Chapter 4

Project Description

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4. Project Description

4.1. Introduction

The EIA Directive requires that the Environmental Impact Assessment Report (EIAR) includes '*a description of the project comprising information on the site, design, size and other relevant features of the project'*. The description of the site, design and scale of the project considers all relevant phases of the life of the project, i.e. from construction through to operation.

This chapter presents the description of the proposed DART+ South West project during operation. It includes information on the site, existing conditions and the permanent features of the project. Detail on the design, railway corridor and other relevant features of the proposed Project is presented to establish the characteristics of the proposed Project for the purposes of environmental assessment.

Chapter 5 Construction Strategy provides information on the construction of the DART+ South West project including construction programme, phasing and construction methodology. It details the activities required for the construction of the DART+ South West project from mobilisation through to testing and commissioning.

This chapter should be read in conjunction with Chapter 5 Construction Strategy and with reference to the technical design drawings presented in Volume 3A of this EIAR.

4.2. Project Location

The proposed DART+ South West Project, referred to hereafter as 'the proposed development' or 'the project', will consist of the electrification of the existing Cork Mainline from Hazelhatch & Celbridge Station to Heuston Station, and to Glasnevin Junction via the Phoenix Park Tunnel Branch Line (Great Southern and Western Rail Line - GSWR). The works extend across three administrative areas/local authority areas, including Kildare, South Dublin and Dublin City. The total length of the proposed development is approximately 20 kilometres.

4.3. DART+ South West Project Overview

The DART+ South West Project will deliver an electrified network, with increased passenger capacity and enhanced train service between Hazelhatch & Celbridge Station to Heuston Station on the Cork Mainline, and Heuston Station to Glasnevin Junction via the Phoenix Park Tunnel Branch Line see Figure 4-1.

DART+ South West Project 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 (i.e., where four tracks reduce to two), 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 electric DART trains will be used on this railway corridor.

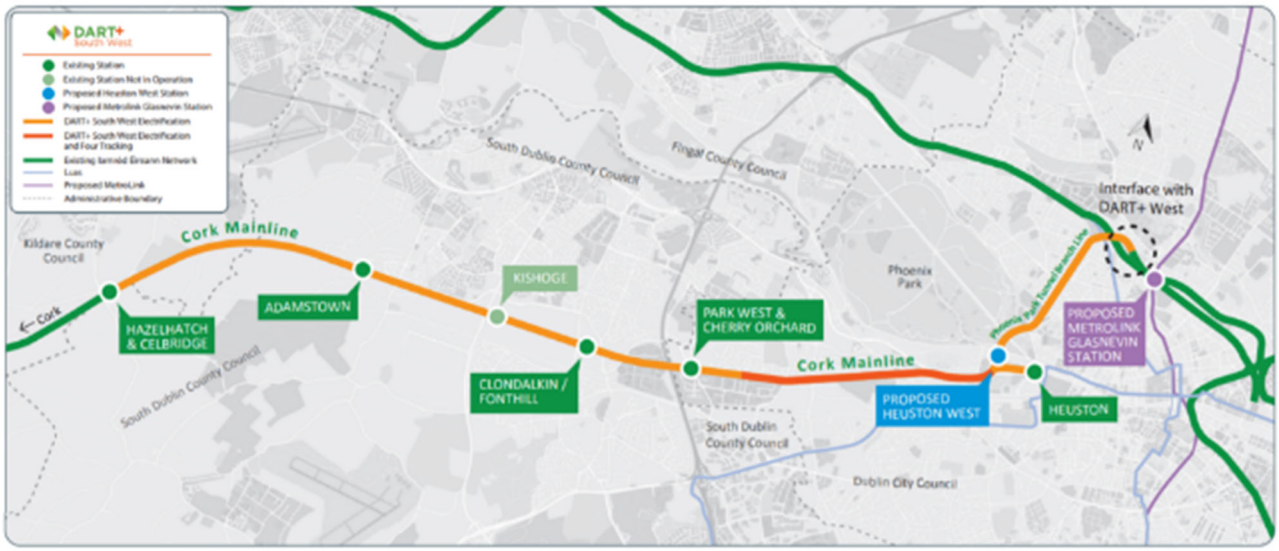

Figure 4-1 Extent of the DART+ South West Project

For the purposes of the EIAR, the proposed Project has been divided into four distinct geographic zones along the length of the corridor (Zones A to D) as follows and as shown in Figure 4-2 The proposed Project is described from west to east along the railway corridor.

- Zone A - Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station (Section 4.6)
- Zone B - Park West & Cherry Orchard Station to Heuston Station, incorporating Inchicore Works (Section 4.7)
- Zone C - Heuston Yard & Station, incorporating New Heuston West Station (Section 4.8)
- Zone D - Liffey Bridge to Glasnevin Junction (Phoenix Park Tunnel Branch Line) (Section 4.9)

Figure 4-2 DART+ South West Geographical Zones

The main features along the existing rail corridor are identified in Table 4.1.

Table 4.1: Main Existing Features within Each Zone

Zone	Main Features
Zone A - Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station.	Hazelhatch R405 Road Bridge (OBC25) New Hazelhatch Footbridge (OBC24A) Hazelhatch & Celbridge Station Hazelhatch Footbridge (OBC24) Straleek Footbridge (OBC23B) Stacumny Bridge (OBC21) Crowley's Bridge (OBC20E) Adamstown Station (OBC20D) Adamstown Station Finnstown R120 Road Bridge (OBC19) Adamstown Footbridge (OBC16A) Kishoge Bridge (OBC14C) Kishoge Station (not currently operational) Kishoge Station Bridge (OBC14D) Clondalkin / Fonthill Station Building West (OBC13D) Clondalkin / Fonthill Station Clondalkin / Fonthill Station Building East (OBC13C) Nangor Road Bridge (OBC13A) Ninth Lock Bridge (OBC13) Cloverhill Road Bridge (OBC11) M50 Motorway Bridge (OBC10A) Park West Station Building Bridge (OBC9D) Park West & Cherry Orchard Station Park West Station Concourse Bridge (OBC9C) Park West Avenue Road Bridge (OBC9B)
Zone B - Park West & Cherry Orchard Station to Heuston Station	Cherry Orchard Footbridge (OBC8B) Le Fanu Road Bridge (OBC7) Kylemore Road Bridge (OBC5A) Inchicore Works / Depot Khyber Pass Footbridge (OBC5) Sarsfield Road Under-Bridge (UBC4) Memorial Road Bridge (OBC3) South Circular Road Junction South Circular Road Bridge (OBC1) St John's Road Bridge (OBC0A)
Zone C – Heuston Yard and Station	Heuston Station Heuston Yard Platform 10 National Train Control Centre (currently under construction)

Zone	Main Features
Zone D – Liffey Bridge to Glasnevin Junction (Phoenix Park Tunnel Branch Line)	Liffey Bridge (UBO1). Conyngham Road Bridge (OBO2) Phoenix Park Tunnel McKee Barracks Bridge (OBO3) Blackhorse Avenue Bridge (OBO4) Old Cabra Road Bridge (OBO5) Cabra Road Bridge (OBO6) Faussagh Road Bridge (OBO7) Royal Canal and LUAS Twin Arches (OBO8) Maynooth Line Twin Arch (OBO9) Glasnevin Cemetery Road Bridge (OBO10)

4.4. DART+ Design Standards

The project design is governed by various technical and safety guidelines, which include European, National and Iarnród Éireann internal standards and specifications. The DART+ South West Project has been designed in accordance with the following standards as summarised below.

4.4.1. Irish Rail Technical Standards

There are different operational departments in Iarnród Éireann, each of them in charge of the operation and maintenance of the different subsystems of the railway system. In this project, from the technical point of view, the most important are CCE (Chief Civil Engineer) Department Technical Standards which give the minimum engineering requirements for track construction, track alignments, layouts and components; SET (Signalling, Electricity and Telecoms) Department Standards which must be followed to design the systems accordingly to the Iarnród Éireann requirements; CME (Chief Mechanical Engineer) Department Standard sets out the requirements for the management of CME Depot facilities and equipment. Iarnród Éireann has other standards regarding operation, stations, rolling stock and maintenance that must also be followed.

4.4.2. Structural Design Standards

All bridges have been designed in accordance with a wide range of codes and technical standards applicable to bridge design. These include TII technical standards along with related civil engineering structures design standards.

4.4.3. Rail Design Standards

All track modifications have been designed in accordance with a range of codes and standards pertaining specifically to the design of the track. These include horizontal and vertical alignment, requirements for track and structures clearance and track construction requirements. The design also takes cognisance of the Technical Specifications for Interoperability (TSI) which define the technical and operational standards which must be met by each subsystem or part of subsystem in order to meet the essential requirements and ensure the interoperability of the railway system of the European Union.

4.4.4. Electrification Standards

The Overhead Line Equipment (OHLE) has been designed in accordance with a range of codes and standards pertaining to the design of the electrical infrastructure. These include electric traction, safety, fixed installations such as switchgear and provision of insulation.

4.4.5. Geotechnical Design Standards

Geotechnical design requirements have been developed in accordance with a range of codes and standards including Eurocode 7 and the Irish Annex to Eurocode 7 along with related standards pertaining to engineering structures and track bed investigation.

4.4.6. Road Design Standards

The transport routes have been designed in accordance with a range of codes and standards applicable to road design published by Transport Infrastructure Ireland (TII) and the National Transport Authority (NTA). These include the Design Manual for Urban Roads and Streets (DMURS) along with standards relating to cycleways and technical standards relating to roads, lighting, drainage and safety.

4.4.7. Buildings Design Standards

The design of the Heuston West Station adheres to project standards related to permanent way and civil engineering. In addition, standards relating to building regulations, and national Technical Guidance Documents including those applicable to footpaths and cycleways published by TII and the NTA, such as the Design Manual for Urban Roads and Streets (DMURS) and the National Cycle Manual, apply together with other international guidelines concerning accessibility and fire safety.

4.5. DART+ South West Design Elements

The Project will require modernisation and modifications to the existing railway line. A range of new elements, general linear works and ancillary works (drainage and utility diversions) are required along the entire length of the railway corridor to facilitate the electrification of the line and the upgrade of the existing network. Additionally, specific elements are required at specific locations along the route such as electrical substations to provide power to the network.

Section 4.5 provides an overview of the infrastructural elements that are proposed at multiple locations along the length of the project, e.g. bridge interventions, substations, compounds, etc.

Sections 4.6 to 4.9 describe the end-to-end development, including details of all other elements that are unique to specific areas. The end-to-end development is described from west to east along the railway corridor.

4.5.1. Track (Permanent Way)

The Permanent Way (PW) is 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.

The project corridor extends from Hazelhatch & Celbridge Station to Heuston Station on the Cork Mainline, whilst also encompassing the Phoenix Park Tunnel Branch Line – commencing from the connection into the Cork Mainline just to the west of Heuston Station Yard, passing through Phoenix

Park Tunnel and extending east to Glasnevin Cemetery Road Bridge. The lengths are approximately 16km for the Cork Mainline and 4km for the Phoenix Park Tunnel Branch Line.

The DART+ South West Project requires alterations to the track as follows:

- Widening of the railway corridor and completion of four-tracking between Park West & Cherry Orchard Station and Heuston Station. In this regard, a continuous four track layout along the Cork Mainline from Hazelhatch to Heuston, comprising two Slow electrified lines (northern tracks) and two Fast non-electrified lines will be provided. There are currently no electrified lines in the area;
- Track lowering to achieve the required vertical clearance under bridges to accommodate the Overhead Line Equipment (OHLE);
- New / additional crossovers (when a train switches from one track to another across points) to accommodate the new operational model;
- Sidings modifications at Inchicore Works, to allow continuity of the operations;
- Track geometry improvements (within the current corridor's limits) to remove existing speed restrictions; and
- Suitable and safe access for the rail maintenance teams is required to be provided.

4.5.2. Drainage

The drainage design has been developed to meet project requirements in relation to both road drainage and track drainage.

4.5.2.1. Track Drainage Design

The preliminary drainage design has been carried out, integrating the existing drainage system with the proposed new drainage infrastructure associated with modifications to the rail corridor.

The drainage strategy takes cognisance of the proposed change in rolling stock that will be used along the route. The proposed Electric Multiple Unit (EMU) have a lower tolerance in terms of flood levels on the track than the existing Diesel Multiple Units (DMU) rolling stock. A summary of the proposed work in each zone is outlined in Table 4.2.

The drainage design has been developed to the specific project needs in each area as follows:

Table 4.2: Overview of Track Drainage Requirements

DART+ South West Project Description Zone	Drainage Zone	Drainage Requirements
Zone A: Hazelhatch & Celbridge Station to Park West Station & Cherry Orchard Station	Hazelhatch & Celbridge Station to Park West Station & Cherry Orchard Station	Minor modifications to the existing drainage network in this zone to incorporate localised track changes and installation of new infrastructure.

DART+ South West Project Description Zone	Drainage Zone	Drainage Requirements
Zone B: Park West Station & Cherry Orchard Station to Heuston Station	Cherry Orchard to South Circular Road	The drainage in this zone will be affected by the upgrade of the rail corridor to a new 4-track layout. As part of these renewal works, a new drainage system will be implemented to collect and attenuate runoff waters generated in the upgraded track infrastructure. The zone has been divided into three different drainage networks: Cherry Orchard to West of Inchicore Works, West of Inchicore Works to Sarsfield and from Sarsfield to Heuston West Station.
Zone C: Heuston Yard and Station	Heuston Yard	The drainage in this zone includes tie-ins with existing tracks, minimal changes in existing railway gradients and levels. The existing drainage system will be retained along the tracks that are being renewed.
		As part of these renewal works, a new drainage system will be implemented to collect and attenuate runoff waters generated in the upgraded track infrastructure. The track drainage system in Heuston West Station connects to the drainage network that runs from Sarsfield to the station itself. A new drainage outfall is proposed adjacent to the new Heuston West Station, the outfall will discharge into the River Liffey.
Zone D: Liffey Bridge to Glasnevin Junction	Islandbridge Junction to North Portal of Phoenix Park Tunnel.	The drainage in this zone involves the replacement of the existing ballasted track to slab track in Phoenix Park Tunnel. The drainage system will be integrated within the slab track system (channel cast in-situ between the tracks). The existing outfall location at the River Liffey will be retained.
	North Portal of Phoenix Park Tunnel to GSWR Junction (Glasnevin)	The proposed work in this zone involves track lowering in certain areas. These changes will require reinstating or upgrading the existing drainage system. The existing pumping station between Twin Arches Bridges (OBO8 and OBO9) will be lowered and its wet well chamber enlarged.

4.5.2.1. Road Drainage Design

Typically, drainage will be provided using new gullies (and in some areas linear kerb drains) at similar locations to the existing gullies, in particular where kerb lines are not being altered. However, where bridge raising requires the approach road to be reconstructed, new storm water pipes will replace the older pipes but will be connected to the same network to which they currently discharge. All new or reconstructed footpaths and cycle lanes (where segregated from vehicular lanes) will generally slope towards the road in order to minimise the need for additional drainage collection measures. In some areas, where this may not be possible, additional channels or measures may be required.

Apart from Le Fanu Road, where the surface area to be drained is increasing, no additional contributory road drainage areas from public roads are considered to impact existing networks.

Where new or improved gravel access roads are required; they will be drained to existing drainage systems and/or soakaway swales local to the gravel access roads, in keeping with preferred sustainable urban drainage requirements as requested by local authorities.

At Le Fanu Road, the hard standing areas to the north of the bridge will be increased due to road widening. Consequently, a nominal portion of additional runoff is envisaged. In accordance with the imperatives of sustainable drainage (and best practice) a planted garden soakaway will be provided to the north east corner of the existing public open space. This will be designed as part of the overall landscaping reinstatement plan for the public open space. This will in effect improve the current combined sewer network locally by reducing the contributory area volume from the existing network.

4.5.3. Clearance at Bridges

There are a total of 38 existing bridges which cross the existing railway line. These comprise a mix of Overbridges (OB) and Underbridges (UB). Where any bridge crosses over the railway, it is necessary to ensure that the proposed OHLE will pass safely below the bridge. Where existing bridges do not provide the necessary clearance for overhead electrification of the lines or horizontal clearance for four tracking, a range of options have been considered on a case-by-case basis in the design development. The options considered in design development included the following (either standalone or in combination):

- Provision of specialist electrical solutions for the OHLE with reduced clearance.
- Lowering the rail track under the bridge.
- Modification of the existing bridge structure.
- Removal of the existing structure and provision of a replacement structure.

In most cases, the existing bridges have the necessary vertical and horizontal clearance. Some will require modifications as summarised in Table 4.3. Further details on modifications to bridges is provided within the relevant zone descriptions (refer to section 4.6 to section 4.9)

Table 4.3: Summary of Modifications to Bridges (Including Parapets)

Zone	Structure Id	Location	Chainage	Proposed Solution
Zone A	OBC25	Hazelhatch R405 Road Bridge	24+500	No modification
	OBC24A	New Hazelhatch Footbridge	24+485	Parapets to be upgraded to meet safety requirements
	OBC24	Hazelhatch Footbridge	24+410	No modification
	OBC23B	Straleek Footbridge	24+000	No modification
	OBC21	Stacumny Road Bridge	22+500	Localised track lowering
	OBC20E	Crowley's Bridge	20+525	No modification
	OBC20D	Adamstown Station	20+300	Maintenance platform over electrified tracks to be upgraded to meet safety requirements
	OBC19	Finnstown R120 Road Bridge	19+295	Localised track lowering Parapets to be upgraded to meet safety requirements
	OBC16A	Adamstown Footbridge	18+920	No modification
	OBC14D	Kishoge Station	17+700	Parapets (in public areas, maintenance areas) and central stairs to be upgraded to meet safety requirements
	OBC14C	Kishoge Bridge	17+735	No modification
	OBC13D	Clondalkin/Fonthill Station Building West	16+170	No modification
	OBC13C	Clondalkin/Fonthill Station Building East	16+100	Parapets (in public areas, maintenance areas) and central stairs to be upgraded to meet safety requirements
	OBC13A	Nangor Road Bridge	16+135	No modification
	OBC13	Ninth Lock Bridge	15+725	No modification
	OBC11	Cloverhill Road Bridge	15+325	No modification
	OBC10A	M50 Motorway Bridge Note 1	14+545	Parapets to be upgraded to meet safety requirements
	OBC9D	Park West Station Building Bridge	14+245	Maintenance platform, Central Stairs to be upgraded to meet safety requirements
	OBC9C	Park West Station Concourse Bridge	14+245	No modification
	OBC9B	Park West Avenue Road Bridge	14+200	No modification

Zone	Structure Id	Location	Chainage	Proposed Solution
Zone B	OBC8B	Cherry Orchard Footbridge	13+350	No modification
	OBC7	Le Fanu Road Bridge	12+610	Bridge Replacement / Upgrade (road raising and track lowering)
	OBC5A	Kylemore Road Bridge	12+140	Bridge Replacement / Upgrade (road raising and track lowering)
	OBC5	Khyber Pass Footbridge	10+820	Bridge Replacement / Upgrade
	UBC4	Sarsfield Road Under-Bridge	10+525	Bridge Replacement / Upgrade Replacement of bridge deck (2 distinct wider decks) and track raising to ensure clearance to road not reduced below current.
	OBC3	Memorial Road Bridge	10+000	Bridge Replacement / Upgrade (nominal road raising, with track lowering of Slow tracks and nominal lowering of the Fast Tracks)
	OBC1	South Circular Road Bridge	9+420	New cut and cover buried portal structure OBC1A. (Raising of Con Colbert Road low point) New Slow tracks through OBC1A structure, adjacent to OBC1, to be approximately approx. 2.5m below existing tracks. Track realignment of Fast tracks under OBC1.
	OBC0A	St John's Road Bridge	9+330	Track realignment under OBC0A
Zone D	UBO1	Liffey Bridge	8+850	Construction/fixing of OHLE masts supports onto the outer face of the masonry arch viaduct walls; immediately in advance of the River Liffey crossing.
	OBO2	Conyngham Road Bridge	8+770	Localised track lowering Parapets to be upgraded to meet safety requirements
	OBO3	McKee Barracks Bridge	7+700	Parapets to be upgraded to meet safety requirements.
	OBO4	Blackhorse Avenue Bridge	7+630	Parapets to be upgraded to meet safety requirements
	OBO5	Old Cabra Road Bridge	7+220	Parapets to be upgraded to meet safety requirements
	OBO6	Cabra Road Bridge	7+030	Localised track lowering Parapets to be upgraded to meet safety requirements

Zone	Structure Id	Location	Chainage	Proposed Solution
	OBO7	Faussagh Road Bridge	6+475	Localised track lowering Parapets to be upgraded to meet safety requirements
	OBO8	Royal Canal and Luas Twin Arch	6+045	Localised track lowering No change to parapets
	OBO9	Maynooth Line Twin Arch	5+915	Localised track lowering No change to parapets
	OBO10	Glasnevin Cemetery Road Bridge	5+645	Bridge Replacement / Upgrade

Note 1: The Project Team has carried out Technical Engagement with TII in relation to the M50 Motorway Bridge. The proposed works will:

- Comply with TII Publications (Standards) in accordance with relevant TII Publications (Technical) for any works that impact the national road pavement, structures and infrastructure including drainage.
- Consultation with the M3 PPP Contractor and fulfilment of requirements to complete their 3rd party protocols, via the relevant road authorities and TII will be completed in advance of proposed works where access for the construction period and any subsequent monitoring and maintenance in relation to any works proposed, including temporary and permanent signage, that affect the national road and associated junctions in terms of operational requirements, timetabling, etc.

Continued Consultation with TII will take place in connection with the proposed works to ensure that all necessary approvals will be in accordance with TII requirements.

4.5.3.1. Bridge Parapets

The existing bridges along the route were originally designed as non–electrified lines. The electrification of the line requires special interventions to maintain the safe operation of the railway. The existing bridges along the route must comply with necessary safety requirements by providing suitable protection for the general public to prevent accidental contact with the OHLE. To achieve the necessary level of safety protection, works are required to bridge parapets to increase their height to minimum 1.8m and include measures to prevent climbing or walking across the top of them.

Six bridges will be replaced / upgraded along the length of the proposed Project. Four overbridges will be fully replaced to meet the vertical and horizontal clearance requirements. These bridges are Le Fanu Road Bridge (OBC7), Kylemore Road Bridge (OBC5A), Khyber Pass Footbridge (OBC5) and Memorial Road Bridge (OBC3). Additionally, the Sarsfield Road Under-Bridge (UBC4) and Glasnevin Cemetery Road Bridge (OBO10) will require a replacement deck. In addition to the bridges, a new cut and cover buried portal structure will also be constructed under the South Circular Road Bridge (OBC1). The bridge replacement / upgrades will require new parapets which meet current containment standards (H4a containment) for bridges crossing railways, where applicable. H4a containment requires that the parapet is a minimum 1.8m height above adjacent footway level with no handrails. It must have a 45-degree symmetrical steeple coping.

A number of existing bridges will also require parapet modification works to ensure that there is an adequate containment barrier to the OHLE from road level. It has been established that the height requirements can be achieved by utilising a full height solid infill parapet or solid infill to 1.2m high with an IP2X rated barrier used for the remaining height to up to 1.8m.

IP2X simply means that no object greater than 12.5mm in diameter (i.e. 12.5mm sphere) can pass through. This is intended to prevent fingers being able to protrude through the parapet. No ledges along

the interface with the solid and IP2X rated sections are allowed, so the sheeting should generally be in line with the face of parapet and the top surface should be such that a person cannot walk across the top of the parapet. A 45° steeple type profile is often preferred here where a thick parapet is used to prevent walking across the top of the parapets.

The modifications to existing bridge parapets are described in further detail in the project description for each of the Zones A, B, C and D (Refer to Section 4.6 to Section 4.9).

4.5.4. Retaining Walls

A variety of retaining wall types are required along the length of the rail corridor to accommodate track widening. The retaining wall types vary in accordance with soil conditions, proximity to buildings and height of required retention. These include bored secant pile wall, gabion basket wall and king post retaining wall solutions. Photograph examples of the various types of retaining wall are presented in Figure 4-3 to Figure 4-5. The typical construction methodology for the proposed retaining walls is outlined in Chapter 5 Construction Strategy and is not repeated in this chapter.

Figure 4-3 Example of a Secant Pile Wall

Figure 4-4 Example of Gabion Basket Wall

Figure 4-5 Example of King Post Retaining Wall

Typical cross sections of the project showing the finished secant retaining walls are illustrated in **Figure 4-6**.

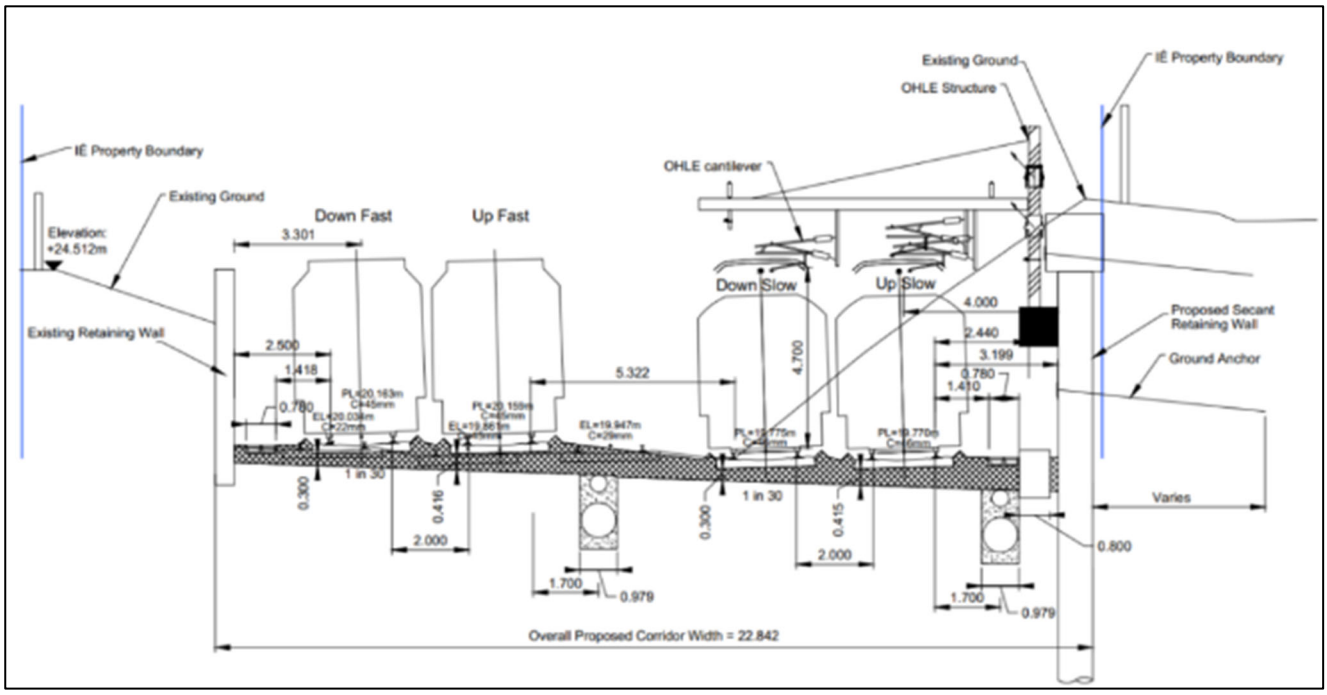

Figure 4-6 Secant Pile Wall & Ground Anchors – Facing West

4.5.5. Stations

The project includes for a new station, located within CIÉ lands at Heuston Station (at the location of the existing Platform 10 of Heuston Station); the new Heuston West Station is described in Section 4.8.

The design of the DART+ South West Project makes passive provision for potential future stations at Kylemore and Cabra including track alignments and other infrastructure which would provide for the delivery of these stations in the future. Iarnród Éireann has committed to developing these stations in the future to provide improved public transport.

Current capacity review studies have concluded that the sizing of the existing stations will be adequate to accommodate forecasted future passenger demand. As such no works are proposed to the existing stations apart from modifications to parapets on structures above tracks (public footbridges, pedestrian decks and maintenance platforms). These will be upgraded to meet the safety requirements of electrified tracks as part of this project. These works are required to the stations within Zone A (Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station). Further detail on the proposed works is provided in Section 4.6.2.

The provision of strategic Park & Ride facilities, car parking and pedestrian and cycle facilities at or near existing train station is not part of the DART+ Programme. The NTA's Park & Ride Development Office is currently working with Iarnród Éireann to identify strategic locations to develop a Park & Ride Scheme that will connect with the rail system. Proposals to develop Park & Ride will be brought forward independently of the DART+ Programme. Pedestrian and cycle facilities associated with many of the existing stations were provided as part of the original Kildare Route Project. The facilities are consistently under review and are the remit of Iarnród Éireann Station Enhancement Programme.

4.5.6. Roads

The urban nature of the existing road networks poses significant constraints in terms of achieving completion of four-tracking between Park West & Cherry Orchard Station and Heuston Station. Where bridge reconstructions are necessary as part of the Project, associated roadworks will also be required (including footpaths or cycle track reinstatement or enhancements).

The DART+ South West Project will replace or enhance (where practicable) pedestrian and cycle facilities in the immediate vicinity of bridge reconstruction works.

The proposed road works are typically confined to the new bridge crossings, approaches to these crossings and localised works to the adjacent road network. Road reinstatement works are also required to facilitate the diversion of existing utilities and also the installation of new utility connections, including the installation of the new electricity supplies to the traction power substations along the route (6 no.).

The proposed road reconstructions to facilitate bridge reconstruction are typically short in length, between approx. 50m and 250m in length. A summary of the road reconstruction works is provided in Table 4.3.

Table 4.4: Summary of Road Reconstruction Works

Zone	Structure ID	Location	Proposed Works
Zone A	-	-	No works proposed to the existing public roads, footpaths or cycle tracks. Proposed works at existing bridges are limited to parapet modifications to meet Iarnród Éireann standards.
Zone B	OBC7	Le Fanu Road Bridge	The replacement of the existing bridge with a new structure with slightly wider cross-section and longer span will require modifications to the existing approach roads on either side of the bridge. Refer to section 4.7 (Zone B) for the description of the works.

Zone	Structure ID	Location	Proposed Works
	OBC5A	Kylemore Road Bridge	The replacement of the existing bridge with a new structure with a longer span will require modifications to the existing approach roads on either side of the bridge. Refer to section 4.7 (Zone B) for the description of the works.
	OBC5	Khyber Pass Footbridge	Replacement of the existing Khyber Pass Footbridge with a new structure which will be of longer span will not result in any new road works.
	UBC4	Sarsfield Road Under-Bridge	The replacement of the existing bridge deck with 2no. independent bridge decks will require modifications to approach roads at Sarsfield Road Under-Bridge including localised road modifications following utility diversions.
	OBC3	Memorial Road Bridge	The replacement of the road bridge will require a range of road works in the vicinity of the bridge, which align with the BusConnects proposals, in addition, the cycle path and footpath design are in compliance with the National Cycle Manual and DMURS. Refer to section 4.7 (Zone B) for the description of the works.
	-	Con Colbert Road	Reinstatement of the Westbound footpath and Road Corridor Boundary Wall between South Circular Road and the Con Colbert Road departure lane to Sarsfield Road; as a consequence of the demolition and reconstruction of the road corridor boundary wall for the railway piling works.
	OBC1 & OBC1A	South Circular Road (SCR) and Con Colbert Road / Chapelizod Bypass	The introduction of the new portal structure (OBC1A) will require reinstatement of existing road facilities along the westbound carriageway, west of South Circular Road with an increase in road levels reaching a maximum of approx. 300mm. The design aligns with the BusConnects proposals. Refer to section 4.7 (Zone B) for the description of the works.
Zone C	-	Heuston Station Road	Localised road layout modifications, works also include pedestrian footpath upgrades between the new Heuston West Station and the main terminal station and other modes of transport (Luas and Bus Services)
Zone D	OBO10	Glasnevin Cemetery Road bridge	Partial resurfacing of the cemetery car park will be required as a result of the replacement of the existing road bridge deck and bridge resurfacing works. Refer to section 4.9 (Zone D) for the description of the works.

To accommodate the provision of the necessary pedestrian and cyclist infrastructure, the proposed scheme requires the removal of several trees at various locations along the scheme. Further details are outlined in Chapter 5 Construction Strategy.

4.5.7. Boundary Treatments (Fencing, Boundary walls)

4.5.7.1. Railway Fencing

Security of the electrified railway from both a health and safety perspective and against trespassing is a design requirement of the project. Fencing upgrading is required in those areas where existing fences do not fulfil the necessary security requirements against electrocution and possible trespassing. No specific deficiencies in fencing have been identified. The construction of new fencing has been proposed in locations where there is currently no fencing and, therefore, no protection against the aforementioned risks. There are other areas where the existing fencing needs to be relocated due to civil works associated with the project, mainly the installation of OHLE masts.

Additionally, the electrification of the railway entails requirements of safety distances to the live parts of the OHLE that must be considered when analysing existing and new fencing. Figure 4-7 below shows the minimum clearances to accessible live parts on the outside of vehicles as well as to live parts of OHLE from standing surfaces which accessible to a person for low voltage traction systems.

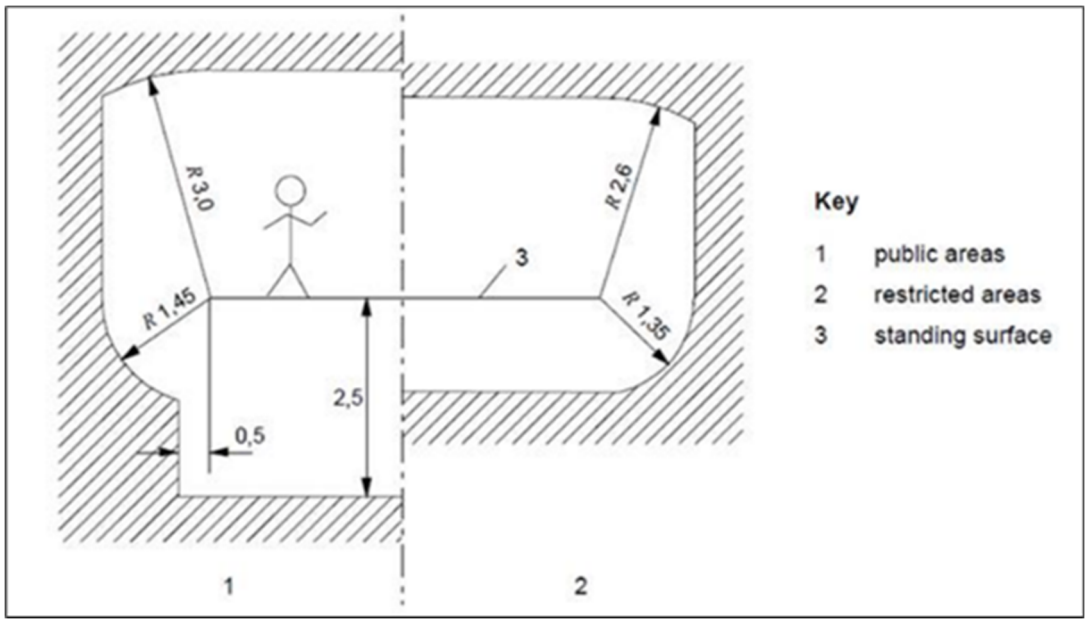

Figure 4-7 Minimum Clearances According to EN-50122

The following are the types of fencing that will be provided:

- Post and Wire / Mesh Fencing: typically used in rural areas to prevent access by livestock
- Palisade fencing 2.4 m Security Purpose (SP): Typically required near stations, level crossings, closures and public open spaces when security against trespassing is required. New palisade fencing shall be powder coated green.
- Palisade fencing 3.6 m Substation Security Purpose (SS-SP): Typically required for substation installations when security against trespassing is required and shall be powder coated green
- Paladin Fencing: typically used near stations when a more aesthetic finish is required, whilst also providing security against trespassing. New paladin fencing shall be powder coated green.

- Acoustic barriers (where required subject to noise impact assessment): They are normally required in urban areas (occasionally rural) with sensitive receptors near the railway line.

Examples of the various types of fencing are presented below.

Figure 4-8 Post and Wire Fence

Figure 4-9 Mesh Fence

Figure 4-10 Palisade Fence

Figure 4-11 Paladin Mesh Fence

4.5.7.2. Railway Corridor Boundary Walls

There are a number of locations within Zone B (the four-tracking section) where reconstruction of existing boundary walls is required. These locations are typically as follows:

- Adjacent to bridge reconstructions along the railway corridor boundary where construction access is required for the project works;
- Reconstructed overbridge approach road walls, as a consequence of road raising, bridge widening and/or increase in containment level;
- As a consequence of the widening of the railway corridor, along sections of the line, the works require the demolition of existing boundary walls and adjoining structures. In most instances, the replaced boundary wall will be located on top of a new railway corridor retaining wall.

New walls and/or wall reconstructions will be in keeping with the existing aesthetic character of the surrounding area. Where stone masonry walls need to be demolished, every effort will be made to reclaim the stone for repurposing elsewhere on the project (i.e. stone masonry walls will be replaced with original stone).

4.5.8. OHLE System

Overhead Line Equipment (OHLE) generally refers to the mechanical and electrical equipment items used to carry and deliver electrical power to the trains. The DART wide programme will adopt a 1,500V DC (Direct Current) OHLE system to provide electrical power to the network's new electric train fleet. While functionally similar to the OHLE on the existing DART network, modern design is being considered to maximise reliability and safety on the route.

Electrical energy is supplied to the train through contact between the equipment mounted on the top of the train (pantograph) and an electrically live overhead cable. This cable is supported by a series of support structures and steel masts measuring 6m – 8.5m in height which will be installed at intervals along the line. Typical spacing between OHLE support structures will be between 40m and 50m, with a maximum spacing of 63m. The OHLE masts will carry support frameworks for the OHLE system over each of the electrified tracks. Vertical hangers will support and separate the upper and lower wires; additional feeder cables, insulators and earth wire. The live overhead cable is fed electrically from individual substations which are located along the route.

The existing rail corridor is not currently electrified and no OHLE infrastructure has been installed, OHLE will therefore be required. While a standardised approach to electrification has been adopted, the OHLE arrangement will vary at different sections along the route depending on the track configuration, clearance to structures and local site conditions.

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. 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).The vegetation clearance and management for the safe operation of the OHLE shall be greater than 1.5m from the rear of the OHLE mast or 1.5m from any wire running between masts.

Apart from its visual impact, currents drawn through the OHLE by the trains will generate quasi-static magnetic fields around various components. The resulting field will vary depending on the magnitude and direction of the current through the conductor. An Electromagnetic Compatibility (EMC) assessment has been carried out as part of this EIAR, in Chapter 22 Electromagnetic Compatibility and Stray Current.

4.5.8.1. OHLE Arrangement

The OHLE arrangement will vary at different sections along the route depending on the track configuration, clearance to structures and local site conditions.

Single Track Cantilevers (STCs) are placed on either side of the line and are used to support the OHLE over one track. Figure 4-12 shows a typical arrangement.

Twin Track Cantilevers (TTCs) are generally placed on one side of the line, to support the OHLE on the two tracks. TTCs will be the predominant OHLE arrangement from Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station. The figures below show typical TTC arrangements.

Below are some examples of typical OHLE cross-sections that will be applied to the project.

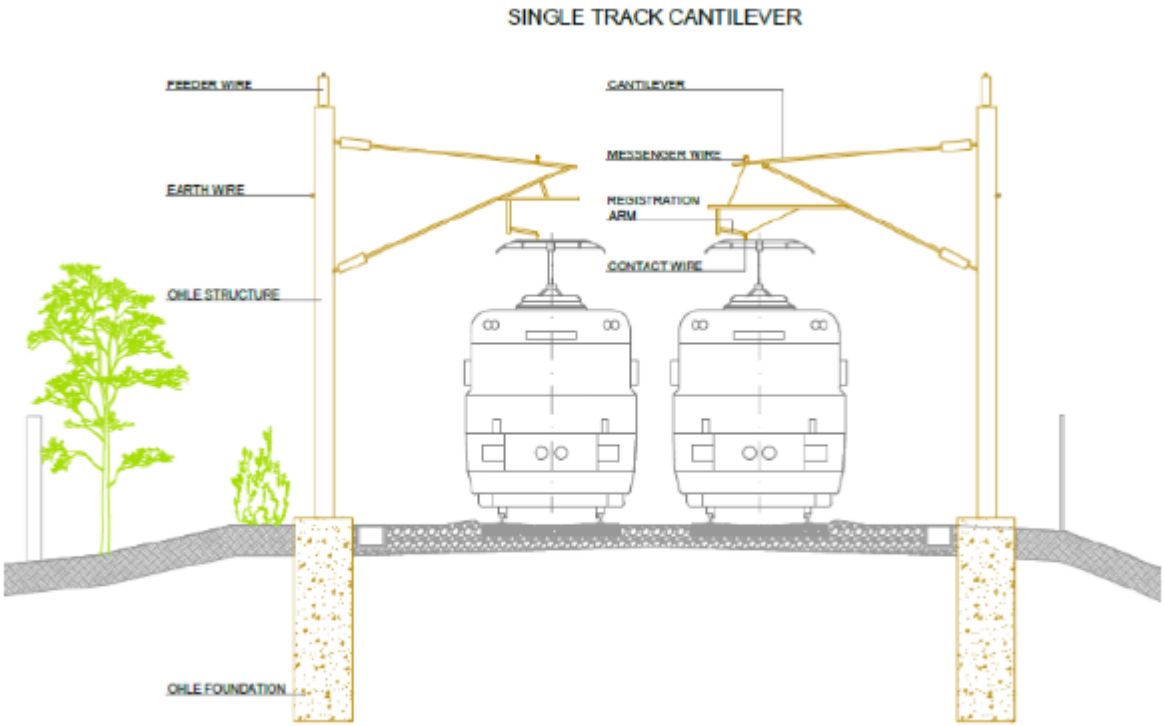

Figure 4-12 Single Track Cantilevers (STC) in 2-Track Section

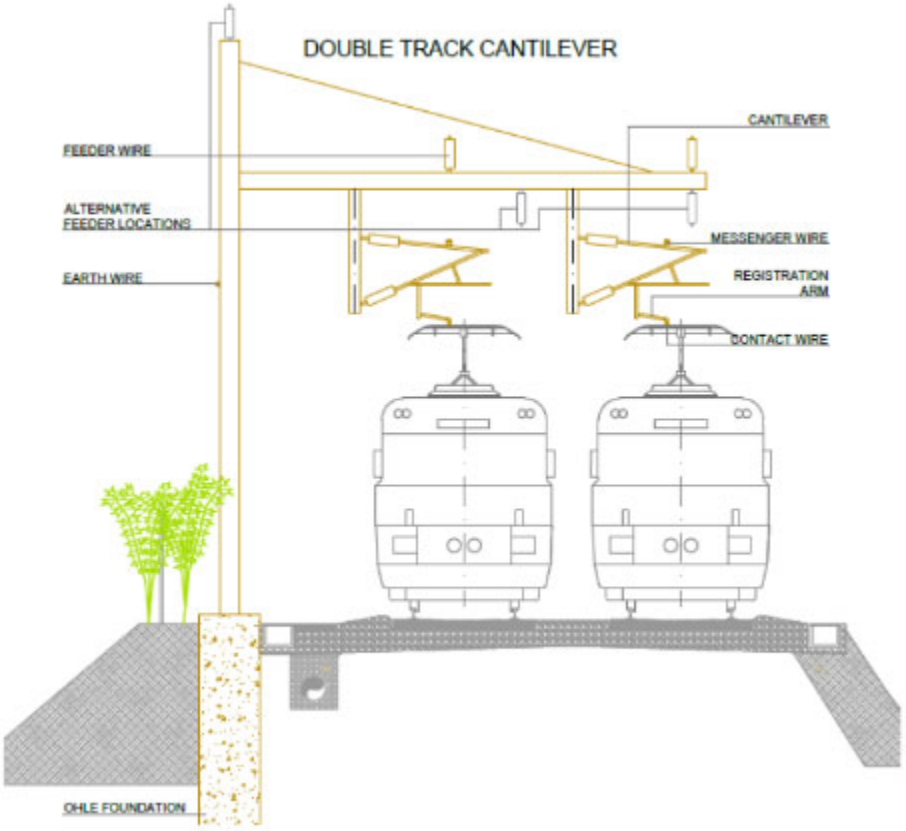

Figure 4-13 Twin Track Cantilevers (TTC) in 2-Track Section

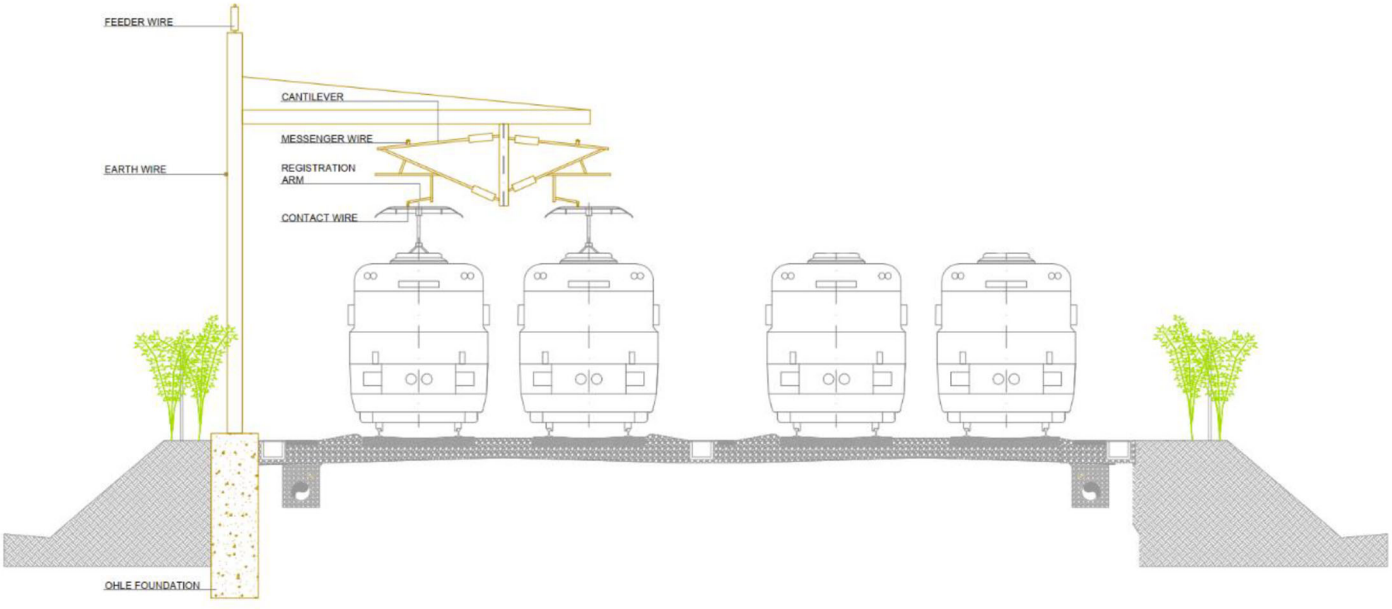

Figure 4-14 Typical OHLE TTC Arrangement in Four Track Open Route

Depending on the site constraints, the OHLE system through the stations will be supported with TTCs or Portals on the platforms. Portals will be used as required by the design and not necessarily through all stations, see Figure 4-15.

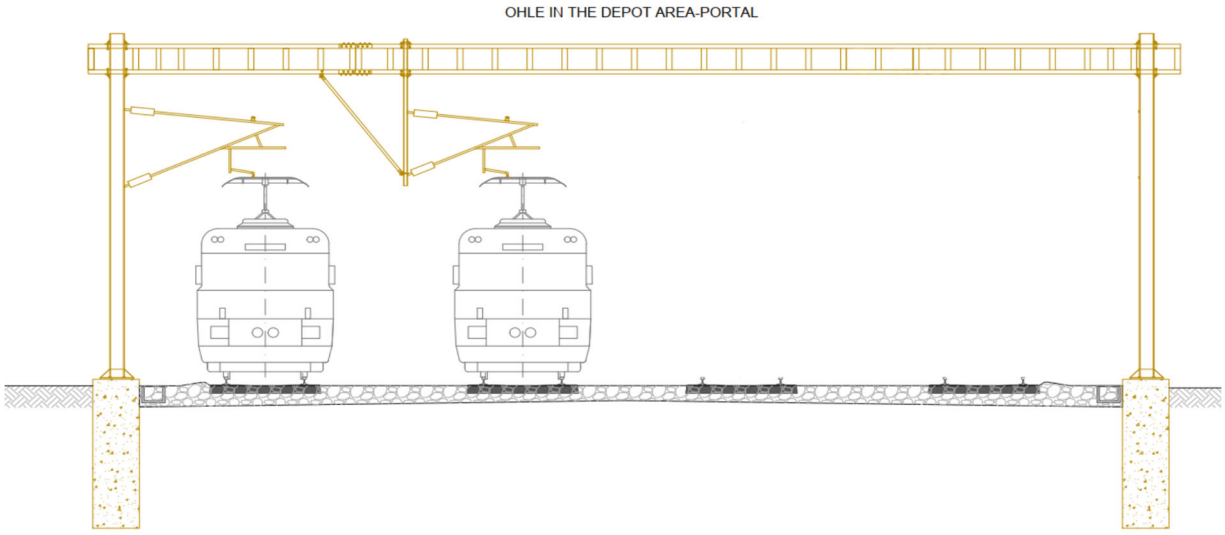

Figure 4-15 Typical OHLE Portal Arrangement

The OHLE comprises a simple (2-wire) auto-tensioned system, the mechanical tension can be achieved by two main solutions, springs or counterweights/balance weights. At intervals of up to 1,500m, 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 4-16 for a typical anchor structure.

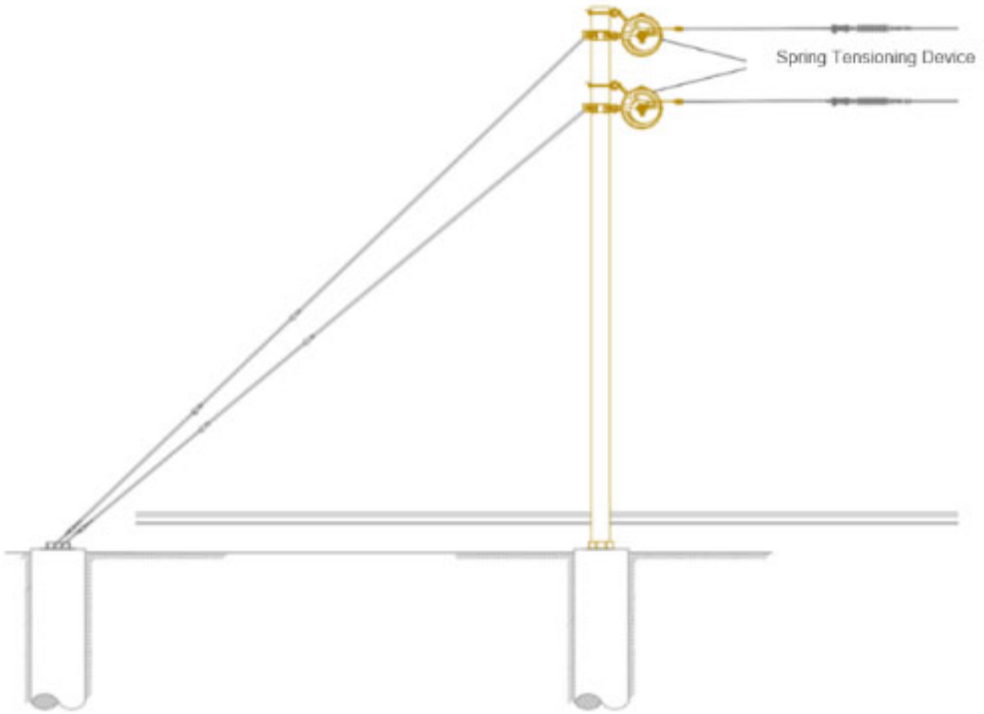

Figure 4-16 Typical Anchor Structure

The OHLE configuration through the overbridges for each track or civils option has been assessed using a clearance assessment tool utilising a set of configurations agreed with Irish Rail Signalling and Electrification Department. 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 4-17 for a typical arrangement on approach to a low bridge.

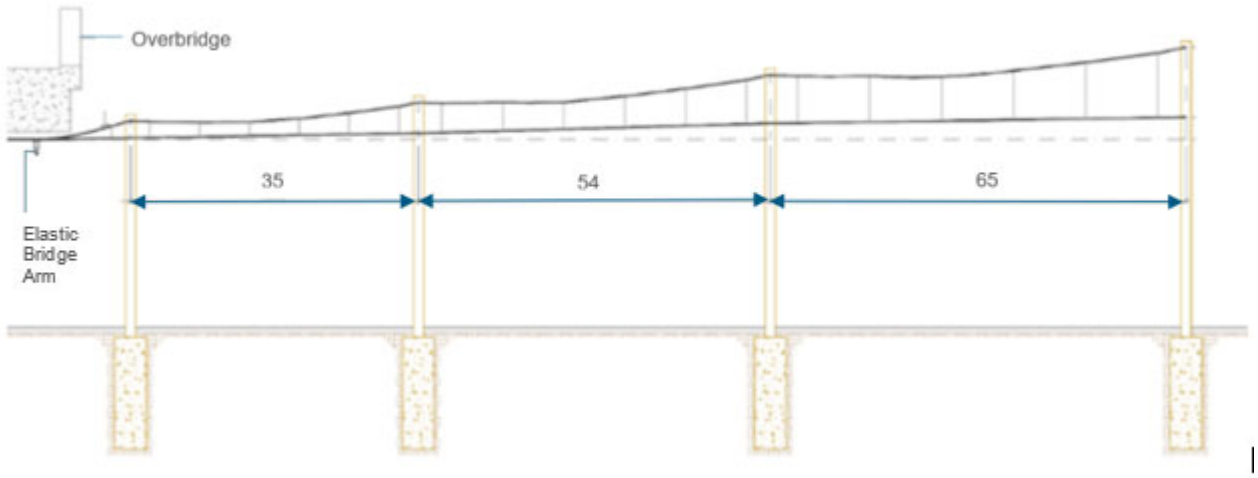

Figure 4-17 Typical Arrangement on Approach to a Low Bridge

4.5.8.2. OHLE Foundations

Three foundation options are considered for the OHLE foundations (steel pile driven, concrete bored pile and concrete pad). The various OHLE foundation options are covered in more detail in Chapter 5 Construction Strategy.

4.5.9. HV Power and Substations

The OHLE system will be supplied with electrical power from the ESB distribution network at regular intervals, at locations known as substations. These substations will receive power from the local power distribution network and transform this into the required 1,500V DC for operation of the OHLE system.

A total of 6 traction electrical substations are necessary along the project extents. The traction power substations will be located in the following locations:

- Islandbridge/Heuston
- Kylemore (Inchicore Depot)
- Park West
- Kishoge
- Adamstown
- Hazelhatch

The substations will comprise a secured, fenced compound surrounding a building which will house all the necessary electrical switching and feeding equipment. Welfare facilities are also required for Iarnród Éireann's maintenance teams.

Where practicable, the project has sought to locate the substations within CIÉ owned lands. They will have a similar appearance to a substation shown in Figure 4-18 below.

The main substation elements are outlined below, but dimensions may vary according to site conditions and constraints:

- Substation compound, approx. footprint 60m x 20m, secured by a 3.6m high palisade / security fence, or similar, enclosing a substation building measuring approx. 45m x 10m x 6m (length x width x height).
- Each substation will require a dedicated access road and vehicle parking area.
- The substation building comprises of an ESB 38kV switchgear building and DART traction power substation building. The DART traction substation building typically contains the following:
  - High Voltage room;
  - Mess rooms;
  - Control room for telecoms;
    - UPS Battery Room,
    - DC Switchboard Room,

- 2 Transformer Rooms,
- Auxiliary Transformer Rooms,
- Diesel Generator Room,
- Metering Room.

