DART+ South West

Volume 3G: Technical Optioneering Report – Memorial Road to South Circular Road Junction

Iarnród Éireann

November 2021

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Glossary of Terms

ABP	An Bord Pleanála
ACA	Architectural Conservation Area
AOD	Above Ordinance Datum
APIS	Authorisation for Placing in Service
ASA	Application for Safety Approval
AsBo	Assessment Body
ASPSC	Application Specific Project Safety Case
ATP	Automatic Train Protection
CAF	Common Appraisal Framework
Cantilever	OHLE structure comprising horizontal or near horizontal members supporting the catenary projecting from a single mast on one side of the track.
Catenary	The longitudinal wire that supports the contact wire.
CAWS	Continuous Automatic Warning System
CBI	Computer-Based Interlocking
CCE	Chief Civils Engineers Department of IE
CCRP	City Centre Re-signalling Project
CCTV	Closed Circuit Television
CDP	County Development Plan
CIÉ	Córas Iompair Éireann
Contact wire	Carriers the electricity which is supplied to the train by its pantograph.
CPO	Compulsory Purchase Order
Cross overs	A set of railway parts at the crossing of several tracks which helps trains change tracks to other directions.
CRR	Commission for Rail Regulation (formerly RSC – Railway Safety Commission)
CSM RA	Common Safety Method for Risk Evaluation and Assessment
CSS	Construction Support Site, Interchangeable with Construction Compound
CTC	Central Traffic Control
Cutting	A railway in cutting means the rail level is below the surrounding ground level.
D&B	Design & Build (contractor)
DART	Dublin Area Rapid Transit (IÉ's Electrified Network)
DART+	DART Expansion Programme

DeBo	Designated Body
DC	Direct Current, electrical current that flows in one direction, like that from a battery.
DCC	Dublin City Council
DRR	Design Review Report
DSR	Design Statement Report
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Environmental Impact Statement
Electrification	Electrification is the term used in supplying electric power to the train fleet without the use of an on-board prime mover or local fuel supply.
EMC	Electromagnetic Compatibility
EMU	Electric Multiple Unit (DART train)
EN	European Engineering Standard
EPA	Environmental Protection Agency
EPO	Emerging Preferred Option
ERTMS	European Rail Traffic Management System
ESB	Electricity Supply Board
Four-tracking	Four-tracking is a railway line consisting of four parallel tracks with two tracks used in each direction. Four track railways can handle large amounts of traffic and are often used on busy routes.
FRS	Functional Requirements Specification
FSP	Final Supply Points
GDA	Greater Dublin Area
GI	Ground Investigation
HAZID	Hazard Identification
Horizontal Clearance	The horizontal distance between a bridge support and the nearest railway track is referred to as horizontal clearance. Bridge supports include abutments (at the ends of the bridge) and piers (at intermediate locations).
HV	High Voltage
IA	Independent Assessor
IÉ	Iarnród Éireann
IM	Infrastructure Manager (IÉ)
IMSAP	Infrastructure Manager Safety Approval Panel
Insulators	Components that separate electricity live parts of the OHLE from other structural elements and the earth. Traditionally ceramic, today they are often synthetic materials.
KCC	Kildare County Council

Lateral Clearance	Clearances between trains and structures.
LCA	Landscape Character Area
Mast	Trackside column, normally steel that supports the OHLE.
MCA	Multi-criteria Analysis
MDC	Multi-disciplinary Consultant
MEP	Mechanical electrical and plumbing
MFD	Major Feeding Diagram
MMDC	Maynooth Multi-disciplinary Consultant
MV	Medium Voltage
NDC	National Biodiversity Data Centre
NIAH	National Inventory of Architectural Heritage
NoBo	Notified Body
NTA	National Transport Authority
OHLE	Overhead Line Equipment
Overbridge (OB)	A bridge that allows traffic to pass over a road, river, railway etc.
P&C	Points and Crossings
Pantograph	The device on top of the train that collects electric current from the contact wire to power the train.
PC	Public Consultation
Permanent Way	A term used to describe the track or railway corridor and includes all ancillary installations such as rails, sleepers, ballast as well as lineside retaining walls, fencing and signage.
POAP	Plan-On-A-Page, high-level emerging programme
PPT	Phoenix Park Tunnel
PRS	Project Requirement Specification
PSCS	Project Supervisor Construction Stage
PSDP	Project Supervisor Design Process
PSP	Primary Supply Points
QA/QC	Quality Assurance/Quality Control
RAM	Reliability, Availability, Maintainability
RC	Reinforced Concrete
Re-signalling	Re-signalling of train lines will regulate the sage movement of trains and increase the capacity of train services along the route.
RMP	Record of Monuments and Places
RO	Railway Order

RPS	Record of Protected Structures
RSC-G	Railway Safety Commission Guideline
RU	Railway Undertaking (IÉ)
SAM	Safety Assurance Manager
SAP	Safety Approval Panel
SDCC	South Dublin County Council
SDZ	Strategic Development Zone
SET	Signalling, Electrical and Telecommunications
Sidings	A siding is a short stretch of railway track used to store rolling stock or enable trains on the same line to pass
SMR	Sites and Monuments Records
SMS	IÉ Safety Management System
STC	Single Track Cantilever
TII	Transport Infrastructure Ireland
TMS	Train Management System
TPH	Trains per Hour
TPHPD	Trains per Hour per Direction
TPS	Train Protection System
Track Alignment	Refers to the direction and position given to the centre line of the railway track on the ground in the horizontal and vertical planes. Horizontal alignment means the direction of the railway track in the plan including the straight path and the curves it follows.
TSI	Technical Specifications for Interoperability
TSS	Train Service Specification
TTAJV	TYPSA, TUC RAIL and ATKINS Design Joint Venture (also referred to as TTA)
TTC	Two Track Cantilever
Underbridge (UB)	A bridge that allows traffic to pass under a road, river, railway etc. The underneath of a bridge.
VDC	Direct Current Voltage
Vertical Clearance	For overbridges, an adequate vertical distance between railway tracks and the underside of the bridge deck (soffit) must be provided in order to safely accommodate the rail vehicles and the OHLE. This distance is known as vertical clearance and it is measured from the highest rail level.
WFD	Water Framework Directive

1. Introduction

1.1 Purpose of the Report

The purpose of this report is to provide technical input to the Option Selection Report to inform Public Consultation No. 2 (PC2). This report shows the options considered as part of the project development and why the preferred option for PC2 was chosen.

This report provides the technical assessment of the area between Memorial Road Bridge (OBC3) and to the east of St. John's Road Bridge (OBC0A). This report presents the approach to option development, options assessment, and options selection. This optioneering process incorporates assessment by the following Design Workstreams and specialist Project Teams:

- Permanent Way
- Civils and Structures
- Signalling, Electrification and Telecommunications (SET) and Low Voltage Power
- Overhead Line Equipment (OLE)
- Environment
- Highways
- Geotechnical
- Construction Compounds

The report provides:

- An area overview and a detailed description of the existing railway infrastructure and challenges.
- The project requirements for this area.
- The technical and environmental constraints, including the horizontal and vertical clearances at structures.
- The options considered for this area.
- The option selection process is leading to the identification of the Preferred Option, including the Sifting process and the Multi-Criteria Analysis process.
- A summary of the feedback received from the first public consultation which was held in May and June 2021.
- An update on the design development.
- An overview of the proposed construction methodology and requirements in terms of construction compounds.

1.2 DART+ Programme Overview

The DART+ Programme is a transformative railway investment programme that will modernise and improve the existing rail services in the Greater Dublin Area. It will provide a sustainable, electrified, reliable and more frequent rail service, improving capacity on rail corridors serving Dublin.

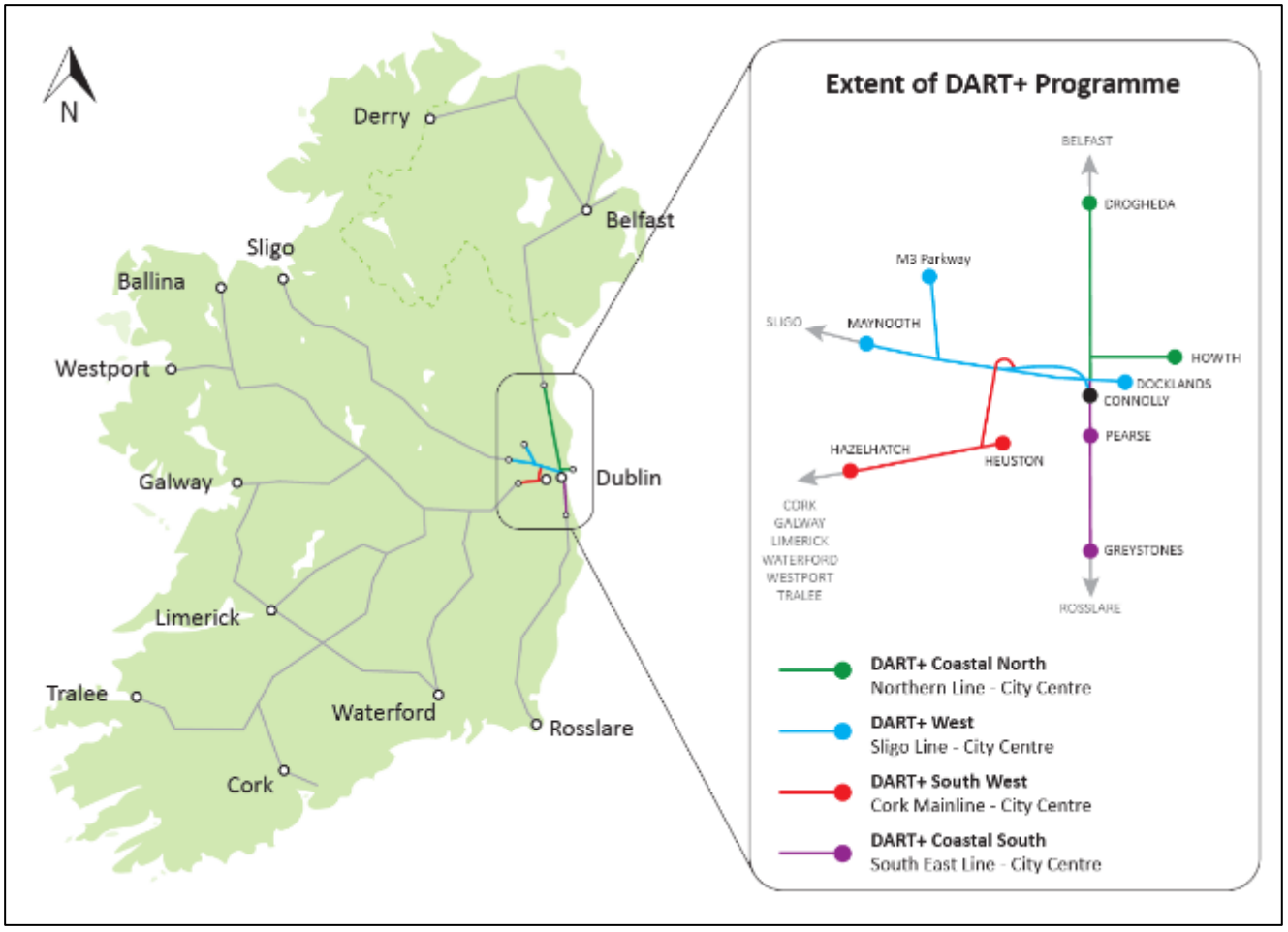


Figure 1-1 DART+ Programme

The current electrified DART network is 50km long, extending from Malahide / Howth to Bray / Greystones. The DART+ Programme seeks to increase the network to 150km. The DART+ Programme is required to facilitate increased train capacity to meet current and future demands, which will be achieved through a modernisation of the existing railway corridors. This modernisation includes the electrification, re-signalling, and certain interventions to remove constraints across the four main rail corridors within the Greater Dublin Area, as per below:

- DART+ South West (this Project) – circa 16km between Hazelhatch & Celbridge Station and Heuston Station and also circa 4km between Heuston Station and Glasnevin Junction, via the Phoenix Park Tunnel Branch Line.
- DART+ West – circa 40km from Maynooth & M3 Parkway Stations to the City Centre.
- DART+ Coastal North – circa 50km from Drogheda to the City Centre.
- DART+ Coastal South – circa 30km from Greystones to the City Centre.
- DART+ Fleet – purchase of new electrified fleet to serve new and existing routes.

The DART+ Programme is a key element to the national public transportation network, as it will provide a high-capacity transit system for the Greater Dublin Area and better connectivity to outer regional cities and towns. This will benefit all public transport users.

The Programme has also been prioritised as part of Project Ireland 2040 and the National Development Plan 2021-2030 as it is integral to the provision of an integrated, high-quality public transport system.

Delivery of the Programme will also promote transport migration away from the private car and to public transport. This transition will be achieved through a more frequent and accessible electrified service, which will result in reduced road congestion, especially during peak commuter periods.

Ultimately, the DART+ Programme will provide enhanced, greener public transport to communities along the DART+ Programme routes, delivering economic and societal benefits for current and future generations.

1.3 DART+ South West Project

The DART+ South West Project will deliver the expansion of an improved electrified network, with increased passenger capacity and enhanced train performance between Hazelhatch & Celbridge Station to Heuston Station (c. 16km) on the Cork Mainline, and Heuston Station to Glasnevin Junction via Phoenix Park Tunnel Branch Line (c. 4km).

DART+ South West will complete four tracking between Park West & Cherry Orchard Station and Heuston Station and will also re-signal and electrify the route. The completion of the four tracking will remove a significant existing constraint on the line, which is currently limiting the number of train services that can operate on this route. DART+ South West will also deliver track improvements along the Phoenix Park Tunnel Branch Line, which will allow a greater number of trains to access the city centre.

Upon completion of DART+ South West electrification, new DART trains will be used on this railway corridor, similar to those currently operating on the Malahide / Howth to Bray / Greystones Line.

Figure 1-2 DART+ South West Route Map

1.4 Capacity Increase Delivered by DART+ South West

DART+ South West will improve performance and increase train and passenger capacity on the route between Hazelhatch & Celbridge Station to Heuston Station and through the Phoenix Park Tunnel Branch Line to the City Centre, covering a distance of circa 20km. It will significantly increase train capacity from the current 12 trains

per hour per direction to 23 trains per hour per direction (i.e. maintain the existing 12 services, with an additional 11 train services provided by DART+ South West). This will increase passenger capacity from the current peak capacity of approximately 5,000 passengers per hour per direction to approximately 20,000 passengers per hour per direction. Upon completion of the DART+ South West Project, train services will be increased according to passenger demand.

1.5 Key Infrastructural Elements of DART+ South West Project

The key elements of DART+ South West include:

- Completion of four-tracking from Park West & Cherry Orchard Station to Heuston Station, extending the works completed on the route in 2009.
- Electrification of the line from Hazelhatch & Celbridge Station to Heuston Station and also from Heuston Station to Glasnevin Junction, via the Phoenix Park Tunnel Branch Line, where it will link with the proposed DART+ West.
- Undertaking improvements / reconstructions of bridges to achieve vertical and horizontal clearances.
- Remove rail constraints along the Phoenix Park Tunnel Branch Line.
- Delivery of a new Heuston West Station.

The 'Preferred Option' will be compatible with the future stations at Kylemore and Cabra, although the construction of these stations is not part of the DART+ South West Project.

1.6 Route Description

The existing rail corridor extends from Heuston Station to Hazelhatch Station, the route also extends through the Phoenix Park Tunnel to Glasnevin Junction. The area descriptions and extents are set out in **Table 1-1** and **Figure 1-2**.

Table 1-1 Route Breakdown

Area Name	Sub-area Description	Extents	Main Features
Hazelhatch to Park West	Area from Hazelhatch to Park West (Volume 3A)	West side of Hazelhatch & Celbridge Station to 50m to west of Cherry Orchard Footbridge (OBC8B)	Hazelhatch & Celbridge Station Adamstown Station Clondalkin/Fonthill Station Park West & Cherry Orchard Station
Park West to Heuston Station	Area from Park West to Le Fanu (Volume 3B)	West of Cherry Orchard Footbridge (OBC8B) to the East of the proposed Le Fanu Road Bridge (OBC7)	Cherry Orchard Footbridge (OBC8B) Le Fanu Road Bridge (OBC7)
	Area from Le Fanu to Kylemore (Volume 3C)	East of the proposed Le Fanu Road Bridge (OBC7) to the East of IE700B (i.e. the points for the Inchicore headshunt turnout)	Kylemore Road Bridge (OBC5A)

Area Name	Sub-area Description	Extents	Main Features
	Area from Kylemore to Sarsfield (Volume 3D)	East of IE700B (i.e. the points for the Inchicore headshunt turnout to the west of Sarsfield Road Bridge (UBC4)	Inchicore Works Depot Khyber Pass Footbridge (OBC5)
	Area from Sarsfield to Memorial (Volume 3E)	West of Sarsfield Road Bridge (UBC4) to the West of Memorial Road Bridge (OBC3)	Sarsfield Road Bridge (UBC4)
	Memorial Road (Volume 3F)	Area around Memorial Road Bridge	Memorial Road Bridge (OBC3)
	Area from Memorial Road to South Circular Road Junction (Volume 3G)	East of Memorial Road Bridge (OBC3) to East of St John's Road Bridge (OBC0A)	South Circular Road Junction South Circular Road Bridge (OBC1) St Johns Road Bridge (OBC0A)
	Area around Heuston Station and Yard (Volume 3H)	Area at the South side of the Heuston Station Yard (non-DART+ tracks)	Heuston Station Sidings around Heuston Station
Heuston West Station	New Heuston West Station (Volume 3I)	Area to the West of Heuston Station, adjacent to Liffey Bridge (UBO1)	Heuston West Station
St John's Road Bridge (Islandbridge) to Glasnevin Junction	East of St John's Road Bridge (OBC0A) (Islandbridge) to North of Phoenix Park Tunnel (Volume 3J)	East of St John's Road Bridge (OBC0A) (Islandbridge) to North of Phoenix Park Tunnel	Liffey Bridge (UBO1). Conyngham Road Bridge (OBO2) Phoenix Park Tunnel
St John's Road Bridge to Glasnevin Junction	North of the Phoenix Park Tunnel to Glasnevin Junction (Volume 3K)	North of Phoenix Park Tunnel to South of Glasnevin Junction	McKee Barracks Bridge (OBO3) Blackhorse Avenue Bridge (OBO4) Old Cabra Road Bridge (OBO5) Cabra Road Bridge (OBO6) Fassaugh Avenue Bridge (OBO7)

Area Name	Sub-area Description	Extents	Main Features
			Royal Canal and LUAS Twin Arches (OBO8) Maynooth Line Twin Arch (OBO9) Glasnevin Cemetery Road Bridge (OBO10)

1.7 Stakeholder Feedback

A large volume of stakeholder submissions were received during the six week public consultation period, which ran from 12th May 2021 to 23rd June 2021, an additional week was provided, extending the consultation period until 30th June 2021. All submissions received either via email, post, telephone, or through the online feedback form, were analysed and recorded by the project team on a dedicated consultation database. Each individual submission was analysed to identify the themes that were raised by the respondent and each submission was classified according to the themes raised. All feedback provided, was then anonymised before being analysed under each of the themes. In addition, further engagement with relevant local authorities and prescribed stakeholders has been ongoing. Engagement with potentially affected landowners has also taken place since the commencement of PC1.

All submissions received as part of the first round of public consultation have fed into the design process and the selection of the Preferred Option. The project team has analysed the submissions and considered all relevant information in re-evaluation and further development of design options leading to the selection of the Preferred Option.

Feedback urged the project to use the opportunity of the major works taking place at South Circular Road Bridge to make substantial changes to South Circular Road and Chapelizod Bypass junction, to allow active travel priority and improve safety. The current junction layout is considered to be high-traffic and ‘hugely hostile’ to pedestrians and cyclists.

Another area of concern is the junction at Chapelizod Bypass (St. John’s Road West); stakeholders advised that this junction should be completely re-designed to make a better entrance to the city and to encourage modal shift away from driving.

Further details of the Stakeholder Feedback are captured in the **Public Consultation No. 1: Findings Report, Volume 4**.

Similarly, all feedback received on the Preferred Option at Public Consultation No.2 will feed into the development of the preliminary design, Railway Order and Environmental Impact Assessment Report (EIAR).

2. Existing Situation

2.1 Overview

This section is approximately 750m in length and extends from the east side of Memorial Road Bridge (OBC3) to 10m west of IE720A (points). The Permanent Way currently consists of 3 no. tracks between Memorial Road Bridge (OBC3) and South Circular Road Bridge (OBC1). The number of tracks increases to the east side of South Circular Road Bridge (OBC1) at Islandbridge Junction. This includes 3 no. tracks which continue towards Heuston, multiple tracks that splay and enter at Heuston Station. The tracks fall in level from west to east towards Heuston Station, at an approximate gradient of 1.3%. There is no known longitudinal drainage system installed along the Permanent Way.

There are two major road overbridges. These are South Circular Road Bridge (OBC1) and St. John's Road Bridge (OBC0A). Together these structures carry road traffic across the rail line and facilitate traffic movements at the junction of South Circular Road (R111), the Chapelizod Bypass (Con Colbert Road - R148) and Chapelizod Bypass (St. John's Road West - R148). The local road network and South Circular Road junction are a major feature. This intersection is one of the busiest in Dublin and is highly congested during peak travel times.

The rail corridor is primarily in a cutting (i.e. the rail level is below the surrounding ground level). The corridor is formed by retaining walls along the south side of the tracks and earthwork cutting slopes along the north side. The south side of the rail corridor between Memorial Road Bridge (OBC3) and South Circular Road Bridge (OBC1) is retained with a battered masonry retaining wall. The north and south sides of the rail corridor between South Circular Road Bridge (OBC1) and St. John's Road Bridge (OBC0A) are retained with a reinforced concrete (RC) cantilever retaining wall. The south side of the rail corridor between St. John's Road Bridge (OBC0A) and IE720A (points) is also retained by an RC cantilever retaining wall.

There are two existing Signal gantries. Portal gantry OBC1B is located approximately 160m east of Memorial Road Bridge (OBC3). Cantilever gantry HN271/HN272 is located adjacent to IE720A (points) to the east. The area does not currently have any provisions for electrification. The major infrastructure features are illustrated in **Figure 2-1**.

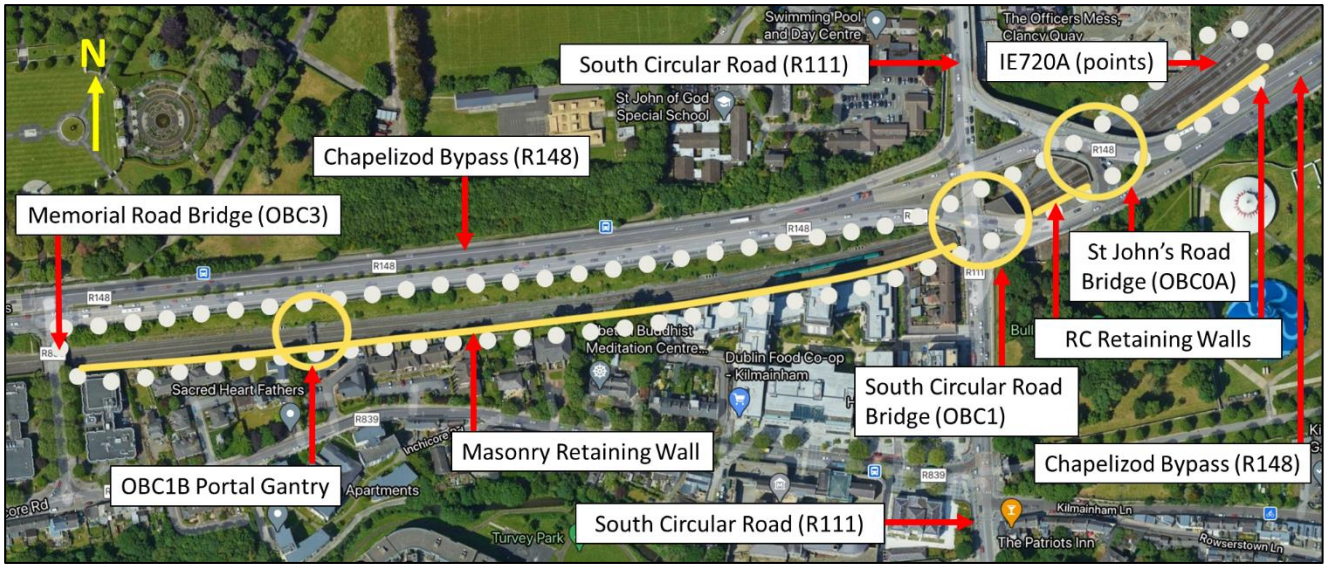


Figure 2-1 Area covered under this Technical Optioneering Report (white dotted outline)

The main Environmental features of this area are described in **Section 2.8 Environment**.

2.2 Challenges

The project requirement is to increase the number of tracks between Park West Station and Heuston Station to 4 no. of tracks and to electrify 2 no. northern tracks from Hazelhatch & Celbridge Station to Glasnevin Junction. There are significant challenges that constrain the options available to achieve the Permanent Way and Overhead Line Electrification (OHLE) project requirements.

It is not practically feasible to add an additional track on the south side of the rail corridor due to the density and proximity of commercial and residential properties between Memorial Road Bridge (OBC3) and South Circular Road Bridge (OBC1). As such, all options include widening the corridor to the North to avoid the impact of the reconstruction of the existing retaining wall on the south properties. The existing tracks will also be realigned to meet design standards. The additional track can be placed on the north side by installing a retaining structure along the cutting slope between South Circular Road Bridge (OBC1) and Memorial Road Bridge (OBC3). The track will be placed between the existing rail line and the Chapelizod Bypass which runs parallel.

The existing South Circular Road Bridge (OBC1), which currently has 3 no. tracks beneath it, has insufficient horizontal clearance for 4 no. tracks. The solution is to either reconstruct the bridge with a wider replacement structure (to facilitate 4 no. tracks) or to retain the existing structure (2 no. tracks) and install a buried portal structure (cut and cover) on the north side to provide space for 2 no. tracks. The buried structure solution, hereon referred to as South Circular Road Bridge (OBC1A), requires significant track lowering to achieve the general clearance requirements for new structures in accordance with Iarnród Éireann standards. Reconstructing South Circular Road Bridge (OBC1) to provide a wider structure for 4 no. tracks would require significant track lowering to achieve the clearance requirement for new structures and the OHLE.

In both cases (i.e. buried structure solution or bridge reconstruction solution), track lowering to absorb the vertical clearance requirements is preferable over increasing the road levels at the South Circular Road junction. Due to the existing road profiles on the approach to the junction, road level increases would require a significant extent of highly disruptive roadworks to tie-in new (increased) road levels to the existing levels. Therefore, track lowering forms the basis of feasible options considered. These issues are discussed further throughout the report.

2.3 Structures

2.3.1 South Circular Road Bridge (OBC1)

South Circular Road Bridge (OBC1) is a single span structure carrying road traffic over the rail corridor. The bridge carries traffic from east to west on the Chapelizod Bypass (Con Colbert Road - R148) and from south to north on the South Circular Road (R111). The bridge consists of pre flexed cast iron concrete encased beams supported on masonry abutments. The east side of the structure has been widened using splayed prestressed concrete beams supported on reinforced concrete abutments. The minimum span of the bridge is approximately 12.2m and varies due to the combined form of construction. The skewed width of the structure is approximately 30m.

Figure 2-2 South Circular Road Bridge (OBC1) - Beneath structure - Facing West

There are currently 3 no. tracks beneath the existing structure. The minimum vertical clearance beneath the existing structure is 4.521m. The abutments of the bridge extension sit on shallow footings. The bridge does not have sufficient horizontal clearance to construct an additional (4th) track.

2.3.2 St John's Road Bridge (OBC0A)

St. John's Road Bridge (OBC0A) is a 2-span reinforced concrete structure. The bridge carries road traffic over the rail corridor. The bridge carries traffic from west to east on the Chapelizod Bypass (Con Colbert Road - R148) and from north to south on the South Circular Road (R111). The structure consists of precast concrete beams on reinforced concrete abutments and central pier. The total span of the bridge is approximately 48m. The skewed bridge width is approximately 30m. The abutments and pier sit on shallow footings. The square span is approximately 14.7m on the north and approximately 15.7m on the south span. There are currently 4 no. tracks beneath the southern span and 1 no. track beneath the north span. The vertical clearance beneath the existing structure is 4.948m. The existing bridge has sufficient horizontal clearance beneath the north span to place an additional track.

Figure 2-3 St. John's Road Bridge (OBC0A) in foreground and South Circular Road Bridge (OBC1) in background

The as-built drawings show that the front of the abutment foundations extends by 2.5m from the face of the walls, and the front of the pier foundations extends by 1.25m from the face of the pier. The foundation dimensions and depth will influence the positioning of tracks beneath the bridge if they need to be realigned horizontally to facilitate track lowering to achieve vertical clearance beneath South Circular Road Bridge (OBC1). If significant track lowering is required in close proximity to the abutment and/or pier foundations, then the stability of the supports will need to be considered, and an engineering stabilising solution may be required. A retaining structure to provide a stabilising solution may be required.

2.3.3 Retaining Walls

There are 5 no. existing retaining walls. The battered masonry retaining wall on the south side of the corridor between Memorial Road Bridge (OBC3) and South Circular Road Bridge (OBC3) is approximately 575m long. The height of the wall is greatest at the South Circular Road Bridge (OBC1) end, where it is approximately 4.5m high. The wall appears to be in good condition generally. The wall provides support to the south side of portal gantry OBC1B. The existing southern track is in close proximity to the face of the wall. All options will consider the effect of track lowering and especially if this operation will cause instability of this wall.

Figure 2-4 Masonry retaining wall along the south side of rail corridor - Facing West

The retaining wall on the north side of the corridor between South Circular Road Bridge (OBC1) and St. John's Road Bridge (OBC0A) is a mechanically stabilised earth (MSE) solution. The wall is approximately 40m in length and approximately 3m high. The wall supports the Chapelizod Bypass (Con Colbert Road - R148), which is on an embankment at this location. The retaining wall is set back sufficiently such that it is unlikely to be unaffected by the works proposals.

Figure 2-5 MSE retaining wall on the north side of the corridor between South Circular Road Bridge (OBC1) and St. John's Road Bridge (OBC0A)

The retaining wall on the south side of the corridor between South Circular Road Bridge (OBC1) and St. John's Road Bridge (OBC0A) is an RC retaining wall. The wall is approximately 40m in length and approximately 4m high. The foundation level is shown to extend to 1.0m in front of the wall face on the as-built drawings.

