Chapter 5
Construction Strategy

Contents

5. Construction Strategy

5.1. Introduction

A description of the project is provided in Chapter 4 Project Description and is not repeated in this chapter. This chapter of the Environmental Impact Assessment Report (EIAR) describes the construction programme, phasing and construction methodology for the proposed DART+ South West Project. 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 4 Project Description and with reference to the technical design drawings presented in Volume 3A of this EIAR. The contents of the chapter are as follows:

- Project wide works and construction methodologies.
- Description of construction methodologies required within each of the zones namely:
- Zone A: Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station.
- Zone B: Park West & Cherry Orchard Station to Heuston Station; and
- Zone C & D: East of St John's Road Bridge (Islandbridge) to Glasnevin Junction (including Heuston Yard and Station incorporating New Heuston West Station).
- An overview of the Construction Environmental Management Plan prepared as part of the project.
- Testing and commissioning of the system; and
- The construction programme and phasing of works.

The zones are ordered from west to east and are shown in Figure 5-1.

Figure 5-1 Project Construction Zone Breakdown

5.1.1. Sustainable Construction Principles

Córas Iompair Éireann (CIÉ) Group of Companies has developed a Sustainability Strategy that coordinates actions that assist in addressing national economic, social and environmental challenges. The key themes which have been used as a focus while designing the project include:

- Avoid, mitigate and if not possible reduce the adverse effects on communities during the construction of the project;
- Reduce the carbon footprint of the project during the design, construction, and operation and encourage more sustainable transport modes;
- Support cleaner energy and lower emissions through implementation of an electrically powered fleet;
- Facilitate population and sustainable development growth, and a low carbon climate resilient economy;
- Design for resilience against future demand changes and climate needs; and
- Minimise waste during construction of the project, while focusing on using sustainable and reusable materials and construction methods.

These key themes will be considered throughout the entire duration of the construction of the project using the following enabling measures:

- Encouraging innovation during the construction process and ensuring sustainable measures as detailed throughout this EIAR are safely and efficiently implemented in the later stages of the project; and
- Working with local communities and publicly sharing information regarding the project's sustainability measures while remaining open to accepting and implementing feedback.

5.1.2. Key Construction Activities

Construction activities will be required along the entire length of the Project. The key activities are summarised in Table 5.1 (per zone) and described in detail throughout this chapter.

Table 5.1: Key Activities in Each Construction Zones

Location	Activities
Zone A - Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station	The zone from Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station includes the following works: • Installation of overhead electrification equipment for the 2 new DART lines; • Four new substations to facilitate the new electrified lines; and • A turnback at Hazelhatch & Celbridge Station.
Zone B - Park West & Cherry Orchard Station to Heuston Station	The zone from Park West & Cherry Orchard Station to Heuston Station includes the following works: • Widening to four tracks between Park West & Cherry Orchard Station and the South Circular Road Junction and installation of retaining walls, in places requiring anchoring, along sections of the route, where needed; • Installation of overhead electrification equipment for the two new DART lines; • Track modifications and interface works to connect the new track layout to Inchicore Deport • Five bridge replacements / upgrades to accommodate the widening of the rail corridor required for four tracks; • Construction of a new cut and cover buried portal structure at South Circular Road Bridge (OBC1A) to accommodate the new DART lines; • One new substation to facilitate the new electrified lines; and • New drainage facilities including the installation of new underground attenuation tanks.
Zone C & D - East of St John's Road Bridge (Islandbridge) to Glasnevin Junction	Proposed work on the East of St John's Road Bridge (Islandbridge) to Glasnevin Junction zone includes: • Installation of overhead electrification equipment;

Location	Activities
	• One new substation to facilitate the new electrified lines; • A new dedicated DART station located at Heuston West; • New drainage facilities including the installation of new underground attenuation tank at Heuston West; • Track siding modification (short section of railway track adjacent to the main tracks used for stabling of trains) at Heuston Station; • Lowering of the tracks along parts of the route to enable the electrification infrastructure to pass through the existing bridges and tunnel with adequate clearance; • Construction, where needed, of new retaining structures to accommodate steepened slopes where the tracks are being lowered and where electrification masts are required; • Soil anchoring / nailing; • A new pump station in the vicinity of McKee Barracks to overcome a low gravity sewer across the line adjacent to Blackhorse Avenue Bridge (OBO4). • Modifications to an existing wet well and pump station to overcome inadequate drainage between the two twin arch structures; and • One bridge replacement / upgrade.

5.2. Project Wide Construction Works

Given that much of the general linear works occur along the full extent of the Project, the construction methodology for these elements is described first in this chapter to avoid the need for repetition. In addition, elements of the Project which are to be provided with common approach are also described initially in this chapter (for example signalling, construction compounds or track lowering). Zone specific detail is then provided in Section 5.3 onwards.

5.2.1. Safe Zones and Safe Working

There are strict safety restrictions related to working on or adjacent to a live railway line. This will include barriers between the live tracks and the working area and in certain circumstances, full possession of the railway (i.e. no trains running). Such possessions are generally planned months or years in advance, depending on the length of possession time required and will vary from night-time slots to full weekend closures or in some cases longer if required depending on the nature of the works to be undertaken at a given location.

Due to the importance of the Cork mainline to commuters, it will remain operational throughout the construction phase. The works will be carried out through a combination of restricted working zones (including sites completely segregated from the live railway) and night-time/weekend possessions. Working possessions along the mainline mean that the work needs to be planned in smaller phases,

particularly in the four-tracking section from Park West & Cherry Orchard Station to Heuston Station and this is reflected in the detailed descriptions per sections later in this chapter.

The complexity of the works required within the Phoenix Park Tunnel (PPT), will require the Phoenix Park Tunnel Branch Line (PPTBL) and the PPT to be closed for a period of approx. 6 months to ensure safe working conditions can be maintained.

Materials delivery times will also predominantly be outside peak traffic hours, particularly for construction HGVs known to restrict natural flow of traffic.

As part of the safe working practices, fencing and safety barriers will be installed at key locations along the construction works including at site compounds.

Site lighting will typically be provided by tower mounted temporary portable construction floodlights. The floodlights will be cowled and angled downwards to minimise light spillage outside of works areas and to surrounding properties. Lighting will be provided with the minimum luminosity sufficient for safety and security purposes and will be shut off at night when not in use or when works cease at the end of the day in order to minimise the effects of light pollution and disturbance to nocturnal species.

5.2.2. Mobilisation and Site Enabling Works

5.2.2.1. Appointment of Project Site Environmental Team

Prior to commencement of any works related to the Railway Order (RO) permission should it be confirmed, the following key environmental personnel will be appointed:

- Environmental Clerk of Works (ECoW) to ensure that the mitigation measures outlined in this document (including any updates to this document following consent) are implemented.
- Project Ecologist to supervise all pre-construction ecological surveying, implementation and overseeing of ecological mitigation measures and ensuring that activities on site are conducted in accordance with the planning permission as they pertain to ecological matters and specifically any works that could have an effect on protected habitats or species.
- Project Archaeologist to supervise the necessary archaeological mitigation, testing and monitoring throughout and particularly in the Dublin Zone of Archaeological Potential (ZAP) and the Deer Park ZAP. This includes overseeing the conduct of any excavations and ensuring they are performed in accordance with any license conditions. The project archaeologist will also ensure that there is liaison with both the Iarnród Éireann programme archaeologist and the Department, in accordance with the relevant Code of Practice[1].
- Project Conservation Architect to oversee and advise on activities in proximity to buildings and features of architectural heritage including modification of bridges along the route. The Project Conservation Architect will also oversee and ensure follow on mitigation is achieved for the deconstruction of any protected features along the route and specifically the Signal Box at Inchicore Works. The Project Conservation Architect will also advise and guide design finishes for all heritage features impact by the project.

[1] Code of Practice between the Department of Arts, Heritage and the Gaeltacht and Iarnród Éireann, 2012.

5.2.2.2. Advanced Works

Should the Railway Order be confirmed, a number of advanced works contracts will be required to facilitate construction. These include:

- **Ground Investigations for Detailed Design**: Preliminary ground investigation works have been undertaken to inform the design of the works to date. Further intrusive ground investigation will be required prior to commencement of construction. This will include but not be limited to the following along the length of the corridor:
  - Hand dug inspection pits;
  - Cable percussive boreholes with rotary follow-on;
  - Rotary boreholes;
  - Geobore S Rotary boreholes;
  - Windowless sample boreholes;
  - Geophysical survey.
- **Pre-construction Ecological Surveys**: This phase of the construction stage will address any required pre-construction surveys. Ecological surveys in particular will be required at this stage, consisting of bat surveys and bird nesting surveys. These will be undertaken prior to any vegetation clearance, tree felling and/or other demolition works as required and detailed in the mitigation measures included in this EIAR. Vegetation clearance will be programmed to avoid bird nesting season. Further detail on the required pre-construction surveys can be found in Chapter 8 Biodiversity and in Chapter 27 Summary of Mitigation and Monitoring Measures.
- **Invasive Species Treatment and Management**: Invasive species have been identified within and adjacent to the rail corridor – see Chapter 8 of this EIAR. Prior to commencing construction, a further invasive species survey will be undertaken within the lands made available and all stands will be taped off to prevent accidental spread. A treatment plan which will include in-situ chemical treatment and / or excavation and disposal at a suitably licensed facility. Good machinery hygiene will be practiced to ensure invasive species are not spread between sites or along the corridor.
- **Archaeological Monitoring**: Pre-construction archaeological surveys will be required under licence by the Department of Housing Local Government and Heritage prior to construction works commencing and a licence will be applied for by a suitability qualified specialist as recommended in the mitigation measures of this EIAR.
- **Site Clearance:** Prior to works commencing, vegetation such as trees, climbing plants, shrubs or vines will be removed. Site clearance to remove any unwanted materials and equipment will also be required. Before the site clearance starts, a survey of the areas will be completed. Site clearance including vegetation removal will take place between September and February inclusive to avoid nesting birds. If vegetation removal is required between March and August inclusive, the area shall be checked by the Project Ecologist. If nesting birds are found, the works in that area will be postponed until the chicks have fledged.

  Machinery for site clearance will vary depending on the location and will include but not be limited to:
  - Chainsaws, axes, and hatchets to fell and remove trees;
  - Stumps grinders to remove tree stumps;

- Mulchers to clear underbrush, small trees and leftover fencing;
- Bulldozers for clearing large areas where leftover structures, boulders, standing tress and debris remain;
- Tractors with frontend loaders to clear rocks, smaller trees, branches etc and for levelling/grading the land;
- Backhoes and excavators for small-scale land-clearing; and
- Woodchippers to turn trees into woodchips for easy disposal.

- **Condition Surveys**: These surveys will be carried out for engineering, property and conservation purposes.
  - Engineering - Site inspection to check the condition of existing foundations existing structures such as bridge decks, walls and abutments. Geometry and properties of materials of the existing structural elements.
  - Property – Structural surveys prior to works with high levels of vibration e.g. piling and soil nailing.
  - Conservation: Structural surveys prior to works with high levels of vibration and / or in proximity to features of conservation interest e.g. turret at Inchicore Works. See Chapter 21 Architectural Heritage of the EIAR for further mitigation.

5.2.3. Earthworks

Earthworks are required along the length of the Project. The two main options to be used for earth moving will be by road and by rail. The former will require haul roads within a safe zone on the railway i.e. barriered off from the operating railway on flat stable ground. This may require excavation at either the top or the base of the cut slopes and may require temporary retaining walls e.g. trench sheets. It will also result in construction traffic on the surrounding road network as material is brought away for management and / or disposal. The majority of material will be brought to suitable licensed sites in line with all relevant waste management legislation. This will include management of any contaminated ground encountered. Smaller volumes of materials e.g. from Heuston West Station and from the Phoenix Park Tunnel Branch Line will be stored at site compounds at Heuston West and Cabra before onward movement to suitable licensed sites. Although the main movement will be by road, movement by rail may also be used in limited circumstances. This will only be possible during possessions and while there is an advantage over dump trucks/road vehicles i.e., there would be fewer vehicles traversing the site creating less disturbance to adjacent properties.

The approximate earthworks volumes are presented in Table 5.2.

Table 5.2: Approximate Earthworks Volumes

Earthworks Type	Approximate Volume
Topsoil	Approx. 15,000m^3, very little will be required in the future works but some may be suitable for use as noise or visual bunds at sensitive locations.
Track ballast volumes	Approx. 55,000m^3 imported to the site in addition to 37,000m^3 recycled (assuming up to 50% wastage).
Soil	Approx. 400,000m^3 to be removed from site which equates to 50,000 truck loads

5.2.3.1. Topsoil Stripping

Topsoil stripping will be required at all widening areas, plus some of the construction compounds. This material will be re-used as far as possible within the Project e.g., for noise and visual bunding at sensitive sites, noting however that as per Table 5.2 very little will be required for future works. Surplus material will be dealt with in line with all relevant waste management legislation.

5.2.3.2. Track Ballast

Where the track is required to be moved it is envisaged that new or recycled ballast will be brought to site in advance and placed in the new position. Old ballast will be removed to a dedicated site in the Inchicore Depot for re-use / recycling / disposal in line with all relevant waste management legislation.

In areas where corridor widening is required, the new tracks will be laid first and then old tracks will be removed (where feasible) and recycled / disposed of the same to be in line with all relevant waste management legislation.

5.2.3.3. Site Water Management

Site water management is required at all earthworks sites to prevent waterlogging of freshly excavated soil, to prevent silty runoff from entering watercourses and drainage systems, and to alleviate rutting of haul routes. It requires ongoing design and management to reflect the changing operational sequences on the site.

Measures will comprise slopes across haul routes and drainage channels leading to outfall positions. At outfall positions, measures will be required to de-silt the runoff using silt traps, settling ponds, pumping to settlement areas or other mechanical means.

There is a history of flooding on the line between the Royal Canal and Luas Twin Arch (OBO8) and the Maynooth Line Twin Arch (OBO9) structures and the infrastructure currently in place to overcome this is a pump station; pumping water to an adjacent filtration area. With track lowering required in this area it is proposed that the pump station will be enlarged to account for a higher volume of water. The change from diesel multiple unit (DMU) to electrical multiple unit (EMU) is also a consideration as the flood levels would need to be compatible with the use of EMUs on the line following electrification.

Where track lowering is required, as excavations are complete, a new drainage system is required to drain the lower foundation level of the rail.

5.2.4. Structures

5.2.4.1. Bridges

There are a total of 38 major bridges along the Project; a mixture of overbridges and underbridges. In most cases, the bridges are adequate to facilitate the new DART+ service i.e. wide enough for the 4 no. tracks and with adequate vertical and lateral clearance for the Overhead Line Equipment (OHLE). However, some of the bridges require interventions ranging from complete reconstruction, track lowering or partial reconstruction to facilitate the installation of the OHLE system. A number of bridges require parapet modification works to ensure that there is adequate clearance to the OHLE from road level.

The bridge reconstructions occur primarily in the four-tracking area, where the existing bridges crossing the rail corridor have insufficient horizontal spans.

At a number of locations, track lowering is the proposed solution under bridges where there is inadequate vertical clearance and restrictions in relation to the surrounding road infrastructure.

A total of six bridges (highlighted in blue in Table 5.3) require replacement / upgrade along the route due to insufficient horizontal spans across the modified arrangements. These include Le Fanu Road Bridge (OBC7), Kylemore Road Bridge (OBC5A), Khyber Pass Footbridge (OBC5), Sarsfield Road Under-Bridge (UBC4), Memorial Road Bridge (OBC3) and the Glasnevin Cemetery Road Bridge (OBO10). South Circular Road Bridge (OBC1) will not be reconstructed but rather a new cut and cover portal structure (OBC1A) will be constructed immediately adjacent to (OBC1) to accommodate the additional track/s.