Figure 4-18 Sample Electrical Substation

To ensure the reliability of supply to the OHLE, each traction substation will receive power from two independent 38kV circuits on the existing distribution network and will convert this incoming supply into the required 1500V DC for distribution along the OHLE system. The provision of power from the local power distribution network to the substations is addressed in Chapter 5 Construction Strategy.

4.5.10. Signalling System

The signalling system is used to safely control and monitor train movement on the Irish Rail network. The existing railway incorporates signalling infrastructure along its length in the form of underground cables, track level sensors and switches, and visible signals on posts or gantries that communicate instructions to the train drivers along the route.

In order to achieve the necessary capacity enhancements and performance required for the DART+ Programme, it will be necessary to upgrade the existing signalling system as well as replacing some of the legacy signalling system. This will include the provision of Signalling Equipment Buildings/Rooms (SEB/SER), Location Cases (LOC) where required along the route in order to accommodate signalling equipment and associated power supplies and backup.

The proposed signalling system will incorporate similar components to those already in use on the DART line. Signal masts, signal gantries, and location cases (LOC) are described and depicted in the images below.

As the existing railway line is currently operating with an existing signalling system, the new signalling infrastructure will need to be installed in parallel with the existing one to ensure that during the re-signalling implementation, the current trains remain operational and running. For that reason, the current signalling system will be retained for the duration of the construction phase until the new signalling system is installed. This is described in further detail in Chapter 5 Construction Strategy.

4.5.10.1. Signals

Signals may be mounted on posts, masts or large structures, such as gantries and cantilevers. Gantries and cantilevers will generally be placed only where required, due to clearance issues.

The project has identified where structures (gantries, cantilevers) will be required to support areas with greater signal density. Figure 4-19 shows a typical signalling cantilever and trackside signal post.

Figure 4-19 Typical Existing Signalling Infrastructure

4.5.10.2. Location Cases (LOC)

In the railway system, the movement of the train is controlled by an interlocking system. Such an interlocking system consists of different components, including a central device (computer) that controls and senses the condition of important equipment such as switches, signals, track sections, 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, housed inside the LOCs. A typical Object Controller Cabinet is shown in Figure 4-20. These typically measure 4m x 2m x 1m (length x width x height).

Figure 4-20 Typical Object Controller Cabinet (OBJ)

In addition, LOCs accommodate railway Low Voltage (LV) to provide the required power to the signalling and telecom systems. LOCs are fed through a 650 V AC line. Inside the LOCs there are 650 / 110 V AC step down transformers to feed the signalling equipment, which is also housed inside the LOCs.

Figure 4-21 Typical Location Case

4.5.10.3. Cable Containment Management System

The installation of new signalling, telecommunications, and power supplies will necessitate new cable routes throughout the length of the Project. A Cable Management System (CMS) will be provided to securely contain the necessary cabling for Signalling, Electricity and Telecoms along the track alignment.

Existing containment routes consist of buried duct, surface troughing and ladder rack/tray and will be reused were possible. Where cable ducts are required to pass under the railway track, they shall be contained by a suitable under track crossing.

4.5.11. Telecommunications System

One of the key elements of the DART+ South West Project is to modernise lineside Telecommunications, based on the DART+ Programme Wide specifications.

Telecom Equipment Rooms (TER) are used to house servers, storage devices, switches, routers, cabling patch panels and any additional passive electronics to provide IT services (access control, CCTV, intrusion detection, public address system, voice announcement system, distributed antenna systems) in the station and its area of influence. This is where the physical connection between the field equipment (signals, train detectors, etc.) and the electronic equipment takes place. A typical TER is shown in the picture below. The typical internal dimensions are 4 m x 3 m x 2.6 m (length x width x height).

TERs will typically be located within stations on CIÉ owed land. For existing stations, a new TER will be considered only when the existing TER lacks sufficient capacity for new equipment. New TERs are proposed at Adamstown Station, Park West & Cherry Orchard Station and Heuston West Station.

They will typically be located as close as possible to the centre of a station, and at a maximum distance of 200 metres from the centre. The following requirements apply to TER:

- The Station TER shall be as per current Iarnród Éireann specifications – e.g. min 4m x 3m, false floor, air conditioned, dedicated power board, 24hr access, access monitoring, fire detection.
- The TER shall be built as close as possible to the existing TER to facilitate the migration of the existing infrastructure into the new facility.
- A secured external light switch shall activate the internal equipment room lights.

Figure 4-22 Example of typical Telecom Equipment Building

4.5.12. Other Technical Buildings and Cabinets

A range of technical equipment cabins are required to support the signalling, electrical and telecommunication infrastructure. These have been located within existing CIÉ owned lands where possible.

The typical types of cabins and associated dimensions are listed below:

- Signalling Equipment Buildings (SEB's). These typically measure 12m x 4m x 2.60m (length x width x height;
- Principal Supply Points (PSP's) for Low-Voltage Power. These typically measure 12m x 4m x 2.8m (width x depth x height); and
- Auxiliary Supply Points (ASP's) for Low-Voltage Power. These typically measure 2.6m x 2.0m x 2.27m (width x depth x height).

The equipment cabins are typically securely fenced to prevent access by the public.

4.5.13. Rolling Stock

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

The current DART fleet is composed of two types of EMU - the 8100 and the 8500 fleets. The 8100 EMU are the first electrical units of the DART fleet and are expected to be out of service in 2027/2028. The 8100 operates as 6-car and 8-car units with trailer and motor cars. The 8500 fleet (8500, 8510 and 8520) will coexist with the new fleet, a basic unit configuration is a 4-car unit with two trailers and two motor cars, but most of the units will be coupled as an 8-car unit. The length of the basic unit is 81.7m, and the 8-car unit is 168 m. The width of the trailer is 2.9m and the height is 3.87m.

CIÉ has recently concluded a procurement process to purchase a new EMU fleet for operating the expansion of the DART network. The main features of the rolling stock are in line with CIÉ standards regarding gauge and infrastructure and thus they shall be capable of operating on the routes stated in the Train Infrastructure Interface Specification (TIIS) (CME-NFP-TS-001). The maximum length of the new trains is 168m. The units will operate as HLU (Half Length unit or 5-car unit) or FLU (Full length unit or 10-car unit).

4.5.14. Energy Efficiency

The energy efficiency approach in the DART+ Programme is aligned with the following three key aspects:

- Energy: the project will promote energy saving with a cost-optimal approach by:

  Reducing the energy demand with passive architectural strategies, reducing energy consumption with energy-efficient equipment and producing energy with renewable technologies. Energy is also related to CO_2 emissions and Iarnród Éireann's future carbon neutrality goal. Architectural design will consider NZEB (Nearly Zero Energy Building) strategies. Iarnród Éireann have a commitment to 80% renewable energy in the overall Iarnród Éireann energy contract for DART+ South West Project.

- Water: Minimise potable water consumption using low consumption fixtures and recycling and reusing greywater

- Materials: Prioritise the use of environmentally friendly materials and the use of recycled and recyclable materials.

4.6. Zone A: Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station

4.6.1. Overview of Zone A

Hazelhatch, on the border between County Kildare and South Dublin, marks the western extent of the DART+ South West Project. Zone A commences approximately 750m to the west of Hazelhatch & Celbridge Station and extends eastwards under a series of existing road bridges, foot bridges and station structures to Park West & Cherry Orchard Station (Figure 4-23). It is approximately 10km in length. The rail corridor is predominantly at grade (i.e. the rail level is at the surrounding ground level) – though there are several retaining wall structures in the vicinity of Park West Station. The rail corridor comprises four existing tracks.

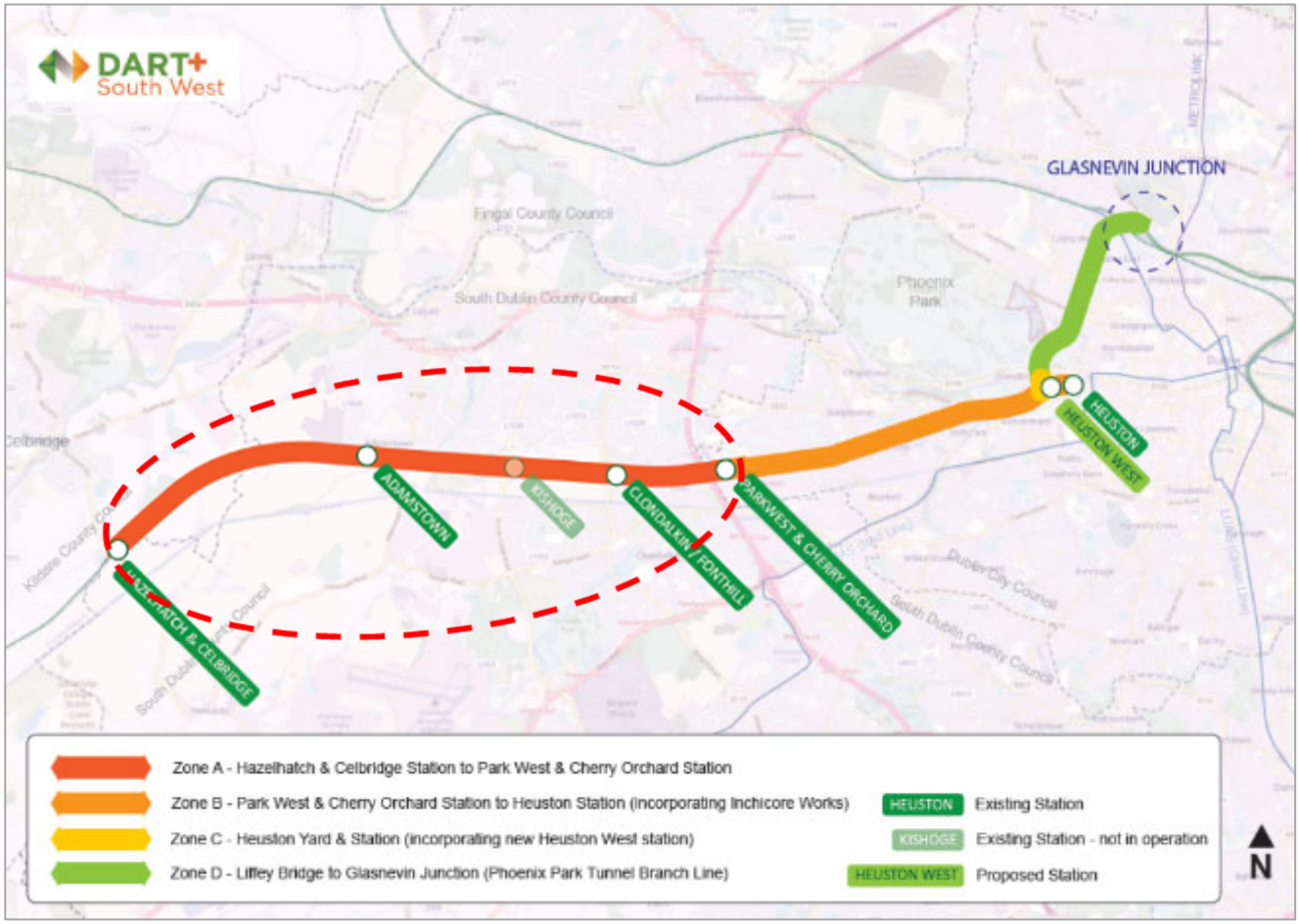

Figure 4-23 Zone A Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station

There are 5 stations located in this zone and indicated in Figure 4-23. These are listed below from west to east as follows:

- Hazelhatch & Celbridge
- Adamstown
- Kishoge (currently not operational)
- Clondalkin / Fonthill

- Park West & Cherry Orchard.

There are numerous existing road bridges, pedestrian bridges and station structures along the line as outlined in Section 4.3. Within Zone A, there are 20 existing structures identified as bridges.

The existing railway line extends east through a farmed landscape from Hazelhatch & Celbridge Station and passes through the townland of Stacumny and onwards towards Adamstown Station. North of the railway has witnessed significant residential development at Adamstown and west of the R120 (Newcastle Road, also known as Twelfth Lock Road and Adamstown Road). The area south of the railway at Adamstown features a rural farmed landscape. Continuing east, the line heads towards Kishoge Station (currently not in operation) and onwards to Clondalkin / Fonthill Station with residential areas located north of the railway and farmland to the south. Although undeveloped, this area, south of the railway is the location of the Clonburris Strategic Development Zone (SDZ), where significant future development is envisaged, focused on the two railway stations. As the line continues east, the landscape changes from a more open farmland area to built-up industrial areas east of Clondalkin. The line then passes under the M50 and heads into Park West & Cherry Orchard Station.

4.6.2. Proposed Development - Permanent Way (including track lowering)

This zone already accommodates a four-track railway. The proposed Project in this area involves the reconfiguration of the existing four running lines to convert them to Up Slow, Down Slow, Up Fast, Down Fast with provision for the electrification of the two tracks on the north side (Slow tracks) for the DART services. All of these works will fit within the existing boundary. New Points and Crossings (P&C) layouts will be required in order to achieve the operational requirements.

Track lowering will be required locally at Finnstown R120 Road Bridge (OBC19) and at Stacumny Bridge (OBC21). Nominal localised track lowering, of up to 0.1m in depth for the 2 tracks on the northern side of the rail corridor, will be required to achieve sufficient vertical clearance to enable the OHLE to pass under each of these bridges (with a contact wire height of 4.4m).

4.6.2.1. Hazelhatch & Celbridge Station

At Hazelhatch & Celbridge Station there will be significant modifications to the track layout commencing approximately 750m to the west of the station, the works include new Points and Crossings (P&C), track realignment, provision of a new siding to facilitate the DART services on the electrified Slow lines to the north side of the corridor.

The station layout consists of one central and two side platform areas with a turnback provided at the eastern end of the station, i.e. 5 platform faces in total, refer to Figure 4-24. The platforms are provided in an offset arrangement, with the central and southern platforms extending west below Hazelhatch R405 Road Bridge (OBC25). The station will operate as terminus station for proposed DART trains. Hence, the turnback service will be enhanced for Heuston and Connolly services. The main station access building is at platform level, to the north of the track area. A pedestrian footbridge provides access via stairs and lifts to the platforms.

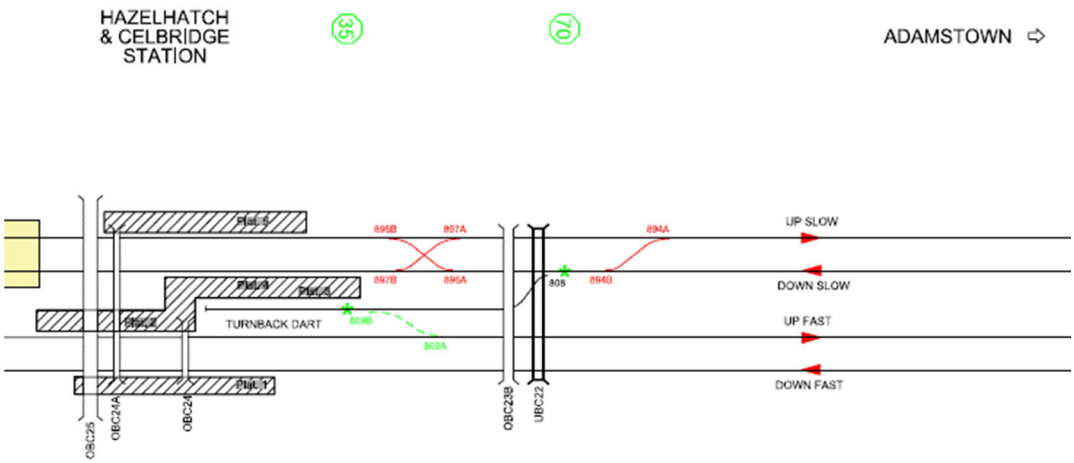

Figure 4-24 Hazelhatch & Celbridge Station – Schematic Track Plan (in red trackwork within this project)

Figure 4-25 shows the additional crossovers between Fast and Slow lines that fulfil the operational requirements (train movements) at this new Hazelhatch Junction. The alignment in the vertical plane essentially matches the existing track throughout this area with the implementation of necessary minor modifications to ensure that crossovers are situated on a level plane to ensure their correct operation.

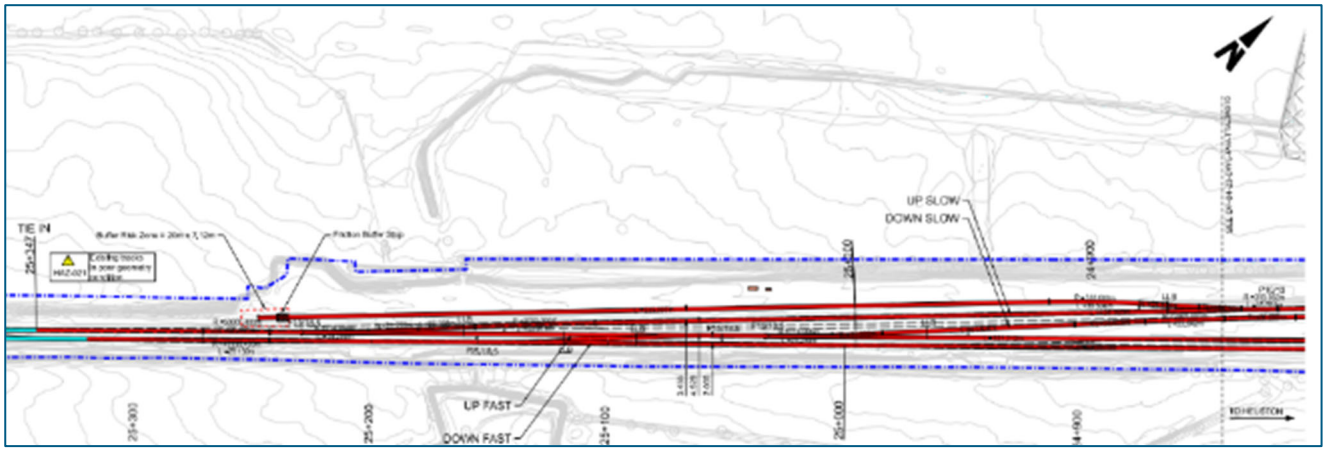

Figure 4-25 Hazelhatch & Celbridge Station – Track Plan Layout (1 of 3)

To the west of the station, the modifications include the installation of a new Turnback Siding (Approximately 356m in length) located on the north side of the rail corridor. A new crossover on the Slow lines will provide access into the siding from both Up and Down directions, see Figure 4-26.

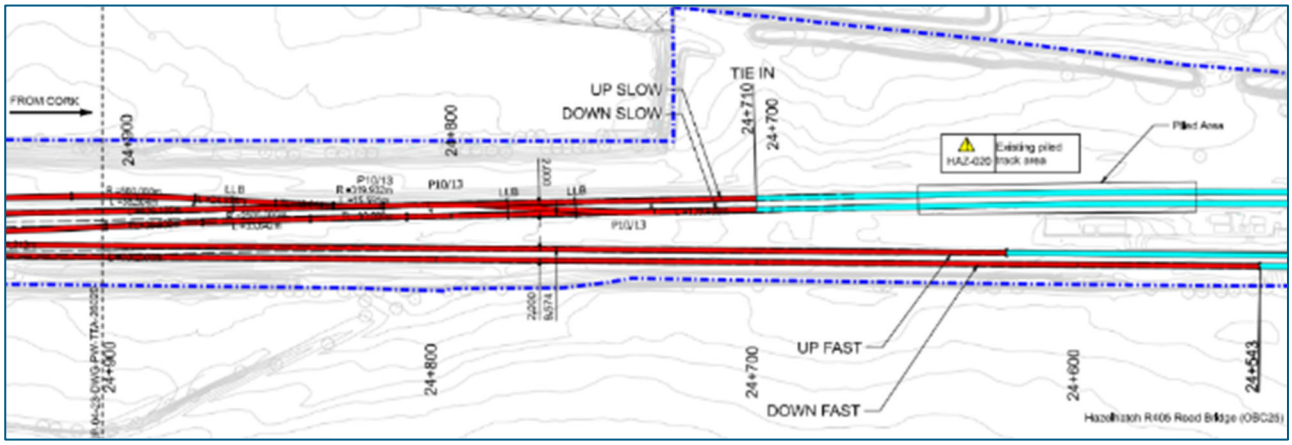

Figure 4-26 Hazelhatch & Celbridge Station – Track Plan Layout (2 of 3)

On the approach to the station, a new crossover will be installed between the Slow lines to provide access to the existing turnback. A new scissors crossover to the immediate east of the platforms provides required functionality (see Figure 4-27).

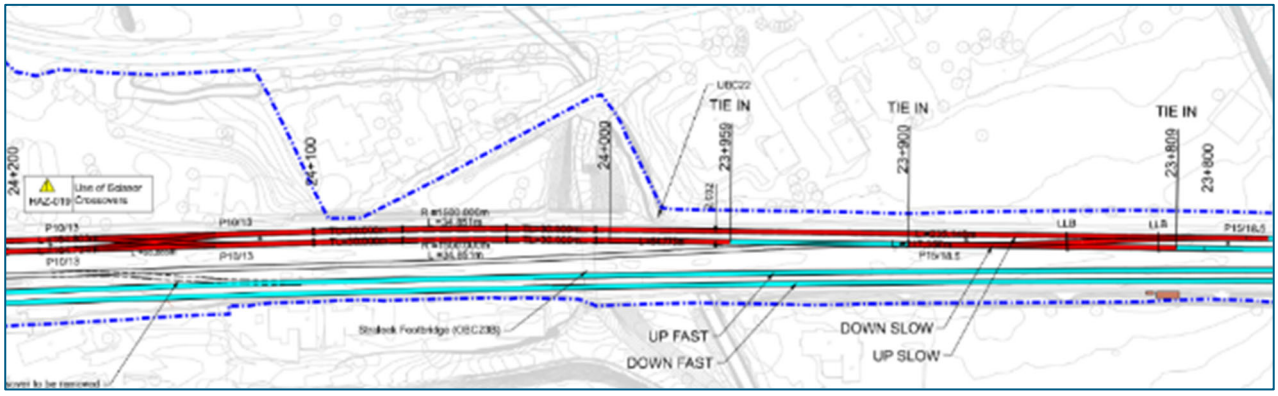

Figure 4-27 Hazelhatch & Celbridge Station – Track Plan Layout (3 of 3)

4.6.2.2. Adamstown Station

At Adamstown Station, the proposed works require modification to the existing points and crossings (P&C) to fulfil operational requirements, with the removal of an existing connection into the turnback on the central platform, see Figure 4-28. Tracks to be removed are shown in dashed.

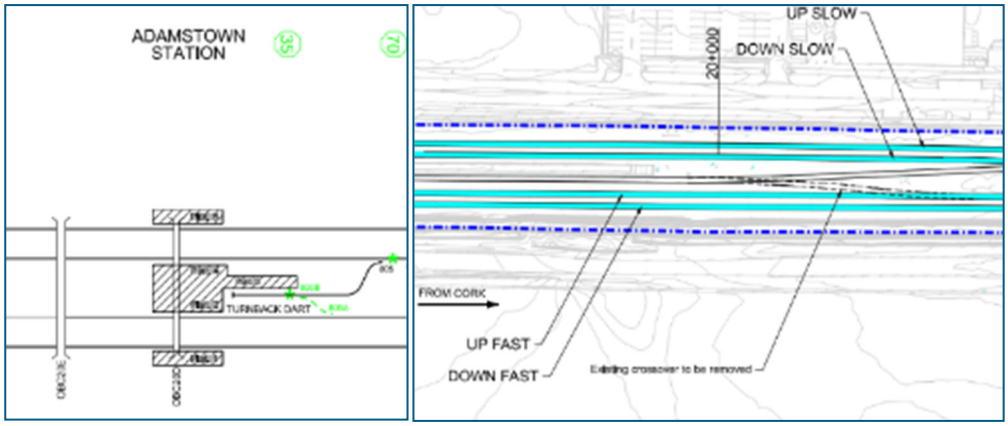

Figure 4-28 Adamstown Station- Track Plan Layout (1 of 2)

Additionally, a new crossover will be provided to the slow lines to the east of Adamstown Station, see Figure 4-29.

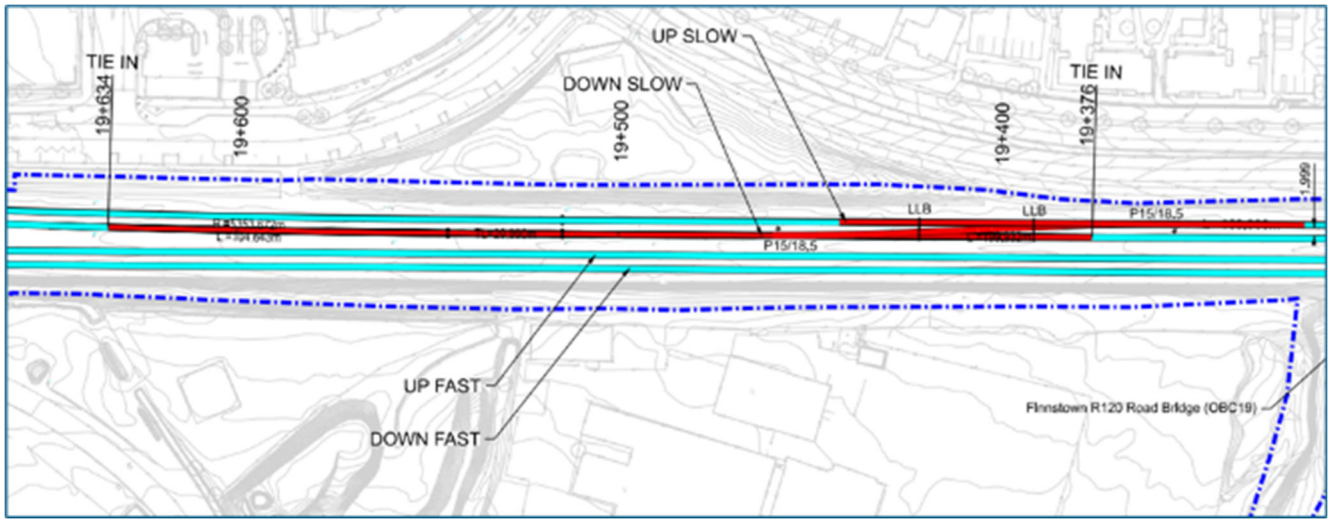

Figure 4-29 Adamstown Station- Track Plan Layout (2 of 2)

4.6.2.3. Kishoge Station

Kishoge Station building is adjacent to the eastern side of Kishoge Bridge (OBC14C). It is similar in layout to the east concourse building at Clondalkin / Fonthill. The three platforms are aligned, centred below the building. The station is not currently operational. No modifications are required in this area.

4.6.2.4. Clondalkin / Fonthill Station

Clondalkin / Fonthill Station has two concourse buildings, located either side of regional road R113. The side platforms are located on the eastern side of the bridge only, while the central platform is continuous throughout and covers both station buildings. The west building was designed to provide access to the central platform and is currently closed. The east building currently provides access to all platforms – see Figure 4-30.

The north (Up) platforms are not currently in use at Clondalkin/Fonthill Station. No modifications are required in this area.

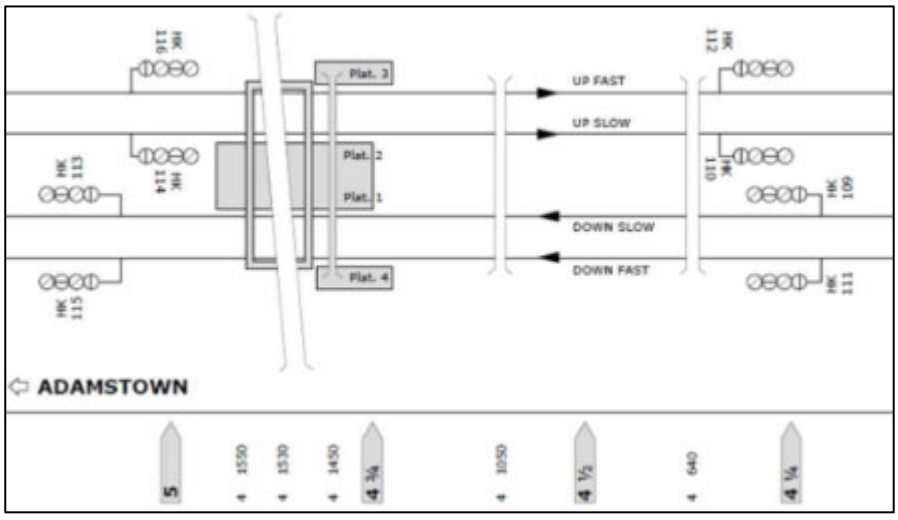

Figure 4-30 Clondalkin / Fonthill Station Platforms

4.6.2.5. Park West & Cherry Orchard Station

At Park West & Cherry Orchard Station, the existing four track layout here is preserved in terms of physical infrastructure. The line designations will change to reflect the segregation of electrified DART services on the Slow lines to the north, with the non-electrified Fast lines to the south. The proposed track plan layout at Park West & Cherry Orchard Station is shown in Figure 4-31.

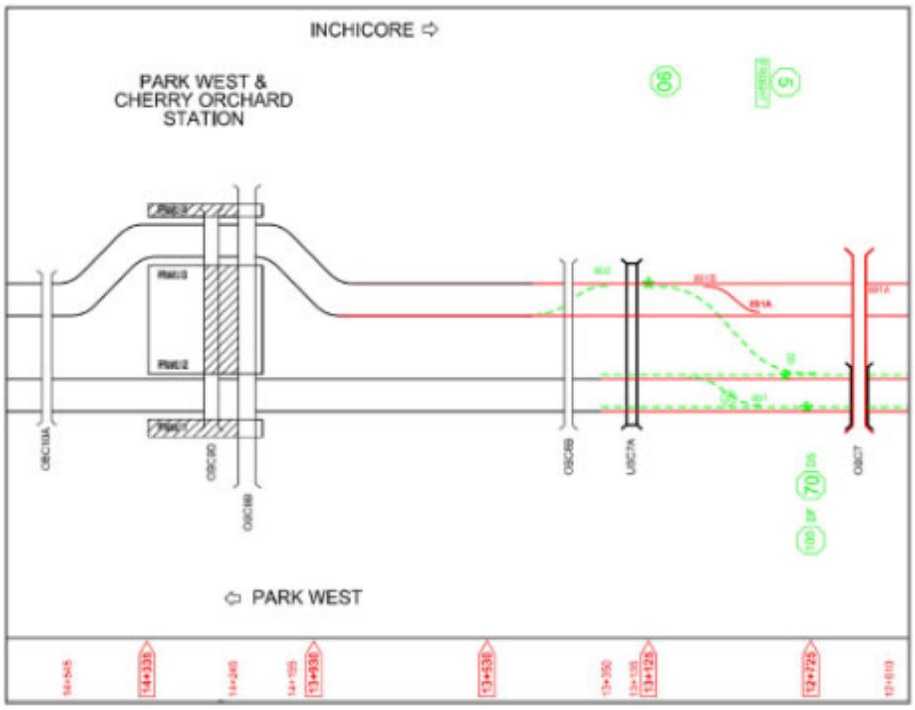

Figure 4-31 Park West & Cherry Orchard Station- Track Schematic[1]

4.6.3. Proposed Development – Clearance at Bridges

There are no new bridges or bridge reconstructions proposed in this zone. The bridges in this section have sufficient vertical clearance with the exception of Stacumny Road Bridge (OBC21) and Finnstown R120 Road Bridge (OBC19) as outlined in Section 4.5.2. Localised track lowering is required at both of these locations to ensure the necessary bridge clearances are achieved.

4.6.3.1. Bridge Parapets

Minor modifications to the parapets of existing bridges will be required where they fall short of the required design standards set out by Iarnród Éireann. The parapets at the Finnstown R120 Road Bridge (OBC19) and M50 Motorway Bridge (OBC10A) do not meet the required design standards in terms of protection for electrification. It is proposed to raise the parapets with a proprietary GRP parapet extension, which have been used in the UK and have been approved by Network Rail on a number of projects. This is a lightweight solution which will allow the parapets to be raised to the required height and preferred steepled coping profile. See Figure 4-32 and Figure 4-33. Modifications to the height of the parapets are also required to the New Hazelhatch Footbridge (OBC24A).

[1] New tracks/structures = red, removed tracks = dashed green

Figure 4-32 GRP Parapet Extension

Figure 4-33 GRP Parapet Extension

4.6.3.2. Station Structures

The existing stations between Hazelhatch & Celbridge and Park West & Cherry Orchard have a number of structures with parapets above tracks for different purposes: public footbridges; other pedestrian decks; maintenance platforms. These parapets will be upgraded to meet the safety requirements associated with electrified tracks.

4.6.3.2.1. Hazelhatch Footbridge (OBC24A)

Hazelhatch Footbridge (OBC24A) is a two-span footbridge over the tracks, one of the spans crosses above the proposed electrified DART+ tracks. The existing bridge has a parapet made of steel panels attached to the structural trusses. Where the parapet height does not reach the required 1.8m height, additional light steel panels similar to the existing ones will be fixed to the existing structure (Figure 4-34).

Figure 4-34 Hazelhatch Footbridge (OBC24A) External Views

4.6.3.2.2. Adamstown and Park West & Cherry Orchard

Both Adamstown and Park West & Cherry Orchard stations have maintenance platforms which are used to maintain and clean the glazed station concourse facades, the platforms are located above the existing tracks. These platforms have a steel grating with a vertical railing approximately 1m high.

Figure 4-35 Park West & Cherry Orchard Station - View of the Maintenance Platform

Figure 4-36 Adamstown Station - View of the Maintenance Platform

Although the maintenance platforms are accessed only by trained staff working under specific procedures (i.e. temporary track possessions), general requirements for parapets above electrified tracks are applicable. Panels up to 1.8m will be installed, the panels will comprise of two sections a solid steel panel up to 1.2m with a 0.6m IP2X panel, the new panels will be attached to the existing railing. See Figure 4-37 below.

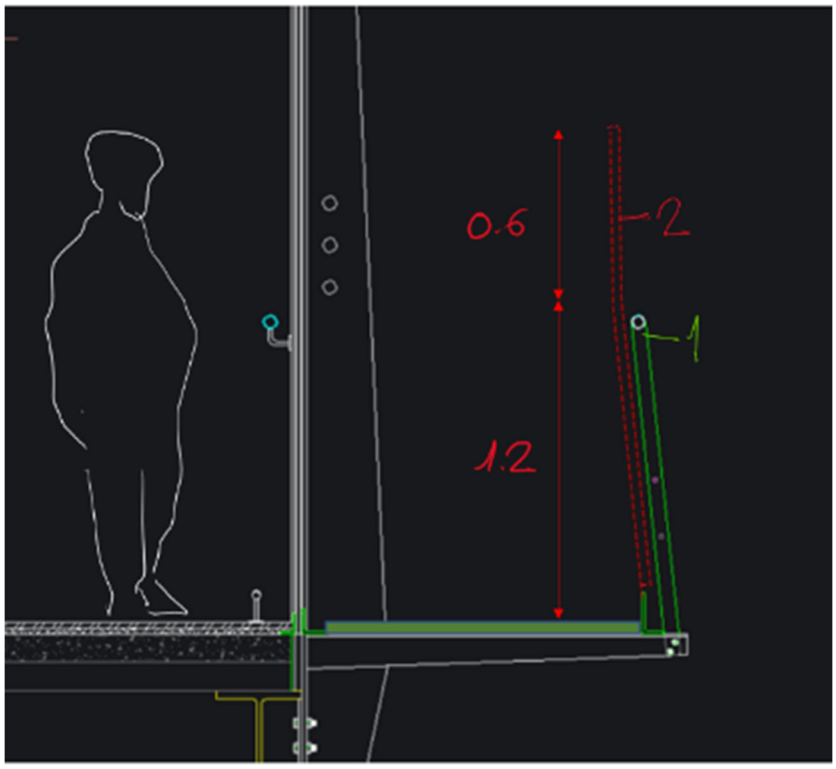

Figure 4-37 Section of the Existing Maintenance Platform - 1 (green) - existing railing; 2 (red) - potential guard extension

The existing maintenance platform floor grating depicted in (Figure 4-38) to be replaced with anti-slip solid steel panels.

Figure 4-38 Typical Detail of Floor Grating (Park West & Adamstown Stations)

At Park West & Cherry Orchard, as well as Adamstown stations, further modifications are necessary to ensure compliance with the electrification requirements. The proposed works are located at the top section of the stairs of the central platform. A solid steel panel will be fixed to the exiting railing, providing an enclosed stair.

The location of the proposed works at Park West & Cherry Orchard Station are depicted in red in Figure 4-39 below.

Figure 4-39 External View of the Central Stair, Park West & Cherry Orchard Station (Areas to Protect are Marked in Red)

4.6.3.2.3. Kishoge and Clondalkin / Fonthill Stations

Kishoge and Clondalkin / Fonthill Stations are of a similar design and layout. The proposed modifications at both stations are as indicated in Figure 4-40.

1. High parapets in public areas, the overall height complies with the electrification requirements. Where the existing steel mesh does not meet the requirement of IP2X or equivalent, it will be replaced by an IP2X mesh. Additional steel panels will be fixed to the inner side of the existing parapet.
2. The existing low parapets, located in restricted maintenance areas to be modified to meet the general requirements for parapets above electrified tracks. Panels up to 1.8m will be installed, the panels will comprise of two sections a solid steel panel up to 1.2m with a 0.6m IP2X panel, the new panels will be attached to the existing railing.

3. Additional modifications required for the top section of the stairs of the central platform. A solid steel panel will be fixed to the exiting railing, providing an enclosed stair, similar to the proposed protection measures for the central platform stairs at Park West & Cherry Orchard and Adamstown Stations.

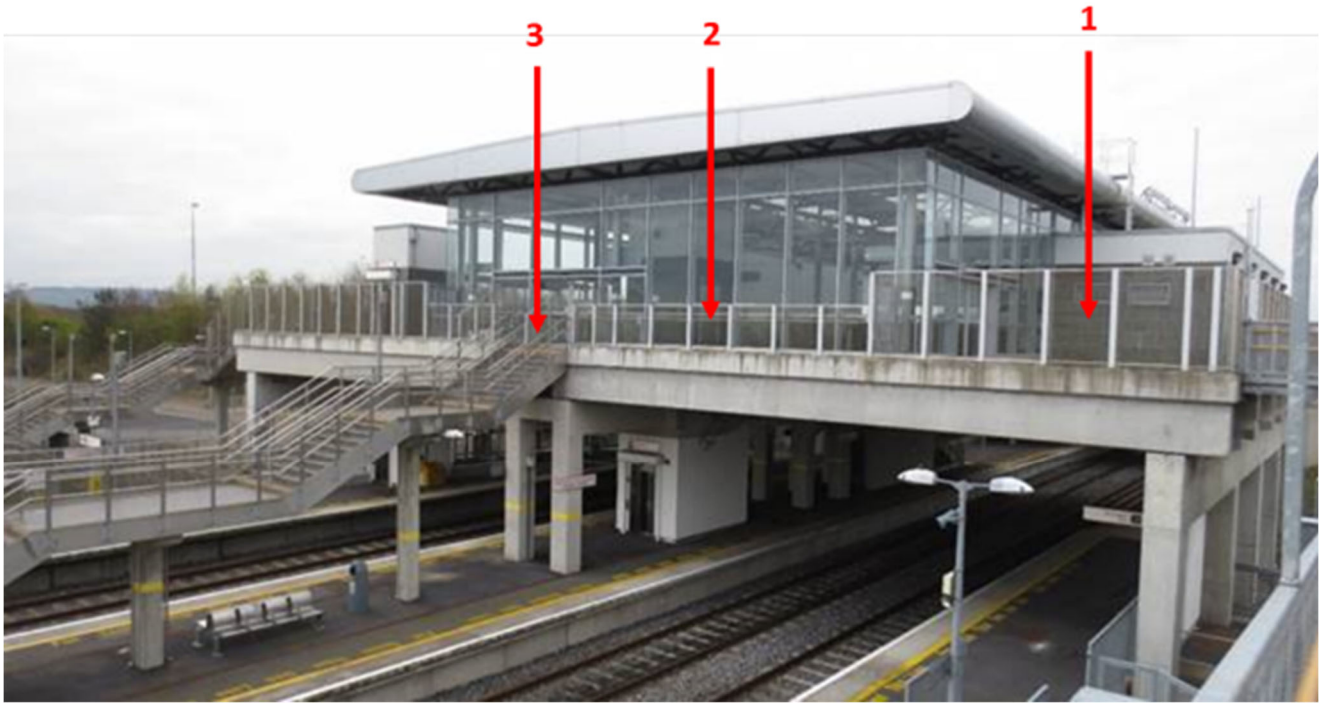

Figure 4-40 View of Clondalkin / Fonthill Station*.

*Typical Parapets to be revised (1-public areas; 2-maintenance corridor; 3-upper level of the stair)

4.6.4. Proposed Development – Retaining Walls

There are no new or modified retaining wall structures proposed.

4.6.5. Proposed Development – Roads

There are several public roads crossing the railway within this zone, all of which are via overbridges. The permanent roadworks within this zone are primarily related to improving access routes to construction compounds and substations, details are summarised in Table 4.5 below:

Table 4.5: Summary of Proposed 38kV Substation Access Road Works

Location Chainage	Location Description	Works Description
25+050 to 25+250	This is an existing gravel railway maintenance access road. It is reached from Lords Road compound north of the Railway.	Realignment/reconstruction of the existing gravel road to accommodate the Hazelhatch turnback siding.
21+150 to 22+800	Adamstown electrical substation access road. This is an existing gravel access road off Stacumny Lane south of the Railway used for CIÉ railway inspection and maintenance works.	Reshaping/regrading of existing road along with existing swale drainage and internal substation set-down area. The upgraded is to facilitate the heavy loads associated with a multi-wheeled low loader for

Location Chainage	Location Description	Works Description
		transporting of transformers and other heavy duty equipment.
18+050	Kishoge electrical substation site access. This is at the location of an existing kerbed bell-mouth junction entrance onto Adamstown Avenue.	Internal gravel hard standing areas are to be constructed to facilitate the heavy loads associated with a multi-wheeled low loader for transporting of transformers and other heavy duty equipment. Connection will be made to the existing paving at the property limit of the existing bellmouth
14+300 to 14+500	This is new gravel maintenance access road for the Park West (ESB 38kV and Traction) substation. It will require a new dedicated driveway access onto Park West Avenue junction in the location of Barnville Park signalised junction	The access road and substation hardstanding areas will be newly constructed to facilitate the heavy loads and turning space requirements; associated with multi-wheeled low loader transporting of transformers and other heavy duty equipment. The drainage will be to swales adjacent to the access road. The route is based on development lands concept design layout received from DCC.

To ensure reliability of supply to the OHLE, each traction power substation will be supplied from two independent 38kV circuits, via the ESB supply network. Details of the road works associated with ESB supply connections to the substations is covered in Chapter 5 Construction Strategy.

4.6.6. Proposed Development – Demolition / Removal

Within this zone, three existing buildings will need to be demolished, as set out in Table 4.6 below.

Table 4.6: Summary of Proposed Demolitions / Removal

Location Chainage	Heritage	Description	Conflict
24+170	n/a	3 No. existing derelict dwellings within CIÉ ownership	Proposed Hazelhatch Substation location

4.6.7. Proposed Development - Drainage

4.6.7.1. Track Drainage

No track drainage structures are proposed for this area. The drainage catchments of the railway track remain as existing, and therefore, no additional drainage system is required for this section.

4.6.7.2. Road Drainage

No changes are proposed to the existing public road layout in this zone. As a result there are no proposed changes to the public road drainage system. Where existing or new gravel road works associated with substations are required these will be served through roadside swales (existing and new).

4.6.8. Proposed Development - Electrification

4.6.8.1. OHLE Arrangement - General

In Zone A, the electrification equipment will be predominantly supported by Twin Track Cantilevers (TTC) structures, Single Track Cantilever (STC) structures will be used dependant on track geometry and space available. Figure 4-41 shows an example OHLE TTC arrangement in a four track open route.

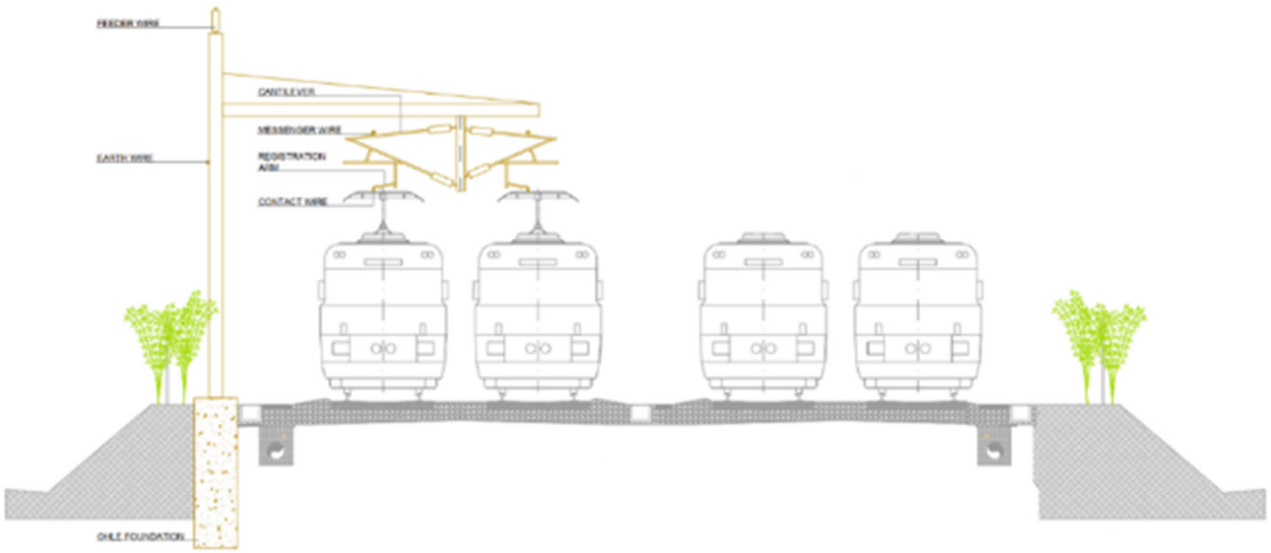

Figure 4-41 Typical OHLE TTC Arrangement in Four Track Open Route (Northern Tracks Electrified) - Facing East.

TTC will generally be placed on the north side of the line, to support OHLE on the northern two tracks. This option will minimise the disruption to the Fast Lines. The project aims to achieve a minimum contact wire height of 4.4m throughout to ensure compliance with the relevant design standards, but some deviation from this standard may be required to match localised conditions.

The proposed OHLE arrangement at the stations at Hazelhatch & Celbridge, Adamstown, Kishoge, Clondalkin/Fonthill and Park West & Cherry Orchard will be Two Track Cantilevers, Portals or Single Track Cantilevers on the platform as outlined in Figure 4-42.

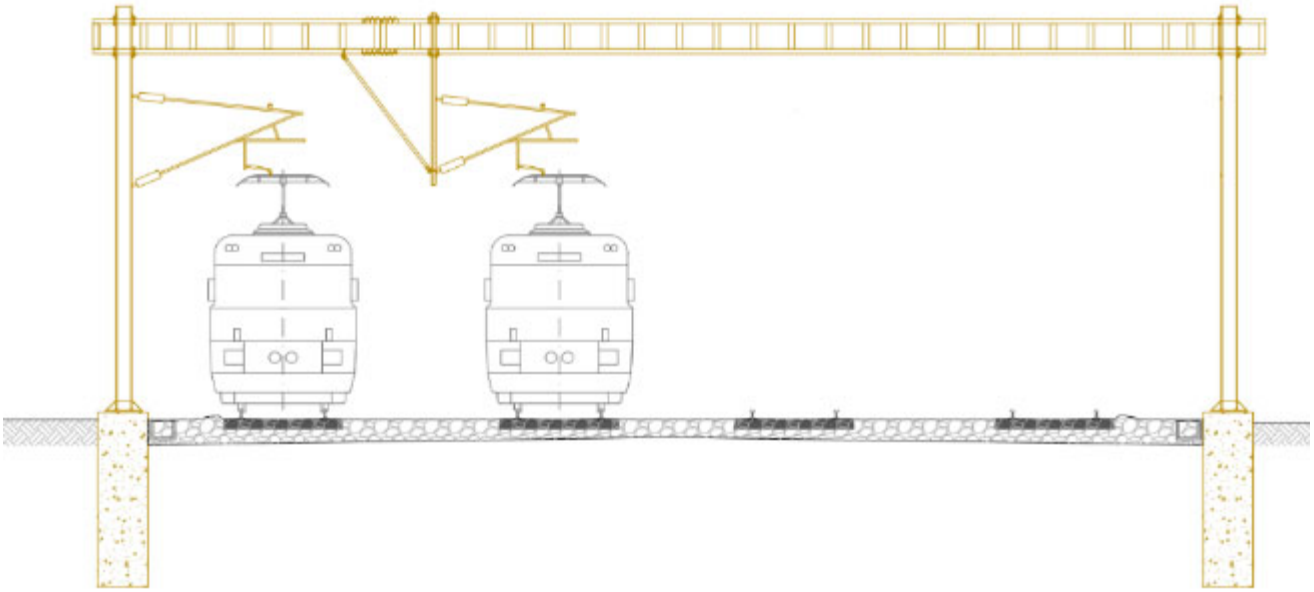

Figure 4-42 Typical OHLE portal arrangement

4.6.8.2. OHLE Arrangement - Bridges

In regard to existing bridge and station structures, the required contact wire height can be achieved throughout Zone A; except for Stacumny Bridge (OBC21) and Finnstown R120 Road Bridge (OBC19), where localised nominal track lowering is proposed to meet the necessary clearance requirements. In relation to the OHLE arrangement at the various structures, the OHLE will be connected to the bridge (Fitted Solution) or will pass through without connection (free running solution) as outlined in Table 4.7 below and Figure 4-43.

Table 4.7:Summary of Proposed OHLE Arrangement at Existing Bridges

Structure Id	Location	Proposed Solution
OBC25	Hazelhatch R405 Road Bridge	Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBC24A	New Hazelhatch Footbridge	Flexible OHLE system - Free running. OHLE to pass through the bridge without connection to the bridge
OBC24	Hazelhatch Footbridge	OBC24 is located on the non-electrified tracks
OBC23B	Straleek Footbridge	Fitted OHLE system at each side of bridge. OHLE will need to be fitted as it passes through, but the bridge itself cannot accommodate fitment
OBC21	Stacumny Bridge	Track Lowering required. Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBC20E	Crowley's Bridge	Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBC20D	Adamstown Station	Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBC19	Finnstown R120 Road Bridge	Track Lowering required. Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge

Structure Id	Location	Proposed Solution
OBC16A	Adamstown Footbridge	Flexible OHLE system - Free running. OHLE to pass through the bridge without connection to them
OBC14D	Kishoge Station Bridge	Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBC14C	Kishoge Road Bridge	Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBC13D	Clondalkin / Fonthill Station Building West	Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBC13A	Nangor Road Bridge	Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBC13C	Clondalkin / Fonthill Station Building East	Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBC13	Ninth Lock Bridge	Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBC11	Cloverhill Road Bridge	Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBC10A	M50 Motorway Bridge Note 1	Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBC9D	Park West Station Building Bridge	Flexible OHLE system - Free running. OHLE to pass through the bridge without connection to them
OBC9C	Park West Station Concourse Bridge	OHLE fitted cantilever. OHLE will need to be connected to the bridge
OBC9B	Park West Avenue Road Bridge	Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge

Note 1: The Project Team has carried out Technical Engagement with TII in relation to the M50 Motorway Bridge. The proposed works will:

- Comply with TII Publications (Standards) in accordance with relevant TII Publications (Technical) for any works that impact the national road pavement, structures and infrastructure including drainage.
- Consultation with the M3 PPP Contractor and fulfilment of requirements to complete their 3rd party protocols, via the relevant road authorities and TII will be completed in advance of proposed works where access for the construction period and any subsequent monitoring and maintenance in relation to any works proposed, including temporary and permanent signage, that affect the national road and associated junctions in terms of operational requirements, timetabling, etc.

Continued Consultation with TII will take place in connection with the proposed works to ensure that all necessary approvals will be in accordance with TII requirements.

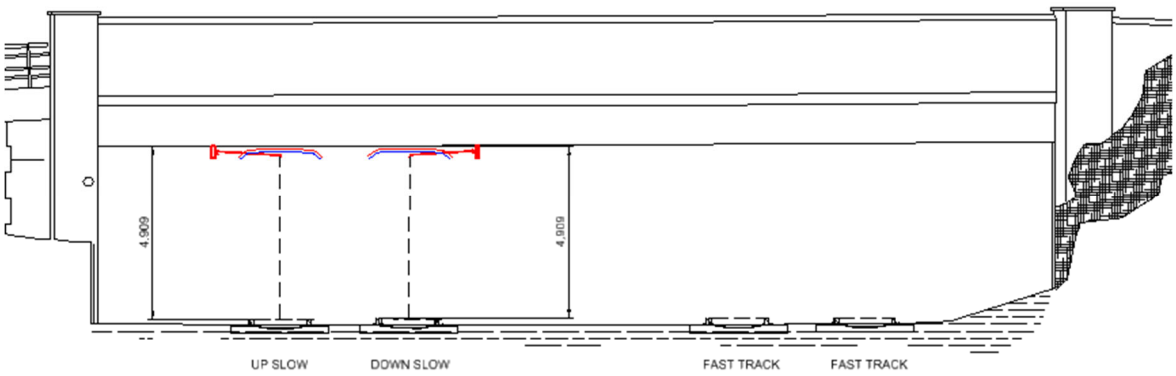

Figure 4-43 Example Cross Section for Fitted OHLE System in Four Tracking Area – Facing East

Typically, OHLE masts would be positioned at spacings ranging between 20m and 40m for a distance either side of the bridge, thereafter, reverting to the normal maximum 63m spacing along open sections of track corridor.

4.6.8.3. Substations

A total of four substations are proposed to be located in Zone A. These will be located at Hazelhatch, Adamstown, Kishoge and Park West. The main substation elements have been outlined in Section 4.5.9 but dimensions may vary according to site conditions and restrictions.

The locations are described and indicated in the figures below.

4.6.8.3.1. Hazelhatch

The proposed location of the substation at Hazelhatch is within a brown field site located to the north of the railway, adjacent to the Hazelhatch & Celbridge station car park. The site is predominantly surrounded by agricultural land with the exception of Hazelhatch and Celbridge train station and a number of adjacent private dwellings located on Loughlinstown Road and Railway Cottages to the southeast of the station on the opposite side of the railway.

The site is in the ownership of CIÉ, there are currently three disused residential dwellings on the site. Following examination of options for substation design, it was found that all three of these buildings will need to be demolished to facilitate the construction of the new substation. To facilitate vehicle access to the substation site, the existing vehicle access track shall be utilised. The existing track enters the site from Loughlinstown Road (Figure 4-44and Figure 4-45).