Figure 2-6 RC retaining wall on the south side of the corridor between South Circular Road (OBC1) and St. John's Road Bridge (OBC0A)

The retaining wall on the south side of the corridor on the eastern side of St. John's Road Bridge (OBC0A) is a RC cantilever retaining wall. The retaining wall is set back sufficiently such that it is unlikely to be affected by the works proposals.

An approximately 1m high king post retaining wall retains an approximately 60m length of cutting slope 'toe' on the north side of the corridor between South Circular Road Bridge (OBC1) and Memorial Road Bridge (OBC3). The west end of the wall is approximately 50m from the east side of Memorial Road Bridge (OBC3). The retaining wall is in poor condition.

Figure 2-7 King post retaining wall on the north side of the corridor between South Circular Road Bridge (OBC1) and Memorial Road Bridge (OBC3)

2.3.4 Signal Gantries

Signal Gantry (OBC1B)

A portal signal gantry (OBC1B) is located approximately 160m to the east of Memorial Road Bridge (OBC3). The steel gantry is supported by a steel gantry column leg on the north side and is supported by the battered masonry retaining wall on the south side. The gantry has secured ladder access at north support to facilitate access for inspection and maintenance. This portal gantry will need to be replaced to facilitate the four-tracking and electrification.

Figure 2-8 Portal signal gantry OBC1B - Facing West

Signal Gantry HN271/HN272

HN271/HN272 is a steel cantilever gantry located adjacent to IE720A (points) at the east boundary of the area. This gantry will need to be replaced to facilitate the installation of the electrification system.

2.4 Permanent Way and Tracks

The Permanent Way between Memorial Road Bridge (OBC3) and South Circular Road Bridge (OBC1) has 3 no. tracks. All tracks fall in level from west to east towards Heuston Station at a gradient of approximately 1.3%. The tracks are labelled from north to south as the 'Up Main', the 'Down Main' and the 'Relief Line'. Islandbridge Junction is located between South Circular Road Bridge (OBC1) and St. John's Road Bridge (OBC0A). The junction connects the Dublin to Cork line with the branch line (via the Phoenix Park Tunnel) and to Heuston station. Points 715 and 714AB are located under South Circular Road Bridge (OBC1) and connect the Up Main and Down Main tracks to the 'Up Branch' track and via the 718 points to the 'Down Branch' track. A schematic layout of the tracks is shown below.

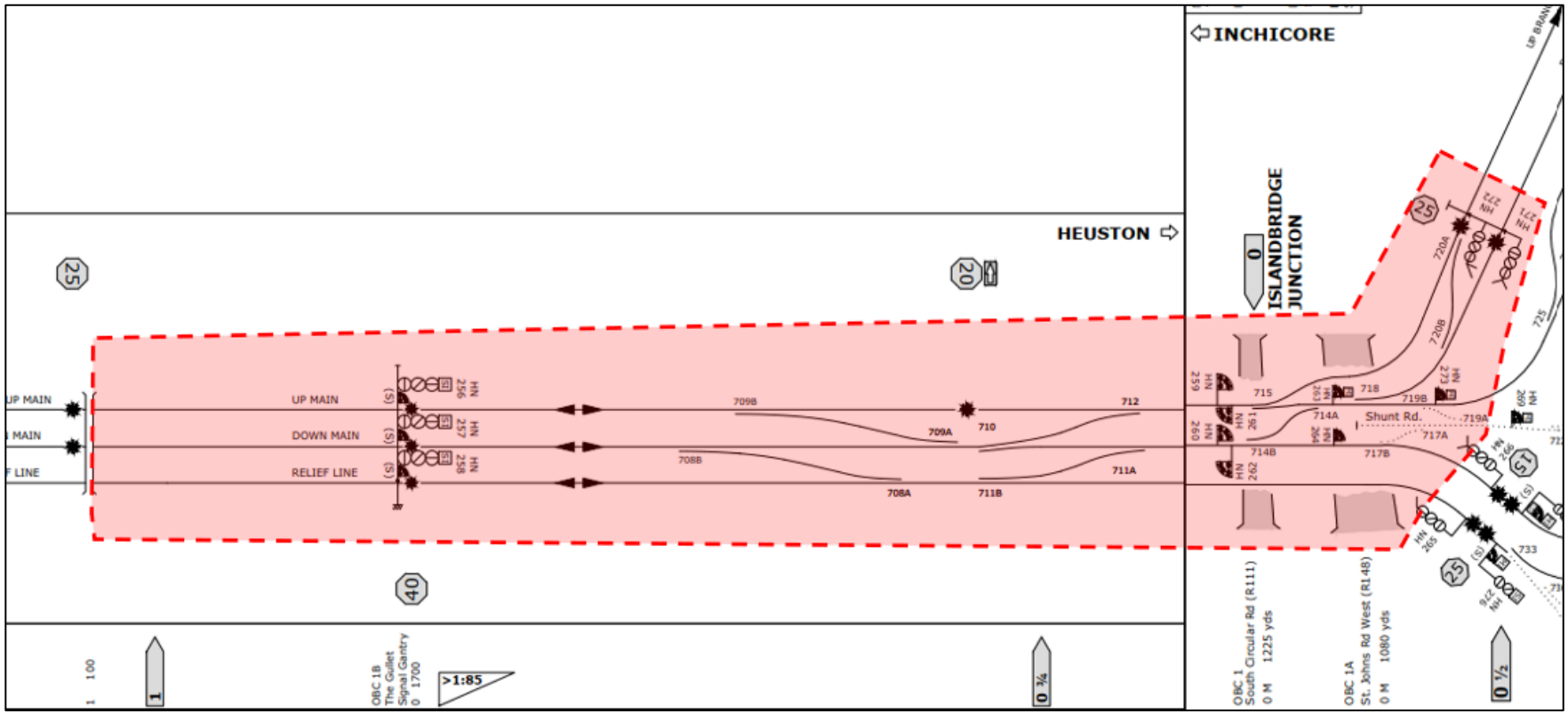


Figure 2-9 Existing track layout (from IÉ Route Information Book)

Figure 2-10 Tight horizontal radius and reduced sight distance at South Circular Road Bridge (OBC1) - Facing East

The track alignment in this area is constrained by the South Circular Road Bridge (OBC1) and the St. John's Road Bridge (OBC0A), which has resulted in a complex existing layout. The 3 no. tracks under South Circular Road Bridge (OBC1) feature a tight horizontal radius of 220m. The points and crossings (P&C) units are in close proximity to each other (e.g. crossover 714AB and points 715). In addition, the lateral clearances from the nearest rail to the bridge abutments are as low as 1.26m. The limited lateral clearances to the existing bridge abutments are further complicated by a tight horizontal radius resulting in limited forward sight distance.

There are a total of 5 no. tracks beneath St. John's Road Bridge (OBC0A). These are labelled from north to south as the 'Up Branch', 'Up Main', 'Down Main', 'Relief Line' and 'Shunt Road'. The P&Cs that connect the Heuston Station depot sidings (the Shunt Road) with the Up Main and Down Main tracks are located below St. John's Road Bridge (OBC0A). The Shunt Road ends in a buffer-stop under the bridge. There are 4 no. tracks beneath the south span and 1 no. track beneath the north span (**Figure 2-11**).

The Permanent Way between Memorial Road Bridge (OBC3) and South Circular Road Bridge (OBC1) is within a deep cutting. There is limited lateral clearance between the southern track and the battered masonry retaining wall. The clearance from the retaining wall to the adjacent rail of the Relief Line track is approximately 1.6m. There are no safety refuges along the wall.

The track gradient falls from west to east (i.e. towards Heuston Station) at a gradient of 1.3% (approx.). The Shunt Road track is also at a gradient of 1.3%. The Shunt Road is currently used to manoeuvre trains into the carriage wash. The distance between the buffer stop and points 728 is 170m, shown in the **Figure 2-12**.

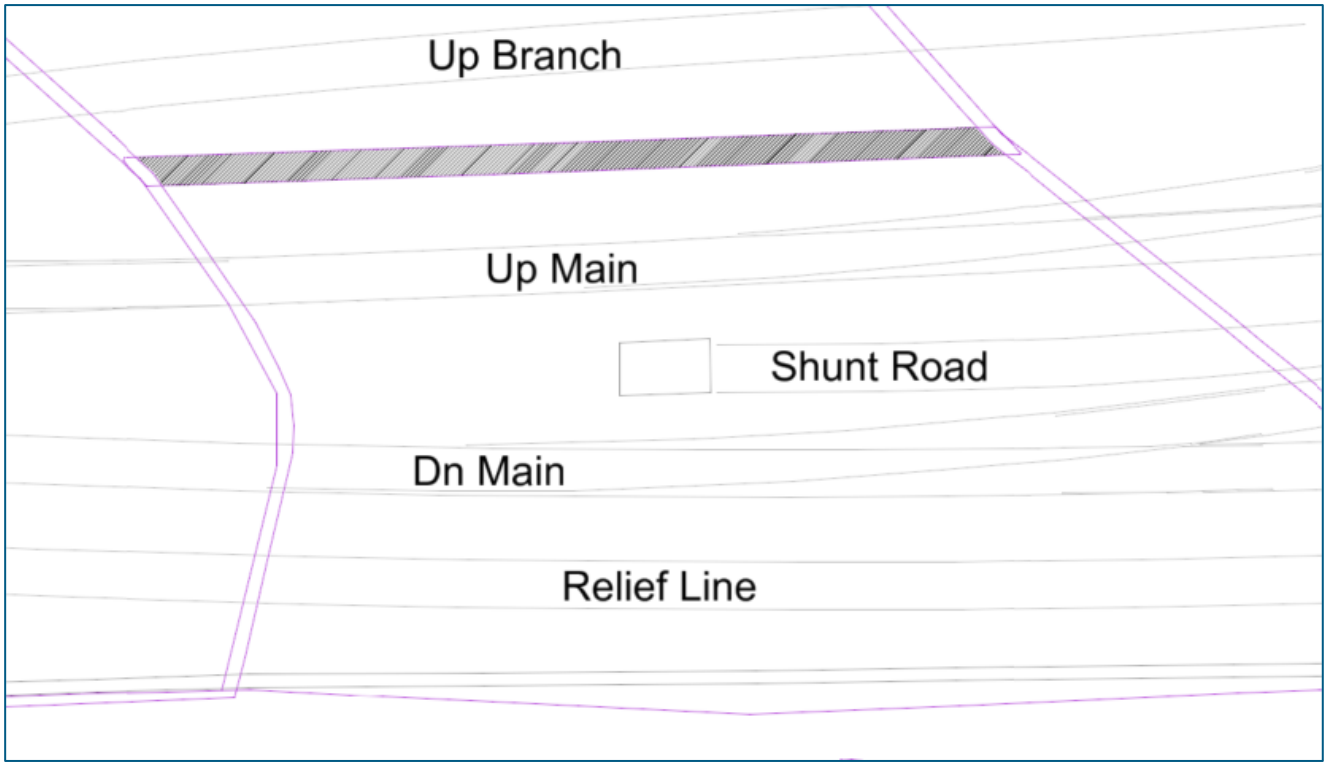


Figure 2-11 Tracks layout beneath St. John's Road Bridge (OBC0A)

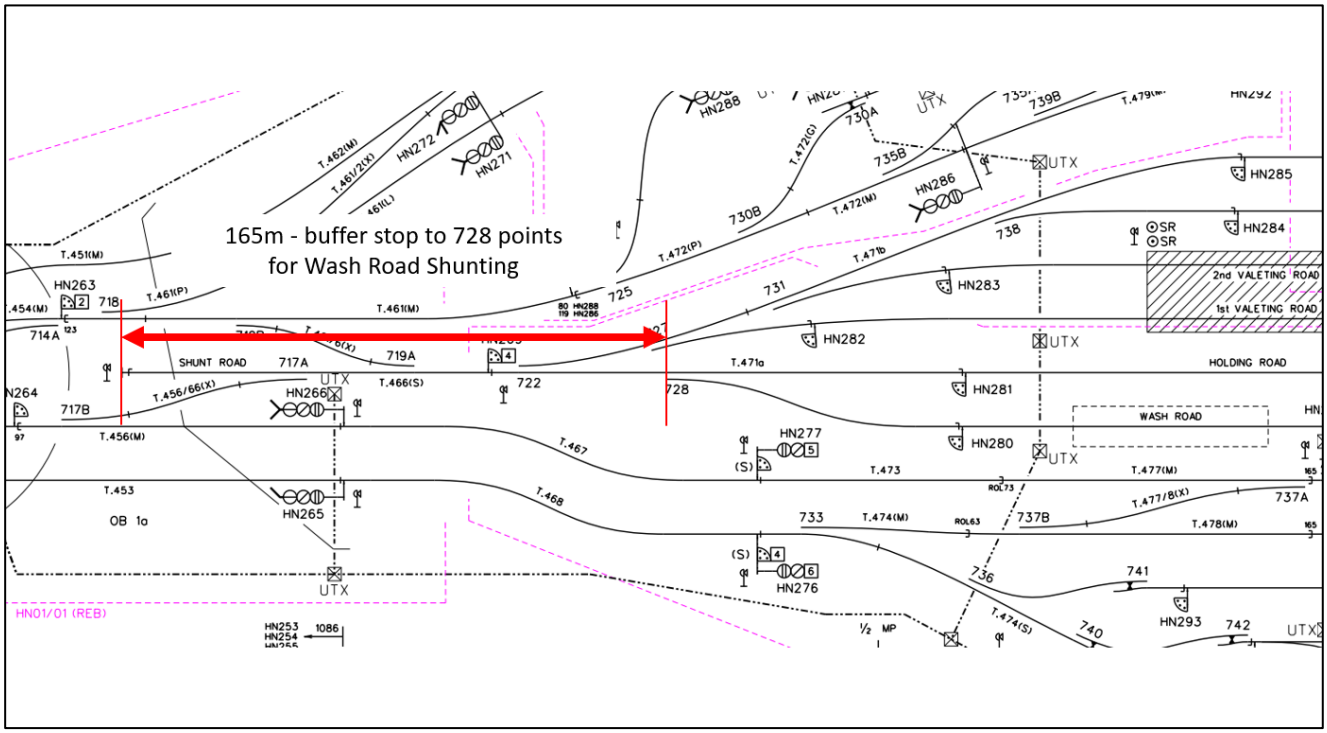


Figure 2-12 Track diagram showing Shunt Road (buffer stop to 728 points = 165m)

2.5 Other Railway Facilities

There is a track access point on the Chapelizod Bypass (Con Colbert Road - R148) at approximately 65m west of South Circular Road Bridge (OBC1). The access stairs traverse the steep cutting slope on the north side of the rail corridor. This access point is to facilitate access for Iarnród Éireann inspection and maintenance staff.

Figure 2-13 Location of the existing track access point from Chapelizod Bypass (highlighted in red)

2.6 Road Network

The primary road infrastructure feature is the junction of Chapelizod Bypass (Con Colbert Road) and the South Circular Road (R111). The Chapelizod Bypass (Con Colbert Road) is a segregated 3-lane dual carriageway. The dual carriageway facilitates the main traffic flows into and out of Dublin city centre (eastbound and westbound). The South Circular Road (south of junction) has 2 no. traffic lanes on approach and departure from the junction. The South Circular Road (north of junction) has 2 no. traffic lanes on approach to the junction and 1 no. lane on departure.

Pedestrian movements are catered for in all directions through the junction. Cycling provision is limited to road marking lanes at some parts of the junction only and this is shared use with vehicular. The junction is due for a review as part of the BusConnects scheme.

The junction is a bespoke 3/4 lane gyratory system which is operating above capacity at peak periods leading to queuing in all directions.

2.7 Ground Conditions

The topography is typically flat, sloping gently towards the River Liffey to the north and towards Heuston Station to the west. As discussed above, the existing retaining walls (and bridge abutments) form the southern boundary of the rail corridor. A combination of a cutting slope, retaining walls and bridge abutments form the northern boundary.

The general superficial geology is anticipated to comprise of a thin layer of made ground underlain by a significant thickness of till overlying bedrock.

A number of historical ground investigation exploratory holes are present in the immediate vicinity of the South Circular Road Bridge (OBC1).

At 100m west of the South Circular Road Bridge (OBC1), a borehole investigation indicated that superficial deposits exist comprising ‘soft to stiff ‘clay, soft silt and gravel (of limestone and sandstone). This extends to bedrock which consists of strong to moderately strong limestone. Moderately strong to weak mudstone and shale was encountered at 20.50m below ground level (bgl).

At 80m north of South Circular Road Bridge (OBC1), a previous borehole investigation indicated 'made ground' between ground level and 3.5m below ground level. The made ground was shown to be underlain by a significant thickness of gravel and stiff clay. Bedrock consisted of strong to very strong limestone with weak to moderately strong mudstone and shale recorded at 18.55m below ground level.

Other sources of ground information (publicly available) regarding the depth to bedrock at the South Circular Road junction indicates that the depth to bedrock is 21m to 37m below ground level.

Groundwater was not encountered (or recorded) during any of the existing historical exploratory holes adjacent to South Circular Road.

It is not envisaged that the development of options will be governed by existing ground conditions as the ground conditions noted will facilitate all likely options. A Ground Investigation is currently ongoing to verify the data obtained in the historical investigations.

2.8 Environment

Along the existing corridor, there are a number of apartment blocks directly adjacent to the rail line. These are interspersed with mix-use commercial activities. Community facilities include the War Memorial Gardens, St. John of Gods School, Kilmainham Gaol and Richmond Park.

Directly opposite Memorial Road and north of the rail corridor are the War Memorial Gardens. In addition to their role as a garden of remembrance, they are also considered to have architectural heritage interest. Further west on the same side of the rail corridor there is a Gaelscoil, St. John of Gods Special School and a swimming pool and day centre. Northeast of the South Circular Road junction there is a residential development associated with Clancy Quay. The junction itself is a site on the Record of Monument and Places (RMP) associated with a number of burials excavated during works on the junction in the past.

There are a number of designated conservation areas which include the War Memorial Gardens and the Royal Hospital Kilmainham and Gardens. South of the junction are the grounds associated with the Royal Hospital Kilmainham with three National Inventory of Architectural Heritage (NIAH) designations relating to graveyards / cemetery at Bullys Acre and also an ecclesiastical site and cross which are listed on the Sites and Monuments Record (SMR). Southeast of the junction there are a small number of residences fronting onto the road and several apartment blocks directly adjacent to the rail line. Mixed use commercial activities are interspersed among the residential receptors, including Hilton Hotel along the South Circular Road. Further west, residential properties associated with Inchicore Road are again a key constraint due to their proximity to the rail corridor. In straddling Memorial Road there are two office blocks understood to be a government data centre. There are several designated landscape areas of note which include the War Memorial Gardens and the Royal Hospital Kilmainham and Gardens.

Biodiversity constraints include invasive alien species as listed by Invasive Species Ireland (third schedule) at the South Circular Road (Japanese Knotweed).

2.9 Utilities

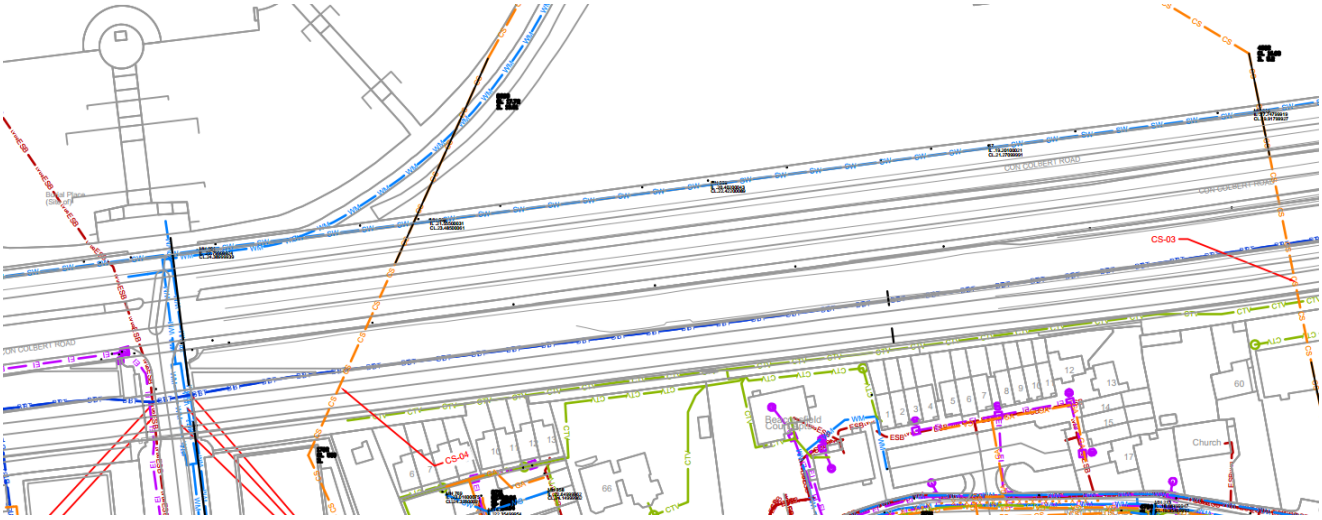
The roads network contains a significant number of utilities typical of an urban environment such as this. Service providers with network assets in this area include the following:

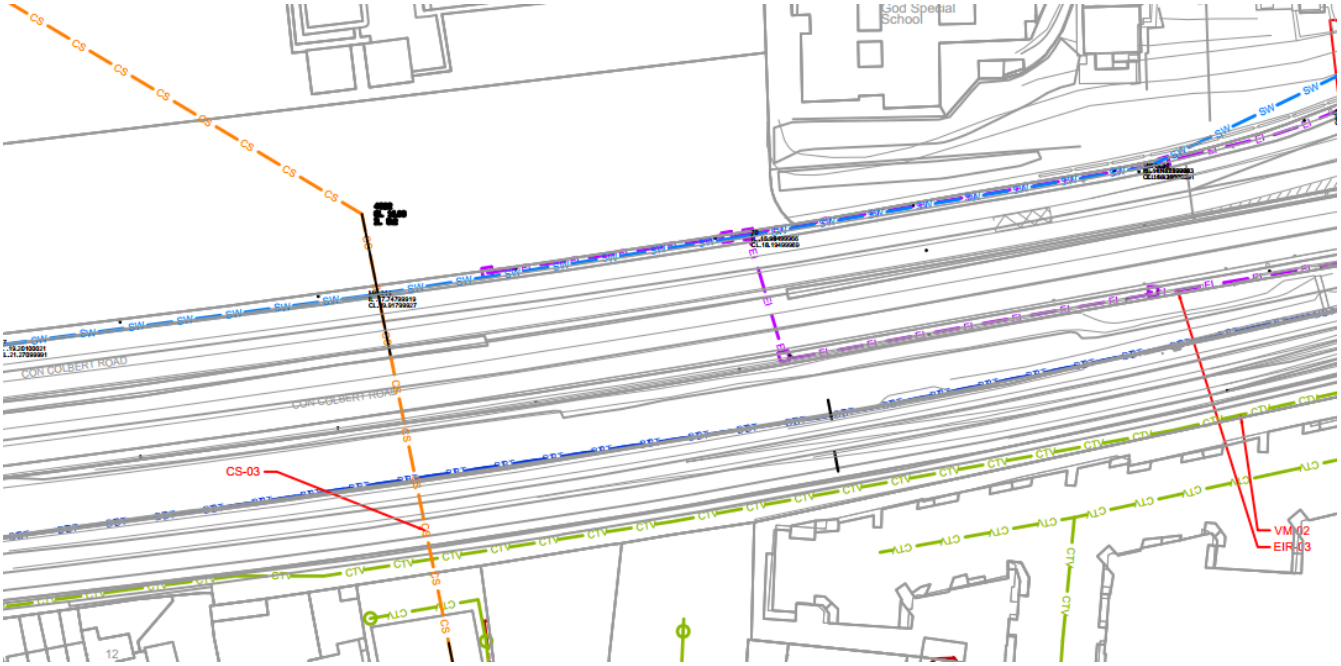
- Aurora Telecom
- EIR
- ESB Networks
- Virgin Media

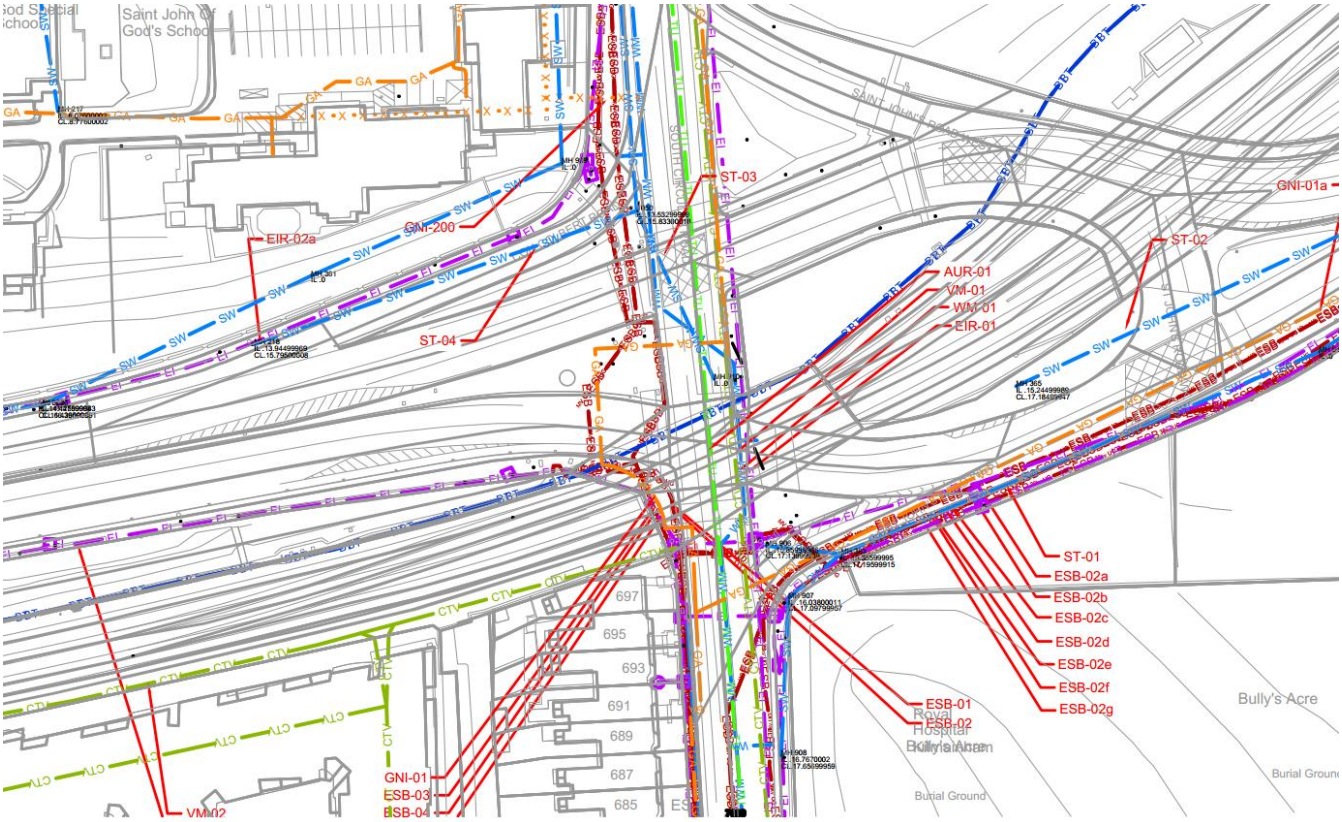
- Gas Networks Ireland
- Dublin City Council Road Drainage (Storm Water Sewers)
- Dublin City Council / Irish Water (Foul Water Sewers)
- Dublin City Council / Irish Water (Water Supply)
- Dublin City Council Traffic Department (Traffic Signals & Communications)
- Dublin City Council Public Lighting

Data in the form of utility service records have been gathered from all providers in the area. The majority of services are located within existing streets and rail line bridge crossings. Hence, where modifications are required to any existing bridges and / or to the road network in the immediate vicinity of existing structures, impacts on utilities will be inevitable. There are two services that cross the railway corridor below the tracks, both of which are combined sewers situated between South Circular Road Bridge (OBC1) and Memorial Road Bridge (OBC3). Where track lowering is proposed, consideration of the impacts on these services will also be necessary.

A number of key network infrastructure elements for particular existing services are present. Therefore, significant forward planning and coordination with the appropriate utility providers will be required to enable works, given that only limited service outage time (if any) will be permissible to each service and its customers.




God Special School
CON COLBERT ROAD
CS-03
VM-02
EIR-03


Saint John of God's School
EIR-02a
GNI-200
ST-04
ST-03
GNI-01a
ST-02
AUR-01
VM-01
WM-01
EIR-01
ST-01
ESB-02a
ESB-02b
ESB-02c
ESB-02d
ESB-02e
ESB-02f
ESB-02g
ESB-01
ESB-02
Bully's Acre
Burial Ground
GNI-01
ESB-03
ESB-04
VM-02

3. Project Requirements

3.1 Area - Specific Requirements

In addition to the general feasibility requirements of constructability, general fitness for intervention and safety, the specific requirements for this area are:

- Increase number of tracks from 3 no. tracks to 4 no. tracks.
- Electrification of 2 no. tracks for DART+.
- Provide vertical electrical clearance through existing structures or amend or reconstruct structures to provide the required clearance.
- Maintain functionality of existing roads and services/utilities (electricity, gas, water, etc)
- Track alignment and drainage requirements.

3.2 Systems Infrastructure and Integration

In addition to the track and civil infrastructure modifications relating to them DART+ South West Project, there is a requirement to provide Overhead Line Electrification Equipment (OHLE) signalling and telecoms infrastructure.

The electrification system will be similar in style to that currently used on the existing DART network and integrated and compatible across the DART+ Programme. It is proposed that a standardised approach to electrification will be adopted, but area-specific interventions will also be required.

The Low Voltage and Telecommunications networks required for Signalling will be 'global systems' and are unlikely to vary significantly between or within the various areas. In order to achieve the necessary capacity enhancements and performance required for the introduction of the new electric multiple unit (EMU) fleet, it will be necessary to upgrade the existing signalling system as well as replacing some of the legacy signalling system. This will include provision of equipment rooms, including Relocatable Equipment Buildings (REB to accommodate signalling equipment and associated power supplies and backup.

Upgrades to the existing telecommunications infrastructure will be required to facilitate improvements to the radio-based technologies used on the network and for signalling and communication with the existing and future network control centres.

3.3 Electrification System

The OHLE system architecture is currently being developed. The DART+ wide programme will adopt a 1500V DC (Direct Current) OHLE system to provide electrical power to the network's new electric train fleet.