Table 5.3: Bridge Interventions

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

Zone	Structure Id	Location	Chainage	Proposed Solution
	OBC13	Ninth Lock Bridge	15+725	No modification
	OBC11	Cloverhill Road Bridge	15+325	No modification
	OBC10A	M50 Motorway Bridge	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 B	OBC8B	Cherry Orchard Footbridge	13+350	No modification
	OBC7	Le Fanu Road Bridge	12+610	Bridge Replacement (road raising and track lowering)
	OBC5A	Kylemore Road Bridge	12+140	Bridge Replacement (road raising and track lowering)
	OBC5	Khyber Pass Footbridge	10+820	Bridge Replacement
	UBC4	Sarsfield Road Under-Bridge	10+525	Bridge Replacement
	OBC3	Memorial Road Bridge	10+000	Bridge Replacement (road raising and track lowering of only the Slow tracks)
	OBC1	South Circular Road Bridge	9+420	New cut and cover buried portal structure OBC1A. (Raising of Con Colbert Road low point) Slow tracks through OBC1A, including track lowering measuring approx. 2.5m at OBC1A, track realignment of Fast tracks under OBC1.
	OBCOA	St John's Road Bridge	9+330	Track realignment under OBCOA
Zone D	UBO1	Liffey Bridge	8+850	No modification
	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

Zone	Structure Id	Location	Chainage	Proposed Solution
	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
	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	Replace existing bridge deck and parapets to be upgraded to meet safety requirements

5.2.4.2. Retaining Structures

5.2.4.2.1. Bored Piled Walls

Due to practicality of construction in spatially constrained areas, piled walls have been selected and secant piled walls are the preferred system for the Project. Secant walls are formed by the construction of alternating unreinforced piles (Primary Piles) and reinforced piles (Secondary Piles). Primary piles are installed first, and the secondary piles are then partially cut though the primary pile either side to create a secant. The primary piles have a low characteristic compressive cube concrete strength, which is retarded to reduce the strength of the mix while the secondary piles are installed between the primary piles. An example of bored piles is shown in Figure 5-2 for information.

Figure 5-2 Example of a Bored Pile Wall

Bored piled walls are constructed using a top-down method i.e. they are constructed through the soil from the ground level and then the soil in front of the walls is removed. Large piling rigs are required to core large diameter holes using augers through soil and corers through rock. Once the soil is removed from the bored holes a reinforcement cage is lowered in and concrete is poured to form the walls. New piles are added to the side of the first to create a wall. Secant pile walls have continuous piles interconnected with each other and contiguous piles have gaps between the piles and are infilled between to create continuous support (Figure 5-3 and Figure 5-4).

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

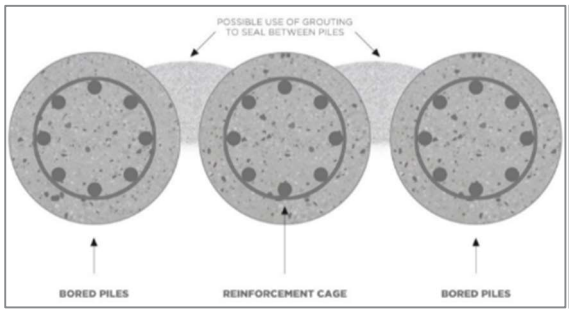

Figure 5-3 Bored Piled Walls – Secant

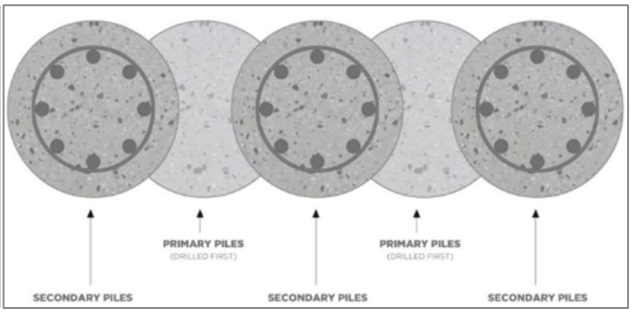

Figure 5-4 Bored Piled Walls Contiguous

For larger retained heights (above 4m), the use of ground anchorages to provide the horizontal support to the retaining wall will also be utilised as this will reduce displacement of the wall and lower stresses in the piles.

5.2.4.2.2. Machinery & Equipment

It is proposed that generally Continuous Flight Auger (CFA) piling rigs would be used as they generally offer quieter and faster boring through a diverse range of sub-strata and because of the stiff boulder clay found across much of the project area as outlined in Figure 5-5. They may require casings where ground water is intercepted or if the finished face is poor. The typical lengths of the piles on this project are estimated to be 12-15m long and in the range of 600-1,000mm in diameter. Owing to the nature of the topography, the walls will be retaining 7-10m of ground that often has a surcharged load (adjacent structures) and would require anchoring (often under adjacent 3rd party lands).

The machinery and equipment which will typically be used is as follows:

- Piling Rigs noise emissions will correspond with 2000/14/EC directive on noise emissions by equipment used outdoors and are generally in the range of 85-90dB;
- Combination (anchor drilling and jet grouting rigs);
- Concrete Trucks and Pumping Rig;
- Cranes (lowering of steel and concrete tremmi systems);
- Excavator (piling platform construction);
- Bulldozer (piling platform construction);
- Mini- Excavator (guide beam trenching);
- Pile Cropping Equipment (breakers and/or jack hammers);
- Welding/cutting equipment (for rebar works but most will be off site); and
- Hand tools.

Figure 5-5 Example of CFA Piling Rig

5.2.4.2.3. Soil Anchoring / Nailing

Soil anchoring is a top down retaining method, from the top, soil is excavated over a short height. The surface of the excavation receives steel mesh and is then spray concreted (Refer to Figure 5-6). Long steel rods (ties) are driven into the retained soil and anchored by grouting to provide stability and strength to the slope. The area beneath the constructed section can then be excavated and the process repeated until the entire wall is complete. Soil anchoring will be used at various locations along the route including but not limited to sections along the Phoenix Park Tunnel Branch Line.

Figure 5-6 Typical Soil Nail / Anchor Installation

Slope regrading is required along sections of the Phoenix Park Tunnel Branch Line. The slopes will be reseeded following the regrading works.

5.2.4.2.4. King Post Retaining Walls

King post retaining walls are constructed using two main components; vertical main posts embedded into the soil, supporting horizontal rails between the posts. This is a bottom-up construction method, soil is excavated, posts are placed by boring or driving the posts into the soil, rails are placed between the posts and then fill is placed behind walls.

The posts are constructed by boring holes in the position of where the posts will be placed. The posts are craned into position and then the voids surrounding are concreted. The posts need to be deeply embedded to prevent overturning of the wall. Once in place, usually concrete panels are placed between the posts to form the retained surface.

Construction will necessitate excavators, dump trucks, coring/boring equipment, concrete supply, and supply vehicles to the site, plus a crane to lift components into place, an example is shown below in Figure 5-7.

Where the section above a wall is accessible and requires parapet (railing) for the safety of maintenance and inspection personnel the kingposts will be extended to provide a minimum 1.1m height above the retained height, with additional panels providing the barrier.

Figure 5-7 Typical Configuration of a King Post Retaining Wall

5.2.5. Permanent Way

5.2.5.1. Track Lowering

Track lowering will be required through the four-tracking section of the line and along parts of the Phoenix Park Tunnel Branch Line. Works will typically comprise:

- Physical and/or operational shifting of tracks; in addition to closure of the operational tracks, utilities and ancillary infrastructure.

- Where excavations are significant, support of adjacent operational tracks;
- Excavation of track bed;
- Excavation of substrata;
- Installation of drainage.
- Replacement of utilities and ancillary infrastructure; and
- Construction of new track bed.

In some cases, the track lowering may be nominal, and the most practical solution will be to reduce the track ballast by the required lowering amount, however this is subject to the resultant ballast depth achieving the minimum depth requirements. Diversion or closure of the operational tracks, utilities and ancillary infrastructure will be limited in these cases.

In the two areas where the most significant track lowering will be required, from west of Le Fanu Road Bridge (OBC7) to Inchicore (in the order of 0.85m) and from Memorial Road Bridge (OBC3) to Heuston West (in the order of 2.6m along the Slow Lines), it is proposed to undertake widening works in advance of any track additions and lowering so there will be appropriate diversion locations for the operational services to continue (mostly unaffected). A retaining wall separating the existing tracks and the new DART tracks will be required between Memorial Road Bridge (OBC3) and the new South Circular Road (OBC1A) portal structure. Track lowering works on the Phoenix Park Tunnel Branch Line are generally located at bridge or tunnel locations and in these cases full closure of the line for a period of time will be required while the lowering operations are ongoing. Track lowering on Phoenix Park Tunnel Branch Line will be required at:

- Liffey Bridge (UBO1) through Conyngham Road Bridge (OBO2) and including part of Phoenix Park Tunnel;
- West of Cabra Road Bridge (OBO6) to East of Faussagh Road Bridge (OBO7); and
- Royal Canal and Luas Twin Arch (OBO8) and Maynooth Line Twin Arch (OBO9).

5.2.5.2. Changes to Horizontal Alignment

The main change to the horizontal alignment is along the Cork Mainline where the existing two or three tracks are being reconfigured to the proposed four-tracking layout. This will require realignment of the existing lines to the southern side (Fast lines) of the corridor between Park West & Cherry Orchard Station and Heuston Station. This provides the room on the northern side of the corridor to construct the new electrified Slow lines.

Discrete areas of track slew/relay are necessary to achieve the western interventions at Hazelhatch & Celbridge and Adamstown Stations, as well as the remodelling of the footprint at the interface with Inchicore Works and Heuston Station Yard.

For the Phoenix Park Tunnel Branch Line the horizontal slewing is the minimal to achieve optimal clearances through Phoenix Park Tunnel and along the open section from the north portal to the project extents at Glasnevin Cemetery Road Bridge (OBO10).

Track form is primarily Continuous Welded Rail (CWR) on ballasted track, with a fixed deck over Sarsfield Road Under-Bridge (UBC4), and slab track through Phoenix Park Tunnel and up to the Liffey Bridge (UBO1). The following plant and machinery or similar will be used to effect the changes to the horizontal alignment:

- Road Rail Vehicles(RRV);
- Engineering Train (for material supply, spoil and scrap);
- Tamping Machine;
- Kirow Crane (lifting P&C panels);
- Rollers (compaction);
- Excavator;
- Bulldozer;
- Welding/cutting equipment;
- Hand tools.

5.2.5.3. Drainage

5.2.5.3.1. Lineside Drainage Pipework

It is proposed that a new drainage system will be put in place as part of the new tracking arrangement between Park West & Cherry Orchard Station and Heuston Station to collect and drain all run-off either flowing through the ballast or standing on it as consequence of the ballast saturation during more intense storm events. The proposed drainage system covering the four-tracking area comprises three independent drainage networks each with two main branches running parallel to the track with filter drains above carrier pipes. The fourth drainage network already exists and serves the Phoenix Park Tunnel Branch Line.

Between Phoenix Park Tunnel and Glasnevin Junction the proposed works include the lowering of the track in some areas but no major changes to the drainage system are expected, apart from re-adjusting the current pipe and chamber levels to the new track profile. There is also a pumping station that drains the excess of water on the cutting located immediately between the Royal Canal and Luas Twin Arch (OBO8) and the Maynooth Line Twin Arch (OBO9) structures, lowering of the existing pumping station is required in addition to an enlargement of the existing wet well chamber.

The main drainage elements that will constitute the proposed drainage system are:

- Ballast layer - although the main function is structural, the track ballast also drains precipitation falling on the track. A sand blanket or geo-composite may be included below the ballast as a formation protection layer.
- Carrier drains are required to transport storm water from the collector drains to the attenuation structure and are not required to collect water from the surrounding area.

- Collector drains, are then installed above the carrier drain to collect storm water run-off from the formation that will have percolated through then ballast and entered the pipe through perforations.

In the Phoenix Park Tunnel it is proposed to install a new slab track system, which will require an integrated drainage solution to ensure a safe and reliable operation of the infrastructure. The proposed slab track drainage is proposed to consist of a 400mm wide by 500mm deep in situ concrete channel located in the 6-foot (between the 2 sets of tracks). The transition between the ballast track section, where a perforated pipe is to be installed, and the longitudinal channel will be done by increasing the channel depth up to 800mm at the manhole connection and then reducing the depth of the proposed channel up to the standard high of 500mm.

5.2.5.3.2. Attenuation Tanks

Stormwater attenuation tanks, where required, are designed to collect and store excess surface water run-off from large storm events. The water is then released from the storage tank at a controlled rate by a flow control unit into to a downstream water body. Where discharging into a natural water body there may also be a requirement for a back water control valve.

As part of the drainage design, two new underground attenuation tanks are proposed for Inchicore Works area and a further one located adjacent to Heuston West Station. The proposed solution for these attenuation structures is cellular tanks. Their modular nature enables them to fit into the specific site constraints in terms of space. The proposed outfall for the new attenuation tank between Heuston West Station and Clancy Quay is the Liffey River.

Construction of the tanks uses excavators down to base level, with spoil removed off site using dump trucks. A membrane is laid across the base, sides and roof of the attenuation system and then soil is backfilled above the tank.

Figure 5-8 Typical Modular Attenuation Tank

The following typical machinery will be required:

- Dump Trucks (bedding and filter materials and removal of excavated material below formation;
- Excavators (for unconfined space construction);
- Backhoe Loaders (pipe slinging and excavation);
- Mini-Excavator (confined space excavation and 3ton to allow for min. 2.5m reach);
- Trench boxes;
- Welding/cutting equipment;
- Hand tools.

5.2.6. Roads

Road reconstruction works are generally limited to within 100m (approx.) of the rail crossing points and are located at Le Fanu Road, Kylemore Road, Memorial Road and South Circular Road. Sarsfield Road works currently only include for reinstatement of the carriageway and footway surfaces. The full length of Con Colbert Road / Chapelizod By-pass requires the reinstatement of footpaths and boundary parapet walls which will be demolished as part of the piled wall construction at that location.

Apart from the road works associated with the large (predominantly at-grade) junction for South Circular Road/Con Colbert Road all other road crossings will require full closure of the existing road to construct the bridges. However, owing to the relatively short length of road works it is envisaged that the majority of the road works would be completed during the bridge construction phase. The potential outstanding works would be the traffic signal commissioning, wearing course as well as line marking; and as such it is expected that the rail crossings could be brought back into public operation under temporary traffic management once the parapet works are completed.

Road works will be required to facilitate the installation of electrical supplies to each of the 6 no. traction power substations. Minor road works will also be required to provide access to construction compounds along the route.

5.2.7. Electrification

The Project is being electrified from Hazelhatch & Celbridge Station to Heuston Station and from Heuston West Station to Glasnevin Junction where it joins with the DART+ West Project. The electrification works will require:

- Substations;
- Overhead Line Equipment (OHLE).

5.2.7.1. Electrical Substations

- The OHLE system will be supplied with electrical power at regular intervals, at locations known as substations. A total of six electrical substations are required for the DART+ South West Project. 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 Irish Rail's maintenance teams. The characteristics of the substation compound and buildings for the DART+ South West Project have been outlined in Section 4.5.9

of Chapter 4 Project Description of this EIAR. The characteristics of the substation compound and buildings are consistent with existing Irish Rail and ESB substations as follows:

- The substation compound will be secured by a palisade fence, or similar. See Figure 5-9 for a typical HV substation including security fencing.
- The architectural finish will be grey brick / blocks, however, there may be site specific areas where a high architectural finish is required.

- The substation will be located at ground level to facilitate the installation or replacement of heavy electrical equipment, the immediate area around the substation should be level.
- Substations will be located so that the access doors open outwards onto a clearly marked low-risk fire area.
- The exterior and the access of the electrical substation will be illuminated with lighting to assure the mobility and the security of any operation during the hours of darkness.

The typical duration of construction for an electrical substation is six months, including civil, mechanical and electrical works.

Figure 5-9 Typical Irish Rail HV Substation

The construction of the substation building will include the following activities:

- Site clearance and earthworks;
- Utilities diversion;
- Signalling, Electricity and Telecoms (SET) cabling diversion;
- Foundations and concrete slab installation;
- Cable troughs and upstands cast into the floor, with the appropriate coverings;
- Building structure erected;
- Facade and finishes;
- Access roads and pavement Works;
- Boundary treatment and landscaping; and
- All concrete surfaces will be cleaned and sealed to minimise dust generation.

MEP (Mechanical, Electrical and Plumbing) elements will be installed: building equipment (lights, fire detection, fire extinguishing, water, sewage, connection to Irish Water).

HV equipment (transformers, switchgear, auxiliary transformer, diesel generator, LV panels and UPS) will be delivered by road and installed using small cranes and cabling will be laid, then equipment will then be electrically and mechanically installed.

Excavated material will, as far as possible, be used as screening berms on site. Opportunities to reuse demolished railway wall / bridge stone cladding to improve the aesthetic of the substations and create a link to the railway heritage will also be taken.

ESB will have a dedicated area and equipment inside the substation building including the high voltage (HV) cable connection between the ESB equpment and the Iarnród Éireann substation. The external cabling connection (ESB network supply) from the ESB network to the DART substation (design and construction) will be the responsibility of ESB and will require cables to be laid between the substation and the appropriate ESB Networks connection point.

To connect the feeder cabling from the substation to the OHLE, the feeder cable will be placed in buried ducts. Road-rail vehicles with excavator attachments are necessary to carry out this excavations for the underground ducting. It is estimated that each substation will require approx. 6 months to construct and fit-out.

