mains power source will be required at each location where a camera is installed. 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.

Poles, between 5m - 8m, will be provided at each signalised junction, unless it is directly adjacent to another observed junction, and as such all approaches are covered by that closed-circuit television (CCTV). These CCTV poles will be erected using a retention socket as a foundation.

Higher CCTV masts may be provided at locations where longer fields of view are required, or where there is a need to mount wireless communications devices at positions to enable clear line of sight between linked devices. These CCTV masts will require a bespoke mass concrete foundation.

CCTV poles will be placed at positions, within the junction, to minimise the impact of solar glare, and to maximise the field of view of the CCTV. In all cases the consideration of the siting of such roadside equipment shall prioritize the health and safety for pedestrians and cyclists, access for pedestrians and cyclists in the area and the aesthetics of the street urban landscape.

12.8 Real-Time Passenger Information

RTPI will be provided at all of the proposed bus stops. This will comprise a “live” display identifying the estimated arrival time of each bus at the stop.

12.8.1 RTPI Display Positioning and Mounting

The RTPI display, where present, is typically located adjacent to the shelter on the same side as approaching buses so that people waiting at the stop can simultaneously view both the display and the oncoming buses. Figure 12.1 illustrates this.

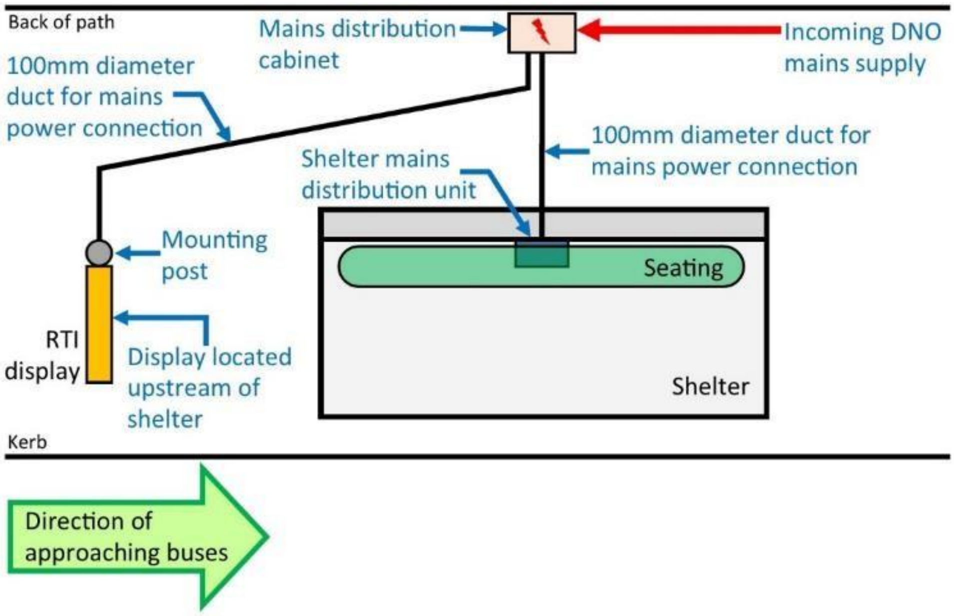


Figure 12.1: Typical layout for bus stop with RTPI display

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

12.8.2 Power Supply for RTPI Display and Bus Shelter

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

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

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

12.8.3 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 Proposed Scheme with the mains power for the display - as described above – also providing power for this comms device. In this case no ducting will be required for data comms at the bus stop and the only physical connection to the display (i.e. ducting and cabling) will therefore be as described above for mains power.

12.9 Roadside Variable Message Signs

Three existing Variable Messaging Signs (VMS) will be retained as part of the Proposed Scheme. An existing VMS sign is located at the end of the inbound merge lane to the N3 from Snugborough Road. A new VMS structure will be provided at this location but set back from the original location to allow for widening of the slip road.

An existing VMS sign is located in the central reservation to the south of the intersection of Navan Road and Hampton Green. Extension to the right turn pocket at the Cabra library junction has resulted in this central reservation being shortened. This VMS sign will be relocated to a section of the retained central reservation at Cabra Library.

An existing VMS is also located in the outbound verge of the R147 Navan Road approximately 350m east of the Auburn Avenue junction. This VMS will remain in its current location.

12.10 Safety and Security

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

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

12.11 Maintenance

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

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

- Use of retention sockets, where applicable, for the erection of Traffic Signals, 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, where practicable, to allow for the ease of installation and replacement of cables;
- Safe areas to be provided for the access and parking of maintenance vehicles; and
- Locating controller, and other, cabinets in positions that allow for safe access and clear visibility of the operation of the junction.

13 Land Use and Accommodation Works

13.1 Summary of Land Use

The land use along the Proposed Scheme comprises a mix of residential and commercial properties. The various land uses are described in the sections below. The extent of the impact due to the Proposed Scheme on a landowner's holding is shown on the Compulsory Purchase Order maps.

The following is a description of the land use along the Proposed Scheme divided into 5 sections.

N3 Blanchardstown Junction to Snugborough Road

The Proposed Scheme commences at Junction 3 (Blanchardstown / Mulhuddart) eastbound off-slip from the N3. The Proposed Scheme continues through the Blanchardstown Shopping Centre with a Bus Interchange being provided. The shopping centre is surrounded by the N3 to the north and east, leisure facilities to the south and housing estates to the north-west. The Proposed Scheme progresses towards the Snugborough Road via L3020 which is bordered by the N3 to the east and commercial and leisure units to the west.

Lands are required through this section to facilitate the scheme, including junction reconfiguration, a new car park access from Blanchardstown Road South, provision of bus layover spaces and Bus Interchange in the vicinity of the shopping centre, widening of carriageway between the Crowne Plaza junction and the tie-in with the Snugborough junction upgrade scheme, widening of a footpath adjacent to Millennium Park and the construction of retaining walls (RW01, RW10, RW11, RW12 and RW13).

Temporary land take is required within this section to facilitate:

- Footpath works and new left turn filter lane along the Old Navan Road;
- The construction of retaining walls RW01, RW10, RW11 and RW12;
- The reconfiguration and regrading of Blanchardstown Shopping centre bus and car parking;
- Regrading works in Blanchardstown shopping centre at the Blakestown Way /Blanchardstown Road South junction and along Blanchardstown Road South;
- Widening of carriageway between Crowne Plaza junction and the junction adjacent to the Liberty Insurance building (Ch A0+200 to Ch A0+600); and
- Construction of a new boundary wall at Millennium Park.

Snugborough Road to N3 / M50 Junction

The Proposed Scheme follows the N3 carriageway from Snugborough Road to the M50 motorway junction. To the north of the N3, the Proposed Scheme is bordered by Tolka Valley Park and Waterville Park, along with an Annex 1 habitat and woodland. To the south of the N3, the land use consists of rural grassland to the western side and extensive modern suburban residential developments further east.

In addition to permanent land take, the existing grass median will be narrowed to facilitate the Proposed Scheme. Elements of the Proposed Scheme for which permanent land take is required includes the following:

- The widening of the BR01 Tolka River Bridge;
- The pedestrian ramps and associated bus stops encroaching into Millstead Estate to the south of the N3 and woodlands to the north;
- Relocation of a variable messaging sign (GY04) and three (GY02, GY07 GY08) overhead sign gantry locations on the N3;
- Outbound bus stop at Old River Road;
- Emergency Refuge layby and maintenance layby on the N3 outbound to the north of Herbert Road;
- Widening of BR02 Mill Road Bridge; and
- Widening to junction approach from Connolly hospital overbridge over N3.

Temporary land take is required for the regrading of slopes, construction of retaining walls at Junction 6 Castleknock (RW 09) and at 3 Catherine’s Well, and to facilitate the works listed above which require permanent land take.

N3 / M50 Junction to Navan Road / Ashtown Road Junction

From the M50 Junction to Phoenix Park Avenue junction, this section is characterised by dual carriageway infrastructure with a mix of residential developments, commercial and sporting uses together with areas of undeveloped land to the north and south of the Proposed Scheme.

The Royal Canal and a railway line also runs along the north of the Proposed Scheme.

From Phoenix Park Avenue junction to the Ashtown Road junction, there is a mix of residential and commercial properties alongside the Proposed Scheme.
It is proposed that works will be contained within the R147 boundary with the exception of:

- Widening being provided for a new bus stop along the southern side at Navan Road Parkway westbound off-slip ramp;
- Widening to provide the general Proposed Scheme cross-section at localised locations;
- Providing a two way cycle track in the southeast quadrant at the Auburn Avenue/Auburn Park junction; and
- Provision of a signalised staggered junction at Phoenix Park Avenue / Ashtown Business Centre junction

Temporary land take is required to facilitate the above works and the construction of a new section of stone wall.

Navan Road / Ashtown Road Junction to Navan Road / Old Cabra Road Junction

This section of the Proposed Scheme progresses through an established residential area with education, retail, employment and community uses along the Navan Road.

In this area, permanent land take is required from properties to accommodate widening required for the Proposed Scheme, resulting in the need to relocate boundary walls and gates at these properties. In this section temporary land take will be needed at these properties to construct new boundaries walls. Temporary land take is also required from properties to allow driveways and accesses to be regraded.

A list of these properties and the type of land take required is shown in Table 13.1.

Navan Road / Old Cabra Road Junction to Ellis Quay

The Proposed Scheme follows the R805 (Old Cabra Road, Prussia Street, Manor Street, Stoneybatter and Blackhall Place) to where the scheme terminates at Ellis Quay. Cycle tracks will be provided along Blackhall Street, George's Lane and Queen Street.