Figure 4-44 Hazelhatch Substation Location

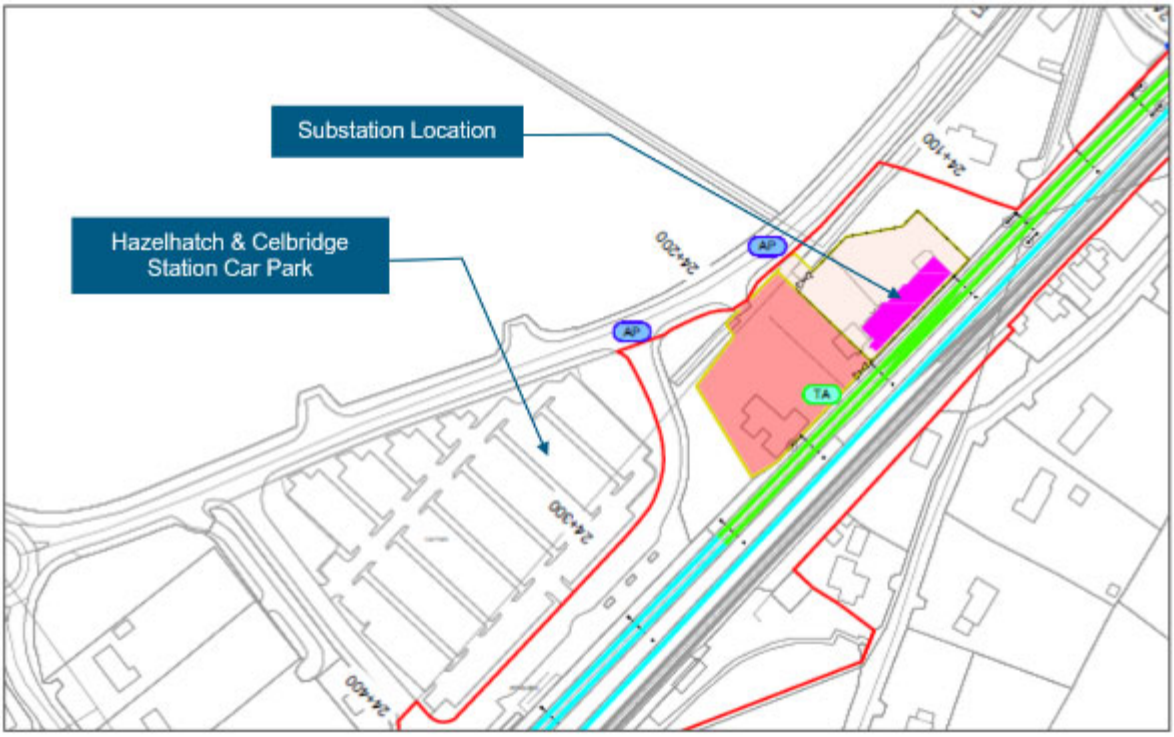

Figure 4-45 Hazelhatch Substation Layout - Indicative

Each traction power substation will be supplied from two independent 38kV circuits, the Hazelhatch substation will be connected to the ESB supply grid via the existing Celbridge Substation, located approximately 2km to the northwest. The ESB network connections and the proposed connection routes are covered in more detail in Chapter 5.

4.6.8.3.2. Adamstown

The location of the proposed Adamstown Substation is south of the railway on a greenfield site (in CIÉ ownership) and adjacent to an existing access road which joins the public road network at Stacumny Bridge. Currently this track does not have any physical separation (i.e. a fence) from the live railway.

This track will require the installation of fencing along the access track to effectively separate it from the permanent way and thus permit access by ESB Networks personnel.

The proposed 38kV supply connections will be made in the vicinity of the existing Balgaddy Substation, located approximately 3.2km to the northeast, connecting into the 38kV Balgaddy – Grange Castle Circuit. A horizontal direction drill to cross below the railway (UTX) would be required to complete the route into the substation. The proposed location is shown in Figure 4-46 and Figure 4-47.

The ESB network connections and the proposed connection routes are covered in more detail in Chapter 5.

Figure 4-46 Adamstown Substation Location

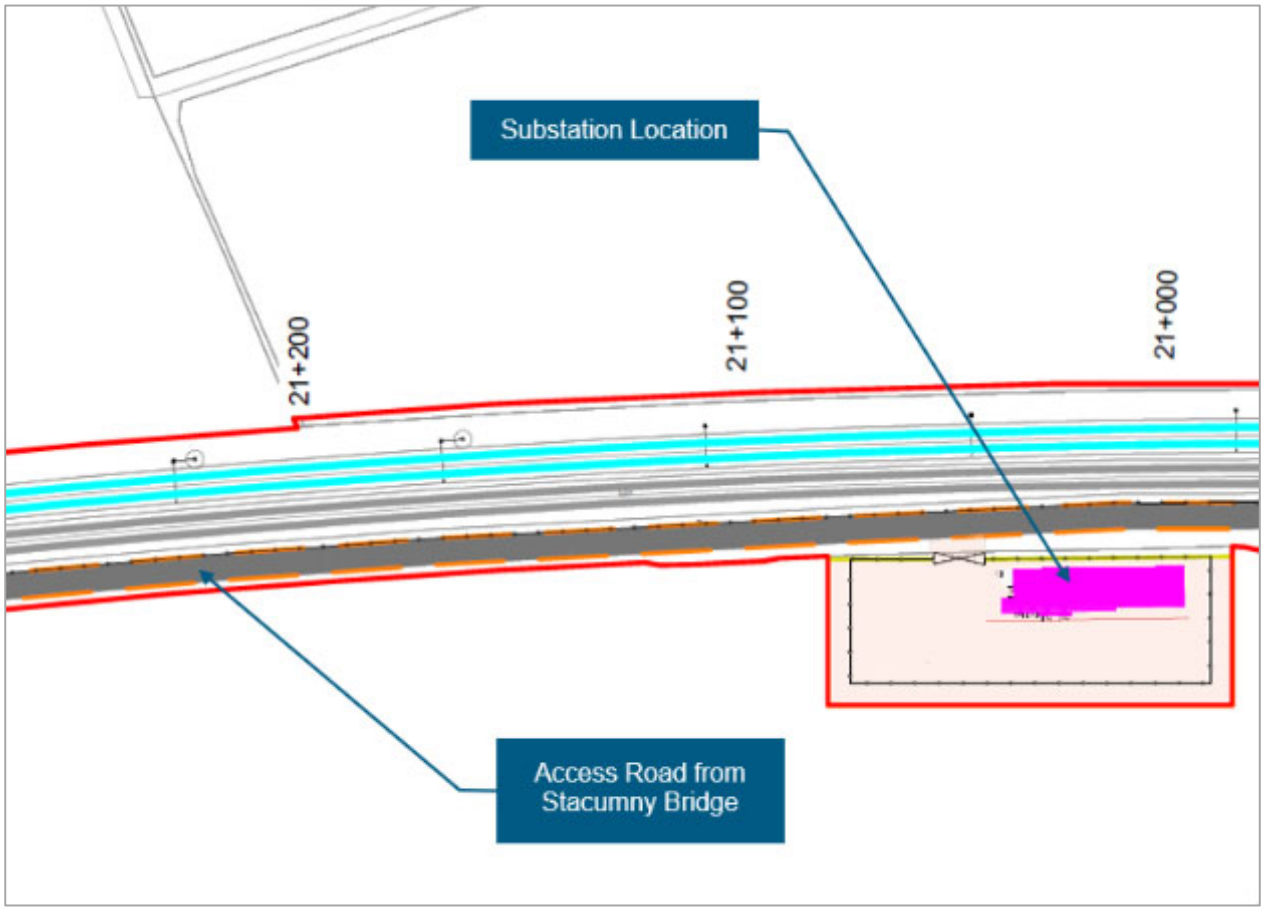

Figure 4-47 Adamstown Substation Layout - Indicative

4.6.8.3.3. Kishoge

Kishoge is located in west Co Dublin, there is an existing station at this location, which is currently not in use, but it is expected to be opened in the near future. The location for the substation is on the northern boundary of the railway corridor approximately 350m west of the R138 road bridge, between the existing road (Adamstown Avenue) and the railway, on a brown field site, currently in the ownership of South Dublin County Council (SDCC). A carpark has been constructed for the railway station and is located on the southern side of the railway corridor. To the north east of the tracks of the station is an existing education facility.

The substation site is located within the proposed 280 hectares Clonburris Strategic Development Zone (SDZ). Following consultation with SDCC, the site selected for the substation is located to the west of the proposed Kishoge Urban Centre.

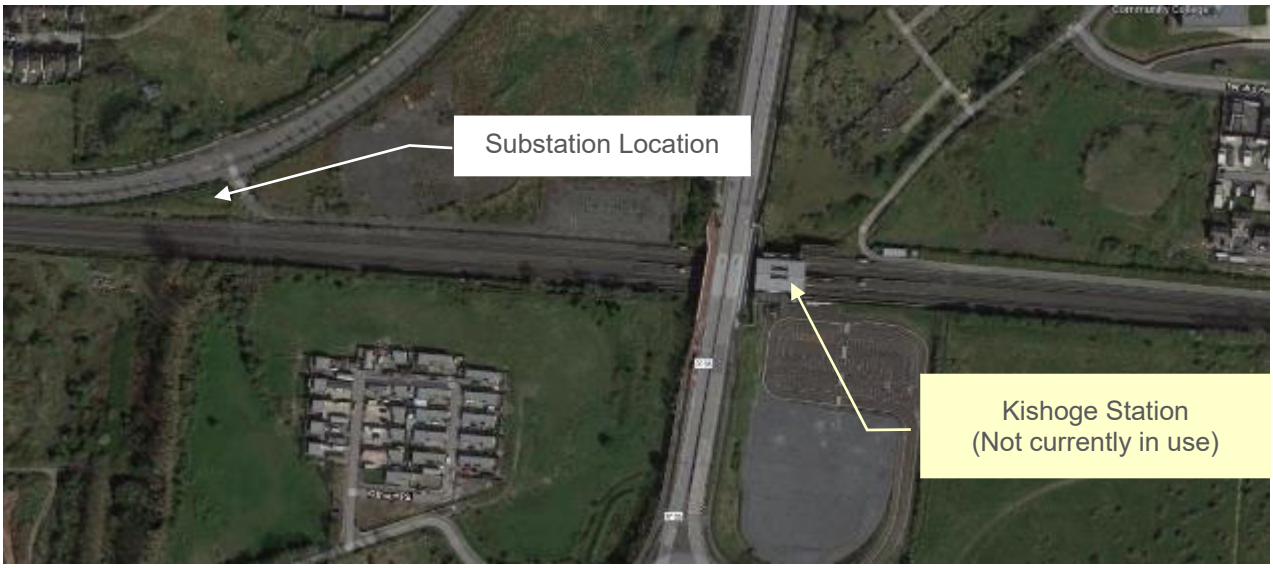

Figure 4-48 Kishoge Substation Location

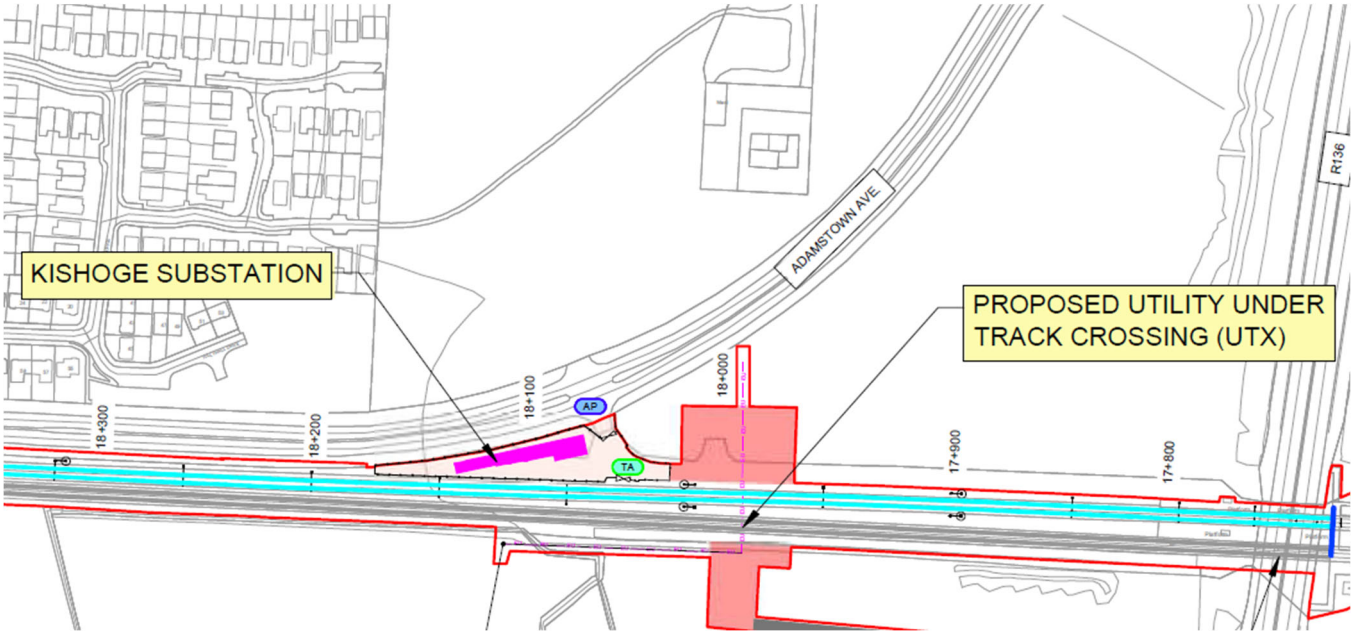

Figure 4-49 Kishoge Substation Layout

It is proposed that ESB network connections will be made by intercepting the existing 38kV circuits at the road entrance to the Grange Castle Business Park development, at the roundabout junction on the R136, located approximately 800m to the southeast.

4.6.8.3.4. Park West

The location for the proposed substation at Park West is to the north of the railway and immediately east of the M50 motorway. This is a brownfield site in the ownership of Dublin City Council. Direct road access is via Park West Avenue to the east. The existing Park West Station is located to the east, existing housing developments in the Cherry Orchard area are located further east of Park West Avenue.

The area around the proposed location is identified within the Dublin City Development Plan as a Strategic Development Regeneration Area (SDRA 4) and is zoned Z14: "*to seek the social, economic and physical development and/or rejuvenation of an area with mixed use, of which residential and Z6 (employment/enterprise uses) would be the prominent uses*". The proposed location is shown in Figure 4-50.

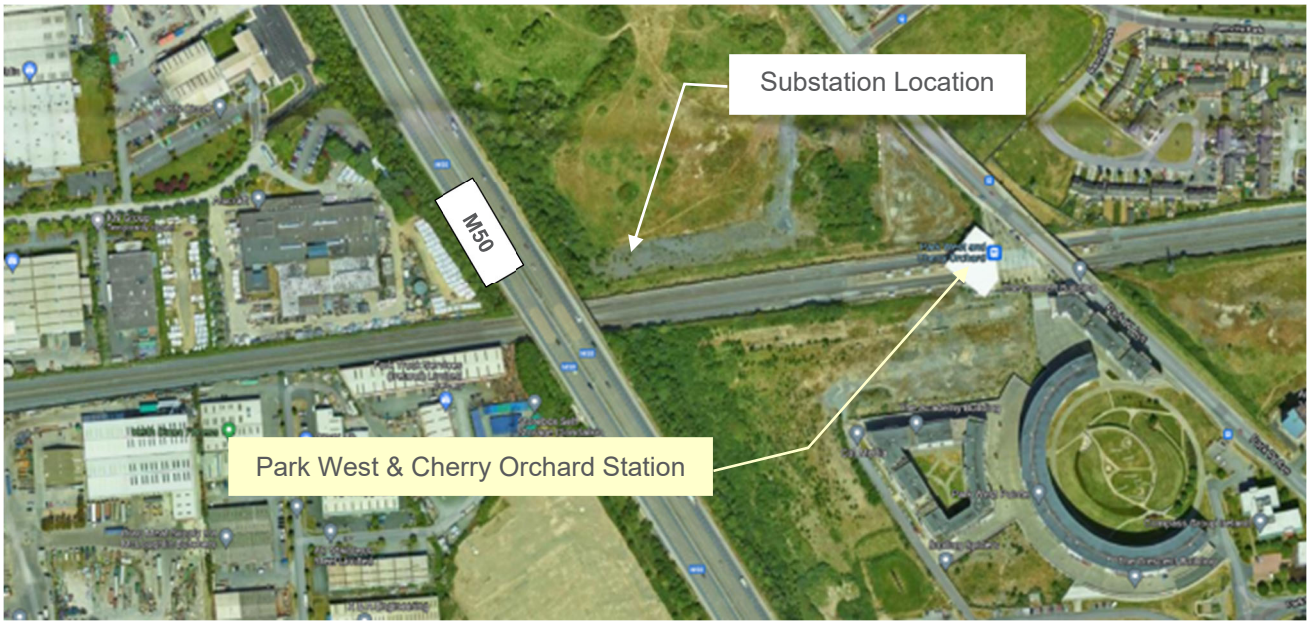

Figure 4-50 Park West Substation Location

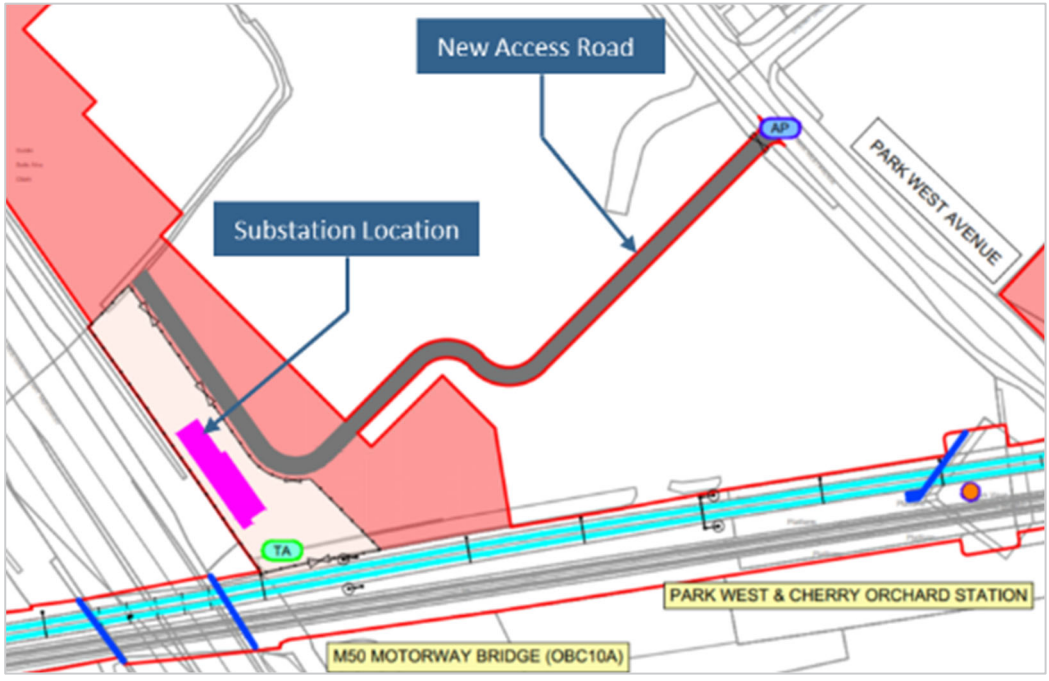

Figure 4-51 Park West Substation Layout - Indicative

The proposed connection to the ESB 38kV network is the existing Inchicore North – Clondalkin 38kV underground circuit located within the Park West development to the south of the railway. It is proposed that both required connections will be made by connecting to the Inchicore North – Clondalkin circuits

within the Park West development, located approximately 500m to the south. The ESB connections and the proposed connection routes are covered in more detail in Chapter 5.

4.6.9. Proposed Development - Signalling and Telecommunications

4.6.9.1. Signalling

New physical signalling and low voltage infrastructure comprising of a network of signalling and LV elements including localised control cabinets and cabins will be installed along this section of the route, all will be located within CIÉ owned property.

There are currently no new signalling cantilevers or gantries proposed for this section of the route. Trackside signals will be located on new signal posts adjacent to trackside.

4.6.9.2. Telecommunications

New Telecom Equipment Rooms (TER) are proposed at the following locations:

- Adamstown Station
- Park West & Cherry Orchard Station

The TER will be located close to the station buildings and within CIÉ owned property.

4.7. Zone B: Park West & Cherry Orchard Station to Heuston Station

4.7.1. Overview of Zone B

The western end of this section begins at Park West & Cherry Orchard Station and runs east, under Cherry Orchard Footbridge (OBC8B) and continues to Le Fanu Road Bridge (OBC7) and Kylemore Road Bridge (OBC5A). The rail corridor is primarily in a cutting (i.e., the rail level is below the surrounding ground level). The rail corridor initially comprises four existing rail tracks, which narrow to two tracks at Le Fanu Road Bridge.

To the east of Kylemore Road Bridge (OBC5A), south of the rail line, is the Inchicore Depot complex. The Inchicore Depot fronts onto the railway line for approximately 1km. It provides several facilities for the maintenance of trains (InterCity trains) and the track infrastructure and offices for Iarnród Éireann. The area to the north of the railway corridor is broadly residential in nature (e.g. the properties along Landen Road). Currently the rear gardens of these properties back onto the rail corridor with a retaining wall providing separation. A retaining wall also sits behind the cutting slope on the southern boundary between Kylemore and Inchicore Depot and terminates at the sidings where the railway reaches ground level. The railway along this section comprises two main line tracks which are joined by two sidings used to access the depot and for train storage.

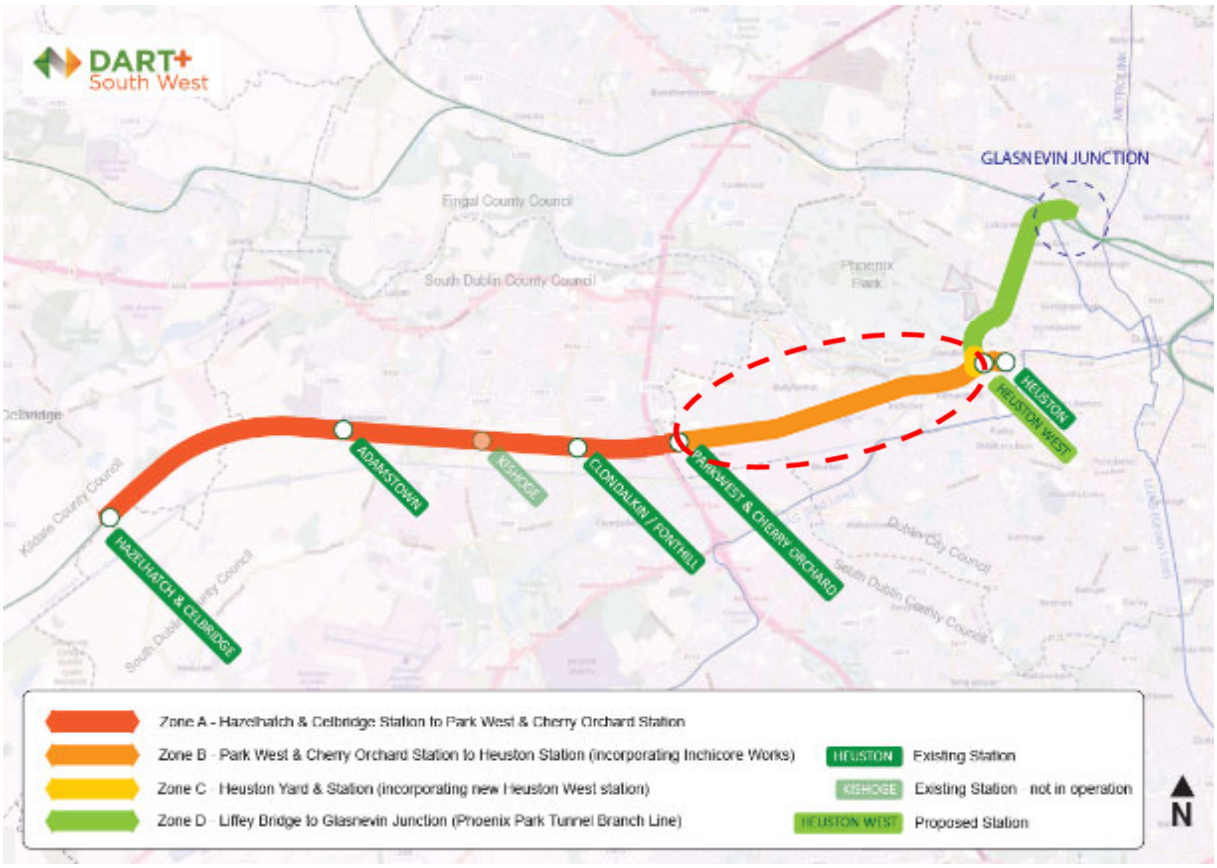

Figure 4-52 Zone B Park West & Cherry Orchard Station to Heuston Station

From here, the rail line continues east and passes under Khyber Pass Footbridge (OBC5). This is a private footbridge for Iarnród Éireann employees to access the Inchicore Depot from the north of the railway. The railway in this area currently consists of three tracks. The rail is at grade and approximately the same level as the surrounding ground. There is a masonry boundary wall along the north side of the rail corridor at this location. There is also a masonry wall on the south side of the track between Inchicore and Sarsfield.

The rail line continues over Sarsfield Road Under-Bridge (UBC4) and under Memorial Road Bridge (OBC3) where the line runs parallel to Con Colbert Road and Chapelizod Bypass. The railway along this section comprises three tracks in a cutting below ground level. The line then approaches the South Circular Road junction with two bridges carrying traffic over the railway – South Circular Road Bridge (OBC1) and St John's Road Bridge (OBC0A). The line then takes a more northerly direction as it approaches the area where the Phoenix Park Tunnel Branch Line merges with lines into/out of the existing Heuston Station i.e. Zone C.

4.7.2. Proposed Development - Permanent Way (including track lowering)

At the beginning of the zone, the Slow (northern) tracks are subject to minor realignment where the new tracks tie-in to the existing tracks. This includes track lifts up to a maximum of 80mm for Cherry Orchard Footbridge (OBC8B) that still enables the OHLE solution of a 4.4m contact wire height for the Slow tracks. The Fast (southern) tracks are not subject to any realignment. The standard width / horizontal clearance between the Slow and Fast lines is 3.6m.

Heading east, the Slow and Fast tracks are at the same level and gradient in order to accommodate the crossover between the Slow lines to the west of Le Fanu Road Bridge (OBC7) (ch.12+300-12+900) and facilitate a level bridge deck across the new span perpendicular to the tracks. The track will be lowered at Le Fanu Road Bridge (OBC7) in order to achieve the minimum contact wire height of 4.4m for the Slow tracks.

The proposed four-track layout comprises the realignment of the two existing tracks on the south side of the rail corridor to become the Fast lines. Two new Slow tracks will be positioned on the north side of the corridor as shown in Figure 4-53.

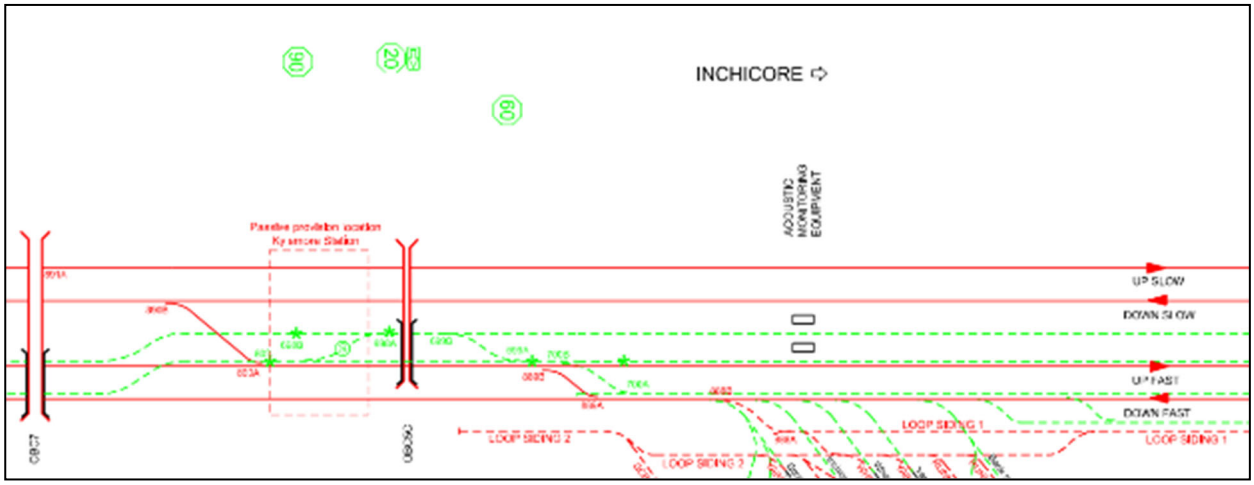

Figure 4-53 Le Fanu Road Bridge (OBC7) to Kylemore Road Bridge (OBC5A) Track Plan Layout*

*New tracks/structures = red, removed tracks = dashed green

A wide track interval between the Slow and Fast lines is proposed on the approach to Kylemore Road Bridge (OBC5A) in order to accommodate the bridge abutments of the proposed new two-span structure, which also has been designed to provide adequate room for a future Kylemore Station.

Vertically, the Slow and Fast tracks are at the same level and gradient in order to accommodate the crossover between the Down Slow and Up Fast lines to the west of Kylemore Road Bridge (OBC5A) and facilitate a level bridge deck across the new span perpendicular to the tracks. The track will be lowered at Kylemore Road Bridge (OBC5A) in order to achieve the minimum acceptable contact wire height of 4.4m for the Slow tracks.

At Inchicore Works, two new tracks (the Slow lines) will be situated on the north side of the corridor and multiple crossovers provide the necessary train pathways to access Inchicore Depot as shown in the Figure 4-54.

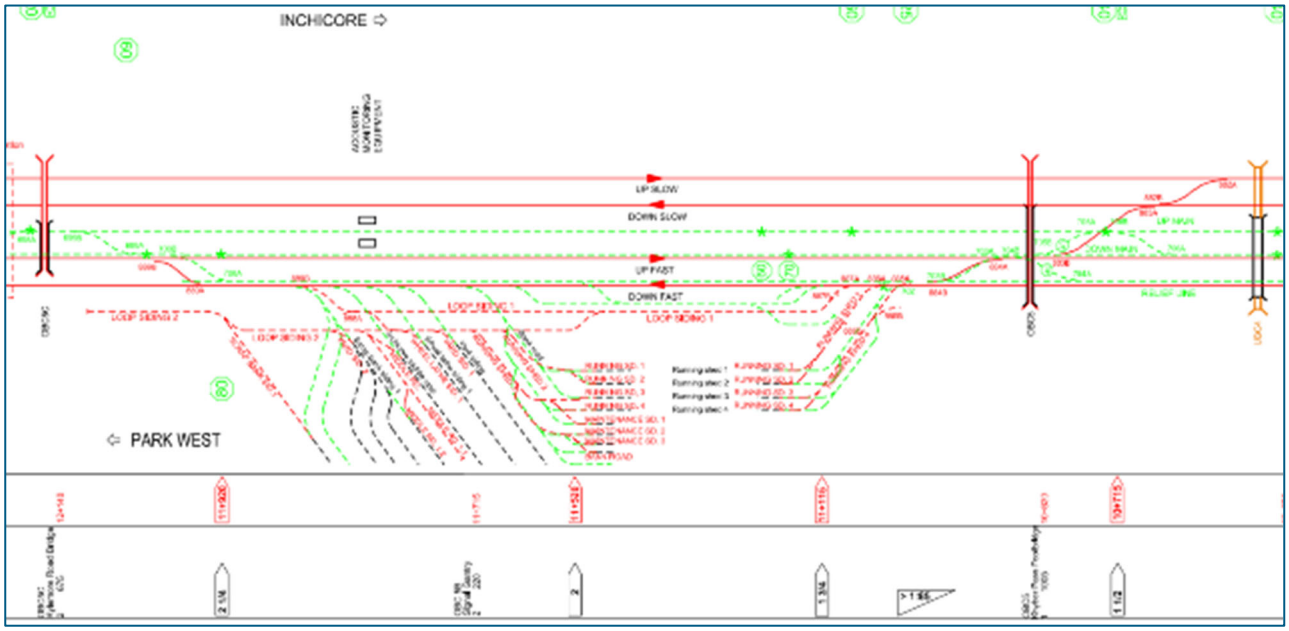

Figure 4-54 Kylemore Road Bridge (OBC5C) to Sarsfield Road Bridge (UBC4) Track Plan Layout*

*New tracks/structures = red, removed tracks = dashed green

Vertically, the Slow and Fast tracks are at the same level and gradient in order to accommodate the crossovers laddering across the four-tracking to the east of Inchicore Works. The proposed four-track layout comprises three existing tracks that are being realigned along the corridor, plus the addition of one new track, resulting in the electrified Slow tracks (north) and non-electrified Fast tracks (south) layout shown in the Figure 4-55. This is achieved by widening the corridor to the south to enable movement of the existing tracks to the south at the start of the section, with the additional fourth track also being situated on the south side over Sarsfield Road Under-Bridge (UBC4).

Further east, the new four-track layout occupies the existing footprint of the three southernmost tracks, with the fourth track now occupying the north side – this continues on eastward until Memorial Road Bridge (OBC3). As the new four-track corridor widens to the north side it cuts into the existing embankment.

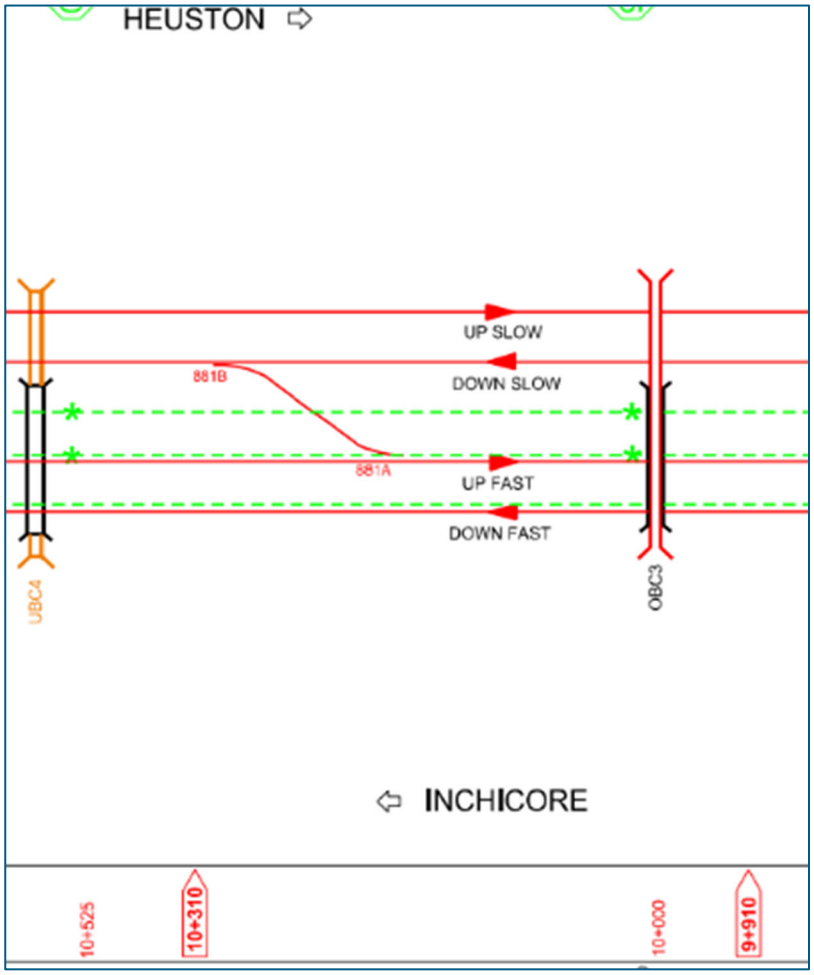

Figure 4-55 Sarsfield Road Bridge (UBC4) to Memorial Road Bridge (OBC3) Track Plan Layout*

*New tracks/structures = red, removed tracks = dashed green

The width / horizontal clearance of the tracks between the Slow and Fast lines is set at the standard clearance interval of 3.6m over Sarsfield Road Under-Bridge (UBC4) and this is maintained through the crossover situated immediately to the east, before gradually widening on the approach to Memorial Road Bridge (OBC3) to an increased interval of approx. 5.4m. This widening is to accommodate an intermediate retaining wall, needed due to the progressive level difference between the Slow and Fast lines further east towards South Circular Road Bridge (OBC1).

Vertically, the Slow and Fast tracks are at the same level and gradient at the west end of this section, in order to accommodate the crossover spanning immediately east of Sarsfield Road Under-Bridge (UBC4). This also ensures that all four tracks are at the same level over the bridge; with nominal lifts of 0.2m over Sarsfield Road Under-Bridge (UBC4). Further east towards Memorial Road Bridge (OBC3) the Slow and Fast tracks begin vertically diverging at CH10+200, 200m west of Memorial Road Bridge (OBC3), to achieve the minimum structural clearance. Track lowering of approximately 0.7m of the Slow tracks (north side) at the western parapet of Memorial Road Bridge (OBC3) will be required. The Fast tracks will be nominally lowered under Memorial Road Bridge (OBC3).

The level segregation between Slow and Fast tracks changes from 0m on the western end, through to a maximum of 2.6m (approximately) at the low point on the Slow lines in the adjacent section of track

(CH9+550); west of South Circular Road Buried Portal (proposed OBC1A cut and cover structure). The figures below show the track plan layout at the Memorial Bridge area.

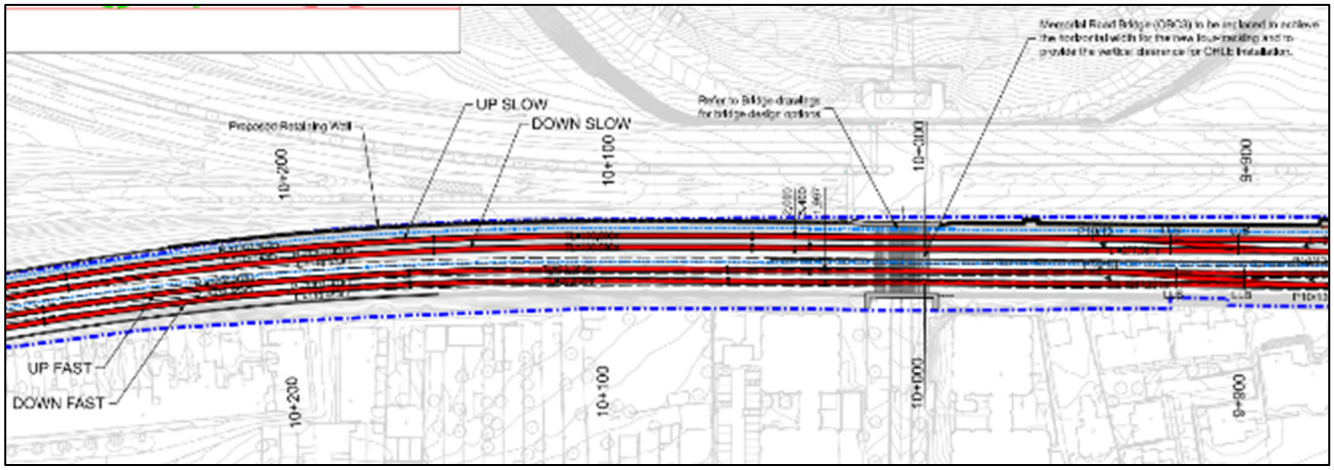

Figure 4-56 Memorial Road Bridge (OBC3) – Track Plan Layout

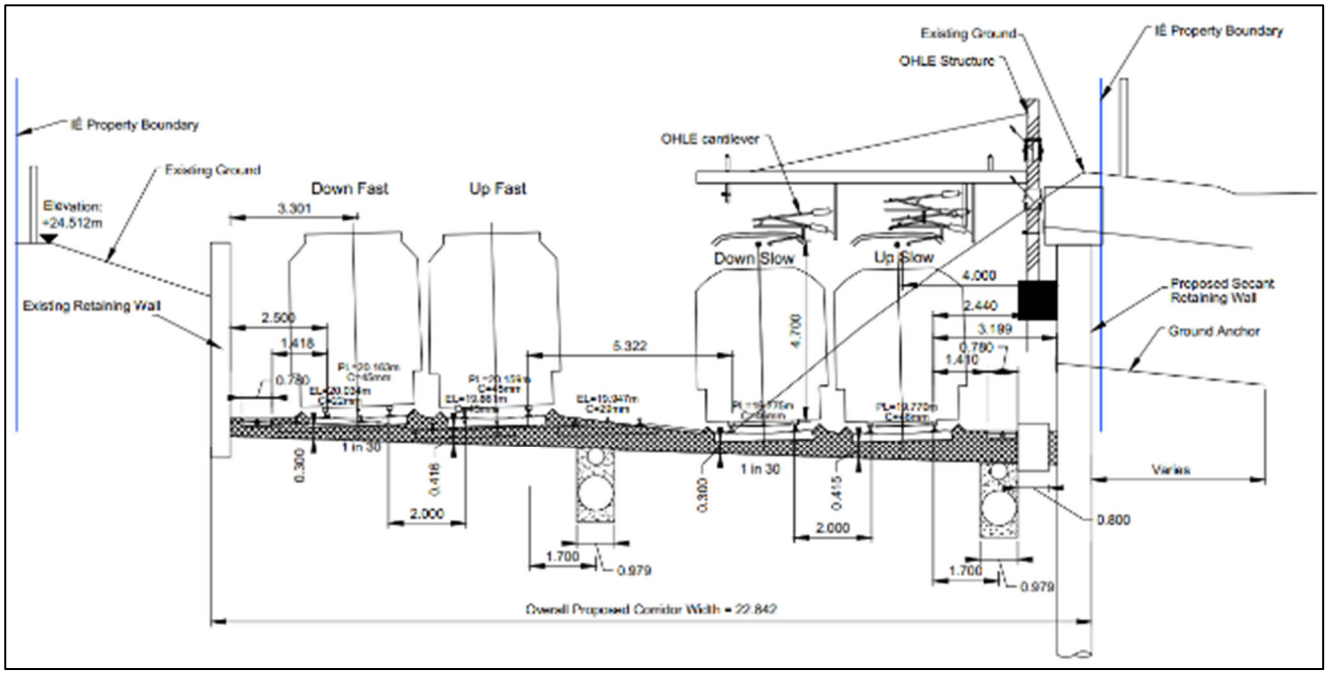

Figure 4-57 Cross section at Ch 10+103 - West of Memorial Road Bridge (OBC3) - Facing West

The proposed four-track layout comprises three existing tracks realigned on the south side of the corridor plus the addition of one new track to the north side, resulting in the electrified Slow tracks (north) and non-electrified Fast tracks (south) layout shown above.

The horizontal layout of the tracks is set at a wide interval of 5.4m to accommodate an intermediate retaining wall due to the level difference between the Slow and Fast lines on the approach to the new cut and cover structure at South Circular Road Bridge (OBC1A). The respective pairs of Slow and Fast tracks are straight, parallel and 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 gradient approaching from the west towards the new cut and cover structure at South Circular Road Bridge (OBC1A), with track lowering to the west of the new structure in the order of 2.6m to achieve the vertical clearance required for installing the OHLE. 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, with some track lowering up to a maximum of 0.2m.

The cross section in Figure 4-58 illustrates the track layout at the east end of this section.

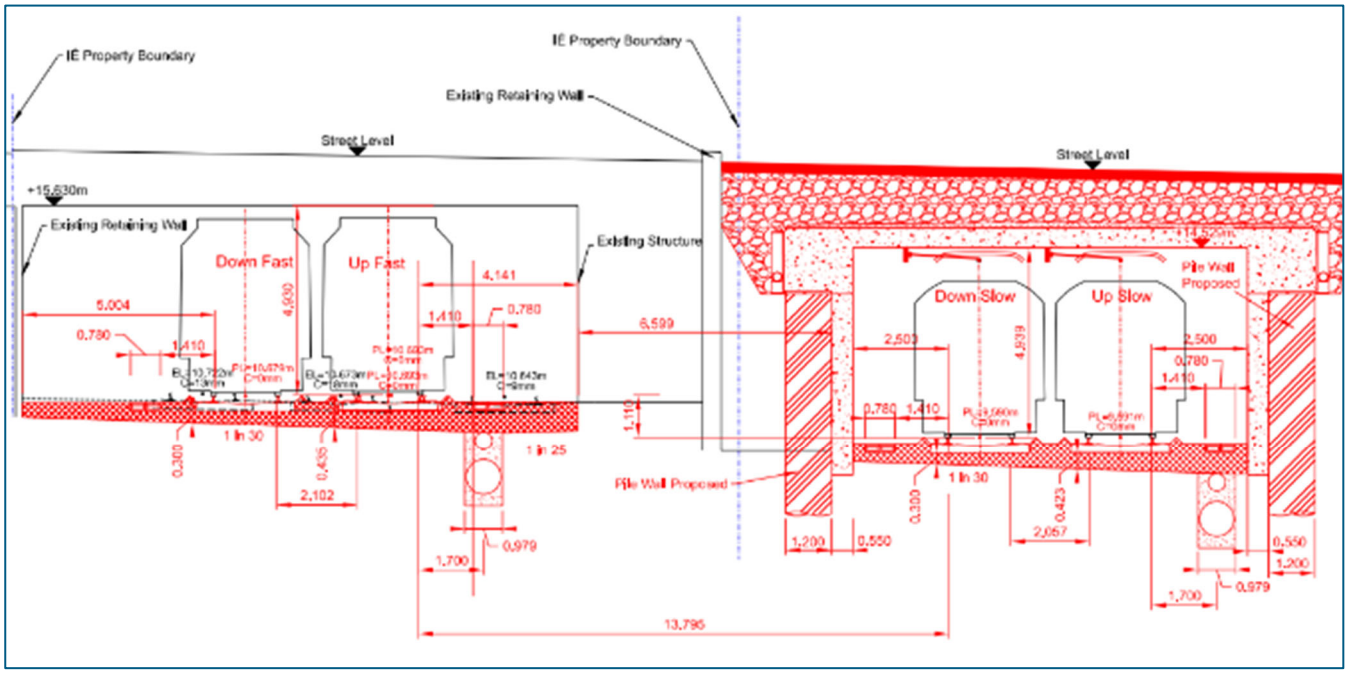

Figure 4-58 South Circular Road Bridge (OBC1) and New Cut and Cover Structure (OBC1A) – Cross section at Ch 9+401, View Facing West

A retaining wall is required to facilitate the difference in ground level between the Slow and Fast lines on the easterly approach to the new cut and cover structure at South Circular Road Bridge (OBC1A) that will accommodate the Slow lines and their associated OHLE.

The Slow to Fast line track interval will be increased between Memorial Road Bridge (OBC3) and South Circular Road Bridge (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 4-59 illustrates this.

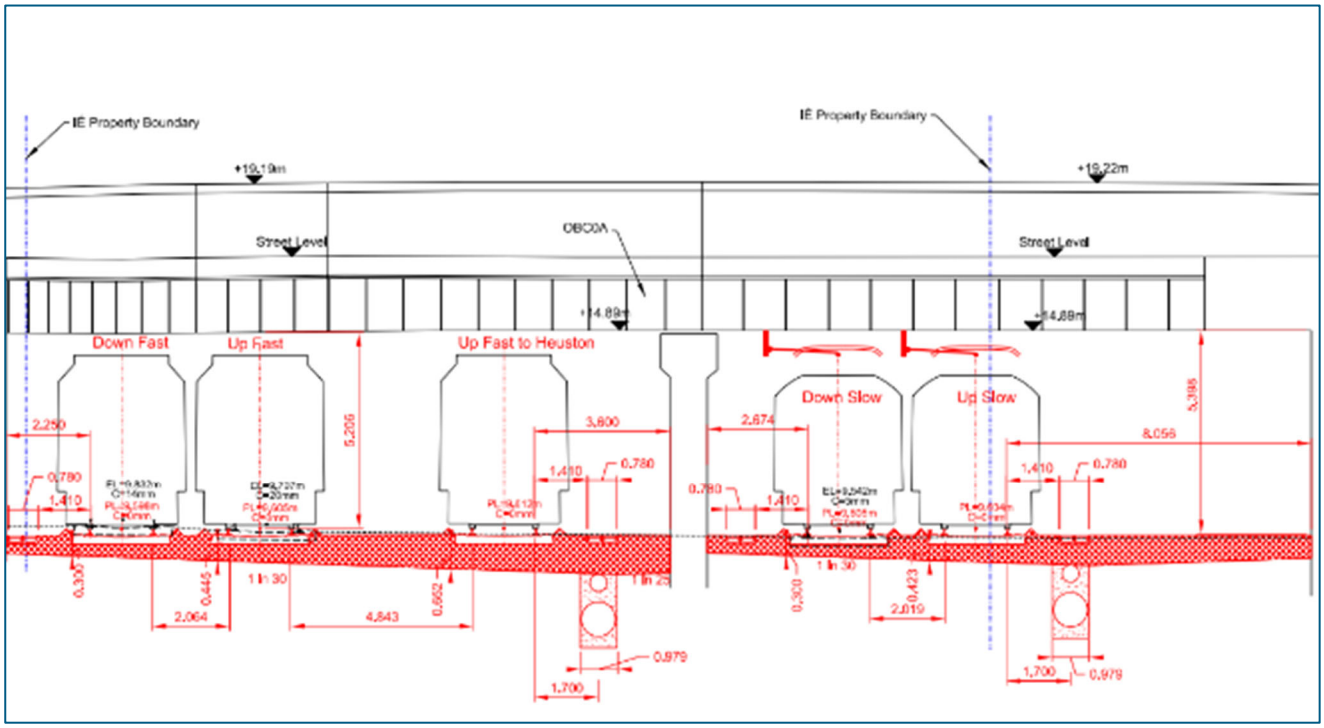

Figure 4-59 St John's Road Bridge (OBC0A) – Cross Section at Ch 9+312, View Facing West

4.7.3. Proposed Development – Clearance at Bridges

Zone B requires works at different bridges in order to achieve the necessary vertical clearance for OHLE, provide protection against electrocution and enough railway corridor width to accommodate four tracks.

The modifications to bridges comprises of bridge replacement, structural interventions, track realignment and track lowering. A summary of bridge modifications for Zone B are set out in Table 4-8**.** Note that the relationship between the bridges and the OHLE is described in Section 4.7.9 Electrification.

Table 4-8: Zone B – Modifications to Existing Bridges

Structure ID and Proposed Solution	Photograph of Structure
OBC8B - Cherry Orchard Footbridge No bridge works proposed. No change to parapets	

Structure ID and Proposed Solution	Photograph of Structure
OBC7 - Le Fanu Road Bridge Bridge Replacement and track lowering measuring approximately 0.9m	
OBC5A - Kylemore Road Bridge Bridge Replacement and track lowering measuring approximately 0.6m	
OBC5 - The Khyber Pass Footbridge Bridge Replacement	
UBC4 - Sarsfield Road Under-Bridge Bridge Deck Replacement (2 distinct wider decks) and Track Raising to ensure clearance to road not reduced below current.	
OBC3 - Memorial Road Bridge Bridge Replacement and Track lowering of Slow tracks (0.7m) and nominal lowering of Fast tracks	

Structure ID and Proposed Solution	Photograph of Structure
OBC1 - South Circular Road Bridge New cut and cover structure OBC1A (Buried Portal). Track lowering measuring 2.5m at OBC1A and track realignment under OBC1.	
OBC0A - St John's Road Bridge Track realignment under OBC0A	

4.7.3.1. Le Fanu Road Bridge (OBC7)

The existing single arch masonry Le Fanu Road Bridge (OBC7) will be replaced at the same location by a new structure with a longer span (approximately 25m) to facilitate the additional width required for the additional tracks and to carry Le Fanu Road traffic over the rail corridor (Figure 4-60). Le Fanu Road will be raised by up to 0.8m (northern abutment). The proposed bridge will be a single span bridge with prestressed beams and in-situ deck seated with abutments supported on a pile foundation.

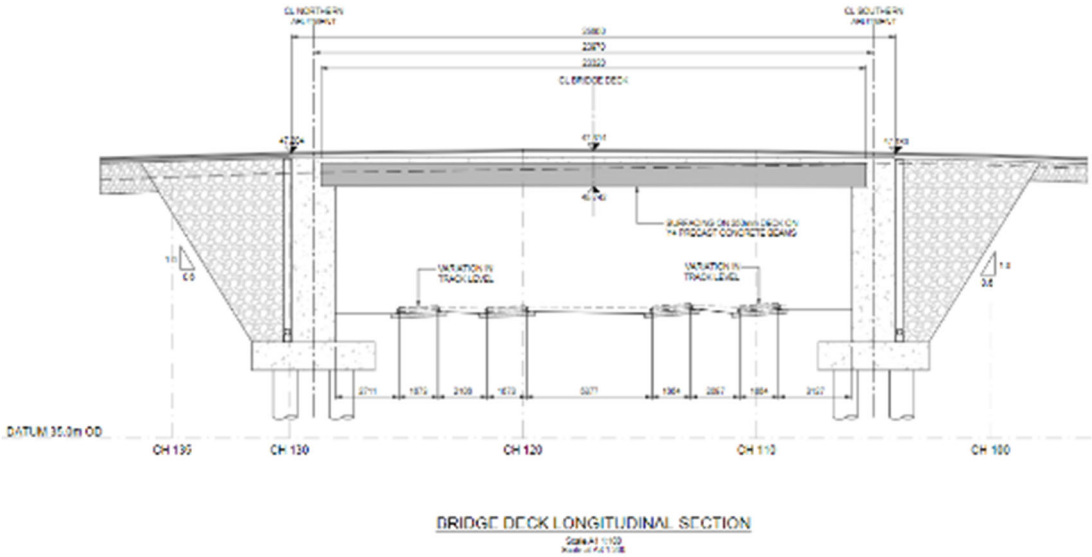

Figure 4-60 Le Fanu Road Bridge (OBC7) Bridge Deck Longitudinal Section – Facing East

The foundation design for Le Fanu Road Bridge (OBC7) will comprise six (6 no.) x 600 mm diameter bored piles socketed into the limestone bedrock at approximately 35 mOD, to support each of the bridge abutments.

The bridge parapets will be a minimum of 1.8m high over the bridge transitioning to 1.2m after the bridge. Stone masonry aesthetic/architectural cladding finishes to the reinforced concrete walls will be provided in keeping with the existing stone masonry boundary walls and bridge parapets. Where possible the stone from the existing bridge will be reclaimed and reused.

Services and road tie in requirements for Zone B are dealt with separately (refer to section 4.7.6).

4.7.3.2. Kylemore Road Bridge (OBC5A)

The existing single span reinforced concrete Kylemore Road Bridge (OBC5A) will be replaced by a new structure with a longer span (approximately 29.5m) to facilitate the additional tracks and to carry Kylemore Road traffic over the rail corridor (Figure 4-61). The bridge has also been designed to include a potential road and rail load combination to accommodate future Luas loading. Additionally, the bridge has been designed in such a way that space provision is made available for future platforms under the bridge associated with a potential future station at this location.

Kylemore Road will be raised on the northern side of the bridge by approximately 0.7m and 0.4m on the southern side. The proposed bridge will have two spans. The bridge deck will be constructed using prestressed beams and an in-situ concrete deck. The end supports will be secant piles abutments, constructed of in-situ reinforced concrete. The central pier foundation will be constructed using rising formwork over a piled foundation.