The typical machinary required for this work is as follows:

- 4x4 vehicle;
- Concrete vibrator;
- Water pump;
- Wheeled dumper or Track dumper (6 to 8 tons);
- Timber or other Shuttering boxes;
- 360˚ tracked excavator (13 ton normally, 22 ton for rock breaker);
- Chains and other small tools;
- Concrete delivered by supplier to closest convenient point (38 ton gross);
- Graders; and
- Rollers and compactors.

5.2.7.2. Overhead Electrification Equipment (OHLE)

The track and civil engineering works will be completed before the OHLE is commissioned. The main components of the OHLE are summarised below:

- Foundations for the OHLE infrastructure, support structures will be either founded by means of piles or spread foundations, depending on soil conditions.
- OHLE masts, structures will be required at a maximum spacing of 63m along the track to support the catenary cables. The support structures are generally supported from one side of the track (cantilever) or from both sides (portal) depending on the permanent way layout. Where there are adjacent walls the support structure can be fixed to the walls negating the need for vertical supports (stanchions).

- Foundations and masts will generally be completed once all the other permanent way civils components have been constructed up to ballast level. The foundation and poles will be installed prior to bringing a new section of track into operation.
- Contact Wire is supported by the Messenger Wire via Droppers. Its function is to deliver the power to the trains via the pantograph.
- Messenger Wire also known as the Catenary Wire, supports the Contact wire and also delivers power to the trains.
- Droppers are the means by which the Contact Wire is suspended from the Messenger Wire to hold it at a consistent height. These are also conducting elements of the traction power delivery system.
- Parallel Feeder is a distribution power cable from each substation attached to the tops of the masts and used to deliver the 1,500V DC power to the Messenger Wire/Contact Wire combination via jumper cables at selected intervals.
- Earth Wire is connected directly to every mast and its primary function is to provide an electrical path to detect and protect from short circuit faults on the system. It also has a function, as part of the equipotential traction bonding circuit, of maintaining the "touch potential" of the rails within safe limits. Additionally, it provides the means by which other metallic structures, such as road bridges, footbridges, certain fencing etc. are maintained at a safe potential.
- Lineside Switches are manually operated lockable switches, mounted on the top of masts. They are used for isolating individual electrical sections of the OHLE in order to provide a safe zone for carrying out works. These are distributed along the track.
- Section Insulators are insulators fitted in-line in the Contact Wire and Messenger Wire and provide isolation of specific OHLE Sections when the appropriate Lineside Switch is opened.

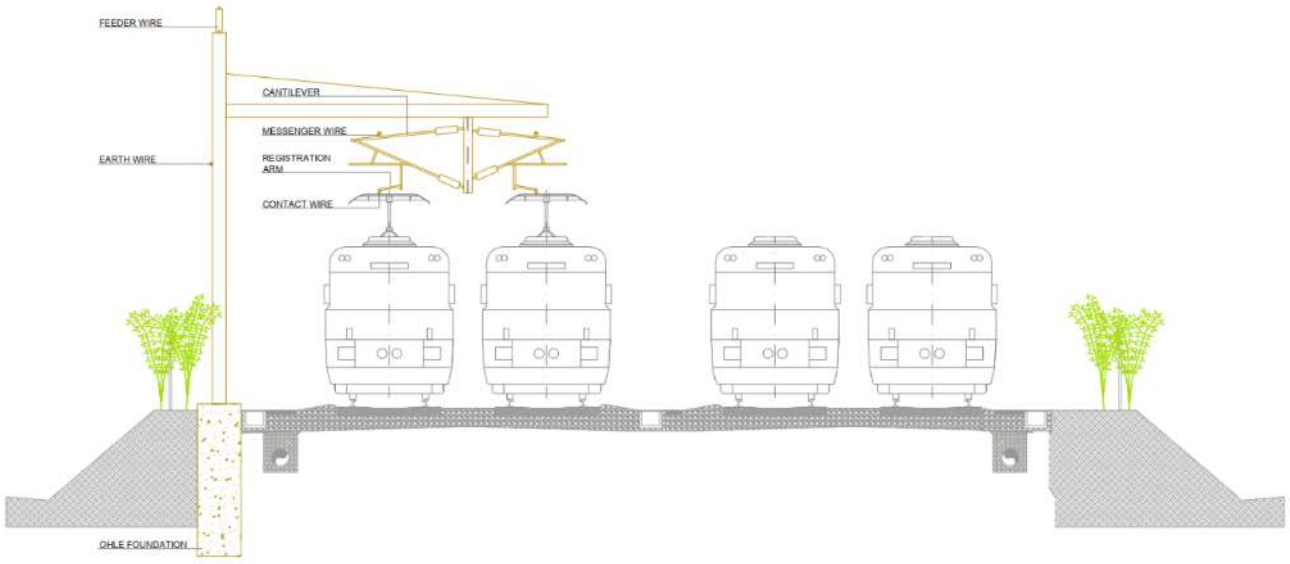

Figure 5-10 Typical OHLE Arrangement in Four Track Open Route

In the four track areas, Two Track Cantilevers (TTC) will generally be placed on the north side of the line, to support OHLE on the northern two tracks.

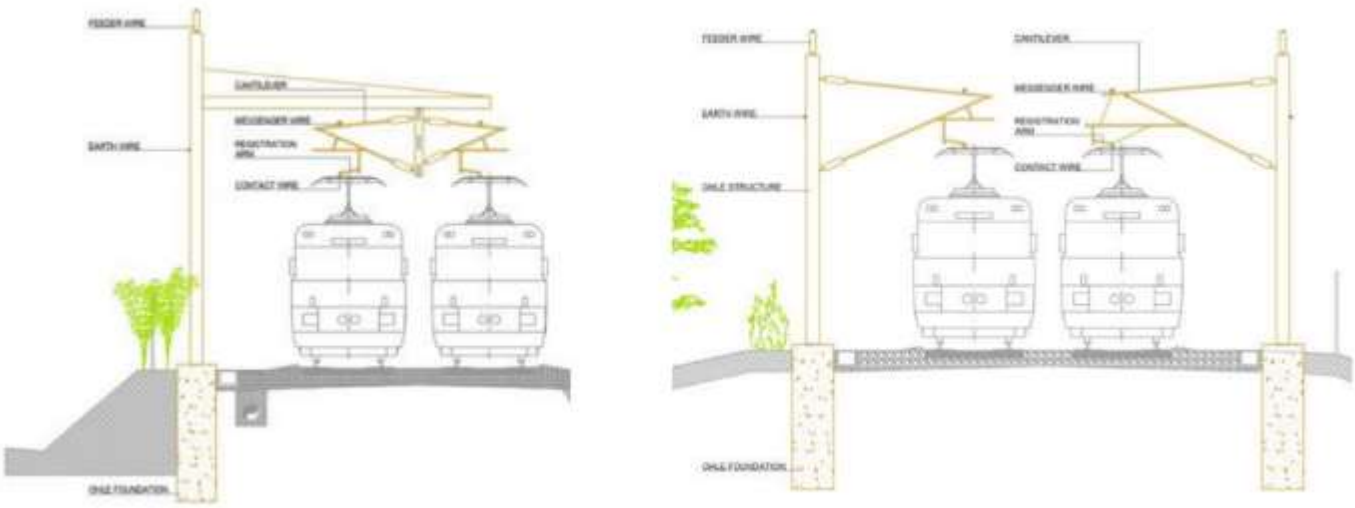

Figure 5-11 Alternative OHLE Arrangements in Two Track Sections

Additional feeder cables will be supported from the masts at heights between 6m and 8.5m on each side of the track. An earth wire will also be suspended from the masts.

The OHLE system and arrangement has been described in Section 4.5.8 of Chapter 4 Project Description of this EIAR.

The key track and civil engineering interventions will be completed before the OHLE is commissioned. The support structures will typically be by means of piles, in certain circumstances spread foundations may be required, depending on soil conditions. In sections with large retaining walls the OHLE can be fixed directly to the walls.

In sections where piled foundations are required, the piles will be constructed using road-rail vehicles. Once the piles have been installed, then masts and overhead wires are installed.

Typical sequence for the OHLE installation is:

1. Install foundations;
2. Install OHLE masts;
3. Install booms if TTCs or portals;
4. Install small parts of steel work including the ties;
5. Install support and registrations;
6. Install Earth wires;
7. Install feeder wires;
8. Install the messenger wires;
9. Install Contact wires;
10. Install droppers;
11. Install section insulators or cut-in insulators;

12. Install jumpers;
13. Testing and commissioning.

5.2.7.3. Signalling and Low Voltage (LV)

Several diversions are expected for the signalling and LV systems during the staging process. To facilitate the civil works, during the initial stages, there will be a requirement for temporary phasing and staging works associated with signalling and telecom systems.

- LOC's (Location Cases) which may be impacted by the civil works will be relocated to the opposite side of the works or temporary protection measures will be put in place, prior to the civil works to beginning.
- Before the civils work commence, the equipment in the new locations must be tested and commissioned.
- The new cabling will have sufficient slack, to allow later lifting and shifting.
- The cabling will be protected to avoid clashes during the construction works.
- Where possible, existing UTX (Under Track Crosses) will be used, if not protection for cables will be used.
- Any planned operational amendments will be planned and agreed in advance of the modifications taking place. This is to ensure the safe operations of the existing train service.
- At the end of the civil works in each stage, it will be possible to install the new LOC and OBJ (Object Controllers).
- Modifications to the (Primary Supply Points (PSP) and Auxiliary Supply Points (ASP) will be carried out prior to the phase in which they have to be commissioned.

The commissioning of the new interlocking in the NTCC (National Train Control Centre), with the new LOC and OBJ will be carried out.

- Signalling Implementation will be phased and agreed with the NTCC and Operations.
- IT systems from LOC / OBJ must be ready and commissioned prior to commission the OBJ itself.
- The interface between the new Heuston part (North) and the remaining part (Heuston South) must be tested and approved prior to commissioning.
- All changes to track alignment will require a correspondent change of the signalling, eventually relocating / relocating signals and cables, will be tested section by section, before they are commissioned into (safe) operation.
- The other interfaces between DART+ West and Heuston, and Hazelhatch and Cork, must be tested and approved prior to commissioning.
- In the situation where the new equipment requires relocation, the cabling will have sufficient slack to allow equipment relocations, where possible.

There is limited civil engineering works planned on the section from Hazelhatch & Celbridge Station to Cherry Orchard Footbridge (OBC8B), as such there is flexibility in relation to construction of the new troughing and the associated staging of the works.

5.2.7.4. Telecommunications

The Telecommunication Equipment Room (TER) are prefabricated buildings and their installation is expected to be carried out during regular working hours. They will be installed during the early stages of the works to facilitate cabling connections as soon as possible. In some cases, existing TERs may be used.

The construction phase of the TER is described as follows:

- Enabling works and Utilities diversions.
- Land levelling and earthworks, which will consist in the contouring and clearing the land in each location before the placement of the building.
- Earthworks will be carried out only within the footprint of the TER consisting of removal or excavation, depositing of soil, and installation of retaining walls if necessary.
- In parallel, trenches will be excavated to facilitate the installation of the cable troughs.
- Lean concrete will be poured to form the foundations.
- After the foundation is complete, a prefabricated building will be moved into position.
- When the structure is finished, the equipment installation will be carried out, which consists of electromechanical and telecom equipment installation.

As a general approach, the proposed strategy for telecommunications cabling is outlined below:

- New cable containment installed on the opposite side of the existing cables.
- New cable containment installed on the same side of the existing cables.
- Cable laying along this new cabling system on both sides.
- Connection of these new fibres to existing equipment. Migration of services. These connections will have to be coordinated with the ones proposed for the signalling equipment.
- Decommissioning of legacy fibres.

Although this process should ideally be carried out for the whole section at the beginning of the project, due to civil works limitations it is necessary to split the works over different zones and stages.

5.2.7.5. Cable Containment Strategy

Where new containment is required to interface with proposed Signalling, Electricity and Telecoms (SET) installations, these shall be interfaced appropriately with the existing containment runs.

Troughing will be installed on a free-draining substrate and top ballast will be installed hard against the troughing route to provide a stable support to minimise movement of the troughing. Any changes in gradient will be made as gradual as possible Where secure trough walkway is used ballast shall finish level with the lid to ensure trip hazards are minimised.

In areas where concrete troughing is reused or new concrete troughing is installed, installation shall be in line with aforementioned free-draining substrate and top ballast, ensuring that there is enough room to accommodate banding to ensure security of troughing lid.

Figure 5-12 Example of Concrete Cable Troughing

Areas along the route such as tunnels where there is limited clearance and space to accommodate a troughing route/walkway such as overbridges and tunnels will utilise galvanised ladder rack secured horizontally along the tunnel wall and will be appropriately interfaced to the ground trough route. This will have additional cable security through installation of galvanised cover that are physically secured to the rack.

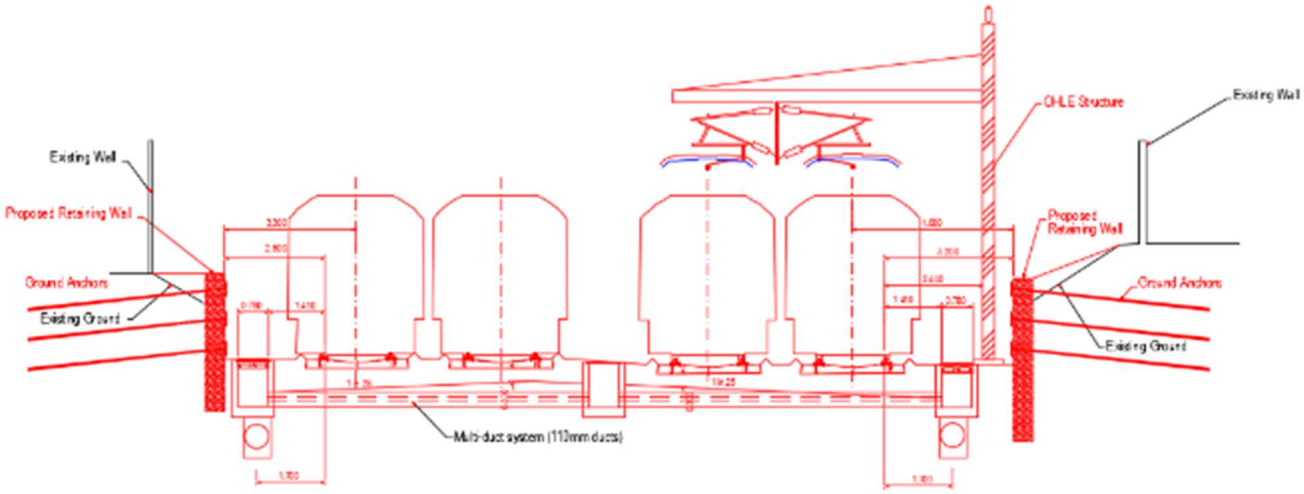

Figure 5-13 Typical Cross Section - Cable Containment

Where cable ducts are required to pass under the railway track, they shall be contained by a suitable under track crossing (UTX). Cabling draw-chambers shall be installed and will be of adequate size to enable cables to be drawn in without damage and accommodating the cable bending radius.

Draw chambers will need to be fitted in the following situations as a minimum:

- Where there is a change in the cable route.
- At each of the sides of an UTX.
- At buried ducts.

These containment solutions shall be utilised for all SET cabling requirements with services separated as far as is reasonably practicable.

Local, functional trackside cables that need to run across the track that are not installed in a UTX will require to be mechanically protected either in a hollow sleeper or protective UVC pipe and will follow a suitable prescribed route in accordance with best practice.

Where there is a need for Under Road Crossings (URX), any proposed cable route shall be buried to a standard depth of 1000mm below ground level at work-related and accommodation crossings, as well as throughfares not protected by highway standards where vehicular traffic passes over it. Similarly, to UTX solution draw chambers will need to fitted.

As part of the construction methodology and staging, there is a requirement to temporarily relocate containment and equipment in certain areas along the track. Where there is a need to do so, all cabling will be suitably protected either by split ducting or temporary troughing.

Installation trenches and ducting will be prepared in the following manner during any pre-works and temporary staging.

1. Trench bottom shall be as level as possible and any changes in gradient should be made as gradual as possible.

2. The trench bottom shall be free of stones and other sharp objects, and the edges of the trench shall be cleared of any foreign body.
3. Any ducts or UTX that are being reused shall be cleaned and proved prior to cable installation by pulling through a mandrel/cleaning pig or required diameter.
4. Duct entries shall be fitted with split bell mouths to prevent damage to the cables during installation.
5. A shallow pit shall be dug at entry positions to ensure that stones etc are not dragged into duct.