Old Cabra Road is characterised as an established residential road with private dwellings and garden fronting onto the road.

South of North Circular Road, the route consists of a cluster of modern residential and retail developments, and transitions to the narrower, more traditional streetscape character. Through Stoneybatter, there is a distinctive traditional mixed use urban neighbourhood providing residential, commercial, retail, community and other uses.

The land use changes at the intersection of Blackhall Place/ Blackhall Street and Ellis Quay to medium rise apartments and commercial premises.

The works within this section generally sit within the existing road boundary. Permanent land take is required in the vicinity of the Park Shopping Centre on Prussia Street to facilitate the scheme.

13.2 Summary of Compulsory Land Acquisition

From the commencement of the design of the Proposed Scheme, every effort has been made to minimise compulsory land acquisition. However, there are a number of public and private lands that are required to meet the objectives of the Proposed Scheme.

In total approximately 5.4 ha of land will be permanently acquired, to construct the Proposed Scheme, of which approximately 4.9 ha of land FCC have an interest and approximately 0.05 ha of land which DCC have an interest. There will also be an additional 4.1 ha approximately of temporary land acquired to allow for construction of boundary treatment and surface tie-in works. This includes approximately 3.0 ha of land that FCC currently have an interest and approximately 0.1 ha that DCC have an interest.

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

13.3 Summary of Impacted Properties

In order to determine what existing landowners/properties will be impacted by the scheme, a desktop study has been carried out. This desktop study has highlighted any property within

5m of the Proposed Scheme, whether they will be impacted by the infrastructure works or otherwise.

This list has then been reduced to landowners/properties being impacted by the scheme on the basis of the preliminary design. These landowners/properties have received notification, via mail, of the potential impact on their property. The properties being impacted are listed in Table 13.1.

Table 13.1: List of Impacted Properties

Address	Permanent land take	Temporary land take
Lands adjacent to Junction 3 eastbound off-slip (public)	Y	Y
Car Park on Old Navan Road adjacent to inbound N3 Slip Road (public)		Y
Lands at Whitestown Grove adjacent to Blanchardstown Road South (public)	Y	Y
Lands at Blanchardstown Shopping Centre	Y	Y
Internal Roads at Blanchardstown Shopping Centre	Y	
Eir, Blanchardstown Centre, Dublin 15, D15 KP23	Y	Y
Lands at Millennium Park (public)	Y	Y
Lands at commercial units, to the south side of the L3020, Blanchardstown	Y	
Lands to northern side of L3020 (public)	Y	
Lands to the south of the N3 carriageway between Snugborough Road junction and River Road junction (public)	Y	Y
Lands to rear of 3 Herbert Road (which forms part of N3 verge/embankment)	Y	
Lands to the north of the N3 carriageway between Snugborough Road junction and River Road junction (public)	Y	Y
Pumping Station, Mill Road, Blanchardstown (public)	Y	Y
River Tolka in vicinity of N3 carriageway between Snugborough Road junction and River Road junction (public)		Y
Millstead Estate adjoining N3, Blanchardstown	Y	Y
Lands to north of N3 carriageway, at eastbound off-slip adjacent to Connolly Hospital (public)		
Land to the rear of 3 Catherine's Well	Y	Y
Land at River Road, south of N3 carriageway (public)	Y	Y
Woodsend Apartments, River Road, Castleknock	Y	Y
Lands adjacent to Junction 6 Health and Leisure Village (public)	Y	Y
Junction 6 Health and Leisure Village	Y	Y
Lands between N3 and Dunsink Lane (public)	Y	Y

Address	Permanent land take	Temporary land take
Green plot adjacent to Auburn Green, Castleknock	Y	Y
Circle K, Ashtown Service Station, Navan Road, Dublin 15, D15 K3VW	Y	Y
Lands to the south of the R147 Navan Road, Phoenix Park Racecourse	Y	Y
Lands to the north of the R147 Navan Road, adjacent to railway line (opposite Phoenix Park racecourse)	Y	Y
Ashtown Business Centre, Pelletstown, Dublin 15	Y	Y
Entrance to Phoenix Park Avenue	Y	Y
Land to south-west of Ashtown Roundabout, Navan Road	Y	Y
Woodlands, 397 Navan Road, Dublin 7, D07 C7Y0		Y
Saint Mary’s, 395 Navan Road, Dublin 7, D07 A5X5		Y
St. Anne’s, 393 Navan Road, Dublin 7, D07 T2P9		Y
391 Navan Road, Dublin 7, D07 P624		Y
Rosebank, 389 Navan Road, Dublin 7, D07 C2R8		Y
Alma, 387 Navan Road, Dublin 7, D07 A2F6		Y
Lyttle Holme, 385 Navan Road, Dublin 7, D07 W8W3		Y
Saint Anthony’s, 383 Navan Road, Dublin 7, D07 VNY3		Y
Belleville Estate (Common areas), Castleknock	Y	Y
Green areas at Navan Road / Kempton Avenue junction	Y	
Little Stars Creche & Montessori, 351A Navan Road, Dublin 7, D07 HP80		Y
351 Navan Road, Dublin 7, D07 VE03		Y
349 Navan Road, Dublin 7, D07 R2C3		Y
347 Navan Road, Dublin 7, D07 F9F9		Y
345 Navan Road, Dublin 7, D07 V6V9		Y
343 Navan Road, Dublin 7, D07 VW11		Y
341 Navan Road, Dublin 7, D07 C6H3		Y
339 Navan Road, Dublin 7, D07 E0V8		Y
337 Navan Road, Dublin 7, D07 N6E5		Y
335 Navan Road, Dublin 7, D07 E2W0		Y
333 Navan Road, Dublin 7, D07 P2F4		Y
331 Navan Road, Dublin 7, D07 X6C7		Y
323 Navan Road, Dublin 7, D07 V2N9	Y	Y
321 Navan Road, Dublin 7, D07 X6F5	Y	Y
319 Navan Road, Dublin 7, D07 Y2X2	Y	Y
317 Navan Road, Cabra, Dublin 7, D07 DC62	Y	Y
315 Navan Road, Dublin 7, D07 E4H2	Y	Y
313 Navan Road, Dublin 7, D07 K797	Y	Y
311 Navan Road, Cabra, D07 W0X2	Y	Y
309 Navan Road, Dublin 7, D07 E0F1	Y	Y
307 Navan Road, Cabra, Dublin 7, D07 R5C8	Y	Y
305 Navan Road, Cabra, Dublin 7, D07 R9Y7	Y	Y
Landings at Saint Vincent’s Centre		Y

Address	Permanent land take	Temporary land take
303 Navan Road, Cabra, Dublin 7, D07 FP78	Y	Y
301 Navan Road, Cabra, Dublin 7, D07 XA32	Y	Y
299 Navan Road, Cabra, Dublin 7, D07 C2P1	Y	Y
297 Navan Road, Cabra, Dublin 7, D07 N8E8	Y	Y
295 Navan Road, Dublin 7, D07 XY26	Y	Y
293 Navan Road, Dublin 7, D07 Y5X4	Y	Y
291 Navan Road, Dublin 7, D07 DA26	Y	Y
289 Navan Road, Dublin 7, D07 H0F3	Y	Y
287 Navan Road, Cabra, Dublin 7, D07 P8K1	Y	Y
285 Navan Road, Cabra, Dublin 7, D07 X567	Y	Y
283 Navan Road, Cabra, Dublin 7, D07 K2Y2	Y	Y
281 Navan Road, Cabra, Dublin 7, D07 K44E	Y	Y
279 Navan Road, Cabra, Dublin 7, D07 V5X8	Y	Y
277 Navan Road, Cabra, Dublin 7, D07 E3CP	Y	Y
275 Navan Road, Cabra, Dublin 7, D07 R5Y3	Y	Y
273 Navan Road, Cabra, Dublin 7, D07 R6C6	Y	Y
271 Navan Road, Cabra, Dublin 7, D07 X4T2	Y	Y
269 Navan Road, Dublin 7, D07 R527	Y	Y
267 Navan Road, Cabra, Dublin 7, D07 E9K3	Y	Y
265 Navan Road, Dublin 7, D07 E7P8	Y	Y
263 Navan Road, Dublin 7, D07 RCK4		Y
Bengore, 257 Navan Road, Dublin 7, D07 X0C2		Y
255 Navan Road, Dublin 7, D07 P8H2		Y
264 Navan Road, Dublin 7, D07 K5V6		Y
262 Navan Road, Dublin 7, D07 W2T0		Y
Belvedere Sports Ground, Navan Road, Dublin 7, D07 A586	Y	Y
225 Navan Road, Dublin 7, D07 F1C2.		Y
Landing outside entrance to St. John Bosco SBS, Navan Road, Cabra		Y
Landing outside entrance to Our Lady Help of Christians Catholic Church, Navan Road, Cabra		Y
Landing outside No. 199, Navan Road, Cabra		Y
212 Navan Road, Dublin 7, D07 KVC2	Y	Y
210 Navan Road, Dublin 7, D07 C9F8	Y	Y
208 Navan Road, Dublin 7, D07 F8H3	Y	Y
206 Navan Road, Dublin 7, D07 H1F1	Y	Y
204 Navan Road, Dublin 7, D07 W3P2 / 204A Navan Road, Dublin 7, D07 PK11	Y	Y
202 Navan Road, Dublin 7, D07 VX92	Y	Y
200 Navan Road, Dublin 7, D07 P4A6	Y	Y
198 Navan Road, Dublin 7, D07 F242	Y	Y
165 Navan Road, Dublin 7, D07 NT99	Y	Y
163 Navan Road, Dublin 7, D07 C4A3	Y	Y