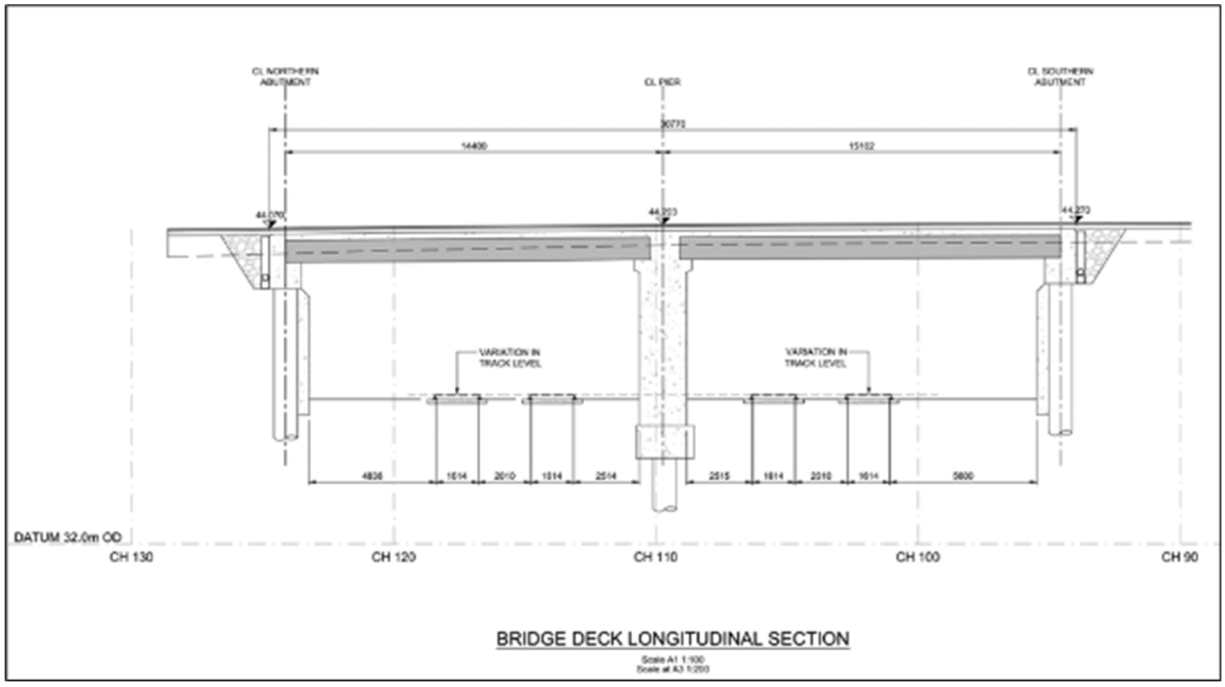

Figure 4-61 Kylemore Road Bridge (OBC5A) Bridge Deck Longitudinal Section – Facing East

The proposed foundation design will comprise a row of fifteen (15 no.) x 900 mm diameter bored piles socketed into the limestone bedrock at approximately 35 mOD, to support each of the bridge abutments and also beneath the central pier. An approximately 0.5m derailment protection wall shall be

constructed to the rail side of the abutment walls to protect the abutment from impact loading associated with derailment.

The bridge parapets will be a minimum of 1.8m high over the bridge transitioning to 1.2m after the bridge. Stone masonry aesthetic/architectural cladding finishes to the reinforced concrete walls will be provided in keeping with the existing stone masonry boundary walls and bridge parapets. Where possible the stone from the existing bridge will be reclaimed and reused.

Services and road tie in requirements for Zone B are dealt with separately (refer to section 4.7.6).

4.7.3.3. Khyber Pass Footbridge (OBC5)

The existing Khyber Pass Footbridge (OCB5) will be replaced at the same location by a new structure with a longer span (approx. 28m) to facilitate the additional tracks (Figure 4-62, Figure 4-63 and Figure 4-63). The proposed bridge will be an Iarnród Éireann owned and managed bridge for the daily use of Inchicore Depot operational personnel. The proposed bridge will comprise prestressed beams and a precast U-Deck with integrated parapets founded onto a piled base at the abutments. A steel mesh enclosure will be placed over the deck to provide full containment in line with the existing bridge. The enclosure will be constructed from a fine unclimbable mesh and shall have a minimum vertical clearance of 2.3m.

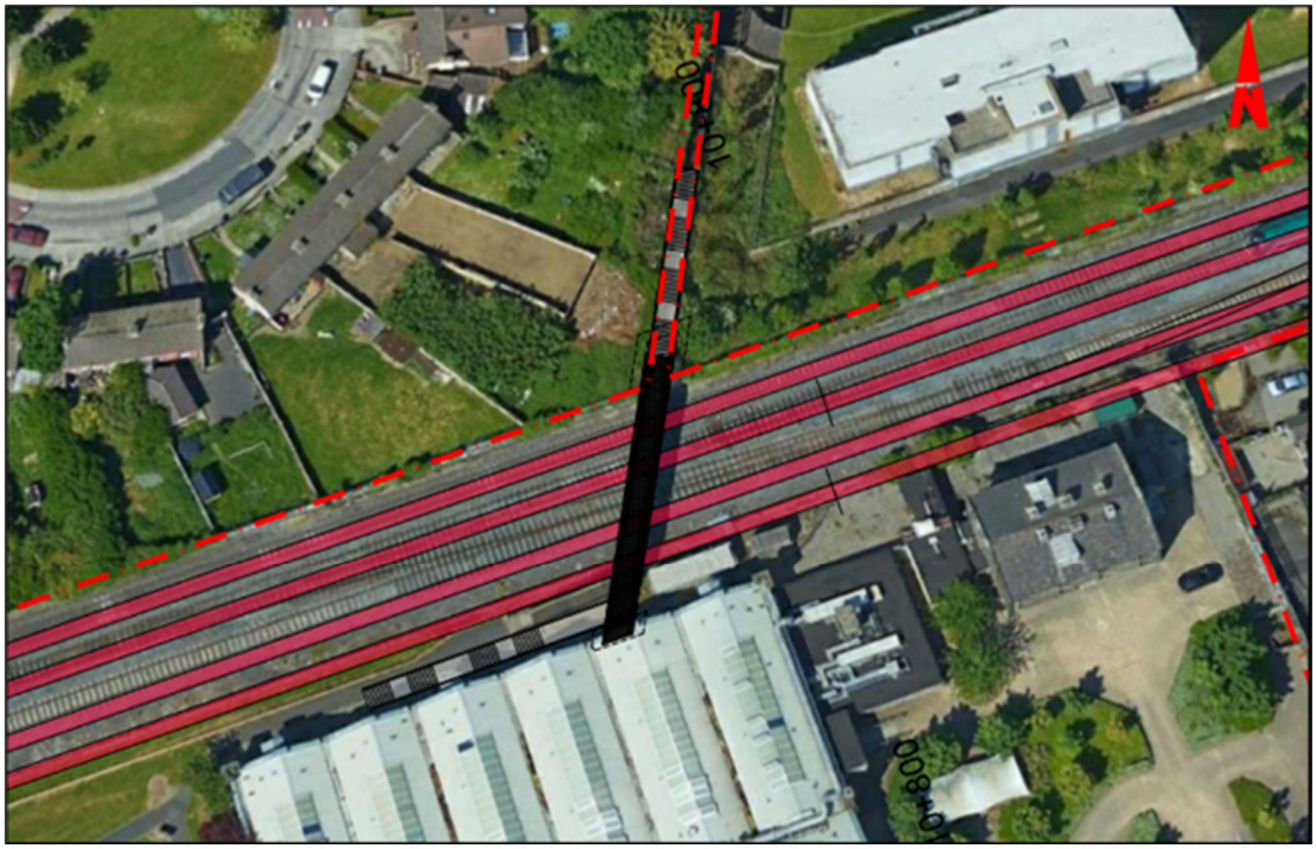

Figure 4-62 Khyber Pass Footbridge (OBC5) General Arrangement

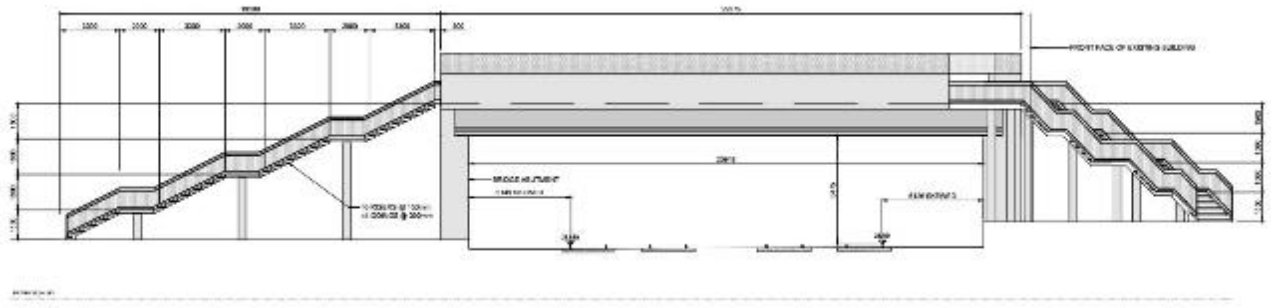

Figure 4-63 Khyber Pass Footbridge (OBC5) Bridge Deck Elevation

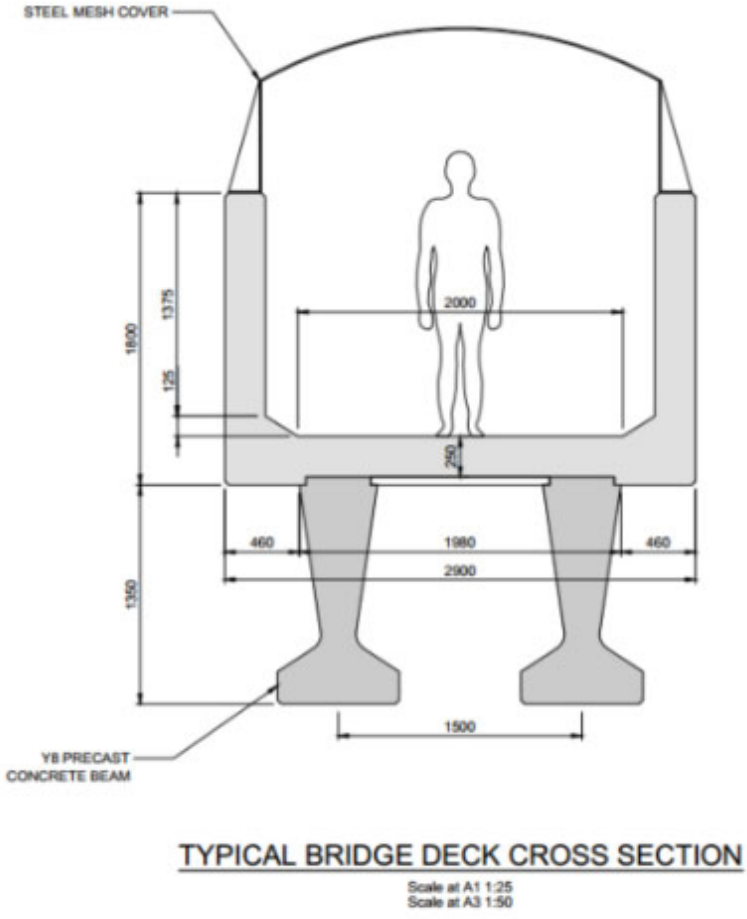

Figure 4-64 Khyber Pass Footbridge (OBC5) Bridge Deck Cross Section

The foundation design for the bridge will comprise two (2 no.) x 500 mm diameter bored piles bearing on very stiff Upper Black Clay at approximately 18mOD, to support each of the bridge abutments and stair piers.

An approximately 0.5m derailment protection wall will be constructed to the rail side of the abutment walls to protect the abutment from impact loading associated with derailment

4.7.3.4. Sarsfield Road Under-Bridge (UBC4)

The existing Sarsfield Road Under-Bridge (UBC4) will be replaced at the same location by two new structures to carry four rail tracks. The northern bridge (approximately 15.5m) will be positioned at the existing abutment location, while the southern bridge (approximately 26.5m) will be positioned to extend past the south of the existing abutments (Figure 4-65 and Figure 4-66). The superstructure will be formed from half though steel girders spanning longitudinally with a composite beam and slab deck supporting the slab track and ballast above.

The southern bridge decks will be supported on piled abutments positioned behind the existing abutments and retaining walls, while the northern bridge deck will be supported on a new curtain wall extension to the existing seating beam.

The slab track will be supported on a composite beam and slab deck arrangement spanning transversely between the main steel girders.

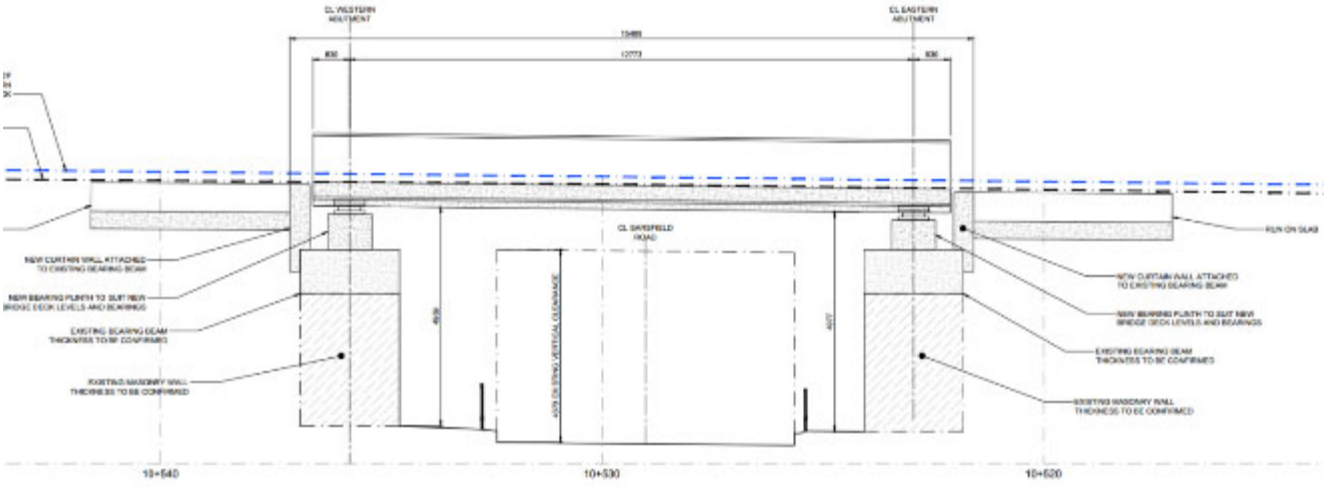

Figure 4-65 Sarsfield Road Bridge (UBC4) Northern Bridge Deck Longitudinal Section

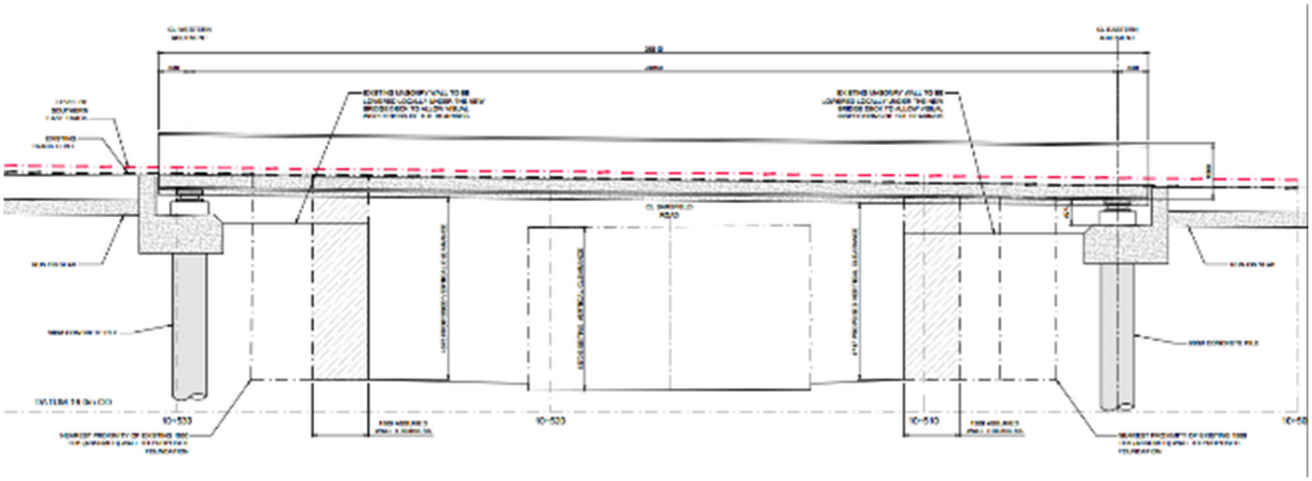

Figure 4-66 Sarsfield Road Bridge (UBC4) Southern Bridge Deck Longitudinal Section

The top of the existing retaining walls (in some localised areas) will need to be removed to allow for the construction of the new southern bridge deck, along with the existing seating beam in the location of the southern deck. Anchoring of the retaining walls at the new bridge location is anticipated. Retaining walls will also be required to support the track on the approach and departure to the structures to minimise land take requirements.

The foundation design for the southern bridge will comprise nine (9 no.) x 900 mm diameter bored piles into medium strong limestone bedrock at approximately 8mOD, to support each of the bridge abutments.

The boundary walls at the top of the road retaining wall immediately south of the new bridge will need to be reconstructed to tie back into the new railway corridor.

4.7.3.5. Memorial Road Bridge (OBC3)

The existing single span bridge connecting the Chapelizod Bypass to Inchicore Road will be replaced at the same location by a new structure with a longer span (approximately 25.5m) to facilitate the additional tracks (Figure 4-67 and Figure 4-68).

The proposed new structure will be widened and lengthened but would maintain the existing horizontal and vertical alignment as the existing structure. Track lowering of the electrified tracks will be used to achieve the required vertical clearances.

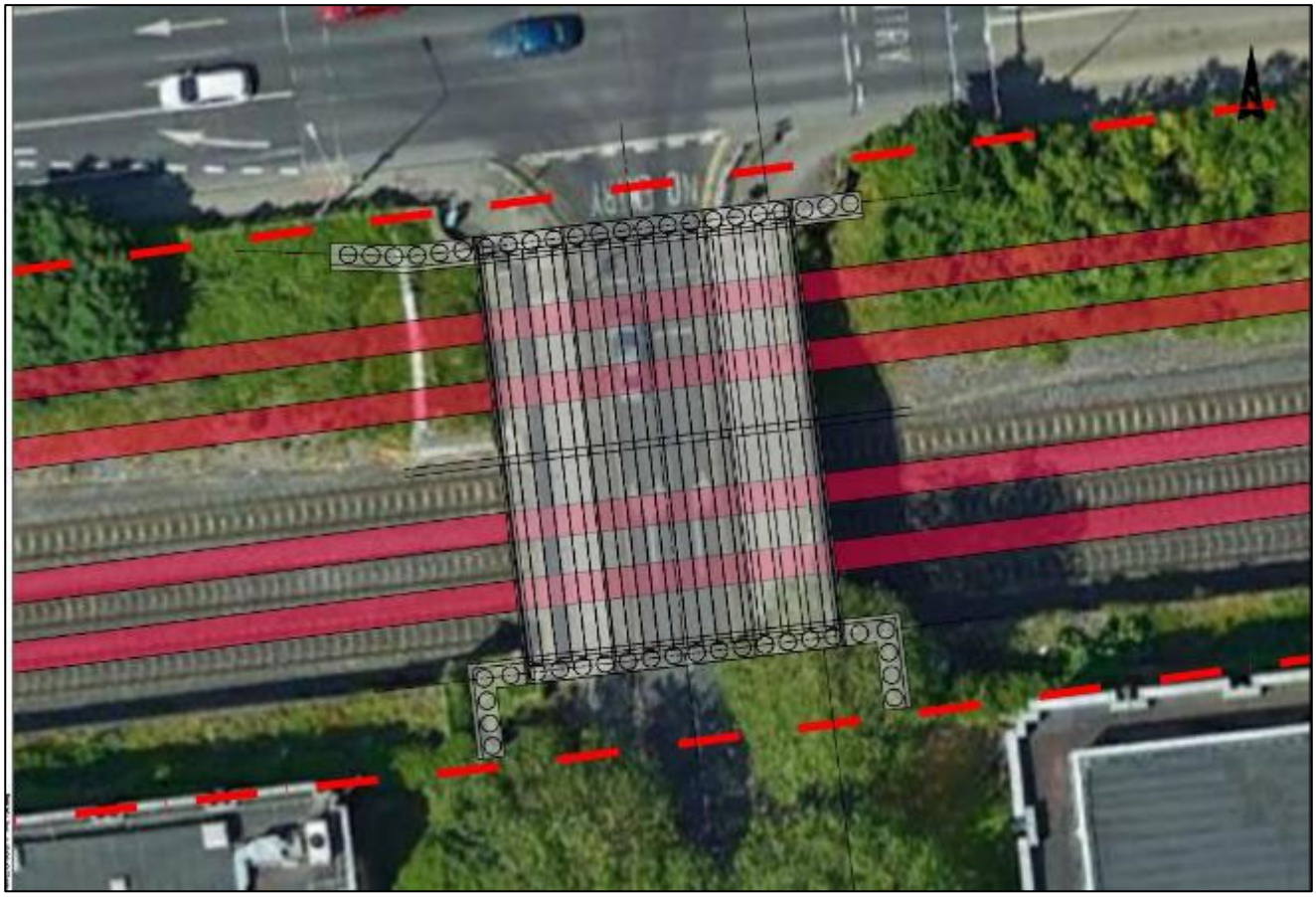

Figure 4-67 Memorial Bridge (OBC3) – General Arrangement

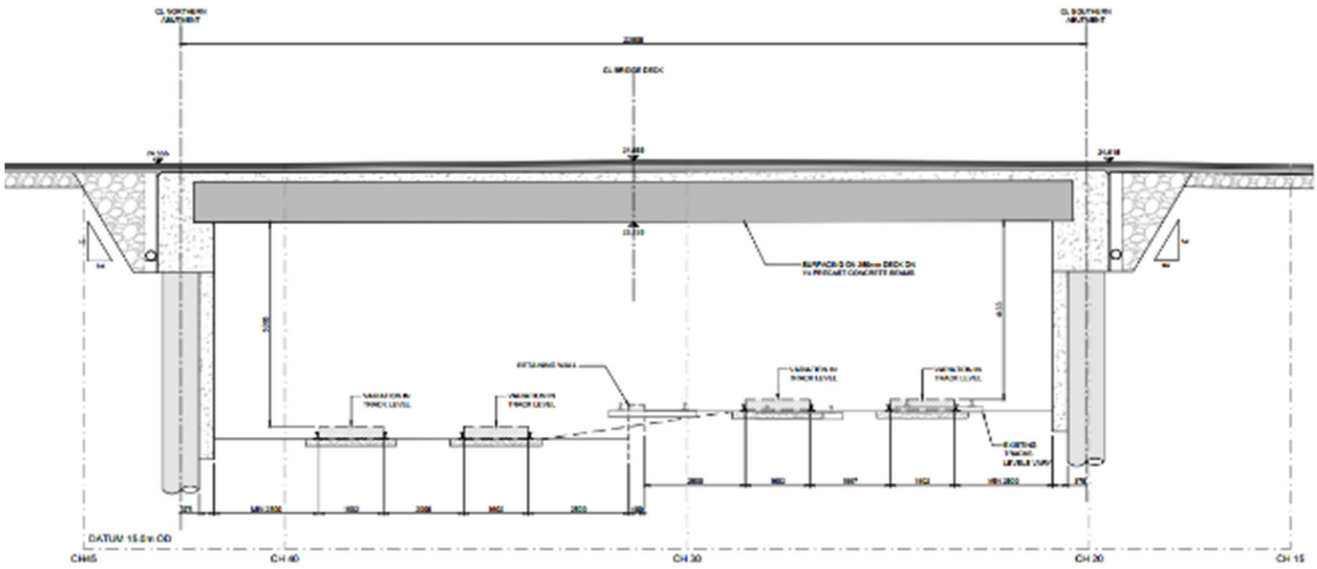

Figure 4-68 Memorial Road Bridge (OBC3) Bridge Deck Longitudinal Section

The overbridge will be integrally connected to the abutments thus removing the requirement for bearings and expansion joints. An in-situ reinforced concrete diaphragm will provide continuity between the superstructure and the abutments.

The foundation design for the bridge will comprise fourteen (14 no.) x 900 mm diameter bored piles socketed into the strong limestone bedrock at approximately 8.5mOD, to support each of the bridge abutments.

The bridge parapets will be a minimum of 1.8m high over the bridge transitioning to 1.2m after the bridge. Stone masonry aesthetic/architectural cladding finishes to the reinforced concrete walls will be provided in keeping with the existing stone masonry boundary walls and bridge parapets. Where possible the stone from the existing bridge will be reclaimed and reused. A Conservation Architect will inform the final finishes of the bridge.

An approximately 0.5m derailment protection wall will be constructed to the rail side of the abutment walls to protect the abutment from impact loading associated with derailment.

4.7.3.6. New Cut and Cover Structure (Buried Portal) South Circular Road OBC1A

A new portal box structure is proposed within the railway corridor on the north side of the existing bridge which would provide space for 2 no. of electrified tracks. This structure will facilitate new tracks at a lower level to that of the existing tracks to achieve the required vertical clearance for the electrification along the new structure. As the track levels will be different, a retaining wall will be required between the Fast and Slow tracks (Figure 4-69 and Figure 4-70).

The buried portal would be approximately 120m long and have a clear span of approximately 10m. The structure will 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. The end supports will be secant piles abutments, constructed of in-situ reinforced concrete.

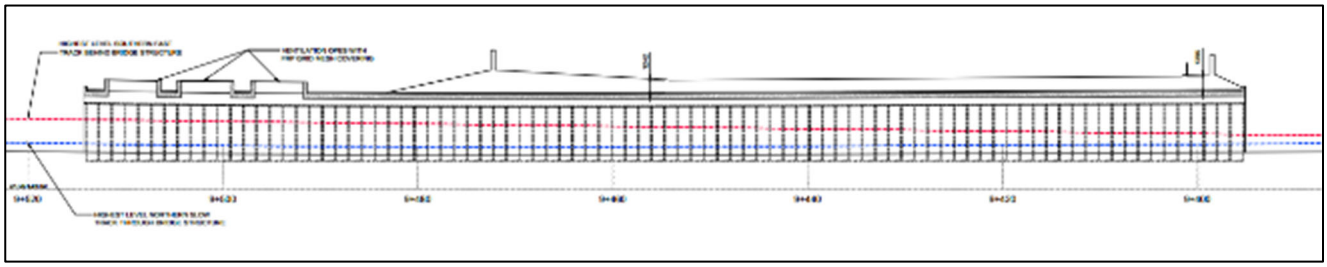

Figure 4-69 New South Circular Road Bridge (OBC1A) Longitudinal Section

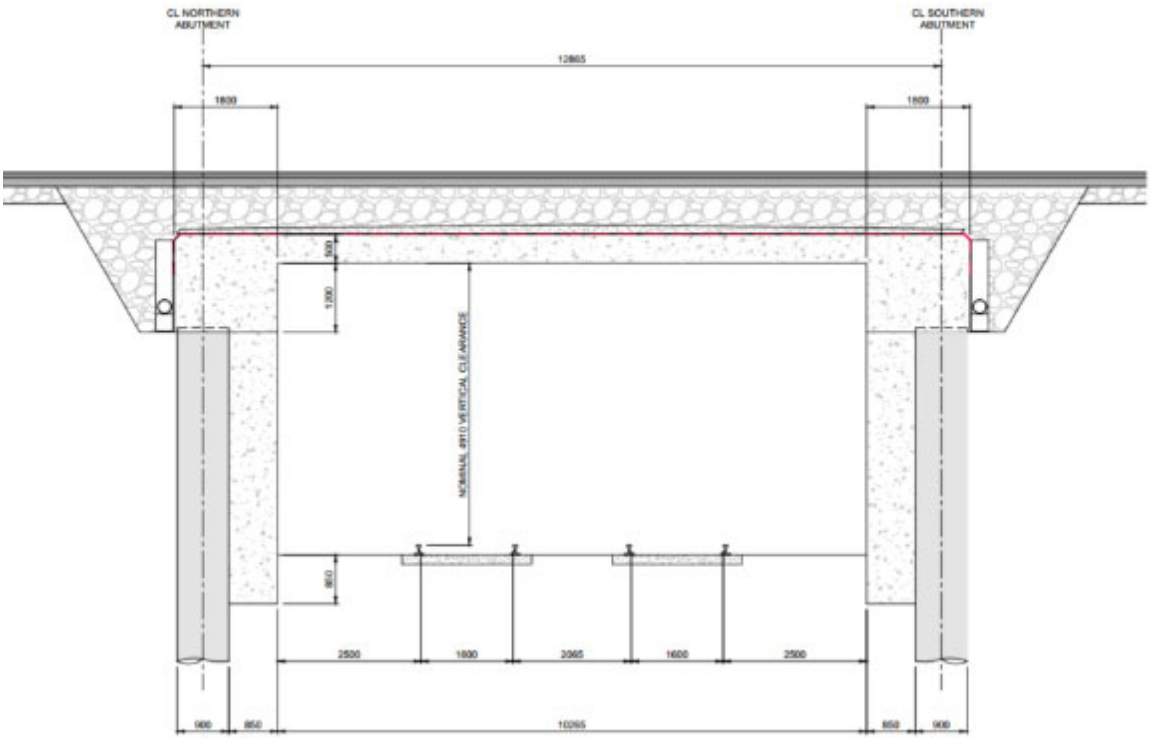

Figure 4-70 New South Circular Road Bridge (OBC1A) Typical Cross Section

The foundation design will comprise a row of 131 no. x 900mm diameter bored piles on stiff to very stiff Black Boulder Clay to support each of the bridge abutments.

The boundary walls will be reconstructed along the length of the existing road corridor. The walls will provide a minimum height of 2.4m above the adjacent footpath.

Stone masonry aesthetic/architectural cladding finishes to the reinforced concrete walls will be provided in keeping with the existing stone masonry walls around the South Circular Road junction.

4.7.4. Proposed Development - Retaining Walls

New retaining walls are required along sections of both the north and south sides of the rail corridor in Zone B in order to form the Slow (northern) and Fast (southern) tracks, cess edges and to retain the slopes as the 4-track corridor enters cutting.

A description of retaining wall structures and wall or soil anchors are set out in Chapter 5. More specifically for Zone B, the location type and height of proposed new retaining wall structures, including extent of substratum wall anchors, are indicated on the alignment drawings and in Table 4.9 and Table

4.10. The new / replacement retaining wall height (above track cess level) will vary 3 - 9m across the zone as shown in the table below. The substratum wall anchors will extend beyond the retaining walls between 8 to 30 m (length) and 1 – 30m (depth) under adjoining properties.

Generally, along the northern perimeter, sections of new retaining walls are proposed starting at ch.13+100 and continuing to ch.11+200. Moving further eastwards the existing boundary wall is to be retained where possible (subject to design development). A new section of retaining wall is required as the rail corridor enters cutting east of Sarsfield Road Under-Bridge (at ch.10+400) to retain the slopes between the railway and Con Colbert Road. This new retaining wall will continue to ch.9+500 where the new portal structure starts. The requirement for retaining walls ends east of the new portal structure.

Generally, along the southern perimeter, sections of new retaining walls or modification to existing retaining walls are proposed starting at ch.13+300 and continuing to the new headshunt into Inchicore Depot at ch.11+650. The existing boundary wall on the southern side of the corridor between Inchicore and Sarsfield will be removed. Sections of new retaining wall are required as indicated in Table 4.9 and Table 4.10 below.

Table 4.9: Zone B New / Replacement Retaining Wall Requirements (Northern Perimeter)

Section	Location	Chainage	Proposed Retaining Wall	Height	New/Replaced
Section 1 (around OHLE mast)	Rear of 18 Cherry Orchard Drive	13+100	Secant Wall	0.8m high	New
Section 2 (Enlargement of rail corridor for four- tracking)	Rear of 7 Cherry Orchard Drive to rear of 33 Cloverhill Road	13+060 – 12+660	King Post Wall	0.5m - 2.0m high	New
Section 3 (Enlargement of rail corridor for four- tracking)	Rear of 33 Cloverhill Road to rear of 421 Landen Road (including Le Fanu and Kylemore Road Bridge)	12+660 – 11+700	Secant Wall + Secant wall anchors	2.0m - 7.2m high	New
Section 4 (Widening of rail corridor for four-tracking)	Rear of 421 Landen Road to rear of 167 Landen Road	11+700 – 11+320 – 11+270	Soil Anchors + Secant Wall and anchors	0.5m - 4.6m high	New
Section 5 (Widening of rail corridor for four-tracking)	Con Colbert Road	10+370 – 11+320 – 10+250	King Post Wall + Secant Wall and anchors	2.2m – 4.6m high	New
Section 6	Con Colbert Road to South	10+240 – 9+510	Secant Wall	4.6m – 10.2m high	New

Section	Location	Chainage	Proposed Retaining Wall	Height	New/Replaced
(Widening of rail corridor for four-tracking / new portal structure)	Circular Road Bridge		+ Secant wall anchors		
Section 7 (Widening of rail corridor for 4 tracking / new portal structure)	South Circular Road	9+400	Secant Wall + Secant wall anchors	8.2m – 10.2m high	New
Section 8 (Heuston West pedestrian/cycle connection to Islandbridge)	The pedestrian and cycle ramp and stairs walls	8+980 – 8+892	Cantilever Wall	1.5m – 3.0m high	New with additional N2 containment parapet and boundary fence on top
Section 9 (Heuston West retaining walls)	Top of River Liffey Embankment	8+895	Cantilever Wall	1.0m – 1.5m high	New with additional N2 containment parapet and boundary fence on top.

Table 4.10: Zone B: New / Replacement Retaining Wall Requirements (Southern Perimeter)

Section	Location	Chainage	Proposed Retaining Wall	Height	New/Replaced
Section 1 (Widening of rail corridor for 4 tracking)	Friel Avenue	13+330 - 12+700	King Post Wall + Wall anchors	0.3m – 4.4m high	New
Section 2 (Widening of rail corridor for four-tracking)	Le Fanu Bridge, Kylemore Park North, Kylemore Bridge and Westlink Industrial Estate	12+700 – 11+940	Secant pile wall + Secant pile anchors	4.2m – 4.6m high	New
Section 3 (Widening of rail corridor for four-tracking)	Inchicore Works	11+940 – 11+760 – 11+680	Secant pile wall and anchors + King Post Wall	0.3m – 3m high	New
Section 4 (Widening of rail corridor for four-tracking)	Under Khyber Pass Bridge and along engineering services building	From 10+870 - 10+800	Cantilever wall	0.5m – 1.0m high	Replaced existing retaining wall at new location with boundary fence on top

Section	Location	Chainage	Proposed Retaining Wall	Height	New/Replaced
Section 5 (Widening of rail corridor for four-tracking)	Inchicore Attenuation Facility	10+615 – 10+580	King Post Wall	2.0m	Replaced existing retaining wall at new location with boundary wall on top.
Section 6 (Widening of rail corridor for four-tracking)	East of Sarsfield Road Under-Bridge to rear of Woodfield Cottages	10+500 – 10+310	King Post Wall + Wall anchors	1.0m – 2.2m high	Replaced existing retaining wall at new location with boundary wall on top.
Section 6 (Widening of rail corridor for four-tracking)	East of Sarsfield Road Under-Bridge to rear of Woodfield Cottages	10+310 – 10+160	Secant pile wall + Secant wall anchors	2 – 3m high	Replaced existing retaining wall at new location
Section 7 (realignment of Guinness siding)	Along western cess of the realigned Guinness Siding	9+080 – 8+950	King Post Wall	1.0m – 2.0m high	Replaced existing retaining wall at new location
Section 8 (Construction of new Islandbridge Substation)	South of Heuston Station yard (close to St John's Road boundary	9+210 – 9+080	Cantilever wall	3.0m – 4.0m high	New with additional N2 containment parapet and boundary fence on top

A retaining wall is also required within the rail corridor to facilitate the difference in ground level between the Slow and Fast lines on the approach from the west towards the proposed new cut and cover structure at South Circular Road Bridge (OBC1A) that will accommodate the Slow lines and their associated OHLE.

4.7.5. Proposed Development – Boundary Treatment

Existing boundary fences and walls will need to be reconstructed in a number of locations as a result of the track widening works in Zone B. In addition, new fencing and/or walls will be required for new infrastructure.

4.7.6. Proposed Development - Roads

4.7.6.1. Le Fanu Road

Le Fanu Road Bridge (OBC7) will be replaced to accommodate the rail corridor widening. The proposed arrangement for both sides of the road over the bridge, and on departures and approaches to the bridge, is:

- 1.75m wide cycle track (approximately);

- 1.8m wide footpath (minimum) with 75mm kerb height to the cycle track adjacent; separating it from the cycle track;
- 6.5m carriageway (approximately).

Off-road segregated cycle tracks are provided except where the geometry of the road dictates reverting to on-road cycle lanes.

Figure 4-71 shows the roadway plan and profile at Le Fanu Road over the area reinstated to accommodate the bridge raising.

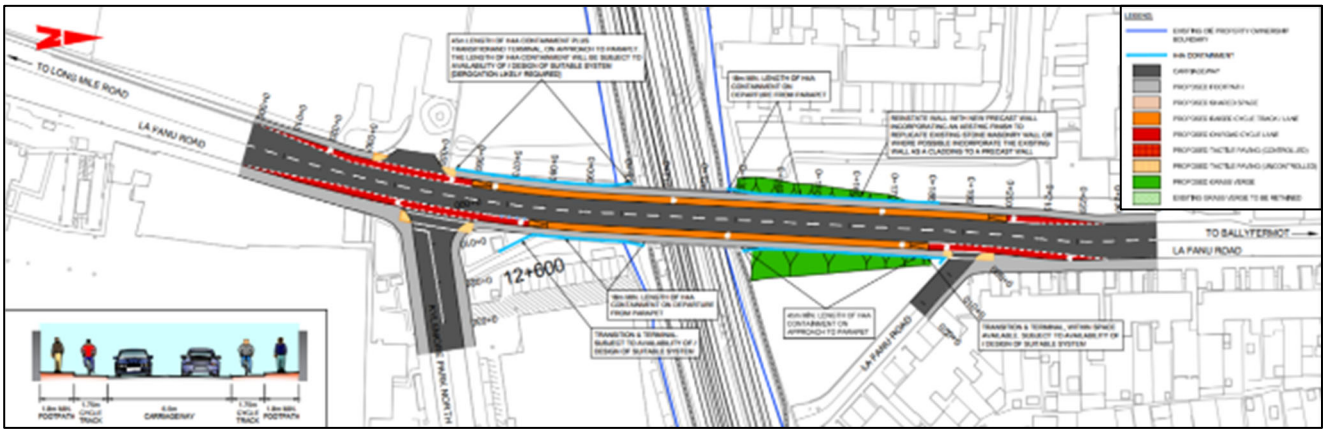

Figure 4-71 Le Fanu Road - Plan and Section

The existing pedestrian crossing of Le Fanu Road, between Kylemore Park North and the bridge is to be removed due to space constraints on the road corridor. However, a replacement crossing is proposed immediately to the south of Kylemore Park North where the road corridor widens at the boundary of its interface with the current proposed reinstatement works area.

4.7.6.2. Kylemore Road

Kylemore Road Bridge (OBC5A) will be replaced to accommodate the widening of the rail corridor. The proposed carriage way arrangement for both sides of the road over the bridge, and on departures and approaches to the bridge, are:

- 1.75m wide cycle track segregated from the carriageway with a 50mm kerb height;
- 1.9m wide footpath (minimum) with 75mm kerb height to the cycle track adjacent; separating it from the cycle track;
- 9.m carriageway (approximate lane widths of 4.5m as per existing).

Kylemore Road will be raised on the northern side of the bridge by approximately 0.8m. A retaining wall is required at the edge of road corridor on the northern side of the bridge to support the layer works. This retaining wall avoids encroachment of the works into the residential service road (north west of the bridge) and provides light duty vehicle (LDV) access to the local ESB substation (north east of the bridge).

The southern entrance to the residential service road (northwest of the bridge) will be closed permanently and the road converted to operate as a cul-de-sac.

Figure 4-72 shows the roadway plan and section at Kylemore Road and the area to be reinstated to accommodate the bridge raising.

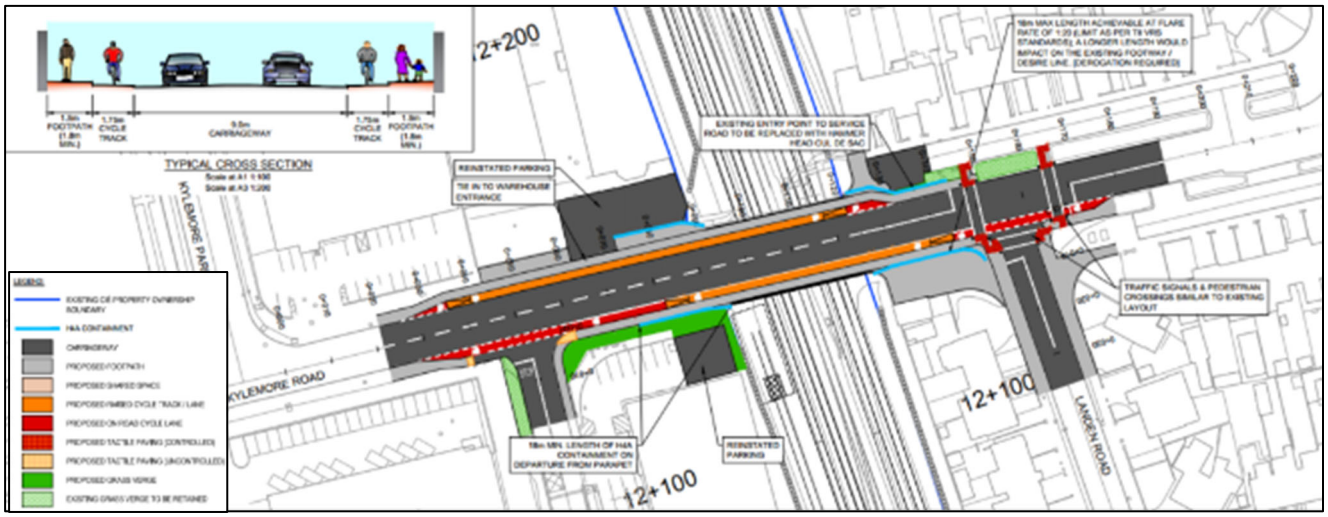

Figure 4-72 Kylemore Road - Plan and Section

4.7.6.3. Sarsfield Road

While the railway bridge reconstruction does not require vertical road alignment changes; associated temporary utility diversion works, will result in the need to reinstate road surfaces, footpaths and in addition kerb lines. The current BusConnects proposal introduces a one way through the bridge with widened footpaths. DART+ South West will reinstate the impacted portion of the carriageway to match existing layout at the time of the works but will not introduce changes into the road alignment (Figure 4-73).

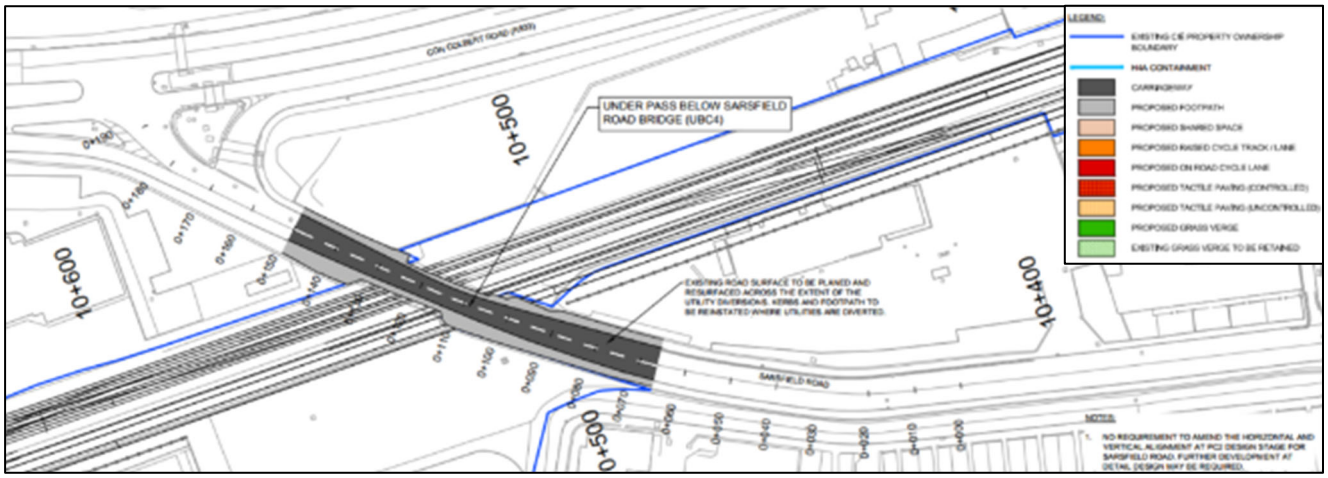

Figure 4-73 Sarsfield Road - Area of Road and Footpath

4.7.6.4. Memorial Road

Memorial Road Bridge (OBC3) will be replaced. The bridge design solution follows consultation with BusConnects, as BusConnects' proposals for both the Liffey and Lucan Schemes, cover the area around the bridge. The BusConnects' proposals include changing Memorial Road from a one-way system to provide bi-directional flow. This will include a dedicated right turn slip lane being provided on the eastbound carriageway of the Chapelizod Bypass (R148) to facilitate southbound turns into Memorial Road (R839).

The proposal as part of this Project, will involve a widened carriageway over the bridge and aligning the new cycle lane kerb line over the bridge with existing kerb line along the remainder of Memorial Road to the south. The carriageway lane widths will be increased to approximately 3.65m.

Memorial Road will remain unidirectional (northbound traffic only) with the eastern lane being a right turn only and the western lane being left and right turn; until such time that the approved BusConnects Schemes are implemented. The cycle lanes will tie in with the existing lanes running west along Con Colbert Road.

The proposed carriage way arrangement for both sides of the road over the bridge, and on departures and approaches to the bridge, are:

- 2m wide cycle track segregated from the carriageway with a 50mm kerb height;
- 2m wide footpath (minimum) with 75mm kerb height, providing separation from the adjacent cycle track;
- 7.3m carriageway.

The removal of the existing curvilinear wall currently defining the back of the footpath (at the four termination points of the bridge parapets) will be reconstructed.

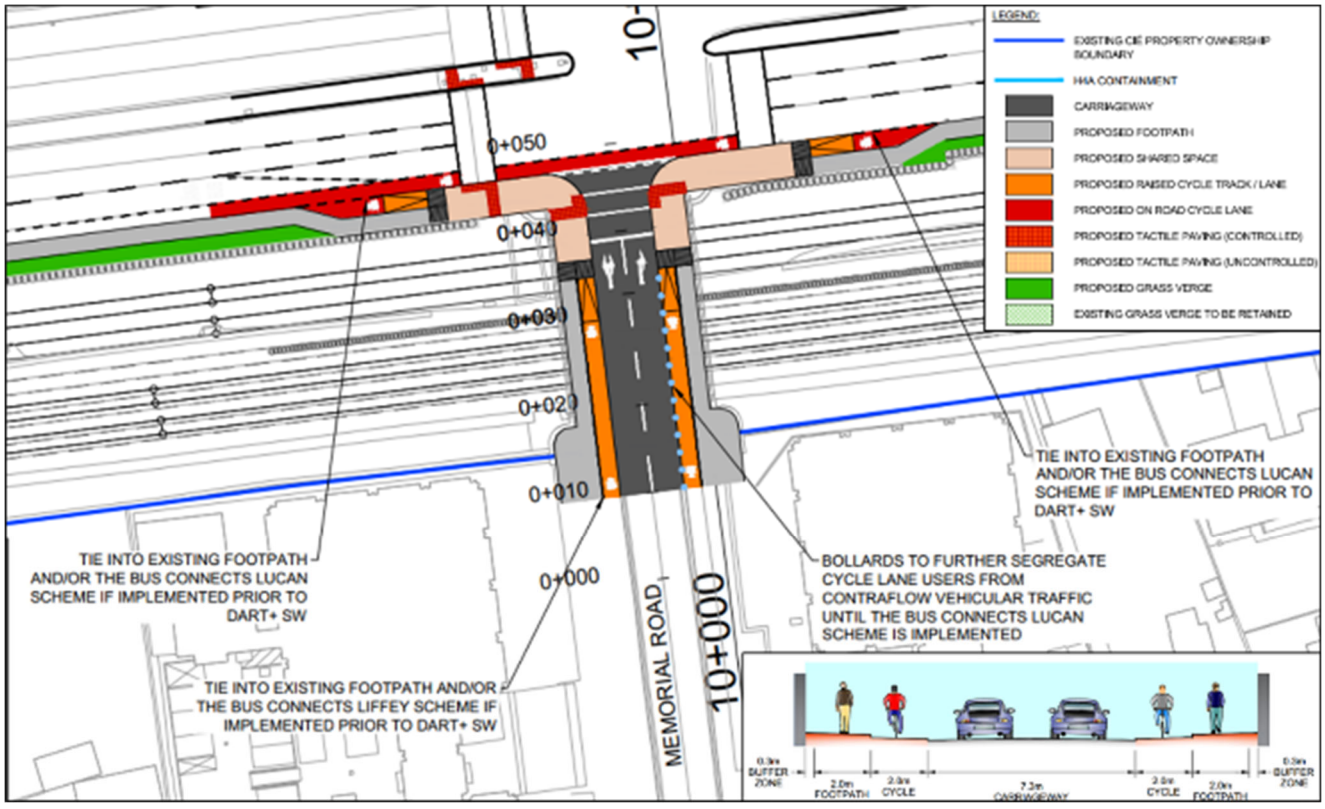

Figure 4-74 Memorial Road - Potential Area of Road and Footpath Resurfacing

4.7.6.5. South Circular and Con Colbert Road / Chapelizod By-Pass

It is not proposed to increase road levels at the existing junction. The existing horizontal road geometry at the junction and along the west bound carriageway will be reinstated after construction of the new structure. The only vertical alignment adjustments will be made to the westbound carriageway, west of South Circular Road. Road raising of 0.3m (approx.) is anticipated at the low point. The length of the

carriageway reconstruction is anticipated to extend 30m (approximately) past the new cut and cover structure at South Circular Road (OBC1A).

The existing southbound cycle lane currently shares the same space as a vehicular lane. However, a nominal lengthening of the proposed new cut and cover structure at South Circular Road (OBC1A) has been provided to the east, that provides a 4m wide space from the existing eastern South Circular Road kerb line to the proposed new parapet face. The design has used this space to provide segregation of southbound cycle traffic from vehicular traffic without impacting the vehicular lane widths across the junction. This has resulted in a new 2m cycle track and 2m footpath. The existing northbound bound cycle lane currently shares the same space as a vehicular lane and will remain as such; subject to the BusConnects Scheme amendment finalisation.

Proposals in the Public Consultation No.3 for the BusConnects - Lucan to City Centre Route, included the 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 of dedicated slip lines into South Circular Road. (See Figure 4-75).

This BusConnects proposal considers the existing parapet walls as the constraints on their design proposals and as such no footpath widening on the corridor boundaries has been proposed.

Further consultation with BusConnects and NTA is required as part of design development interfaces for the two projects.

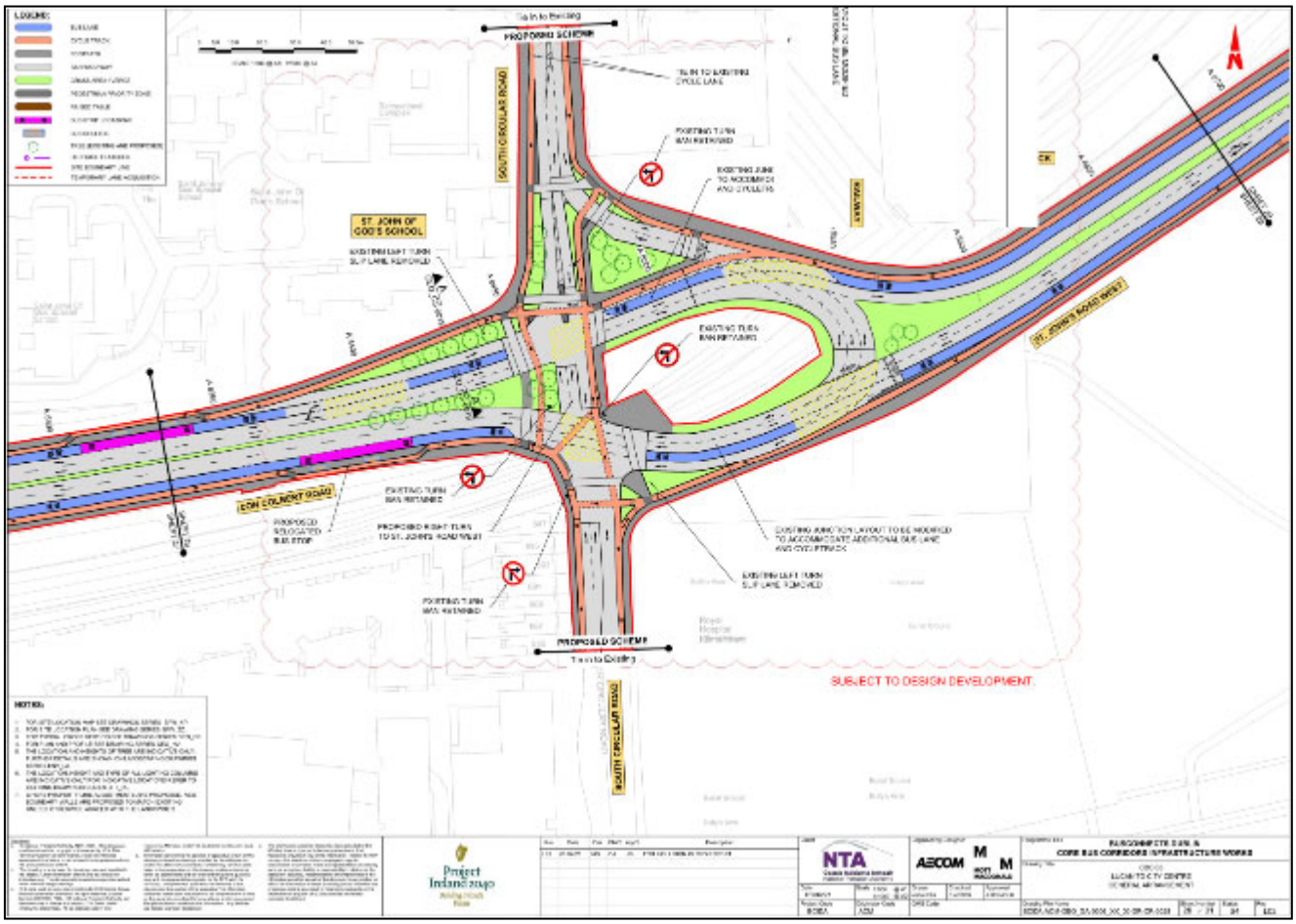

Figure 4-75 Bus Connects' Lucan Scheme Proposal at South Circular Road

4.7.7. Proposed Development – Demolition / Removal

Within this zone, several buildings and structures will need to be demolished and / removed in their entirety. These are set out in Table 4.11. Several of the structures are within the Inchicore Depot. Temporary or partial demolitions / reconstruction requirements associated with the proposed Project are addressed in Chapter 5.

Table 4.11: Summary of Proposed Demolitions / Removal

Structure	Location Chainage	Heritage	Description	Conflict
Vinny Byrne Paint Store	12+110	No	Unit 1, Westlink Business Park	The headshunt piled retaining wall is in close proximity to the North West corner of the building. Building may be affected (in part) by the works.
Lookout Tower	11+800	No	Lookout enclosure mounted on a lattice tower structure	Located immediately adjacent to existing rail lines and within proposed enlarged railway corridor.
Signalling Gantry	11+700	No	Signalling Gantry	Multitrack signalling gantry to be removed, located within proposed enlarged railway corridor.