It should be noted that all OHLE diagrams in this report are for visual information only. Construction details will be determined during Detail Design, which will be developed at later stages of the project.

The OHLE concept comprises a simple (2-wire) auto-tensioned system, supported on galvanised steel support structures. See **Figure 3-1** for a typical OHLE arrangement in a four track open route.

In 4 no. track areas, Two Track Cantilevers (TTCs) will generally be placed on the north side of the line, to support OHLE on the northern two tracks. The project aims to achieve a minimum contact wire height of 4.4m throughout to ensure compliance with the relevant design standards, localised special conditions may be required. For contact wire details under Memorial Road bridge, see **Section 7.3.3. Signalling, Electrical and Telecommunications (SET)**.

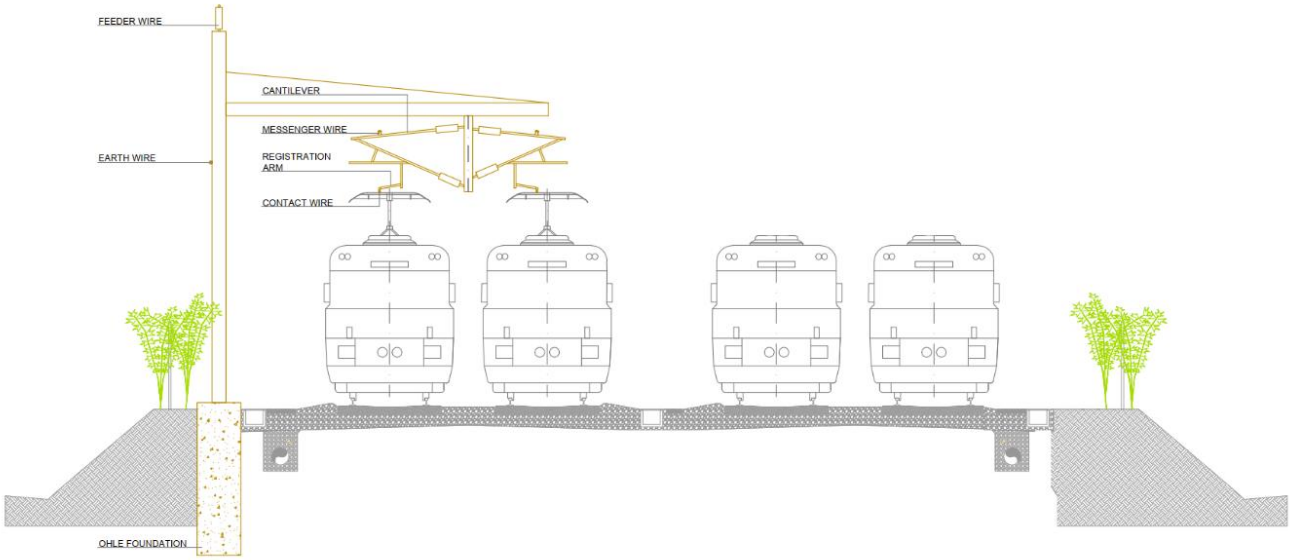


Figure 3-1 Typical OHLE arrangement in four track open route – Facing East

Additional feeder cables will be supported from the masts at heights between 6.5m and 8m on each side of the track. An earth wire will also be suspended from the masts.

Maximum installed tension length is 1600m. Overlaps will comprise three spans, with spring tensioners used throughout. Midpoint Anchors (MPAs) will generally be of the tie-wire type, although the portal type may be needed in some locations.

At intervals of up to 1500m the OHLE wires will be anchored at an arrangement known as an overlap, and a new set of wires will take over. The anchors provide the mechanical tension that the wires need to perform reliably and safely. In areas of crossovers and junctions, additional wiring will be provided for the extra tracks, and these will also be provided with anchors. See **Figure 3-2** for a typical anchor structure.

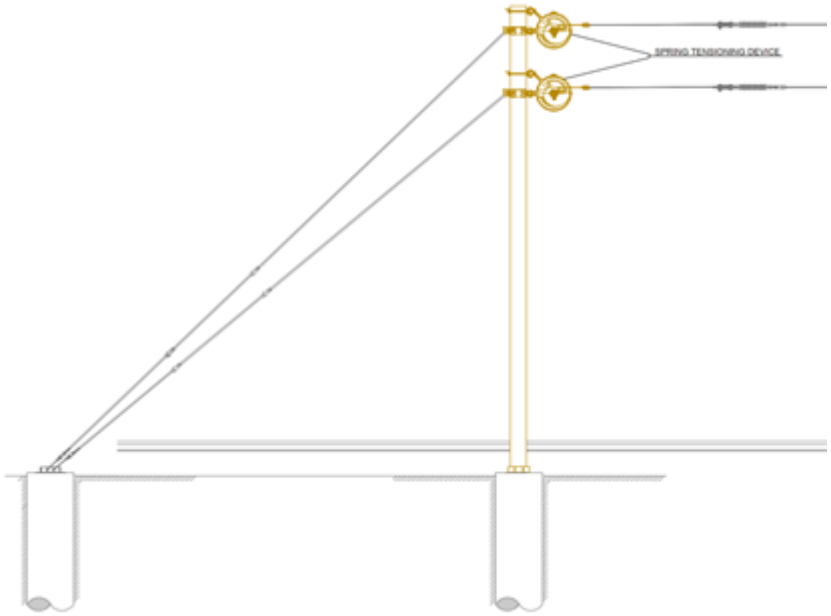


Figure 3-2 Typical anchor structure

The OHLE configuration through the overbridges for each track or civils option is being assessed using a clearance assessment tool derived from the System Wide Functional Requirement Specification (FRS) relating to Overhead Line Equipment (OHLE). This includes level and graded free running options, as well as level and graded options with elastic bridge arms fitted to the bridge. See **Figure 3-3** for a typical arrangement on approach to a low bridge.

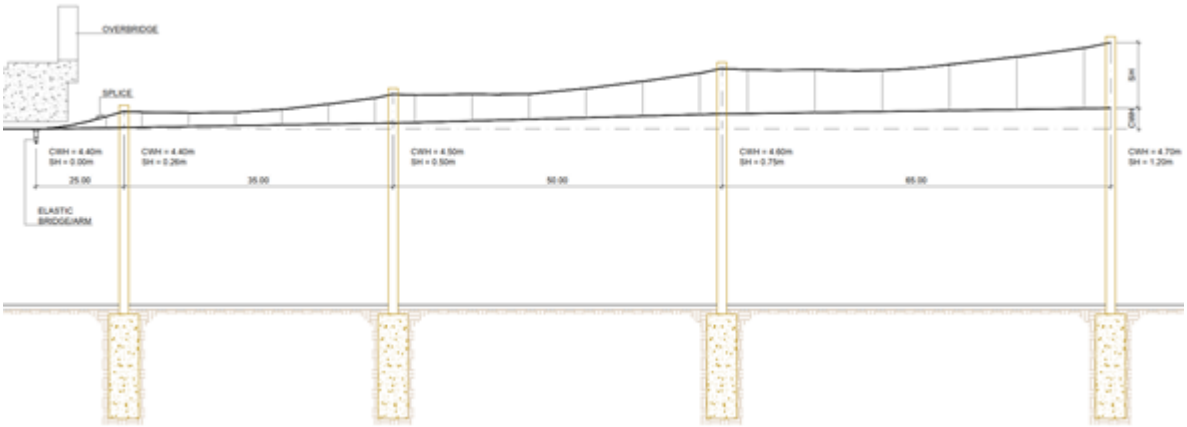


Figure 3-3 Typical arrangement on approach to a low bridge

3.4 Substations

In order to facilitate the introduction of the new OHLE scheme across the DART+ network a power supply study has been carried out. There is a requirement to provide six new substations on the DART+ South West scheme, but none of them fall within this section of the route.

3.5 Design Standards

The project design is governed by various technical and safety guidelines, which include European, National and Iarnród Éireann internal standards and specifications.

Compliance with these standards will be ensured via internal and external technical and safety assurance processes throughout the delivery and commission stages of the project

4. Constraints

4.1 Environment

Further desk and field survey work has been undertaken to inform the environmental constraints identified in Section 2.8 and the feedback from PC1 has been reviewed. Together that information has improved the understanding of the environmental constraints in the study area. Details of the further desk and field survey work is outlined below.

Ecological field surveys of the route have been carried out to establish the baseline ecological conditions. Surveys for mammals (badger, bats), amphibians, invasive alien species, birds, and terrestrial and freshwater habitats have been carried out to date. Bat activity monitoring using a static bat detector has been carried out at a location along the Chapelizod Bypass (R148).

In relation to Built Heritage; a comprehensive desktop assessment of built heritage assets within 50m either side of the railway centreline has been undertaken by a Heritage Specialist. This assessment confirmed the designated status of the features of heritage interest i.e., Protected Structure status and/or inclusion in the NIAH record, and/or inclusion in the Industrial Heritage Record. Stakeholder feedback from PC1 highlighted Memorial Bridge as a strategic heritage link and noted its historic and architectural integrity and relationship with the Irish National War Memorial Gardens (INWMG). Feedback also noted that almost all of the highlighted Architectural Heritage lies within the Kilmainham and Inchicore area and that due recognition and preservation of these sites is upheld while works are ongoing. A meeting with Dublin City Council noted that a new City Development Plan for 2022-2028 is being prepared. The new City Development Plan for 2022-2028 may contain modifications (additions/deletions) to the Record of Protected Structures (RPS). A structure must be listed on the planning authority's RPS to qualify for protected status under the Planning and Development Act 2000 (as amended). The RPS will be monitored on an on-going basis by the Heritage Specialist.

A flood Risk Assessment (FRA) is currently under preparation. The FRA will be completed in accordance with "The Planning System and Flood Risk Management – Guidelines for Planning Authorities" (DOEHLG, 2009). Detailed mitigation measures will be specified in the final FRA and will inform the EIAR which will be submitted to An Bord Pleanála for Railway Order approval.

Stakeholder feedback from PC1 noted the rich cultural and heritage amenities in the area, such as the Irish Museum of Modern Art at the Royal Hospital Kilmainham, Kilmainham Gaol, Richmond Barracks, as well as the proposed restored Kilmainham Mill and the Liffey Vale Biodiversity Centre. Further issues or concerns raised during PC1 are described in the **Public Consultation No. 1 Findings Report, Volume 4.1**.

4.2 Roads

The existing road network poses significant constraints in terms of achieving the project requirements of providing an additional 4th track and electrifying 2 no. tracks.

The Chapelizod Bypass is directly adjacent and parallel to the top of the cutting slope between Memorial Road Bridge (OBC3) and South Circular Road Bridge (OBC1). This removes the option to provide the additional track on the north side of the corridor by means of a standard earthwork widening solution along and through the existing cutting on the north side of the corridor. A retaining structure would be required to create space for the additional track in this section.

The existing South Circular Road Bridge (OBC1) cannot accommodate an additional track due to its constrained horizontal geometry (insufficient span length). The existing vertical clearance at the bridge is also insufficient to accommodate the OHLE infrastructure required to electrify the rail line. The junction of the South Circular Road

(R111) and the Chapelizod Bypass (Con Colbert Road - R148) is a major constraint in terms of reconstructing South Circular Road Bridge (OBC1) to provide the clearances needed. The existing road levels on the South Circular Road fall steeply towards Island Bridge (River Liffey) on the north side of the junction. The existing road levels on the Chapelizod Bypass also fall on the west departure from the junction.

The extent of tie-in works for even a minor increase in finished road level at South Circular Road bridge (OBC1) would be significant due to the rapid fall-off in existing levels on the north and west side of the junction. The road works and traffic management scheme required to achieve this would cause major traffic disruption during the works.

There is a significant network of congested utilities beneath the existing road.

Options to reconstruct the bridges at this location would likely have a severe impact on the traffic in the area. Approximate traffic volumes in the morning peak are 1,500 veh/h in the east west direction while both north to south and west to south account for approx. 700 and 500 veh/h respectively. Traffic management is a major constraint to be considered in determining the most appropriate option solution.

If either the South Circular Road Bridge (OBC1) is reconstructed, or a new cut and cover buried portal option is considered, the design will consider the sequencing of the construction work to minimise traffic disruption.

4.3 Property

The density and proximity of the residential and commercial properties along the south side of the rail corridor between South Circular Road Bridge (OBC1) and Memorial Road Bridge (OBC3) is a major constraint in terms of achieving the project requirements. Extending the rail corridor to the south is not considered to be a feasible option. Please refer to Property Boundary lines on the Bridge and Permanent Options Drawings in **Appendix B Supporting Drawings**.

4.4 Permanent Way

The vertical and horizontal alignment is constrained by the elements summarised in **Table 4-1** and **Figure 4-1**.

Table 4-1 Permanent way geometrical constraints

ID	Name	Description
1	Proximity of Private Property (Residential & Commercial)	The proximity and density of private residential and commercial property on the south side of the corridor between South Circular Road Bridge (OBC1) and Memorial Road Bridge (OBC3) is a major constraint in terms of the horizontal Permanent Way alignment.
2	Masonry Retaining wall	The masonry retaining wall is in close proximity to the existing tracks. Normal lateral clearance should be incorporated into the new design in accordance with design standards (2.5m). This would require the new track alignment to be moved to the north, Any track lowering would be subject to a GI survey confirming the structural integrity of the retaining wall.
3	Chapelizod Bypass (Con Colbert Road - R148)	The north side of the rail corridor between South Circular Road Bridge (OBC1) and Memorial Road Bridge (OBC3) is constrained by the level difference between the railway and highway. The proximity of the Chapelizod Bypass (Con Colbert Road - R148) is a significant longitudinal constraint. A retaining structure would be required to provide the additional space for the realigned and additional track through this section.
4	Exiting OBC1	The existing structure does not have sufficient horizontal clearance to provide an additional track in accordance with the project requirements.
5	Existing OBC0A	The depth and dimensions of the abutment and pier foundations may pose a constraint on the horizontal alignment of the Permanent Way if significant track lowering is required (e.g. to achieve vertical clearance for OHLE at South Circular Road Bridge OBC1)
6	Corner of private property	There is a pinch point between Clancy Quay property wall and the existing ‘Up Branch’ track. Existing distance between rail and wall is 1.68m.
7	Existing station and depot functionality	The location of the fixed valeting and carriage wash buildings pose constraints on the possible Permanent Way alignments.

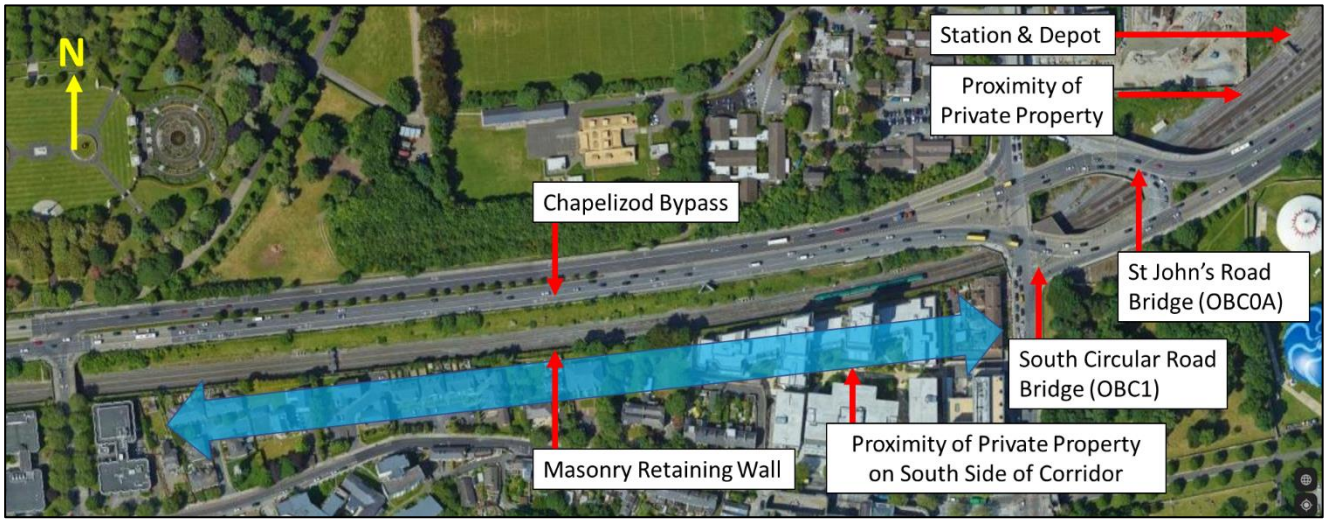


Figure 4-1 Constraints of permanent way design

The main constraint to selecting a horizontal permanent way alignment is the proximity and density of the private residential and commercial properties on the south side of the corridor between South Circular Road Bridge (OBC1) and Memorial Road Bridge (OBC3). To include an additional track on the south side of the existing corridor is not feasible for this reason.

In addition to the constraints that will have an effect on the track alignment, there is no track drainage system installed in this area. Although there are no known drainage issues in the area, the proposed track formation and vertical design may require the installation of a new positive drainage system.

4.5 Existing Structures

The existing South Circular Road Bridge (OBC1) has insufficient span length to accommodate a fourth track or adequate vertical clearance to implement track electrification. Proposed interventions include replacement of the bridge or construction of a new cut and cover buried portal on the north side.

If a replacement bridge is to be constructed, the bridge would require a longer span to incorporate the fourth track. New abutments will need to span (overstep) existing abutments to facilitate constructability requirements.

The existing St. John's Road Bridge (OBC0A) has sufficient horizontal clearance beneath its spans to place an additional track. A constraint to the new horizontal alignment beneath the bridge is the dimensions and depth to the existing bridge abutment and shallow pier foundations. The bridge has sufficient vertical clearance such that it can be electrified using fitted solutions.

The proximity between the two bridges is such that they need to be considered together when defining the OHLE solution.

Where track lowering is required between South Circular Road Bridge (OBC1) and Memorial Road Bridge (OBC3), the retaining wall at this location may be destabilised and hence horizontal realignment would be required to overcome this (i.e. realign away from the masonry retaining wall) to avoid a clash with the foundation. Apart from track realignment any significant track lowering adjacent to the existing masonry wall would require the consideration of options to stabilise the wall.

4.6 Geotechnical

Based on the existing information, onerous ground or groundwater conditions are not anticipated.

Where significant track lowering is required, the stability of the existing retaining wall along the southern boundary could be affected as discussed above. This may necessitate below ground ties, anchors or walls which for the purposes of this stage of scheme development should be assumed to be required for a track lowering option.

Based on historical ground investigation data, bored pile walls are considered to be suitable at this stage of development.

Existing nearby walls, buildings, structures and earthworks will require monitoring (e.g. vibration monitoring) during piling of any new structures to ensure no structural damage is caused during construction to the proposed foundation construction works. Con Colbert House (on Memorial Road) houses a government data centre and as such may be particularly sensitive to vibration.

Due to the proximity of the adjacent Chapelizod Bypass (Con Colbert Road) and height of the cutting slopes to be retained, it is considered that the inclusion of soil nails or ground anchors to tie back the retaining wall along the north side of the rail corridor will be required. To maintain the integrity of the existing masonry retaining wall along the southern side of the rail corridor a level difference between the new slow lines electrified lines (to the north of the corridor) and realigned fast lines (to the south of the corridor) was introduced. To maintain the integrity of this level difference, a retaining wall will be provided between the two lines (slow electrified tracks and fast tracks).

4.7 Existing Utilities

The significant number of utilities will be constraints during both the design and construction phases. As such, their treatment in the temporary and permanent situations has been carefully considered during the development of options. There are a large number of services crossing the rail corridor via South Circular Road Bridge (OBC1) and St. John's Road Bridge (OBC0A). Whether the South Circular Road Bridge (OBC1) is reconstructed or a new cut and cover buried portal is constructed to the north side of the bridge to facilitate the additional track, the services in the existing bridge would need to be maintained or outage durations absolutely minimised. All existing utilities pose constraints to the area options. Where they conflict with bridge and area-wide options, their potential treatment is being discussed with the utility providers. The 2No. existing combined sewers situated between Memorial Road Bridge (OBC3) and South Circular Road Bridge (OBC1) have been confirmed to be significantly below track level. As such, these sewers pose no major constraints to track lowering in the area.

5. Options

This section presents the options associated with the following elements between Memorial Road to South Circular Road Junction:

- Civil and OHLE infrastructure solutions
- Construction Compounds locations

5.1 Civil and OHLE Options

5.1.1 South Circular Road Bridge

The existing South Circular Road Bridge (OBC1), which currently has 3 no. tracks beneath it, has insufficient horizontal clearance for four tracks. The existing vertical clearance beneath the bridge would also be sub-optimal for electrification.

The potential options are to either reconstruct the bridge with a wider replacement structure (to facilitate 4 no. of tracks) or to retain the existing structure (2 no. of tracks) and install a buried portal (cut and cover) on the north side of the bridge to provide space for 2 no. of tracks.

Permanent way options comprise realignments to provide standard clearances, both vertically and horizontally.

A total of nine 'Options' have been developed for the area and presented at PC1. The Options include a 'Do-Nothing' Option and a 'Do-Minimum' Option.

- A Do-Nothing option means that the design endeavours to achieve the project requirements without any intervention to the existing infrastructure.
- A Do-Minimum option means that the design endeavours to achieve the project requirements with only minor intervention to the existing infrastructure.

A summary of Options presented at PC1 as part of the Emerging Preferred Option Selection process is presented in the Table 5-1. Please refer to **Section 5.1.3 Permanent Way (All Do-Something Options)** for a description of the permanent way Options for the area (that are compatible with the bridge Options referred to in **Table 5-1**).

Table 5-1 Options summary South Circular Road Bridge

Option	Description
Option 0: Do Nothing	The existing infrastructure remains unchanged. There are no interventions.
Option 1: Do Minimum	This option endeavours to achieve the four-tracking and electrification project requirements without widening the existing rail corridor or providing additional vertical and horizontal clearance at South Circular Road Bridge (OBC1) and St. John's Road Bridge (OBC0A).
Option 2	This option is the Concept Design. South Circular Road Bridge (OBC1) would be reconstructed with a greater span and height to provide sufficient vertical and horizontal clearance for four-tracking and electrification. All vertical clearance requirements would be absorbed by track lowering.
Option 3	This Option is similar to Option 2, but all vertical clearance requirements and increases to structural depth would be absorbed by track lowering (50%) and increasing road levels (50%).
Option 4	This option proposes to replace the existing South Circular Road Bridge (OBC1) with a wider structure. The new structure would take the form of a long over-widened single span portal. The structure would be over-widened so that it can be constructed in two phases. This potentially reduces the level of traffic disruption during the reconstruction works. All vertical clearance requirements are absorbed by track lowering.

Option	Description
Option 5	This Option is similar to Option 4 but all vertical clearance requirements and increases to structural depth are absorbed by track lowering (50%) and increasing road levels (50%).
Option 6	This Option would retain the existing South Circular Road Bridge (OBC1). A new 'cut and cover' buried portal structure would be constructed on the north side of the existing bridge. The existing bridge would facilitate two non-electrified tracks. The new structure would provide the space for the two electrified tracks. All vertical clearance requirements would be absorbed by track lowering and localized road level increases.
Option 7	This Option is similar to Option 2 but would incorporate a minor and localised increase to road levels on the Chapelizod Bypass on the north west side of the new bridge. The increase in levels at this location would facilitate a corresponding reduction in track lowering requirements throughout (but at the bridge in particular). This localised area would need to be reconstructed to construct the new bridge in any case so is not considered as a major intervention at road level.
Option 8	This Option is similar to Option 4 but would incorporate a minor and localised increase to road levels on the Chapelizod Bypass on the north west side of the new bridge. The increase in levels at this location would facilitate a corresponding reduction in track lowering requirements throughout (but at the bridge in particular). This localised area would need to be reconstructed to construct the new bridge in any case so is not considered as a major intervention at road level.

With the exception of Option 0 (Do-Nothing) and Option 1 (Do-Minimum), there are some design disciplines that have technical features that are common to all Options (e.g. OHLE and Cable & Containment). Similarly, there are technical aspects that have been considered but are determined to have no (or insignificant) bearing on the development or selection of Options (e.g. ground conditions). To remove repetition among the Option descriptions, these issues are addressed at the end of the Option Description section.

5.1.1.1 Option 0: Do-Nothing

The Do-Nothing Option proposes no changes to the existing road or rail infrastructure. The rail corridor would not be widened (inside or outside the Iarnród Éireann property boundary). The horizontal and vertical constraints at South Circular Road Bridge (OBC1) would not be resolved. As such, this option would not facilitate the inclusion of the additional fourth track or the installation of an OHLE system. The project requirements would not be achieved.

5.1.1.2 Option 1: Do-Minimum

This Option seeks to achieve the four-tracking and electrification by means of minor interventions only. A review of the constraints has concluded that there are no minor interventions that by themselves alone could achieve the project requirements.

5.1.1.3 Option 2

This option is the original Concept Design proposed for the Kildare Line Upgrade Project developed by ARUP (2018). South Circular Road Bridge (OBC1) would be reconstructed with a greater span and height to provide sufficient vertical and horizontal clearance for four-tracking and electrification in accordance with the design standards. All vertical clearance requirements and increases to structural depth would be achieved by track lowering. The junction alignment would be reinstated to the existing layout when construction is completed. Road construction works would be required adjacent to the abutments to tie the pavement on the new bridge deck into the existing approach roads.

The replacement bridge would be of reinforced concrete beam and slab construction and would be of similar width to the existing bridge (approximate plan area is 1,880 m^2). The prestressed bridge beams would be of varying type and span and have a high and variable skew. The skew is such that bearings and joints would be

required. Inspection galleries and bearing shelves would be constructed to facilitate inspection, maintenance and replacement of the bearings throughout the life of the structure.

The construction costs will be higher than a structure of comparable dimensions utilising standardised beams and spans. The bearing requirement will increase the construction cost and increase the operational expenditure and whole life cost of the structure. Bearings typically have a design life much shorter than the design life of the main bridge structure. As such they would need to be replaced over the lifetime of the bridge. This is a relatively complex procedure that will likely require rail possession access to execute.

From Memorial Road Bridge (OBC3) to South Circular Road Bridge (OBC1) the existing tracks would be renewed. Horizontally, they would be repositioned to provide a compliant horizontal clearance to the masonry retaining wall that runs along the south side of the rail corridor between the two bridges. The new position of the Fast lines would see its lateral distance to the retaining wall increase up to 2.5m (the existing lateral clearance between the retaining wall and the nearest rail is as low as 1.5m in some instances), improving the pre-existing situation regarding safety in the event of derailment. A continuous safe walkway could be installed resulting in benefits in maintainability and safety between these two bridges. The space for the additional fourth track would be created on the north side of the rail corridor by constructing a retaining wall through and along the existing cutting slope. The required retaining structure would be approximately 575m in length and up to 6metres high (varies). The retaining structure may take the form of a bored pile retaining wall or similar. At this section a standard 10-foot dimension would be provided: i.e., the distance between the Slow (northern 2 no. electrified tracks) and Fast tracks (southern 2 no. inter-city non-electrified tracks).

Between South Circular Road Bridge (OBC1) and St. John's Road Bridge (OBC0A), the horizontal alignment complies with the new Islandbridge junction configuration that provides a direct connection from the Slow track to the DART Platforms (Platforms 6, 7 & 8). 4 no. of tracks would be installed under South Circular Road Bridge (OBC1) and 6 No. of tracks beneath the existing St. John's Road Bridge (OBC0A). The distance from nearest rail to the bridge abutment would be 2.5m as a minimum.

Significant changes in the existing rail vertical levels are required to provide the minimum vertical clearance for the electrification of the Slow lines at the new South Circular Road Bridge (OBC1). The existing road levels at South Circular Road junction would be maintained.

All track and ballast would be removed and the rail corridor excavated to install the new track formation. This would result in an excavation depth of more than 2.0m. The excavation would have an impact on the existing masonry retaining wall. A structure would be installed to the base of the existing masonry retaining wall to counteract any destabilising effects of adjacent track lowering works. This structure would be installed over a significant length of the existing retaining wall.

Please refer to **section 5.1.3** a description of the Permanent Way proposed designs. The design speed at Islandbridge junction would be 40km/h (25mph) for the Fast lines and 30km/h (20mph) for the Slow tracks, based on current design development.

The horizontal clearance from the edge of the new outer rail of the northernmost track to the face of the new north abutment of South Circular Road Bridge (OBC1) would be less than 4.5m and as such the north abutment would be designed for derailment loading.

Signalling, Telecommunications and Low Voltage cable containments would be moved to new positions. OHLE masts would be installed along the north side of the rail corridor, as the 2 no. northern tracks are the ones to be electrified. OHLE equipment would be fitted to the underside of the new South Circular Road Bridge (OBC1) and to the existing St. John's Road Bridge (OBC0A) to allow for continuous electrification through the structures. The existing signal gantries would be removed.

This Option has low merit in terms of its constructability and would be extremely disruptive to traffic. To reduce the impact on both the traffic above and the operation of the railway below, new abutments would be piled behind the existing abutments. The existing bridge would then be demolished, and the new single-span bridge deck constructed. The proposal to place beams at a high skew (46 degrees approximately) would result in the removal of several traffic lanes for the duration of the construction period, and this means that a phased deck re-construction strategy could not be implemented.

There are two options for traffic management to enable construction works. The first would involve using the current western circulatory carriageway to accommodate eastern circulatory traffic in a contraflow operation. This would leave fewer lanes in each direction, less queueing space and would create high conflict turning movements.

The second option would involve diverting all north and west bound traffic away from the junction via the South Circular Road, Inchicore Road and R839. This would put further demand on these roads.

Both options would severely affect traffic in the area with potential for unsafe driver responses borne out of frustration. The options would also have a detrimental effect on vulnerable road user safety, with reduced lane widths, the removal of dedicated provisions and changing provision (causing uncertainty).

There are a significant number of utilities crossing the existing South Circular Road Bridge (OBC1). This Option would require the utilities to be diverted temporarily (via St. John's Road Bridge (OBC0A) or on a temporary utility bridge). A second utility diversion would subsequently be required to relocate utilities to their permanent positions on the reconstructed bridge. The existing Gas and Fibre Optic utilities could not be disconnected without (temporary) disruption as there are no alternative back feeds to the supply areas. The road works that would be required to facilitate such utility diversions would be highly disruptive. **Figure 5-1** and **Figure 5-2** show the indicative plan and cross section arrangement of South Circular Road Bridge (OBC1) for this Option.