Address	Permanent land take	Temporary land take
161 Navan Road, Dublin 7, D07 N7X8	Y	Y
159 Navan Road, Dublin 7, D07 X3T9	Y	Y
Mount Eden, 157 Navan Road, Dublin 7, D07 K8X6	Y	Y
The Haven, 155 Navan Road, Dublin 7, D07 FH93	Y	Y
153 Navan Road, Dublin 7, D07 K2P8	Y	Y
151 Navan Road, Dublin 7, D07 F5T6 & 151A Navan Road, Dublin 7, D07 KW95	Y	Y
149 Navan Road, Dublin 7, D07 F2X9	Y	Y
147 Navan Road, Dublin 7, D07 CD68	Y	Y
145 Navan Road, Dublin 7, D07 PR64	Y	Y
143 Navan Road, Dublin 7, D07 P3CN	Y	Y
141 Navan Road, Dublin 7, D07 Y5R5	Y	Y
139 Navan Road, Dublin 7, D07 DC03	Y	Y
137 Navan Road, Dublin 7, D07 H9C9	Y	Y
An Garda Síochána, Cabra Garda Station and adjoining car park, Navan Road, Dublin 7, D07 XN61	Y	Y
124 Navan Road, Dublin 7, D07 T6P1		Y
122 Navan Road, Dublin 7, D07 C2Y9		Y
St. Joseph’s School for Deaf Boys, Navan Road, Dublin 7, D07 TH79	Y	Y
Curam Care Home, Navan Road	Y	Y
Landing at Aras Slainte, Navan Road		Y
116 Navan Road, Dublin 7, D07 TY8N		Y
114 Navan Road, Dublin 7, D07 H2V0		Y
112 Navan Road, Dublin 7, D07 N4C1		Y
Prague, 110 Navan Road, Dublin 7, D07 A0W6		Y
72 Navan Road		Y
Grass verge adjacent to Telephone exchange, Navan Road, Dublin 7	Y	Y
MLS Park Motors, Navan Road, Dublin 7, D07 H938	Y	Y
Lands at Navan Road / Old Cabra Road junction (public)	Y	
Old Cabra Road Railway Bridge (public)		Y
Landing at Lidl, Old Cabra Road		Y
Footpath to Front of No. 46 Prussia Street		Y
Footpath to Front of No. 45 Prussia Street		Y
Footpath to Front of No. 44 Prussia Street		Y
Footpath to Front of No. 43 Prussia Street		Y
Park Shopping Centre Car Park and access	Y	Y
Landing at BA Steel Fabrications Limited		Y
Luas tracks at Blackhall Street / Benburb Street (public)		Y
Luas tracks at Queen Street / Benburb Street (public)		Y

13.4 Demolition

13.4.1 General

It is envisaged that demolition works will be limited to the demolition of boundary walls along the Proposed Scheme. Localised demolition of portions of BR01 Mill Road Bridge and BR02 Tolka River Bridge are also proposed to allow widening of the structures to take place.

The demolition works shall be in accordance with the specific demolition items set out the following National Standards and guides:

- I.S EN 1991-1-6:2005 – Actions on Structures: General Actions – Actions During Execution (Including National Annex);
- BS 6187:2011 – Code of practice for full and partial demolition;
- BS 5228 – Code of practice for noise and vibration control on construction and open sites – Part 1: Noise; and
- BS 5228 – Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration.

All reasonable precautions to prevent pollution of the site, works and the general environment including streams and waterways shall be taken. All demolition waste shall be segregated and, where practicable, sent for recycling. This shall be 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 shall 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 (DEHLG) July 2006.

13.5 Summary of Accommodation Works and Boundary Treatment

This section outlines the proposed design of the accommodation works along the Proposed Scheme. All directly impacted landowners have been written to and follow-up telephone calls offered to each directly impacted landowner. A number of meetings and telephone calls has taken place with directly impacted landowners.

All requests made by the directly impacted landowners and the general public have been evaluated and, where it was deemed appropriate, in the context of not impacting on the objectives of the Proposed Scheme, have been included in the preliminary design.

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

Where boundary walls are being relocated and the existing access is less than 3.6 m in width, the maximum width of new accesses will be 3.6 m, with the new driveway tying in with the existing driveway at the temporary land acquisition boundary. The proposed maximum width is consistent with Dublin City Council's 'Parking Cars in Front Gardens' document.

In addition, there are two additional locations whereby it is proposed to provide widened accesses of a maximum width of 5.0 m and 5.8 m i.e. 151 Navan Road (relocated) and a shared access at 141/143 Navan Road respectively. It is also proposed to relocate the accesses at both 72 Navan Road and 263 Navan Road to facilitate revised junction layouts.

Where cellars and private landings are affected by the Proposed Scheme pre-construction and post construction surveys will be performed by the appointed contractor. It will be determined during the detailed design stage if strengthening works are required to any existing structures, impacted by the Proposed Scheme.

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. Final details of boundary walls, gates, driveways and grassed areas where affected, will be agreed between the directly impacted landowners and the NTA.

14 Landscape and Urban Realm

14.1 Overview of Landscape and Urban Realm

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

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

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

Guidance

In addition to the overarching aims and objectives for the design of Landscape and Urban Realm, the Fingal County Development Plan 2017 – 2023 and the Dublin City Development Plan 2016 – 2022 include a range policies and objectives that have been considered in developing landscape and urban realm proposals. The objectives and concepts contained in the *BusConnects Urban Realm Concept Designs* have also been referenced as a basis for the proposals.

Fingal Development Plan 2017 – 2023

The Fingal County Development Plan 2017 – 2023 is the county level planning framework applicable to the northern end of the Proposed Scheme from Blanchardstown Town Centre to the N3 Navan Road Ashtown Roundabout junction.

- Chapter 3 Placemaking includes Objective PM64 which seeks to protect, preserve and ensure the effective management of trees and groups of trees.
- Chapter 7 Movement and Infrastructure, includes amongst others, Objective MT03 to implement Smarter Travel A Sustainable Travel Future 20009 -2020; Objective MT13 to promote walking and cycling as efficient, healthy, and environmentally-friendly modes of transport by securing the development of a network of direct, comfortable, convenient and safe cycle routes and footpaths, particularly in urban areas; Objective MT22 to improve pedestrian and cycle connectivity to stations and other public transport interchanges; and Objective MT33 Facilitate and promote the enhancement of bus services through bus priority measures including bus lanes and bus gates.
- Chapter 8 Green Infrastructure includes Objectives GI01 to GI36. Objective GI07 to ensure green infrastructure protection and provision promotes pedestrian access, cycling, and public transport in preference to the car, as appropriate; Objective GI08 to integrate the provision of green infrastructure with infrastructure provision and replacement,

including walking and cycling routes, as appropriate, while protecting biodiversity and other landscape resources; and GI21 requires all new development to address the protection and provision of green infrastructure for the five GI themes set out in the Development Plan (Biodiversity, Parks, Open Space and Recreation, Sustainable Water Management, Archaeological and Architectural Heritage, and Landscape) in a coherent and integrated manner.

- Chapter 9 Natural Heritage includes Objective NH27 Protect existing woodlands, trees and hedgerows which are of amenity or biodiversity value and/or contribute to landscape character and ensure that proper provision is made for their protection and management.
- Sheet 13 Blanchardstown South identifies High Amenity Landscape along the River Tolka Valley and tree preservation objectives for existing trees within the Tolka Valley.

Dublin City Development Plan 2016-2022

The Dublin City Development Plan 2016-2022 is the county level planning framework applicable from the N3 Navan Road Ashtown Roundabout junction to the City Centre.

- Chapter 9 Sustainable Environmental Infrastructure includes Policy SI18 to use SuDS in all new developments where appropriate, as set out in the Greater Dublin Regional Code of Practice for Drainage Works.
- Chapter 10 Green Infrastructure includes Objective GIO24 to support the implementation of the Dublin City Biodiversity Action Plan 2015-2020 and reflects the Strategic Objectives of Ireland's National Biodiversity Plan (Actions for Biodiversity 2011-2016)
- Chapter 10 Green Infrastructure also includes the Dublin City Tree Strategy 2016-2020 incorporating a set of policies for the long-term promotion and management of public trees in Dublin and Objective GIO28 to identify opportunities for new tree planting.

14.2 Consultation with Local Authority

Consultation has taken place with FCC and DCC throughout the design process.

14.3 Landscape and Character Analysis

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

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

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

14.4 Arboricultural Survey

14.4.1 Scope of Assessment

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

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

The AIAR includes the following:

- Description of the site/route and summary of the trees surveyed;
- Summary of any statutory or non-statutory designations affecting trees within the survey area;
- A brief summary of trees to be removed;
- Outline guidance for the design team and any key considerations, or issues which need to be addressed;
- Schedule and corresponding drawings of surveyed trees and key;
- Recommendations for tree works and incursions related to the proposed development; and
- Tree Protection Plans.

14.5 Hardscape

Throughout the design process, a palette of materials has been developed to create a consistent yet locally relevant design response appropriate to different locations along the route. The proposed materials are based on the existing materials and treatments along various parts of the route to match existing material treatments, while also identifying areas of opportunity for enhancement through the use of higher quality materials. Material palettes are described by reference to different typologies appropriate to different sections of the route.