Structure	Location Chainage	Heritage	Description	Conflict
Shunters Cabin	11+370	No	Single storey structure	Located immediately adjacent to existing rail sidings and within proposed enlarged railway corridor (and location for new rail sidings).
Extension to Maintenance Shed and Shunting Hut.	11+300	DCC IHR	Single storey structure, office accommodation, addition to the original structure	Located immediately adjacent to existing rail sidings and within proposed enlarged railway corridor (and location for new rail sidings).
The Signal Box / Cabin	11+000	DCC IHR NIAH RPS	Detached four-bay two-storey former signal box, built c.1850 etc.	Located immediately adjacent to existing rail lines and within proposed enlarged railway corridor.
Office Toilet Block Facility & Lunch Block (Prefab Unit)	10+795	No	Single storey prefabricated structure	Located immediately adjacent to existing rail sidings and within proposed enlarged railway corridor
Inchicore Works Boundary Wall	Various	DCC IHR NIAH RPS		Parts of the boundary wall are located immediately adjacent to existing rail lines and within proposed enlarged railway corridor.
Retaining (Southern Boundary from Inchicore to Sarsfield)	10+800 to 10+540	Yes	Variable height but typically on the south it is currently stone masonry wall (2.4m high) with an additional 1.2m height of corrugated steel and barbed wire roll. In limited locations it is a 3.6m high wall.	Parts of the boundary wall are located immediately adjacent to existing rail lines and within proposed enlarged railway corridor.
Dan Ryan Truck Rental Building	10+450	No	Single storey industrial unit, attached to single storey office and admin building	Parts of the boundary wall are located immediately adjacent to existing rail lines and within proposed enlarged railway corridor
Signalling Gantry	10+350	No	Signalling Gantry	Signalling gantry to be removed, located within proposed enlarged railway corridor.
Signalling Gantry	9+840	No	Signalling Gantry	Signalling gantries to be removed, replaced by new gantries for Fast and Slow tracks between Heuston Station and Memorial Road as well as by single post signals where required.
Signalling Gantry	9+210	No	Signalling Gantry	

Part of Inchicore Works, on the northern side of the rail tracks, is the Old Signal Box building (Figure 4-76). This structure is listed in the NIAH (Reg. No. 50080417). In the Dublin City Development Plan, it is included on the Record of Protected Structures (see Chapter 21 Architectural Heritage for further details). It is located approximately 1.6m to the nearest rail and will have to be removed as part of the rail corridor widening in this area.

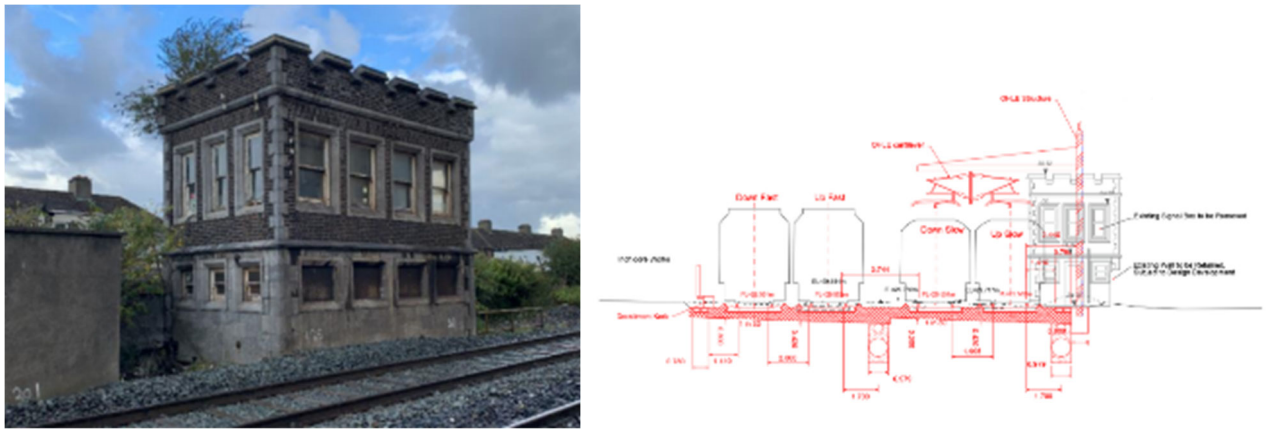

Figure 4-76 Old Signal Box. Inchicore Works (Existing and Proposed)

The Maintenance Shed at Inchicore Works is where the regular maintenance of rail vehicles is carried out (Figure 4-77). An extension on the north side has been added to the building. In the extension are offices, toilets, lockers and plant rooms which houses tanks and pumps for the train wash. There is a limited clearance area between the building and the Long Siding (circa 1.8m interval). This is an area where the standard distance between the track and the structure is not achieved, and the passing of the maintenance personnel is prohibited during the rail operation time.

As part of the proposed works, the extension to the Maintenance Shed will be removed to provide room for a new train siding. The administrative and ancillary functions in the extension will be relocated elsewhere within Inchicore Works/ Depot. The shunters hut to the west of the Maintenance Shed will also be removed.

Figure 4-77 Maintenance Shed, Attached Building and Sidings, Inchicore Works

A small section of the northern railway corridor boundary wall to the Inchicore Works complex will have to be removed to facilitate the construction of the Khyber Pass Footbridge (OBC5); the wall will be reinstated to match the existing walls. Sections of the boundary wall along the southern railway corridor between Sarsfield Road and Khyber Pass Footbridge will also need to be removed, this will impact the boundary wall of No. 4 St George's Villas.

The Dan Ryan Truck Rental site which is located on the south side of the corridor, adjacent to Sarsfield Road Under-Bridge (UBC4) and will be impacted by the works in this area, primarily due to the widening of the rail corridor. The extent of works in this area cannot be carried out without the demolition of the existing structure on site.

The southern track, between Sarsfield Road Under-Bridge (UBC4) and Memorial Road Bridge (OBC3), is in very close proximity to the existing stone masonry retaining walls. Sections of this retaining wall (and in some cases the private boundary walls above them), on the southern side of the track, will need to be replaced with new retaining wall structures in a new location. There are no existing retaining walls on the northern side of the track in this same section.

Figure 4-78 Masonry Retaining Wall on the South Side of the Rail Corridor

Figure 4-79 Masonry Retaining Wall Buttress and Heightened Wall Sections (Southern Boundary)

4.7.8. Proposed Development – Drainage

4.7.8.1. Track Drainage

A new drainage system is proposed for the zone in order to meet the increased runoff volumes generated by the new four-tracking layout, as well as the attenuation requirements needed to comply with the allowable discharge rates.

The new drainage system is based on three independent drainage networks (Network 1, Network 2 and Network 3) based on three outfall locations and the existing open areas along the track that are suitable for locating the required attenuation structures (Figure 4-80).

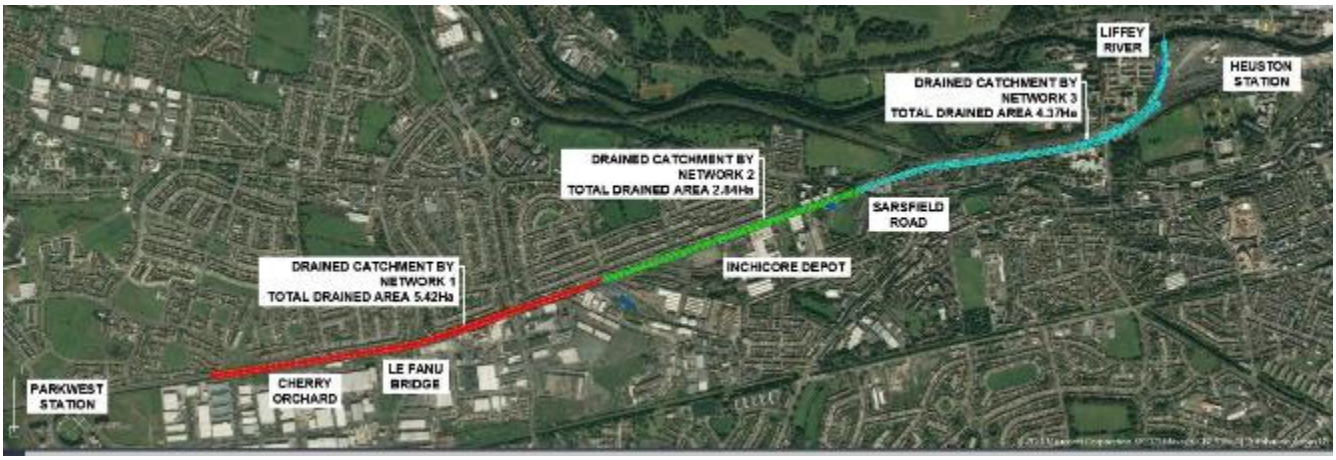

Figure 4-80 Proposed Network Delimitation

Catchments have been identified for each network differentiating between ballast and green areas draining towards the track as shown in Table 4.12.

Table 4.12: Catchment Areas for the Drainage Networks in Zone B

	Network 1 Cherry Orchard to Inchicore Works	Network 2 Inchicore Depot to Sarsfield Road	Network 3 Sarsfield Road Underbridge to Heuston Station
Ballast Area (sq m)	40,405	25,207	38,369
Green Area (sq m)	11,775	2,497	6,253
Total Area (sq m)	52,180	27,705	44,623

4.7.8.1.1. Network 1 (Cherry Orchard to Inchicore Works)

The first network drains the track length from Cherry Orchard up to Inchicore Depot and conveys collected runoff waters up to a proposed attenuation tank located west of Inchicore Depot by pumping.

This network consists of two main branches running parallel to the track with filter drains above carrier pipes. Runoff water percolates through the ballast up to the low points of the ballast layer where the filter drains are placed. Water is then collected by the perforated drains and discharged into the carrier pipes that convey runoff flows through the drainage network.

The northern branch runs parallel to the track along its entire length and shall be laid at a minimum distance of 1.7m from the north running edge of the Slow track, as shown in Figure 4-81.

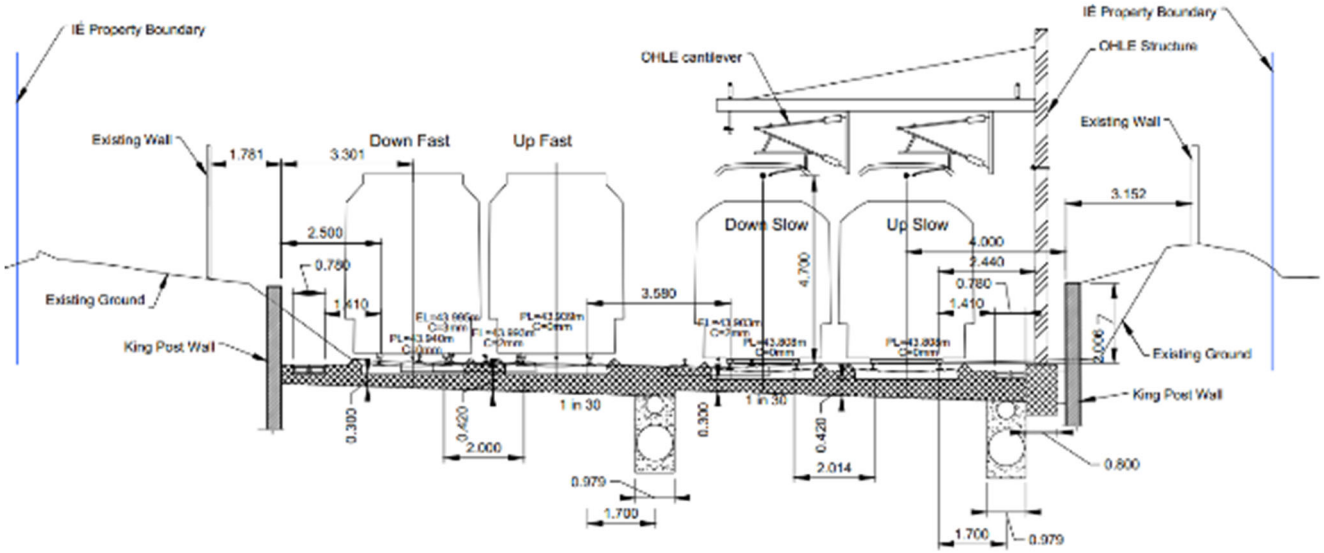

Figure 4-81 Network 1 Cross Section from Cherry Orchard Footbridge (OBC8B) to Kylemore Road

The southern branch runs in the middle section between tracks at a minimum distance of 1.7m from the nearest rail up to Kylemore Road Bridge (OBC5A), where the pipeline crosses the Slow tracks to the southern track boundary, this second branch then runs parallel to the proposed headshunt siding at Inchicore up to the connection point with the main branch at ch.11+750, refer to Figure 4-82. From this connection manhole a single carrier branch conveys flows to the proposed attenuation tank.

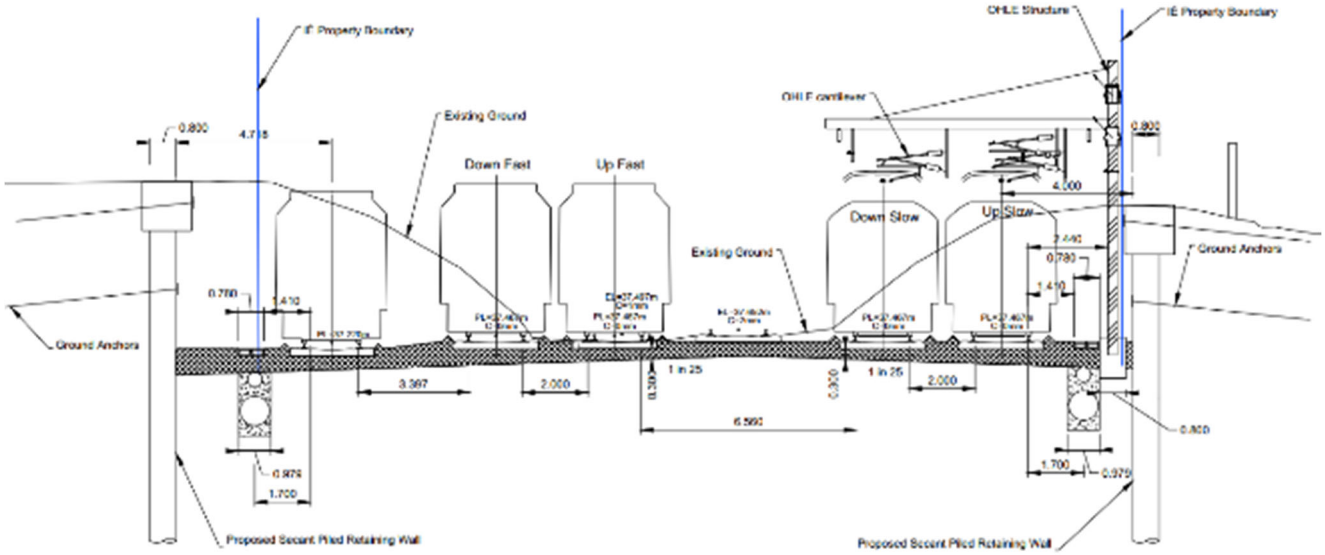

Figure 4-82 Network 1 Cross Section from Kylemore Road to Inchicore Depot

Attenuation for Network 1 comprises of an attenuation tank facility designed to retain storm water volumes up to 1 in 100-year return period plus 30% climate change allowance. The proposed attenuation tank is located west of Inchicore Depot (

Table 4.13).

Table 4.13: Network 1 Attenuation Requirements

Attenuation Tank for Network 1			
Area (m2)	**Depth (m)**	**Void Ratio (%)**	**Volume (m3)**
1574.4	2.65	90%	4172.16

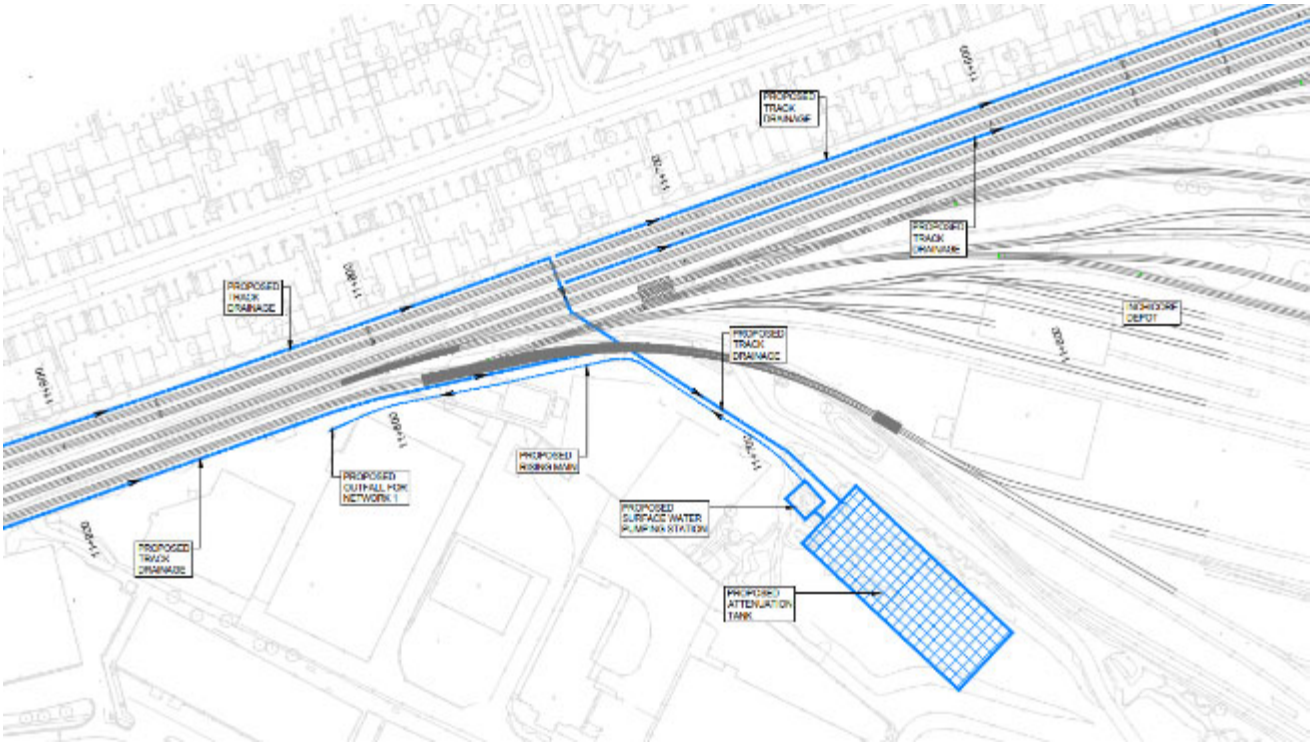

Figure 4-83 Network 1 Location of Underground Attenuation Tank

The discharge point for Network 1 is at the existing storm water sewer that crosses the track between Kylemore Road Bridge (OBC5A) and Inchicore Depot from south to north, as shown in Figure 4-84.

The invert level of the existing storm water sewer, where the proposed outfall point is located, do not allow to connect Network 1 by gravity, as the invert level of the public sewer is 1.9m higher than the outlet level of the proposed attenuation tank. The invert level of the attenuation tank is approximately 31.9m and the utility records show an invert level of the existing sewer at the proposed connection point of 33.8m. In order to save this level difference a storm water pumping station is required.

A new pumping system is proposed downstream of the attenuation tank to pump surface water flows up to the discharge level and into the existing SW sewer. The proposed pump rate to comply with DCC requirements and is set at a maximum flow of 14.3 l/s.

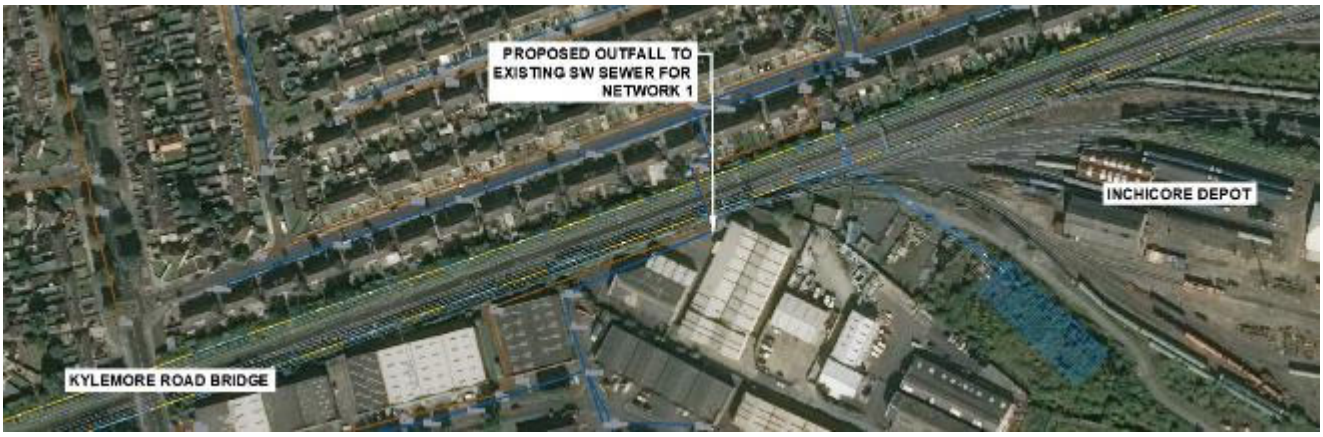

Figure 4-84 Proposed Outfall for Network 1

4.7.8.1.2. Network 2 (Inchicore Depot to Sarsfield Road Underbridge)

The second drainage network extends from Inchicore Depot to Sarsfield Road Underbridge. As described above, the proposed drainage system includes filter drains to collect percolated water from the ballast, above carrier pipes, which convey the collected flows to the attenuation structure.

This second network is also split into two main branches that run parallel to the track alignment. A northern branch placed at a minimum distance of 1.7m from the north Slow track up to the crossing point at ch.10+660, where joins the southern branch prior to discharging into the attenuation tank, as per Figure 4-87 and Figure 4-88 below.

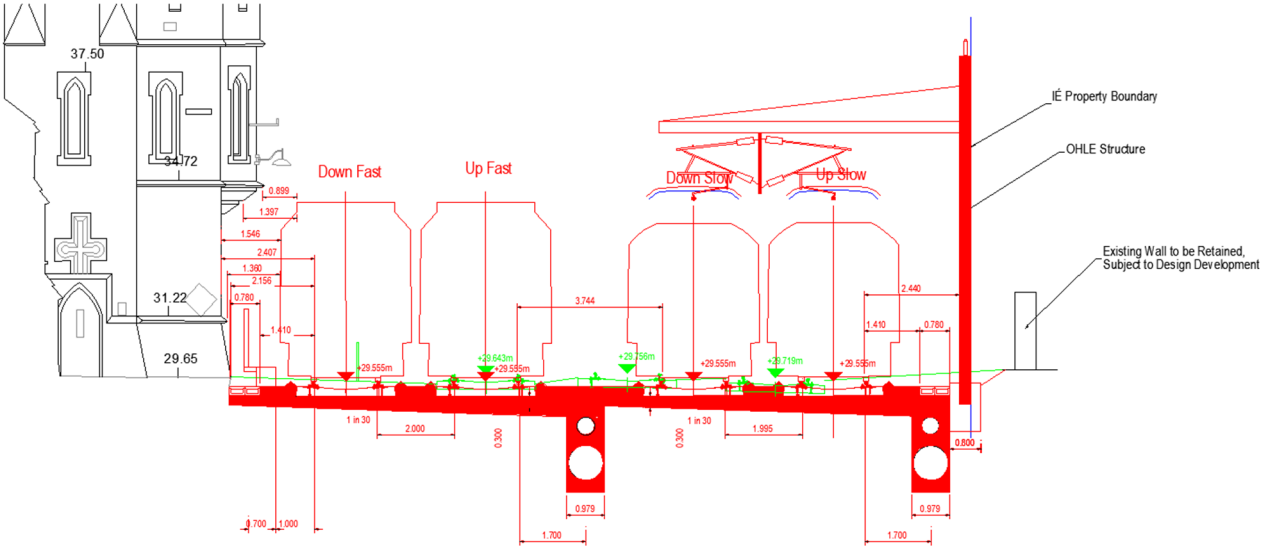

Figure 4-85 Network 2 Cross Section from ch.10+780 to 11+720

The second branch is located between the Slow and Fast tracks by keeping a minimum distance of 1.7m from the nearest rail. This central location is kept up to the crossover at ch.10+750, where the proposed pipeline crosses the track up to the southern boundary to run parallel to the Slow tracks until joining the north branch at ch.10+660.

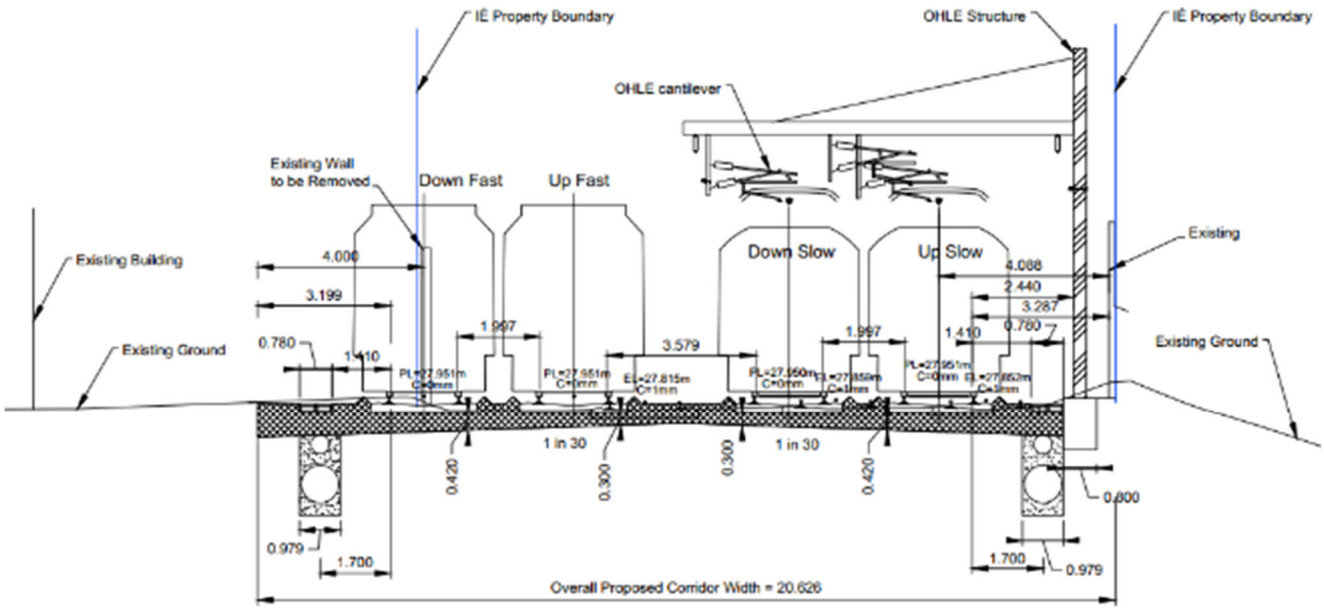

Figure 4-86 Network 2 Cross Section from ch.10+650 to 10+780

Network 2 also drains a short track section from Sarsfield Road up to ch.10+650 by two additional branches that flow east to west up to the proposed attenuation tank.

Attenuation for Network 2 will be facilitated by means of an attenuation tank facility designed to retain storm water volumes up to 1 in 100-year return period plus 30% climate change allowance (Table 4.14). The proposed attenuation tank is located east of Inchicore Depot.

Table 4.14: Network 2 Attenuation Requirements

Attenuation Tank for Network 2			
Area (m2)	**Depth (m)**	**Void Ratio (%)**	**Volume (m3)**
832	2.65	90%	1780.8

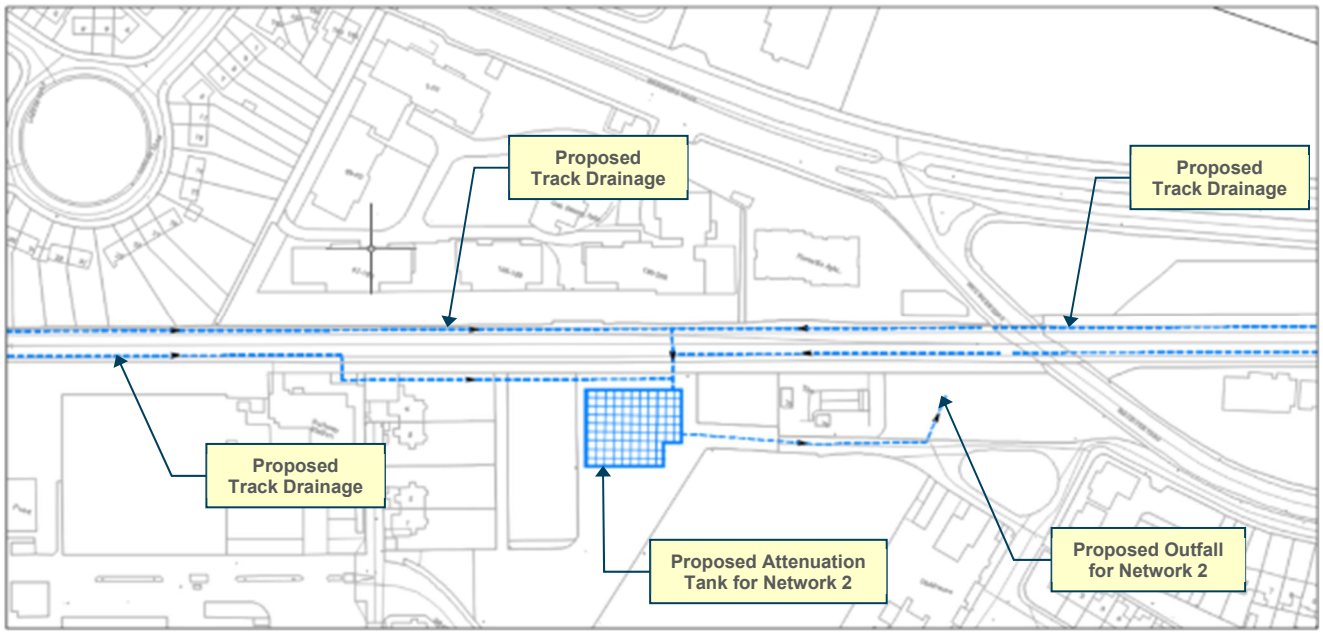

Figure 4-87 Network 2 - Location of Underground Attenuation Tank

The discharge point for Network 2 is at the existing storm water sewer that crosses the track south to north at Sarsfield Road, as shown in Figure 4-88.

Figure 4-88 Proposed Outfall for Network 2

4.7.8.1.3. Network 3 (Sarsfield Road Under-Bridge to Heuston West)

The third network drains the new track arrangement from Sarsfield Road Under-Bridge to Heuston West by following the vertical profile of proposed track.

The head of this third network is located at Sarsfield Road Under-Bridge to drain the water runoff generated by the slab track section proposed on the bridge. From this location two parallel pipe

branches run west to east draining the four-tracking section, which includes a northern pipeline at a minimum distance of 1.7m from the north Slow track, as shown in Figure 4-89.

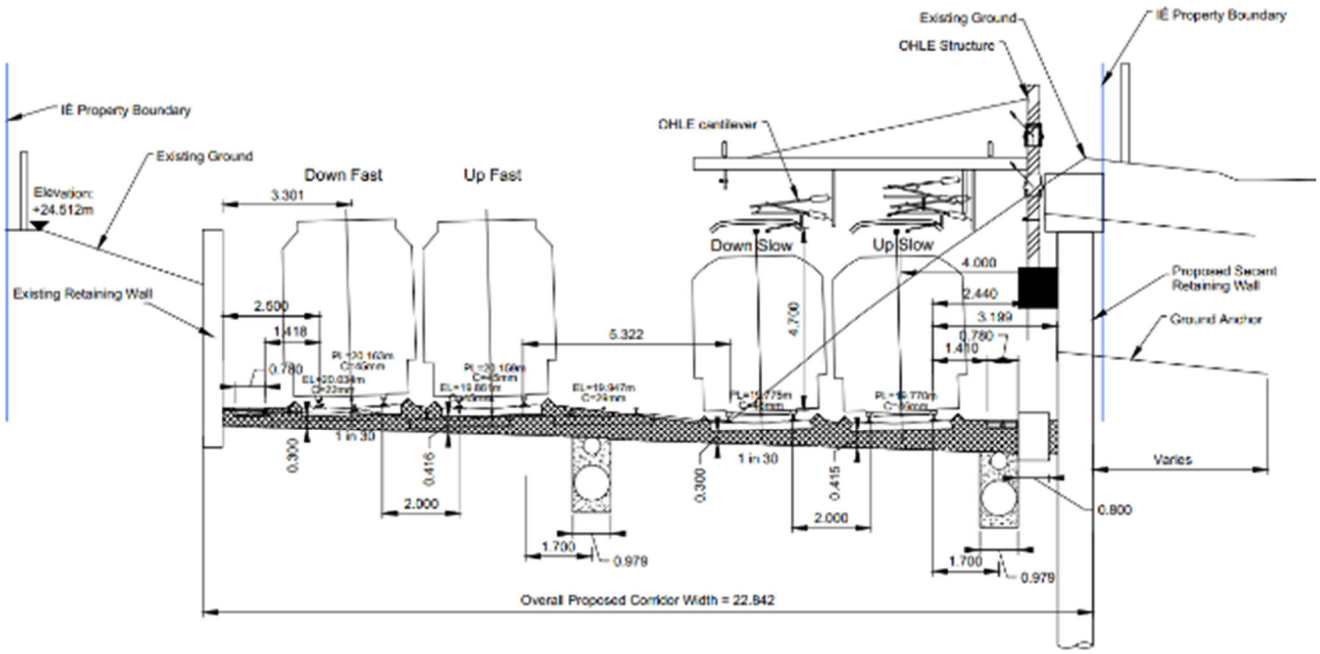

Figure 4-89 Network 3 Cross Section 1

The Slow and Fast tracks are located at different levels from ch.9+513 to ch.10+050, where the drainage is located at the south side of each at a distance of 1.7m from the nearest rail, as shown in Figure 4-90.

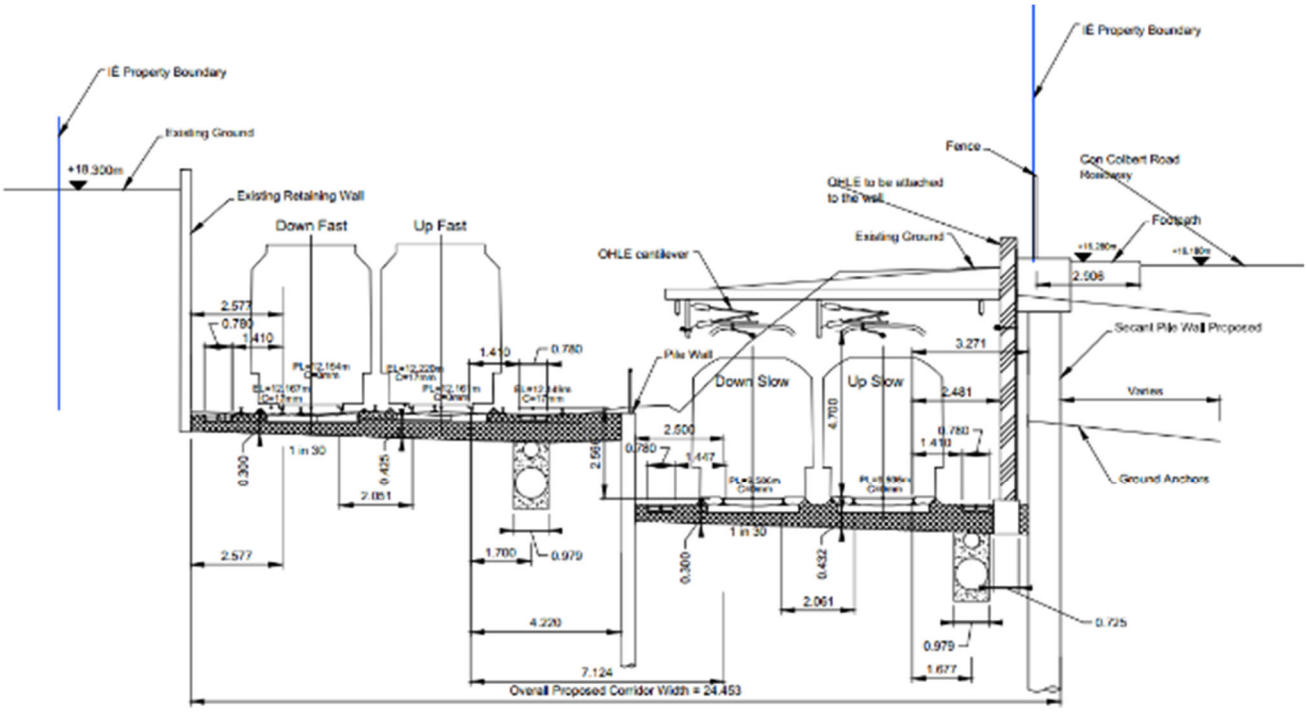

Figure 4-90 Network 3 Cross Section 2

A second pipeline is placed in the middle track section between the Slow and Fast tracks and at minimum horizontal distance of 1.7m from the nearest rail.

This drainage configuration continues until the crossover at ch.9+300 where the central pipeline crosses the middle lanes to keep its original location next to the up Fast track. From this point, the southern branch runs parallel to the Fast tracks up to ch.9+150, where it joins the northern pipeline into a single branch that flows parallel to the tracks to the Liffey River.

Attenuation for Network 3 includes an attenuation tank facility designed to retain storm water volumes up to 1 in 100-year flooding level of Liffey River (3.47m), plus 30% climate change allowance (Table 4.15). The proposed attenuation tank is located west of the proposed Heuston West Station.

Table 4.15: Network 3 Attenuation Requirements

Attenuation Tank for Network 3			
Area (m2)	**Depth (m)**	**Void Ratio (%)**	**Volume (m3)**
1216	2.65	90%	3222.4

A drainage pipe is currently running under Heuston West Station platform. This will be relocated between the tracks.

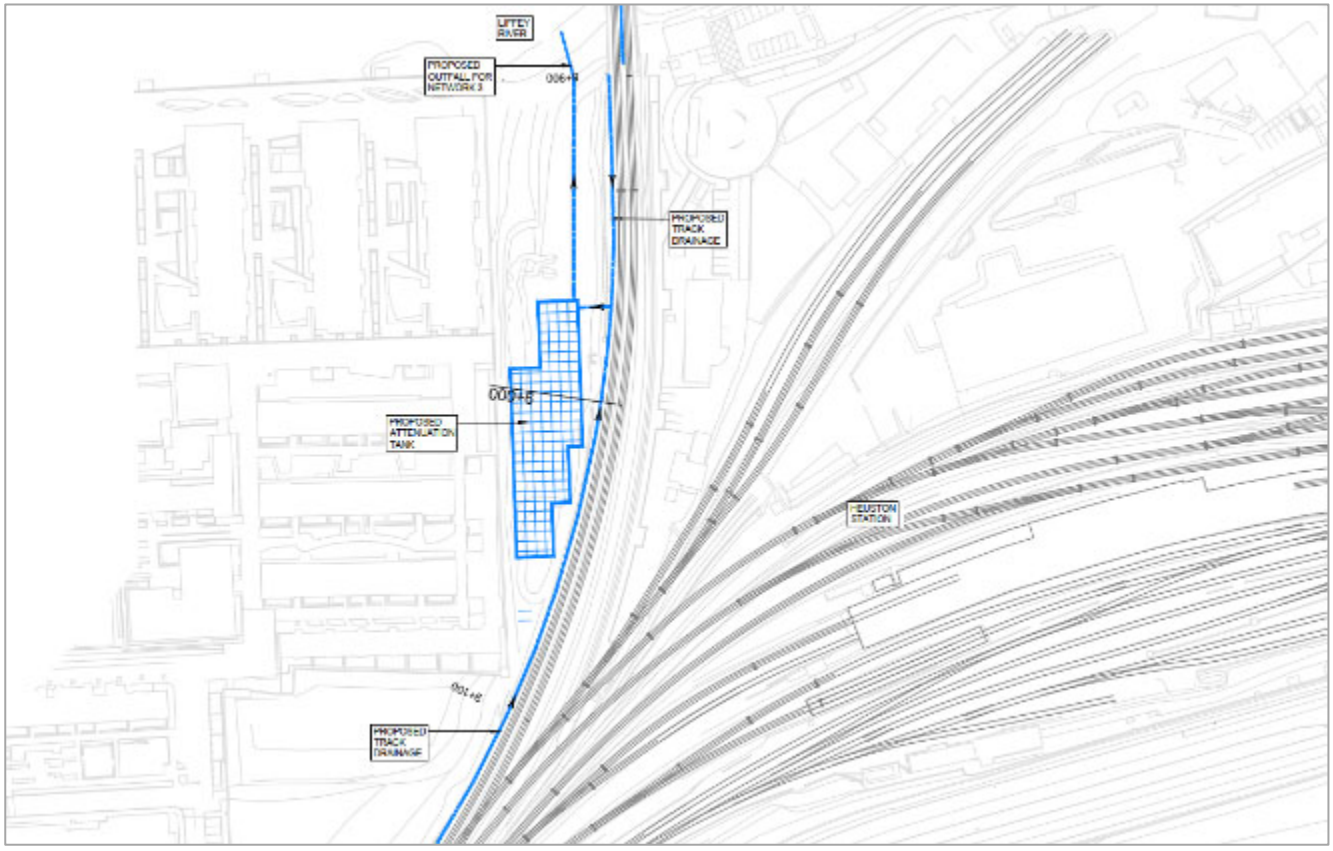

Figure 4-91 Network 3 - Location of Underground Attenuation Tank

The drainage network downstream of the attenuation tank will discharge by gravity to the outfall location at the Liffey and will include a flow control unit to restrict outgoing flows to the agreed rate

The discharge point for Network 3 is at Liffey River, next to Heuston West, as per Figure 4-92. Outfall level shall be located above the 1 in 100-year water level of Liffey River, which is set at level 3.5m.

Figure 4-92 Proposed Outfall for Network 3

4.7.8.2. Road Drainage

The road drainage will only be reinstated new where vertical geometry is changed or where existing system is removed. Additional gullies will however be provided to account for the change in kerb edge geometry. All low points will typically be reinstated with a double gulley configuration to provide a level of mitigation against the potential for blockages. Where feasible gullies will 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.

The Le Fanu Road is the only public road reconstruction where the hard standing areas across the bridge and to the north of the railway line (up to Le Fanu Road cul-de-sac) are being increased due to road widening as part of the safety improvement initiatives.

At Sarsfield Road Under-Bridge (UBC4), the proposed works will be limited to minor kerb line modifications and surface reinstatement works. No carrier drain network pipes are being reconstructed; however, the contractor will ensure that all gullies are free draining and if feasible will install double gullies at low points, as responses during public consultation noted that ponding does occur periodically.

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 to aid runoff of large areas, junction configurations and particularly where longitudinal gradients are at their minimum but still compliant.

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

4.7.8.2.1. Proposed Road Drainage Le Fanu

The road drainage will be reinstated with typical pipe and gulley collection system, with gullies located similarly to the current drainage layout. Additional gullies will however be provided to account for the

nominal widening of the road corridor. All low points will typically be reinstated with a double gulley configuration to provide a level of mitigation against the potential for blockages.

The short section of road 60-80m north of the crest of the road, at the bridge, is proposed to drain into an engineered infiltration trench/bed located in the public open space to the east of Le Fanu road. The details of the infiltration bed and associated planting will be agreed at the detailed design stage to include appropriate sustainable planting for this public amenity area.

This infiltration bed will serve to:

- Reduce runoff into the existing combined sewer gravity system located in the area. All such systems tend to be overloaded owing to the increased runoff over time.
- Provide an enhanced level of natural treatment of aromatic hydrocarbons associated with road runoff as well as attenuate fine particular matter that normally enters the closed gravity systems.
- Provide a more direct source of water for the planting and trees that would be relocated and reinstated as part of the road widening.

4.7.9. Proposed Development - Electrification

4.7.9.1. OHLE Arrangement - General

A description of the typical track area OHLE arrangement for the Project is set out in Section 4.5. Relevant observations for Zone B are set out below.

In the four-track area for Zone B, the electrification equipment will be supported by Twin track Cantilever (TTC) and Single track Cantilever (STC) structures. The OHLE will be terminated with an anchor arrangement, when required, in areas with limited space. Figure 4-93 shows an example OHLE TTC arrangement in a four-track open route.

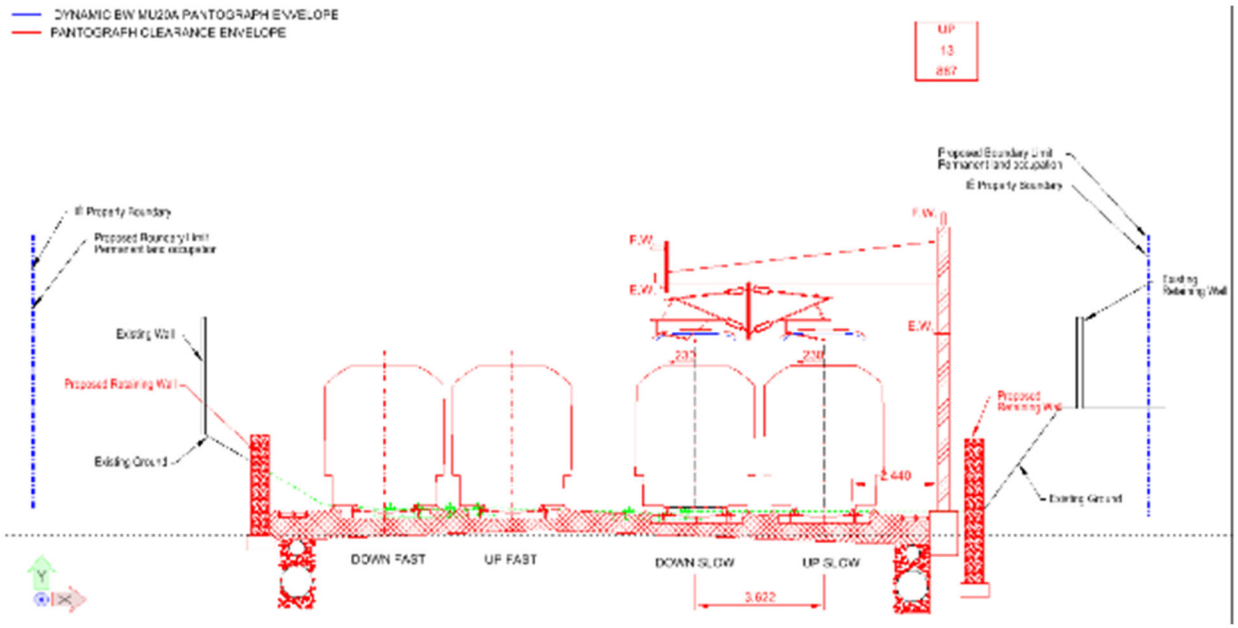

Figure 4-93 Example OHLE TTC Arrangement in a Four-track Open Route – Facing West

4.7.9.2. OHLE Arrangement - Bridges

The specific solutions for bridges in Zone B are set out in Table 4.16, including for the replacement bridges.

Table 4.16 : Summary of proposed OHLE arrangement

Structure Id	Location	Proposed Solution
OBC8B	Cherry Orchard Footbridge	OHLE solution Fitted OHLE system at each side of bridge
OBC7	Le Fanu Road Bridge	Bridge Replacement Fitted OHLE system (Flexible)
OBC5A	Kylemore Road Bridge	Bridge Replacement Fitted OHLE system (Flexible)
OBC5	Khyber Pass Footbridge	Bridge Replacement Flexible OHLE system - Free running
UBC4	Sarsfield Road Bridge	Deck Replacement Flexible OHLE system - Free running
OBC3	Memorial Road Bridge	Bridge Replacement Fitted OHLE system (Flexible)
OBC1A	South Circular Road Bridge	New cut and cover structure under bridge and track realignment Fitted OHLE system (Flexible)
OBC0A	St Johns Road Bridge	

The OHLE configuration through these bridges will be provided with 4.4m minimum contact wire height under all conditions. Electrical clearance from the live OHLE to the bridge will be 100mm static and 80mm dynamic.

For Cherry Orchard Footbridge (OBC8B), as the bridge is narrow the OHLE shall be supported either side of the bridge on the standalone masts with elastic bridge arms with a contact wire height of 4.6m. Typically, OHLE masts would be positioned between 20m and 40m on each side of the bridge before reverting to normal spacings. Figure 4-94 shows an example of a cross section for fitted OHLE system in the four-tracking area.

Le Fanu Road Bridge (OBC7), Kylemore Road Bridge (OBC5A), Memorial Road Bridge (OBC3) will be designed to provide a minimum soffit clearance to track of 4.9m. In this configuration the OHLE will be graded down, fitted with elastic bridge arms supported from the bridge at a single location in the middle of the bridge.

The Khyber Pass Footbridge (OBC5) will be reconstructed as a flat deck footbridge with a minimum track to soffit clearance of 5.5m. In this configuration the OHLE will be wired using a free-running arrangement. The contact wire height will be 4.7m throughout the bridge.

South Circular Road Bridge (OBC1A) and St. Johns Road Bridge (OBC0A) have been considered together for the OHLE solution. The OHLE through this bridge will be fitted with elastic bridge arms and supported from the bridge at multiple locations due to its length.

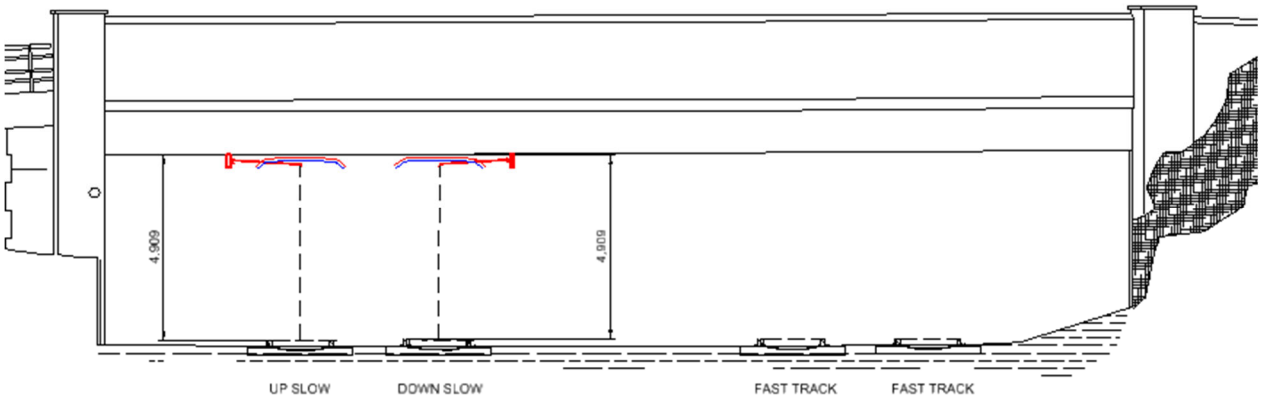

Figure 4-94 Example Cross Section for Fitted OHLE System in Four Tracking Area – Facing East

4.7.9.3. Substation

One substation is required for this section of the route, the proposed location for the substation is within Iarnród Éireann's Inchicore Depot on the southern side of the railway as shown in Figure 4-95. Access to the site is from Jamestown Road via an existing access gate to the Inchicore Depot. The area is a brownfield site currently used as a maintenance and storage area. A dedicated and segregated vehicle access route will be provided within the depot from the site entrance to the substation to provide safe and unfettered access for ESB staff (Figure 4-95 and Figure 4-96).

Figure 4-95 Kylemore (Inchicore) Substation Location

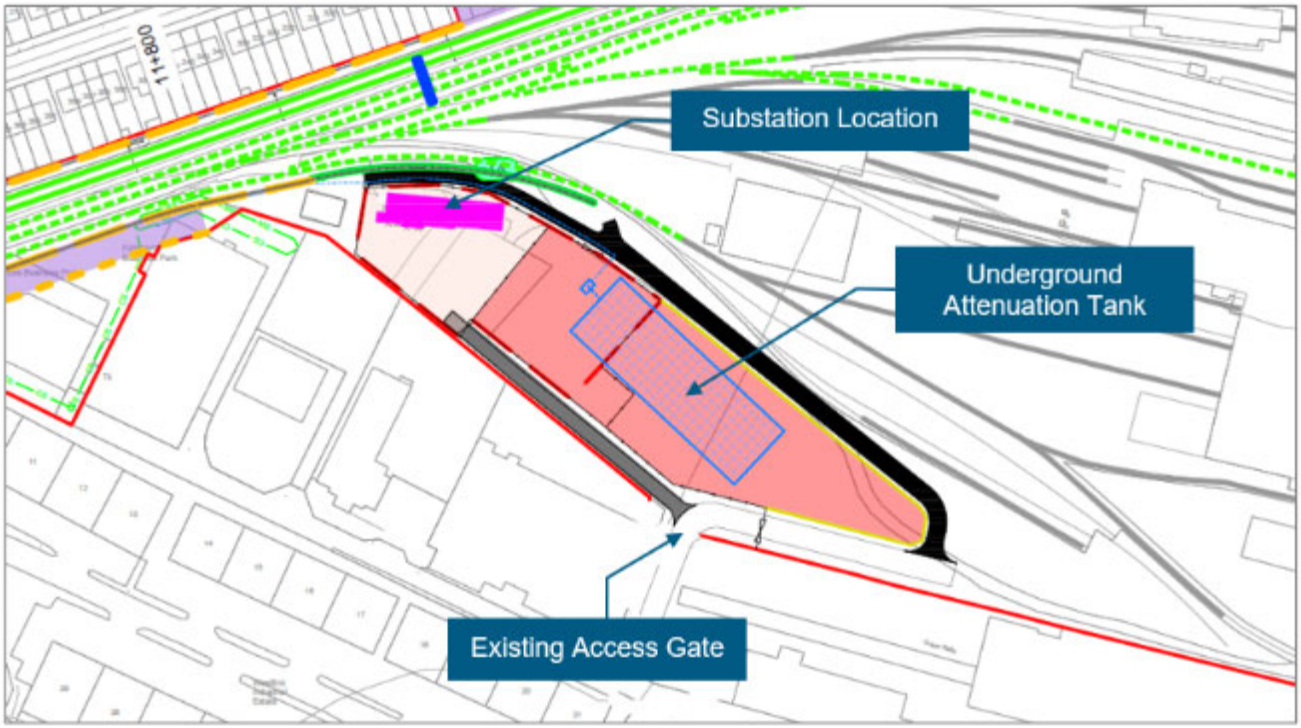

Figure 4-96 Kylemore (Inchicore) Substation Layout

The proposed connection to the existing ESB 38kV network from the substation is an existing underground circuit located within the ESB yard on Kylemore Way. The approximate length for each electrical circuit is 520m. The ESB network connections and the proposed connection routes are covered in more detail in Chapter 5.

4.7.10. Proposed Development – Signalling and Telecommunications

4.7.10.1. Signalling System

New physical signalling and low voltage infrastructure comprising of a network of signalling and LV elements including localised control cabinets and cabins will be installed along this section of the route. The physical signalling infrastructure will be located within the existing CIÉ property boundary.

4.7.10.2. Signalling Posts

New signalling cantilevers are proposed at chainage 9+750 and 9+970 to accommodate the signals. The locations of the new cantilevers are shown in Figure 4-97 below.