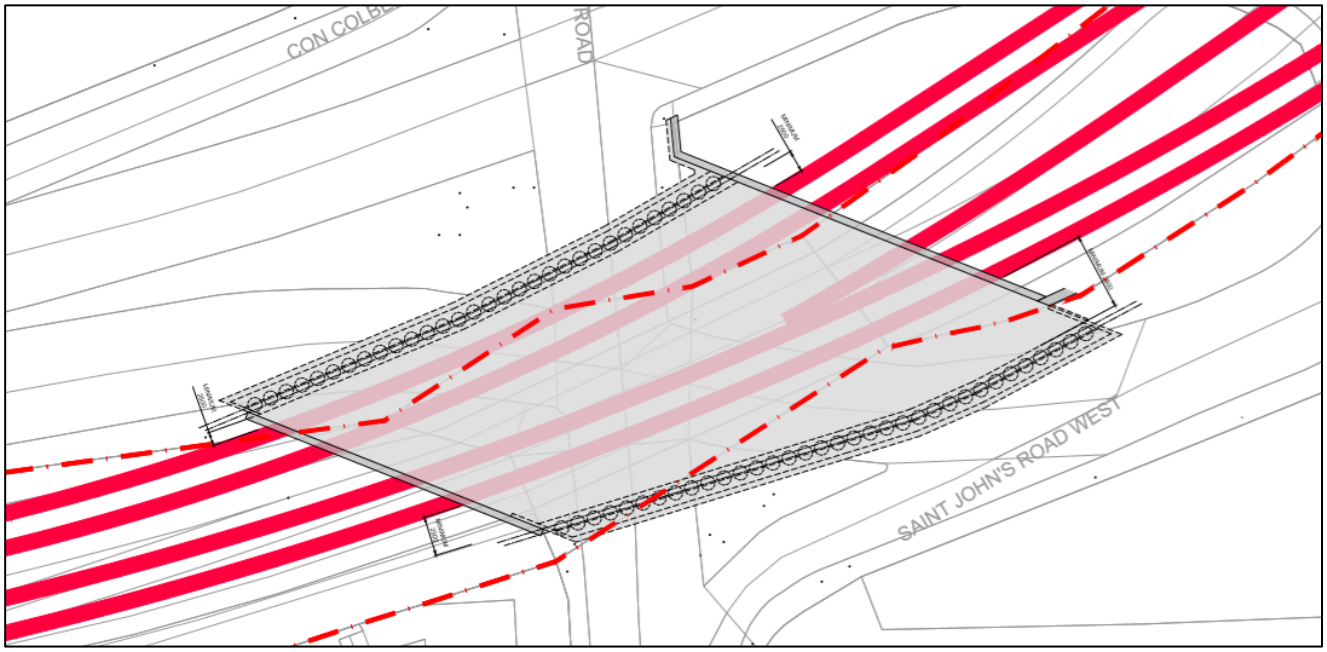


Figure 5-1 Option 2 plan

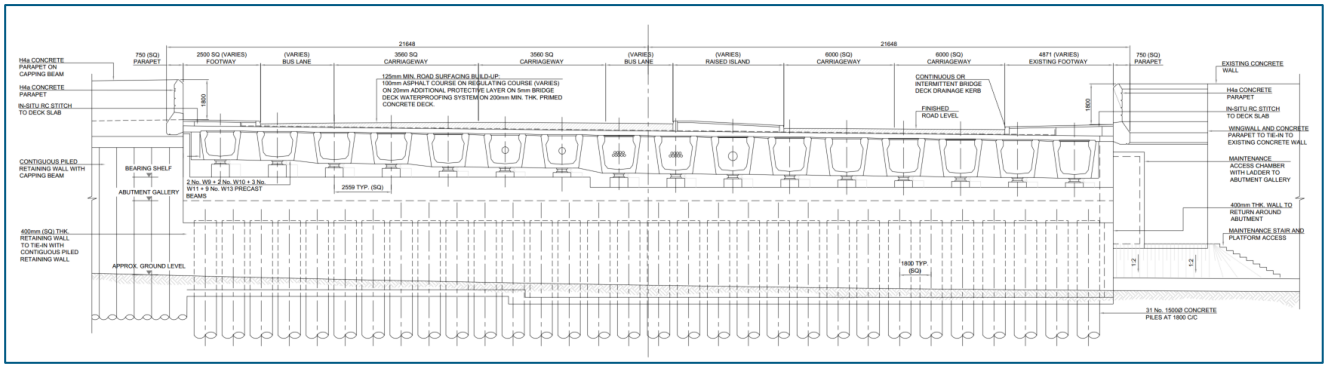


Figure 5-2 Option 2 typical cross section

Figure 5-3 Pavement construction impact with road reinstatement at grade

5.1.1.4 Option 3

Option 3 is similar to Option 2, but the vertical clearance requirements would be achieved by raising the road levels and lowering the track levels. Both the road levels and tracks levels would be adjusted by 50% of the total adjustment required for this Option. For example, if an adjustment of 0.7m is required to achieve adequate vertical clearance, then the road levels would be raised by 0.35m, and the track levels would be lowered by 0.35m also.

Even minor increases to the road levels at South Circular Road Bridge (OBC1) would require significant areas of road works to tie-in the new levels to the existing levels. The South Circular Road on the north side of the junction falls steeply towards Islandbridge (River Liffey). The tie-in works would need to 'chase' the vertical profile of the South Circular Road over a significant distance to create tie-in at gradients that are in accordance with the standards.

A similar (but less significant) situation exists on the Chapelizod Bypass on the north-west side of the structure where the road levels decrease on the departure (to the west) from the bridge. This would require the levels to

be ‘chased’ along the westbound dual carriageway until they can tie-in using gradients that are in accordance with the standards.

Full-depth pavement layer reconstruction works would be required on all approaches to the junction structure within approximately 50m of the bridge structure and would likely require some road works on St John’s Road Bridge (OBC0A). The extent of the works depends on the vertical clearance to be provided at South Circular Road Bridge (OBC1). All the parapets at the top of the retaining walls at the junction (in all directions) would need to be raised or rebuilt. Utility companies would be unlikely to accept large increases in the cover above their existing utilities without a requirement to relay their services. Works to utilities to raise their levels would be required in the vicinity of the bridge.

Figure 5-4 Pavement construction impact for new road levels >0.6m above existing levels

5.1.1.5 Option 4

This option proposes to replace the existing South Circular Road Bridge (OBC1) with a wider structure. The new structure would take the form of a long over-widened single span portal. The structure is over-widened to enable a two-phase construction of the works. This potentially reduces the level of traffic disruption during the reconstruction works compared to Options 2 and 3.

The new structure has a span and height that would provide sufficient vertical and horizontal clearance for four-tracking and electrification. The replacement bridge is much wider than the existing bridge. All vertical clearance requirements and increases to structural depth are absorbed by track lowering only.

The proposed bridge has a single span of approximately 31m and a width of approximately 76m. The plan area of the structure is approximately 2,500m^2. The bridge deck would consist of precast prestressed Super W8 beams (1.2m deep). The bridge beams would be parallel and have no or negligible skew. Unlike Option 2 and 3, the bridge could be designed to be fully integral, and as such would not require bearings, expansion joints, inspection galleries, bearing shelves or bearing replacement works over the lifetime of the structure.

The permanent way configuration would be the same as that described for Option 2 with adjustments to the vertical levels.

Signalling, Telecommunications and Low Voltage cable containments would be moved to new positions. OHLE masts would be installed along the north side of the rail corridor. OHLE equipment would be fitted to the new South Circular Bridge (OBC1) and to the existing St. John's Road Bridge (OBC0A) to allow for continuous electrification through the structures. The existing signal gantries would be removed.

This Option would be designed to facilitate improved Traffic Management when compared with Options 2 and 3. The wide structure could be be constructed in two phases. An over-widened structure allows a two-phase traffic management approach and maintains very similar lane allocations and movements as is currently present when compared to all other options.

While the maintenance costs of this integral structure would be considered less than the Option 2 and 3 structure, the capital cost would be higher. Large out-build areas of the portal would be utilised in the temporary construction phases only and would require inspection and maintenance throughout the lifetime of the structure. However, the over widened portion would provide potential flexibility / adaptability for enhancing vulnerable user safety as well as for the installation of new utilities with limiting impact on the South Circular Road carriageways.

The Option would seek to minimise traffic disruption through phased construction. As this Option would not impact on St John's Road Bridge (OBC0A), traffic management would be marginally better when compared with Options 2 and 3. However, it would be expected that the level of disruption / impact on traffic movements would be significant given the scale and duration of the construction work required.

At least one residential property on the south-west side of the structure would need to be acquired. It may be possible to minimise the impact at this location at the detail design stage by stepping, flaring or curving the abutment. This would be assessed at the detailed design stage. **Figure 5-5** and **Figure 5-6** show the indicative plan and cross-section arrangement of South Circular Road Bridge (OBC1) for this Option.

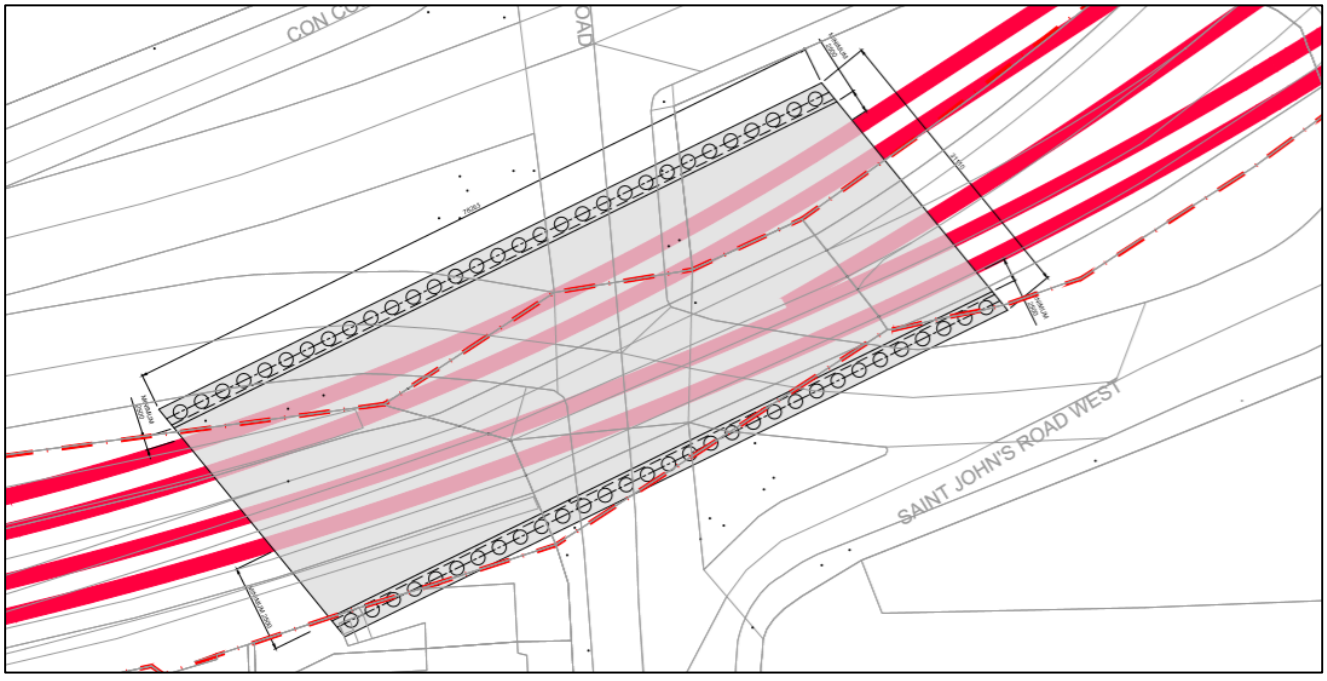


Figure 5-5 Option 4 plan

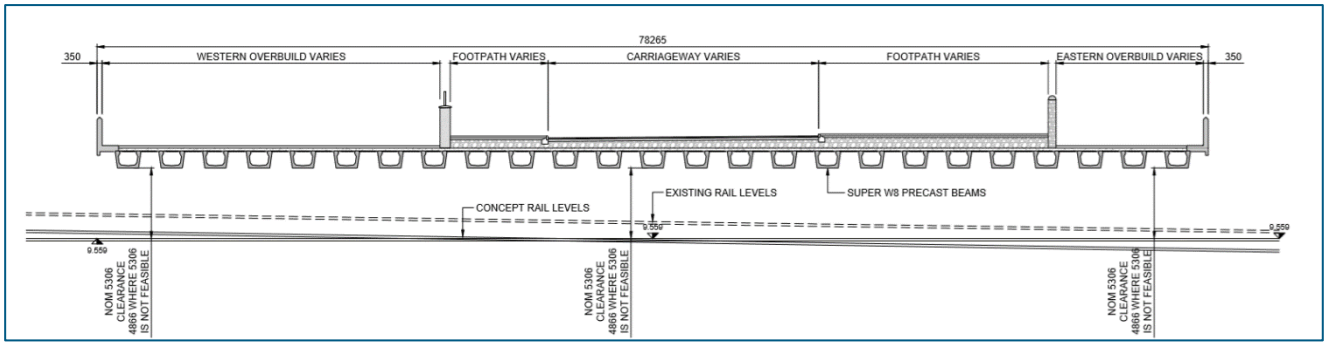


Figure 5-6 Option 4 typical cross section

Figure 5-7 Pavement construction impact with road reinstatement at grade

5.1.1.6 Option 5

Option 5 is similar to Option 4, but the vertical clearance requirements are achieved by raising the road levels and lowering the track levels. Both the road levels and tracks levels are adjusted by 50% of the total adjustment required for this Option.

As discussed previously in the report, even minor increases to the road levels at South Circular Road Bridge (OBC1) would require significant areas of roadworks to tie-in the new levels to the existing levels. Pavement works would be required on all approaches to the junction within approximately 50m of the bridge structure and likely requiring some road works on St John's Road Bridge (OBC0A). The extent of the works depends on the vertical clearance to be provided at South Circular Road Bridge (OBC1). All the parapets at the top of the retaining walls at the junction (in all directions) would need to be raised or rebuilt.

Figure 5-8 Pavement construction impact for new road levels >0.6m above existing levels

5.1.1.7 Option 6

This Option retains the existing South Circular Road Bridge (OBC1). A new 'cut and cover' buried portal structure would be constructed on the north side of the existing bridge (immediately north of the existing north abutment). The buried portal would provide space for 2 no. electrified tracks. The existing bridge would now facilitate 2 no. non-electrified tracks, therefore removing the requirement for installation of OHLE (and additional vertical clearance) under the existing structure.

The proposed cut and cover buried portal would be approximately 120m long and have a clear span of approximately 10m. The horizontal clearance to both abutments would be 2.5m and, as such, the abutments would be designed for derailment impact loading. The structure would be fully integral and would not require bearings, expansion joints or inspection galleries.

It is proposed that both abutments of the buried structure would be piled from the existing road level. It is envisaged that the abutment piling works would be carried out in short sections at night-time and under traffic management. It may be possible to temporarily reinstate and cover the ongoing works each night with road plates to allow full use of the existing carriageway during the day. If this is not possible, the piling and roof slab works could be carried out in two or three phases under traffic management. Similar to Option 4, the existing traffic island on the north side of South Circular Road Bridge (OBC1) would be temporarily reconstructed to facilitate two temporary lanes to allow traffic to flow from east to west on the Chapelizod Bypass. The roof slab (which may be constructed of precast units) may also be installed in short sections at night-time and made integral to the abutments using an in-situ stitch. The fill within the new structure could be subsequently excavated at track level from the east end of the buried portal so that this activity would not cause disruption to traffic. This Option would provide the optimum solution in terms of minimising traffic disruption.

The two Slow tracks would be realigned towards the north to pass through the new cut and cover structure and, after this, through the north span of St. John's Road Bridge (OBC0A). The track level of the Slow tracks would be significantly lower than the existing rail levels to achieve the required vertical clearance for the electrification

along the new structure. The proposed vertical profile shows a track lowering of 2.5m at the west entrance of the cut and cover, necessary to achieve the standard vertical clearance of 4.91m. This is due to the low level required for the buried portal soffit, which is constrained by existing road levels and existing utilities.

As a result, the track gradient of the west approach of the structure would be 1.674% (greater than 1.3% which is the existing track gradient at the area). In addition, the track level of the Slow tracks would be slightly lower than the existing through the St John's Road bridge (OBC0A) – up to 0.2m (refer to **Figure 5-9**).

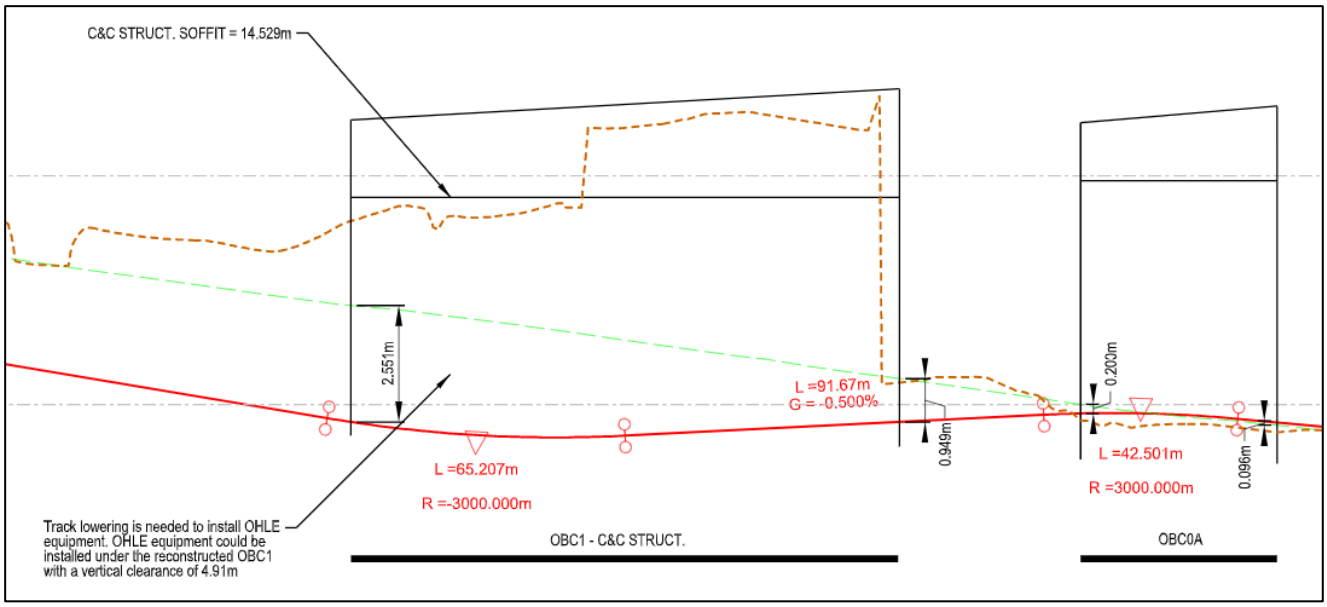


Figure 5-9 Longitudinal gradients

The proposed Fast tracks would be realigned, separated further from the existing masonry retaining wall along the south side of the corridor between South Circular Road Bridge (OBC1) and Memorial Road Bridge (OBC3), to remove the limited clearance area. Also, because the number of tracks through the existing South Circular Road Bridge (OBC1) would be decreased from 3 no. tracks to 2 no. tracks, the separation between tracks and the existing abutments would be enough for the installation of a continuous walkway. Considering the Fast tracks would not be electrified, significant track lowering to achieve OHLE clearances in the vicinity of South Circular Road bridge (OBC1) would not be required.

This configuration would result in the Slow and Fast tracks being at different levels, with a differential close to 2.6m at the cut and cover entrance. A retaining wall would need to be installed in the Slow to Fast track interval from Memorial Road up to the start of the cut and cover structure – as shown in **Figure 5-10**.

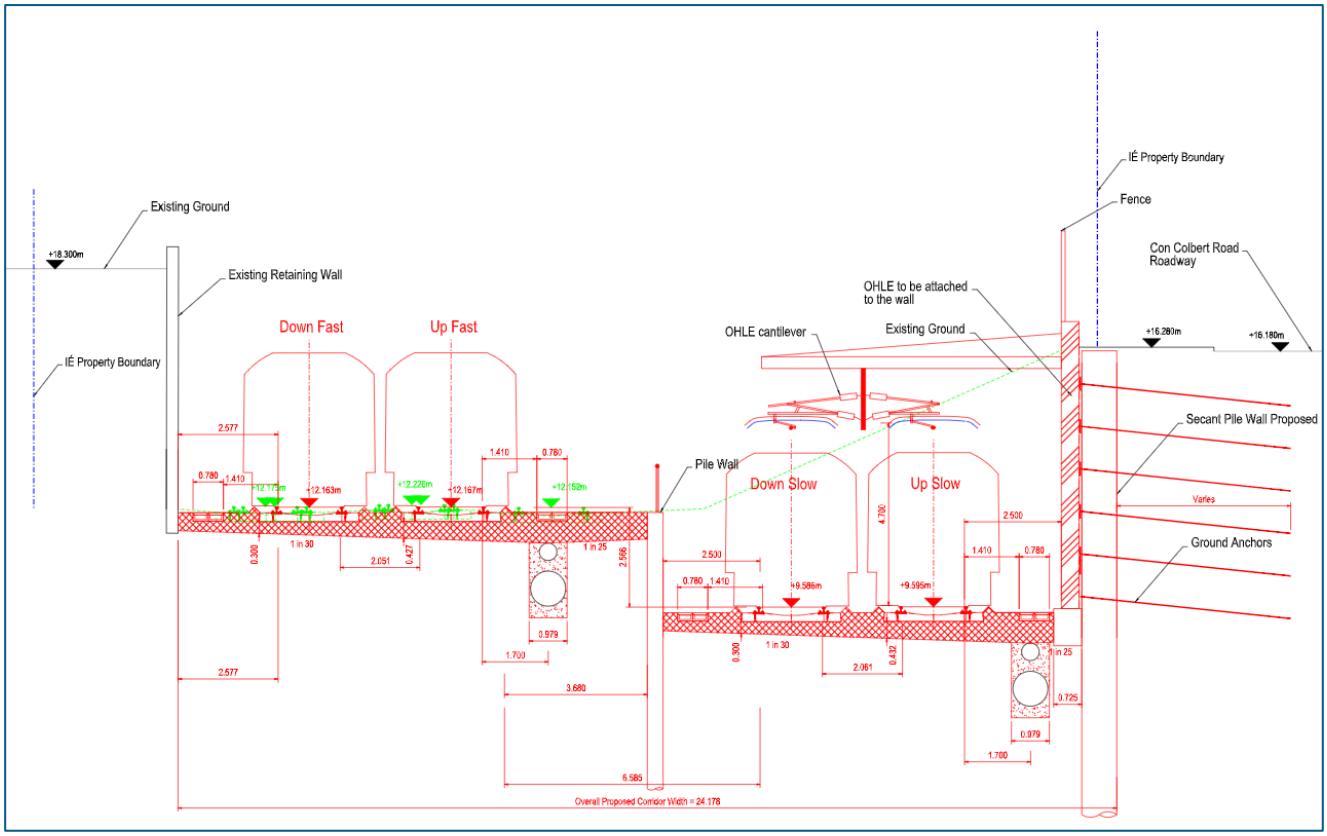


Figure 5-10 Cross section, view looking west

The differential level between the two set of tracks, Slow and Fast, would preclude the connection of the Fast and Slow tracks with crossovers. This would represent a reduction in the operational flexibility of this solution with respect to the permanent way layout presented in the other options. However, further operational optimisation of the layout could be examined as part of the design development process.

As previously mentioned, the Slow tracks beneath St. John's Road Bridge (OBC0A) would be up to a maximum of 0.2m lower than the existing level – and this only over a short length of approximately 17m on the west elevation before tracks meet the existing rail level. Here, the Up Slow is set at a horizontal distance of a minimum 3.2m away from the northern bridge pier. As-built drawings of the bridge show that the track will therefore be clear of the pier foundations, so they will be unaffected. Ongoing geotechnical investigation is expected to verify this (trial pits conducted in the area to date show over 1.0m formation depth below sleeper level to pier foundation on the south side, adjacent to the Fast tracks, which have a maximum lower of 0.1m – easily accommodated).

This option would be the most favourable in terms of utility diversions. The sequencing of the buried portal construction would allow utilities to be diverted across the top of the roof slab to temporary and permanent locations as required and with relatively little disruption compared to other options. This option would not propose to increase road levels at the junction itself, and as such it would not require existing utility networks beyond the extents of the existing and proposed structures to be raised to levels / depths that are acceptable for inspection and maintenance by the Utility providers. The existing horizontal road geometry at the junction and along the west bound carriageway would be reinstated after construction. The only vertical alignment adjustments will be made to the westbound carriageway, west of South Circular Road. Road raising of 300mm (approx.) is anticipated at the low point. The length of the carriageway reconstruction is anticipated to extend 30m (approx.) past the cut and cover buried portal structure.

Similar to Options 2 to 5, the existing tracks would be renewed and repositioned to provide sufficient clearance in accordance with design standards. Space for the additional fourth track would be created on the north side of

the rail corridor by constructing a retaining wall through and along the cutting slope. The retaining structure required would be significant at approximately 575m in length and several metres high (varies). The retaining structure may take the form of a bored pile retaining wall or similar.

Signalling, Telecommunications and Low Voltage cable containments would be relocated to new positions and existing access points from street level (Chapelizod Bypass / Con Colbert Road) repositioned accordingly. OHLE masts would be installed along the north side of the rail corridor. OHLE equipment would be fitted to the new 'cut-and-cover' structure and to the existing St. John's Road Bridge (OBC0A) to allow for continuous electrification through the structures. The existing portal gantries would be removed.

Figure 5-11 and **Figure 5-12** show the indicative plan and cross-section arrangement for the 'cut and cover' structural element of this Option.

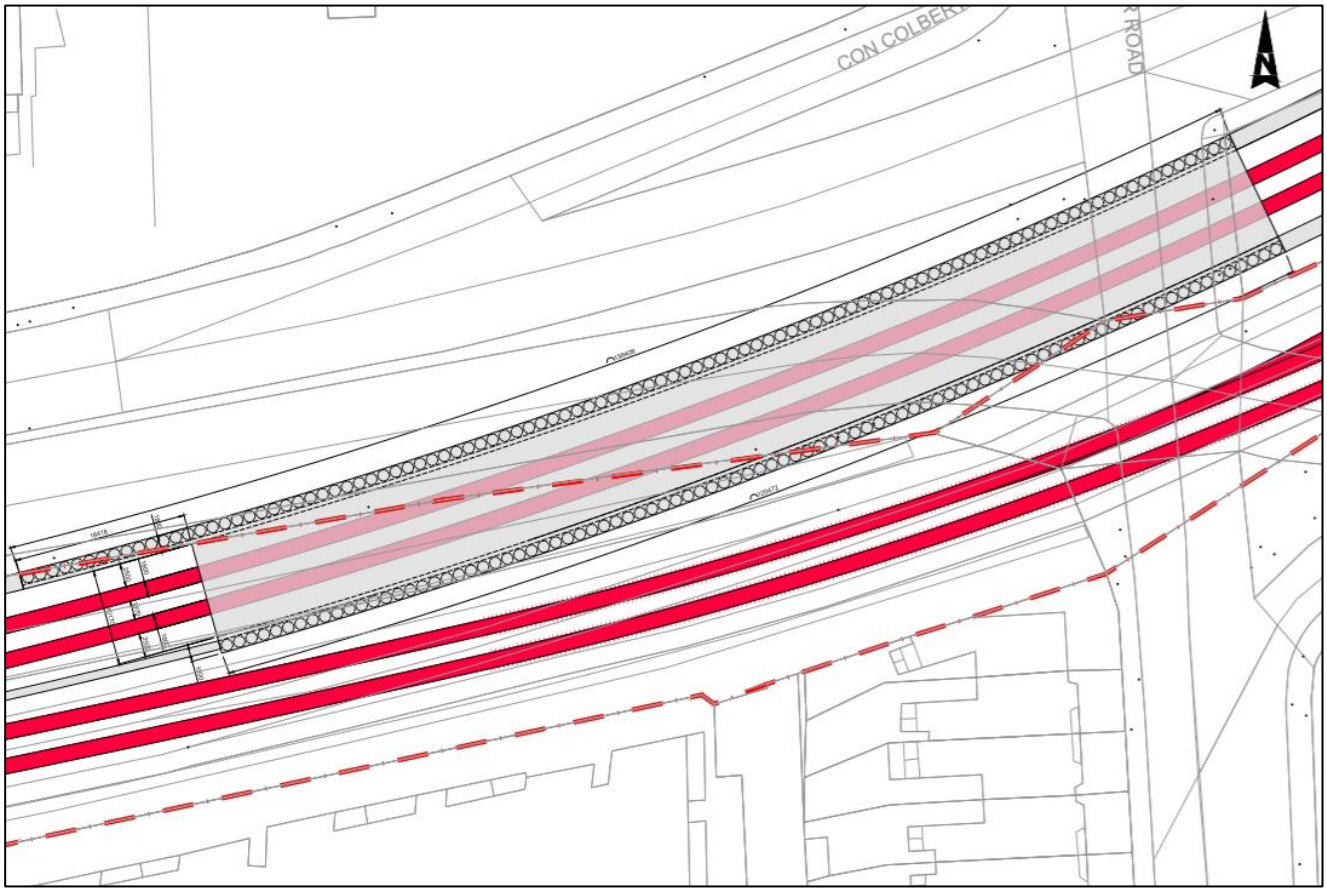


Figure 5-11 Option 6 plan

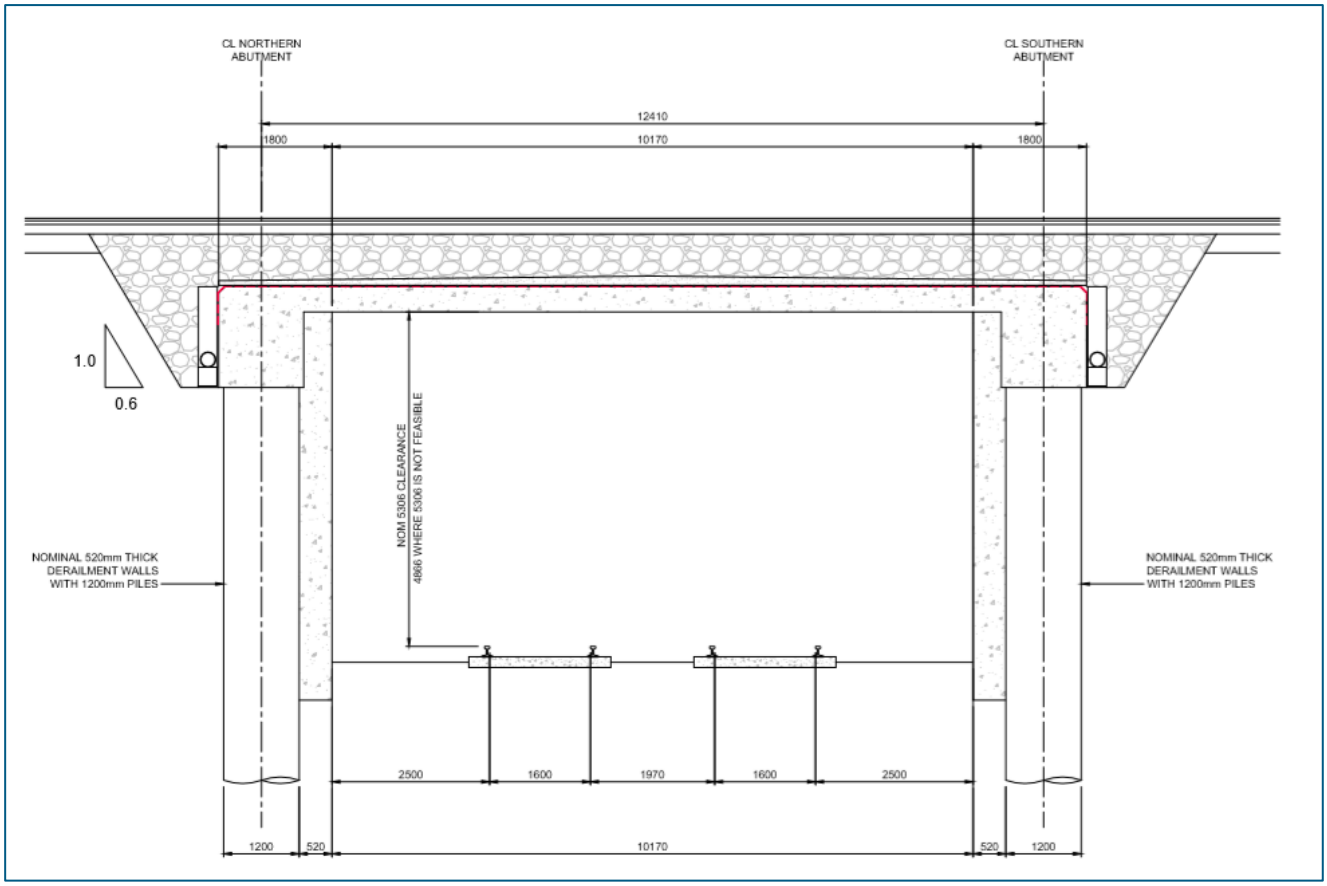


Figure 5-12 Option 6 typical cross section

5.1.1.8 Option 7

This option is similar to Option 2 but incorporates a minor and localised increase to road levels on the Chapelizod Bypass on the north-west side of the new bridge (to the westbound carriageway and median). The increase in levels at this location facilitates a corresponding reduction in track lowering requirements throughout (but at the bridge in particular). This localised area of the road would need to be reconstructed to construct the new South Circular Road Bridge (OBC1) in any case so is not considered as a major intervention at road level.