14.5.1 Material Typologies

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

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

Detailing

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

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

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

Sustainable Drainage Systems (SuDS) will be incorporated within hardscape areas to locally manage surface water run-off and reduce demand for piped surface water drainage infrastructure.

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

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

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

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

14.6 Softscape

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

14.6.1 Planting Strategy

The planting strategy has been developed in response to the objectives of the Proposed Scheme and as set out in both the Fingal County Development Plan 2017 –2023 and the Dublin City Development Plan 2016 – 2022. The planting strategy is also in response to landscape and urban realm opportunities arising from the Proposed Scheme to integrate new infrastructure within the existing local context and to enhance the visual and amenity value of streets and spaces.

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

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

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

In addition to trees and street trees, other vegetation is also proposed along the route including hedgerows, ornamental planting and amenity grassland, shrub and meadow grass areas. These will be utilised to reinstate property boundaries altered by the Proposed Scheme.

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

Refer to Table 14.1 for Tree and Woodland/Tree Group Schedule for an overview of the net increase in tree planting along the route that will result from the Proposed Scheme and Table 14.2 for Proposed Tree Planting Species, noting Benefit for Wildlife. Both tables can be found towards the end of this chapter.

Refer to Table 14.3 Schedule of Proposed Planting Areas, Table 14.4 for Proposed Hedgerow species, noting Benefit for Wildlife, Table 14.5 for Proposed Native Planting species, noting Benefit for Wildlife and Table 14.6 for Proposed Ornamental Planting Species, noting Benefit for Wildlife.

14.6.2 Typical Planting Typologies

A range of general planting typologies are incorporated into the Proposed Scheme as appropriate to localities and character areas along the route. In some instances, planting is focussed on reinstatement and repair of existing woodland or tree group areas that will be impacted to facilitate construction of new footpaths, cycle tracks and road infrastructure. In other cases, planting is focussed on enhancing the amenity, green infrastructure and biodiversity along the route and in providing distinctive and attractive places for people to gather and relax.

New Street Trees

A range of urban street tree species (Figure 14.1) have been incorporated into the overall route design depending on location and whether trees are to be planted in grass verges or in tree pits within paved urban environments as appropriate, and also to ensure diversity of species and provide habitats for urban wildlife.

Typically, trees will be semi-mature and have a tree girth of 14/16 cm or 16/20 cm and where appropriate, selected for having a clear stem height to facilitate visual permeability. The full range are included in Table 14.1 and Table 14.2.

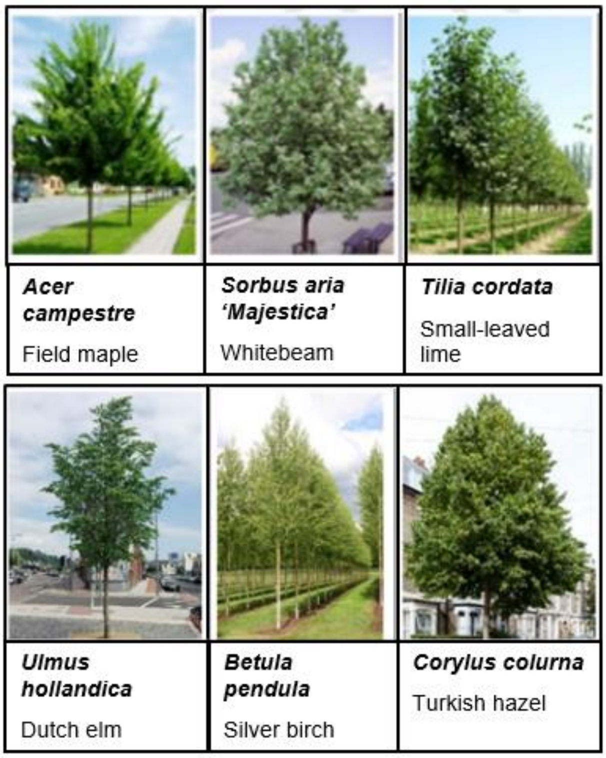


Figure 14.1: Street tree types

New Woodland Areas and Tree Groups

The Proposed Scheme includes a range of existing mature and immature woodlands areas. Some of these will be impacted where the existing carriageway will be widened or cycling infrastructure will be provided. It is proposed to reinstate construction working areas and also to replant the edges of impacted woodland areas, so as to reinstate the streetscape or roadway character. Additionally, there are areas of land within the corridor that are presently in grass or scrub, and new woodlands areas will be established in these locations to offset the loss of woodlands elsewhere and to provide more consistent presentation along carriageway edges. Woodland tree planting will typically comprise bare-root native tree species including Alnus glutinosa (Black Alder), Salix aurita, Salix cinerea oleifolia, Salix caprea, Salix petrandra (Willow sp.), Betula pendula (Silver Birch), Pinus sylvestris (Scots Pine), Crataegus monogyna (Hawthorn), Quercus petraea (Sessile Oak), Prunus spinosa (Blackthorn) and Viburnum opulus (Guelder Rose).

Elsewhere along the Proposed Scheme, there are smaller areas of existing and proposed woodlands and tree groups that will be retained, reinstated or established in order to provide appropriate landscaping connectivity and design interventions at a range of different spaces, including carriageway boundaries, new landscape spaces arising from junction reconfiguration, reinforcement of established vegetation areas, and also establishing new public realm and landscape opportunity areas. Tree species will be determined by location and will comprise either native woodland trees as set out above, or selected street trees as set out in Table 14.2. Additionally, understory planting, long grass and swathes of bulbs will be provided to reinforce the character of landscaped areas along the scheme corridor.

A number of different landscaped central median areas exist along the scheme, including those within high-capacity dual carriageway and smaller scale medians within suburban and urban settings. Landscaping proposals respond to the different localities and may include grass planting, hedgerows and trees as appropriate in medians within the larger scale roadways, and grasses, ornamental planting, hedgerows and trees within the suburban and urban medians.

Boundary Planting

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

Impacted property boundaries will be reinstated following construction. In some instances, boundaries will be re-built along their original alignments. In other cases, boundaries will be re-built on a new setback alignment. In general, property boundaries will be reinstated on a ‘like for like’ basis, including any walls, piers, fences, railings, gates, driveway finishes and private landscaping.

Private grounds that are utilised in part for construction access will be reinstated following completion of the works to match the existing landscaping of the property. Where private grounds are reduced by virtue of permanent land take required for the scheme, the remaining grounds will be reinstated to match the landscape and character of the existing grounds in consultation with the property owner.

14.7 Proposed Landscape and Urban Realm Design

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

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

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

Codes of Practice and Recommendations

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

- BS 3936-1:1992 Nursery stock specification for trees and shrubs
- BS 3998:2010 Tree work.

Recommendations:

- BS 4043:1989 Recommendations for Transplanting Root-Balled Trees
- BS 4428:1989 (Section 7)
- BS 8545:2014 Trees: from nursery to independence in the landscape – Recommendations.

Mitigation Measures

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

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

Mitigation, as an integral part of the design process, includes:

- reinstatement of impacted built or other features on a ‘like for like’ basis so as to restore established streetscape and spatial character;
- upgrading the condition and/or quality of built elements to restore or enhance overall character and amenity;
- introduction of new and reconfigured public spaces and streetscapes to provide more coherent, attractive and useable public realm;
- planting new street trees, woodland/tree groups and other landscaping to offset any unavoidable impacts on existing landscape features along the Proposed Scheme; and
- enhancing the sustainability of public spaces through improving biodiversity and introduction of Sustainable Drainage Systems (SuDS) wherever possible.

14.7.1 N3 Blanchardstown Junction to Snugborough Road

Existing Character: This is the start of the route and comprises the modern Blanchardstown Shopping Centre set within the wider suburban residential context. This section of the route is characterised by both the N3 and connected road network as well as the large-scale district centre with extensive retail, community and leisure facilities and expansive surface parking areas. The shopping centre attracts significant volumes of people by private car, public transport, walking and cycling. It includes substantial tree and hedge planting around and within surface parking areas and primary access routes, and the N3 road network also comprises significant landscaped embankments. It is noted that the separate Snugborough

Junction Upgrade Scheme to the southeast of Blanchardstown Shopping Centre is presently under construction and includes site clearance, removal of vegetation and enabling works within that project area.

Design Proposals: The existing bus lane facility to the northeast of Blanchardstown Shopping Centre and leading along Blanchardstown Road South will be upgraded together with pedestrian and cycle facilities. The additional space required will necessitate removal of sections of perimeter woodland planting at the shopping centre, however, new street trees will be introduced to upgrade the amenity value of the street and the edges of the mixed woodland group along the shopping centre boundary will be replanted so as to mitigate impacts on existing landscape. A new dedicated bus lane will be provided from Blanchardstown Road South into the shopping centre. The junction at Blanchardstown Road South will be converted from a roundabout to a signalised junction, with new street trees around the junction to enhance the presentation and amenity of the entrance to the western shopping centre.

Within the shopping centre, the development of a new Bus Interchange (refer to Figure 14.2) provides a Public Realm Opportunity Site between the primary shopping centre and the northern retail outlets and with strong pedestrian connections to and from both. The Bus Interchange will establish an accessible and attractive location with the overall shopping centre that provides convenient access to and from public transport services within the shopping centre.