5.2.8. Construction Compounds

Works on this linear Project requires construction compounds at specific locations. The construction compound locations are illustrated in drawing DP-04-23-DWG-CV-TTA-21350 of Volume 3A of this EIAR. The sites will be used to accommodate offices for the contractor and client teams, storage facilities, recycling facilities, parking for cars and plant and potentially fabrication areas. The compounds vary in size and are located as close as possible to the rail corridor and areas where significant works are to be undertaken i.e. bridge reconstruction, retaining wall access points. The compounds will typically consist of areas of hardstanding for vehicles and materials, the sites will be fully serviced with electricity, water, sewerage and telecoms.

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

General pollution prevention measures representing good housekeeping and good practice at the construction site will include, but not be limited to, the following:

- Construction compounds will be kept clean, access routes and designated parking areas will be kept free and clear of excess dirt, rubbish piles, scrap wood, etc.; wheel washing or other similar systems and other contaminant measures as required will be provided in each working area.
- A site layout map showing key areas such as first aid posts, spill kits, material and waste storage, welfare facilities and details of site management contact numbers, including out of hours will be provided.
- Material handling and/or stockpiling of materials, where permitted, will be appropriately located to minimise exposure to wind. Water misting or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods. All loading and unloading of vehicles will take place off the public network wherever this is practical.
- All plant machinery, material and equipment required to complete the construction work will be kept in good order, clean, and tidy.
- Adequate welfare facilities will be provided for site personnel; appropriate security, lighting, fencing, and hoarding at each working area will be provided; appropriate waste management facilities will be provided at each working area with regular collections to be arranged.

- Effective prevention of oil, grease or other objectionable matter being discharged from any working area;
- No discharge of site runoff or water discharge without agreement of the relevant authorities.
- Infestation from pests or vermin will be prevented through good site management. Any infestations that do occur will be managed by an appropriate pest contractor appointed by the main contractor.
- Open fires will not be permitted;
- Use of less intrusive noise alarms, which meet the safety requirements will be used wherever possible; and
- Public rights of way, diversions and entry/ exit areas around working areas for pedestrians and cyclists will be maintained as far as practicable and to achieve inclusive access.

Fencing and in some cases screening along with topsoil bunds where topsoil has been removed may be required. Noise screening and temporary guide rail fencing may be required at access locations to the railway corridor. Security fencing will be required in addition to gated access to the sites and compounds to check vehicles and personnel arriving on site. Access roads will be required to connect compounds to the public road network. These access roads will be the main route for vehicles entering the site, including deliveries and arrival and departure of the workforce.

The construction compounds will be located such that they require minimal modification, if any, over the duration of the construction programme.

5.2.9. Haul Routes

Haul routes are designated routes used to haul material to and from the various construction sites, the haul routes have been broken down as follows:

- External Haul Routes – these are primarily on the public road network,
- Site Haul Routes – these are primarily between or within worksites or compounds.

5.2.9.1. External Haul Routes

The proposed external haul routes indicated in this chapter are for construction traffic associated with areas where a significant proportion of the works are to be undertaken, requiring considerable vehicular movements.

The routes below are anticipated to be limited to arterial roads wherever possible. It is assumed that most construction traffic serving works west of the M50 would emanate from junctions off the N7 and N4; while works within the M50 cordon would emanate from M50 junctions with the N7/R110, N4/R148, N3 /R147, N2/R135 and Ballymun (R108).

Materials delivery times will predominantly be outside peak traffic hours particularly in urban centres and particularly for construction Heavy Good Vehicles (HGV's) that have the potential to restriction natural flow of traffic.

Project areas east of South Circular Road have additional access restrictions governed by the Dublin City HGV Cordon for vehicles above 5 axles. Special permitting will be required for departures from

this, in accordance with the City Cordon conditions of access. In addition, where possible, long duration night works will be limited in areas close to residential units unless appropriate noise mitigation can be provided.

For the purposes of explanation, the haul traffic is separated into the following construction zones as illustrated in Figure 5-14 to Figure 5-18:

- Zone A-1: Hazelhatch to Adamstown Station
- Zone A-2: Adamstown Station to Kishoge Station
- Zone A-3: Kishoge Station to Celbridge Station to Park West & Cherry Orchard Station
- Zone B-1: Park West & Cherry Orchard Station to Le Fanu Road Bridge
- Zone B-2: Le Fanu Road Bridge to Kylemore Road Bridge
- Zone B-3: Kylemore Road Bridge to Sarsfield Road Bridge
- Zone B-4: Sarsfield Road Bridge to South Circular Road Bridge
- Zone C: Heuston Yard & New Heuston West Station
- Zone D-1: Liffey Bridge to PPT (inclusive)
- Zone D-2: Phoenix Park Tunnel Branch Line (PPT to Glasnevin Connection inclusive)
- Zone D-3: Glasnevin Cemetery

Figure 5-14 Construction Zone A-1: External Haul Routes

Figure 5-15 Construction Zone A-1, A-2 & A-3: External Haul Routes

Figure 5-16 Construction Zones A-1 & A-2: External Haul Routes

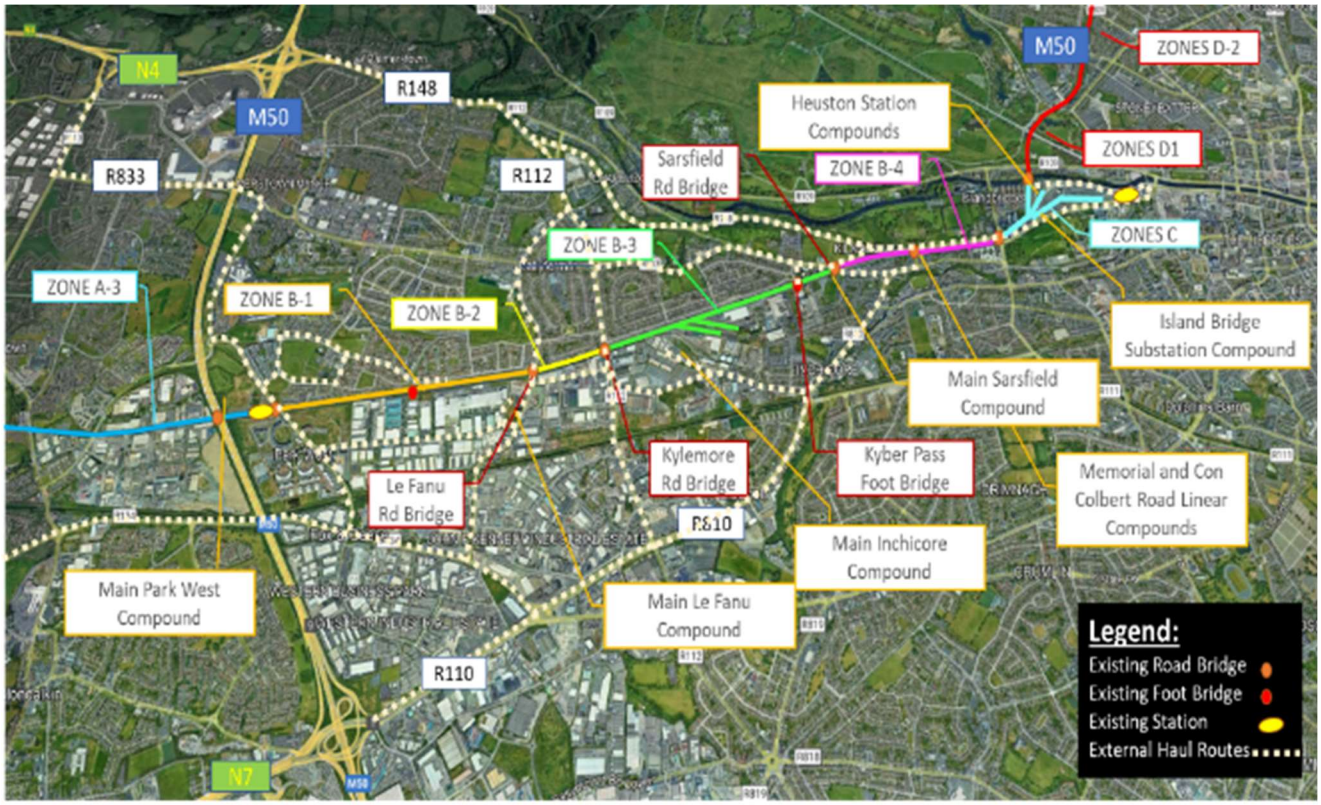

Figure 5-17 Construction Zones B-1 to B-4 & C: External Haul Routes

Figure 5-18 Construction Zones C, D-2 & D-3: External Haul Routes

5.2.9.2. Site Haul Routes

In order to access certain sites along the route, contractors will be required to leave the local public road network and access proposed internal haul routes in the vicinity of the railway line. Haul routes will be used to connect the construction compounds to the works areas. Haul routes will be separated from the track by barriers and will be subject to speed restrictions to ensure that the railway operation is protected. Speed restrictions for construction vehicles will be required along the haul routes.

The main on-site haul routes will be required within the four-tracking area, where large volumes of soil is required to be excavated for preparation of piling platforms and.

Site haul routes will be required at the following locations:

- Heuston West to Cabra Road and through to Glasnevin (north side of corridor);
- South Circular Road to Memorial Road (north side of corridor);
- Memorial Road to Sarsfield Road (both sides of corridor);
- Sarsfield Road to Inchicore Depot (predominantly south side of corridor);
- Khyber Pass to east of Kylemore Road (mainly northern side but also from yard on southern side);
- Kylemore Road to east of Le Fanu Road (both sides of corridor); and
- Le Fanu Road to east of Chery Orchard Footbridge (both sides of corridor).

Where works are limited to electrification and re signalling, it is assumed that these will be undertaken from rail mounted vehicles.

The phasing of works will determine where the haul routes will be located, for example, through the Kylemore area, it is proposed to widen to the North first using haul routes on the north side. The rail service will then be moved to the northern corridor and then works transferred to the southern side of the rail corridor. Due to limited space, haul routes will need to be engineered into the cut slopes using both cut and fill with engineered fill.

For the Phoenix Park Tunnel Branch Line, haul routes will be needed through the areas where track lowering is required. The track lowering exercise will be undertaken during a full closure of the Phoenix Park Tunnel Branch Line and Phoenix Park Tunnel.

The piled retaining wall locations on the project are in areas with limited access to works fronts from the public realm and in areas requiring constrained operational workspaces (i.e. much of the four-tracking section). The piling platforms (between 2.5m and 7m high) will also serve as unidirectional haul roads for material extraction and delivery. These combined haul route/piling platforms may need to be stabilised as several may not be possible with a natural angle of repose. In some instances, they may require temporary soil nailing to reduce the embankment width, as well as the use of geo-composites under the tracked surface to account for the heavy static and dynamic loads imposed by piling and earth moving vehicles.

Stone road construction involves the excavation of the topsoil and storage of the material adjacent to the track where possible. Geotextile reinforcement would be placed on the subsoil surface and approximately 200mm of stone placed on top and compacted to form the track.

Typical machinery & equipment:

- 4x4 vehicle;
- Wheeled dumper or Track dumper (6 to 8 tons);
- 360˚ tracked excavator (13 ton normally, 22 ton for rock breaker);
- Teleporter or other mobile aerial platform and lifting equipment. All terrain crane (depending on site);
- Transit van;
- Chains and other small tools; and
- Road material delivered by supplier to closest convenient point (38 ton gross).

5.2.10. Utility Diversions

Diversions are required for utilities located along the route as part of the enabling works for the Project. These will act as a prerequisite to any intrusive works to ensure that vital utilities serving public and private entities maintain operation or experience minimal downtime to customers. Utility verification surveys will be conducted to ensure accurate locations of each utility prior to any works commencing. This will include in locations where track lowering is proposed to ensure protection of any utilities.

5.2.10.1.1. Temporary Diversions

The majority of utilities requiring diversion will be contained within the bridges that require reconstruction along the four-tracking area. In these instances, agreements have been made with the various relevant utility providers to accommodate temporary utilities in the proposed temporary bridges that will be constructed prior to works on the existing bridges. These works will be completed in three stages:

- Once traffic management is operational and existing / proposed utility routes have been mapped, contractors will begin the civil works by excavating trenches to facilitate the temporary diversion route. The trenches will be excavated to the required width and depth as agreed with each utility provider. Necessary components such as pipes, ducts, chambers etc. will be laid in situ during these works.
- At certain locations, temporary pedestrian/cycle/road bridges have been proposed adjacent to the existing bridge to facilitate temporary diversion of the utilities to these bridges before the bridges can be demolished and reconstructed.
- Utility provider personnel will utilise the laid components to install the temporary services (e.g. pull cables through laid ducts) where appropriate and complete any internal connections on the isolated temporary diversion. Once complete, the existing operational service will be shut off and capped / spliced to allow the utility provider to connect to the temporary diversion. Following connections between the existing and temporary pipes or ducts, the service will be switched back on. This will reroute the service through the temporary diversion, rendering the pipe or duct located in the existing bridge redundant.

5.2.10.1.2. Permanent Diversions

For any utility rerouted along a temporary bridge, the corresponding permanent diversion will be laid during the reconstruction of the proposed permanent bridge and associated roadworks. Depending on the utility, pipes or ducts will be laid between the supporting beams of the bridge or within the footpath. Works for these will be completed in two stages:

- Contractors will begin the permanent diversion civil works by excavating a trench from where the service was previously shut off to an access point to the new service in the newly constructed permanent bridge. The trenches will be excavated to the required depth as agreed with each utility provider. Necessary components such as pipes, ducts, chambers etc. will be laid in situ during these works.
- Utility provider personnel will install the permanent service (e.g. pull cables through laid ducts) where appropriate and complete any internal connections on the isolated pipe or duct. Once complete, the operational service facilitated by the temporary diversion will be shut off and capped / spliced to allow the utility provider to connect to the permanent diversion across the newly constructed bridge. The temporary diversion will then be removed, and the service will be operational across the newly constructed bridge.

The connection point to the service will vary depending on the utility. For example, for gas mains, the location where the service is shut off and capped is unusable for any future connections due to irreversible shaping of the pipe. In this case, a connection point of minimum distance away will be agreed upon for reconnection.

Other permanent diversions are located beneath the tracks and consist of foul, stormwater and combined sewer pipes and low voltage (ESB). Phasing of such permanent diversions will rely on the nature of adjacent project works, such as piling, retaining wall installation, track lowering etc., depending on the impact of such works on adjacent utilities. Provisions will be made to ensure future access to the service is possible for utility providers for maintenance or emergency works.

5.3. Description of Construction Works in Zone A – Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station

This zone extends between Hazelhatch & Celbridge Station and Park West & Cherry Orchard Station and is illustrated in Figure 5-19.