5.1.1.9 Option 8

This option is similar to Option 4 but incorporates a minor and localised increase to road levels on the Chapelizod Bypass on the north-west side of the new bridge (to the westbound carriageway and median). The increase in levels at this location would facilitate a corresponding reduction in track lowering requirements throughout (but at the bridge in particular). This localised area of the road would need to be reconstructed in order to construct the new South Circular Road Bridge (OBC1) in any case so is not considered as a major intervention at road level.

5.1.2 OHLE Arrangement – All Do-Something Options

St. John's Road Bridge (OBC0A) has sufficient vertical clearance such that it can be electrified under all Options (using fitted solutions) without any track lowering or major structural interventions. However, its proximity to South Circular Road Bridge (OBC1) is such that the two bridges have been considered together when defining the OHLE solution for each Option.

The existing South Circular Road Bridge (OBC1) has insufficient vertical clearance to provide an OHLE solution. Therefore, Options 0 and 1 are not feasible.

Minimum soffit height of 4.91m required to provide the electrification with minimum contact wire height of 4.4m. OHLE configuration would be graded contact wire, twin contact equipment (zero system height), and a contact wire height of 4.4m through the bridge. Due to the width of the structure, the OHLE would be fitted with elastic bridge arms supported from the structure at multiple locations. Electrical clearances would be 100mm static, and 50mm passing. Allowance has been made for 25mm of upward track movement.

Due to the width of the St John's Road Bridge (OBC0A), the OHLE would be connected to the bridge at multiple locations to counteract sagging. The contact wire would be graded upwards from 4.4m to nominal wire height towards the east side of the bridge. This would assist with achieving minimum separation distances at Heuston Station. The system height under the bridge would be increased where possible to minimise the use of elastic bridge arms. The support and registration through the bridge are likely to comprise of small system height cantilevers supported from the bridge deck or abutment.

Where a 5.3m vertical clearance at South Circular Road (OBC1) is found to be feasible, the OHLE configuration through the bridges would be similar, but the contact wire height would be 4.7m throughout, and so no grading is required. Electrical clearances would be 150mm static and 100mm passing, and an allowance has been made for 75mm of upward track movement. This also applies to the electrification in the cut & cover structure in Option 6.

5.1.3 Permanent Way

A total of 2 no. Permanent Way configurations have been developed. They follow the existing rail corridor footprint as much as possible. Widening of the rail corridor is proposed on the north side for all Options. Widening the rail corridor towards the south is not feasible due to the density and proximity of private residential and commercial properties. A summary of the Permanent Way variations is set out in the table below.

Table 5-2 Permanent Way Options

ID	Description
Per Way alignment for Options 2-4-7-8 (common track layouts for these integrated multi-disciplinary options)	Per Way Option 2-4-7-8 is similar to the Concept Baseline solution: • Design speed through Islandbridge Junction is 30km/h (20mph) for the Slow tracks and 40km/h (25mph) for the Fast lines. • Complete track renewal is required. • Standard Slow to Fast line track interval dimension is proposed between Memorial Road Bridge (OBC3) and South Circular Road Bridge (OBC1). • Track lowering is needed to achieve vertical clearances at bridge Options. The rail levels will be adjusted to fit final designs of road, overbridge and OHLE system. • Track gradients are increased from 1.3% to 1.5% (approximate, depending on bridge options) • Complete upgrade of track formation is required. • New drainage may be required. An access walkway can be installed to both cesses (the space along the outside of the track).
Per Way alignment for Option 6	The proposed Slow tracks are slued towards the north and would cross the road junction through a cut and cover buried structure solution. The existing South Circular Road Bridge (OBC1) and St John's Road Bridge (OBC0A) structures would be retained. • Design speed through Islandbridge is 35km/h (20 mph) • Complete track renewal is required. • Significant track lowering is required for the Slow lines to achieve the required vertical clearance at the cut and cover structure. Slow and Fast tracks would be at different levels (up to 2.6m) • Track gradients of Up Slow track are increased from 1.3% to 1.674%. • Upgrade of track formation is required. • New drainage may be required. • An access walkway can be installed to both cesses (the space along the outside of the track). • Configuration of Islandbridge junction is constrained by the differential level of Slow and Fast tracks. The connection of the Slow and Fast track may only be possible to the west of St John's Road Bridge (OBC0A). • A retaining wall is to be installed in the interval between the Slow and Fast tracks. This Slow to Fast line track interval dimension may need to be increased from the standard 3.58m up to 5.4m to ensure continuous position of safety.

The geometrically constrained area requires the track alignment to consist of tight track radii and the P&Cs to be installed on curves.

5.1.4 Geotechnical (All Do-Something Options)

The general superficial geology in this area is anticipated to comprise a thin layer of made ground underlain by a significant thickness of Glacial Till overlying bedrock. From an assessment of the available historical ground investigation summarised in this report, no onerous ground or groundwater conditions are expected that would significantly impact any of the Options proposed based on the available ground investigation information at the time of writing. Therefore, the ground and groundwater conditions currently do not pose any significant concerns from a geotechnical design perspective (e.g. selection of shallow foundations or piling).

5.1.5 Roads (All Do-Something Options)

The South Circular Road junction is used by vulnerable users (pedestrians, cyclists, disabled, blind, partially sighted), primarily making north and southbound movements along South Circular Road. Dublin City Council has requested that the Options provide the same level of service for pedestrians and cyclists as the existing.

Both the Lucan and Liffey Valley Bus Connect Schemes are currently at Stage 3 - Public Consultation and if implemented prior to DART+ South West could potentially impact the reinstatement and temporary traffic management strategies envisaged for use with the Options under review in this report. Consultation with the relevant stakeholders is ongoing.

5.1.6 Cable and Containments (All Do-Something Options)

With the exception of Option 0, all Options will require the relocation of a variety of service cables, utilities and containments throughout and the integration of the existing maintenance access point from Chapelizod Bypass into the proposed retaining structure between Memorial Road Bridge (OBC3) and South Circular Road Bridge (OBC1A).

Dublin City Council has requested that its existing CCTV traffic monitoring system is to remain active throughout the construction project; this will require further consultation to determine suitable temporary or permanent relocation location of this system.

5.2 Construction Compounds

One Construction compound is required in this area:

- In the vicinity of South Circular Road / Chapelizod Bypass (Con Colbert Road)

5.2.1 South Circular Rd / Chapelizod Bypass (Con Colbert Rd)

A Construction compound is required to service the South Circular Road junction works and the widening of the rail corridor along this section of the route. The Construction compound will also need to act as the facility for moving materials from roadside to trackside by means of steep ramps. The proposed works at the South Circular Road will require significant space for either in situ or precast concrete works, excavations and retaining wall operations.

Only one location has been identified for a Construction compound to service the works at South Circular Road junction. The proposed Construction compound is adjacent to Chapelizod Bypass (Con Colbert Road), to the west of the South Circular Road junction, and to the east of Memorial Road bridge. The proposed site is primarily located within the Irish Rail boundary and is constrained by Chapelizod Bypass (Con Colbert Road) to the north and residential properties to the south.

It will be used to service the South Circular Road junction works which include track lowering and the widening of the rail corridor along this section.

If situated or extended on to the adjacent road, agreement with Dublin City Council (DCC) will be needed as the first lane (bus lane) of Chapelizod Bypass (Con Colbert Road) will be required to excavate soil and construct the new wall. It is therefore proposed to close the first lane of this road from the South Circular Road junction to beyond Memorial Road and to utilise this space as a construction compound.

Due to the significance of the structural work required at South Circular Road, the bus lane would already be required here locally for that work, regardless of the construction requirements of the new retaining wall to the west.

The site provides good access to the road network, located adjacent to Chapelizod Bypass (Con Colbert Road) which leads directly to the M50 by means of a dual carriageway.

Figure 5-13 Proposed Chapelizod Bypass Construction Compound Site Location

6. Options Selection Process

6.1 Options Selection Process

A clearly defined appraisal methodology has been used in the selection of the Preferred Option for the Project. Consistent with other NTA projects, it is based on *'Guidelines on a Common Appraisal Framework for Transport Projects and Programmes' (CAF)* published by the Department of Transport, Tourism, and Sport (DTTAS), March 2016 (updated 2020) and informed by TII's *Project Management Guidelines (TII PMG 2019)*.

The Option Selection Process involves a two-stage approach (if/as appropriate):

- Stage 1 Preliminary Assessment (Sifting)
- Stage 2 Multi Criteria Analysis (MCA)

The starting principle of the optioneering process and a focus of the Project Team has been to reduce the potential impacts on the surrounding environs by accommodating necessary works and interventions within the existing rail corridor, where practicable. However, a number of discrete elements extend beyond the boundary of the existing railway. The optioneering process has focused on these elements for which alternative options manifest, options which are markedly different from one another, and which have varied impact on the local environment. Examples of such include four tracking, bridge replacements, and options for the location of substations and construction compounds.

The above selection process has been used to asess the options associated with the following elements bewteen Memorial Road and South Circular Road junction:

- Civil and OHLE
- Construction Compounds

6.1.1 Stage 1: Preliminary Assessment Process (Sifting)

The Stage 1: Preliminary Assessment (Sifting) involves an initial assessment of a long list of options, each of which are assessed against Engineering, Economics and Environmental criteria.

The assessment is based on whether an option meets the Project Objectives / Requirements and whether the option is technically feasible. All feasible options are brought forward to the second stage of the assessment process (MCA) to be explored in greater detail.

A total of nine 'Options' were initially developed for this area. The options assessed for selecting the Preferred Option for the corridor between Memorial Road Bridge and South Circular Road Junction, ranged from a 'Do-Nothing' Option, 'Do-Minimum' Option to a range of 'Do-Something' Options, each of the options were assessed to determine if they were feasible and met the Project Objectives / Requirements.

The 'Do-Something' Options in this area involve the widening of the existing rail corridor to accommodate the required four tracks. Widening of the rail corridor is proposed on the north side of the existing tracks to minimise impact on the private residential and commercial properties located on the southern side of the existing rail corridor. Existing structures in this area were analysed to determine if they could accommodate the additional tracks and installation of the new Overhead Line Electrification (OHLE) system. The existing road network poses significant constraints in terms of achieving the project requirements of providing an additional fourth track and electrifying 2 no. tracks in this area.

Where the sifting results in only one feasible option being retained, it is not required to complete a multi-criteria analysis (MCA) on that one option.

6.1.2 Stage 2 Multi Criteria Analysis (MCA)

Stage 2 of the optioneering process comprises a detailed multi-disciplinary comparative analysis of the feasible options that passed through Stage 1: Preliminary Assessment (Sifting).

The options are assessed against the criteria of Economy, Safety, Environment, Accessibility and Social Inclusion, Integration and Physical Activity in line with the criteria required for multi-criteria analysis under the Department of Transport, Tourism and Sport (DTTAS), Common Appraisal Framework (CAF) for Transport Project and Programmes (March 2016). These parameters were split into a number of sub-criteria considered relevant to the DART+ South West Project.

The assessment compares the options, identifying and summarising the comparative merits and disadvantages of each alternative under all applicable criteria and sub-criteria leading to a Preferred Option.

Relevant considerations include:

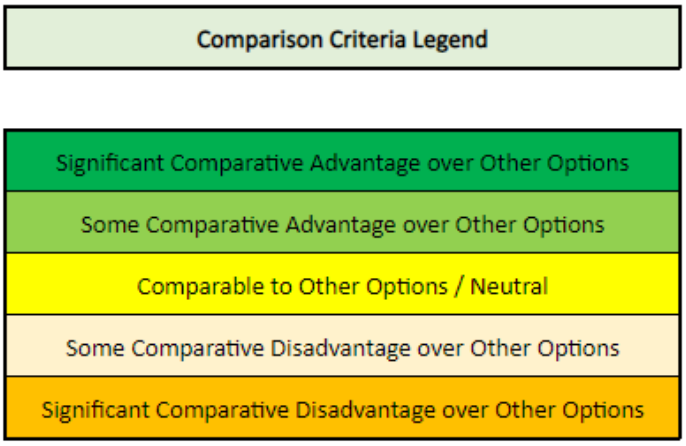
- This is a comparative analysis between the various options, not an impact assessment of each option. The impact from the Preferred Option will be assessed in the environmental impact assessment report (EIAR) in the next phase of the development.
- Not all sub-criteria and qualitative and/or quantitative indices may be relevant in every case.
- For each Option there are potential design variations. In due course design variations will be subject to detailed technical analysis (in respect of the Preferred Option).
- For each Option an indicative envelope was identified for permanent and temporary works, property and/or land take; a worst-case scenario was considered. Detailed design, technical and construction related solutions will seek to minimise land take in respect of the Preferred Option.
- The envelope around each Option was used to spatially represent environmental constraints within / proximate to the options.

The options which were brought forward from the Preliminary Screening were developed further to facilitate the more detailed Stage 2 Multi Criteria Analysis.

The process adopted for the Stage 2 MCA involved assessing the performance of each option against relevant quantitative and qualitative indicators, the assessment was carried out by a multi-disciplinary team including commercial, technical, safety and environmental specialists.

Presented in a matrix format, each specialist included a commentary of his/her analysis for each option. They then compared the options relative to each other based on whether an option had a ‘some’ or ‘significant’ advantage or disadvantage over other options or whether all options were ‘comparable / neutral’. This basis of comparison is consistent with the NTA Guidelines which use the following five-point ranking scale when comparing options against each other for comparative analysis.

Table 6-1 Comparison Criteria



6.2 Civil and OHLE Option Selection

6.2.1 Stage 1 Sifting

Table 6-2 provides details of the assessment undertaken as part of the Stage 1 Preliminary Assessment (Sifting) Process, used in the selection of the Preferred Option for the Civil and OHLE elements of the Project (see **Appendix A Sifting Process Backup** for more details).

Options which were assessed as feasible and fulfilled the project requirements were brought forward to Stage 2 MCA for a more detailed assessment.

Table 6-2 Preliminary Assessment (Sifting) Findings

Option	Requirements		Description
0	Engineering	Constructability	Not applicable. No intervention proposed.
		Geometrical fitness for intervention	Not applicable. No intervention proposed.
		Safety	Not applicable. No intervention proposed.
		four-tracking Park West-Heuston	FAIL. No intervention proposed. four-tracking is not achieved.
		Electrification of DART+ tracks	FAIL. No intervention proposed. Electrification of the DART+ tracks not achieved.
		Vertical electrical clearance in structures	FAIL. No intervention proposed. Vertical electrical at structures not achieved.
		Bridge Design Standards	Not applicable. No intervention proposed.
		Keep current functionality of roads	PASS. No intervention proposed.
	Economy		Compatible with the investment guidelines and programme for DART+
	Environment		No impact on Environmental sites of National or International significance.
	SIFTING OUTCOME		**FAIL. Do not progress to Stage 2 Assessment**
1	Engineering	Constructability	PASS. Minor interventions to the rail corridor are possible.
		Geometrical fitness for intervention	PASS. Minor interventions without geometrical fitness concerns are possible.
		Safety	PASS. Minor interventions that pose no safety concerns are possible.
		four-tracking Park West-Heuston	FAIL. Minor interventions only cannot achieve four-tracking.

		Electrification of DART+ tracks	FAIL. Minor interventions only cannot achieve electrification of the DART+ tracks.
		Vertical electrical clearance in structures	FAIL. Minor interventions only cannot achieve vertical electrical clearance requirements at structures.
		Bridge Design Standards	PASS. Minor interventions to the rail corridor in accordance with standards are possible.
		Keep current functionality of roads	PASS. Minor interventions to rail corridor that do not affect road functionality are possible.
	Economy		Compatible with the investment guidelines and programme for DART+.
	Environment		No impact on Environmental sites of National or International significance.
	SIFTING OUTCOME		**FAIL. Do not progress to Stage 2 Assessment**
2	**Engineering**	Constructability	PASS. This Option would be difficult to construct, but it is considered feasible.
		Geometrical fitness for intervention	PASS. This would require a maximum track lowering of 1.650m. This track lowering is difficult to achieve from a technical perspective in terms of track gradients and longitudinal drainage, but it is considered feasible.
		Safety	PASS. No issues.
		four-tracking Park West-Heuston	PASS. This option achieves the 4 tracking.
		Electrification of DART+ tracks	PASS. This option achieves the electrification of DART+ tracks.
		Vertical electrical clearance in structures	PASS. This option achieves electrical clearance in structures
		Bridge Design Standards	PASS. Option is in accordance with derogated standards.
		Keep current functionality of roads	PASS. Current road functionality maintained.
	Economy		Compatible with the investment guidelines and programme for DART+
	Environment		No impact on Environmental sites of National of International significance.
	SIFTING OUTCOME		**PASS. Proceed to Stage 2 Assessment**
3	**Engineering**	Constructability	PASS. This Option would be difficult to construct but it is considered feasible.
		Geometrical fitness for intervention	PASS. This would require a minimum road level increase and track lowering of 0.825m. This track lowering is difficult to achieve from a technical perspective in terms of track gradients and longitudinal drainage, but it is considered feasible.
		Safety	PASS. No issues.
		four-tracking Park West-Heuston	PASS. This option achieves the 4 tracking.
		Electrification of DART+ tracks	PASS. This option achieves the electrification of DART+ tracks.
		Vertical electrical clearance in structures	PASS. This option achieves electrical clearance in structures
		Bridge Design Standards	PASS. Option is in accordance with derogated standards.
		Keep current functionality of roads	FAIL. This would require a minimum road level increase and track lowering of 0.825m. This level of road level increase at OBC1 would require extensive works to the junction and to the approach roads. It is not a feasible solution in terms of maintaining the functionality of roads.
	Economy		Compatible with the investment guidelines and programme for DART+
	Environment		No impact on Environmental sites of National of International significance.
	SIFTING OUTCOME		**FAIL. Do not progress to Stage 2 Assessment**
4	**Engineering**	Constructability	PASS. This Option would be difficult to construct but it is considered feasible.

		Geometrical fitness for intervention	PASS. This would require a track lowering of 1.781m. This track lowering is difficult to achieve from a technical perspective in terms of track gradients and longitudinal drainage, but it is considered feasible.
		Safety	PASS. No issues.
		four-tracking Park West-Heuston	PASS. This option achieves the 4 tracking.
		Electrification of DART+ tracks	PASS. This option achieves the electrification of DART+ tracks.
		Vertical electrical clearance in structures	PASS. This option achieves electrical clearance in structures
		Bridge Design Standards	PASS. Option is in accordance with derogated standards.
		Keep current functionality of roads	PASS. Current road functionality maintained.
	Economy		Compatible with the investment guidelines and programme for DART+
	Environment		No impact on Environmental sites of National of International significance.
	SIFTING OUTCOME		**PASS. Proceed to Stage 2 Assessment**
5	**Engineering**	Constructability	PASS. This Option would be difficult to construct but it is considered feasible.
		Geometrical fitness for intervention	PASS. This would require a minimum road level increase and track lowering of 0.890m. This track lowering is difficult to achieve from a technical perspective in terms of track gradients and longitudinal drainage, but it is considered feasible.
		Safety	PASS. No issues.
		four-tracking Park West-Heuston	PASS. This option achieves the 4 tracking.
		Electrification of DART+ tracks	PASS. This option achieves the electrification of DART+ tracks.
		Vertical electrical clearance in structures	PASS. This option achieves electrical clearance in structures
		Bridge Design Standards	PASS. Option is in accordance with derogated standards.
		Keep current functionality of roads	FAIL. This would require a minimum road level increase and track lowering of 0.890m. This level of road level increase at OBC1 would require extensive works to the junction and to the approach roads. It is not a feasible solution in terms of maintaining the functionality of roads.
	Economy		Compatible with the investment guidelines and programme for DART+
	Environment		No impact on Environmental sites of National of International significance.
	SIFTING OUTCOME		**FAIL. Do not progress to Stage 2 Assessment**
6	**Engineering**	Constructability	PASS. This Option would be difficult to construct but it is considered feasible.
		Geometrical fitness for intervention	PASS. This would require track lowering, for the Slow lines, of 2.5m at the proposed Cut and Cover Structure. Existing track levels on the Fast lines would be nominally maintained at the existing bridge. The Slow line track lowering is difficult to achieve from a technical perspective in terms of steep track gradients (for rolling stock traction) and longitudinal drainage, but it is considered feasible.
		Safety	PASS. No issues.
		four-tracking Park West-Heuston	PASS. This option achieves the 4 tracking.
		Electrification of DART+ tracks	PASS. This option achieves the electrification of DART+ track levels.
		Vertical electrical clearance in structures	PASS. This option achieves electrical clearance in structures

		Bridge Design Standards	PASS. Option is in accordance with derogated standards.
		Keep current functionality of roads	PASS. Current road functionality maintained.
	Economy		Compatible with the investment guidelines and programme for DART+
	Environment		No impact on Environmental sites of National of International significance.
	SIFTING OUTCOME		**PASS. Proceed to Stage 2 Assessment**
7	**Engineering**	Constructability	PASS. This Option would be difficult to construct but it is considered feasible.
		Geometrical fitness for intervention	PASS. This would require a road level increase of 0.2m and a minimum track lowering of 1.450m. This track lowering is difficult to achieve from a technical perspective in terms of track gradients and longitudinal drainage, but it is considered feasible.
		Safety	PASS. No issues.
		four-tracking Park West-Heuston	PASS. This option achieves the 4 tracking.
		Electrification of DART+ tracks	PASS. This option achieves the electrification of DART+ tracks.
		Vertical electrical clearance in structures	PASS. This option achieves electrical clearance in structures
		Bridge Design Standards	PASS. Option is in accordance with derogated standards.
		Keep current functionality of roads	PASS. This would require a road level increase of 0.2m and track lowering of 1.450m.
	Economy		Compatible with the investment guidelines and programme for DART+
	Environment		No impact on Environmental sites of National of International significance.
	SIFTING OUTCOME		**PASS. Proceed to Stage 2 Assessment**
8	**Engineering**	Constructability	PASS. This Option would be difficult to construct but it is considered feasible.
		Geometrical fitness for intervention	PASS. This would require a road level increase of 0.2m and track lowering of 1.581m. This track lowering is difficult to achieve from a technical perspective in terms of track gradients and longitudinal drainage, but it is considered feasible.
		Safety	PASS. No issues.
		four-tracking Park West-Heuston	PASS. This option achieves the 4 tracking.
		Electrification of DART+ tracks	PASS. This option achieves the electrification of DART+ tracks.
		Vertical electrical clearance in structures	PASS. This option achieves electrical clearance in structures
		Bridge Design Standards	PASS. Option is in accordance with derogated standards.
		Keep current functionality of roads	This would require a road level increase of 0.2m and a minimum track lowering of 1.581m.
	Economy		Compatible with the investment guidelines and programme for DART+
	Environment		No impact on Environmental sites of National of International significance.
	SIFTING OUTCOME		**PASS. Proceed to Stage 2 Assessment**

A total of 9 No. Options were developed for the area from the Memorial Road Bridge (OBC3) to the east of the St John's Road Bridge (OBC0A). Following the assessment completed as part of the Sifting Process, as shown in **Table 6-3**, a total of 5 no. Options have been shortlisted and will progress to Stage 2 (MCA) of the assessment process.

Table 6-3 Summary of Sifting Process Results

Main Option	Result	Brought forward to MCA
Option 0: 'Do Nothing'	FAIL	NO
Option 1: Do Minimum	FAIL	NO
Option 2	PASS	YES
Option 3	FAIL	NO
Option 4	PASS	YES
Option 5	FAIL	NO
Option 6	PASS	YES
Option 7	PASS	YES
Option 8	PASS	YES

The following options did not meet the necessary Engineering Feasibility and Project Requirements and shall not be brought forward to Stage 2 (MCA) of the assessment process:

- **Option 0** - The Do-Nothing Option proposes no changes to the existing road or rail infrastructure, as such, this option would not facilitate the inclusion of the required four tracks or the installation of the OHLE system. The project requirements would not be achieved as such this option was not brought forward.
- **Option 1** – The Do-Minimum Option seeks to achieve the four-tracking and electrification by means of minor interventions only. Due to the constraints in this area, minor interventions would not be sufficient to achieve the project requirements, as such this option was not brought forward.
- **Option 3** - This option involves the reconstruction of the South Circular Road Bridge (OBC1) with a greater span and height, it would require the road level to be increased by 0.825m in addition to lowering the track by 0.825m. This option was not brought forward due to the required road level increase, which would require extensive works to the junction and to the approach roads, significant disruption would also be caused during construction.
- **Option 5** – This option involves the replacement of South Circular Road Bridge (OBC1) with a wider structure. The new structure would take the form of a long over-widened single span portal. This option would require the road level to be increased by 0.890m in addition to lowering the track by 0.890m. This option was not brought forward due to the required road level increase, which would require extensive and disruptive works to the junction and to the approach roads.

The following options met the necessary Engineering Feasibility and Project Requirements and were brought forward to Stage 2 (MCA) for detailed assessment:

- **Option 2** – This option involves the reconstruction of the South Circular Road Bridge (OBC1), replacing it with a larger span and higher structure, the works would also involve track lowering.

- **Option 4** – This option involves the replacement of the South Circular Road Bridge (OBC1) with an over widened portal which could be constructed in phases, works would also involve track lowering.

- **Option 6** – This option involves the retention of the existing South Circular Road Bridge (OBC1) and the construction of a new cut and cover portal structure.

- **Option 7** – This option is similar to Option 2 but would incorporate a minor and localised increase to road levels on the Chapelizod Bypass on the north west side of the new bridge.

- **Option 8** – This option is similar to Option 4 but would incorporate a minor and localised increase to road levels on the Chapelizod Bypass on the north west side of the new bridge.

6.2.2 Stage 2 MCA

Table 6-4 shows the summary findings of the comparative assessment undertaken during the Stage 2 MCA, the detailed matrix is provided in **Appendix B MCA Process Backup**.

Table 6-4 MCA Summary

CAF Parameters	Option 2	Option 4	Option 6	Option 7	Option 8
1. Economy	Some Comparative Disadvantage over Other Options	Some Comparative Disadvantage over Other Options	Significant Comparative Advantage over Other Options	Some Comparative Disadvantage over Other Options	Significant Comparative Disadvantage over Other Options
2. Integration	Some Comparative Disadvantage over Other Options	Some Comparative Advantage over Other Options	Some Comparative Advantage over Other Options	Some Comparative Disadvantage over Other Options	Some Comparative Advantage over Other Options
3. Environment	Some Comparative Disadvantage over Other Options	Some Comparative Disadvantage over Other Options	Some Comparative Advantage over Other Options	Some Comparative Disadvantage over Other Options	Some Comparative Disadvantage over Other Options
4. Accessibility and Social	Some Comparative Advantage over Other Options	Some Comparative Advantage over Other Options	Some Comparative Disadvantage over Other Options	Some Comparative Advantage over Other Options	Some Comparative Advantage over Other Options
5. Safety	Some Comparative Disadvantage over Other Options	Some Comparative Disadvantage over Other Options	Some Comparative Advantage over Other Options	Some Comparative Disadvantage over Other Options	Some Comparative Advantage over Other Options
6. Physical Activity	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral
Conclusion			Preferred Option		

Option 6 is identified as the preferred option or solution, the basis for this, is as follows:

Economy: Option 6 is the least expensive option having regard to land take, traffic disruption (temporary works) and capital costs of the works. Option 8 is the most expensive because of extent of capital works and potential for greater traffic disruption.