The Bus Interchange is designed as a dedicated public transport island providing sheltered passenger waiting areas centrally within a double-sided bus stop gyratory. The location and layout optimise passenger access to the full range and frequency of bus services at the centre. The central area is designed as a pedestrian plaza with high quality hard and soft landscaping providing an attractive, comfortable and convenient facility for passengers within the shopping centre. A distinctive curved canopy system will over sail the entire interchange to provide cover for pedestrians and will also be illuminated from ground recessed uplighters in the pavement to provide uniform illumination of the structure.

Figure 14.2: Blanchardstown Shopping Centre Bus Interchange

Development of this Bus Interchange will necessitate alterations of existing internal carriageways and perimeter tree and hedge planting; however, the interchange includes new tree and hedge planting as an integral part of the design as well as reinstatement tree planting at the interface with the existing carparking areas.

The eastern access road will be widened to provide the dedicated bus lanes, cycle and pedestrian facilities and bus stops. The additional facilities will encroach into the existing roadside tree screening, however new street tree planting and grass verges will be introduced to establish a more pedestrian friendly streetscape in place of the existing vehicle dominated roadway.

This revised access road is designed to tie into the separate Snugborough Junction Upgrade Scheme (by Fingal County Council) to the southeast of Blanchardstown Shopping Centre and will upgrade public transport, pedestrian and cycle facilities from the shopping centre to the eastern side of the N3.

14.7.2 Snugborough Road to N3/M50 Junction

Existing Character: This section is approximately 1.5 km long and is characterised by substantial road infrastructure leading along and over the Tolka Valley Park with a slip lane from Snugborough Road passing between the southern woodland of the Tolka Valley Park and Waterville Park. There are extensive modern suburban residential developments to the east and west.

Design Proposals: The Proposed Scheme will tie in with the Snugborough Junction Upgrade Scheme (by Fingal County Council) which will provide an additional bridge crossing over the N3 alongside the existing bridge and revised and upgraded junction connectivity with the adjoining roads.

Beyond the Snugborough Junction, the Proposed Scheme will generally utilise the existing N3 and associated road infrastructure with modifications to carriageway allocation to provide dedicated bus lanes. New bus stops will be provided on the N3 at the Mill Road overbridge and will require widening of the N3 to accommodate segregated bus stops on the N3. Ramps and steps will be constructed from Mill Road to the elevated east and westbound carriageways of the N3 to provide pedestrian connections to the new bus stops. Construction will require clearance of tree screening from the N3 embankments on the northern and southern side of the carriageway. Post construction, new trees will be planted to mitigate tree removal and to integrate the new construction with the adjoining landscaped embankments and provide an attractive and safe environment for pedestrian commuters.

Elsewhere, there will be localised areas of tree removal to accommodate new bus stop and kerb line adjustments. Trees will be reinstated where practicable and new areas of tree planting, grass verges and species rich grassland will be introduced where practicable to enhance amenity and biodiversity characteristics along the N3.

14.7.3 N3/M50 Junction to Navan Road / Ashtown Road Junction

Existing Character: This section continues for approximately 2.2 km from the M50 interchange to the Ashtown roundabout. The majority of this section is characterised by dual carriageway roadway infrastructure with median and roadside landscaping with a mix of residential developments, commercial and sporting uses together with areas of undeveloped land.

Approaching the Ashtown roundabout, the adjoining built context intensifies with apartment buildings on the southern side of the road comprising strong boundary vegetation and industrial, commercial and apartment buildings on the northern side with more sporadic tree planting along the boundaries. Ashtown roundabout incorporates a copse of mature Monterey Pine trees and the roundabout leads to the tree lined Ashtown Gate entrance to the Phoenix Park.

Design Proposals: For much of this section, changes will consist of localised interventions and reallocation of existing road space. A new dedicated citybound bus lane will be constructed immediately east of the M50 interchange to provide bus priority to the Auburn Avenue / Dunsink Lane. Intermediate lands between the Royal Canal, N3 and various slip lanes will be planted with new mixed woodland planting.

A two-way shared surface cycle facility (Quite Street treatment) will be introduced along Castleknock Manor, and the Auburn Avenue roundabout will be rationalised to provide continuous pedestrian and cycle facilities with new tree planting, grass verges and species rich grasslands introduced to enhance amenity and biodiversity.

New amenity grass planting is proposed in the modified R147 median. East and west of the Parkway Station overbridge, sections of the existing median hedge will be removed and replanted more centrally within the median together with new grass planting within the median.

Continuous footpaths and cycle tracks will be provided from this junction eastwards along the Navan Road and will include upgraded bus stops. These facilities will encroach onto existing roadside woodland tree planting, however new tree planting will be provided where practicable to reinstate the boundary screening. Approaching the Ashtown roundabout, localised boundary realignments will be required including the removal of some boundary and street trees. Following construction, new trees will be planted where practicable.

The Ashtown roundabout currently incorporates Monterey Pine trees and presents as a well-known landmark when approaching or departing the city along the N3.

The roundabout will be reconfigured as a signalised junction (refer to Figure 14.3) and this change presents an Urban Realm opportunity. The revised junction will greatly improve pedestrian and cycle facilities at the junction and conversion from a roundabout will provides substantial additional pedestrian space around the junction. This additional space will incorporate high quality hard and soft landscaping that establishes a contemporary landscape character at the junction that will become a new gateway landmark while also facilitating local pedestrian and cyclist movements. Low level shrub planting will provide a buffer between pedestrians and the junction and new trees, ornamental planting, species rich grass areas and high-quality paving will provide an attractive public space. New trees will include semi-mature Monterey Pine referencing the existing trees on the roundabout.

Figure 14.3: Ashtown Road Junction

14.7.4 Navan Road / Ashtown Road junction to Navan Road / Old Cabra Road junction

Existing Character: This section of the route is approximately 2.5 km long and is both an access route from the west into the city and a local road leading to established residential settlements along both sides of the road. The road varies in character and includes the more heavily wooded character towards the western end at The Paddock and Kempton Avenue.

The majority of the road comprises residential properties with front gardens fronting onto the road with varying degrees of landscaping in private gardens as well as educational, sporting, community and retail uses with frontages onto the road. Street trees are located in the narrow grass verges and vary considerably in maturity as some have failed and been replanted over time and others have not been replanted.

Design Proposals: The Proposed Scheme will require removal of existing verge planted street trees and realignment of property boundaries. Modified boundaries will be reinstated to match existing, and continuous footpaths and cycle tracks will be constructed along both sides of the road to facilitate local and commuting pedestrians and cyclists. Junctions will also be upgraded to provide proper pedestrian crossings. Pavements will be renewed throughout, and high-quality paving and new soft landscaping will be provided at the Church and Public Library. Where practicable, new street trees will be planted to reinstate some of the tree planting and existing character of the road.

The Old Cabra Road junction will be rationalised (refer to Figure 14.4) and will provide an Urban Realm opportunity. Some of the existing slip lanes will be removed to facilitate reconfiguration of the junction to provide dedicated bus lanes and to substantially improve pedestrian and cycle facilities throughout the junction. New hard and soft landscaping will be introduced to enhance the presentation, amenity and biodiversity value of the junction and to create a more pedestrian friendly and distinctive character. Some existing street trees will need to be removed to facilitate the revised layout, however new tree planting will be provided within the Navan Road median and within peripheral landscape areas that will create an attractive pedestrian environment.

Figure 14.4: Old Cabra Road Junction

14.7.5 Navan Road / Old Cabra Road Junction to Ellis Quay

Existing Character: This last section is approximately 2.0 km long and is characterised as an established residential road with private dwellings and gardens fronting onto the road with varying amounts of private landscaping and occasional street trees along the public footpath. The street then transitions to the more compact and urban local centre at Hanlon's corner at the junction with North Circular Road.

South of North Circular Road the route is characterised by a cluster of modern residential and retail developments, but quickly transitions to the narrower, finer grained and more traditional streetscape character of Prussia Street. At the junction of Prussia Street and Aughrim Street, the street enters the distinctive traditional mixed use urban neighbourhood of Stoneybatter with fined grained period terraced buildings providing residential, commercial, retail, community and other uses. Stoneybatter has been well maintained and includes high-quality public realm and landscape enhancements throughout.

Design Proposals: The Proposed Scheme will introduce traffic management measures that will substantially reduce through traffic at Stoneybatter and provide opportunities to further develop the public realm to create an even stronger pedestrian priority urban neighbourhood character. Refer to Figure 14.5.

The carriageway width will be reduced in many locations and the footpaths widened to match the existing urban realm works. New and upgraded bus stops will be installed and continuous cycle tracks will be provided on both sides of the street. The junction at Aughrim Street will be reduced to a single lane only and the existing public spaces either side of the junction will be extended and further developed to increase the public amenity value of these spaces. The existing mature trees will be retained, and the revised layout will facilitate planting of additional new trees and other landscaping.

Figure 14.5: Stoneybatter Village

Along the main streetscape, the existing established urban realm will be extended to incorporate wider footpaths and new cycle tracks.

After Brunswick Street North, Stoneybatter becomes particularly narrow. Brunswick Street North will become one-way westbound for general traffic and will incorporate widened footpaths and dedicated cycle tracks. The public realm along Brunswick Street North will be upgraded to match Stoneybatter and to connect to that along George’s Lane which will be further upgraded and will incorporate two-way cycle facilities and new tree planting. The pedestrian route between Stoneybatter and the River Liffey will be upgraded in width, amenity and quality, and will incorporate continuous high quality cycle facilities bringing additional life and animation to these streets. Refer to Figure 14.6.