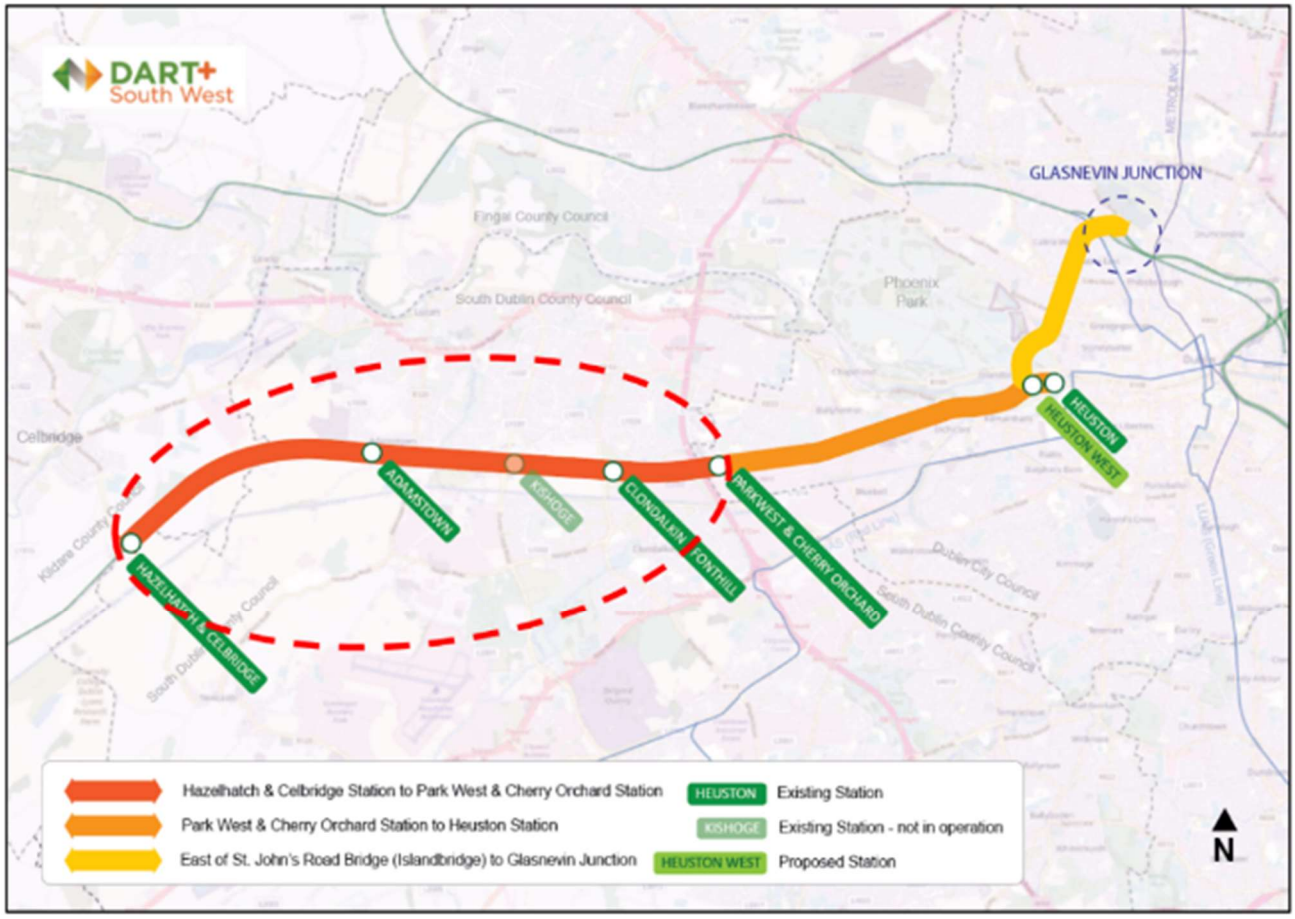

Figure 5-19 Construction Zone A Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station

5.3.1. Modifications to Bridges

There are 20 bridge structures in this zone and no significant structural interventions are required to these existing bridge structures as they were modified as part of the previous Kildare Route Project (KRP). However, 7 structures – three bridges and four stations will require some modification to parapets. Three of the bridges requiring some modifications to achieve the Iarnród Éireann 1.8m height requirement are outlined in Table 5.4 and include: New Hazelhatch Footbridge (OBC24A), Finnstown R120 Road Bridge (OBC19) and M50 Motorway Bridge (OBC10A). and. The New Hazelhatch Footbridge (OBC24A) is a two-span footbridge over the tracks. One of the spans crosses above the future electrified tracks. It has a parapet of steel panels attached to the truss structure that complies with the requirements as there are no openings. In sections where the height does not reach the required 1.8m, additional steel panels will be added as part of the project.

It is proposed to raise the parapets of the M50 Motorway Bridge (OBC10A) and Finnstown R120 Road Bridge (OBC19) with a proprietary GRP (glass reinforced plastic) parapet extension. This is a

lightweight solution which will allow the parapets to be raised to the required height and introduces a 45° steepled coping profile as shown in Figure 5-20.

Table 5.4: Structures within the Zone Requiring Intervention

Structure Ref	Structure Name	Intervention
OBC24A	New Hazelhatch Footbridge	Parapets to be upgraded to meet safety requirements
OBC20D	Adamstown Station	Maintenance platform over electrified tracks to be upgraded to meet safety requirements
OBC19	Finnstown R120 Road Bridge	Parapets to be upgraded to meet safety requirements
OBC14D	Kishoge Station	Parapets (in public areas, maintenance areas) and central stairs to be upgraded to meet safety requirements
OBC13C	Clondalkin/Fonthill Station Building East	Parapets (in public areas, maintenance areas) and central stairs to be upgraded to meet safety requirements
OBC10A	M50 Motorway Bridge Note 1	Parapets to be upgraded to meet safety requirements
OBC9D	Park West Station Building	Maintenance platform, Central Stairs to be upgraded to meet safety requirements

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 5-20 GRP Parapet Extension

The four stations requiring some modification to parapets are listed in Table 5.4. These include Adamstown Station (OBC20D), Kishoge Station (OBC14D), Clondalkin/Fonthill Station Building East (OBC13C) and Park West Station Building (OBC9D). The required modifications have been outlined in Section 4.6.3.2 of Chapter 4 Project Description of this EIAR.

5.3.2. Modifications to Roads

The only permanent road construction works in this area of the project will be provision of substation access roads where required and site paving associated with entrance tie-in works to existing roads. No public roads are due for reconstruction.

5.3.3. Modifications to Walls and Other Structures

There are no proposed modifications required to retaining walls or other structures within this section.

5.3.4. Building/Structures Demolitions

Within this zone, three buildings require demolition to facilitate the construction of the proposed Hazelhatch substation. The buildings are vacant dwellings adjacent to the car park at Hazelhatch & Celbridge Station. The buildings are under the ownership of CIÉ.

5.3.5. Substations

Four of the six substations required to supply the route with electrical power are located in this zone from Hazelhatch and Celbridge Station to Park West & Cherry Orchard Station. They are located at: Hazelhatch; Adamstown, Kishoge and Park West. These substations are described in more detail in the following sections.

5.3.5.1. Hazelhatch Substation

The Hazelhatch substation is located on a brown field site in the ownership of CIÉ (Refer to Figure 5-21 and Figure 5-22). The site is located adjacent to the Hazelhatch & Celbridge Station carpark and other disused dwellings also owned by CIÉ. It is situated to the east of Hazelhatch & Celbridge Station with direct access to the local road network. The existing drainage attenuation measures associated with the carpark are located to the north of this site potentially discharging to the existing watercourse located also north of the site. There are currently 3 disused dwellings on the site.

Figure 5-21 Hazelhatch Proposed Substation Location

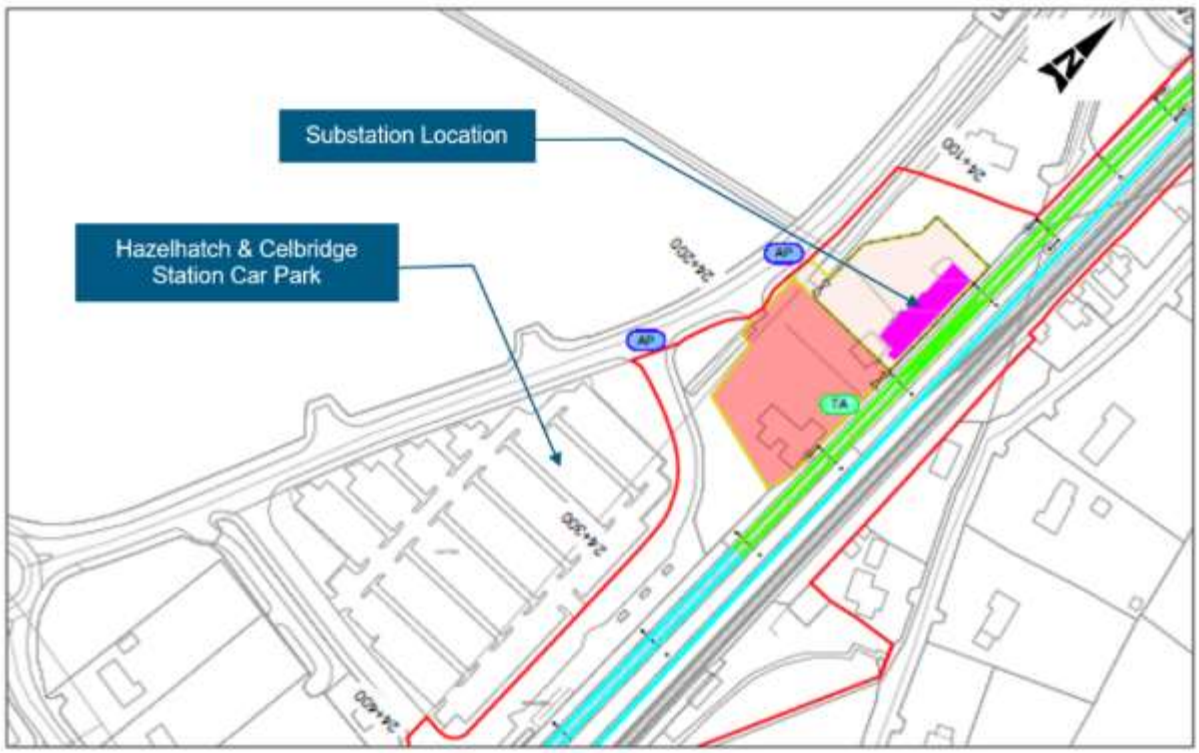

Figure 5-22 Indicative Hazelhatch Substation Layout

5.3.5.1.1. Hazelhatch Substation Grid Connection

Each traction power substation will be supplied from two independent 38kV circuits, it is proposed that the Hazelhatch substation will be connected to the ESB supply grid via the existing Celbridge Substation, located approximately 2km to the northwest. This route starts from the existing substation and runs southwards along the R405 Hazelhatch Road.

It then turns eastwards at the Loughlinstown roundabout and follows the Loughlinstown Road before connecting to the proposed Hazelhatch substation, this work will be undertaken by ESB Networks. Figure 5-23 below shows the proposed cable connection route.

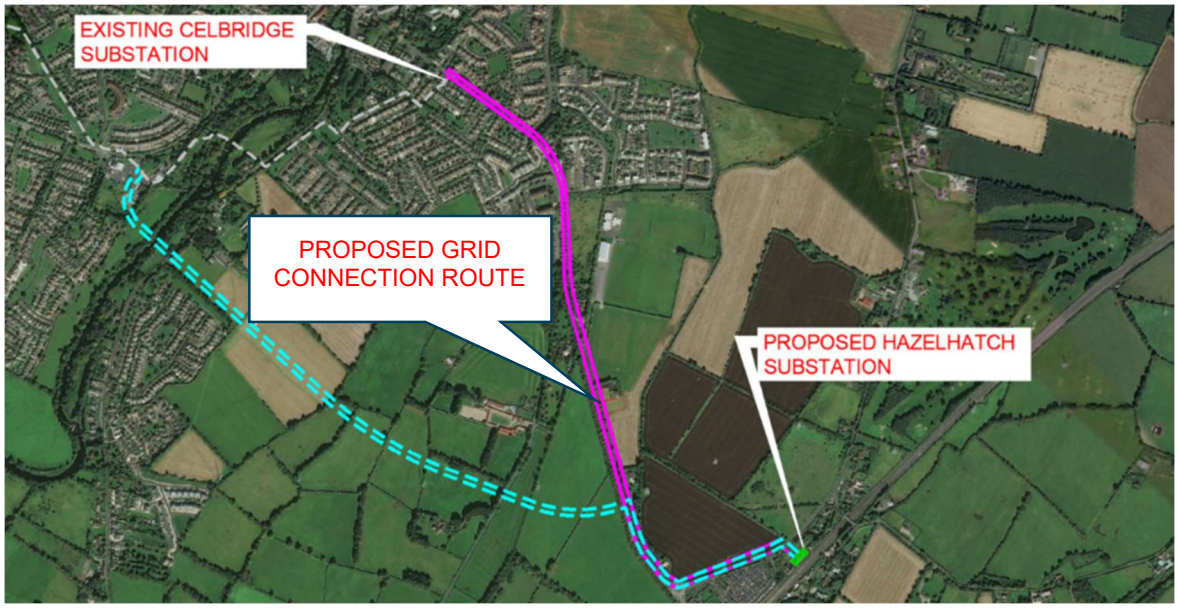

Figure 5-23 Hazelhatch Substation Proposed Grid Connection

The works will involve laying underground cables (UGC) 38kV electricity connection in the existing road. All road works involving cable require traffic management procedures when installing within public roads. Partial or temporary road closures may be required along particular sections of the cable route.

The traffic management plan and corresponding works will be carried out in consultation with the local authority. These will be typically daytime works that are transient in nature and temporary as they move along the road network.

5.3.5.2. Adamstown Substation

The Adamstown substation is located in a green field site currently in CIÉ ownership. It is located to the south of the railway (Refer to Figure 5-24 and Figure 5-25).

There is an existing service road that runs adjacent / parallel to the railway providing an established access route between the proposed site and the public road network to the west. Currently this service road does not have any physical separation from the live railway. This track will require the installation of fencing along the access track to effectively separate it from the permanent way.