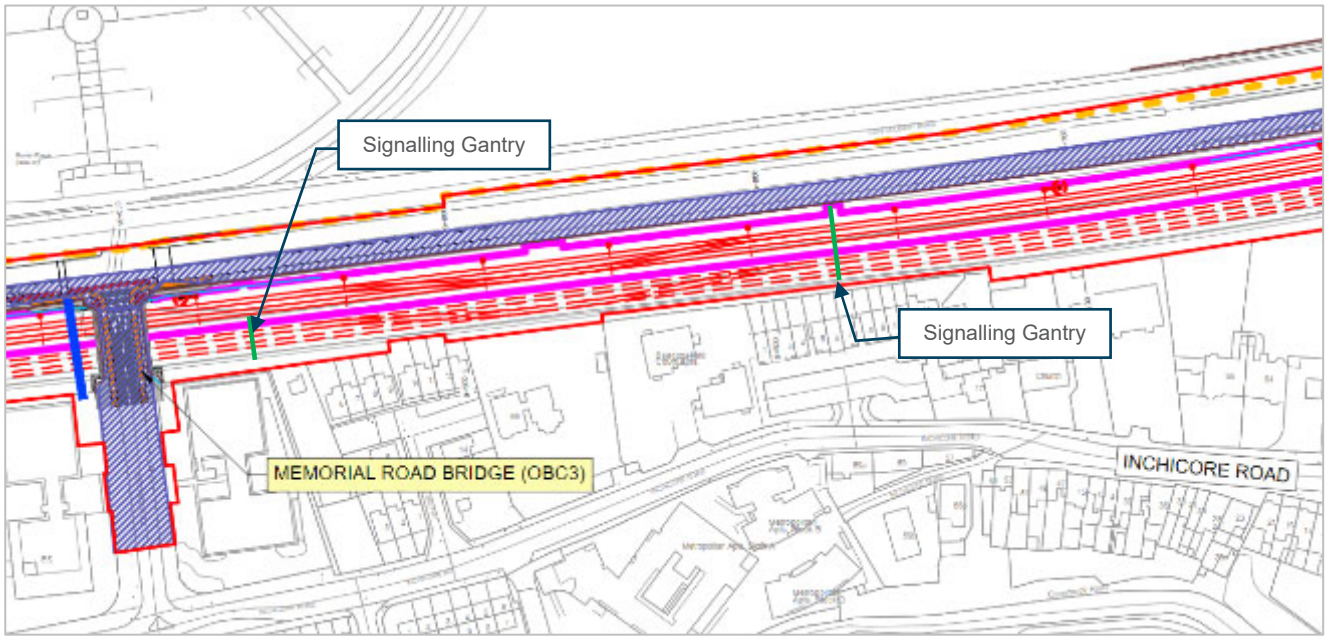

Figure 4-97 New Signalling Cantilevers (Chainage 9+780 and 9+970)

4.7.10.3. Telecommunications

No new Telecom Equipment Rooms (TER) required in Zone B.

4.8. Zone C: Heuston Yard and Station (incorporating New Heuston West Station)

4.8.1. Overview of Zone C

Zone C includes Heuston Station and Heuston Yard including the site for the proposed Heuston West Station. The area extends west to east from St John's Road Bridge (OBC0A) eastwards to include the existing Heuston Station and from the CIÉ boundary along the Chapelizod Bypass northwards to the CIÉ boundary on the banks of the River Liffey. The location and extents of this zone is illustrated Figure 4-98 below.

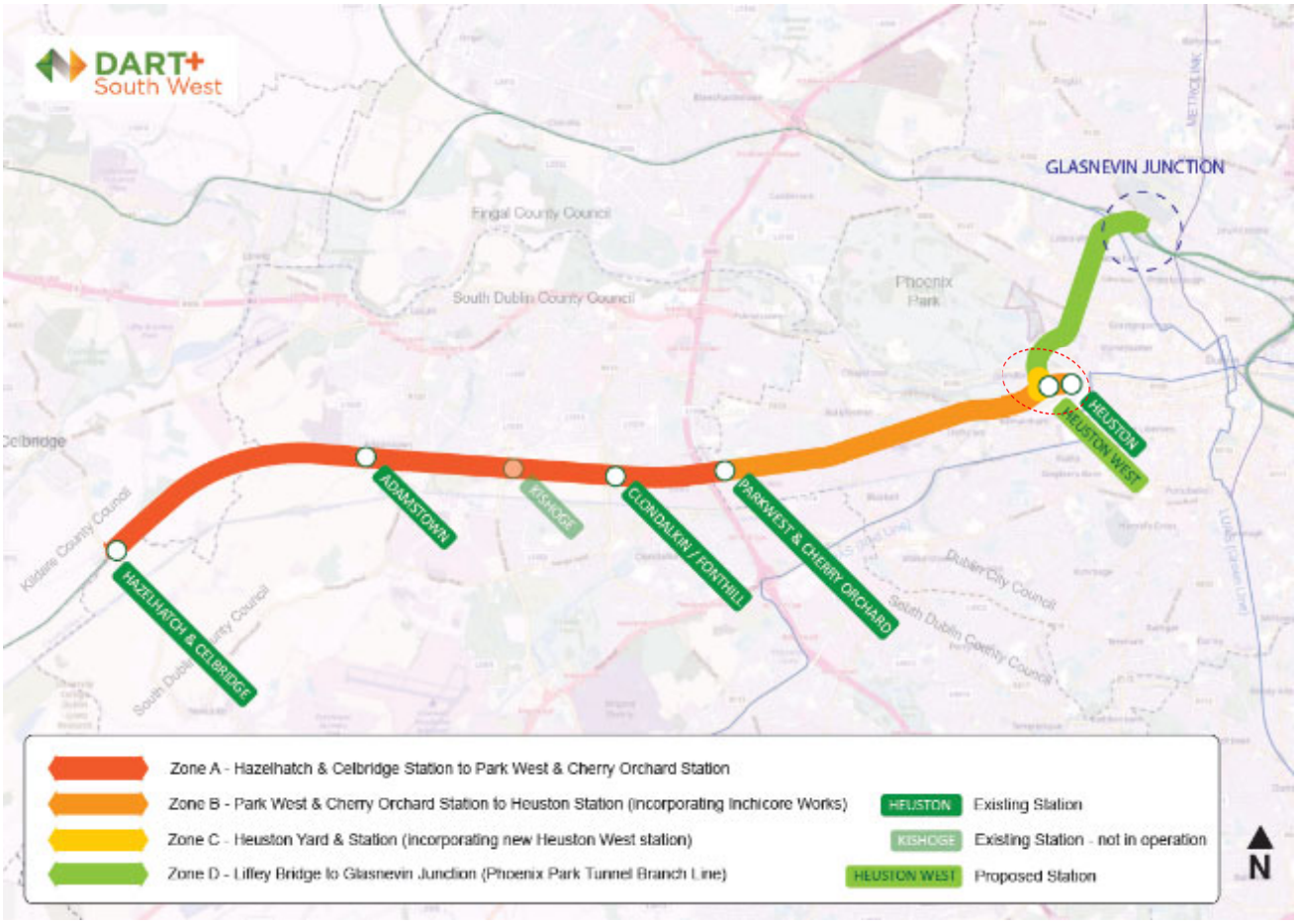

Figure 4-98 Zone C: Heuston Yard and Station (incorporating New Heuston West Station)

This zone features the main Heuston Station building and an extensive railway yard area located to the west of this building. The station and yard area features various ancillary buildings, platforms, track areas, car parks and maintenance facilities. The site for the proposed new Heuston West Station is located in the north western part of this zone, adjacent to the existing Clancy Quay Development and the new National Train Control Centre (NTCC) site currently under construction.

The topography of the site is flat, sloping gently to the east towards Heuston Station and north towards the River Liffey, where at the riverbank, there are steepened banks down towards the water's edge. St Johns Road immediately is at an elevated level sloping east towards Heuston Station. The western approach of the railway into Heuston Yard is in cutting and this cutting reduces on entry into the yard.

There is existing pedestrian and vehicle access which extends from the proposed site, along the existing access road to the main Heuston Station and the LUAS Red Line stop which is located at the front entrance to Heuston Station.

The existing Heuston Station comprises nine (9 no.) Platforms. Platforms 1 to 8 are formed in a block of parallel tracks at the terminus end of the mainlines, and Platform 10 situated alongside the Down Loop on the Phoenix Park Tunnel Branch Line. Platform 10 which, due to current operational constraints at Heuston, is not used for passenger services. To the south of Platform 1, there are multiple sidings, as well as further sidings around the Valeting Depot and the Wash Road. Numerous Points & Crossings (P&C's) provide the operational capability necessary to access all of the platforms and train servicing facilities. Additionally, to the north of Platform 8 there are the Guinness Sidings and the Carriage Sidings. All tracks fall in level from west to east towards Heuston Station, platforms being on flat gradients. Line speed is predominantly limited to 30 km/h (20 mph) in the platforms.

There are a number of signalling structures controlling all of the passenger services and operational/ service requirements in the station area. The area does not currently provide for electrification. There are a number of retaining walls in this area.

There is a subway structure (UBC1A), providing access for Iarnród Éireann personnel to the valeting plant at Heuston Yard.

A new National Train Control Centre (NTCC) at Heuston Station is near completion. The facility is located between the Guinness Sidings and carriage sidings.as outlined in Figure 4-99. The facility will comprise of a 5,500m2 building constructed over 5 floors over basement as outlined in Figure 4-100. The NTCC will be Iarnród Éireann's centre for the management and regulation of train movements on their network and will also provide real-time customer information at stations and on Iarnród Éireann's website and social media platforms. The NTCC is to replace Centralised Traffic Control centre (CTC).

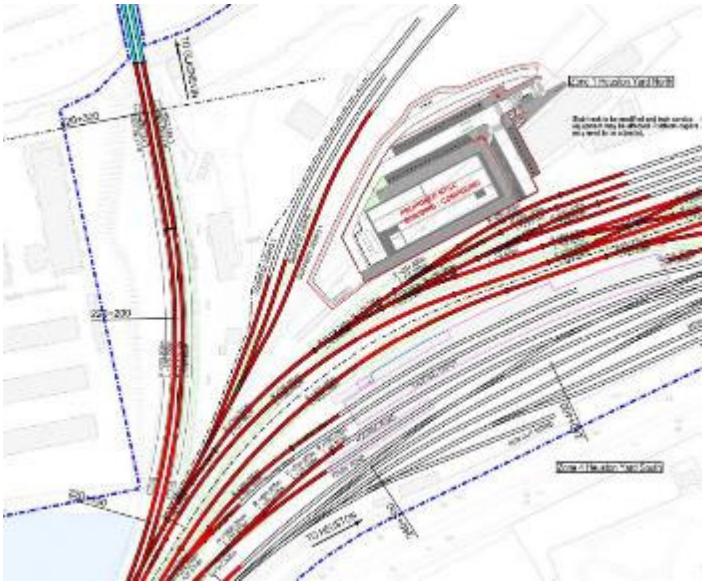

Figure 4-99 National Train Control Centre Location

Figure 4-100 Image of National Train Control Centre

4.8.2. Proposed Development

Heuston Station currently does not have provision for electrification and as such platforms and sidings within the Heuston area will need to be electrified to receive the new DART+ fleet.

Within the Heuston Station area, platforms 6, 7 and 8, as well as additional carriage sidings 3 to 6 to the North, are to be electrified to receive the DART+ rolling stock, one of the sidings (Sidings 6) will need to be extended, whilst retaining the existing functionality of Heuston Station Yard. Due to the modifications to the existing sidings, the existing fencing adjacent to the station car park will need to be replaced with new palisade fencing. The extension of Carriage Sidings 6 will impact the parking area located at the north of the existing sidings. A total of 40 car parking spaces will be removed.

In addition, the proposed Project includes for the provision of a new station at Heuston West, located to the west of the main Heuston Station. The new station will provide connectivity to other transport modes in the Heuston area. The station will occupy the former Platform 10 area having two platforms serving Up and Down directions of the line. A new pedestrian and cycle access route is to be provided between the lower ground level of the Clancy Quay residential area and the new station, a new segregated pedestrian / cycle bridge will provide access to both platforms and the public areas to east and west of the station. A public Right of Way is proposed to be registered along the entirety of Waterloo Avenue; as it is most direct route between South Circular Road (SCR) and the boundary between Clancy Quay Development and CIÉ lands at Heuston West. This right of way will include the existing footpaths as well as the vehicular paved areas between SCR and Heuston West for use by cyclists.

The new station design comprises the following specific elements:

- Two open platforms, each 174m long as required for the 8-cars trains service, finished with ramps for maintenance and emergency access to the tracks.
- Pedestrian and cyclist access to be provided – connecting both platforms and the public areas to east and west of the station by a segregated pedestrian/cyclist bridge.
- Access to the bridge will be via stairs and ramps in accordance with accessibility requirements. The bridge structure will require adequate clearance from the top of rail level to provide track electrification clearance.
- The new station bridge and ramps will provide segregated pedestrian and cyclist access, the bridge parapet height will be 1.80 m high.
- The station will be accessible by road, including a bus set-down area, short term parking bays for disability user set-down, access also to be provided for emergency services vehicles. The existing road and roundabout layout to be modified to accommodate the new station, bridge and ramps.
- Cycle parking areas will be located on both side of the station.
- The platform area and track area will be secured with a perimeter fence. Station access will be closed during non-operation hours. The station will be unstaffed, with full CCTV coverage. CCTV and platform help points are to be monitored from the customer communications centre within the NTCC. The external circulation area accessing both platforms will have ticket vending machines and a ticket validation system – tag on / off validation poles.

4.8.3. Heuston West Station Design

Figure 4-101 Proposed Heuston West Station Location

The station design incorporates the requirement for the proposed underground attenuation tank (shown below in dashed line in Figure 4-102.

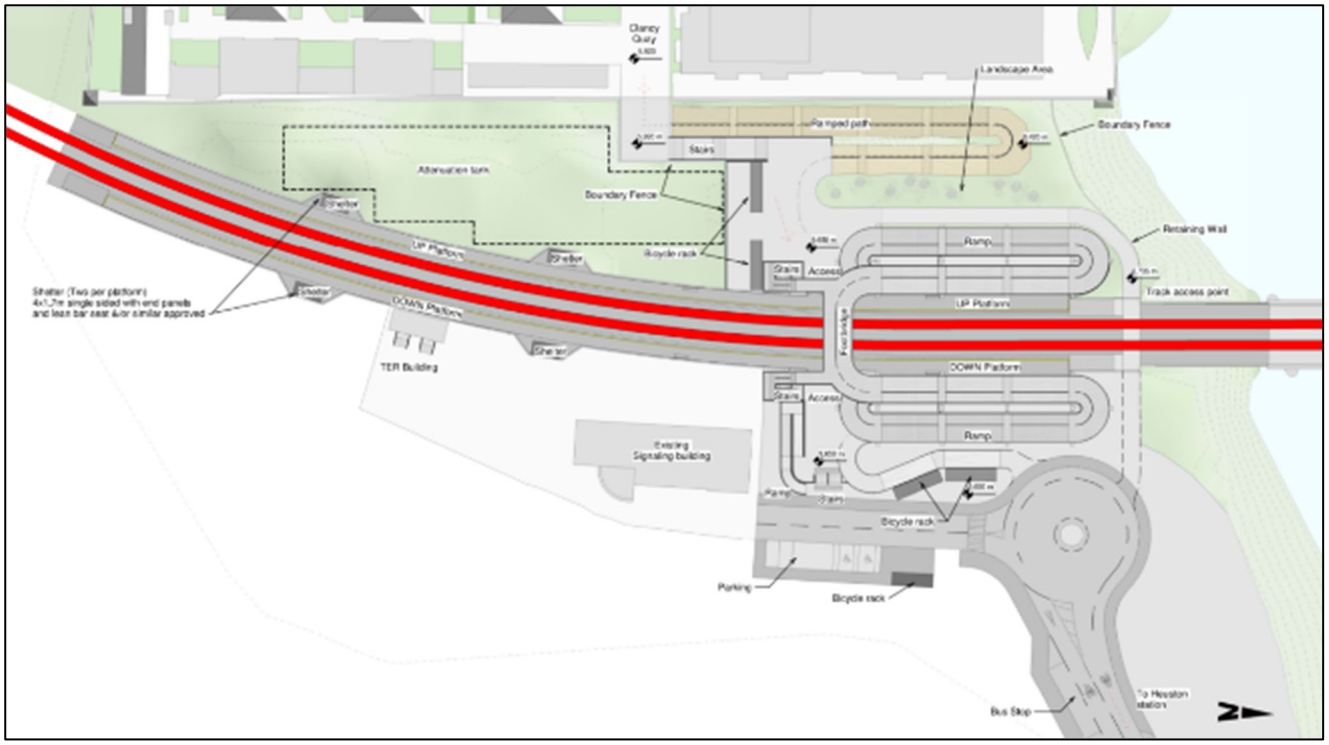

Figure 4-102 Proposed Heuston West Station Plan

The access to the station is by means of either stairs or ramps. The design includes for a track access point (Maintenance Only) north of the platforms which is intended for the maintenance services access. The design includes the use of curved shapes in the station structures to soften visual impact.

Platforms will be 174m long, 3m wide, the bridge and ramps have been designed to provide segregated pedestrian and cyclist access, the ramps will be approx. 5.2m wide.

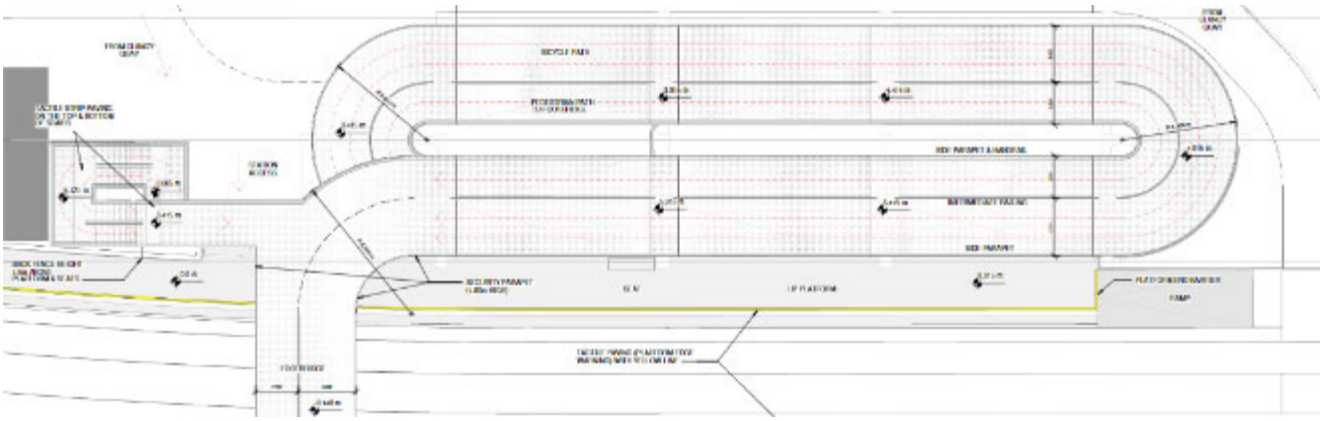

Figure 4-103 Proposed Station Plan - Western Platform

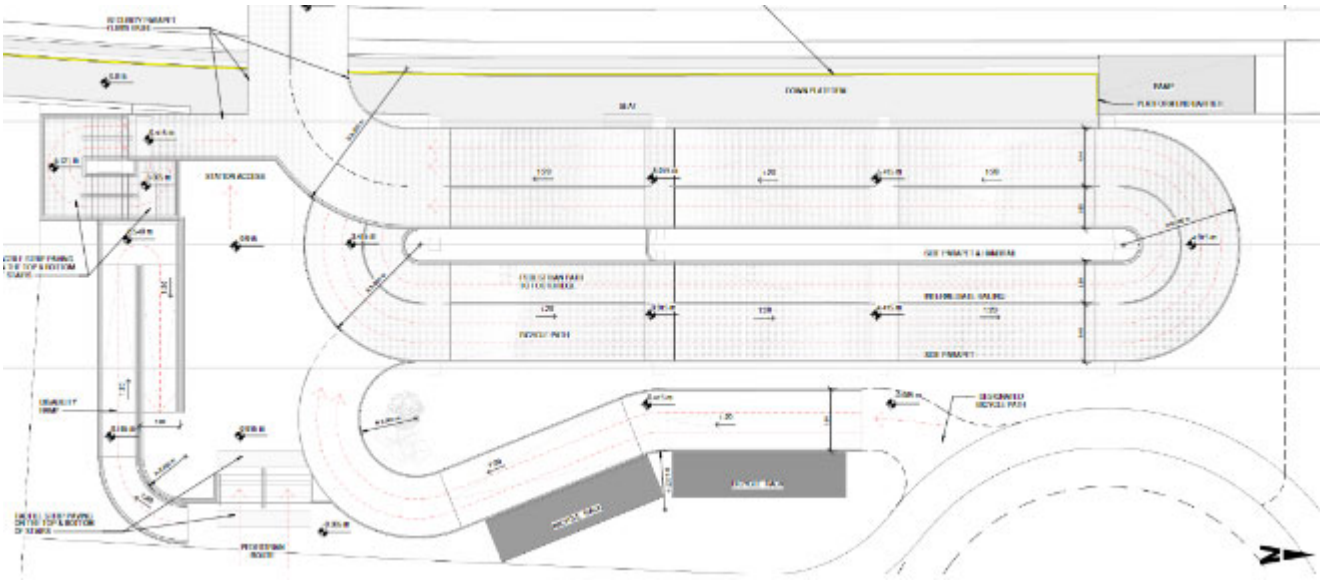

Figure 4-104 Proposed Station Plan - Eastern Platform & Station Access

Figure 4-105 Proposed Heuston West Station, Elevation, East Elevation

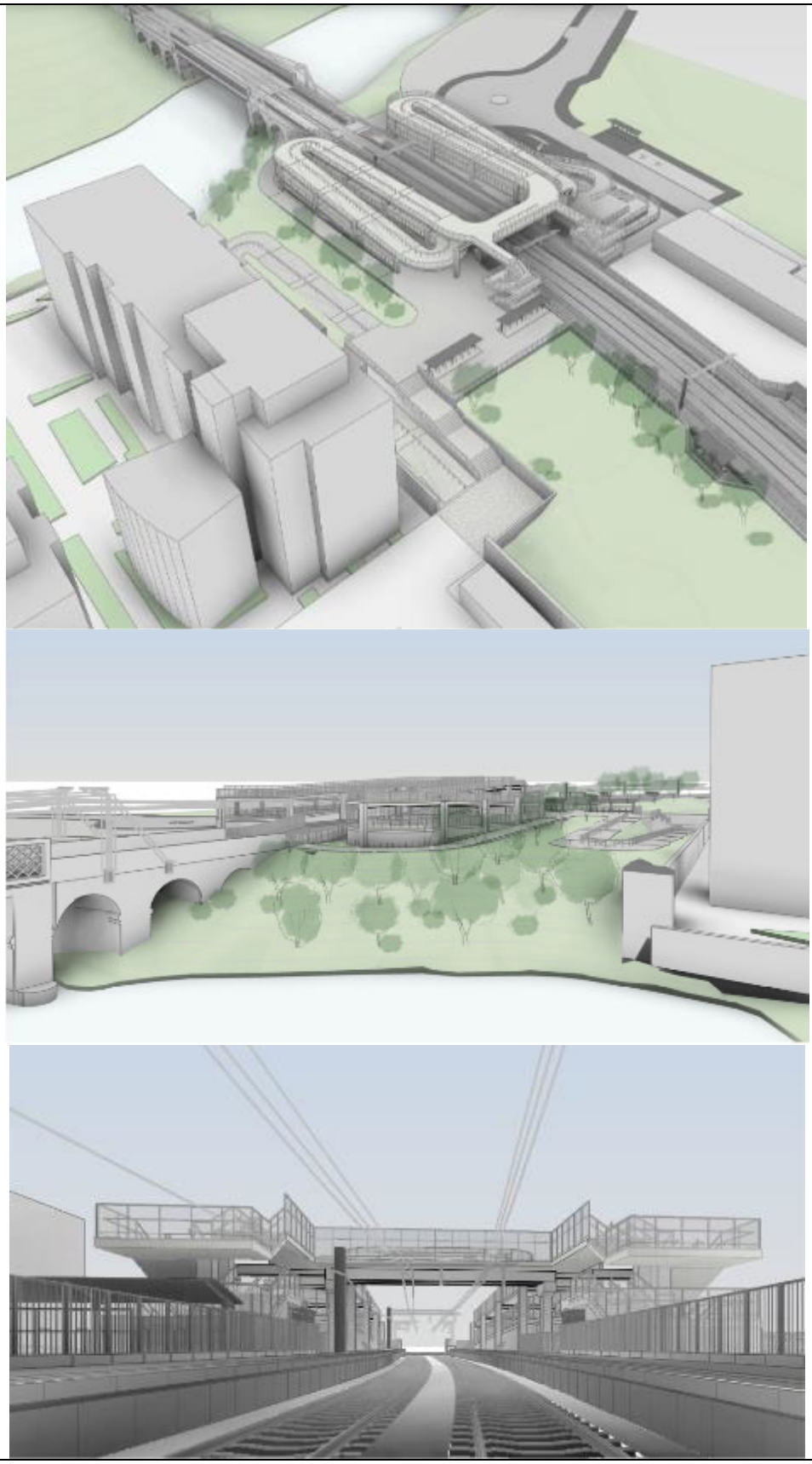

Figure 4-106 Proposed Heuston West Station Views

4.8.3.1. Pedestrian Transfer Route

The access route to the proposed Heuston West Station will be via the same access road serving the existing Heuston Station main carpark and Platform 10. The existing carriageway and lane widths along the majority of the access road will not be altered, owing to the restrictions imposed by existing buildings or infrastructure along the route. The road layout and roundabout adjacent to the new station will be modified to accommodate the new station layout. Most of the existing central median traffic calming, along the non-pedestrianised sections of the route will also remain as is or be reinstated in a like manner.

The lack of lateral space does not afford the opportunity to provide dedicated/segregated cycle lanes, however there is a low volume of vehicular traffic using the access road and there is a 15km/hr speed restriction. Additional signage and line marking will be provided to inform vehicular users that cyclists have priority on the access road leading to the proposed Heuston West Station. The core enhancements will be those that improve passenger safety as they transfer between Heuston Station (as well as the Luas and Bus stops) and the proposed new Heuston West Station. The proposed interventions are listed below and visible in Figure 4-107 to Figure 4-109.

The access route has been divided in three works areas. The main works for Area 1 are listed below (Figure 4-107):

- Widen footpaths after yard compounds between existing fence and back of existing path.
- Modify road and roundabout layout, provision of bus parking, disability parking and bike storage.
- Relocate existing car park spaces that are currently to the west the existing signal control building access road to the eastern side of the access road.
- Line marking a shared use cycle lane with vehicles, between the Heuston Terminal Station entrance and the proposed Heuston West Station.
- Install a Zebra crossing with solar powered Belisha Beacons east of the main Heuston Station car park roundabout.

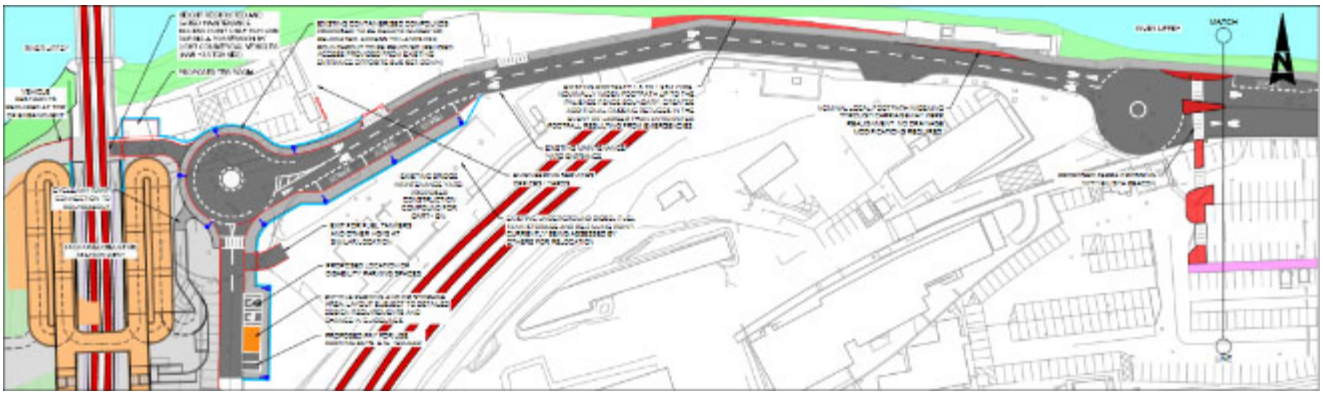

Figure 4-107 Area 1 - Pedestrian Transfer Route Upgrades

Main works for Area 2 are listed below (See Figure 4-108)

- Install courtesy crossings inside the Main Heuston Station car park; from a new pedestrian gate at the crossing to existing covered walkway (that runs along the spine of the car park)
- Line marking a shared use cycle lane with vehicles, between the Heuston Terminal Station entrance and the proposed Heuston West Station.

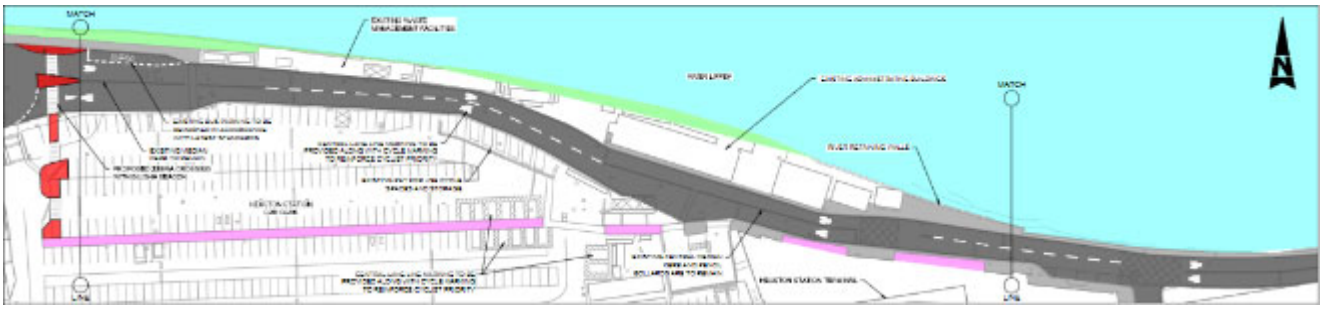

Figure 4-108 Area 2 - Pedestrian Transfer Route Upgrades

Main works for Area 3 are listed below

- Install zebra crossing and build out footpath at bus stop adjacent to the River Liffey (bus stop line marking and signage to be revised accordingly).
- Restrict Access to River Liffey side footpath using bollards and or other method.
- Line marking a shared use cycle lane with vehicles, between the Heuston Terminal Station entrance and the proposed Heuston West Station.

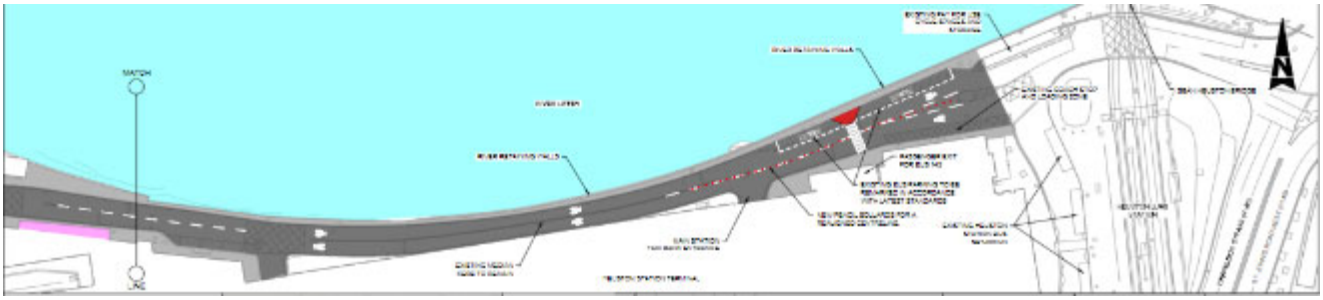

Figure 4-109 Area 3 - Pedestrian Route Preferred Option Enhancement Proposals

4.8.4. Proposed Additional Infrastructure

There are no new or modified bridges (apart from the proposed pedestrian footbridge crossing) or retaining wall structures anticipated in this section.

4.8.5. Proposed Development – Permanent Way

The constraints on track work in Heuston Station are predominantly those posed by the need to maintain the operational capability of the existing inter-city routes, freight routes, station platforms and servicing infrastructure (such as the train wash, service and stabling sidings), as well as the existing drainage and signalling. The number of tracks, their configuration and connectivity through existing Points & Crossings (P&C) mean that any modifications must be carefully considered to tie in with the

platforms and service facilities. A crossover has been added between Platforms 6 and 7 as part of the electrification requirements (Figure 4-110).

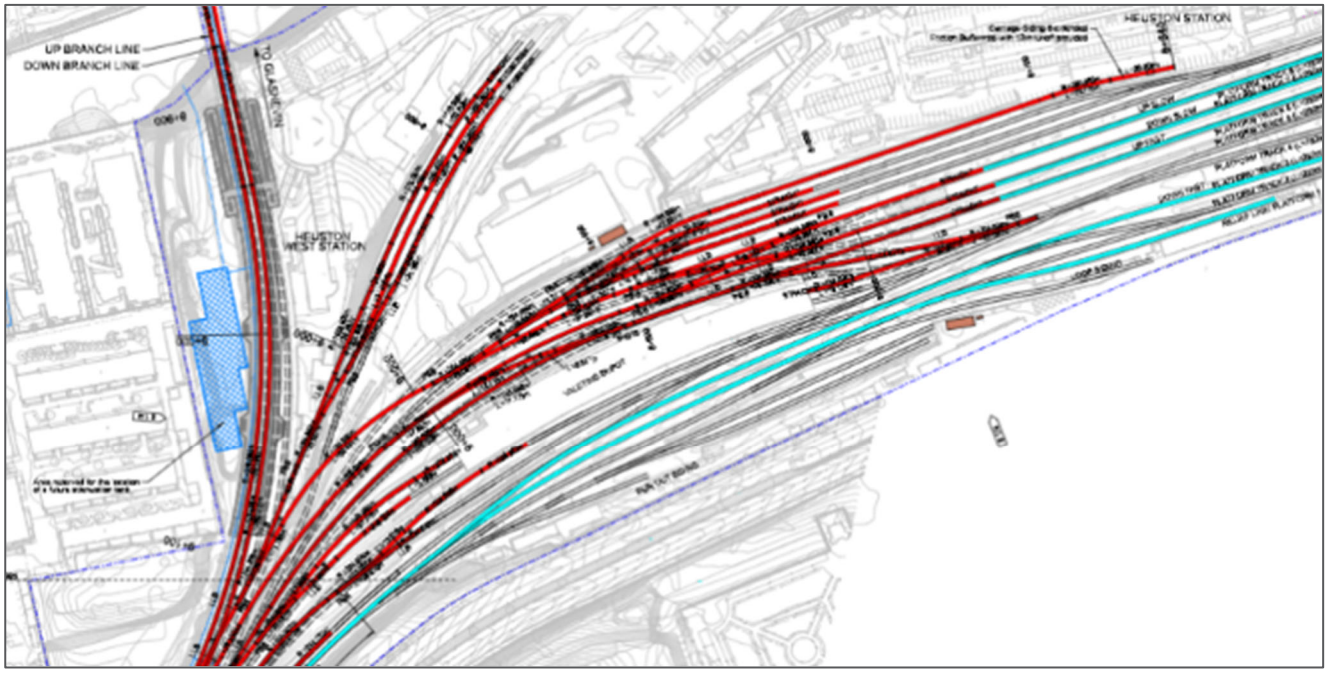

Figure 4-110 Heuston Station Yard – Track Plan Layout

The proposed layout comprises four tracks at the start of the section to the east of St John's Road Bridge (OBC0A) - the three existing tracks being realigned on the south side of the corridor plus the addition of a new track on the north side.

To maintain the standage lengths of the Guinness Sidings, and retain existing connectivity, it has been necessary to undertake significant remodelling at the western approach. An additional requirement was to avoid interlacing crossing long bearers with switch toes. The following describes the changes to meet these requirements:

- The Up Slow (Heuston) has been redesigned in order to create a straight alignment in the area where the turnouts going into the Carriage Sidings are located.
- Optimisation of the horizontal alignment geometry for the three Guinness Sidings, in order to avoid the use of reverse curves, short elements and the use of tight horizontal radii.
- Ensure a separation be achieved between follow-on turnout units of the Guinness Sidings.

This has resulted in a significant shift to the west of the main entry line, Guinness Siding 1, that impacts the existing structures shown in Figure 4-111 which will need to be demolished to accommodate the new track layout.

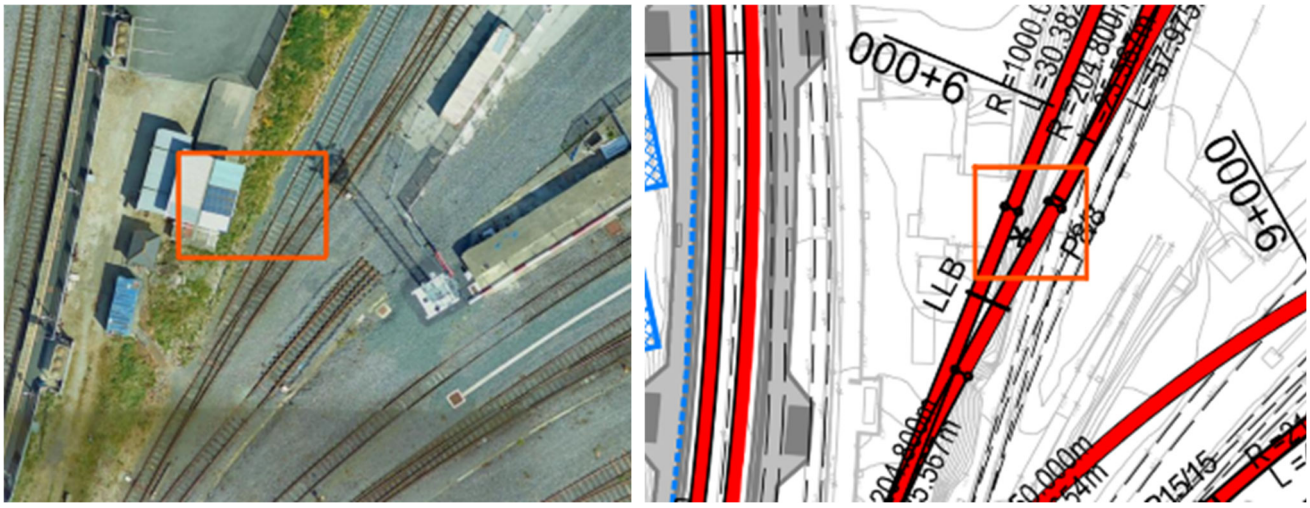

Figure 4-111 Heuston Station Yard – Track Plan Layout

The 2 no. northern tracks tie-in to the existing Phoenix Park Tunnel Branch lines and become the electrified Slow lines, whilst the Fast lines to the south approach Heuston Station. There are also other connections from the Slow lines into Heuston Station, as well as the Slow lines passing through the new Heuston West Platforms (10 and 11). The layout is illustrated in Figure 4-112.

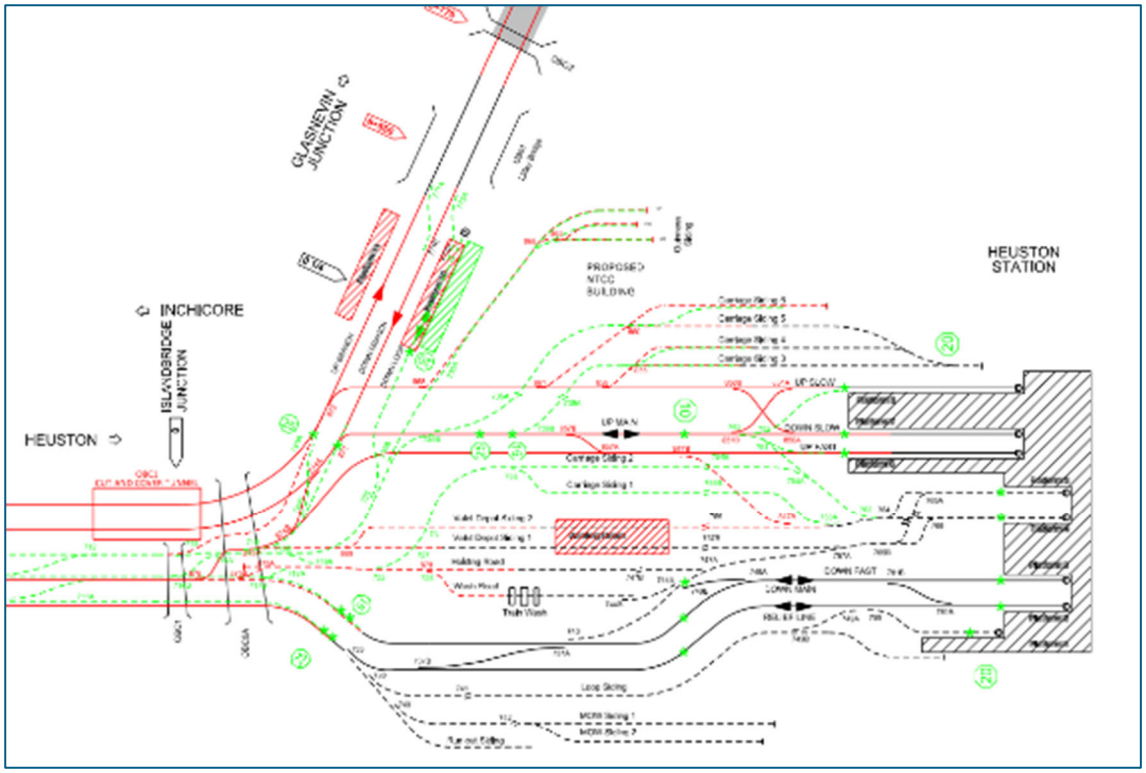

Figure 4-112 Heuston West Station – Track Plan Layout

4.8.6. Proposed Development – Demolition / Removal

Within this zone, the proposed demolitions or removal of buildings or structures are set out in Table 4.17 below.

Table 4.17: Summary of proposed Demolitions / Removal

Location Chainage	Heritage	Description	Conflict
Ch.8+940	No	Existing containerised toilets	To be demolished to facilitate Heuston West Station footbridge and access.
Ch.8+963	No	Existing Signalling Gantry at Platform 10 (Heuston West)	To be demolished to facilitate track realignment and Heuston West Station
Ch.8+900 to 9+100	No	Platform 10	Existing platform 10 to be demolished to facilitate construction of Heuston West Station
Ch.9+000	No	Maintenance Building adjacent to platform 10 and NTCC bldg.	Building to be demolished to facilitate track realignment in this area
Ch.9+010 to 9+030	No	Existing structures adjacent to Guinness Sidings	Existing structures to be demolished to facilitate shift to the west of the main entry line, Guinness Siding 1

4.8.7. Proposed Development – Drainage

As part of the drainage system installation, it is proposed to install a new underground attenuation tank between Clancy Quay and the tracks. The location of the tank has been considered and integrated into the station design. The catchment area for the proposed attenuation tank is outlined in Figure 4-113 and has been described in Section 4.7: Zone B.

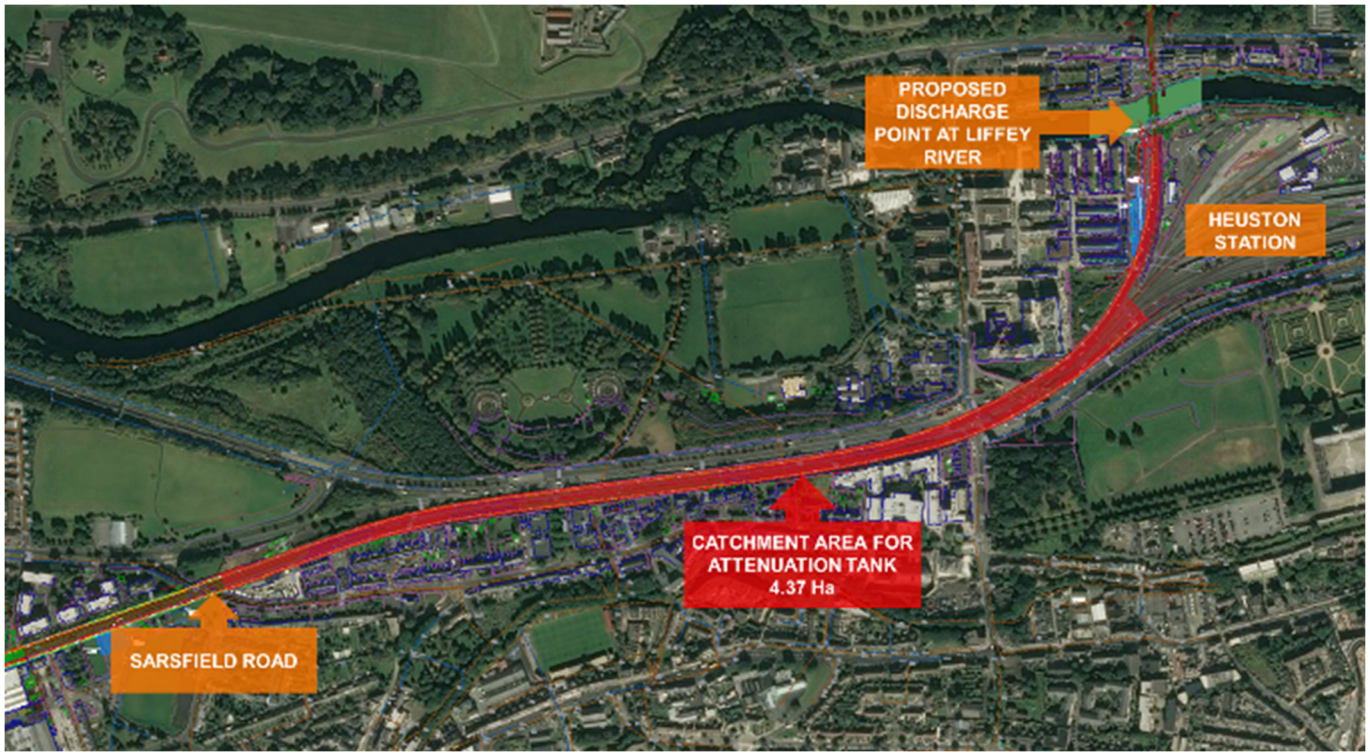

Figure 4-113: **Catchment Area for the Proposed Attenuation Tank**

The drainage network for this track section consists of a single pipe branch running parallel to the track beneath the ballast layer.

The proposed track drainage system includes filter drains to collect ballast and surrounding areas runoff. The proposed filter drains discharge into the collector pipes through manholes, which are to be

spaced between 30 to 50 metres apart which in turn convey the runoff to the proposed attenuation structure. The attenuation tank will be located underground, located as shown in Figure 4-114.

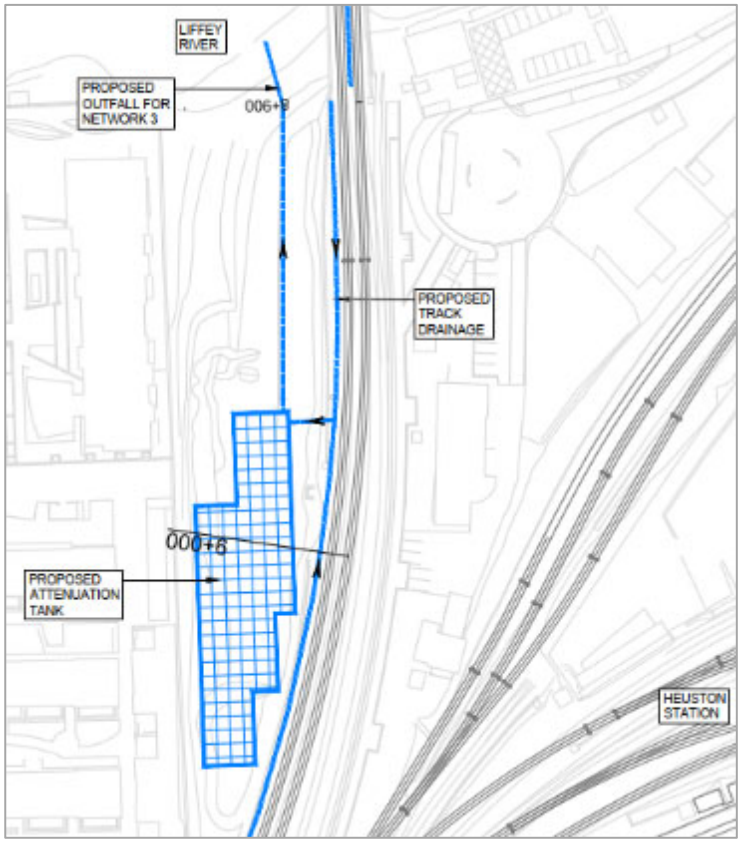

Figure 4-114: **Proposed Track Drainage Layout at Heuston West**

A proposed outfall for the new attenuation tank is to be located between Heuston West Station and Clancy Quay. The attenuated flows will, discharge to the River Liffey, at controlled discharge rates.

4.8.8. Proposed Development – Electrification

4.8.8.1. OHLE Arrangement

There is a requirement to electrify Platform 6, 7 & 8 and Carriage Sidings 3 to 6. The area through Heuston station to Platforms 6, 7 & 8 and the sidings will be provided with Twin Track Cantilever (TTC) or portals or over the platforms and the sidings. The OHLE structures shall be positioned in the space between the line side equipment. It is proposed that portal structures shall be positioned on the platforms through the canopy to support the OHLE wires with 30-50m spacing (Figure 4-115).

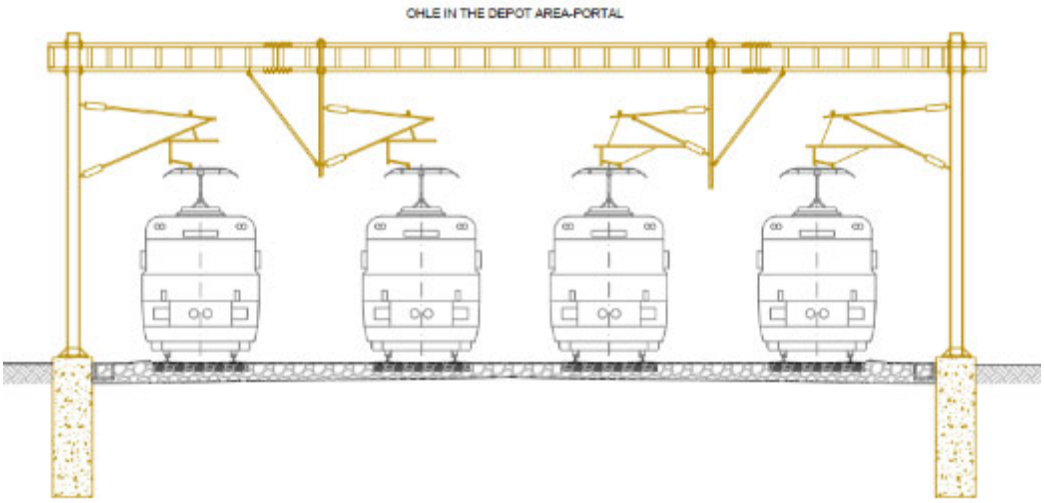

Figure 4-115 Typical OHLE Portal Arrangement in Station Area

In the area between the station and main route, new OHLE structures shall be positioned in the space between the track and railway boundary. The type of structures will typically be Single Track Cantilever (STC) or Two Track Cantilever (TTC) depending on the space between the tracks.

Figure 4-116 shows a typical OHLE arrangement with TTC structure in the four-track area.

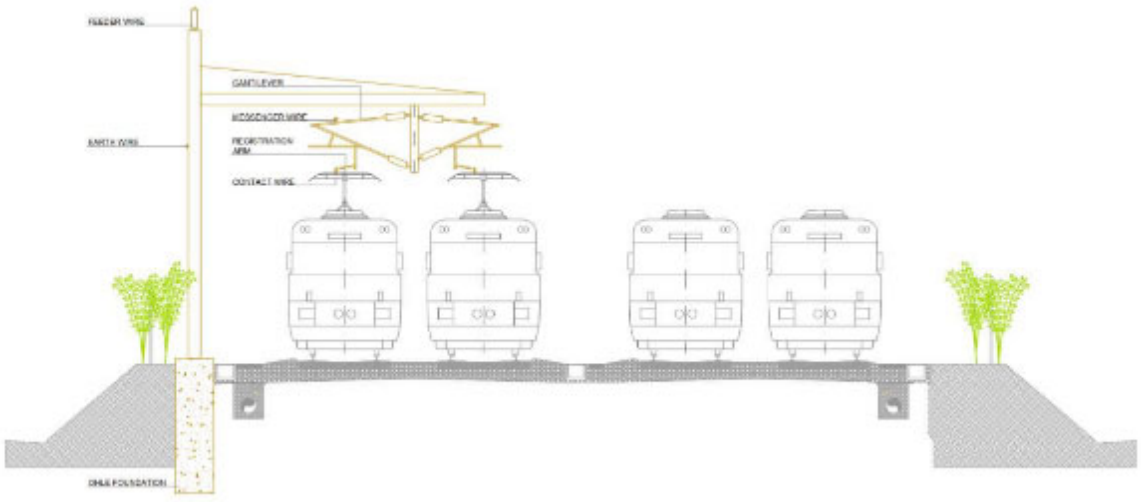

Figure 4-116 Typical OHLE Arrangement in Four-Track Open Route

Localised platform canopy modifications will be required to accommodate the OHLE masts but only if further design development finds it necessary to position some masts on the platforms. The canopy structure in such instances poses no impediment to the platform line electrification.

In the Heuston West Station section, in the twin track area, the electrification equipment will be supported by TTC structures at north side of the lines to support OHLE on both tracks. TTC type OHLE masts shall be positioned through station area to minimise the OHLE masts on one platform. The OHLE masts shall be placed to avoid clashing with station footbridge and shelter (Figure 4-117 and Figure 4-118).

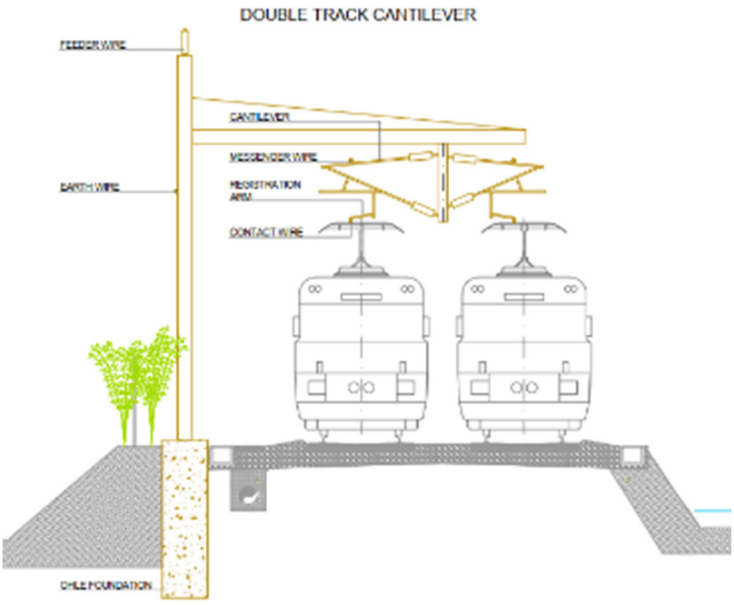

Figure 4-117 Typical OHLE Arrangement in Two Track Open Route – Facing East

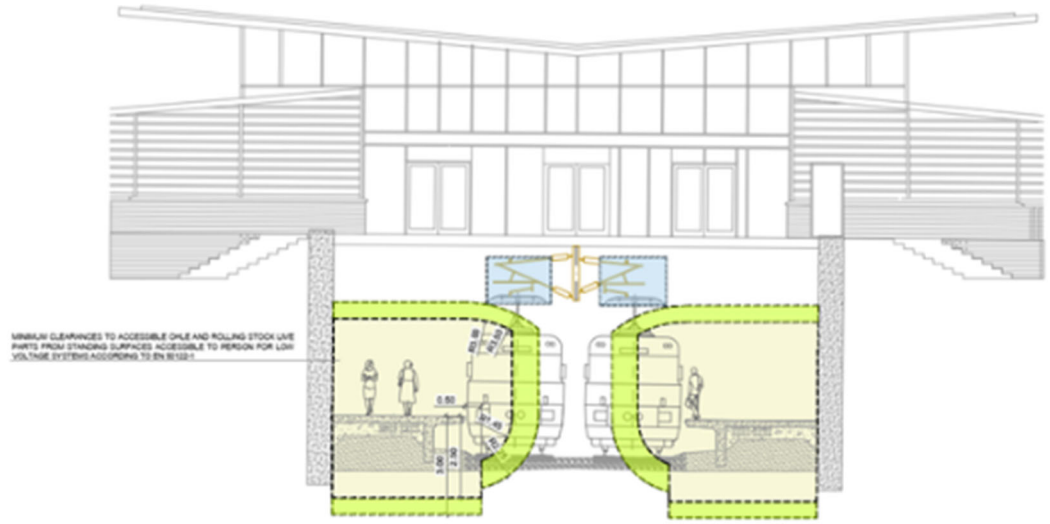

Figure 4-118 Example OHLE System in Station Area with Clearance

4.8.8.2. Substations

One substation will be provided in the Heuston Station / Islandbridge area to provide the requisite power for the network demand. The proposed Islandbridge substation is located within the Heuston Yard area adjacent to the R148 (St John's Road West). It is a brown field site in the possession of CIÉ on the southern side of the railway yard as shown in Figure 4-119.