Figure 14.6: Brunswick Street North and George's Lane

Table 14.1: Tree and Woodland/Tree Group Schedule

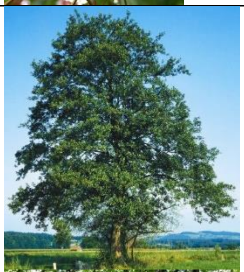
Trees										
Existing Trees to be removed			**413**							
New Trees to be planted (comprising as follows:)			**793**							
Species - Scientific name	**Common names in English**	**Size**	**Qty.**	**Qty. 10%**	**Genus**	**Qty.**	**Qty. 20%**	**Family**	**Qty.**	**Qty. 30%**
Acer Platanoides 'Globosum'	Norway maple	14/16	3	0%	Acer	123	16%	Sapindaceae	124	16%
Acer palmatum	Japanese maple	100-140 cm	5	1%						
Acer campestre ‘Elegant’	Field maple	14/16	49	6%						
Acer campestre ‘Elsrijk’	Field maple	14/16	28	4%						
Acer rubrum	Red maple	14/16	38	5%						
Aesculus x carnea	Red horsechestnut	14/16	1	0%	Aesculus	1	0%			
Alnus glutinosa	Common alder	14/16	40	5%	Alnus	40	5%	Betulaceae	196	25%
Corylus colurna	Turkish hazel	16/20	25	3%	Corylus	25	3%			
Betula pendula	Silver birch	14/16 16/20	55	7%	Betula	75	9%			
Betula albosinensis ‘Fascination’	Chinese silver birch	14/16	11	1%						
Betula jacquemontii	White-barked Himalayan birch	14/16	9	1%						
Carpinus betulus ‘Frans Fontaine’	Hornbeam	16/20	35	4%	Carpinus	56	7%			
Carpinus betulus 'Fastigiata'	Hornbeam	16/20	21	3%						
Pinus sylvestris	Scots pine	16/20	50	6%	Picea	50	6%	Pinaceae	50	6%
Amelanchier arborea 'Robin Hill'	Shadbush	2.0 - 3.0m	15	2%	Amelanchier	15	2%	Rosaceae	161	20%
Crataegus monogyna ‘Stricta’	Hawthorn	14/16	1	0%	Crataegus	1	0%			
Malus ‘Rudolph’	Crab apple	14/16	18	2%	Malus	31	4%			
Malus sylvestris	Crab apple	14/16	13	2%						
Sorbus aria ‘Majestica’	Whitebeam	14/16	41	5%	Sorbus	64	8%			
Sorbus aucuparia ‘Streetwise’	Rowan	14/16	12	2%						
Sorbus aucuparia 'Fastigiata'	Rowan	14/16	5	1%						
Sorbus hupehensis	Chinese rowan	14/16	6	1%						
Prunus avium ‘Plena’	Wild cherry	14/16	14	2%	Prunus	39	5%			
Prunus cerasifera ‘Nigra’	Cherry plum	14/16	5	1%						
Prunus padus	Bird cherry	14/16	20	3%						
Pyrus calleryana 'Chanticleer'	Callery pear	16/20	11	1%	Pyrus	11	1%			
Ginkgo biloba	Maidenhair tree	16/20	11	1%	Ginkgo	11	1%	Ginkgoaceae	11	1%

Species – Scientific name	**Common names in English**	**Size**	**Qty.**	**Qty. 10%**	**Genus**	**Qty.**	**Qty. 20%**	**Family**	**Qty.**	**Qty. 30%**
Cercis Canadensis ‘Forest Pansy’	Redbud	14/16	16	2%	Cercis	16	2%	Fabaceae	48	6%
Gleditsia triacanthos 'Street Keeper'	Honey locust	16/20	15	2%	Gleditsia	32	4%			
Gleditsia triacanthos ‘Skyline’	Honey locust	16/20	17	2%						
Platanus x acerifolia	London plane	16/20	8	1%	Platanus	8	1%	Platanaceae	8	1%
Quercus palustris ‘Fastigiata’	Pin oak	16/20	3	0%	Quercus	24	3%	Fagaceae	40	5%
Quercus robur ‘Fastigiata Koster’	Common oak	16/20	21	3%						
Fagus Sylvatica	European beech	14/16	16	2%	Fagus	16	2%			
Tilia cordata ‘Green Spire’	Small-leaved lime	16/20	42	5%	Tilia	104	13%	Malvaceae	104	13%
Tilia cordata ‘Rancho’	Small-leaved lime	16/20	59	7%						
Tilia x europaea ‘Euchlora’	Caucasian linden	16/20	3	0%						
Ulmus 'New Horizon'	Elm	16/20	38	5%	Ulmus	51	6%	Ulmaceae	51	6%
Ulmus hollandica ‘Dodoens’	Dutch elm	16/20	13	2%						
		Total	**793**			793			793	
Woodland / Tree Groups										
Existing Woodland Trees to be removed				Total Area			0.93 ha.			
New Woodland Trees to be planted				Total Area			0.96 ha.			

Table 14.2 Proposed Tree Planting Species

Scientific name Common name	Size	Qty.	Criteria for use	Photo
Acer Platanoide 'Globosum' Norway maple	16/20	3	'Lollypop' form of the Norway Maple Dense rounded crown and intense yellow autumn colour Low maintenance architectural tree Feature accent element in squares Attractive to pollinating insects Tolerates air pollution and resists drought	 
Acer palmatum sp. Japanese maple	100-140cm	5	A small deciduous tree Attractive shape and delicate looking foliage Feature accent element	 

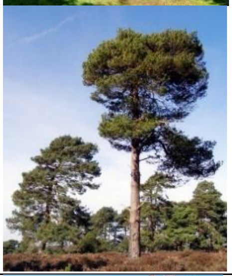
Scientific name Common name	**Size**	**Qty.**	**Criteria for use**	**Photo**
Acer campestre 'Elegant' Field maple	16/20	49	Compact and elegant ascending structure of the branches Intense yellow and orange autumn colour A good avenue tree for use on green belts, road verges, streets, housing estates and squares Tolerates air pollution and resists drought Attractive to a number of invertebrates and pollinating insects. Fruits are eaten by small mammals.	 
Acer campestre 'Elsrijk' Field maple	16/20	28	Upright oval to widely conical shaped, dense crown Intense yellow and orange autumn colour Suitable for narrow streets Tolerates air pollution and resists drought Attractive to pollinating insects	 

Scientific name Common name	Size	Qty.	Criteria for use	Photo
Acer rubrum Red Maple	16/20	38	Medium-sized tree with a spherical to conical crown, dense and closed Feature accent in urban environment Low maintenance architectural tree Bright red autumn colour Acid soils will give the best autumn colour Tolerates air pollution and resists drought Attractive to pollinating insects	 
Aesculus x carnea Red horsechestnut	14/16	1	Large, deciduous tree with a rounded crown Feature accent in urban environment Low maintenance architectural tree Bright red autumn colour The Red Horse Chestnut is more disease-resistant than the horse-chestnut	 
Alnus glutinosa Common alder Black alder	14/16	40	Irish native tree Ideal tree for planting in wet and mixed woodland and forest ages Tolerates most coastal sites A very good soil-enhancing tree due to its nitrogen-fixing capabilities Poor tolerance to hard surfaces Alder trees support over 80 different types of insects. Attractive to a	 

Scientific name Common name	**Size**	**Qty.**	**Criteria for use**	**Photo**
			number of invertebrates pollinating insects	
Corylus colurna Turkish hazel	14/16	25	Extremely tolerant of exposure and paved areas which make it a perfect candidate for urban planting Seasonal interest is provided by elegant long yellow catkins in spring, clusters of edible nuts in frilly cups and good yellow autumn foliage colour Low maintenance architectural tree Generally disease free Attractive to a number of invertebrates and pollinating insects. It produces and drops nuts in large beaked husks that are popular with wildlife, especially squirrels	 
Betula pendula Silver birch	14/16 16/20	55	Irish native tree Intense yellow autumn colour with striking white, pink, or peeling brown bark Important tree for reforestation projects and soil protection Birch trees support over 200 different types of insects. Catkins are a good food source for a variety of birds	 

Scientific name Common name	**Size**	**Qty.**	**Criteria for use**	**Photo**
Betula albosinensis 'Fascination' Chinese silver birch or Chinese red-barked birch	14/16	11	Low maintenance architectural tree Golden yellow autumn colour with striking white or peeling red, brown bark Tolerant of a wide range of conditions and soil types It's an outstanding addition to any landscape, particularly good when planted in groups	 
Betula jacquemontii White-barked Himalayan Birch	14/16	9	Ornamental tree Golden yellow autumn colour with striking snowy white bark It's an outstanding addition to any landscape, particularly good when planted in groups	 

Scientific name **Common name**	**Size**	**Qty.**	**Criteria for use**	**Photo**
Carpinus betulus ‘Frans Fontaine’ Hornbeam	16/20	35	Uniquely upright and dense foliage ‘Frans Fontaine’ is the narrowest of all the Carpinus Ideal for narrow streets and avenues The autumnal colours are a varied mixture of yellows and oranges The tough tree is suitable for many locations Attractive to a number of invertebrates. Seeds eaten by birds. Can provide a dense nesting cover	
Carpinus betulus 'Fastigiata' Hornbeam	16/20	21	Uniquely upright and dense foliage Ideal for narrow streets and avenues The autumnal colours are a varied mixture of yellows and oranges The tough tree is suitable for many locations	