Option 6 is the only option that leaves the Intercity and Regional Rail service tracks approximately at the same level as they have today. This negates the need to implement a substantial track lowering in these tracks to accommodate a new electrification driven by the DART tracks, which in this case run under a new separate structure, thus avoiding the significant works required to the wall in response to lowering the track.

Neither Option 2 nor 7 allow for phased construction (requiring the removal of the entire bridge) and this would result in significant disruption and diversions (and associated costs) during construction for users immediately around the junction, business in the area (in particular Inchicore) but also strategically in the context of the wider transport network. While the other options (Option 4, 6 and 8) allow for phased construction maintaining local and strategic access, Option 6 allows for phasing in localised areas, allowing traffic to continue throughout the construction period with local diversions. Having regard to the importance of the South Circular Road Junction for local and strategic access to economic activities Option 6 is preferred because the nature of the proposed works can facilitate shorter traffic disruption / diversions than other options.

In terms of Economy, Option 6 is the preferred option.

Integration: Neither Option 2 nor 7 allow for phased construction (requiring the removal of the entire bridge) and this would result in significant local and strategic accessibility issues from disruption and diversions to the local and wider strategic road network. While the other options (Option 4, 6 and 8) allow for phased construction maintaining local and strategic access, Option 6 allows for phasing in localised areas, allowing traffic to continue throughout construction with local diversions. Having regard to the importance of the South Circular Road Junction for local and strategic accessibility Option 6 is preferred from a constructability perspective.

However, there are some comparative advantages of the over-widened structures of Options 2, 4, 7 and 8 where there is greater potential for enhanced junction geometry in the long term.

Railway services would be significantly affected by the need to lower the existing tracks to achieve OHLE clearances, a feature of all options except option 6. Option 6, however, does necessitate the construction of a retaining wall between the existing and the new tracks from South Circular Road junction to Memorial Road.

In terms of Integration, Options 4, 6 and 8 are comparable with some comparative advantage over the other options considered.

Environment: In terms of the Environmental criteria, Option 6 was found to have 'Some Comparable Advantage' over the other options, in terms of minimising the potential effect on: Air and Climate (less effect on traffic during construction); Landscape and Visual; Cultural Heritage and Architectural Heritage; and Agricultural and non-agricultural land use factors. Option 6 has less effect on the housing to the southwest of South Circular Road Bridge (OBC1). **In terms of Environment, Option 6 is the preferred option.**

Accessibility and Social Inclusion: In terms of Accessibility and Social Inclusion, while there is no comparative advantage or disadvantage between options 2, 4, 7 and 8, in service it is considered that Option 6 would not have the same degree of flexibility or marginally less available space to provide facilities for road users. Hence, Option 6 was found to have 'Some Comparable Disadvantage over Other Options'. **In terms of Accessibility and Social Inclusion all options are identified as comparable, with Option 6 scoring Some Comparative Disadvantage.**

Safety: In terms of Safety, Options 6 and 8 are identified as having 'Some Comparative Advantage' over Options 2, 4 and 7.

This relates to a combination of risks associated with steep gradients, requirements to underpin walls and whether construction can be phased to provide sufficient space to accommodate vulnerable road users.

In terms of safety Options 6 and 8 are identified as having a 'Some Comparative Advantage'.

Physical Activity: In terms of Physical Activity, there is no comparative advantage or disadvantage between all the options. **In terms of Physical Activity all options are identified as comparable.**

6.3 Construction Compounds Option Selection

6.3.1 South Circular Road/ Chapelizod Bypass (Con Colbert Road)

The works are taking place in a spatially constrained location and the proposed location for the Construction Compound is the only one identified in this area that can reasonably meet the construction requirements. The construction compound is required to serve the localised works in this area and to meet the construction phasing strategy, where the works are reasonably complex. Access routes for removal of spoil are therefore required west of South Circular junction to meet the construction needs. As no other suitable alternative locations in the area were identified through the option development process, the selected construction compound location did not require multi-criteria analysis.

7. Preferred Option Design Development

7.1 Review of Preferred Option

The baseline information or outcomes of design development since PC1 (inclusive of stakeholder input) have not materially impacted the optioneering and MCA outcomes that resulted in the selection of Option 6 as the Preferred Option. This Option retains the existing South Circular Road Bridge (OBC1). A new 'cut and cover' buried portal structure would be constructed on the north side of the existing bridge. The buried portal would provide space for two electrified tracks. The existing South Circular Road Bridge (OBC1) would facilitate two non-electrified tracks, therefore would not require any major modifications.

The two Slow tracks will be realigned towards the north to pass through the new cut and cover structure and, after this, through the north span of St John's Road Bridge (OBC0A). The track level of the Slow tracks will be significantly lower than the existing rail levels to achieve the required vertical clearance for the electrification along the new structure. This is due to the low level required for the buried portal soffit, which would be constrained by existing road levels, existing utilities and the vertical clearance requirements for new structures.

In terms of permanent way, this option enables the existing tracks under South Circular Road Bridge (OBC1) to be realigned to provide standard lateral clearances. However, slightly increased vertical gradients would be utilised for the new DART+ South West tracks.

This option is the most favourable in terms of utility diversions. The sequencing of the buried portal construction would allow utilities to be diverted across the top of the roof slab to temporary and permanent locations as required and with relatively little disruption compared to other options.

Signalling, Telecommunications and Low Voltage cable containments would be moved to new positions. OHLE masts would be installed along the north side of the rail corridor. OHLE equipment would be fitted to the new cut and cover buried portal and to St John's Road Bridge (OBC0A) to allow for continuous electrification through the structures. The existing portal gantries would be removed.

This structure is atypical of the other existing or proposed bridges along the project route but, owing to the physical constraints on the P-Way alignment and Road Level changes above, the same minimum structural clearance for the associated contact wire height has been provided for this proposed new South Circular Road Bridge (OBC1A) as for all the other new road bridge reconstructions along the project route.

This change did not materially affect any of the previously assessed options but resulted in a raising of the track to reduce the impact on adjacent sensitive masonry retaining walls to the south and reduction in pile sizes and/or anchor lengths between Memorial Road and South Circular Road; as well as a reduction in earthworks volumes and associated haulage anticipated during construction.

In light of the above, the Option has been validated, and its design progressed as the Preferred Option.

7.2 Review of Stakeholder Feedback

This project is a railway scheme upgrade and the only road works are as a result of reconstructions or reinstatements specific to the bridges being reconstructed in order to facilitate the widening and electrification of the railway.

Stakeholder feedback concerning the active travel improvements across the junction (which include South Circular, Chapelizod Bypass (Con Colbert Road and St John's Road Wests) are covered by Bus Connects design proposals which have already progressed through its own Public Consultation process.

There exists a potential that portions of the BusConnects proposals be implemented as part of the localised reinstatement works across the junction if this section of the DART+ SW project happens to progress in advance of the Bus Connects Project.

Conversely if the Bus Connects project is advanced earlier then this scheme will reinstate the improvements that BusConnects will have implemented for the junction. Further consultations will take place with respective stakeholders to limit abortive works.

The Preferred Option of the DART+SW project does provide some limited road corridor widening (to the east of South Circular Road) that facilitates additional footpath/cycle lane space; shifting one of the parapet boundary constraints that Bus Connects would have had for its south bound traffic.

Further issues or concerns raised during PC1 are described in the **Public Consultation No. 1 Findings Report, Volume 4.1**.

7.3 Design Development

The minimum 4.4m contact wire height is the standard requirement for electrification. Design has been developed to meet this requirement.

The following sub-sections provide greater clarity on the development of the design towards the preferred option, including:

1. Structures
2. Permanent Way
3. Signalling, Electrical and Telecommunications (SET)
4. Roads
5. Drainage

7.3.1 Structures

7.3.1.1 Bridges

As noted earlier in the report, electrifying the line requires the installation of overhead electrical lines along the railway. The lines pass under existing bridges. In many instances the existing bridges are too low to accommodate the overhead lines at their normal heights and special measures are warranted to facilitate the electrification. In relation to the proposed new South Circular Road Bridge (OBC1A), a total of six (9 No.) Options were initially developed, following the selection process, Option 6 was identified as the Preferred Option for this area. This Option requires the reconstruction a new bridge that facilitates phased construction (Precast slabs supported on piled abutments) to accommodate reinstatement of utilities, and so limit negative impact on road users, as well as accommodate OHLE clearances. The tracks under OBC1 Bridge will have limited negligible lowering but will be reconfigured/realigned through the structure to provide improved inspection safety. While the new electrified slow tracks will pass through the new OBC1A Bridge Structure. See **Figure 7-1** and **Figure 7-2** for a general arrangement of the bridge and the deck longitudinal section.

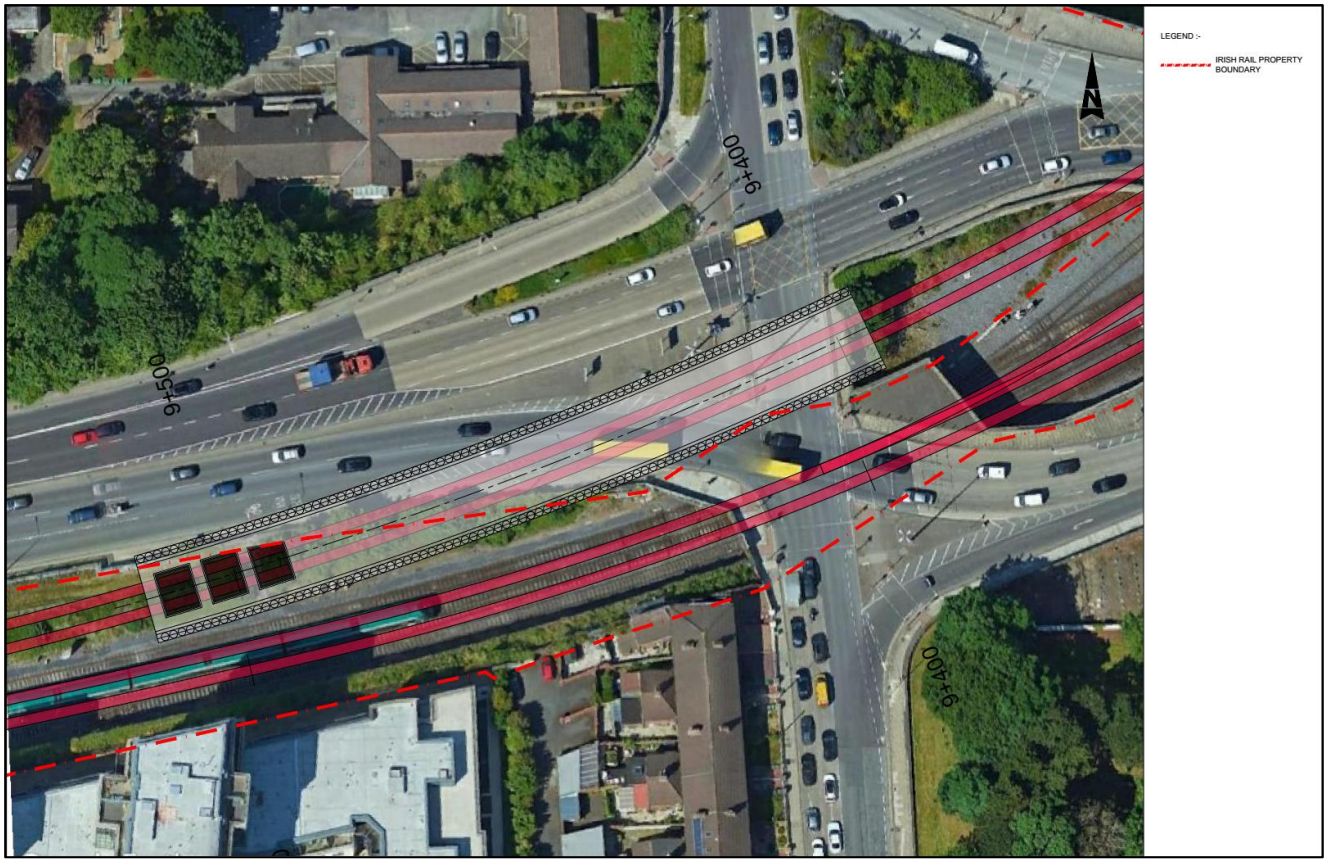


Figure 7-1 South Circular Road Buried Portal Bridge (OBC1A) General Arrangement

Design development has focused on providing a bridge structure that facilitates (as a minimum) the same road corridor width that currently exists over the structure. Summary of the proposed bridge details:

- Proposed Bridge Type = Prestressed roof/deck slabs seated on secant pile walls and anchored back under Chapelizod Bypass (Con Colbert) and South Circular Roads for the eastern 94m (Approx).
    - With the remaining being a combination of prestressed roof/deck slabs seated on piles along the northern side of structure and in-situ concrete abutments constructed over piles to the south
- Proposed Bridge Total Length = 119m (Approx.)
    - Proposed Cut & Cover Buried Portal Section Length = 94m (Approx.)
    - Proposed In-situ Concrete Wall over Piles Section Length (Northern Abutment will be seacant piles to the roof slab as per previous section) = 25m (Approx.)
- Proposed Bridge Width (incl. Parapets) = 13.87m
- Proposed Bridge Slab Depth = 0.5m
- Proposed Parapet = H4A containment walls to the Road Corridor, 1.8m higher than adjacent footpath
- Proposed Utility Space Proofing = Ducts to cross over the top of structure which will have a minimum of 850mm cover to Chapelizod Bypass (Con Colbert Road).

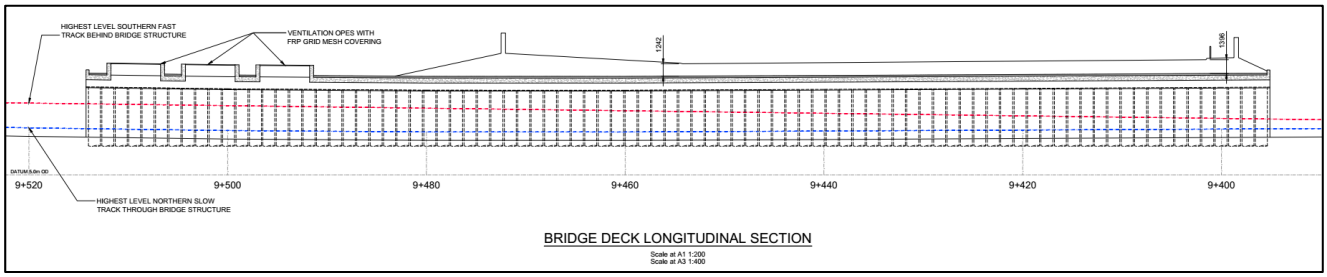


Figure 7-2 New South Circular Road Bridge (OBC1A) Longitudinal Section

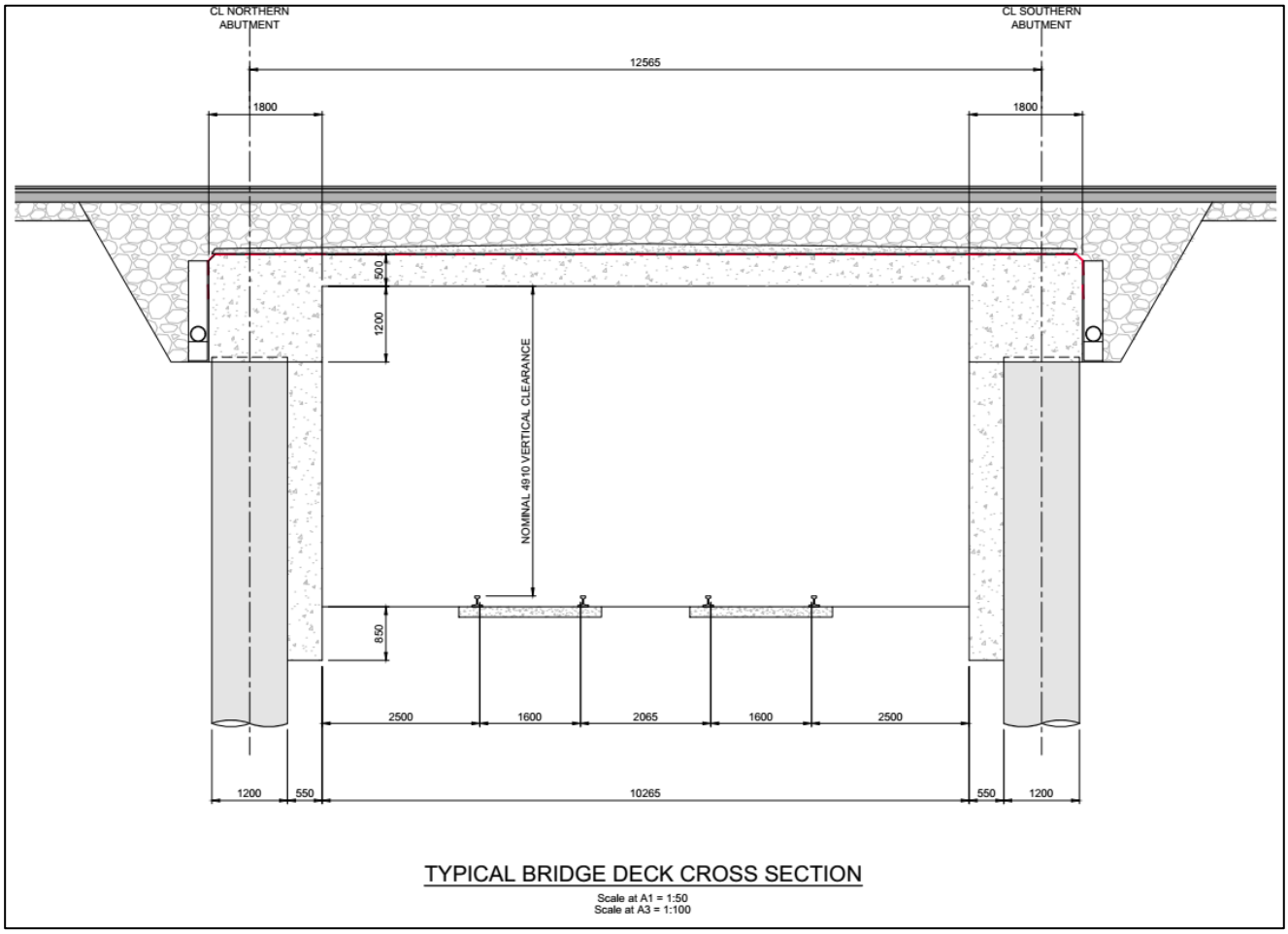


Figure 7-3 New South Circular Road Bridge (OBC1A) Cross Section (Southbound Lane)

There are currently a number of options being evaluated for parapets and approach road containment walls for the new bridges. The main criteria for the parapet is that they achieve an overall height of 1,8m above deck level. The options under consideration include full height precast reinforced concrete parapets, full height steel parapets, and 1200m high RC parapets with perforated or glazed sections to the remaining 600mm to achieve the min height requirement. All parapets will have a H4a containment level. More information on parapets and approach on road containment walls will be available at Railway Order stage.

As the aesthetic is an important factor a number of finishes are being considered for the precast concrete options. These include introducing patterned concrete formers to replicate the existing masonry parapets currently in place, see **Figure 7-4**. There a many different finishes available to use and the panels can be coloured. See below some examples.

Figure 7-4 Parapets and/or H4A containment wall finishes for precast concrete

Other options are to fully clad the precast panels with masonry cladding to match the exiting parapets, see **Figure 7-5**, or to retain and repurpose the existing masonry in the parapets to be used as cladding to the new precast parapets. Other options being considered take into account landscape and visual considerations where a desire has been expressed to retain views of the Dublin mountain skyline from some of the structures.

Figure 7-5 Precast panels fully cladded with masonry

7.3.1.2 Retaining Walls

Retaining Walls are proposed for 2no. functions in the Memorial Road Bridge to South Circular Road section:

- To retain the change in level between slow and fast tracks: This wall retaining wall height (above track cess level) would vary between 1m and 3m along this section. These will be piled walls.
- To retain Chapelizod Bypass (Con Colbert Road): The Chapelizod Bypass (Con Colbert Road) retaining wall height (above track cess level) will vary between 4.5m and 7m along this section and a bored secant pile wall solution will be adopted for this section of retaining wall along the northern perimeter to form the northern (slow) tracks cess edge. The over steepened nature of the existing cutting slopes, proximity of the adjacent Con Colbert Road and height of the cutting slope to be retained, necessitates a piled wall solution with the inclusion of soil nails or ground anchors.

The over steepened nature of the existing cutting slopes, proximity of the adjacent Chapelizod Bypass (Con Colbert Road) and height of the cutting slopes to be retained, necessitates a piled wall solution with the inclusion of soil nails or ground anchors, along the north side of the rail corridor west of Memorial Road Bridge towards South Circular Road Bridge.

To facilitate the widening along the northern perimeters to form the northern (slow) and southern (fast) track cess edges and retain the slopes of the cutting, a bored secant pile wall solution will be adopted for this section of retaining wall. The average retaining wall height of the secant piled wall will be approximately 8.5 m.

To accommodate the proposed widening, track lowering along the northern slow lines will be required. To facilitate the level difference between the northern and southern lines, a retaining wall will be required along the centre of the rail alignment. A bored secant pile wall solution wall will be adopted along this centrally retained section.

An example of a typical section of the wall and finished wall are shown in **Figure 7-6**, **Figure 7-7** and **Figure 7-8**.

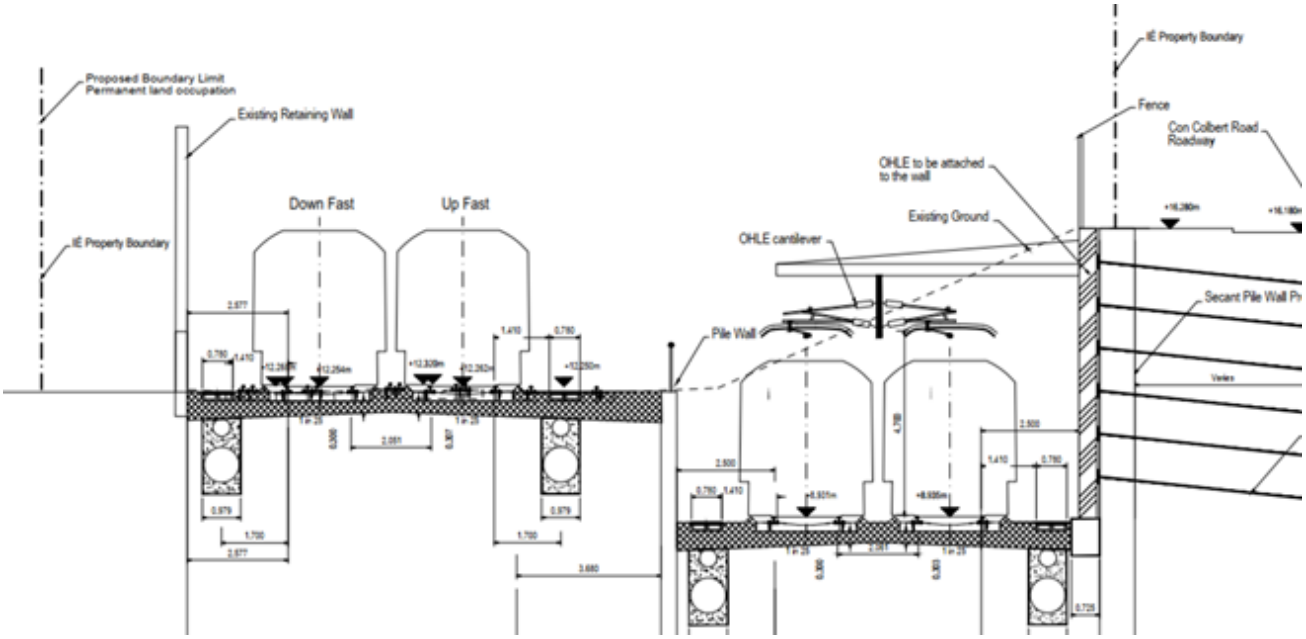


Figure 7-5 Chapelizod Bypass (**Con Colbert Road) Retaining Wall & Ground Anchors – Facing West**

Figure 7-6 Example of a Secant Wall

Figure 7-7 Examples of Retaining Walls

7.3.1.3 Signalling Cantilevers

Where possible, signalling infrastructure will be located within IE existing land; however, in areas where the track encroaches into adjacent land, then consideration will be given to nominal additional land take for signalling structure access. Where space for foundations in the cess is not available, consideration will be given to integrating the signalling cantilevers into the retaining wall structural design locally.

Access to the top of man access cantilevers will be from steps within the cess unless local access from IE land is safer and operationally more efficient.

7.3.1.4 Track Bed Design

A new track bed design is required along this section. Bedrock has been indicated between Kylemore Road Bridge and Sarsfield Road Bridge near elevation 9 m AOD, and to facilitate the track lowering, the new track bed formation shall be constructed consisting of subgrade, sub ballast and ballast.

7.3.2 Permanent Way

The proposed 4-track layout comprises 3 existing tracks realigned on the south side of the corridor plus the addition of 1 new track to the north side, resulting in the electrified Slow tracks (north) and non-electrified Fast tracks (south) layout shown in **Figure 7-9**.

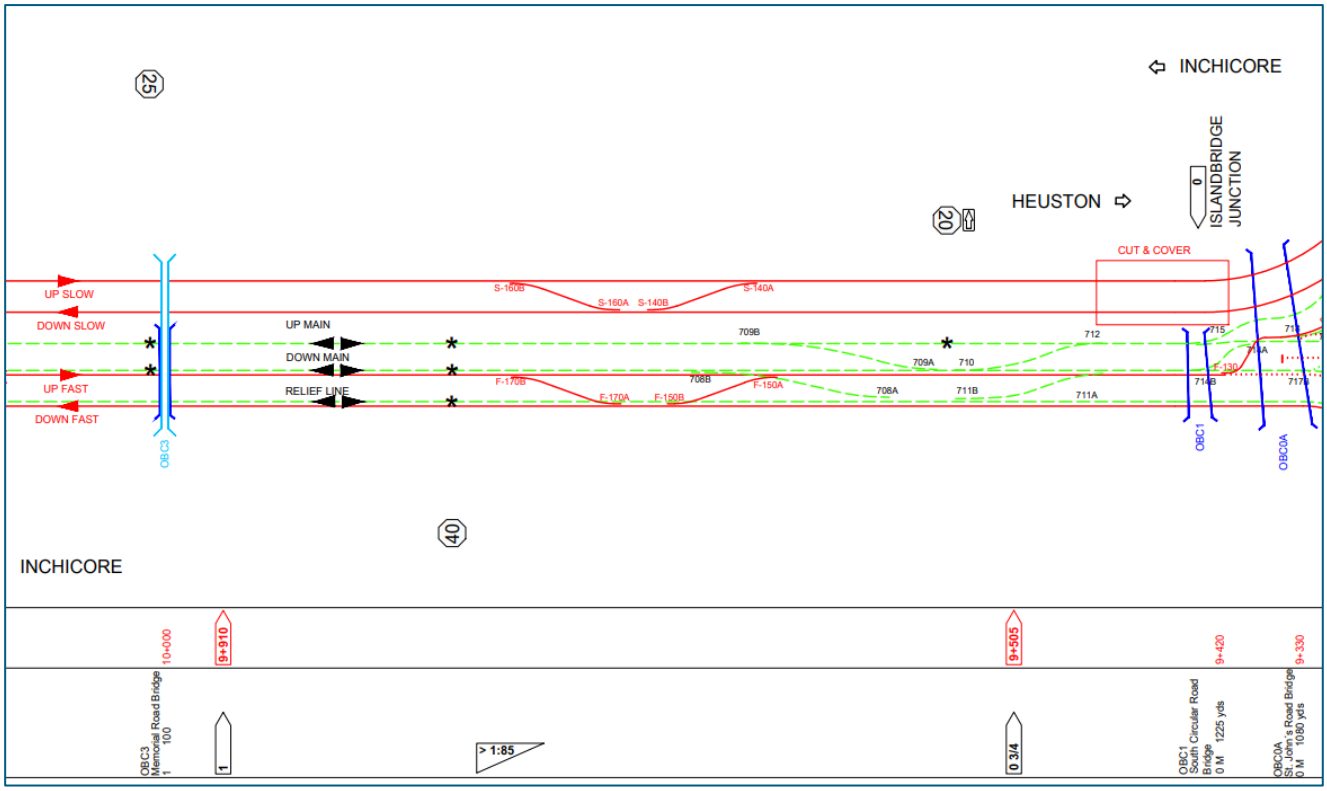


Figure 7-8 Memorial Road Bridge (OBC3) to South Circular Road Bridge (OBC1)– Track Plan Layout

(new tracks = red, removed tracks = dashed green, structures = blue)

The horizontal layout of the tracks is set at a wide interval of 5.400m, greater than the standard 3.58m, to accommodate an intermediate retaining wall due to the level difference between the Slow and Fast lines on the approach to the OBC1A cut and cover structure. The respective pairs of Slow and Fast tracks are straight, parallel and co-planar (at the same level and gradient) through the crossovers that are situated between Memorial Road Bridge (OBC3) and South Circular Road Bridge (OBC1).

Vertically, the Slow lines are on a falling 1.674% (gradient limited by rolling stock traction/braking performance) approaching from the west towards South Circular Road Bridge (OBC1A) cut and cover structure, with track lowers of approximately 2.5m to achieve the headroom required for installing the OHLE in order to achieve the minimum acceptable contact wire height of 4.4m. The Slow lines then rise to meet the existing rail levels at St. John's Road Bridge (OBC0A).

The Fast tracks remain nominally at grade at a gradient of 1.285%, with some track lowering up to a maximum of 200mm.

The line speeds in this section are limited by the constraints imposed on the track geometry by the curvature of the track corridor. The Slow lines achieve 70 mph (110 km/h) on the approach to South Circular Road Bridge (OBC1), before decreasing to 20mph (35 km/h). In similar fashion the Fast lines achieve 75 mph (120 km/h) before decreasing to 25mph (40 km/h). Overall, this offers an improvement on the existing line speeds in this section.

The cross section in **Figure 7-10** illustrates the track layout at the east end of this section.