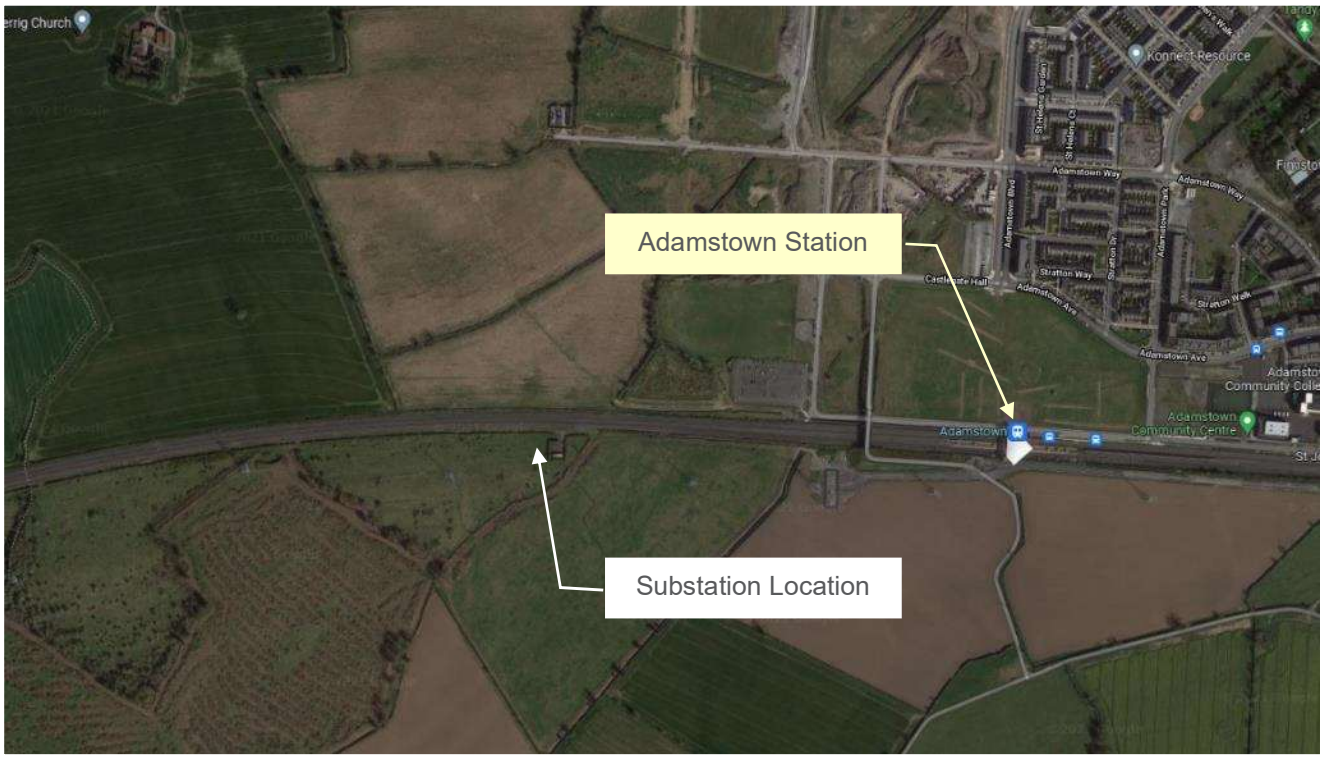

Figure 5-24 Adamstown Proposed Substation Location

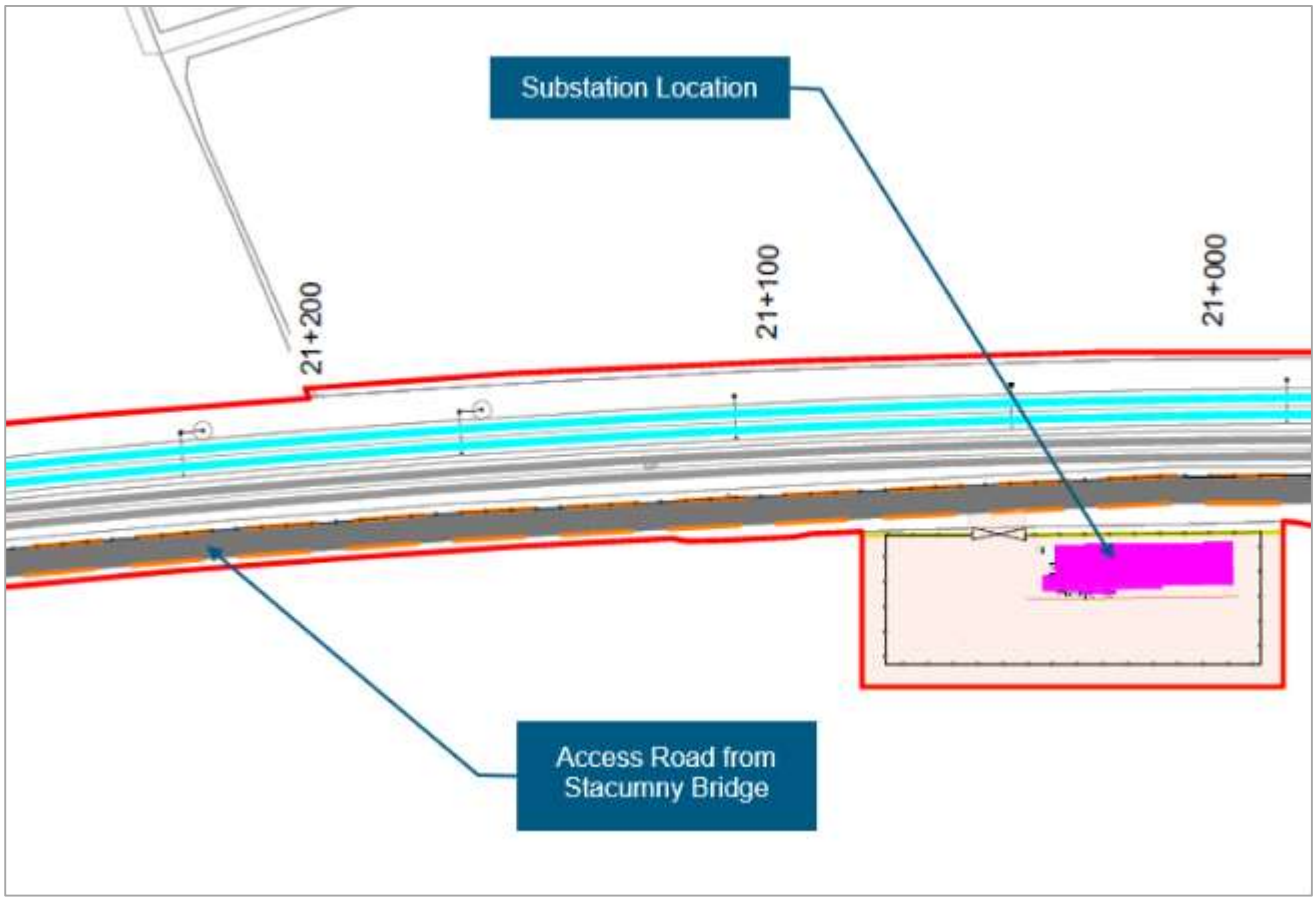

Figure 5-25 Indicative Adamstown Substation Layout

5.3.5.2.1. Adamstown Substation Grid Connection

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.

The route (beginning at the connection point to existing 38kV) will run westwards along Thomas Omer Way and Station Road. It will also cross private green field lands and run along the northern railway boundary. Figure 5-26 below shows the proposed route.

Figure 5-26 Adamstown Substation Proposed Grid Connection

The works will involve laying underground cables (UGC) 38kV electricity connection in the existing road and across greenfield sites. All road works involving cable require traffic management procedures when installing within public roads. Partial or temporary road closures may be required along particular sections of the cable route. The traffic management plan and corresponding works will be carried out in consultation with the local authority. These will be typically daytime works that are transient in nature and temporary as they move along the road network.

A horizontal direction drill will be required to cross below the railway (UTX) to complete the route into the proposed substation.

5.3.5.3. Kishoge Substation

The Kishoge substation is located on the northern boundary of the railway corridor approximately 350m to the west of the R138 road bridge, nestled between the existing road (Thomas Omer Way) and the railway (Refer to Figure 5-27 and Figure 5-28).

This is a brown field site currently within the 280 hectares Clonburris Strategic Development Zone. Following consultation with South Dublin County Council, the selected site is to the west of the future Kishoge Urban Centre.

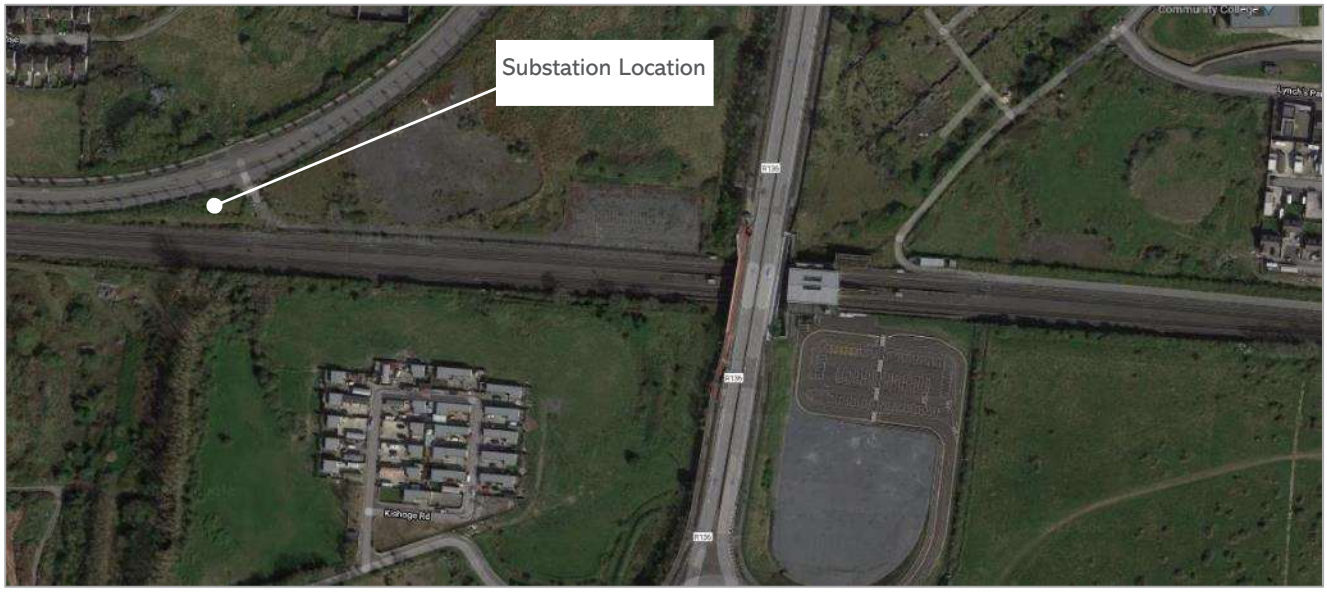

Figure 5-27 Kishoge Proposed Substation Location

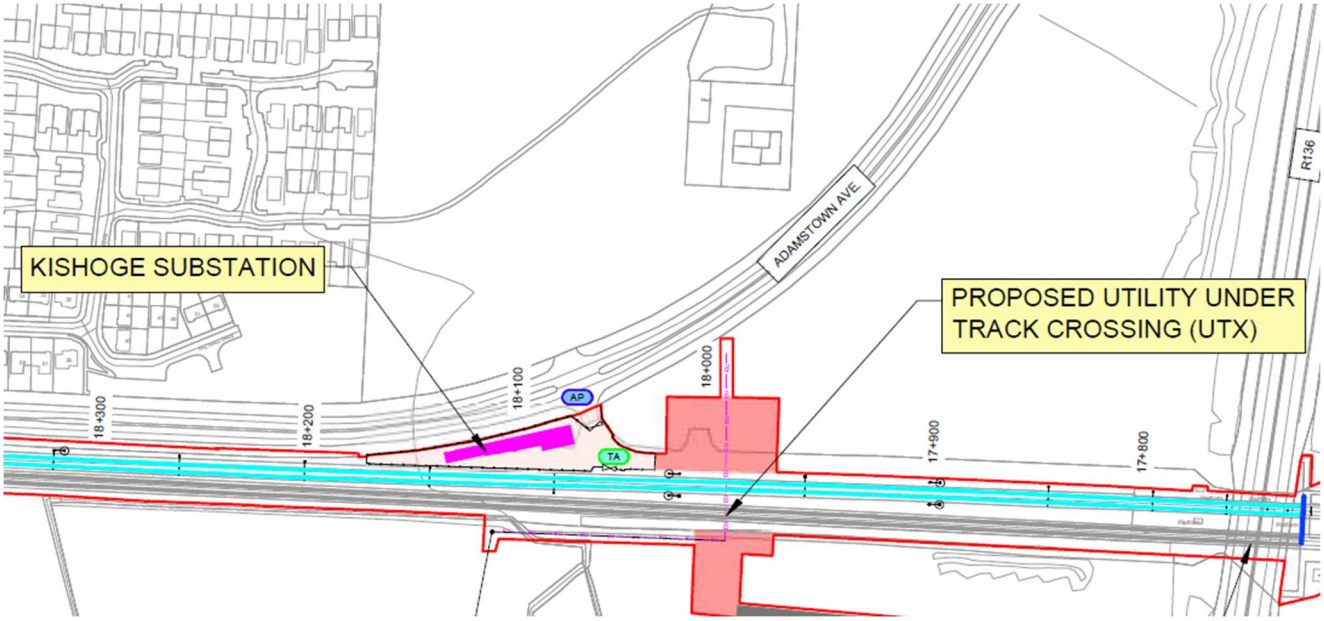

Figure 5-28 Indicative Kishoge Substation Layout

5.3.5.3.1. Kishoge Substation Grid Connection

It is proposed that the required 38kV supply connections will be made by intercepting 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 as outlined in Figure 5-29.

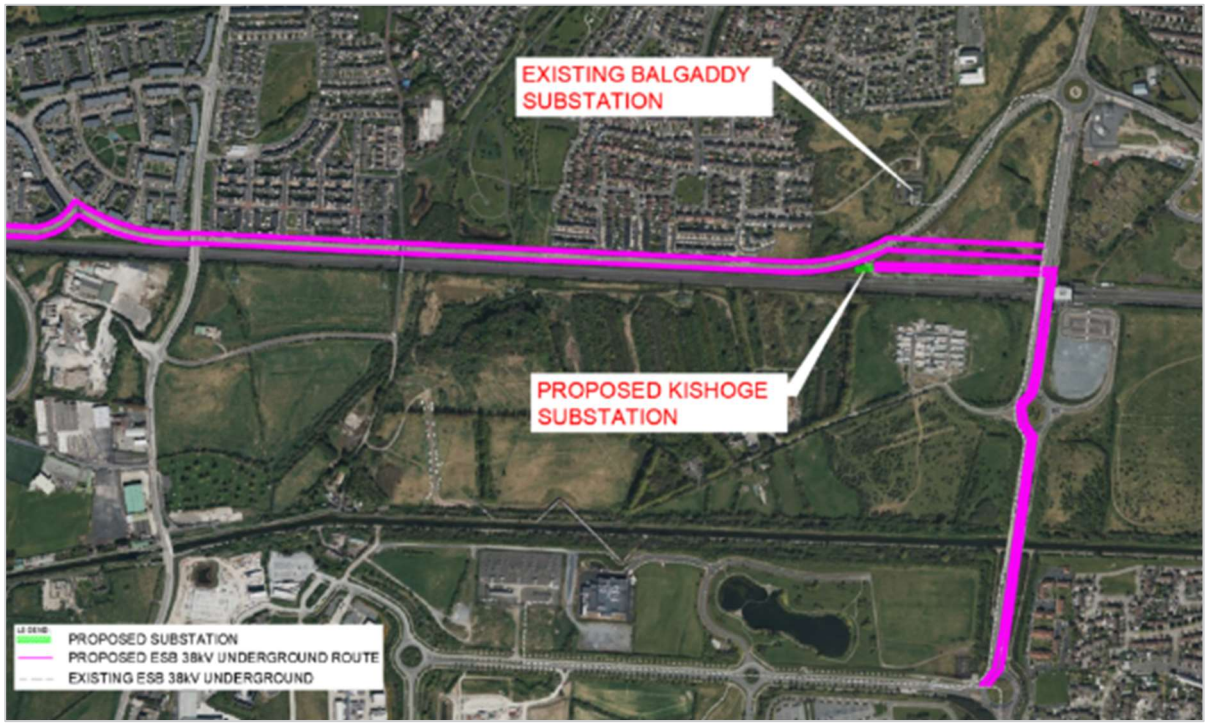

Figure 5-29 Kishoge Substation Proposed Grid Connection

The works will involve laying underground cables (UGC) 38kV electricity connection in the existing road. All road works involving cable require traffic management procedures when installing within public roads. Partial or temporary road closures may be required along particular sections of the cable route.

The traffic management plan and corresponding works will be carried out in consultation with the local authority. These will be typically daytime works that are transient in nature and temporary as they move along the road network.

5.3.5.4. Park West Substation

The Park West substation is located 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 & Cherry Orchard Station is located to the east and existing housing developments in the Cherry Orchard area are located further east of Park West Avenue (Refer to Figure 5-30 and Figure 5-31).

The area around the substation 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*".