Scientific name Common name	Size	Qty.	Criteria for use	Photo
Pinus sylvestris Scots pine	16/20	50	Irish native tree Best suited in parks, gardens, heath land, woodlands and coastal areas Low maintenance architectural tree Creates habitats for native Irish fauna, including many bird species and squirrels	 
Amelanchier arborea 'Robin Hill' Shadbush	2.0-3.0m	15	Feature accent element on urban squares and parks Small ornamental tree with decorative pink and white flowers Bright red and orange autumn colour Available as a multi-stem and a standard tree Attracts a wide assortment of birds and wildlife	 

Scientific name Common name	Size	Qty.	Criteria for use	Photo
Crataegus monogyna 'Stricta' Hawthorn	14/16	1	Irish native tree Because of its columnar growth this tree is suitable for narrow streets and small gardens White flowers in late spring followed by conspicuous red berries in autumn Tolerant of exposed locations such as windy and coastal sites It provides food for more than 150 different insect species. Attractive to pollinating insect	 
Malus 'Rudolph' Crab apple	14/16	18	A great choice for colour and year-round interest Small ornamental tree that starts off by growing vertically Used as an avenue tree because of the small fruit Attractive to a number of invertebrates and pollinating insects. Many species of birds and mammals eat fruit and disperse the seeds	 

Scientific name Common name	Size	Qty.	Criteria for use	Photo
Malus sylvestris Crab apple	14/16	13	Irish native tree Feature accent element on urban squares and parks Small to medium-sized deciduous trees with showy flowers in spring and ornamental or edible fruit in autumn Attractive to a number of invertebrates and pollinating insects. Many species of birds and mammals eat fruit and disperse the seeds	 
Sorbus aria 'Majestica' Whitebeam	14/16	41	Forms a compact, broad, pyramidal crown Stands up well to hard surfaces 'Majestica' is a good avenue and street tree Tolerant of atmospheric pollution and dry conditions Attractive to a number of invertebrates and pollinating insects. Berries provide a valuable food source for birds	 

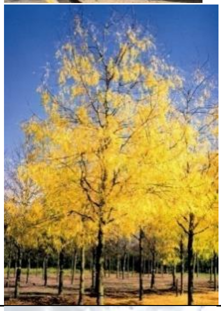
Scientific name Common name	Size	Qty.	Criteria for use	Photo
Sorbus aucuparia 'Streetwise' Rowan	14/16	12	Irish native tree Ideal for tighter urban locations with a very neat upright habit Tolerant of atmospheric pollution and dry conditions Attractive to pollinating insects. It produces an important berry crop for wildlife	 
Sorbus aucuparia 'Fastigiata' Rowan	14/16	5	Irish native tree Grows in a narrow upright fashion Ideal for tighter urban locations with a very neat columnar habit Tolerant of atmospheric pollution and dry conditions Attractive to pollinating insects. It produces an important berry crop for wildlife	 

Scientific name Common name	Size	Qty.	Criteria for use	Photo
Sorbus hupehensis Chinese rowan	14/16	6	Round headed shape White or white tinged pink fruits and glorious red autumn colour Feature accent element on urban squares and parks It is one of the faster growing rowans	 
Prunus avium 'Plena' Wild cherry	14/16	14	Irish native tree Double flowered Wild Cherry produces no fruit Rounded and regularly branched closed crown Feature accent element on urban squares, parks and avenues Attractive to a number of invertebrates and pollinating insects. Berries provide a valuable food source for birds	 

Scientific name Common name	Size	Qty.	Criteria for use	Photo
Prunus cerasifera 'Nigra' Black cherry plum	14/16	5	Ornamental tree with a round, dense, spreading head and dark purplish-black branches and twigs Feature accent element on urban squares, parks and avenues Great for attracting native wildlife	 
Prunus padus Bird cherry	14/16	20	Irish native tree Popular native hedge plant commonly used in mixed native hedgerows Attractive to a number of invertebrates and pollinating insects. Berries provide a valuable food source for birds	 

Scientific name Common name	Size	Qty.	Criteria for use	Photo
Pyrus calleryana 'Chanticleer' Callery pear	16/20	11	Narrow conical to ovoid, half-open crown Perfect for avenue planting due to its slender form Great for attracting native wildlife	 
Ginkgo biloba Maidenhair tree	16/20	11	The World's Oldest Tree Species Intense yellow autumn colour Feature accent element on urban parks and avenues Pests and diseases free Resistant to air pollution	 

Scientific name Common name	Size	Qty.	Criteria for use	Photo
Cercis Canadensis 'Forest Pansy' Redbud	14/16	16	Large deciduous shrub or small, often multi-stemmed or standard tree with purple, heart-shaped leaves which turn yellow in autumn before falling Grown mainly for striking foliage effects Feature accent element on urban parks and squares Attractive to pollinators	 
Gleditsia triacanthos 'Street keeper' Honey locust	16/20	15	Suitable for urban streets with ascending branches and a narrowly pyramidal growth habit Vivid yellow autumn colour Feature accent element on urban parks and avenues Resistant to drought and pollution	 

Scientific name Common name	**Size**	**Qty.**	**Criteria for use**	**Photo**
Gleditsia triacanthos 'Skyline' Honey locust	16/20	17	Suitable for urban streets with ascending branches and a narrowly pyramidal growth habit Vivid yellow autumn colour Feature accent element on urban parks and avenues Resistant to drought and pollution	
Platanus x acerifolia London plane	16/20	8	A large tree for a large space Coherence with existing planting scheme Tolerates air pollution and resists drought and heavy pruning Great for attracting native wildlife	

Scientific name Common name	Size	Qty.	Criteria for use	Photo
Quercus palustris 'Fastigiata' Pin oak	16/20	3	Columnar, half-open crown Perfect for avenues and narrow streets planting due to its slender upright habit Low maintenance architectural tree Oak trees provide food and shelter to over 450 species of insects. Attractive to a range of invertebrates and are important for insect eating birds. Acorns are eaten by a variety of birds and mammals	 
Quercus robur 'Fastigiata Koster' Common oak	3 - 3.5m	21	Irish native tree Tall narrow pyramidal version of the Common Oak -Ideal for growing along an avenue or where space is at a premium Oak trees provide food and shelter to over 450 species of insects. Attractive to a range of invertebrates and are important for insect eating birds. Acorns are eaten by a variety of birds and mammals	 

Scientific name Common name	Size	Qty.	Criteria for use	Photo
Fagus Sylvatica European Beech	12/14	16	Large, vigorous deciduous tree with a broad, spreading crown Leaves stay on the tree over the winter months, giving a rustic brown look Resists heavy pruning Replacement tree to match existing	 
Tilia cordata 'Green Spire' Small-leaved lime	16/20	42	Pyramidal, later oval to ovoid, half-open crown. Coherence with existing planting scheme. Popular choice for urban planting Tolerates air pollution and resists heavy pruning Attractive to many invertebrates and pollinating insects	 
Tilia cordata 'Rancho' Small-leaved lime	16/20	59	Narrow conical, later narrow ovoid, half-open crown Coherence with existing planting scheme Popular choice for urban planting Tolerates air pollution and resists heavy pruning Attractive to many invertebrates and pollinating insects	 

Scientific name Common name	**Size**	**Qty.**	**Criteria for use**	**Photo**
Tilia x europaea 'Euchlora' Caucasian linden	16/20	3	Coherence with existing planting scheme It is very versatile, being suitable for urban settings, avenues, verges and parks. Tolerates air pollution and resists heavy pruning Attractive to many invertebrates and pollinating insects	 
Ulmus 'New Horizon' Elm	16/20	38	Fast-growing tree with dense pyramidal crown High resistance to Dutch elm disease (DED) Tolerant of urban conditions Support over 80 different types of insects. The early flowers of elm are visited by many insects and the seeds are valued by red squirrels	 
Ulmus hollandica 'Dodoens' Dutch elm	16/20	13	Fast-growing tree with dense broad spherical crown 'Dodoens' is wind-resistant and can be of excellent use in both urban and rural settings High resistance to Dutch elm disease (DED) Tolerant of urban conditions	 

Table 14.3: Schedule of Proposed Planting Areas

Planting Type	Length (m) / Area (m2)
Hedgerow	1,119 m
Native Planting	1,358 m2
Ornamental Planting	5,485 m2
Grass Verge and Amenity Areas	36,753 m2
Species Rich Grassland	6,373 m2

Table 14.4: Proposed Hedgerow species, noting Benefit for Wildlife

Latin name	Common name	Benefit
Buxus sempervirens	Common Box	Attractive to pollinators. Can provide a dense nesting cover.
Ceanothus species	Lilac Bush	Provide nectar and pollen for butterflies, bees and other pollinators in their dense flower clusters in spring.
Cornus sanguinea	Dogwood	The flowers produce a scent that is attractive to many species of invertebrates. The berries are eaten by some species of birds.
Corylus avellana	Hazel	Reddish-brown nuts in a green husk are seen on hazel in the late summer and autumn; but these are generally eaten quickly by birds and mammals.
Crataegus monogyna	Hawthorn	Provides a source of nectar and berries providing food for birds including thrushes. If allowed to grow dense it will provide good nesting opportunities for birds.
Euonymus europaeus	Spindle	Spindle produces flowers that provide a good source of food for bees and other insects. The fruits attract aphids which in turn attract insect-eating birds.
Ilex aquifolium	Holly	The berries are greatly enjoyed by birds and mammals. Holly also plays a crucial part in the life cycle of the beautiful butterfly the holly blue, which lays eggs on holly leaves in spring and is a frequent visitor to gardens in town. Requires male and female plants to produce berries.
Ligustrum vulgare	Privet	Wild privet is the preferred choice for wildlife and may provide nesting sites for blackbirds and other species. Left to grow a little less tidily than many gardeners allow, the structure will become more open and also offer nesting opportunities for many more species. Good for bees and butterflies.
Pyracantha coccinea	Scarlett Firethorn	Very valuable to birds as a source of food and as a nesting site. Also, a good security plant due to the thorns.