To facilitate vehicle access to the substation a new vehicle access route will be required. The site will be accessed from St. Johns Road West, due to site constraints, access gates are proposed either side of the proposed substation location to enable vehicles to traverse the site without turning. Due to the site topography, a retaining wall will be required along the track side of the site to raise the level of site to align with St. Johns Road West. This access track and substation site will require the installation of

fencing along track side of the site to effectively separate it from the permanent way and thus permit access by ESB Networks personnel.

Figure 4-119 Islandbridge Substation Location

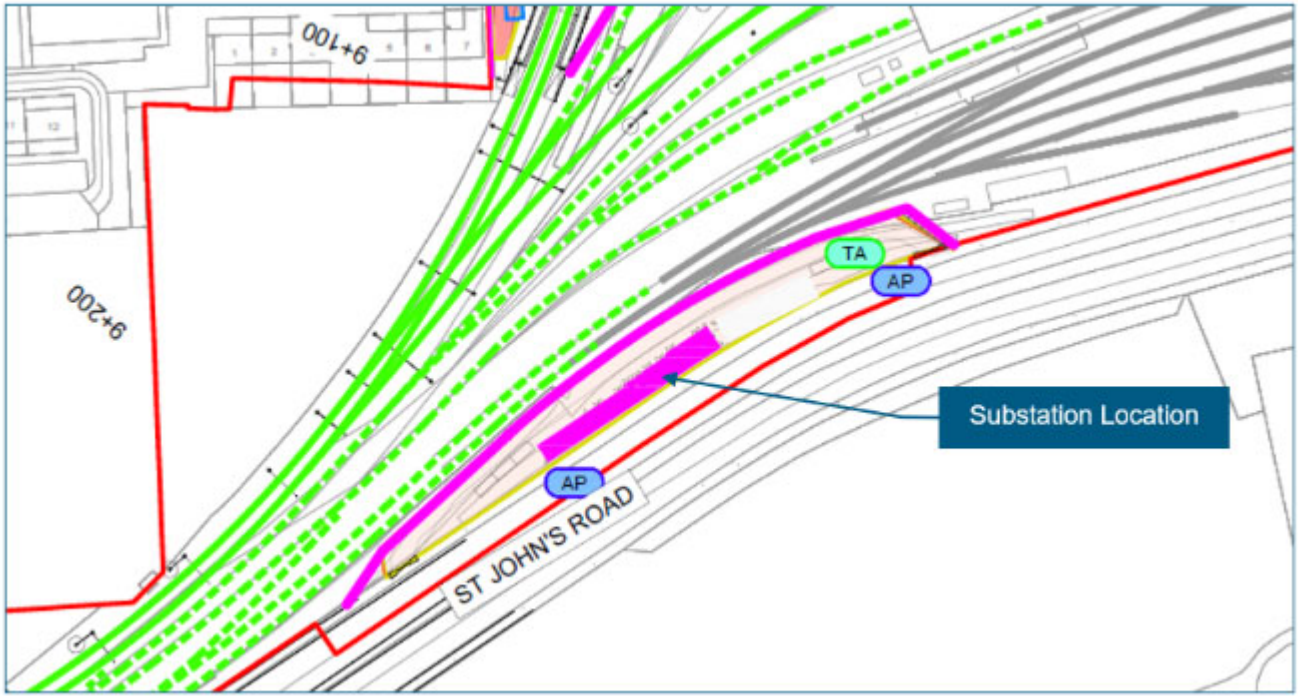

Figure 4-120 Islandbridge Substation Layout

The nearest ESB 38kV network from the proposed substation is the existing Knightsbridge – Inchicore North 38kV underground circuit located on the westbound verge of St John's Road and running parallel along it. The ESB network connections and the proposed connection routes are covered in more detail in Chapter 5.

4.8.9. Proposed Development - Signalling and Telecommunications

4.8.9.1. Signalling System

New physical signalling and low voltage infrastructure comprising of a network of signalling and LV elements including localised Location Cases/Cabinets (LOCs) and Signalling Equipment Buildings (SEB) will be installed along this section of the route.

The location of the Signalling Equipment Building (SEB) and Location Cases/Cabinets (LOCs) for LV equipment are within Heuston Station environ, adjacent to the new Heuston West Station.

4.8.9.2. Signalling Post

There are currently no new signalling cantilevers or gantries proposed in this section and trackside signals would be located on new signal posts adjacent to trackside.

4.8.9.3. Telecommunications

A new Telecom Equipment Building/Room (TER) is required within this zone, it will be located adjacent to the new Heuston West Station as shown in Figure 4-121 below.

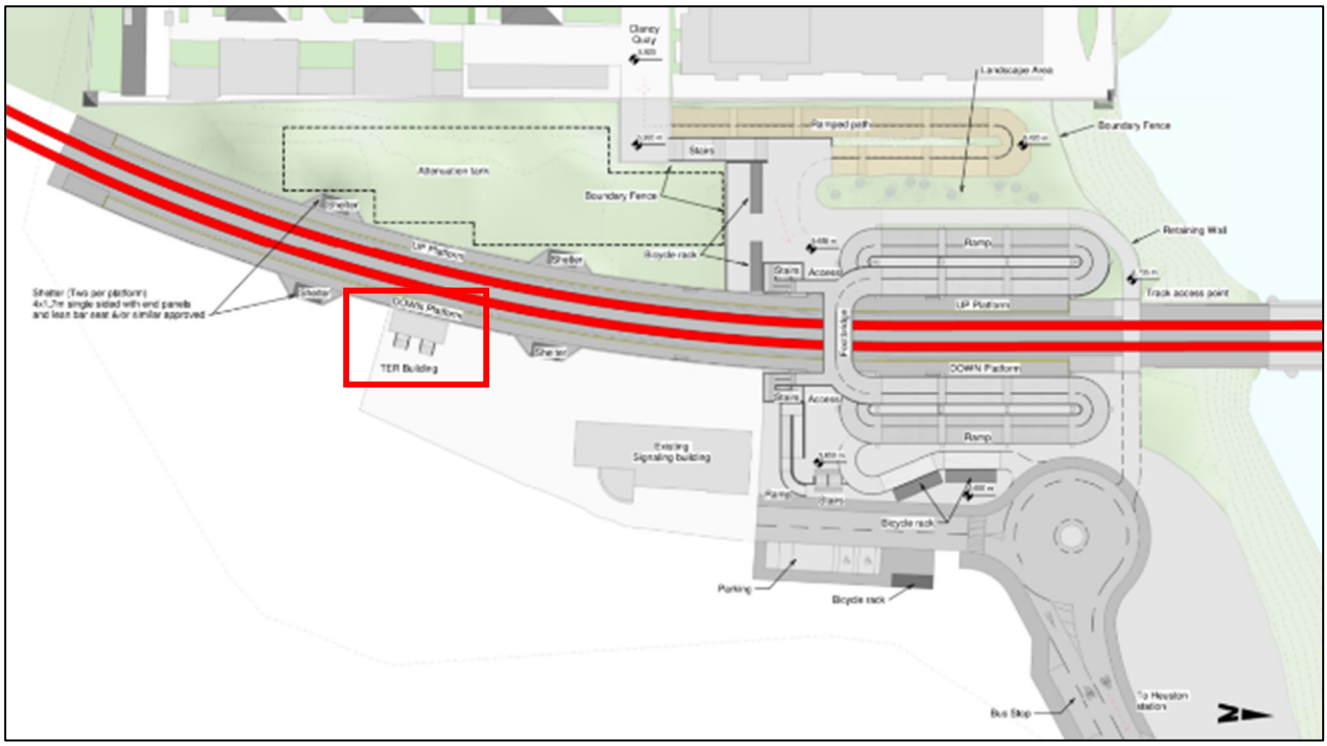

Figure 4-121 Proposed Location for New TER at Heuston West Station

4.9. Zone D: River Liffey Bridge to Glasnevin Junction

4.9.1. Overview of Zone D

Zone D commences on the south bank of the River Liffey (adjacent to the northern boundary of the Heuston Yard) and extends north east terminating at Glasnevin Junction. The route extends northwards over the River Liffey via the Liffey Bridge (UBO1) and under Conyngham Road Bridge (OBO2) after which, it enters the existing Phoenix Park Tunnel (PPT).

The Phoenix Park Tunnel has a length of approximately 700m and has two ballasted tracks through the tunnel. The tunnel was originally built by the Great Southern and Western Railway company to connect Heuston Station to the Dublin Docklands and was primarily used for freight. It reopened to regular passenger traffic on 21 November 2016. There is a lateral clearance issue in the tunnel with substandard separation between tracks and reduced clearances between trains and tunnel walls.

The route emerges on the north side of the PPT, thereafter extending north east under a series of bridges along the Phoenix Park Tunnel Branch Line where the DART+ South West Project extent ties in to the existing track at Glasnevin Junction and interfaces with the DART+ West Project, where the route then continues to the Dublin Docklands area (Spencer Dock and Grand Canal Dock). The rail corridor comprises two existing tracks.

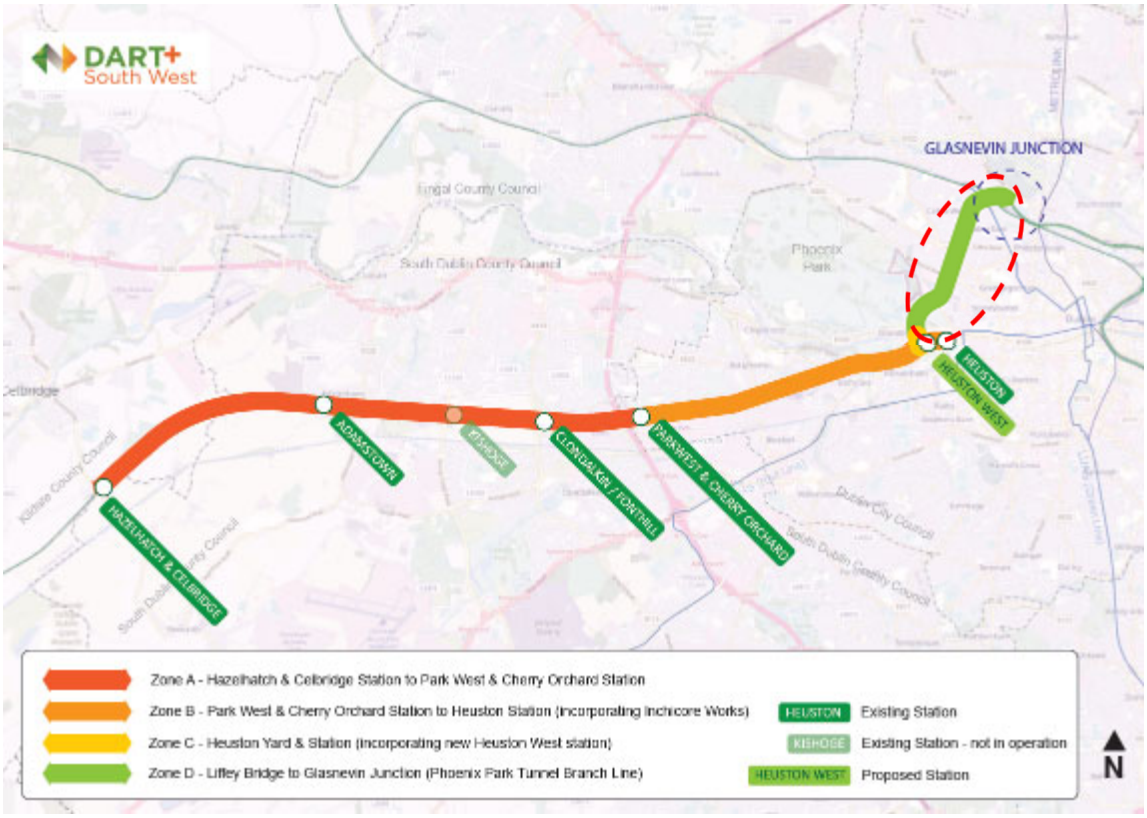

Figure 4-122 Zone D River Liffey Bridge to Glasnevin Junction

The line exits the Phoenix Park Tunnel 85m north of the junction of North Circular and Infirmary Roads. It is primarily in cutting (i.e. the rail level is below the surrounding ground level) and the corridor is formed mainly by earth embankments; with the track passing under 8 no. overbridges and over 1 no. culvert.

The northern boundary of this section of the line is approx. 10m east of Glasnevin Cemetery Road Bridge (OBO10). The road bridges along the Phoenix Park Tunnel Branch Line are outlined in Section 4.5.2. Within Zone D there are 10 bridges.

The topography is generally flat, with the land north and south of the River Liffey sloping gently towards the river. The Phoenix Park itself is a key recreational and amenity area. Mc Kee Barracks extends along and adjacent to the western boundary of the track. The track then passes under the Blackhorse Avenue Bridge (OBO4) and the Old Cabra Road Bridge (OBO5). There is extensive residential development either side of the railway corridor extending from McKee Barracks Bridge to Cabra Road Bridge (OBO6). The track passes under Cabra Road Bridge (OBO6) and Faussagh Road Bridge (OBO7). The existing railway line then crosses under the Royal Canal and Luas Twin Arch (OBO8). There is residential development either side of the rail corridor, as well as some commercial development near the Luas line/ Canal.

The railway line then crosses the Maynooth Line Twin Arch (OBO9) and Glasnevin Cemetery Road Bridge (OBO10). There is existing residential development on the northern side of the existing line at Glasnevin.

Glasnevin Cemetery is located further north, the southern part of it just within 250m distance of the existing rail centreline. The Glasnevin Museum is also located here and is a Fáilte Ireland visitor attraction. Prospect Cemetery is located just on the inside bend of the existing line.

4.9.2. Proposed Development - Permanent Way (including track lowering)

At Liffey Bridge (UBO1) the existing fixed track system on the bridge deck will be retained. There is no track work proposed here. On the approach to Conyngham Road Bridge (OBO2) the Branch lines will be lowered by approximately 0.4m in order to achieve the necessary vertical clearance to install OHLE.

The track alignment through Phoenix Park Tunnel will be realigned horizontally and vertically to ensure that structural and passing clearances are achieved, whilst providing the necessary vertical clearance for the installation of OHLE required to electrify the lines. It is proposed to install slab track from Conyngham Road Bridge (OBO2) through the Phoenix Park Tunnel, in order to provide improved restraint and positioning of the rails and maintain structure and passing clearances. There is an additional benefit in that slab track offers a shallower “track form” compared to ballasted track that will aid the provision of drainage through the tunnel, whilst facilitating the track lowering required to install the OHLE system.

To the east of the Phoenix Park Tunnel, the track corridor needs to be widened in some areas. It is in locations where a number of sub-standard track intervals have been identified, which would otherwise restrict passing clearance for the new DART+ rolling stock.

Vertically, the section is on a falling gradient heading east from St. Johns Road Bridge (OBC0A) before levelling out through Heuston West Station, Platforms 10 and 11. The alignment then continues east towards a local high point over the Liffey Bridge (UBO1) prior to a low point at Conyngham Road Bridge (OBO2). Upon entering Phoenix Park Tunnel the gradient climbs sharply, heading east until the end of the section at the north portal.

The following cross sections illustrate the proposed slab track and OHLE arrangements through Conyngham Road Bridge (OBO2) and the Phoenix Park Tunnel.

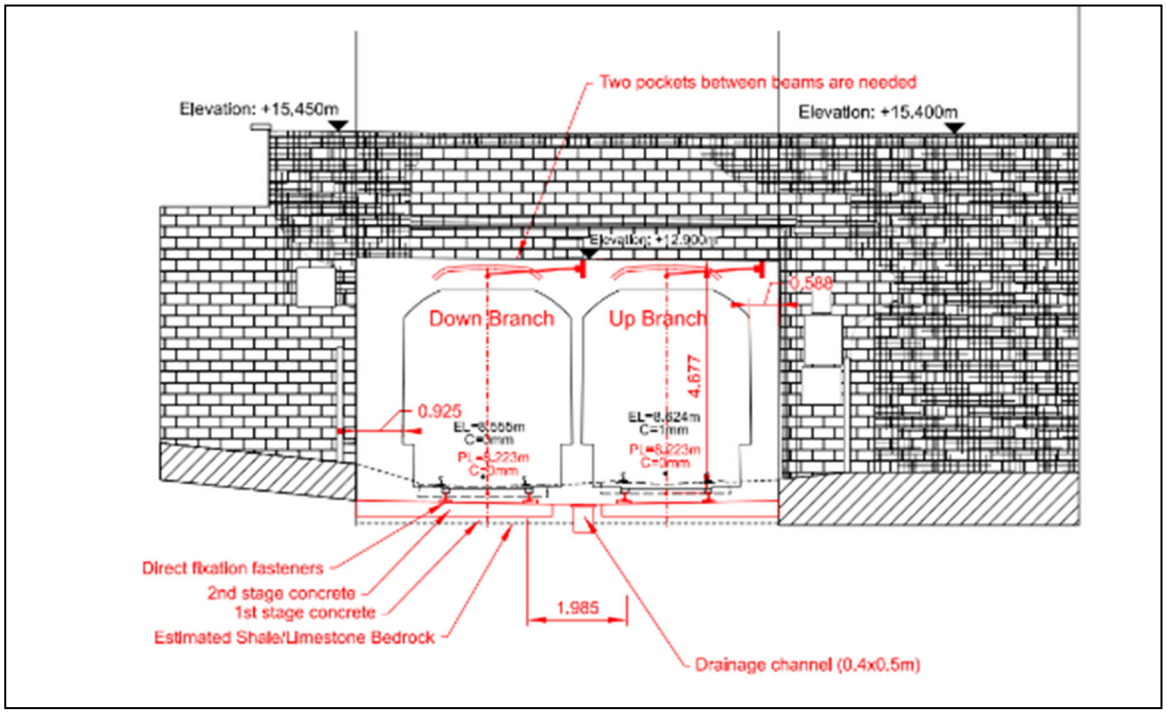

Figure 4-123 Conyngham Road Bridge (OBO2) – Cross Section at Ch 8+771, View Towards Heuston West

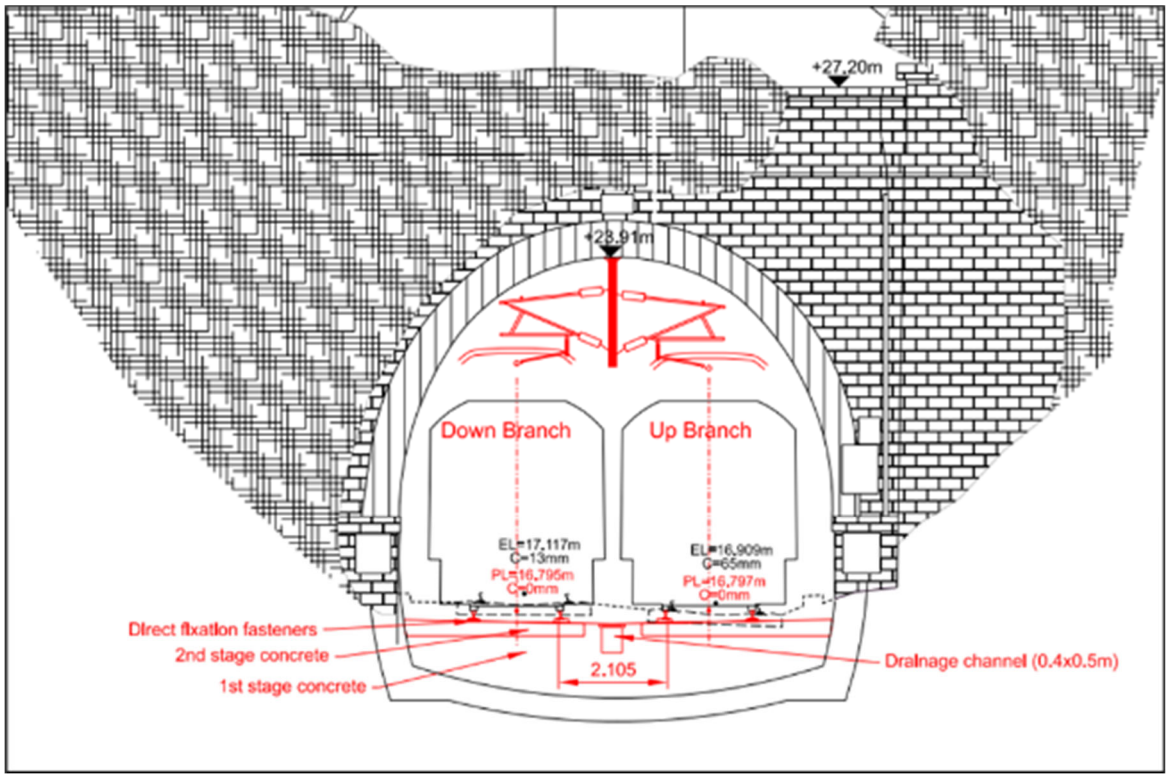

Figure 4-124 Phoenix Park Tunnel – Cross Section at Ch 8+056 – View From Glasnevin Junction

Track lowering is proposed at certain sections along the Phoenix Park Tunnel Branch Line between the Phoenix Park Tunnel and Glasnevin Junction in order to achieve the required vertical clearances beneath a number of the existing bridges. A new track bed and modifications to the drainage system are required in these sections to facilitate the track lowering. The new track bed shall be constructed using subgrade, sub-ballast and ballast.

4.9.3. Proposed Development – Clearance at Bridges

Currently there are 10 no. existing bridges which will cross the newly electrified track on the Phoenix Park Tunnel Branch Line. No major structural modifications are currently proposed to these bridges, with the exception of the Glasnevin Cemetery Road Bridge (OBO10) where a new replacement bridge deck will be installed on this structure's existing abutments to provide the required clearances to OHLE. The proposed modifications to the remaining bridge locations include track realignment, track lowering and parapet height adjustments.

No changes are proposed to the parapets at the Royal Canal and Luas Twin Arch (OBO8) and the Maynooth Line Twin Arch (OBO9). These bridges currently have full height palisade type fencing installed along their embankments.

The remaining 7 bridges on the Phoenix Park Tunnel Branch Line currently feature solid parapets topped with steel railings or mesh panels.

Five of the seven bridges currently meet the minimum height requirement of 1.8m from adjacent footway. The railings currently in place do not meet the IP2X requirement. The railings will therefore need to be replaced with an agreed IP2X infill, that prevents the potential for climbing and the ability to walk along the top surface.

The two bridges which do not meet the minimum 1.8m parapet height requirement are Conyngham Road Bridge (OBO2) and McKee Barracks Bridge (OBO3). Both bridges currently have masonry parapets measuring approx. 1.2 – 1.4m in height. The proposed solution is to install an agreed IP2X infill panel to the top of the existing masonry parapets to raise their height to a minimum 1.8m.

A summary of the modifications to bridges is presented in Table 4.18. Note that the relationship between the bridges and the OHLE is described in Section 4.9.8.

Table 4.18: Zone D – Modifications to Existing Bridges

Structure ID and Proposed Solution*	Photograph of Structure
UBO1- River Liffey Bridge No track works proposed. No change to parapets	

Structure ID and Proposed Solution*	Photograph of Structure
OBO2 - Conyngham Road Bridge Track lowering measuring approx. 0.4m Existing masonry parapet topped with a proposed IP2X panel.	
OBO3 - McKee Barracks Bridge No track lowering required Existing masonry parapet topped with a proposed IP2X panel.	
OBO4 - Blackhorse Avenue Bridge No track lowering required Existing masonry parapet topped with a proposed IP2X panel.	
OBO5 - Old Cabra Road Bridge No track lowering required Existing masonry parapet topped with a proposed IP2X panel.	

Structure ID and Proposed Solution*	Photograph of Structure
OBO6 - Cabra Road Bridge Track lowering measuring approx. 0.3m Existing masonry parapet topped with a proposed IP2X panel.	
OBO7 - Faussagh Road Bridge Track lowering measuring approx. 0.4m maximum Existing masonry parapet topped with a proposed IP2X panel.	
OBO8 - Royal Canal and Luas Twin Arches Track lowering measuring approx. 0.1m No change to parapets	
OBO9 - Maynooth Line Twin Arch Track lowering measuring 0.1m No change to parapets	

Structure ID and Proposed Solution*	Photograph of Structure
OBO10 - Glasnevin Cemetery Road Bridge No track lowering required. Replace existing bridge deck and parapets topped with a proposed IP2X panel.	
* See mitigation in Chapter 15 Landscape and Visual for further mitigation relating to parapets	

4.9.3.1. Glasnevin Cemetery Road Bridge (OBO10)

A new deck to replace that existing will be required at Glasnevin Cemetery Road Bridge (OBO10). The new deck will be of the same span (approx. 12m) and width (approx. 5.9m) as the existing and will include 1.8m high parapets with an H4a containment classification. The replacement of the existing reinforced concrete slab deck will result in a slight increase in the car park levels due to associated regrading and resurfacing works within the carpark and on the approach ramps to achieve the new bridge road surface level approx. 0.6m higher than current. In addition, the existing utility crossings will be integrated into the new deck slab.

The proposed structure will be supported on the existing masonry abutments. The old deck seating will be removed, and a new precast cill beam will be installed to raise the deck 0.6m (approx.). The new deck will be constructed using either pre-cast portal units or MY3 prestressed precast concrete beams with an in-situ deck slab. This will be determined at detailed design stage as both will require similar periods for construction.

The parapet will be a solid structure 1.8m across the bridge and approach road ramps. Aesthetic/architectural concrete finishes and masonry cladding will be considered to suit the surroundings masonry stone walls of the cemetery.

Owing to the low speeds, proximity to existing graves and limited access to the cemetery it is deemed that H4a containment is not necessary for replacement of the southern boundary walls that will be temporarily dismantled for the approach ramps reconstruction.

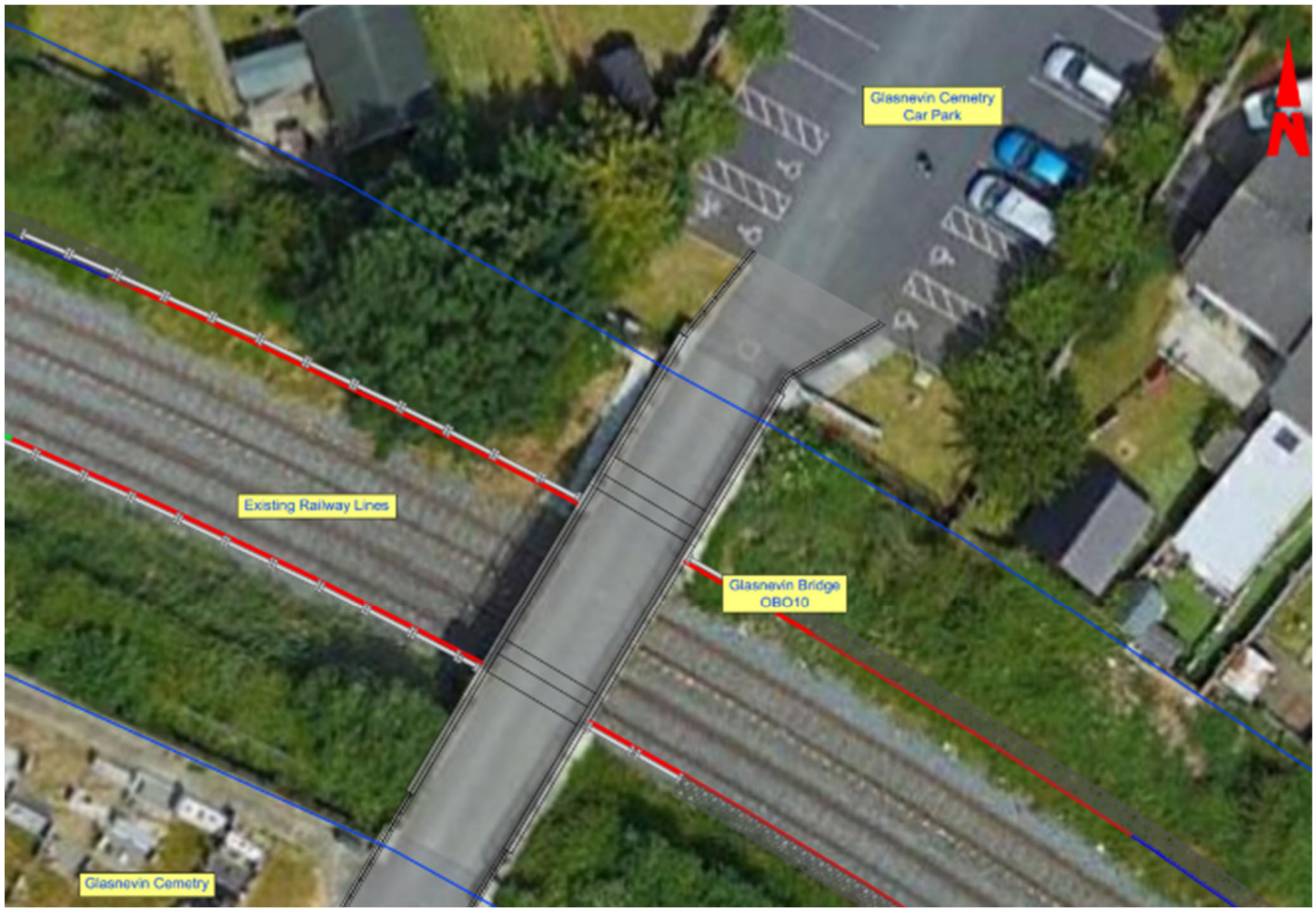

Figure 4-125 Glasnevin Cemetery Road Bridge (OBO10) – General Arrangement

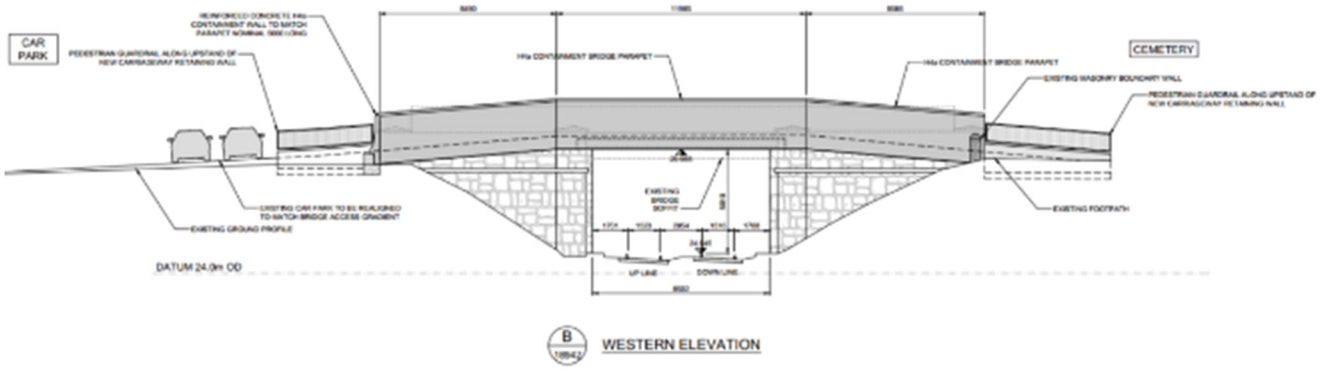

Figure 4-126 Glasnevin Cemetery Road Bridge (OBO10) Longitudinal Section – Facing East

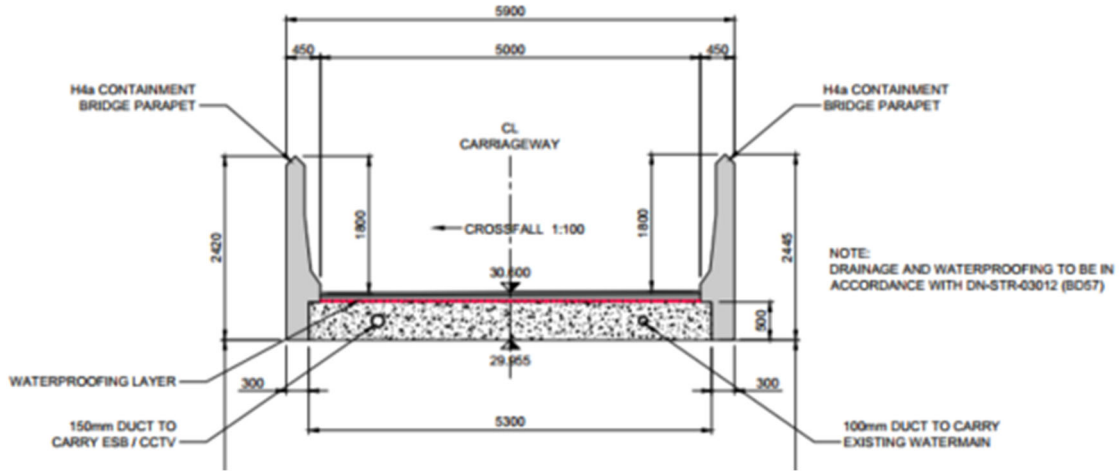

Figure 4-127 Glasnevin Cemetery Road Bridge (OBO10) Cross Section – Facing North

4.9.4. Proposed Development - Retaining Walls and Soil Anchors

No new retaining walls are proposed in the section from Liffey Bridge (UBO1) to the north portal of the Phoenix Park Tunnel.

New retaining walls are required at various sections along both sides of the rail corridor, specifically the section north of the Phoenix Park Tunnel to Glasnevin Junction. These are required to retain the slopes of the two-track corridor within the existing cutting, only in the areas where track modifications are proposed. The retaining walls will be located at the toe of the slopes adjacent to the tracks and will typically consist of gabion basket and king post walls with heights typically ranging from 0.5 to 1.5 m in height.

Additional soil anchors will be installed on the slopes above the new retaining wall locations to complement the existing soil anchors previously installed, to provide greater stability of the cutting slopes and to ensure the long term safety and stability of the rail operations. The new soil anchors and mesh facing system, will extend along the entire slope face and will typically extend 10 to 15m into the slopes. In some instances, the soil anchors will extend beyond the CIÉ property boundary and under third party properties.

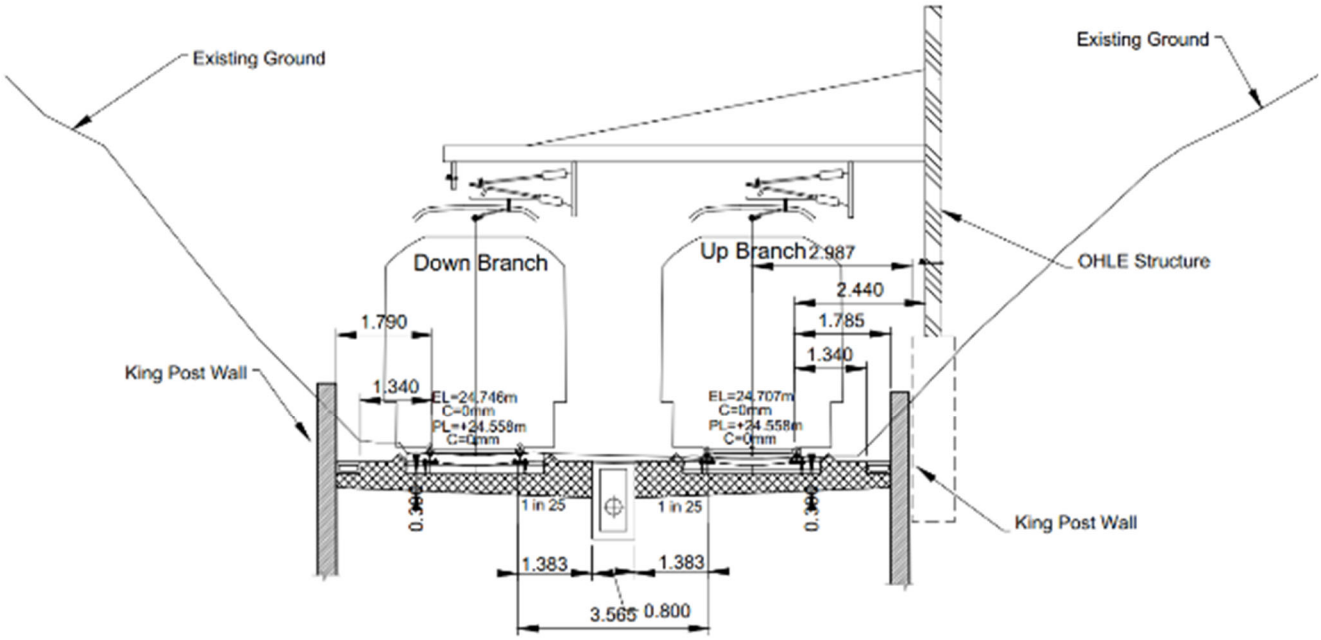

Figure 4-128 Cross Section showing typical retaining wall structures

4.9.5. Proposed Development – Roads

The works to the existing bridges on the Phoenix Park Tunnel Branch Line can be accommodated within the existing rail corridor, minimising disruption to the existing surrounding road infrastructure. The only road design amendments for this section of the project is to accommodate the proposed Glasnevin Cemetery Road Bridge (OBO10) deck reconstruction which requires additional works to the Glasnevin Cemetery Car Park and the approach ramps to the bridge.

4.9.5.1. Glasnevin Junction

The road works proposed in this area include regrading and resurfacing of part of the existing car park along with the new bridge deck which will replace that of the existing Glasnevin Cemetery Road Bridge (OBO10).

To ensure no parking spaces are lost as a result of the proposed changes; the carpark north of the rail corridor will be reinstated with the current parking configuration. The design proposes a regrading of the southern 20m of the carpark. The regrading will result in the rail corridor side of the car park raising by 0.5-0.6m (max.). This will require the carpark kerb line and adjacent greenspaces to be regraded and landscaped accordingly.

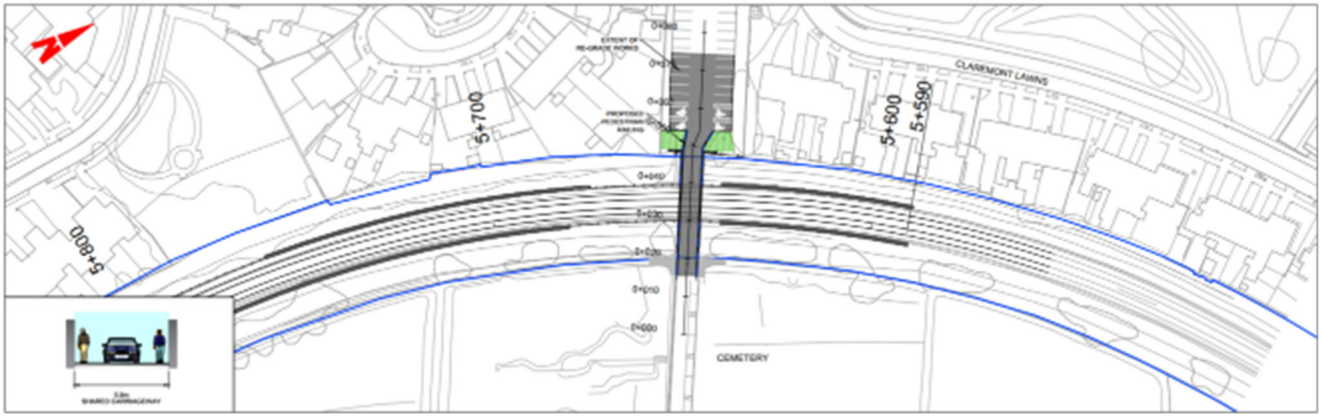

Figure 4-129 Glasnevin Cemetery Road Bridge (OBO10) Plan

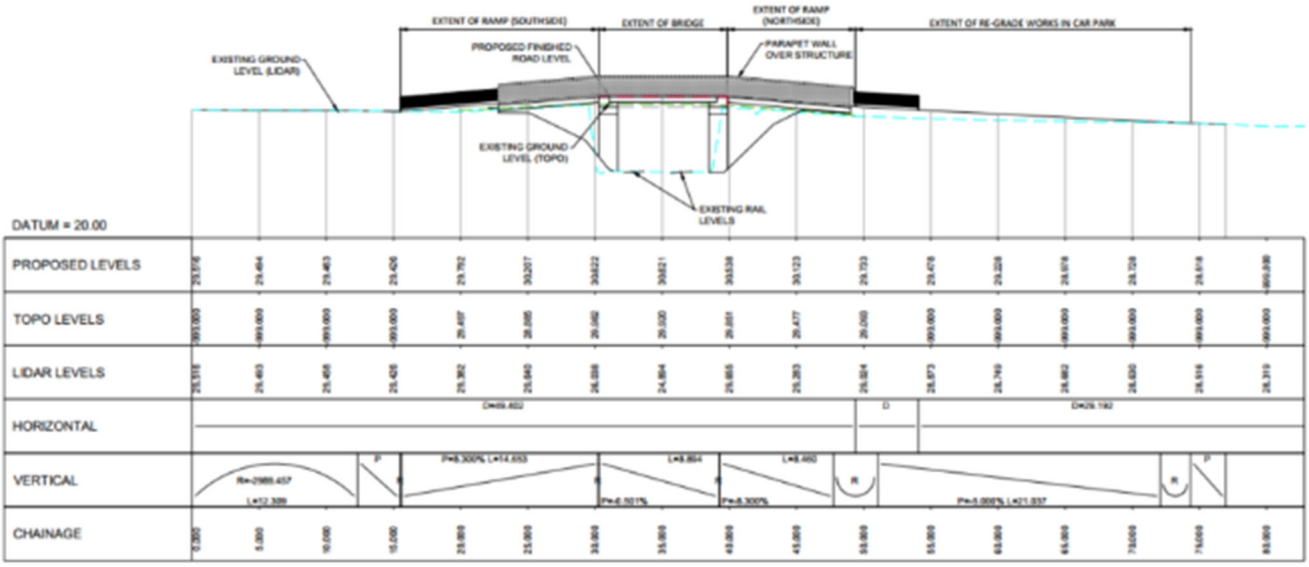

Figure 4-130 Glasnevin Cemetery Access Road – Profile

4.9.6. Proposed Development - Demolitions / Removal

Within this zone, the proposed demolition or removal of buildings or structures is set out in Table 4.19.

Table 4.19: Summary of proposed Demolitions / Removal

Location Chainage	Heritage	Description	Conflict
Ch. 5+650	No	Glasnevin Cemetery Bridge Deck	Bridge Deck to be replaced, insufficient vertical clearance
Ch. 7+635	No	Utilities pipe bridge	Utility to be diverted, insufficient vertical clearance

For Blackhorse Avenue Bridge (OBO4) - The steel service bridge on the south side of the Blackhorse Avenue Bridge (OBO4) will need to be removed prior to electrification.

4.9.7. Proposed Development - Drainage

4.9.7.1. Track Drainage – Phoenix Park Tunnel

The current ballasted track will be replaced with slab track in the Phoenix Park Tunnel, which will require a dedicated drainage system.

The current catchment area at the tunnel and its portals will not be modified by the proposed track works and therefore, the generated runoff volumes will not increase. Based on this, the existing drainage strategy along the track will be retained but the current water collection system will be upgraded for the proposed slab section. In line with the above, the existing discharge rate and outfall location of this drainage network at the River Liffey will be retained. The existing collection system (perforated pipe) will be replaced by an in situ concrete channel drain 400mm wide by 500mm deep placed between tracks, as shown in Figure 4-131, to collect any surface water runoff on the track and convey flows from the upstream drainage network up to the existing outfall at the River Liffey (Figure 4-132).

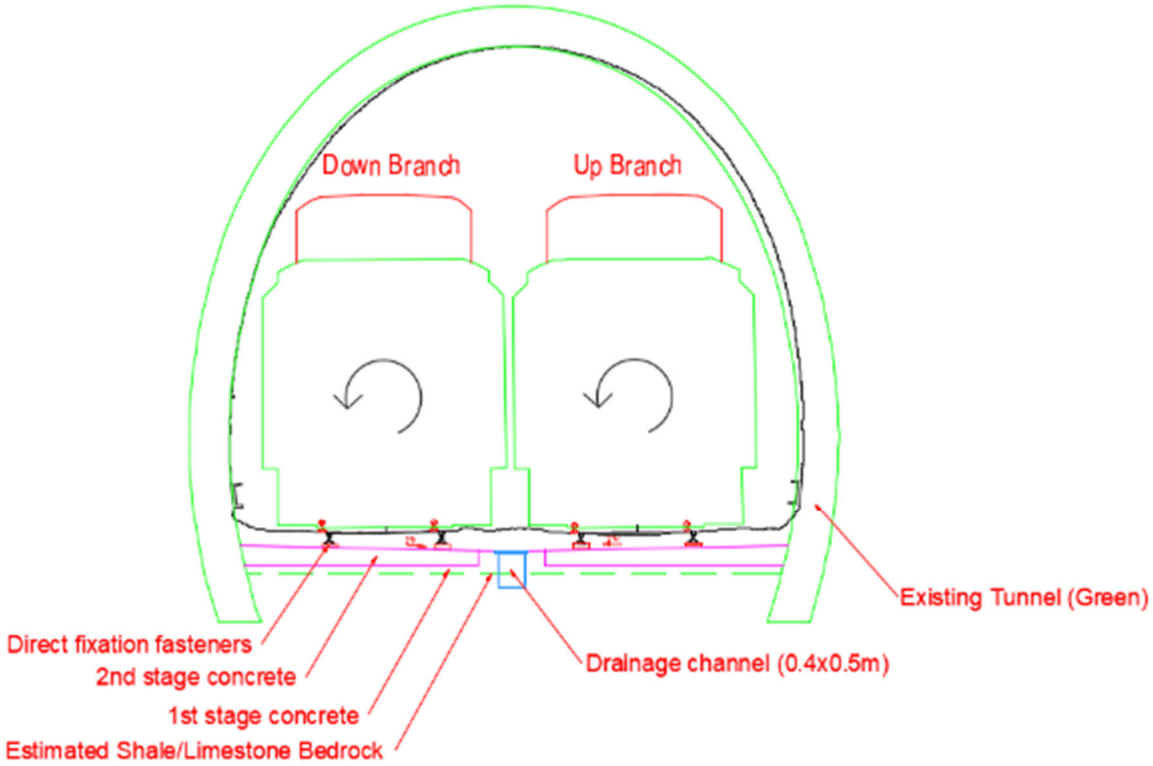

Figure 4-131 Proposed Cross Drainage System at Phoenix Park Tunnel

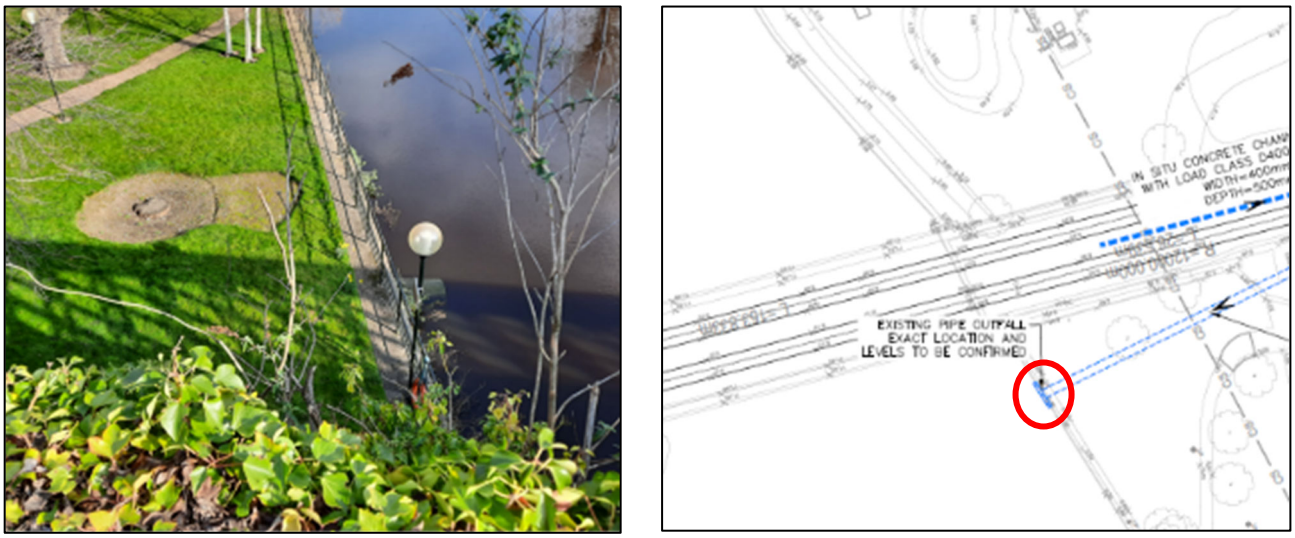

Figure 4-132 Existing Outfall for Phoenix Park Tunnel Drainage Network

The People's Park Pond (within Phoenix Park) is located directly above the tunnel. There is an existing pond overflow pipe which enters the Phoenix Park Tunnel structure and discharges into the existing track drainage. As part of the slab track works within the tunnel, a new connection manhole and pipework is proposed within the tunnel. This then will direct the overflow flow into a channel, located within the structure of the proposed slab track. The channel will transport storm water runoff from the track drainage catchment north of the tunnel and continue to accommodate the existing pond overflow discharge. The proposed minimum depth of channel will be 500mm, with a maximum depth of 800mm. The channel will have removable covers along its length, for safety and ease of maintenance.

Figure 4-133 Existing Pond Overflow Pipe and Inspection Chamber

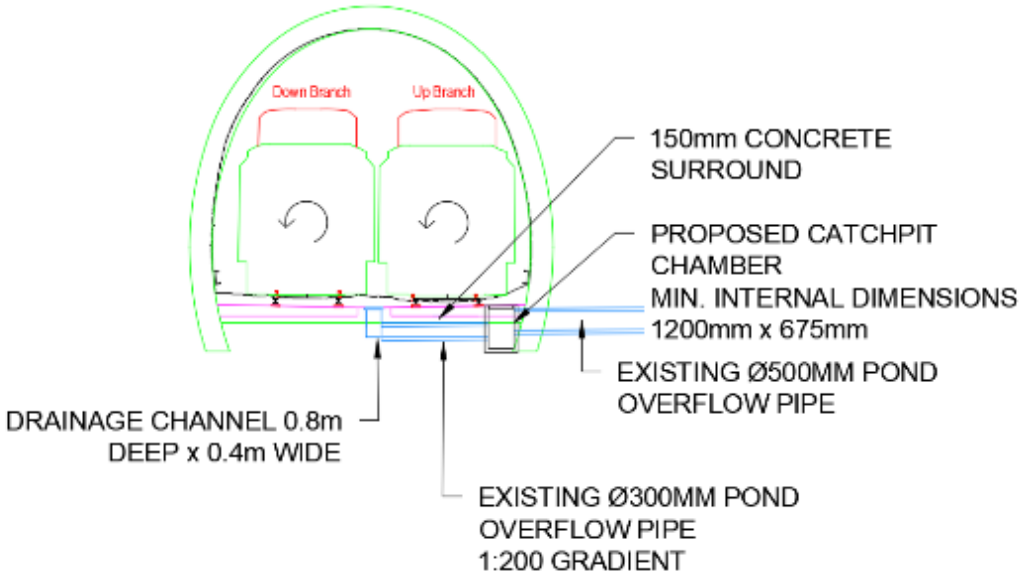

Figure 4-134 Proposed Drainage System at Tunnel for Pond Overflow

The transition between the ballast track section, outside the north portal of the tunnel, where a perforated pipe is to be installed, and the slab track channel will be completed by increasing the channel depth at the manhole connection providing continuity to drainage system levels.

Regarding the existing outfall at the Liffey River, the proposal is to keep the current outlet arrangement but replacing the existing manhole, located in between the tracks close to the southern tunnel portal, by a new one that meets proposed track levels and allows the discharge connections from the longitudinal channel into the outlet pipe, as shown in Figure 4-135.

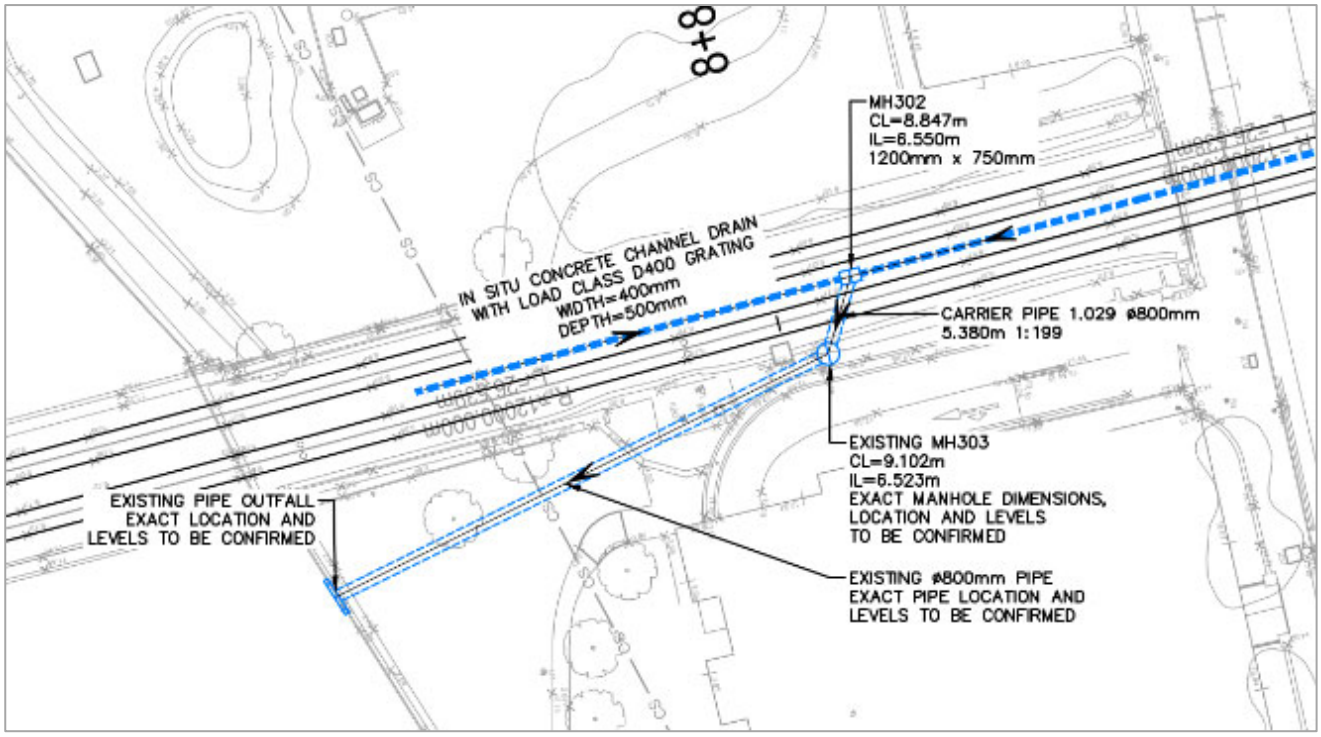

Figure 4-135 Proposed Drainage Works at Liffey River Outfall

4.9.7.1. Track Drainage – North Portal of Phoenix Park Tunnel to Glasnevin Junction

The existing drainage catchment between the Phoenix Park Tunnel and Royal Canal and Luas Twin Arch (OBO8) and Maynooth Line Twin Arch (OBO9) will remain as existing, and therefore, runoff flows will not be increased as result of the proposed works. There is no need for additional attenuation structures and the existing drainage strategy will be retained in the area. Therefore, the only drainage works for this track section include reinstating the existing drainage elements according to the new track levels.