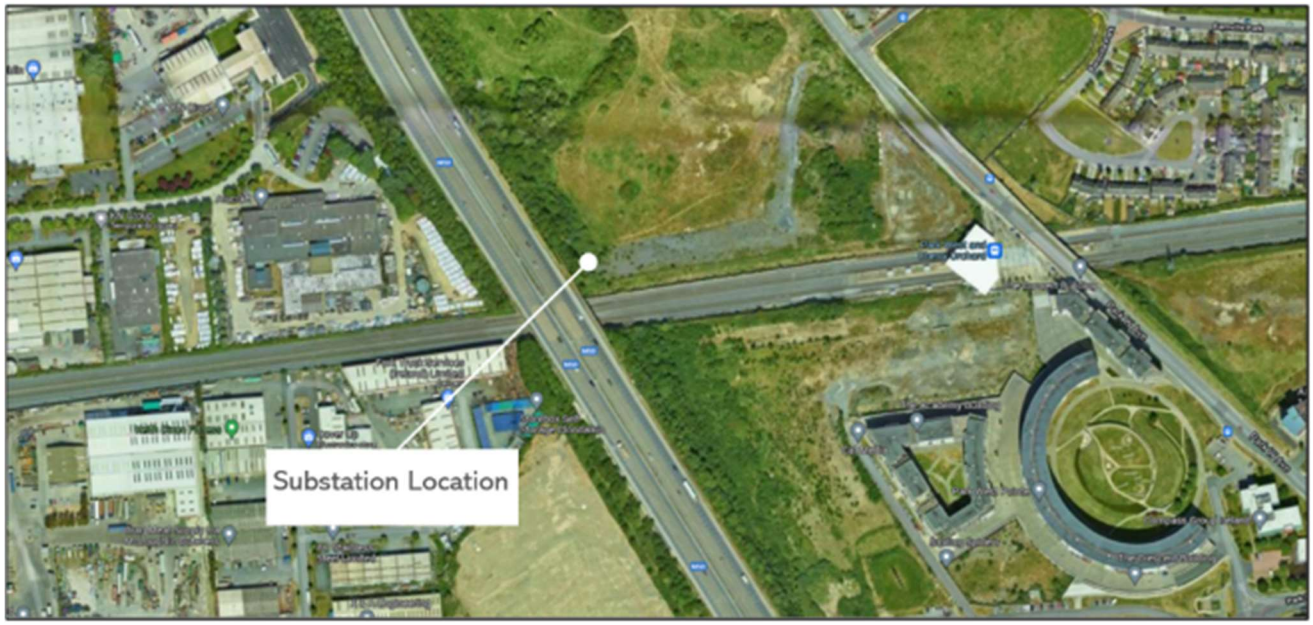

Figure 5-30 Park West Proposed Substation Location

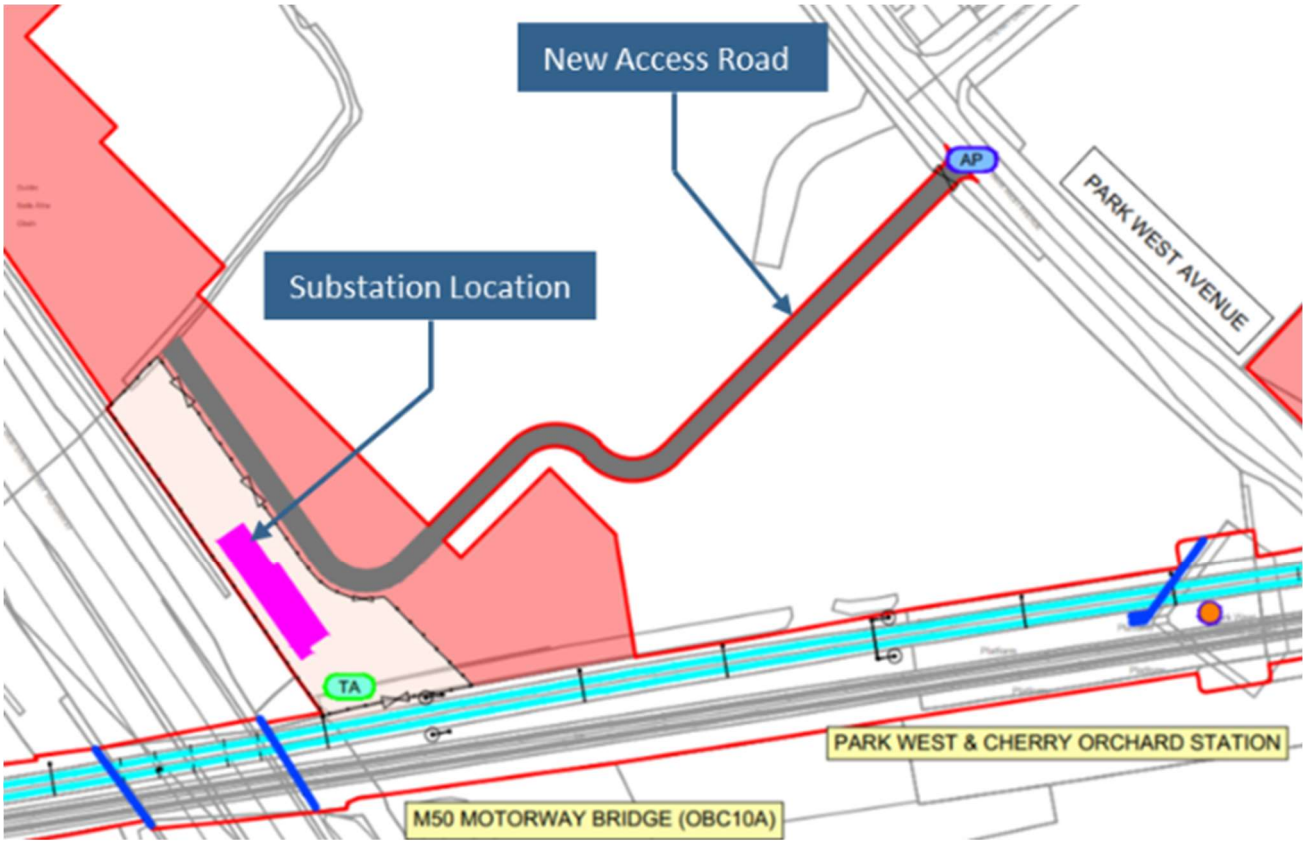

Figure 5-31 Indicative Park West Substation Layout

5.3.5.4.1. Park West Substation Grid Connection

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.

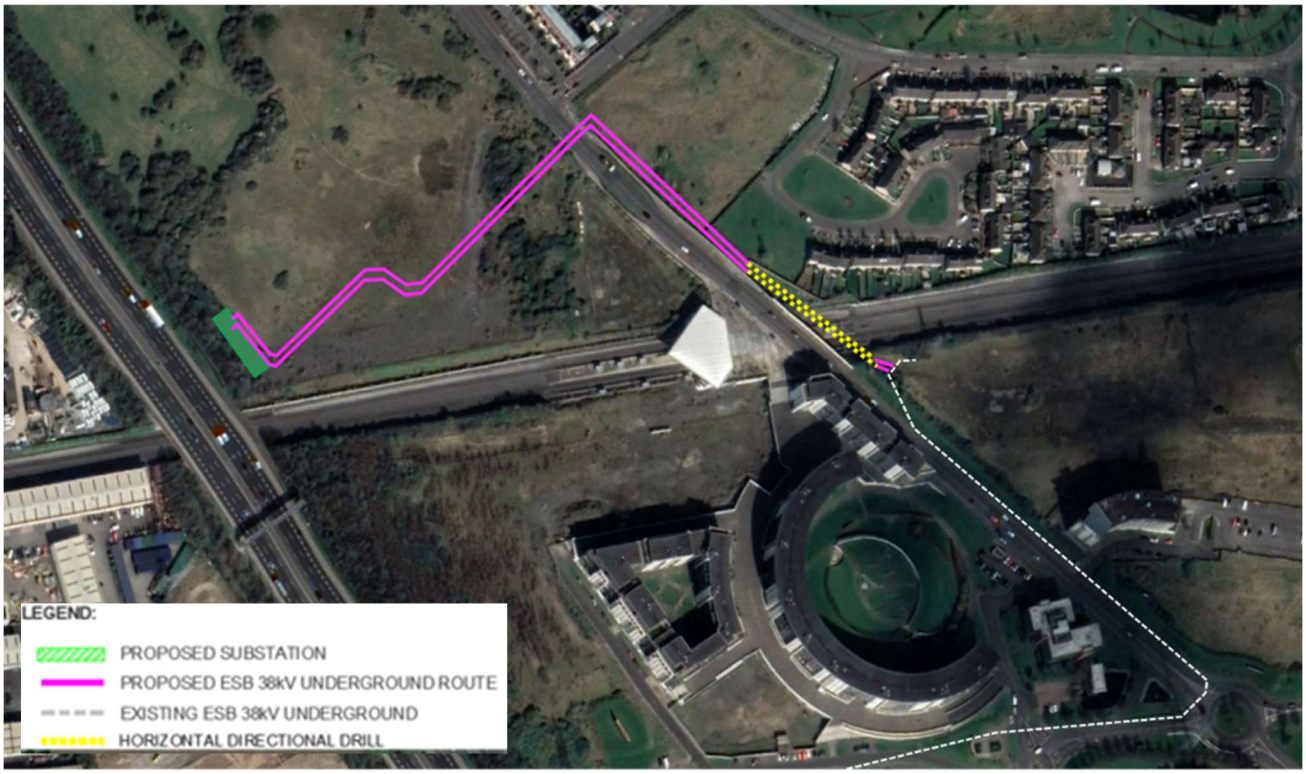

Figure 5-32 Park West Substation Proposed Grid Connection

This route would initially connect to the existing network east of Park West and Cherry Orchard Station and run northwest parallel to Park West Avenue. It would then cross Park West Avenue at the Cedar Brookway junction, enter the development lands and run southwest perpendicular to Park West Avenue through the development lands to the new substation site. The route through the lands follows a route based on a current concept design development layout proposal provided by Dublin City Council. The route is as outlined in Figure 5-32.

This route would interact with existing underground services running parallel and perpendicular to the public road, and it is likely that the work for this route would require temporary traffic management where located within or crossing public roads to facilitate installation of ducting.

5.3.6. Utility Diversions

5.3.7. ESB

Proposed diversions in this area involves ESB cables. There are several instances of ESB overhead cables crossing the tracks, ranging from low and medium voltage distribution lines (LV and MV) to high voltage transmission lines (HV). There are four overhead ESB services that will require diversions (one LV and three MV). These existing overhead lines cross the tracks resulting in inadequate clearances to the proposed OHLE system. All four diversions will comprise of a horizontal direction drill (HDD) solution, which consists of a drilled bore beneath the tracks that will facilitate underground cables to cross the tracks without interfering with the OHLE. The underground cables will then transition to overhead on either side of the tracks and follow the same arrangement as existing.

5.3.8. Temporary Traffic Management

There are no major traffic diversions anticipated in construction Zone A. Where parapet enhancement works are proposed these will be under temporary lane occupation (reductions or closures) and in accordance with Part 8 of the Traffic Signs Manual.

5.3.9. Construction Compounds

Several construction compounds or worksites will also be required along this section of the route.

5.3.9.1. Hazelhatch Construction Compounds

A construction compound will be established at Hazelhatch for undertaking the construction of the new electrical substation, electrification works along the corridor, in addition to localised works including the installation of new trackwork to facilitate the turnback of trains at the station. The proposed location for the site is on the north side of the corridor. It is proposed to locate the compound on CIÉ property to the east of the main station car park as outlined in Figure 5-33. There are currently three disused dwellings on the site, this area is also proposed for the new electrical substation.

The Compound will include:

- Compound facilities: Site offices, welfare facilities, laydown, security, car park.
- Compound access to main road network: Access would be achieved via Loughlinstown Road, Hazelhatch Road to M4.

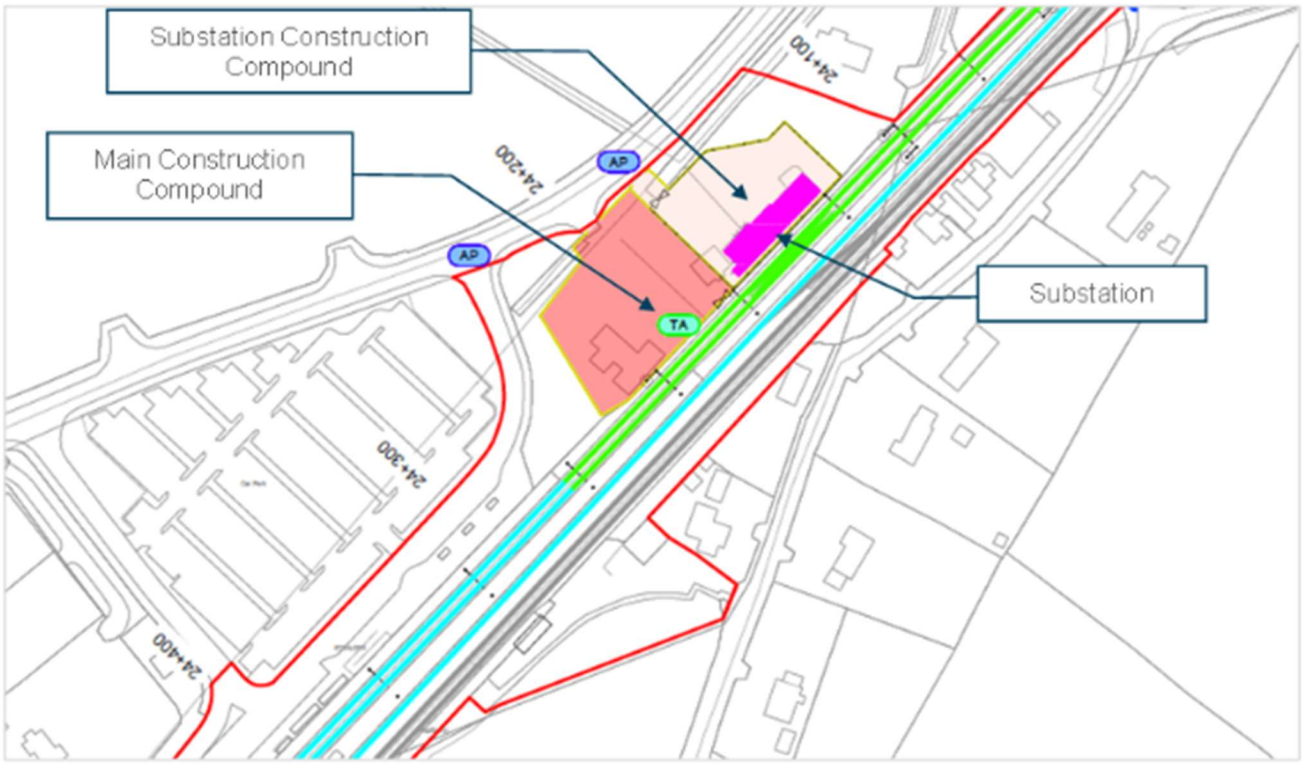

Figure 5-33 Hazelhatch Proposed Construction Compound Location (East)

Another construction compound is required to the west of the Hazelhatch Station, it will be accessed from the Lords Road via an existing access track as outlined in Figure 5-34. The area is currently used for track maintenance.

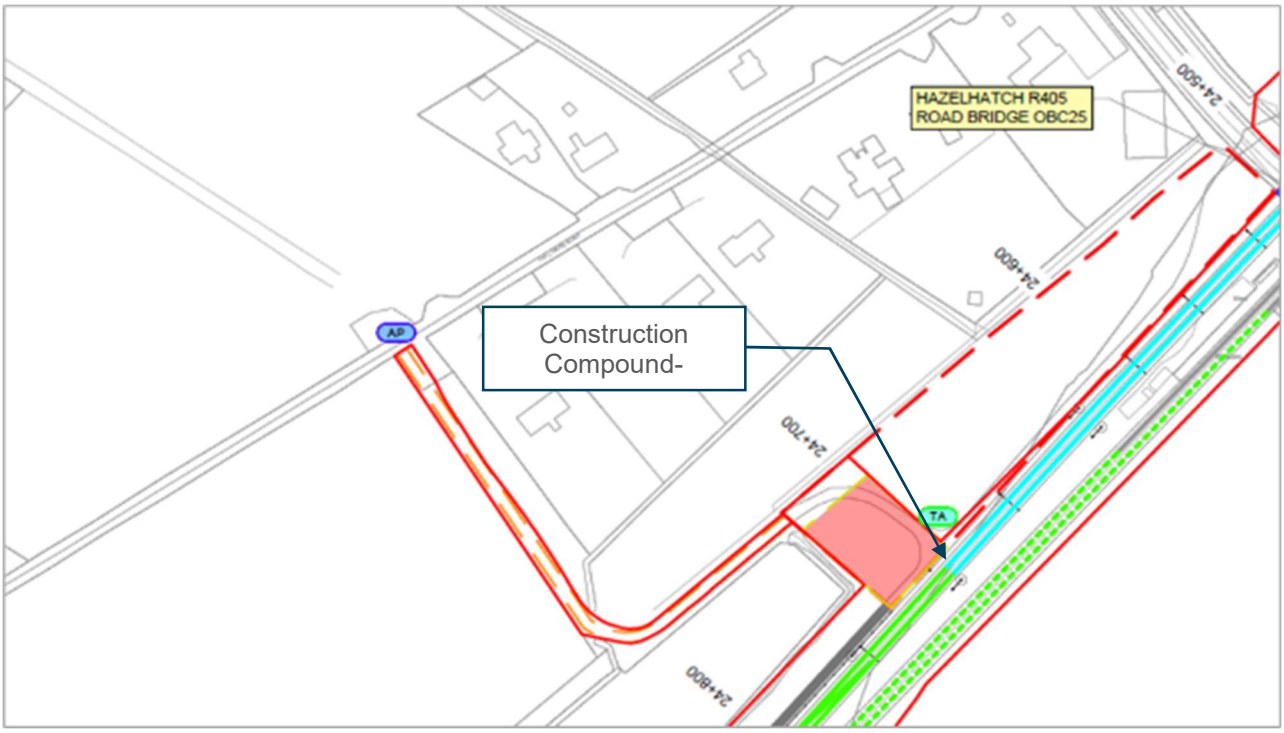

Figure 5-34 Hazelhatch Proposed Construction Compound Location (West)

5.3.9.2. Loughlinstown Road Construction Compounds

Two small temporary construction compounds (approx. Ch 23+650) are required to facilitate the diversion of an existing overhead power cable, the service will be diverted under the tracks, launch pits will be required on either side of the track to facilitate the directional drilling. A temporary access route will be required across Elm Hall Golf Club, access will be from Loughlinstown Road. A second temporary access route to the south of the rail corridor is also required, a temporary access route across farmlands from the end of an existing CIÉ track maintenance road which is accessed from Stacumny Lane.

5.3.9.3. Stacumny Construction Compounds

Two small temporary construction compounds (approx. Ch 22+550) adjacent to Stacumny Bridge (OBC21) are required to facilitate the diversion of an existing overhead power cable, the service will be diverted under the tracks. Launch pits will be required on either side of the track to facilitate the directional drilling. The sites will be accessed from Stacumny Lane via existing access points.

5.3.9.4. Adamstown Substation Construction Compound

A construction compound is required to facilitate the construction of the new Adamstown Substation. Access to the site will be via the existing CIÉ maintenance road from the existing gated access off Stacumny Lane. Works will include fencing / hoarding, site offices, welfare facilities, storage facilities, workshops, as well as storage of certain construction plant and equipment required to carry out the works.

5.3.9.5. Finnstown Construction Compounds

Two small temporary construction compounds (approx. Ch 19+500) are required to facilitate the diversion of an existing overhead power cable, the service will be diverted under the tracks, launch pits will be required on either side of the track to facilitate the directional drilling. The southern launch site will be accessed via the existing private gravel access road, adjacent to the Lucan /Sarsfield GAA Club off the R120. The northern launch site will be accessed from Adamstown Avenue.

5.3.9.6. Kishoge Construction Compounds

A construction compound is required to facilitate the construction of the new Kishoge Substation. Access to the site will be from Adamstown Avenue. Works will include fencing / hoarding, site offices, welfare facilities, storage facilities, workshops, as well as storage of certain construction plant and equipment required to carry out the works. The compound will also include a track access point to support adjacent track electrification works as well as provide for the diversion works associated with the existing overhead power cables.