Latin name	Common name	Benefit
Rosa species	Roses	Provides nectar for bees and butterflies. Hips are valuable for small birds and mammals.
Salix aegyptiaca	Musk Willow	Winter-flowering shrub pollinated by bees and other insects.
Sambucus nigra	Common Elder	Provides flowers for insects and berries for birds.
Sarcococca confusa	Sweet Box	Flowering in winter, followed by black berries eaten by birds.
Viburnum spp	Viburnum	Excellent for attracting hoverflies and are a good source of nectar for bees. The shiny berries provide a food source for birds and mammals alike.

Table 14.5: Proposed Native Planting species, noting Benefit for Wildlife

Latin name	Common name	Benefit
Cornus sanguinea	Dogwood	The flowers produce a scent that is attractive to many species of invertebrates. The berries are eaten by some species of birds.
Corylus avellana	Hazel	Reddish-brown nuts in a green husk are seen on hazel in the late summer and autumn; but these are generally eaten quickly by birds and mammals.
Crataegus monogyna	Hawthorn	Provides a source of nectar and berries providing food for birds including thrushes. If allowed to grow dense it will provide good nesting opportunities for birds.
Euonymus europaeus	Spindle	Spindle produces flowers that provide a good source of food for bees and other insects. The fruits attract aphids which in turn attract insect-eating birds.
Hypericum androsaemum	Tutsan	Flowers attract insects especially bees while the berries are eaten by birds and small mammals.
Ilex aquifolium	Holly	The berries are greatly enjoyed by birds and mammals. Holly also plays a crucial part in the life cycle of the beautiful butterfly the holly blue, which lays eggs on holly leaves in spring and is a frequent visitor to gardens in town. Requires male and female plants to produce berries.

Latin name	Common name	Benefit
Ligustrum vulgare	Privet	Wild privet is the preferred choice for wildlife and may provide nesting sites for blackbirds and other species. Left to grow a little less tidily than many gardeners allow, the structure will become more open and also offer nesting opportunities for many more species. Good for bees and butterflies.
Rosa species	Roses	Provides nectar for bees and butterflies. Hips are valuable for small birds and mammals.
Salix aegyptiaca	Musk Willow	Winter-flowering shrub pollinated by bees and other insects.
Sambucus nigra	Common Elder	Provides flowers for insects and berries for birds.
Thymus species	Thyme	The rose-purple flowers grow in long, whorled, upright spikes and are very attractive to bees, hoverflies and butterflies.
Viburnum spp	Viburnum	Excellent for attracting hoverflies and are a good source of nectar for bees. The shiny berries provide a food source for birds and mammals alike.

Table 14.6: Proposed Ornamental Planting Species, noting Benefit for Wildlife

Latin name	Common name	Benefit
Abelia chinensis	Bee Bush or Chinese Abelia	Attractive to pollinators. Flowering in October.
Ajuga reptans	Bugle	Bugle is excellent for ground cover under shrubs since it prefers semi-shade, and is attractive to a wide range of insects.
Anemone nemorosa	Wood Anemone	Provides a good early source of pollen and nectar for bees and other insects.
Armeria maritima	Thrift, Sea Pink	Attractive to pollinators.
Aster novi-belgii	Michaelmas Daisy	Attractive to a range of bees, butterflies, moths and birds.
Aubrieta deltoidea	Purple Rock-cress	Provides a good early food source for bees and adds colour to edges of flower beds, prefers full sunlight.
Bergenia purpurascens	Elephant’s Ear or Purple Bergenia	Attractive to pollinators.
Campanula glomerata	Clustered Bellflower	Attractive to pollinators.
Clematis vitalba	Clematis ‘Old Man’s Beard’	Provides nectar for bee and butterflies.

Latin name	Common name	Benefit
Conopodium majus	Pignut	Attractive to pollinators.
Crocus tommasinianus	Early Crocus	As a winter-flowering, provides a good early source of pollen and nectar for bees and other insects.
Cynoglossum officinale	Hound’s Tongue	Attractive to pollinators.
Digitalis purpurea	Foxglove	Attractive to pollinators.
Filipendula vulgaris	Dropwort	Attractive to pollinators.
Galanthus nivalis	Common Snowdrop	As a winter-flowering, provides a good early source of pollen and nectar for bees and other insects.
Hedera helix	Ivy	Provides a late nectar source and cover / hibernating sites for many species of invertebrates.
Humulus lupulus	Hop	Provides nectar for bee and butterflies.
Hyacinthoides non-scripta	Bluebell	Provides a source of pollen and nectar for bees and other insects. Ensure that suppliers do not provide either Spanish bluebell or the hybrid between this and Bluebell (or any other hybrids) and have not stripped native bluebells from the wild.
Hypericum perforatum	Perforate St John’s Wort	Attractive to pollinators.
Jasminus officinale	Summer Jasmine	Night-scented. The scent from jasmine at night can attract bats.
Lathyrus pratensis	Meadow Vetchling	Attractive to pollinators.
Leucanthemum vulgare	Ox-eye Daisy	Attractive to pollinators.
Linaria vulgaris	Common Toadflax	Attractive to pollinators.
Lonicera periclymenum	Honeysuckle	The flowers of the Honeysuckle attract night flying moths and other insects which in turn can provide food for bats. Honeysuckle can provide nest sites for small garden bird species while the bark is often used in nest building by species including the House Sparrow.
Lunaria biennis	Honesty	Attractive to butterflies.
Malva moschata	Musk Mallow	Attractive to pollinators.

Latin name	**Common name**	**Benefit**
Matthiola longipetala	Night-scented Stock	Night-scented. emits a pleasant scent in the evening and through the night attracting night-flying pollinators and insects and therefore bats.
Mahonia species	Mahonia	Flowering occurs in autumn, winter and early spring benefiting winter-active pollinators (like bumblebees or some hoverflies). Flowers produce abundant nectar. Berries are eaten by birds.
Monarda didyma	Bergamot	Provides a good source of pollen and nectar.
Nicotiana	Tobacco Plant	Attractive to night pollinators like moths (beneficial for bats).
Oenothera biennis	Evening Primrose	Particularly attractive to night flying insects (therefore can attract bats).
Persicaria bistorta	Common Bistort	Attractive to pollinators.
Rudbeckia hirta	Black-eyed Susan	Attractive to pollinators. Flowering in October.
Silene vulgaris	Bladder Campion	Attractive to pollinators.
Thalictrum flavum	Meadow Rue	Attractive to pollinators.
Viola riviniana	Dog Violet	Flowers from April to June and is attractive to bees and other insects.

15 How are we achieving the Objectives

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

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

Currently, bus priority is characterised by discontinuity. Bus priority is only provided along certain sections and a number of pinch-points cause significant delays which result in a negative impact on the performance of the bus service as a whole. Within the extents of the Proposed Scheme route, bus lanes are currently provided on only approximately 10% and 40% of route outbound and inbound respectively.

Issues related to frequency, reliability and a complex network have persisted for many years and will continue to do so without further intervention. As such, there are a number of high frequency public bus services along the routes to be improved by the Proposed Scheme (including the 38 and 39 bus routes), as well as multiple private and coach services. In addition to this there are multiple other bus services which run along this corridor intermittently, providing interchange opportunities with other bus services. Many of these services suffer from journey time unreliability, particularly in peak times, due to the lack of bus priority provision.

In addition to the level of service improvements the Proposed Scheme will facilitate for existing bus services, the ongoing Dublin Area Bus Network Redesign will see continued investment in bus services into the future, which will also be afforded similar journey-time reliability and therefore improve their attractiveness as an alternative to private car usage.

Without the interventions of the Proposed 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.

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 provided on approximately 14% and 15% of the route outbound and inbound respectively, while advisory cycle lanes are provided on approximately 23% and 16% of the route outbound and inbound respectively. The remaining extents have no dedicated cycle provision or cyclists must cycle within the bus lanes provided.

The Proposed Scheme is implementing safe, segregated infrastructure (inclusive of Quiet Street treatment) to 78% of the Proposed Scheme, and as such is greatly enhancing the potential for cycling.

Within the extents of the Proposed Scheme there are a number of amenities, villages and urban centres which experience high pedestrian usage including along Prussia Street, Stoneybatter Village, Queen Street, Blackhall Street and George's Lane, among others. 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 NTA, local authorities and stakeholders. The proposals have been developed amongst the BusConnects Infrastructure Team 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.

The Proposed Scheme encourages local journeys to be taken through active travel modes by:

- The provision of safe and efficient sustainable transport networks;
- Improved infrastructure for walking and cycling;
- Improved public realm; and
- Improved connectivity to facilities which will be developed for the mobility and visually impaired.

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 a key access corridor in the Dublin region, enabling the delivery of efficient, safe, and integrated sustainable transport movement along this corridor.