The following figures show the proposed alignment in the vicinity of Old Cabra Road Bridge (OBO5), Cabra Road Bridge (OBO6) and the Royal Canal and Luas Twin Arch (OBO8) and Maynooth Line Twin Arch (OBO9).

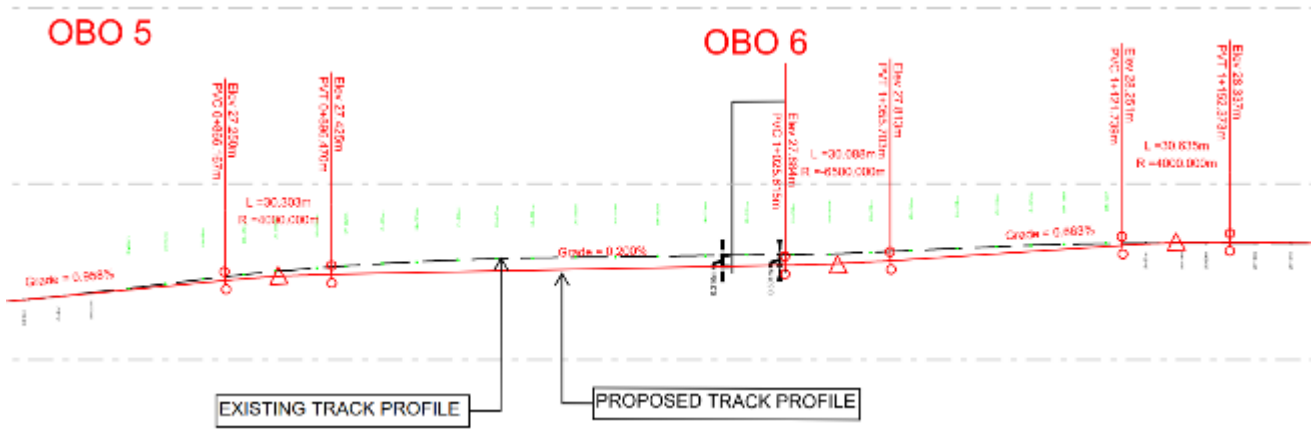

Figure 4-136 Longitudinal Profile of the Proposed Alignment in the Area of Old Cabra Road Bridge (OBO5) and Cabra Road Bridge (OBO6)

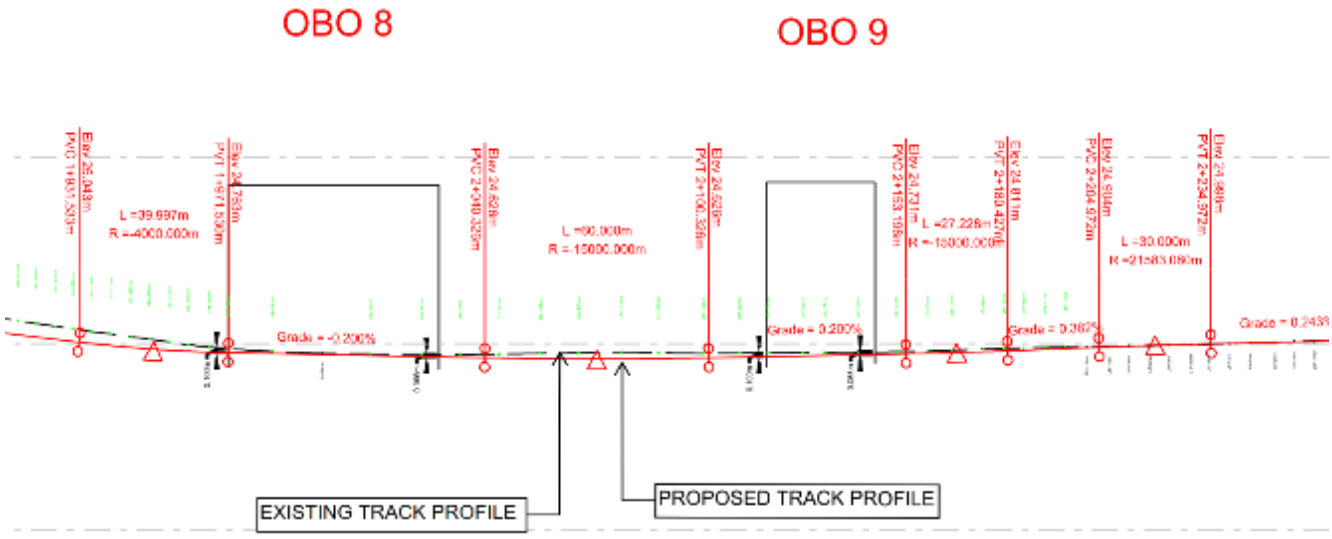

Figure 4-137 Longitudinal Profile of the Proposed Alignment in the Area of the Royal Canal and Luas Twin Arch (OBO8) and Maynooth Line Twin Arch (OBO9)

Although track lowering is proposed at Cabra Road Bridge (OBO6), no changes to the drainage system are proposed, apart from re-adjusting the current pipe and chamber levels to the new track profile. Currently, the track falls to the south (at approximately 1% gradient), towards the northern portal of the Phoenix Park Tunnel.

In the case of Faussagh Road Bridge (OBO7), Royal Canal and Luas Twin Arch (OBO8) and Maynooth Line Twin Arch (OBO9), where track lowering is proposed a new drainage system will be installed between the tracks (similar to the existing situation).

This is not expected to change in a significant way the drainage catchments and gradients. However, there is a potential impact to the performance of the existing pumping station located between the Royal Canal and Luas Twin Arch (OBO8) and Maynooth Line Twin Arch (OBO9). The existing pumping station drains the excess of water on the cutting located immediately to the west of the Royal Canal and Luas Twin Arch (OBO8) (Twin Arch Bridge 1 in Figure 4-138). This facility directs the inflows to the attenuation tank located to the northwest, thereafter infiltrating into the surrounding substratum.

Figure 4-138 Location of the Twin Arch Bridges (OBO8 & OBO9) and the Stabilization Works

The pumping station appears to receive inflows from the track when the water reaches a certain level. The track lowering and the restrictions associated with the maximum permissible water levels for the new EMU rolling stock does impact on the current hydraulic balance.

Lowering the existing pumping station would be required with an increase of the existing wet well chamber dimensions. This increase in size will allow holding the additional volumes collected by the drainage system in order to keep the water levels within operating limits required by the EMU's. The proposed wet well will deal with the extra volume collected by the system whilst maintaining current pumping flows.Error! Reference source not found.Figure 4-139 shows the proposed drainage strategy, which includes additional filter drains and catchpit chambers to drain the northern track lane, in addition to the lowering of the existing drainage system according to the new track levels.

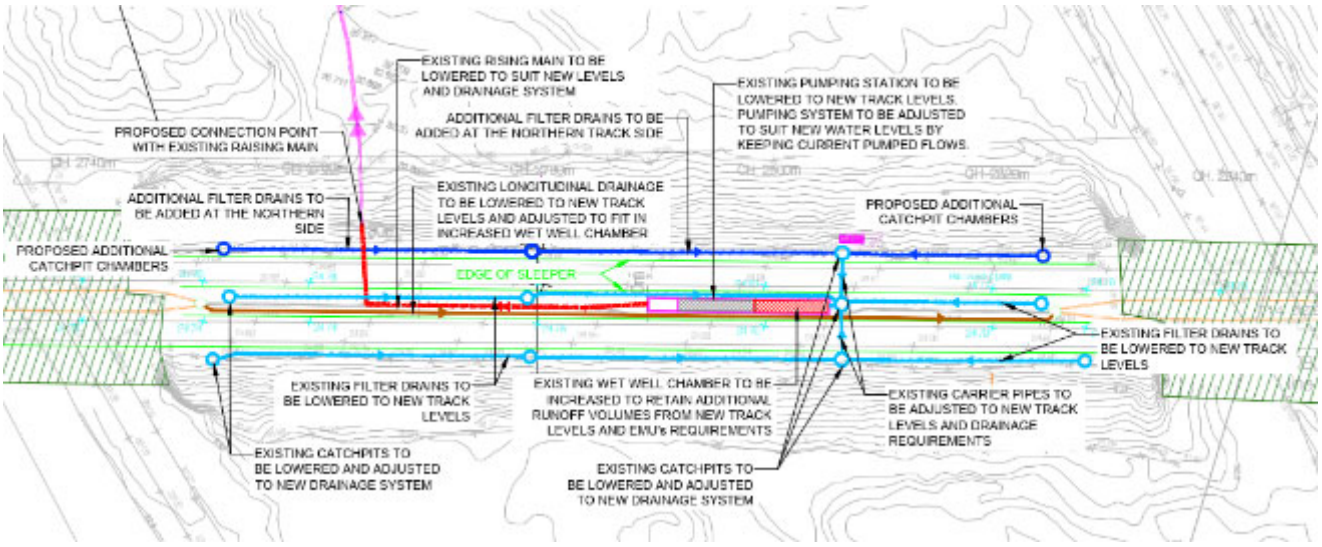

Figure 4-139 Proposed Drainage Upgrade Between OBO8 and OBO9

Manholes will be installed along the pipeline at an average distance of 50m or change of gradient or direction, to allow their inspection and maintenance. A solution for the railway ballast cleaning machine to work properly without affecting the proposed chambers is needed. This can be accomplished by installing removable modular concrete inspection chambers, as per Figure 4-140 and Figure 4-141.

Figure 4-140 Proposed Catch-Pit with Modular Inspection Chamber

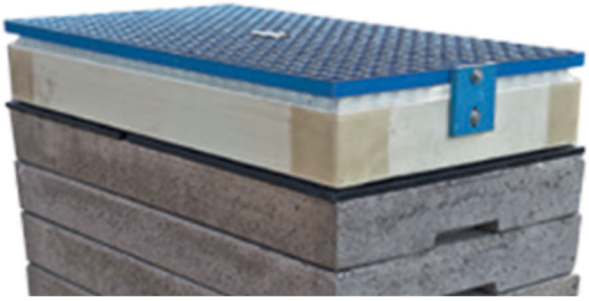

Figure 4-141 Concrete Raising Frames and Frame System for Between the Tracks

4.9.7.2. Road Drainage

As outlined previously, the only roads design amendments in this zone relate to Glasnevin Cemetery car park and access ramps over the bridge; to accommodate the proposed Glasnevin Cemetery Road Bridge (OBO10) deck reconstruction.

The existing drainage flow paths in the carpark will not be altered, and the same gullies will remain in the cemetery and the car park. However, it is proposed to add additional gullies east and west of the car park at the northern most point of the car park reconstruction.

4.9.8. Proposed Development – Electrification

The proposed two electrified Slow lines will continue through the Phoenix Park Tunnel Branch Line at Islandbridge Junction, extending to Glasnevin Cemetery Road Bridge (OBO10). Track lowering at existing bridge locations will be required to accommodate the 4.2m contact wire solution.

Table 4.20 provides a summary of the proposed OHLE arrangements along the track in Zone D. The proposed OHLE arrangement is described in detail for each of the following areas:

- Liffey Bridge (UBO1) to south portal of Phoenix Park Tunnel;
- Phoenix Park Tunnel;
- North portal of Phoenix Park Tunnel to Glasnevin Junction.

Table 4.20: Summary of proposed OHLE Arrangement at Existing Bridges

Structure ID	Location	Proposed Solution
UBO1	Liffey Bridge	No track works proposed. Cantilevered support structures, OHLE will be fitted to the bridge
OBO2	Conyngham Road Bridge	Track lowering measuring approx. 0.4m Fitted OHLE system (Flexible).
OBO3	McKee Barracks Bridge	No track lowering required Flexible OHLE system - Free running. OHLE to pass under the bridge without connection to it
OBO4	Blackhorse Avenue Bridge	No track lowering required Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBO5	Old Cabra Road Bridge	No track lowering required Flexible OHLE system - Free running. OHLE to pass under the bridge without connection to it.
OBO6	Cabra Road Bridge	Track lowering measuring approx. 0.3m Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBO7	Faussagh Road Bridge	Track lowering measuring approx. 0.4m Fitted OHLE system (Flexible). OHLE will need to be connected to the bridge
OBO8	Royal Canal and Luas Twin Arch	Track lowering measuring approx. 0.1m.

Structure ID	Location	Proposed Solution
		OHLE Multiple Fitted Tunnel arms OHLE will need to be connected to the bridge
OBO9	Maynooth Line Twin Arch	Track lowering measuring approx. 0.1m OHLE Multiple Fitted Tunnel arms OHLE will need to be connected to the bridge
OBO10	Glasnevin Cemetery Road Bridge	Bridge Deck Replacement No track lowering required Fitted OHLE system, OHLE will be fitted to standalone masts either side of the bridge

4.9.8.1. Liffey Bridge (UBO1) to South Portal of Phoenix Park Tunnel

For Liffey Bridge (UBO1), the electrification equipment will be supported by four Single Track Cantilever (STC) type OHLE masts and one Twin Track Cantilever (TTC). These structures will be attached to the Liffey Bridge (UBO1). This will require bespoke design (informed by a conservation architect) to attach the OHLE masts to the bridge structure. An assessment will be required to accommodate the tension and loading of OHLE. In this area OHLE masts may need to be positioned outside of the railway.

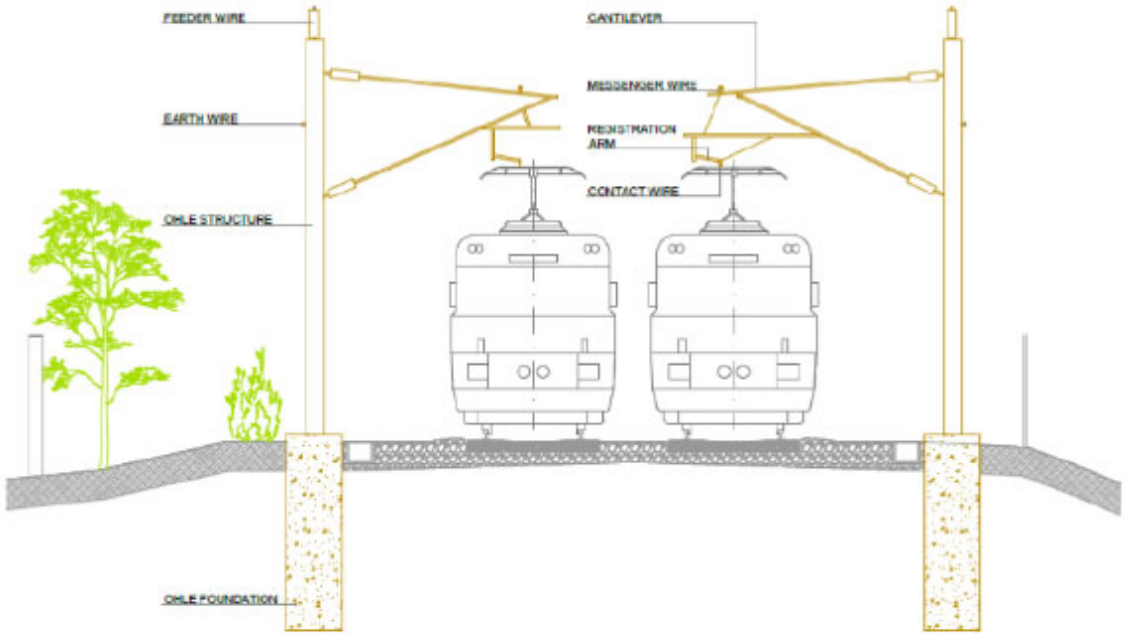

Figure 4-142 Typical OHLE STC in Two Track Open Route.

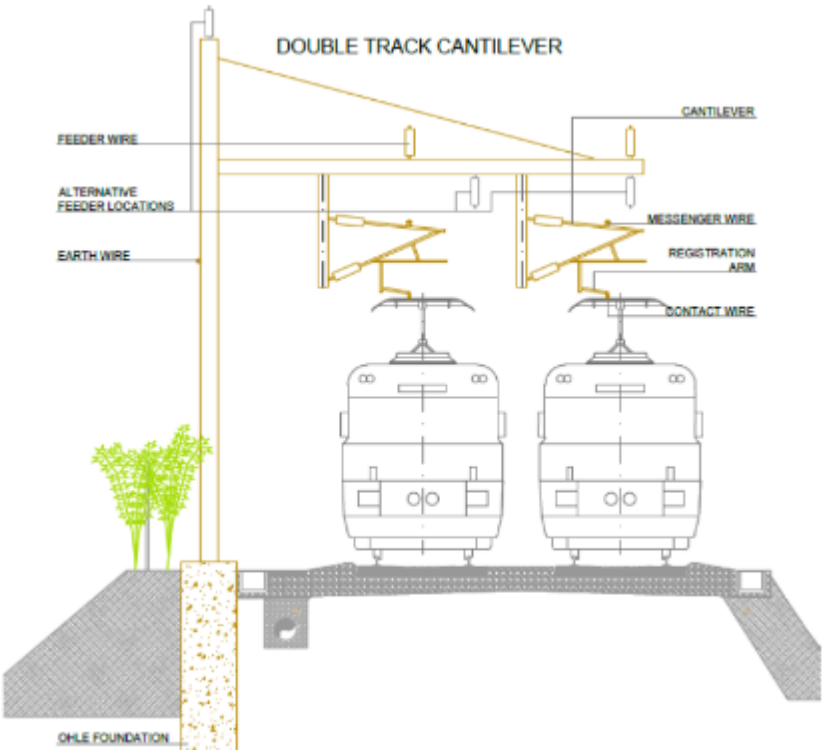

Figure 4-143 Typical OHLE TTC in Two Track Open Route

Figure 4-144 OHLE Mast Position for Liffey Bridge (UBO1) and Conyngham Road Bridge (OBO2)

OHLE switching shall be mounted on the TTC structure at the north of the STC structures shown above. A hard standing surface will be required for switch operation.

Then another TTC type OHLE masts shall be positioned to support the OHLE between the Liffey Bridge (UBO1) and the Phoenix Park Tunnel, due to the limited space on the east side of the track. Two OHLE

masts will be positioned 2m away from the Conyngham Road Bridge (OBO2) with a short anchor span to terminate the OHLE running from Heuston West Station.

These structures have formed an electrical section break (a special four span insulated overlap) to provide sectioning for Heuston West Station and Phoenix Park Tunnel.

The Phoenix Park Tunnel is directly adjacent to the Conyngham Road Bridge (OBO2) and therefore, these two structures have been considered together when defining the OHLE solution for each option.

The OHLE through Conyngham Road Bridge (OBO2) will be fitted, with elastic bridge arms supported from the bridge at multiple locations due to its length. These connections would not be visible from road level. Slab track will be used through Conyngham Road Bridge (OBO2) and Phoenix Park Tunnel and therefore, no upward track movement allowance has been provided.

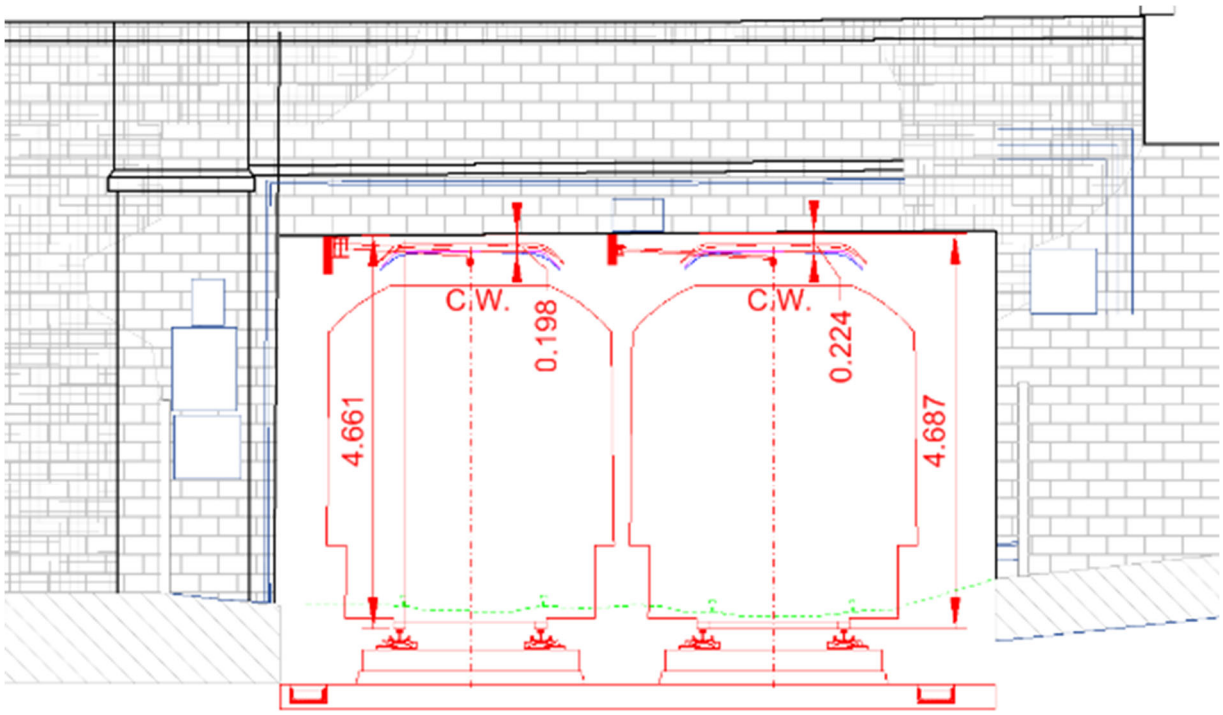

Figure 4-145 Example cross section for fitted OHLE system in twin area - Facing North

4.9.8.2. Phoenix Park Tunnel

Phoenix Park Tunnel is sufficiently high that the OHLE can pass through the tunnel, but due to its length the OHLE will be connected to the tunnel at multiple locations. This option provides a continuation of the flexible OHLE arrangement through the tunnel. The OHLE shall be graded up from 4.2m to a greater value within the tunnel. Where the tunnel is high enough, the OHLE within the tunnel shall be designed with a larger system height, removing the need for elastic bridge arms to reduce the dynamic resonance problems within the tunnel. The support and registration through the tunnel in this option is likely to comprise a small system height cantilever supported from the centre of the tunnel roof.

Due to the shape of the tunnel and restricted clearance between the OHLE live equipment and the tunnel face in this option, compression arms will be required where necessary to keep all the registration from the centre of the tunnel. Due to the low line speed at the location (30kph) it will be

possible to use compression arms at multiple locations without affecting the dynamic performance of the system.

The length of the tunnel is 700m, with the overlap at each end of the tunnel, the total tension length for this section will be more than 800m. Therefore, a mid-point anchor is required in the middle of the tunnel.

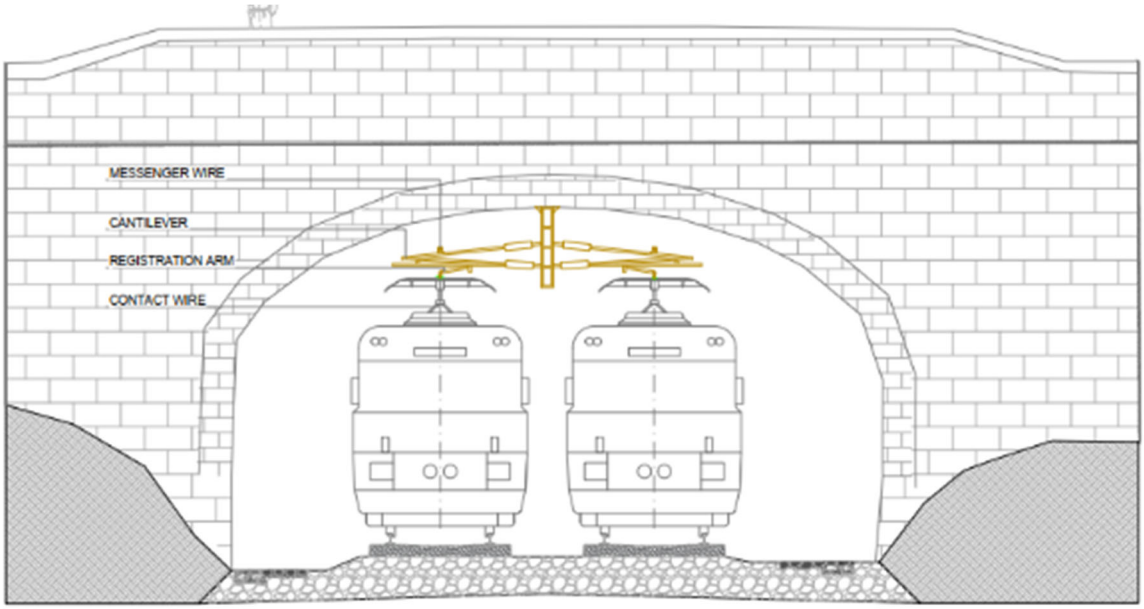

Figure 4-146 Typical OHLE Tunnel Cantilever Arrangement

4.9.8.3. North Portal of Phoenix Park Tunnel to Glasnevin Junction

In this two track section, the electrification equipment will be supported by TTC structures on the north side of the lines to support OHLE for both tracks, and STC structures where the OHLE to be terminated with anchor arrangement required to minimized the total length of the Mid-Point Anchor or Overlaps.

To the east of Phoenix Park Tunnel, the site for the future Cabra Station is located adjacent to a straight section of track alignment between Cabra Road Bridge (OBO6) and Faussagh Road Bridge (OBO7) in order to accommodate the future platform to standard offsets to facilitate passenger stepping to the train.

McKee Barracks Bridge (OBO3) and Old Cabra Road Bridge (OBO5) are sufficiently high in their existing configuration for the OHLE to pass through the bridge without connection to them. Electrification under these bridges will be a “Free-running” arrangement with a contact wire height of 4.7m with 4.4m minimum contact wire height under all conditions. OHLE masts are expected to be positioned between 20m and 30m either side of the bridge from outer edge of these bridges.

For Blackhorse Avenue Bridge (OBO4), OHLE through the bridge will be fitted with graded down contact wire height with a minimum contact wire height of 4.4m through the bridge under all conditions due to the limited soffit height available. It will be fitted with elastic bridge arm supported from the bridge at a single location in the middle of the bridge due to its length. The steel service bridge on the south side of the Blackhorse Avenue Bridge (OBO4) will need to be removed prior to electrification.

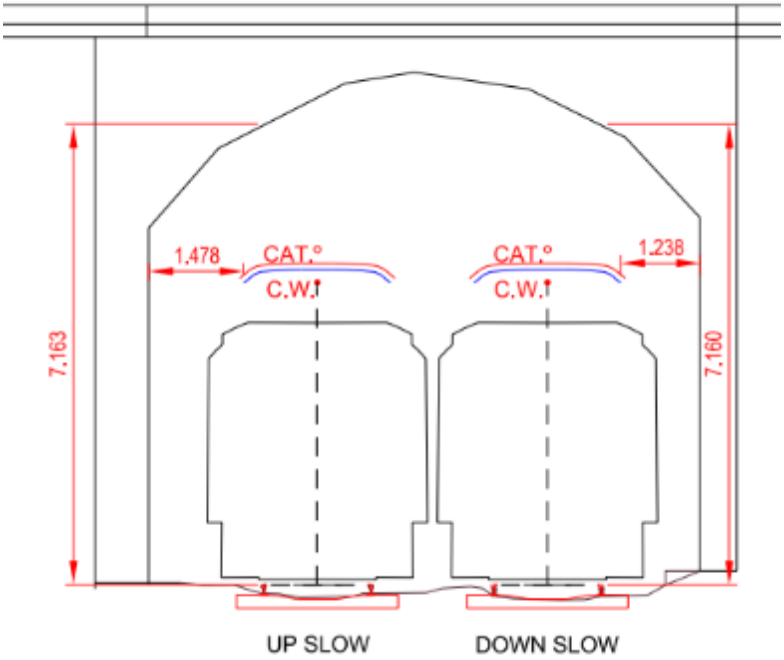

Figure 4-147 Example Cross Section for Free Running OHLE System in Twin Area

For Cabra Road Bridge (OBO6) and Faussagh Road Bridge (OBO7), a similar arrangement to that at Blackhorse Avenue Bridge (OBO4) will apply with graded down contact wire height with a minimum contact wire height of 4.2m through the bridge under all conditions due to the limited soffit height available. The fitted bridge arm for Faussagh Road Bridge (OBO7) will be placed at the Arch section of the bridge. Track lowering is required to achieve the proposed soffit height.

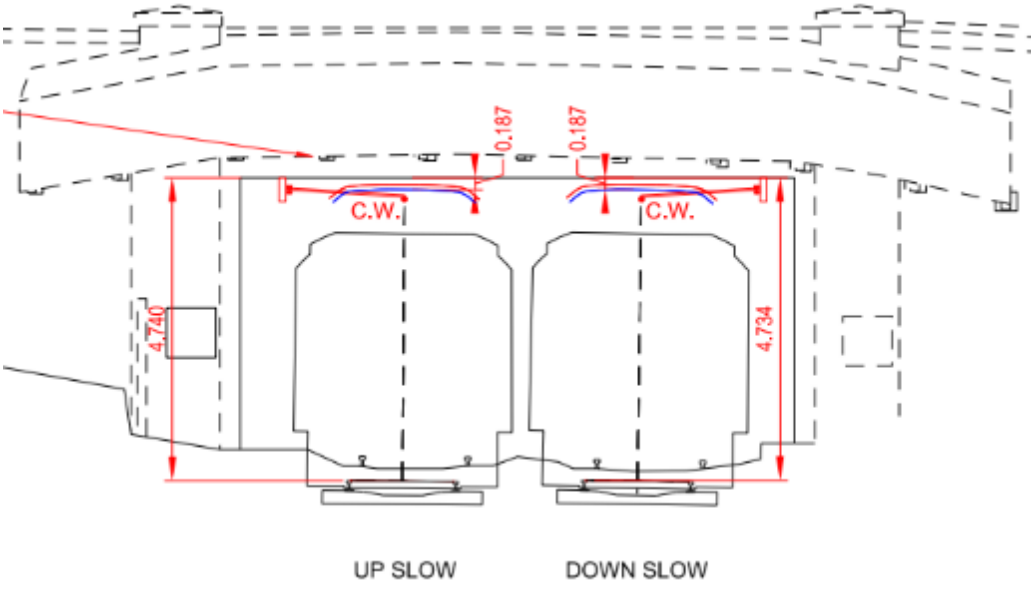

Figure 4-148 Example Cross Section for Fitted OHLE System in Twin Area

For the Royal Canal and Luas Twin Arch Bridge (OBO8) and Maynooth Line Twin Arch Bridge (OBO9), OHLE through the bridge will be fitted with graded down contact wire height with a minimum contact wire height of 4.2m through the bridge under all conditions due to the limited soffit height available. It will be fitted with tunnel arms supported from the bridge at multiple locations due to its length. Track lowering is required to achieve the proposed soffit height.

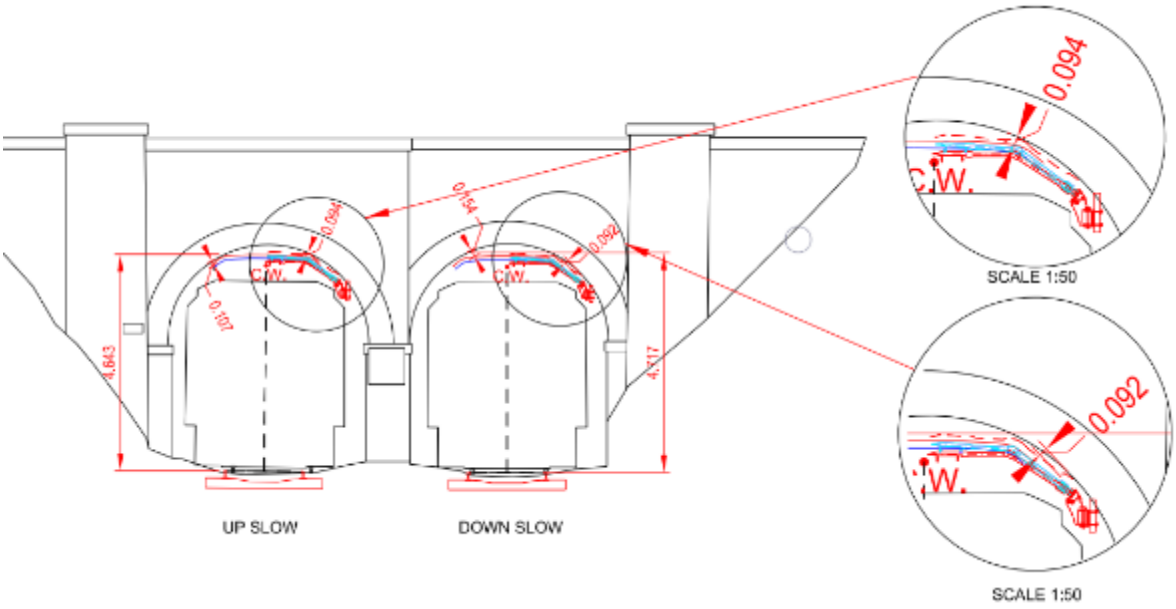

Figure 4-149 Example Cross Section for Fitted Tunnel Arm OHLE System in Twin Area

For Glasnevin Cemetery Road Bridge (OBO10), the bridge deck will be reconstructed with a soffit height of 4.9m so that the OHLE can be fitted as it passes through. As the bridge is narrow, the OHLE shall be supported either side of the bridge on the standalone masts with elastic bridge arms with a 4.4m minimum contact wire height under all conditions. This arrangement will not require OHLE fixing to the bridge.

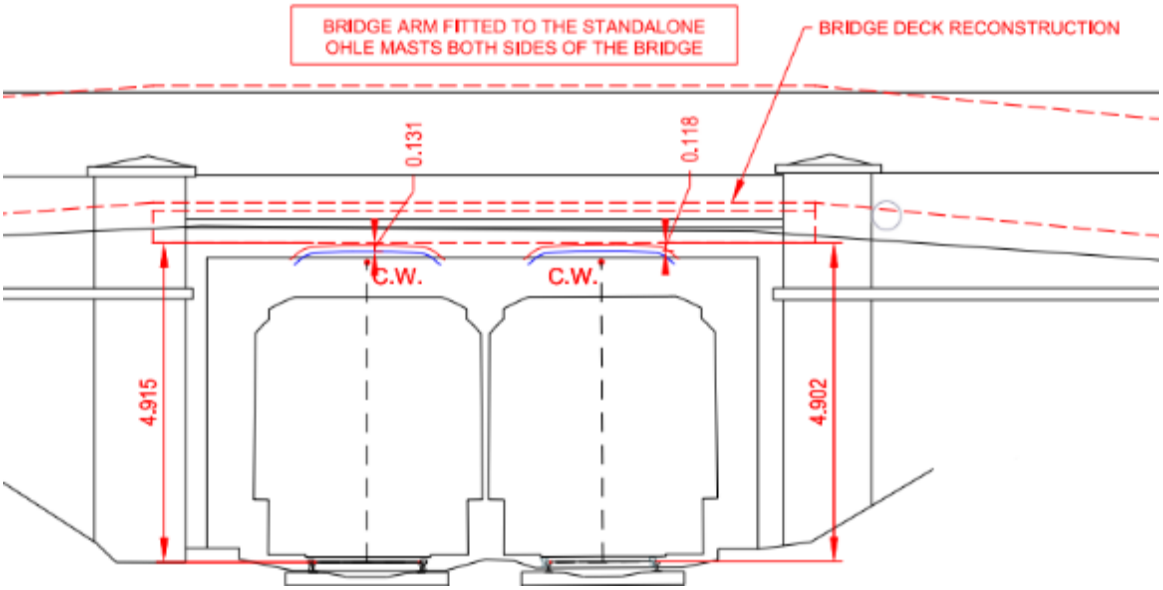

Figure 4-150 Example Cross Section for Fitted at Each Side of Glasnevin Cemetery Road Bridge (OBO10)

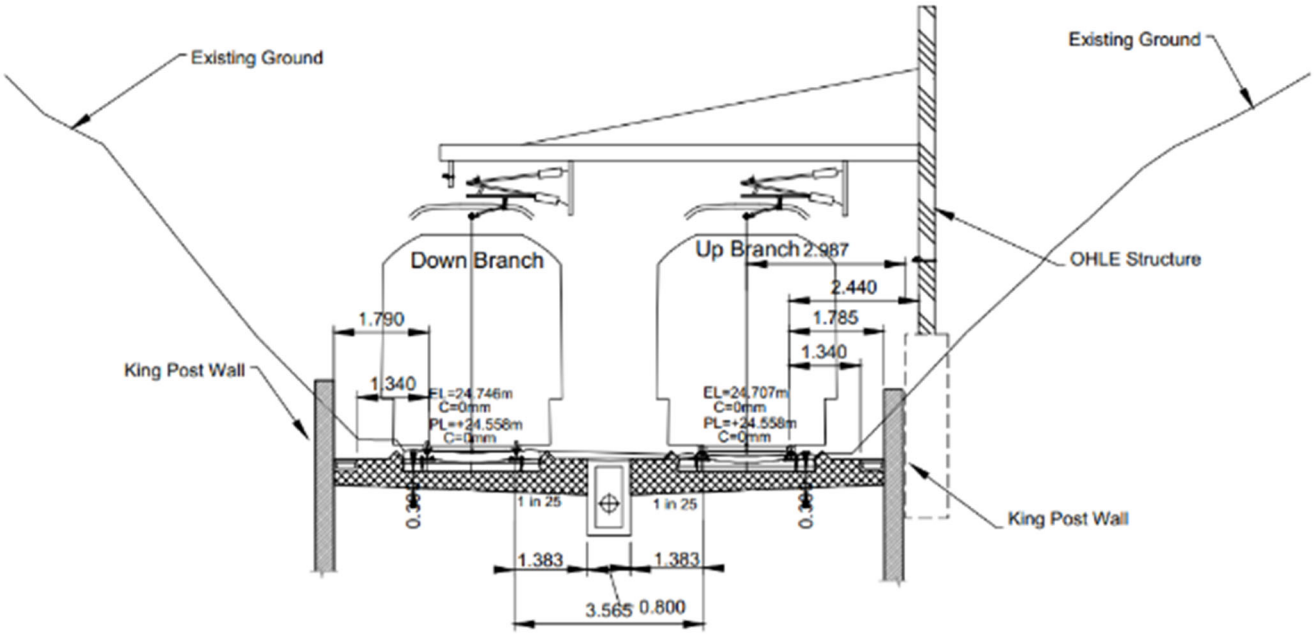

Figure 4-151 Typical Cross Section West of Glasnevin Cemetery Road Bridge (OBO10), View from Glasnevin Junction

4.9.8.4. Substations

There are no proposed substations in this zone.

4.9.9. Proposed Development - Signalling and Telecommunications

4.9.9.1. Signalling

On Phoenix Park Tunnel Branch Line track, north of the Phoenix Park the proposed physical signalling infrastructure includes the installation of a Location Case (LOC) for LV equipment.

4.9.9.2. Signalling Post

There are currently no new cantilevers or gantries proposed in the section between the Liffey Bridge (UBO1) and Phoenix Park Tunnel. Trackside signals would be located on new signal posts adjacent to tracks.

4.9.9.3. Telecommunications

No new Telecom Equipment Room (TER) is required in Zone D.

4.9.10. Proposed Development Additional Infrastructure

On the Phoenix Park Branch Line it is proposed to add to two new emergency track access and egress points. One access/egress point will be adjacent to the Phoenix Park Tunnel northern portal, it is proposed to install new stairway along the existing embankment, which will exit onto the North Circular Road adjacent to the entrance to the Phoenix Park.

The second access/egress point will be at McKee Barracks Bridge (OBO3) on the eastern side of the rail corridor, it is proposed to install a new stairway along the existing embankment, the exist will be onto Marlborough Road.

4.10. Operational Phase

4.10.1. Scheme Wide Operation

4.10.1.1. OHLE Maintenance

OHLE maintenance activities, as they are on the live line, need to be undertaken with track possession strategies looking for dates/hours of minimum rail operation (nights, weekends, etc.) unless the urgency of the issue requires intermediate interventions. The kind of maintenance activities and machinery used is the same as for the construction, with hybrid vehicles from the nearest compound.

As a reference for the frequency of the OHLE maintenance works, the current electrified Coastal line maintenance works are carried out 6 nights per week, reviewing the whole line 4 times per year.

4.10.1.2. Rail Maintenance

The main maintenance operations that are most frequently performed on ballasted lines are:

- Alignment and levelling of tracks performed by tamping machines - This is considered a corrective maintenance task, therefore is not a scheduled maintenance as it depends on the condition of the track. This is to be done whenever a track defect (poor horizontal line, incorrect cross level, cant (superelevation), poor vertical line, or dipped joints) is detected during the periodic inspections.
- Track tamping which is the process of repacking the ballast under the bearing areas of sleepers, using a rack mounted machine fitted with vibrating tines. This maintenance activity is performed by ballast tampers. The frequency of this maintenance task depends on the maintenance strategy. Based on Iarnród Éireann information, tamping works are carried out every two to five years.

There are several inspections and regular maintenance tasks, outlined below, that are to be carried out in addition to the core maintenance operations:

4.10.1.2.1. Visual Inspection

The track layout must be inspected in order to detect and control a series of parameters related to the wear of the track, the condition of the rail, geometry of the track, rail fastening and welding, among others.

These inspections will have a frequency that guarantees the correct durability of the infrastructure according to its service life. Depending on the system to be inspected, the periodicity can be monthly, quarterly, or even higher.

4.10.1.2.2. Preventive Maintenance

Periodic maintenance operations will have to be carried across all facets of the railway infrastructure within the railway corridor.

- Ballast track reprofiling

Ballast track infrastructure is profiled to ensure it maintains the proper shape, by redistributing the ballast. This operation is carried out by a tamper-levelling machine. The frequency of this task varies

depending on the maintenance plan but can be considered every two to five years depending on the status of the track superstructure.

- Ballast track replacement

Ballast track replacement (complete removal of existing ballast and new ballast placement) is carried out every 20-25 years. A ballast cleaning machine removes the ballast, ballast cars/hoppers lay the ballast on tracks and a tamper-levelling machine levels the tracks.

- Rail and manholes cleanliness

Inspections of the rail corridor should be scheduled at least once every four months to determine the status of the track.

During these inspections, a series of drainage manholes will be opened randomly to check their status. These inspections are to be carried out by one or two people walking throughout system layout.

- Points and crossing cleaning

Complete cleaning of switches including electric devices will be done at least once every week. In rainy seasons, it can be carried out two times a week.

- Track geometry inspection

In order to evaluate the railway track geometry condition and plan maintenance activities, track inspection cars run over the track at night-time when there is no railway traffic to monitor it and record geometry measurements.

This is done annually and/or according to track condition.

4.10.1.2.3. Corrective Maintenance

If during the previous inspections failures are detected in the track installations and civil works of the system (inadequate parameters, damaged or deteriorated parts, etc.), the defects will be immediately corrected by means of the corrective maintenance.

4.10.1.2.4. Machinery

There is a whole range of machines from large scale track relaying trains down to spot sleeper changing machines. Commonly used machines are:

- Tamper – for lifting track to levels and packing ballast.
- Liner – for slewing track to a design alignment. This function is often combined with the tamper.
- Ballast regulator – for distributing and shaping the ballast profile along the track.
- Dynamic track stabiliser – for consolidating newly placed bottom ballast prior to a final tamp to level.

Also, there is a large range of road-rail machines including tampers, excavators, dozers, elevating platforms, load carriers, personnel carriers, and specialist function machines that can circulate both on the road and on the rail track.

4.10.1.3. Vegetation Management

Iarnród Éireann has over 4,000Km of boundary to manage with thousands of trees growing near the railway. Operating a safe railway necessitates the cutting back of trees and vegetation along the railway boundary as they can obscure signals and contribute to low rail adhesion. Vegetation clearance and management is specifically required for the safe operation of the OHLE and a distance greater than 1.5m from the rear of the OHLE mast or 1.5m from any wire running between masts is required.

To enable the efficient use of resources, Iarnród Éireann manages vegetation control on a priority programmed basis over pre-determined lengths of railway boundary.

4.10.2. Operating Railway System

Most of the traffic in the DART+ area is operated by Electric Multiple Units (EMUs). The new fleet will operate as FLUs (Full length units of 10-car units) with a length of 168 metres. It is possible in case of lower demand hours to uncouple half of the trainset and operate 4-car units independently.

Diesel, hybrid or battery-electric trains (different options and types of rolling stock are taken under consideration) will operate on services that run beyond the DART+ area.

The maximum level of services provides for scheduling of 72 EMUs to operate in the DART+ network

4.10.3. Design Speed

The proposed line speeds are defined in the project scope as 100mph (160 km/h) for the Fast lines and 70mph (110 km/h) for the Slow lines.

Speed reduces at the following locations, to match the existing line speed published in the Route Information Book 1 Dublin (Heuston) to Cork – Cobh - Midleton, 7th Edition:

Heuston Station Yard – varies from 35km/h on approach to 10 km/h in platforms

Inchicore Works – 5mph (8km/h) from driver handbook

For the Phoenix Park Tunnel Branch Line (Great Southern and Western Rail Line - GSWR)

- Maximum line speed on the Branch lines between Islandbridge Junction and Glasnevin Junction is 25mph (40 km/h), with 20mph (32 km/h) in the Down Loop.

4.10.4. Operating Pattern and Indicative Timetable

The operational analysis has been carried out for the DART+ Programme. In general, it is assumed that commercial (passenger) services start at approximately 6:00 (some exceptions apply for trains from more distant stations to arrive at the Dublin city centre before 7:00) and finish between 24:00 and 1:00. Technical runs, related to morning deployment from depots or stabling locations start at 4:30 (Maynooth line) or 5:00 (remaining lines). Passenger train traffic ends at 1:00 to allow for overnight maintenance and service of railway infrastructure.

Based on Iarnród Éireann requirements, the modelling process for different options of train service specifications was carried out. The Baseline Scenario, preferred by Iarnród Éireann, provides for a high number of trains on each of the lines leading to the city centre area. On several lines, services have mixed character – both stopping DART trains and commuter/long-distance services share the same lines.

The figure below shows the number of trains per hour per direction (tphpd) for the peak hour in the DART+ area for the preferred option (Baseline Scenario).

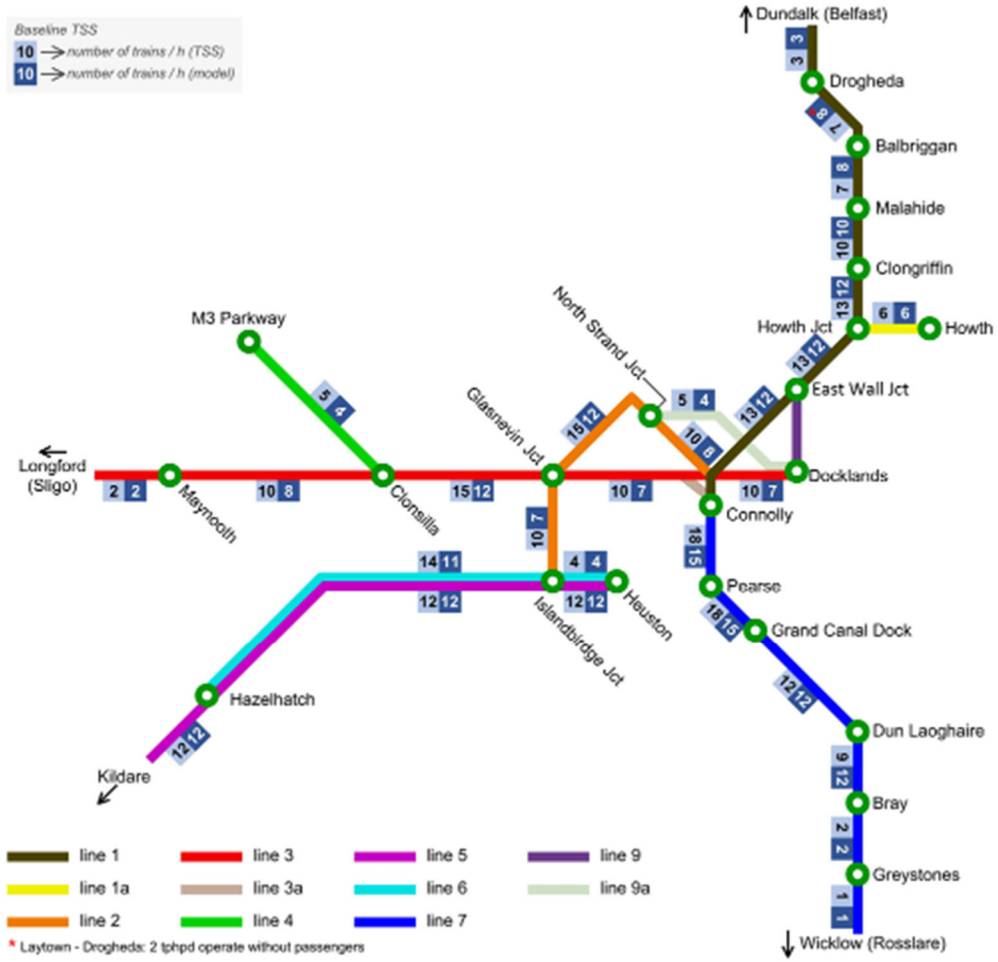

Figure 4-152 Train Service Specification

Scheduling and modelling analysis were carried out on the basis of the Baseline Train Services Specification.

For scheduling, certain assumptions were adopted as regards rolling stock.

Three different types of rolling stock for three categories of trains were taken under consideration:

- Intercity fast train (DMU/locomotive-hauled)
- Commuter (DMU)
- DART (EMU)

Each type of rolling stock has different features because of the different characteristics of the traffic demand.

Intercity services that involve high-speed traffic and few stops need powerful units with smooth acceleration and aerodynamic structure. For commuter/DART trains, high acceleration is more important than high speed due to frequent stops at short distances.

As a potential modern EMU to be modelled, the Stadler FLIRT trainset was chosen as one of the most popular suburban EMU trains in the world, with very good tractive parameters and data available for different compositions of trainsets (including a 2x4-car set).

The following table below (based on information provided by Iarnród Éireann) shows the proposed level of service during one normal day of operations for a future Do Minimum scenario (proposed level of service with future capacity delivered with existing infrastructure i.e. DART+ South West not in effect) and Do Something scenario (DART+ South West Project is in effect). The future year is assumed to be 2030 as construction will be completed in 2029.

The DART+ South West Project will separate Intercity and fast regional services from the future DART service. This allows for the faster Intercity and regional services to operate efficiently along the future DART services. The future DART service will operate on the electrified lines (northern tracks), while the Intercity and fast regional services will operate on the fast non-electrified lines. Along with an increase to service levels within the electrified DART+ area, there will also be service enhancements to the Intercity and Outer Commuter service levels with the proposed Project in place.

In relation to freight operations, Iarnród Éireann has confirmed that freight services will not operate over DART+ South West during peak periods.

Iarnród Éireann will incrementally introduce new services and enhanced timetables in response to growing demand. As such, the proposed level of service for the Do Something scenario with the DART+ South West Project in effect will be delivered over a period of time and will not come into effect in one timetable change.

Table 4.21: Proposed Service Levels (Nos of Trains for DART+ South West)

Service Type	Train Model and Type	Do-Minimum (proposed level of service delivered with existing infrastructure)	Do-Something (with proposed Project)
Dart Commuter	New fleet to comprise of 5 and 10 carriage BEMU or EMU	0	126
Outer Commuter	22000 class DMU	84	72
Intercity	Existing MkIV + 201 locomotive	84	84
Freight		8	8
Empty trains		5	5
Total		**181**	**295**

Note: DART+ South West - Increasing passenger capacity from approximately 5,000 to 20,000 passenger per hour, by utilising new DART trains and lengthening existing diesel trains, operating at increased service frequency (i.e. 12 (existing) to 23 (proposed) trains per hour)

4.10.5. Train Movements

The following tables shows the proposed level of service for the Do-Minimum scenario (proposed level of service with future capacity delivered with existing infrastructure i.e. DART+ South West not in effect) and Do Something scenario (DART+ South West Project is in effect). The proposed level of service is

the projected number of train movements during one normal day of operation. This is for a 24-hour period and is for the inbound direction, with an identical service pattern assumed in the reverse pattern from Dublin. The information on the future 24 hour Do- Minimum and Do Something level of service has been provided by Iarnród Éireann and has been used by the technical environmental specialists for the environmental assessments where relevant.

For freight and empty trains, the same level of service is assumed for the Do-Minimum and the Do Something (proposed Project).

Noise barriers are required at a number of locations along the proposed Project to mitigate operational noise impact. Further details of the proposed noise mitigation are provided in Chapter 14 Noise and Vibration. The selection of final materials and finishes for proposed noise barriers will be carried out at detailed design stage.

Table 4.22: Train Movements for DART+ South West Project – Future Do-Minimum Level of Service

Hour	Service Type					
	DART+ Commuter	Outer Commuter	Intercity	Freight	Empty Trains	Total/hr
00:00 – 01:00					2	2
01:00 – 02:00						
02:00 – 03:00						
03:00 – 04:00						
04:00 – 05:00						
05:00 – 06:00						
06:00 – 07:00		6	6			12
07:00 – 08:00		6	6			12
08:00 – 09:00		6	6			12
09:00 – 10:00		4	4	1		9
10:00 – 11:00		4	4	1		9
11:00 – 12:00		4	4			8
12:00 – 13:00		4	4	1		9
13:00 – 14:00		4	4			8
14:00 – 15:00		4	4	1		9

Hour	Service Type					
	DART+ Commuter	Outer Commuter	Intercity	Freight	Empty Trains	Total/hr
15:00 – 16:00		4	4			8
16:00 – 17:00		6	6			12
17:00 – 18:00		6	6			12
18:00 – 19:00		6	6			12
19:00 – 20:00		4	4	1		9
20:00 – 21:00		4	4	1		9
21:00 – 22:00		4	4			8
22:00 – 23:00		4	4	1		9
23:00 – 00:00		4	4	1	3	12
Total/day	**0**	**84**	**84**	**8**	**5**	**181**

Table 4.23: Train Movements for DART+ South West – Future Do Something Level of Service

Hour	Service Type					
	DART+ Commuter	Outer Commuter	Intercity	Freight	Empty Trains	Total/hr
00:00 – 01:00					2	2
01:00 – 02:00						0
02:00 – 03:00						0
03:00 – 04:00						0
04:00 – 05:00						0
05:00 – 06:00						0
06:00 – 07:00	11	6	6			23
07:00 – 08:00	11	6	6			23
08:00 – 09:00	11	6	6			23

Hour	Service Type					
	DART+ Commuter	Outer Commuter	Intercity	Freight	Empty Trains	Total/hr
09:00 – 10:00	5	3	4	1		13
10:00 – 11:00	5	3	4	1		13
11:00 – 12:00	5	3	4			12
12:00 – 13:00	5	3	4	1		13
13:00 – 14:00	5	3	4			12
14:00 – 15:00	5	3	4	1		13
15:00 – 16:00	5	3	4			12
16:00 – 17:00	11	6	6			23
17:00 – 18:00	11	6	6			23
18:00 – 19:00	5	6	6			23
19:00 – 20:00	5	3	4	1		13
20:00 – 21:00	5	3	4	1		13
21:00 – 22:00	5	3	4			12
22:00 – 23:00	5	3	4	1		13
23:00 – 00:00	5	3	4	1	3	16
Total/day	**126**	**72**	**84**	**8**	**5**	**295**