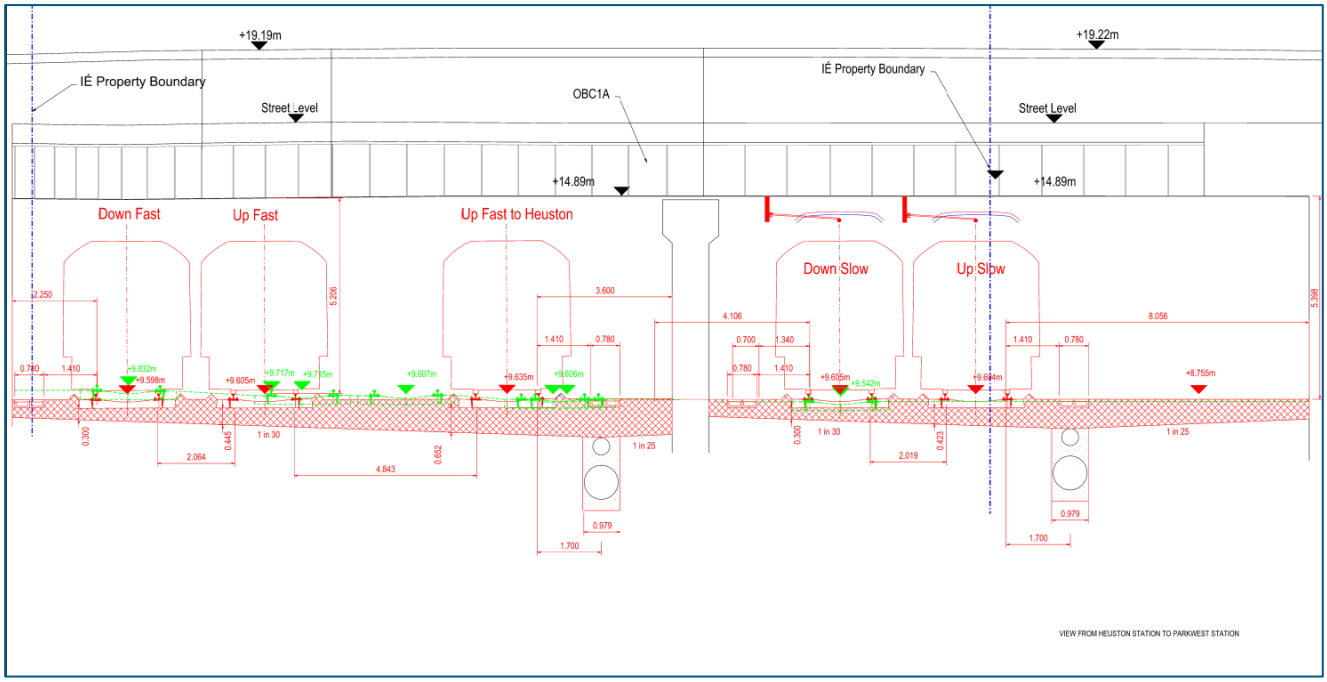


Figure 7-9 St John's Road Bridge (OBC0A) – Cross section at Ch 9+312, view from Heuston Station to Park West Station

A retaining wall is required to facilitate the difference in ground level between the Slow and Fast lines on the easterly approach to the proposed OBC1 cut and cover structure that will accommodate the Slow lines and their associated OHLE equipment. As such, the Slow to Fast line track interval has been increased between OBC3 and OBC1 from the standard 3.58m up to 5.0m – this provides compliant clearances between the face of the structure (the retaining wall) and the running edge of the adjacent line (Slow line on north side of wall, Fast line on south). The cross section of the corridor in **Figure 7-11** illustrates this.

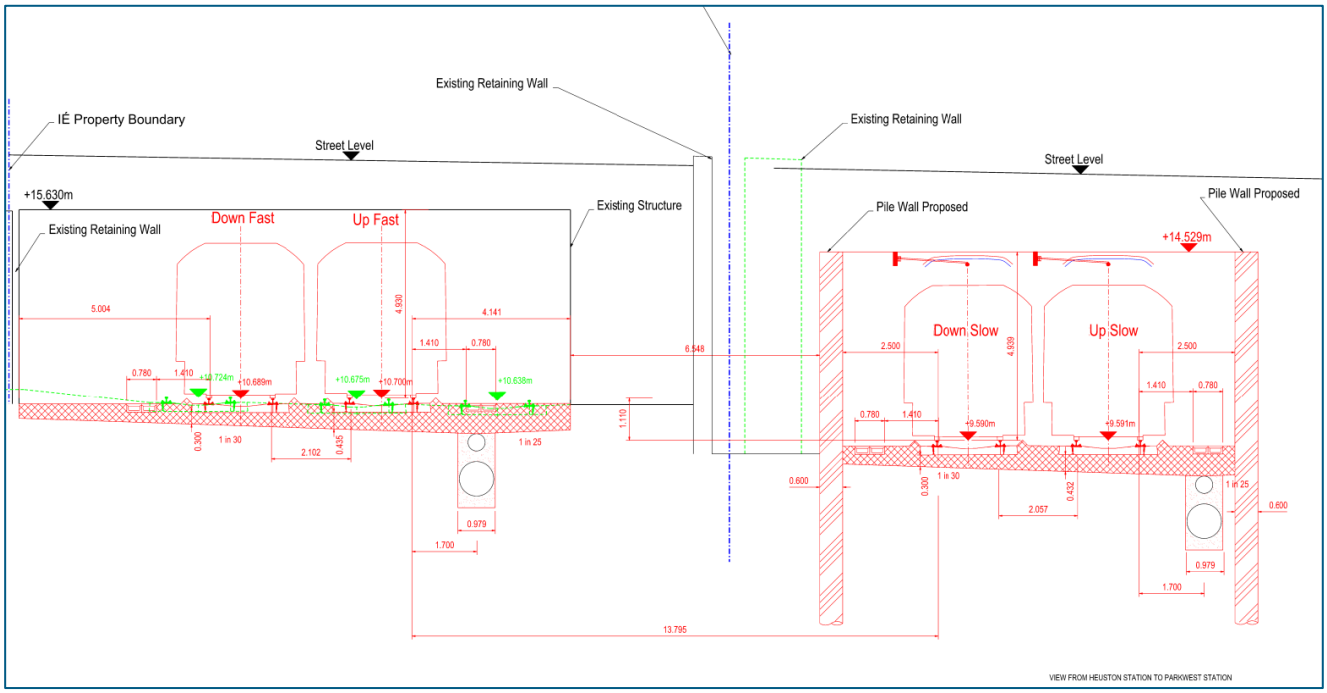


Figure 7-10 South Circular Road Bridge (OBC1) – Cross section at Ch 9+401, view from Heuston Station to Park West & Cherry Orchard Station

7.3.3 Signalling, Electrical and Telecommunications (SET)

This section provides detail on the proposed SET equipment and components which will be distributed along this section of the railway. More information on the typical SET equipment is included in **Volume 2 Option Selection – Technical Report**.

7.3.3.1 Signalling

The signalling system is used to safely control and monitor train movement on the Irish Rail network. The system comprises a network of sensors, controls, signs and lights. It also includes localised control cabinets and cabins.

A Signalling scheme plan has been developed for the entire route, the section pertaining to this area is detailed in **Figure 7-12**. The scheme plan shows the number and type of signals that will be allocated on this section of the route and the points and crossings that they interface with. The following section details the physical signalling infrastructure that will be installed.

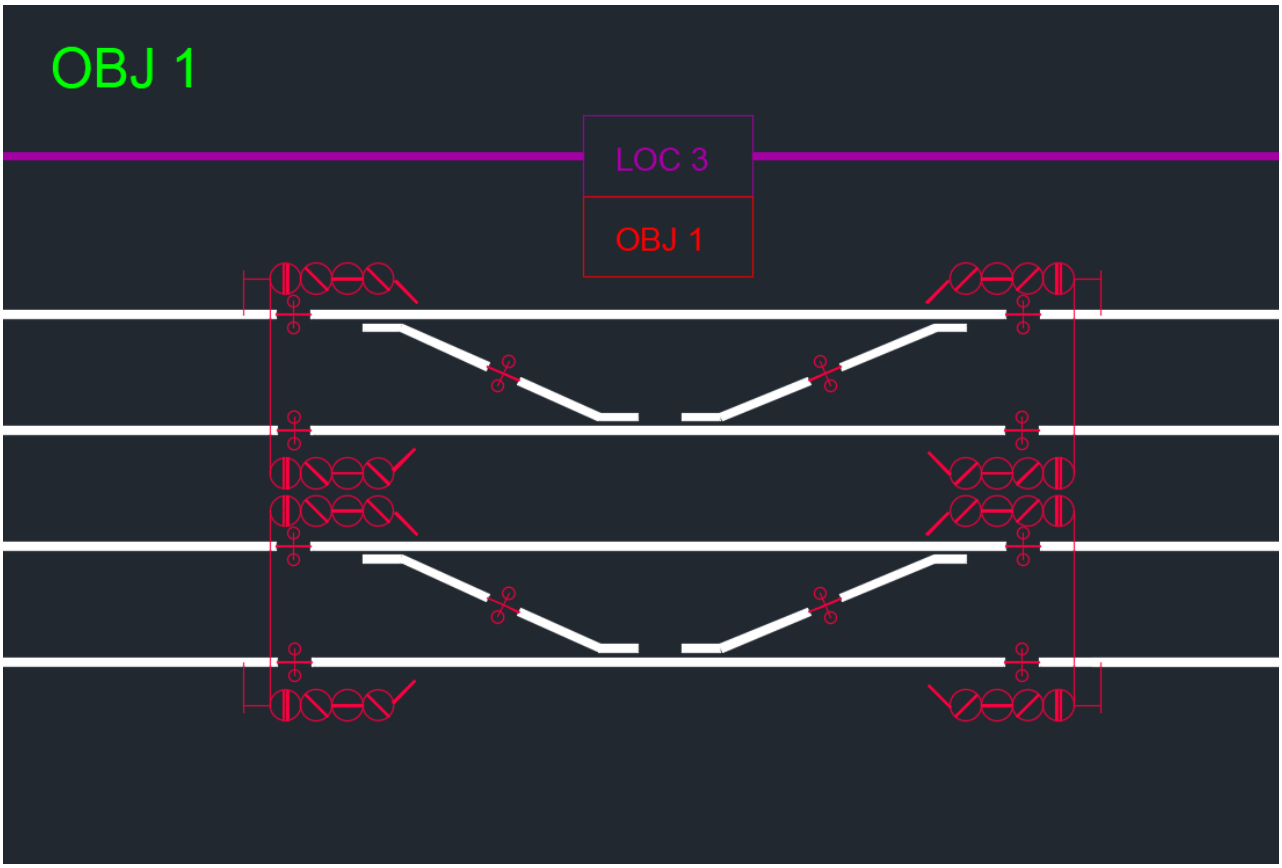


Figure 7-11 Signalling Scheme Plan (Memorial Road – South Circular Road Junction)

Legend:

- Purple line: 650 V line
- Purple square: LV cabinet
- Orange square: OBJ cabinet (signalling)
- Green square: OBJ influence area
- Black lines: Tracks
- Red: Signals

The physical signalling infrastructure has been developed and is indicated in **Figure 7-13**. This figure shows an Object Controller Cabinet (blue box) and two trackside signal gantries. All equipment proposed will be located within the existing IE land boundary to minimise the impact to the public.

Infrastructure highlighted as follows at **Figure 7-13**:

- Blue box – Object Controller Cabinet
- Orange line – Trackside signal gantry

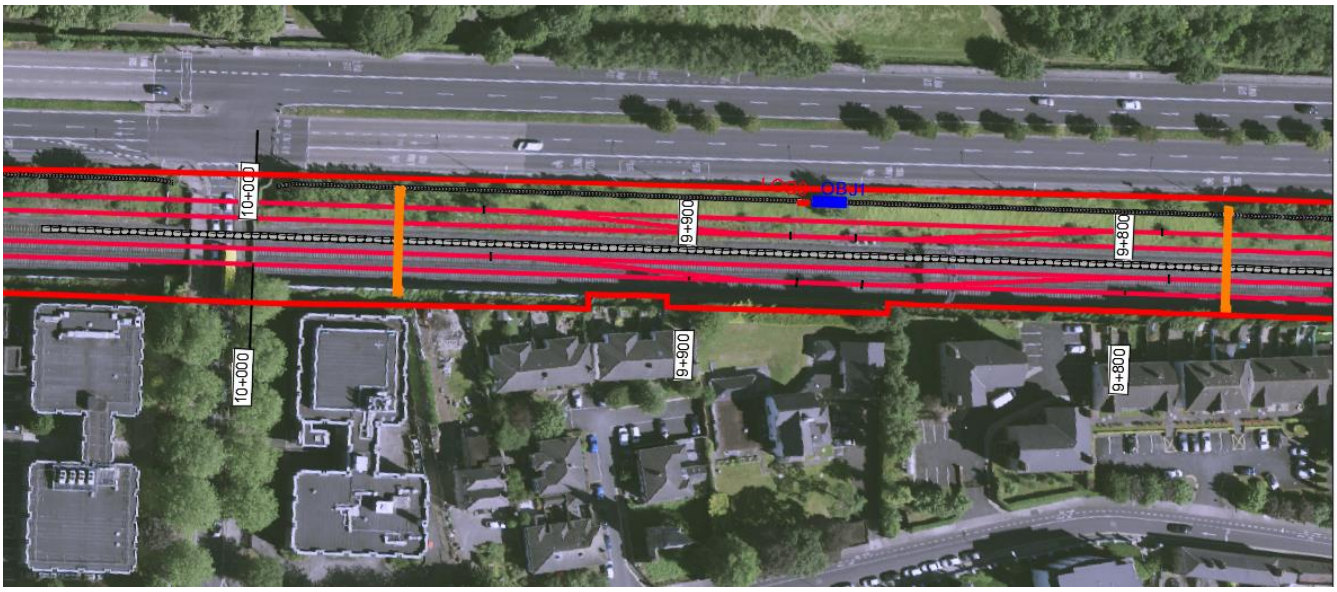


Figure 7-12 Signalling Infrastructure (Memorial Road – South Circular Road Junction)

7.3.3.2 Signalling Post

There are currently no proposed signalling cantilevers or gantries in this section and trackside signals would be located on signal posts adjacent to trackside. A typical signalling post is shown in **Figure 7-14.**

Figure 7-13 Typical Signalling Post

7.3.3.3 Object Controller Cabinet (OBJ)

In the railway system, the movement of the train is controlled by an interlocking system. Such an interlocking system consists of different parts. From a logical perspective, there is a central device (computer) that controls and senses the condition of important equipment such as switches, signals, track circuits, etc. This equipment is collectively referred to as an object or rail side object. The equipment that handles the interface between the central device and the object is referred to as an object controller. A typical Object Controller Cabinet is shown in **Figure 7-15**.

Figure 7-14 Typical Object Controller Cabinet (OBJ) and Location Case

7.3.3.4 Location Case

Location Cases (Locs) accommodate railway signalling equipment to detect the location of trains, control the trackside signals and switch the points. They link the physical asset to the control equipment within. Additionally, they are used to accommodate the required power distribution to the signalling equipment. A typical Location Case is in **Figure 7-15**. There are no Location Cases planned for this section of the route.

7.3.3.5 Cable Containment

A cable containment strategy has been progressed and following review of several alternatives such as traditional concrete troughing and direct burying cable routes and secure anti-slip walkways (see **Figure 7-16**), with ladder rack being used on the tunnel walls. Secure troughing occupies the same footprint as concrete troughing but is of lighter more manageable construction. As this trunking also acts as a designated non-slip walkway it will help to mitigate space constraint issues along the route as well as minimise the aesthetic impact to the public. It also has the added advantage that it provides security of cabling from theft and damage as well as providing easy maintenance going forward.

Figure 7-15 Containment walkway

The cable containment route will run adjacent to the track in accordance with standard railway practice and will cross under the track where required using under track crossings (UTX) and secure turning chamber. Type of containment at each stage of the track will be shown at the permanent way cross section drawings. See **Appendix C Drawings**.

7.3.3.6 Telecommunications

According to the current design, no Telecom Equipment Building (TER) is required for this area.

7.3.3.7 Electrification

Open route

The electrification equipment, in 4 track area between Memorial Road and South Circular Road Junction, will be supported by TTC structures and STC structures where the OHLE to be terminated with anchor arrangement required in limited space, as detailed in **Section 3.2.1 Electrification System**. In areas with there is retaining wall on the north side of the line or limited boundary, the distance between the running rail to the OHLE mast can be reduced if required.

Bridges

St. John's Road Bridge (OBC0A) has sufficient vertical clearance such that it can be electrified under all Options (using fitted solutions) without any track lowering or major structural interventions. However, its proximity to South Circular Road Bridge (OBC1A) is such that the two bridges have been considered together when defining the OHLE solution for each Option.

South Circular Road Bridge (OBC1A) will be designed to provide a soffit height of 4.91m. In this configuration the OHLE will be graded down with a minimum contact wire height of 4.4m through the bridge under all conditions. OHLE through the bridge will be fitted, with elastic bridge arms supported from the bridge at multiple locations in the middle of the bridge due to its length. Electrical clearance from the live OHLE to the bridge will be 100mm static and 80mm dynamic. These connections would not be visible from road level. Typically, OHLE masts would be positioned between 20m and 40m on each side of the bridge before reverting to normal spacings. The contact wire will be graded up. **Figure 7-18** shows an example of a cross section for fitted OHLE system in the four tracking area.

Due to the width of the St John's Road Bridge (OBC0A), the OHLE would be connected to the bridge at multiple locations to counteract sagging. The contact wire would be graded upwards from 4.4m to nominal wire height towards the east side of the bridge. This would assist with achieving minimum separation distances at Heuston

Station. The system height under the bridge would be increased where possible to minimise the use of elastic bridge arms. The support and registration through the bridge are likely to comprise of small system height cantilevers supported from the bridge deck or abutment.

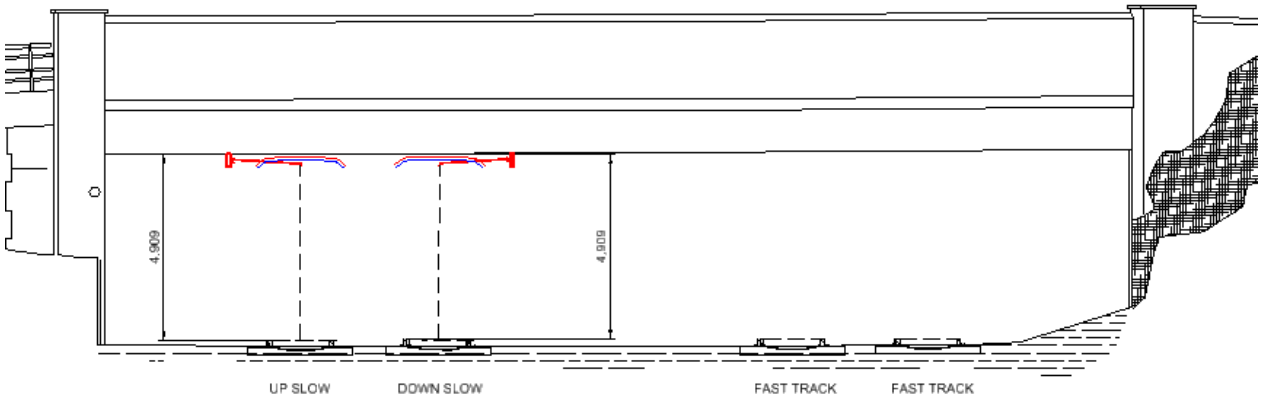


Figure 7-16 Example cross section for fitted OHLE system in four tracking area – Facing East

7.3.4 Roads

As part of PC1 it was anticipated that low point along the westbound kerb over the proposed structure would need to be raised 300mm (Approx.) with surface overlays and central median crossfall steepening. This section of median between the north and westbound in not pedestrianised and as such would not be impacted and would be similar in nature to the median island east of St John's Road Bridge (OBC0A). After receipt of a revised topographical survey and further alignment design proposal has resulted in shifting the low point off the structure without extensive extending of road works to the west of the previously identified area impacted at PC1.

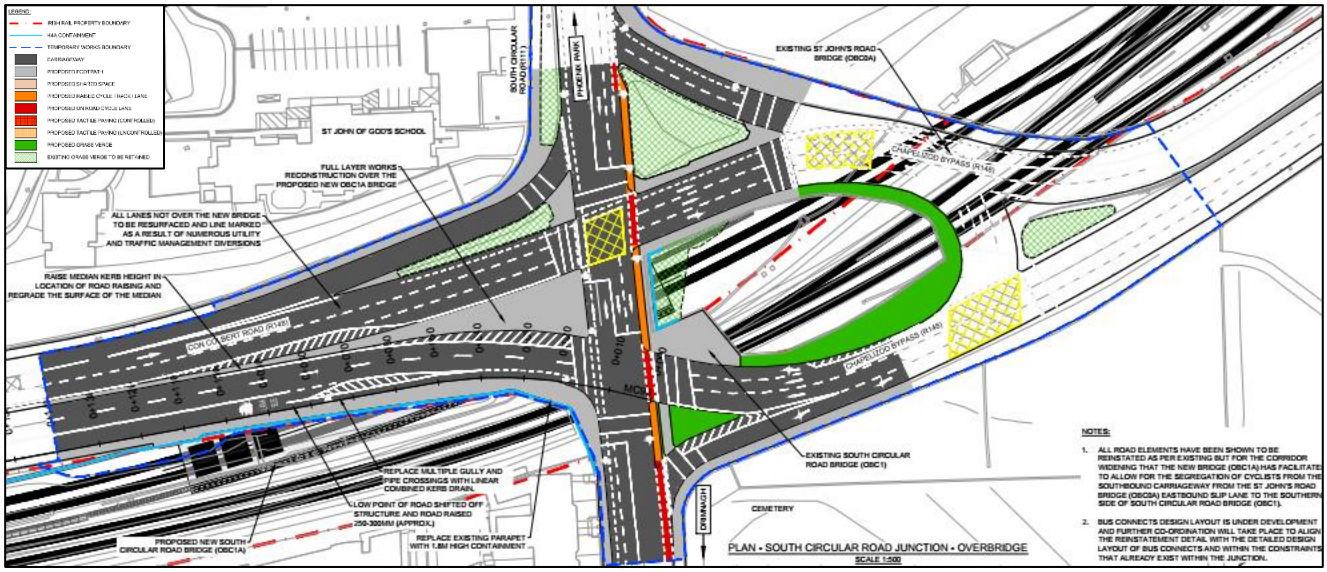


Figure 7-17 South Circular Road (OBC1A) Plan

Proposals for the BusConnects - Lucan to City Centre Route – PC3, include entire reconfiguration of vehicular and vulnerable user routes through South Circular Road Junction (Including South Circular Road Bridge (OBC1) and St John's Road Bridge (OBC0A) which includes reconstruction of existing fishtail medians as well as the removal segregated slip lines into South Circular Road. (See **Figure 7-19**).

The Bus Connects proposal considered the existing parapet walls as the constraints on their design proposals. A nominal extension has been added to the east of the proposed new South Circular Road Bridge (OBC1A) that provides a space 4m wide from the east of the existing eastern South Circular Road kerbline. This additional space would facilitate the segregation of southbound cycle traffic from vehicular traffic without impacting the vehicular lane widths across the junction by providing a 2m cycle track and 2m footpath.

The existing southbound cycle lane currently shares the same space as a vehicular lane

Should the Bus-Connects Scheme Lucan Scheme works be implemented before DART + SW then it will be reinstated accordingly. The co-operation between all appropriate stakeholders will continue to refine and align the implementation interfaces of the 2No. Projects; with potential for the scope local to the junction being incorporated into tender package of the DART+ SW, to limit the potential for abortive works.

In the interim the DART+ South West roads layout drawings for PC2 only indicate a reinstatement of the existing lane configurations. However, this is only because the Bus Connects scheme layout is still under development. The extent of reinstatement works would include reinstating the status quo and covers also the entire area impacted by the complex temporary traffic management required for the phased construction of the proposed new South Circular Road Bridge (OBC1A) structure.

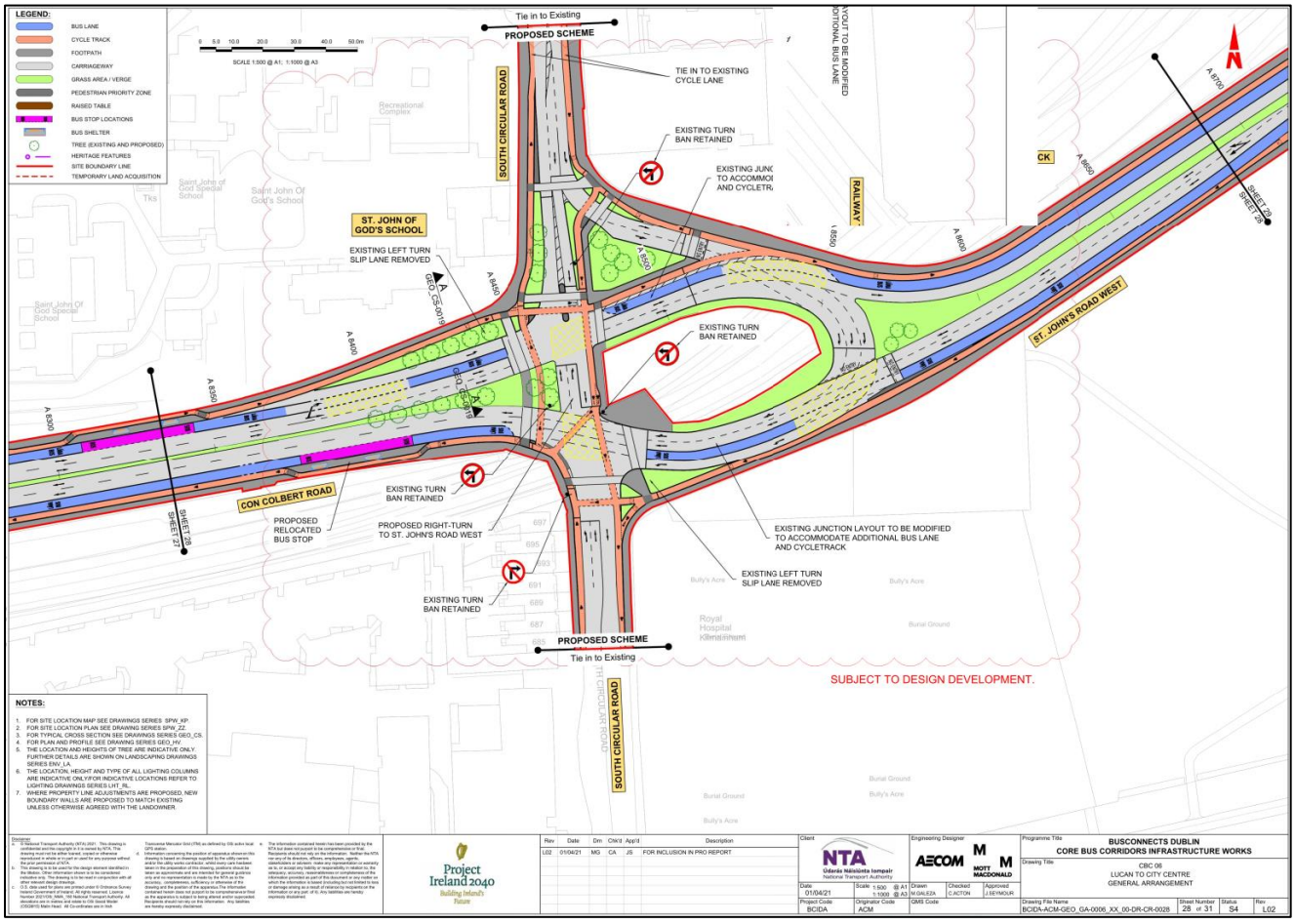


Figure 7-18 Bus Connects' Lucan Scheme Proposal at South Circular Road

7.3.5 Drainage Requirements

7.3.5.1 Road Drainage

The road drainage would only be reinstated where vertical geometry is changed or where existing system is removed. Additional gullies would however be provided to account for the change in kerb edge geometry. All low points would typically be reinstated with a double gulley configuration to provide a level of mitigation against the potential for blockages. Where feasible gullies would be located on the high ends of the bell mouth entry point at junctions to avoid and/or in advance of pedestrian crossings to avoid the potential build-up of water at pedestrian crossing points.

There are multiple gullies along the southern kerb line of the westbound carriageway of Chapelizod Bypass (Con Colbert Road) west of South Circular Road, in the area over the proposed new structure. It is proposed to replace the gullies with linear combined kerb drains and reduce the number of road crossings requiring future maintenance and reinstatement. These shallower drains are used throughout the Greater Dublin Region and by TII on its latest schemes. The kerb line gradient is already relatively flat and while the road reinstatement will only nominally improve this, hence the recommendation for the liner combined kerb drain to avoid ponding on this main arterial road.

As part of the reinstatement design there are no additional contributary areas being added to the road drainage network. In addition, proposed reinstatement will not alter the primary surface drainage paths.

7.3.5.2 Track Drainage

The proposed track drainage system includes filter drains to collect runoff waters from the ballast and surrounding areas, and carrier pipes to convey collected runoffs to the proposed attenuation structure and discharge point, located at Liffey River. The proposed filter drains discharge into the collector pipes through manholes, which are to be spaced between 30 to 50 metres.

The drainage network for this track section consists of two main branches running parallel to the track beneath the ballast layer. No track drainage attenuation structures are proposed in this section between Memorial Road to South Circular Road Junction; as the retention tank and outfall point for the network draining this track length are located In Irish Rail Land between the proposed Heuston West Station and the Islandbridge – Clancy Barracks Development.

8. Construction

This section of the report sets out the approach in relation to the construction methodology for the works in the area between Memorial Road Bridge (OBC3) and St John's Road Bridge (OBC0A).

The section of the railway corridor between Park West Station and Heuston Station must be widened to accommodate the additional 1No. track for the new DART+ service. The cross section varies through this area but is predominantly in cutting, with property boundaries close to the top of the cut slopes. The widening operation is further complicated by the need to lower the slow tracks through much of the 4-tracking area so that roads that cross the corridor on bridges are not raised too much (creating significant impact on local properties and road infrastructure); this is particularly relevant to this section, as it is linked to the adjacent section to its east (the approach to the South Circular Road Buried Portal (OBC1A).

8.1 Retaining Structures

To achieve the widened cross section, to limit the impact of the construction works on Chapelizod Bypass (Con Colbert Road), it is proposed to construct retaining walls along the northern corridor boundary where there will be a level difference between the proposed tracks and the adjacent land (Chapelizod Bypass / Con Colbert Road Corridor).

Several different wall types and /or earth retaining methodologies are proposed across the project depending on the height of the retained soil, the soil conditions and the proximity of buildings to the corridor. Refer to **Section 7.3.1 Structures** for typical examples of the types referred to below.

8.1.1 Secant piled walls and contiguous bored piled walls

Secant and contiguous bored piled walls are constructed using a top down method, i.e. they are constructed through the soil and then the soil in front of the walls is removed. Large piling rigs are required to core large diameter holes through the soil using augers through soil and corers through rock. Once the soil is removed a reinforcement cage is lowered into the holes and concrete is poured. New piles are added to the side of the first to create a wall. Secant pile walls have continuous piles interconnected with each other and contiguous piles have gaps between the piles and are infilled between to create continuous support.

The boring of the piles, the removal of spoil, the supply of reinforcement cages and concrete to and from the wall position is a significant operation requiring large piling equipment, cranes, dump trucks, and large concrete and rebar supply and dump vehicles. These operations require good access and egress, a stable operational platform and significant working space.

8.1.2 Large cantilever walls constructed using trench shields

Large Cantilever retaining walls can be constructed using trench shields using the following methodology. The working area is first prepared so that a min 3m bench is cut into the side slope. To achieve this on the existing slope, small temporary sheet piles are pushed into position to create a temporary retaining wall on the upslope of the bench. The trench shields are then excavated into the ground using excavators from the top. A reinforced concrete base and wall is then poured. For long term slope stability, the cantilever wall will require an additional toe to be added to the wall once the trench shield and remaining soil in the front of the wall is removed.

8.1.3 Soil Nailing

Soil nailing is a top down walling method. From the top, soil is excavated over a short height. The surface of the excavation is spray concreted with steel mesh placed in position. When the concrete has cured sufficiently, long steel rods are driven into the retained soil and stressed to give the wall global stability and strength. The area beneath the constructed section of wall can then be excavated and the process repeated until the entire height is complete.

The main advantage of soil nailing is that relative to other options it has less impact on the properties in terms of noise and disruption. It also does not need so much large plant to install the wall and is therefore considered safer to the railway operation.

The main disadvantage of this method is that vertical walls cannot generally be created so more land take is required to form the wall. Also, the nails are required to extend several metres past the face of the wall and may encroach into property outside of the ownership of Irish Rail. In this case a wayleave or other ownership mechanism may be required under certain properties.

8.1.4 Embankments and Retaining Walls Design

It is proposed that a bored secant pile wall solution will be adopted for the section of retaining wall along the northern perimeter to form the northern (slow) tracks cess edge. The retaining wall will be approximately 4.5 to 7 m in height and will be constructed utilising access from track side within Irish Rail lands.

The over steepened nature of the existing cutting slopes, proximity of the adjacent Chapelizod Bypass (Con Colbert Road) and height of the cutting slope to be retained, necessitates a piled wall solution with the inclusion of soil nails or ground anchors.

To minimise the pile size and associated lateral movement of the upper portion of the walls and to maintain the integrity of the infrastructure beyond the crest of the retained slope along Chapelizod Bypass (Con Colbert Road), the retaining wall along this section shall be anchored using soil nails extending into the existing slope substratum beneath Chapelizod Bypass (Con Colbert Road). The length of the soil nails/ground anchors will vary based on the height of the cutting slope to be retained and are anticipated to be approximately 15 to 20m in length.

The soil nails/ground anchors will be installed utilising access from track side within Irish Rail lands

8.2 Bridges

For the proposed new South Circular Road Cut and Cover Buried Portal (OBC1A) it is intended pile the northern and southern abutments, with a 60m (approx.) section to the east of the southern abutment requiring the final 1-1.5m to be constructed traditionally with RC concrete in formwork.

Once a significant portion of a section's abutments are completed and assure then precast decking slabs will be installed. This is done in order to facilitate a faster reconstruction of the affected portions of South Circular Road and Chapelizod Bypass (Con Colbert Road) and so reduce the impact of the temporary traffic diversions on this busy junction. It is proposed to then excavate the existing ground under the South Circular Road section that would have been encapsulated by the constructed portal. This proposed methodology is intended to allow for completion the road works over the structure and switching between the phased diversions.

The cut and cover structure option shall be constructed on a phased basis in order to facilitate temporary and permanent utility diversions, among other reasons for different disciplines in the project. Hence, the location and timing of phase 1 and 2 of the cut and cover structure define new constraints for utilities. Diversions required have been designed in tandem with each phase to maintain vital services where possible and to minimise outage durations for utilities affected by the project.

This construct phasing will be facilitated by 2No. main traffic management diversions. These phased diversions would require a number of temporary utility diversions to be completed in advance of the phasing (see **Section 8-6 Temporary Traffic Management** for temporary traffic management phasing plans).

8.3 Permanent Way

Track lowering will be required through this area to facilitate the provision of four tracking and electrification. Works will comprise:

- Diversion or closure of the operational track, utilities and ancillary infrastructure
- Where excavations are significant, support of adjacent operational track
- Excavation of track bed
- Excavation of sub strata
- Replacement of utilities and ancillary infrastructure
- Construction of new track bed
- Construction of new cut and cover structure OBC1A

Between Memorial Bridge and Heuston West, a retaining wall separating the existing tracks and the new DART tracks will be required. Due to the proximity of this wall to the existing track, it is probable that a number of staging phases may be required to facilitate construction. Alternatively, the supporting wall will need to be constructed during night-time possessions

8.4 OHLE Infrastructure

Structures will be required at a maximum spacing of 60m along the track to support the catenary cables. The support structures are generally supported from one side of the track (cantilever) or from both sides (portal) depending on the permanent way layout. Where there are adjacent walls the support structure can be fixed to the walls negating the need for vertical supports (stanchions).

Support structures will be either founded by means of piles or spread foundations, depending on soil conditions or the contractor's preferred methodology.

It is envisaged that the OHLE will typically be constructed in safe zones adjacent to the live railway or in night-time possessions. As there will be predominantly 2 working railway tracks through the Cork line and ultimately 4 tracks will be provided, it is envisaged that a safe zone will be possible for construction works. For the majority of the section between the Sarsfield Road Bridge (UBC4) and St John's Road Bridge (OBC0A) the OHLE will be installed unhindered and without imposition on existing track operations as the proposed new slow tracks are substantially segregated from existing and proposed new fast tracks in this area.

8.5 Construction Compounds

Works on this linear scheme will require Construction Compounds at specific locations. The sites will need to accommodate offices for the contractor and client teams, storage facilities, recycling facilities, parking for cars and plant and potentially fabrication areas. It is a prerequisite that the compounds are located close to and ideally with direct access to the site. The sites must be fully serviced with electricity, water, sewerage and telecoms and must have good access to the public road.

The compounds are required at specific construction sub-sites and also distributed along the scheme by geographical features. For example, compounds will be required at each of the bridge reconstruction locations plus will be required to for material processing and storage of construction components. The compounds will be

used to support earthworks, ecological clearances, enabling works, site clearance, utility diversions work, civil works, the demolition of bridges, OHLE, track installation, signalling and telecoms equipment and all ancillary works.

Fencing and in some cases screening along with topsoil bunds where topsoil has been removed may be required for each construction compound. Noise screening and temporary guide rail fencing may be required at access locations to the railway corridor. Security fencing will be required for security purposes of both the workforce and the public. Gated access to the site and compounds will be required to check vehicles and personnel arriving on site are permitted to gain access. An access road will also be required from each compound to the site and also joining up to the public road. These access roads will be the main route for vehicles entering the site, including deliveries and arrival and departure of the workforce.

The construction compounds will be located such that they require minimal modification, if any, over the duration of the construction programme. The compounds will typically consist of areas of hardstanding for vehicles and materials and therefore the water runoff will be managed and treated as required.

A number of potential geographic locations have been identified as construction compounds along the route to support the project construction; one of them has been identified at the following location:

- South Circular Rd/ Chapelizod Bypass (Con Colbert Rd)

Section 5 Options outlines the preferred locations for the construction compounds required for this area; **Section 6 Options Selection Process** provides a detail of the option selection methodology. **Figure 8-1** illustrates the preferred option indicative site layout for this construction compound.

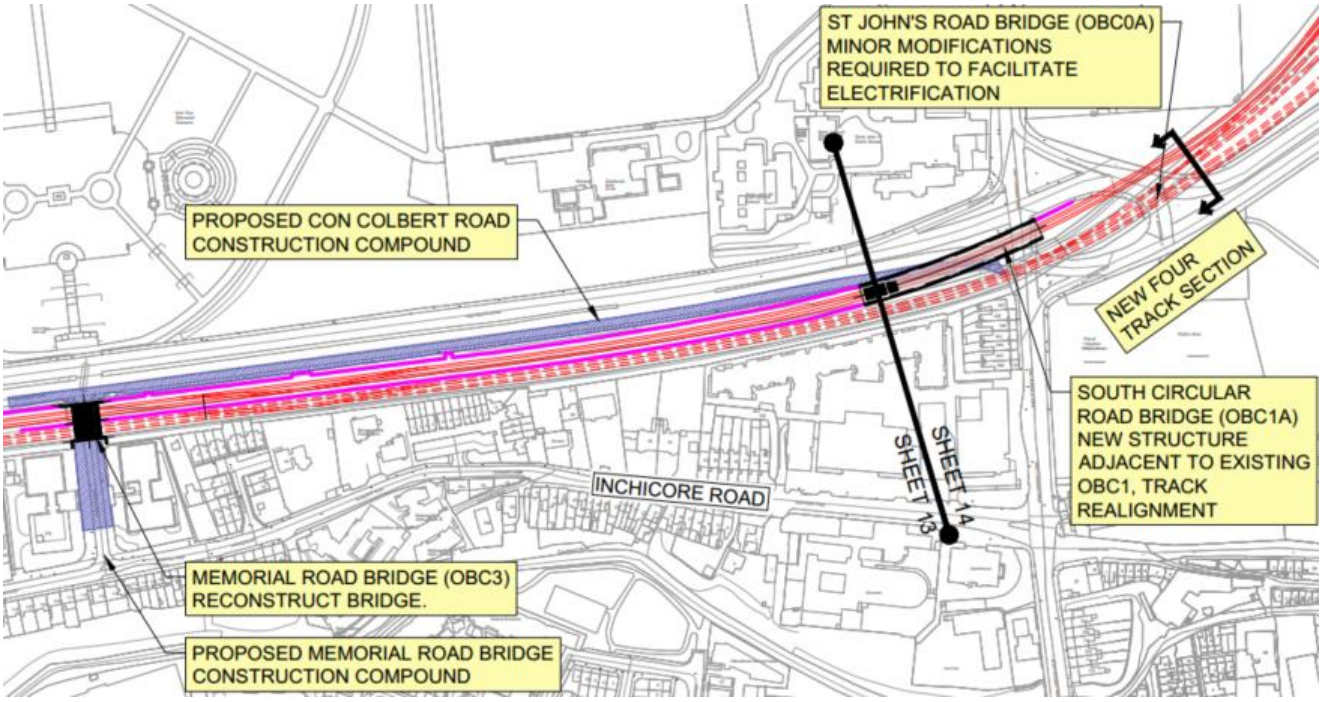


Figure 8-1 Proposed South Circular Rd/Con Colbert Rd construction compound location

The section between Memorial Road and South Circular Road is generally geographically constrained, with options limited for materials handling and welfare facilities. Large sections of the westbound bus lane will require closure to facilitate access and egress to construction compounds as well as the works itself. Shorter sections have the potential to pose a greater hazard.

8.6 Temporary Traffic Management

The construction of the South Circular Road Cut and Cover Buried Portal (OBC1A) requires a minimum of 2 no. no significant traffic management diversion layouts, amongst numerous shorter duration localised diversions, to facilitate temporary utility diversions in advance of these traffic management Phases. The two major temporary traffic management layouts are shown in **Figure 8-2** and **Figure 8-3**.

The layouts are primarily driven by the constraints of the existing traffic volumes passing through each arm of the junction but also considers the location of a number of key utilities that currently do not currently have dual redundancy or network loops that would allow for near uninterrupted supply to the end users for their respective utility (Gas, numerous ESB-HV and numerous Telecommunications). The morning and evening peak hour traffic volumes are shown in **Figure 8-4** and **Figure 8-5**.

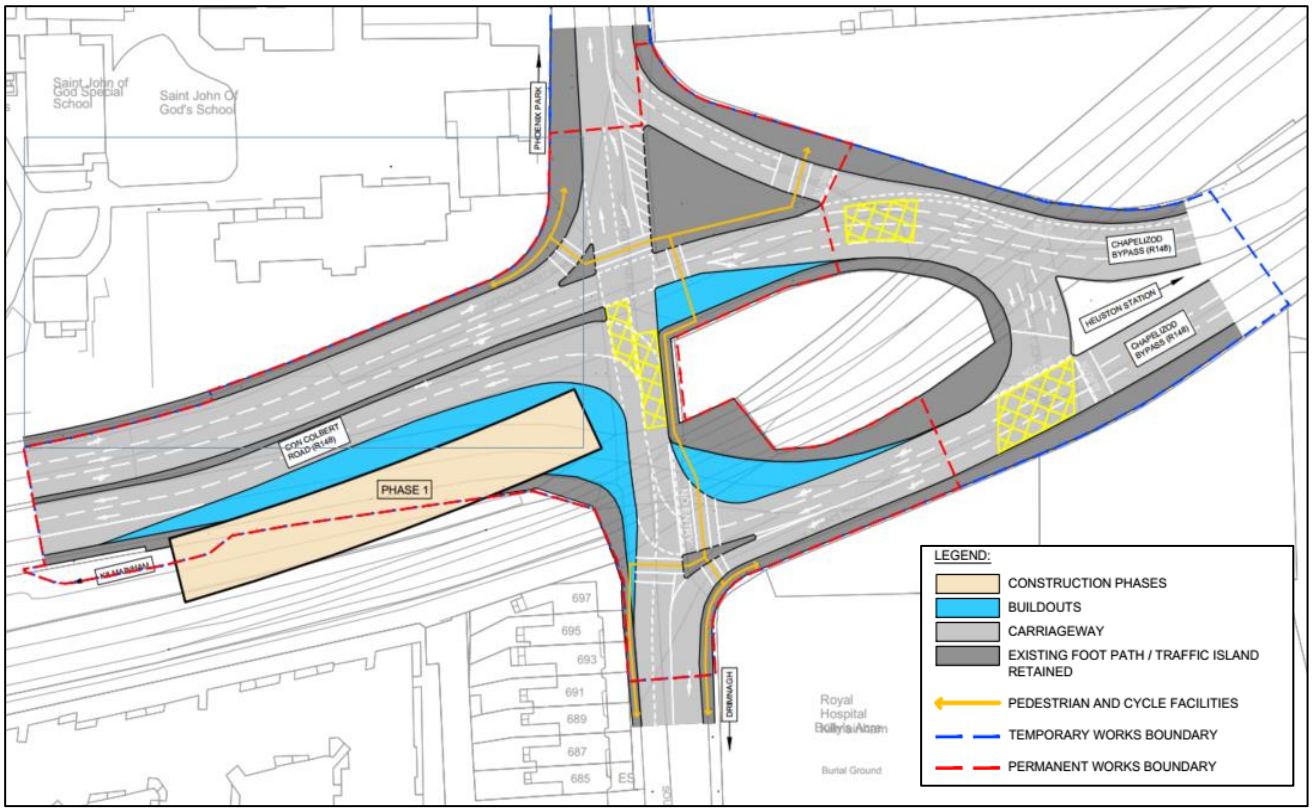


Figure 8-2 - Proposed Temporary Traffic Management Measures - Phase 1

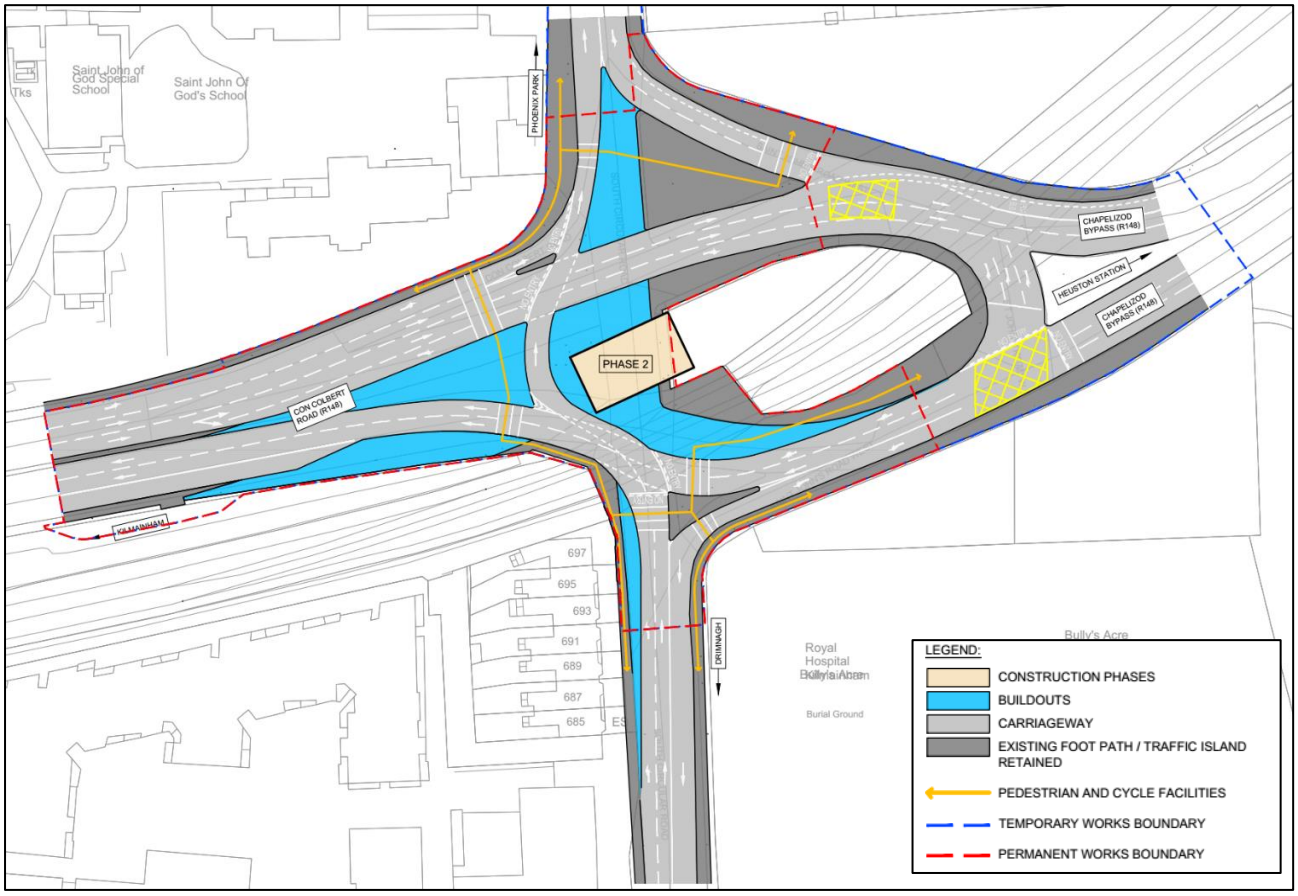


Figure 8-3 - Proposed Temporary Traffic Management Measures - Phase 2

Row Labels	Sum of TOT
AB	63
AC	685
AD	76
BA	16
BC	51
BD	593
CA	293
CB	0
CD	206
DA	421
DB	992
DC	484
Grand Total	**3880**

Figure 8-4 - Morning Peak Hour Volumes (08h15 - 09h15)

Row Labels	Sum of TOT
AB	25
AC	329
AD	104
BA	72
BC	161
BD	1106
CA	314
CB	0
CD	209
DA	391
DB	497
DC	247
Grand Total	**3455**

Figure 8-5 - Evening Peak Hour Volumes (16h45 - 17h45)

8.6.1 Private and Commercial Users

No restrictions are anticipated for private and commercial road users. The phased approach is anticipated to result in additional congestion, but it is not expected to be significant.

8.6.2 Vulnerable Users (Pedestrians, Wheelchair users and Cyclists)

Vulnerable Users are not restricted from passing through South Circular Road Junction during the construction of the Cut and Cover Buried Portal (OBC1A). They are proposed to be accommodated in local diversions for safety.

While currently there are some that would walk the length of Con Colbert Road using the southern footpath; during the construction of this section of track and the structure, the southern footpath will be closed and they will need to choose one of the 2No. alternatives proposed below.

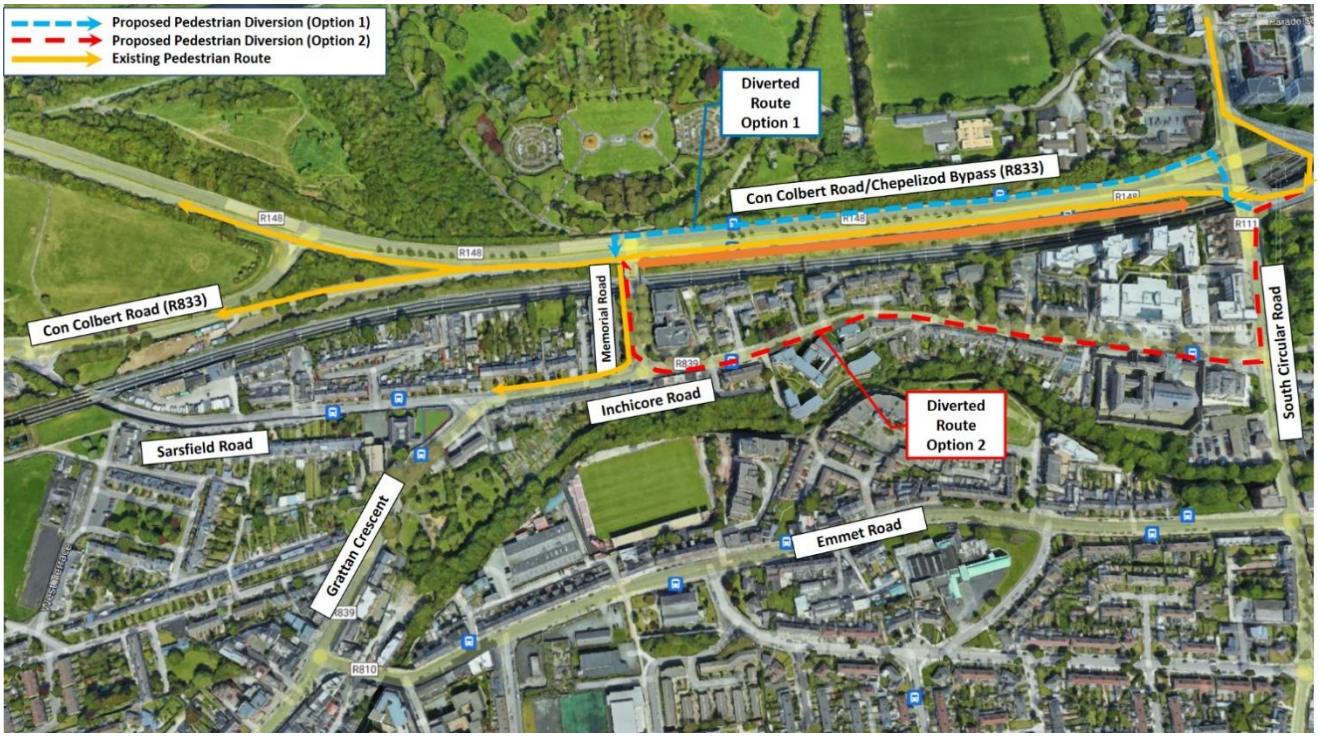


Figure 8-6 Proposed Pedestrian Diversion Routes (Westbound)

8.6.3 Public Transport

To construct the section of northern track cess retaining wall between the western face of the proposed new buried portal (OBC1A) and Memorial Road Bridge (OBC3) will required the closure of the entire bus lane over this section for a large duration of the construction period associated with this section of project. It would be considered safer to do so than to have multiple point of weaving in and out of the adjacent lane (the middle of 3No Lanes available over this section of the project). This lane will be used as dedicated local haul route for the large volume of trucks anticipated to receive the track construction excavated material and for the delivery of certain materials. While the piling works is anticipated from the track side of the road rail corridor boundary and as such would not be anticipated to impede traffic.

The Dublin Bus Routes that would be affected by the temporary closure of the bus lane are:

- Chapelizod Bypass, stop (2721) serving the 25A, 25B, 25D, 25X, 66X, 79A, 67X, 51D & 860,
- Memorial Gardens, stop (7012) serving the 25A, 25B, 25D, 25X, 66X, 79A, 67X, 51D, 845 & 847

Subject to the further confirmation of the peak boarding and alighting times for the various services, one proposal would be to divert a portion of the routes' westbound buses via South Circular Road to the Inchicore Road, stop (2640) adjacent to Kilmainham Goal (opposite the Hilton Hotel) this could then proceed to Memorial Road and across the bridge to re-join its old route. In this case the Camac Court, stop (2641) would replace the Memorial Gardens stop (7012). The proposed diversion is shown in **Figure 8-7**.

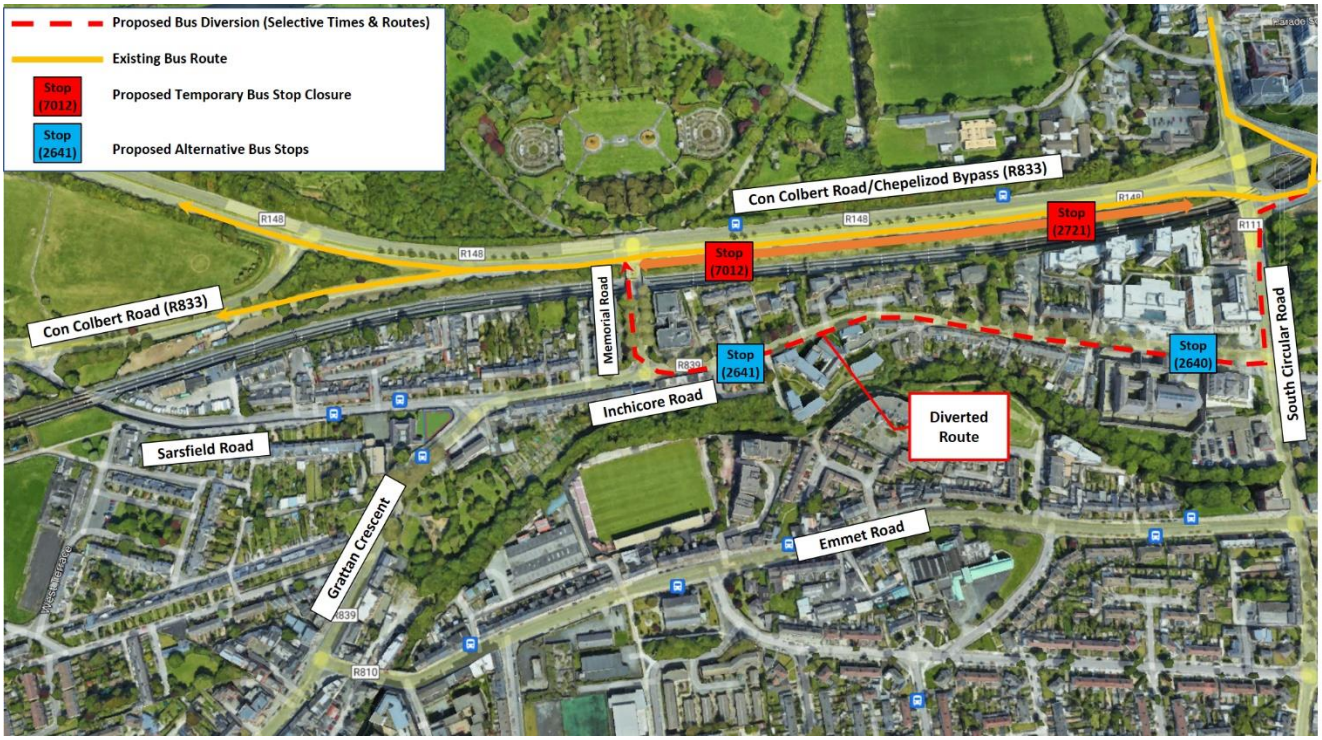


Figure 8-7 Proposed Bus Route Diversion via South Circular and Inchicore Roads

8.7 Restrictions

There are restrictions associated with working on or adjacent to the live railway line. Irish Rail will mandate a safe system of work which will invariably include barriers between the live tracks and the working area or full possession of the railway (no trains running).

Where feasible materials delivery times will be limited to outside peak traffic hours; particularly for construction HGV's known to restrict natural flow of traffic. In addition where possible long duration night works will be limited in residential areas unless appropriate noise mitigation can be provided.

A full methodology of the setup and construction methods will need to be sympathetic to both the railway operations, as well as local residents and/or employers in the area. The methodologies will be fully reviewed by the Irish Rail team before the works are given approval to proceed (taking account of all stakeholder concerns from the public consultation phases as well as planning compliance criteria stipulated in the Railway Order).

Appendix A - Sifting Process Backup

A.1 Sifting Process Backup – South Circular Road Bridge.

Appendix B - MCA Process Backup

B.1 MCA Process Backup – Civil and OHLE at Memorial Road to South Circular Road Junction area.

Appendix C - Supporting Drawings

The following drawings accompany the Technical Optioneering Report for this area:

Bridge Drawings

DP-04-23-DWG-ST-TTA-57120: South Circular Road Bridge (OBC1) – General Arrangement

DP-04-23-DWG-ST-TTA-57121: South Circular Road Bridge (OBC1) – Bridge Deck Plan

DP-04-23-DWG-ST-TTA-57122: South Circular Road Bridge (OBC1) – Bridge Deck Longitudinal Section

DP-04-23-DWG-ST-TTA-57123: South Circular Road Bridge (OBC1) – Bridge Deck Cross Section Type 1

DP-04-23-DWG-ST-TTA-57124: South Circular Road Bridge (OBC1) – Bridge Deck Cross Section Type 2

Road Drawings

DP-04-23-DWG-CV-TTA-56551: South Circular Road Bridge (OBC1) – Road – Plan and Profile

Traffic Drawings

DP-04-23-DWG-TF-TTA-57270: South Circular Road Bridge (OBC1) – Temporary Traffic Management Phase 1

DP-04-23-DWG-TF-TTA-57271: South Circular Road Bridge (OBC1) – Temporary Traffic Management Phase 2

Permanent Way Drawings

DP-04-23-DWG-PW-TTA-57000: South Circular Road (OBC1/OBC1A) – Track Plan Layout and Longitudinal Profile (Sheet 1 of 2)

DP-04-23-DWG-PW-TTA-57001: South Circular Road (OBC1/OBC1A) – Track Plan Layout and Longitudinal Profile (Sheet 2 of 2)

DP-04-23-DWG-PW-TTA-57002: St. John's Road Bridge (OBC0A) – Cross Section @Ch 9+312

DP-04-23-DWG-PW-TTA-57003: South Circular Road (OBC1) – Cross Section @Ch 9+401

DP-04-23-DWG-PW-TTA-57004: Con Colbert Road – Cross Section @Ch 9+513