Two small temporary construction compounds (approx. Ch 18+000) are required to facilitate the diversion of an existing overhead power cable as outlined in Figure 5-35. The service will be diverted under the tracks, launch pits will be required on either side of the track to facilitate the directional drilling. The compound to the south of the rail corridor will be accessed from Kishoge Road (from R136), via an existing gravel road track.

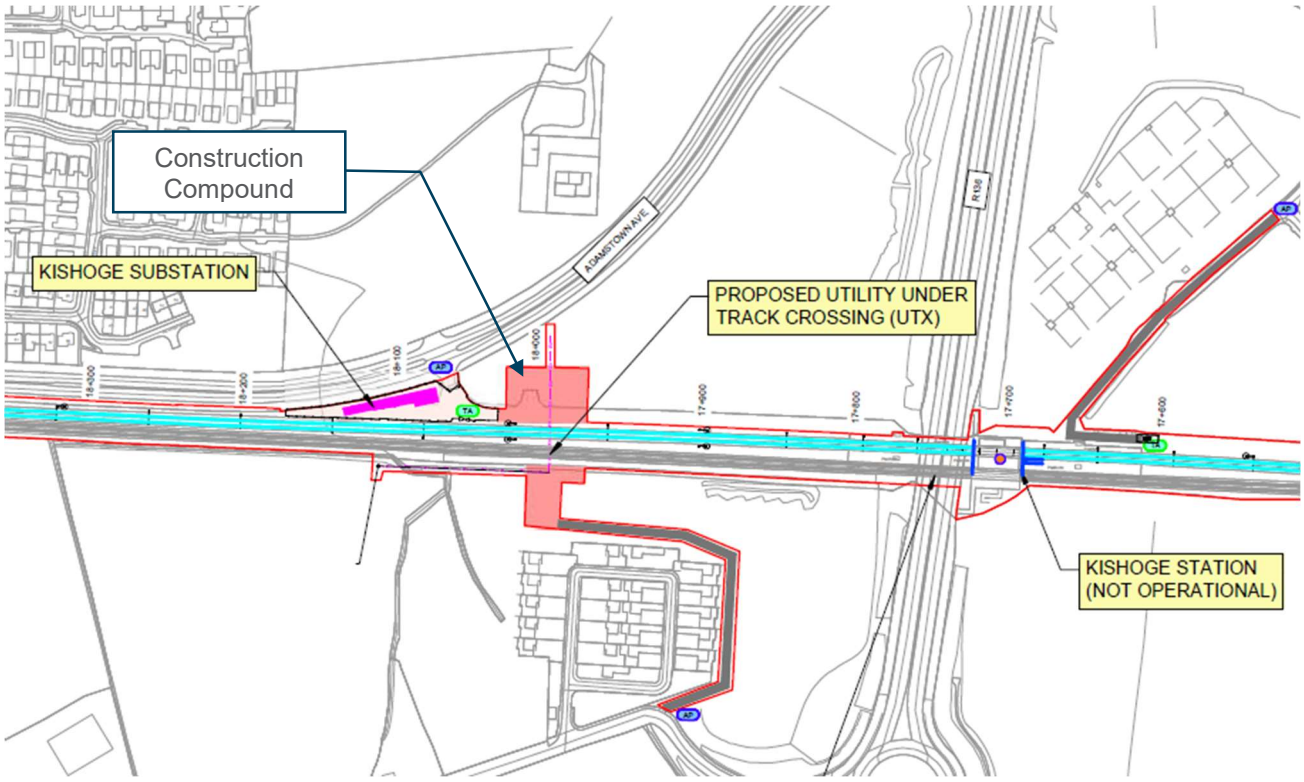

Figure 5-35 Kishoge Proposed Construction Compounds

5.3.9.7. Cloverhill Road Construction Compound

Establishment of a temporary construction compound is required on the site of a previous track construction compound on CIÉ lands (approx. Ch 15+500); with access from an existing site access

point on Cloverhill Road as outlined in Figure 5-36. Works will include fencing / hoarding, site offices, welfare facilities, storage facilities, workshops, as well as storage of certain construction plant and equipment required to carry out the works.

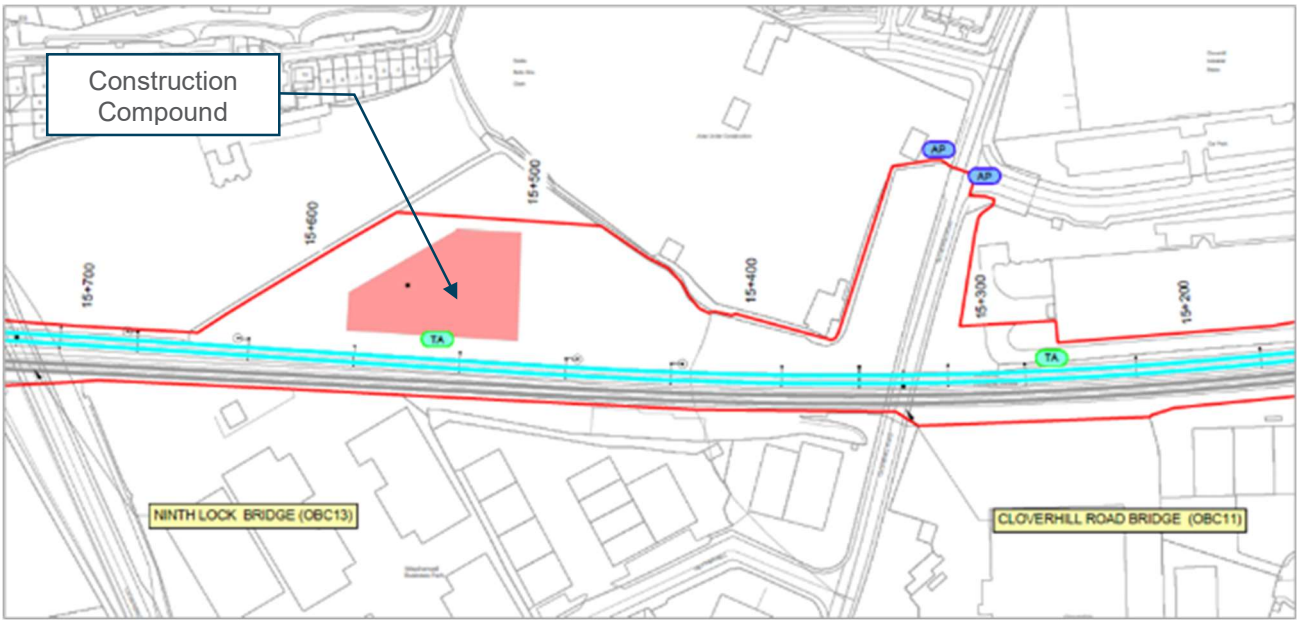

Figure 5-36 Cloverhill Road Construction Compound

5.3.9.8. Park West Construction Compound

A construction compound is required at Park West to facilitate the electrification works and the construction of a new electrical substation as outlined in Figure 5-37. The compound is proposed at 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 & Cherry Orchard Station is located to the east and existing housing developments in the Cherry Orchard area are located further east of Park West Avenue. The construction compound will also be used to facilitate the construction of the new electrical substation at Park West.

The Compound will include:

- Compound facilities: Site offices, welfare facilities, medical and training facility, fabrication warehouse, material lay down and storage, security, car park.
- Compound access to main road network: Access will be via Park West Avenue, new Nangor Road to Naas Road.

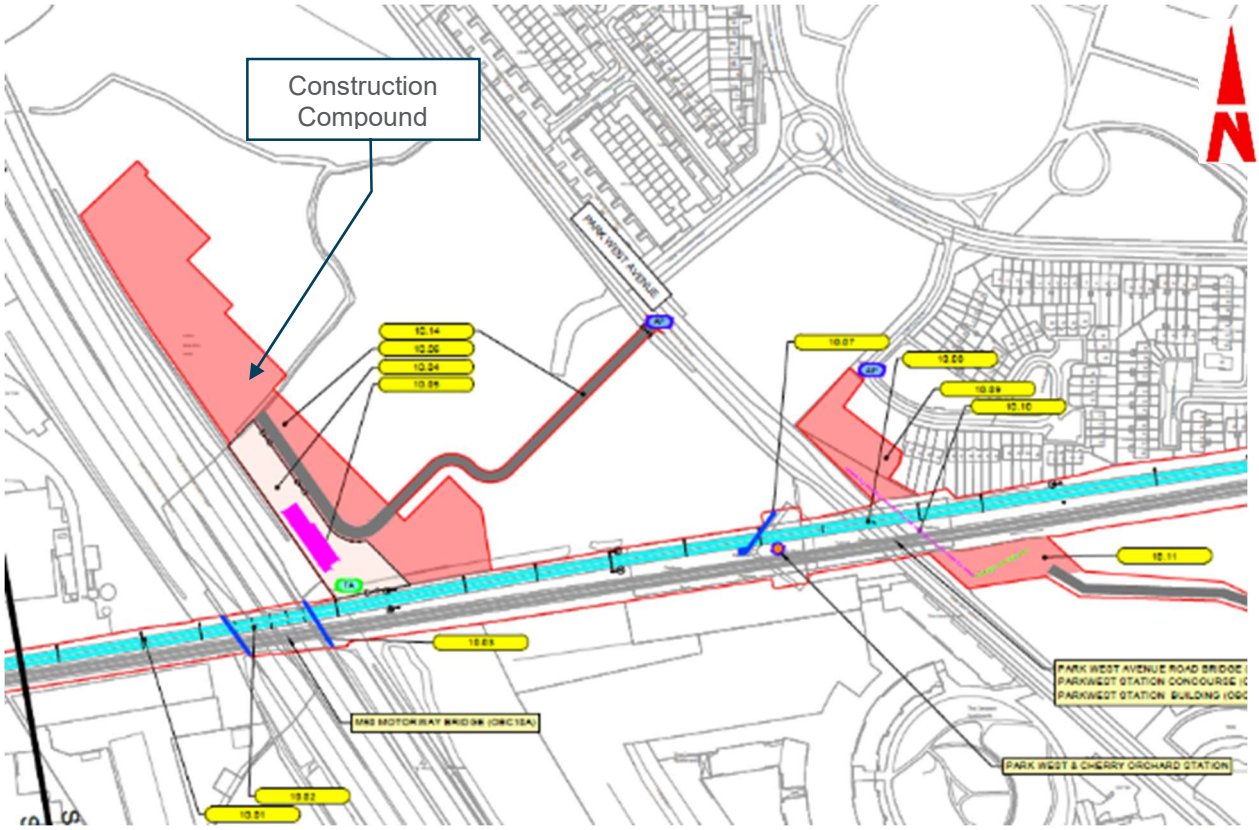

Figure 5-37 Park West Proposed Construction Compound Location

Two additional small temporary construction compounds (approx. Ch 14+200) are required to the east of Park West Avenue. The compounds are required to facilitate the diversion of an existing overhead power cable, the service will be diverted under the tracks, launch pits will be required on either side of the track to facilitate the directional drilling. The northern compound will be accessed from a public open space located between Barnville Park Road and Park West Avenue.

The compound located to the south of the rail corridor will be accessed via an existing gravel access track from Park West Road.

5.3.10. Haul Routes

5.3.10.1. External Haul Routes

The external haul routes required to facilitate construction across Zone A includes construction sub-zones A-1 to B-1 (as previously referred to in Section 5.2.9).

Zones A-1 to A-3: Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station

Works in Zone A includes some localised trackwork (mainly in Hazelhatch & Celbridge Station), including the longest section of electrification works, minor parapet improvement works and the construction of four substations. The construction traffic volumes will be low relative to the current traffic volumes and as such restricted haul roads have not been identified. HGV's will be governed by the prevailing road signage and constraints on access in Zone A. The track access points are all existing and appropriate temporary signage will be in place during construction to highlight increased

frequency of access and other relevant construction signage. The external haul routes are shown in Figure 5-38 to Figure 5-40.

Figure 5-38 Construction Zone A-1: External Haul Routes

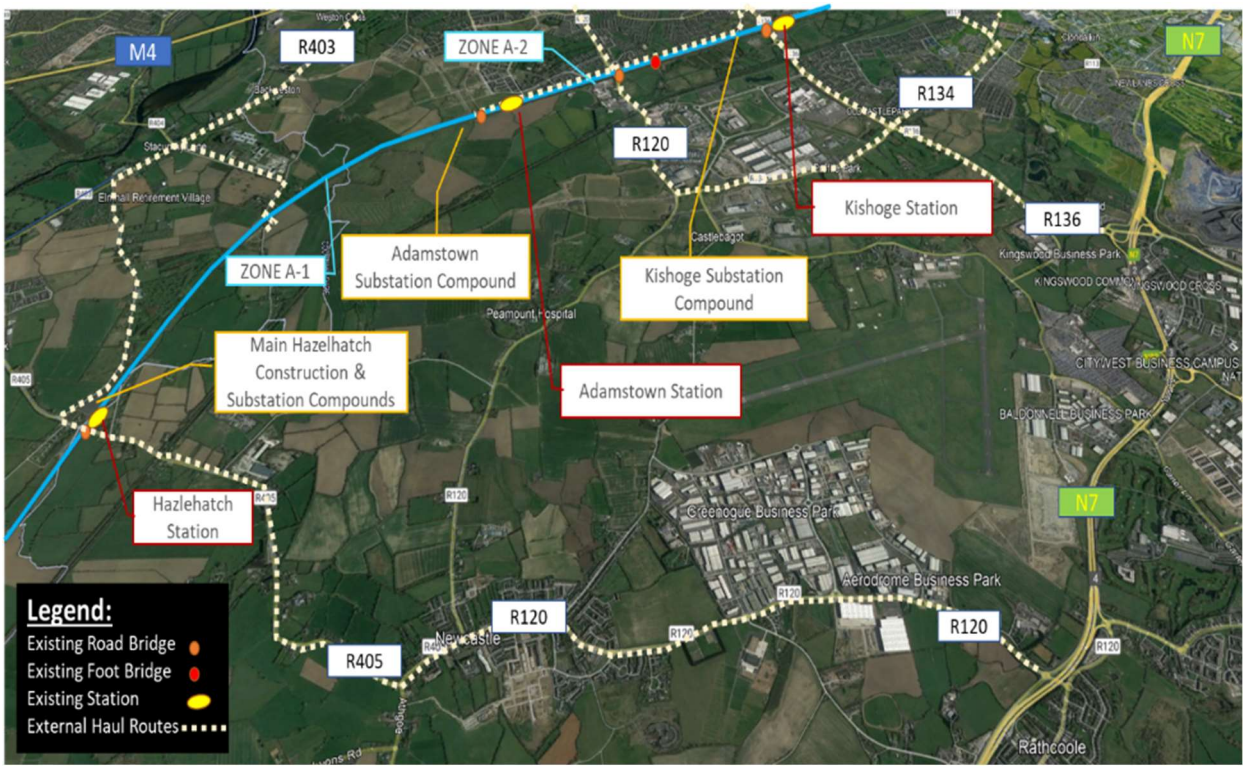

Figure 5-39 Construction Zones A-1 & A-2: External Haul Routes

Figure 5-40 Construction Zones A-1, A-2 & A-3: External Haul Routes

Zone B-1: Park West & Cherry Orchard Station to Le Fanu Road Bridge (incl. Le Fanu Road)

Works in this sub-zone include minor works at Park West & Cherry Orchard Station, track electrification. The increased construction traffic volumes will be low relative to the current traffic and as such restricted haul roads have not been identified. HGV's will be governed by the prevailing road signage and constraints on the access routes in this Zone. The track access points are all existing and appropriate temporary signage will be in place during construction to highlight increased frequency of access and other relevant construction signage. The external haul routes are shown in Figure 5-41.

Figure 5-41 Construction Zone B: External Haul Routes

5.3.10.2. Site Haul Routes

Materials delivery and plant will be predominantly track based for what is mainly OHLE installation works within Zone A. Existing track access points will be utilised in the main with temporary track access proposed.

5.3.11. Attenuation and Pumping Requirements

There are no attenuation tanks or pumping stations proposed in Zone A.

5.4. Description of Construction Works in Zone B – Park West & Cherry Orchard Station to Heuston Station

5.4.1. Overview of the Works

Between Park West & Cherry Orchard Station and Heuston Station the railway corridor has to be widened to accommodate the additional two tracks for the new DART+ service. Given the complexity of the design in this zone the descriptions to follow have been sub-divided into five sub-zones for ease of descriptions.

The sub-zones are shown below and is illustrated in Figure 5-42:

- Between Park West and Le Fanu Bridge (B-1)
- Between Le Fanu Bridge and Kylemore Road (B-2)
- Between Kylemore and Sarsfield Road Underbridge (B-3)
- Between Sarsfield Road Underbridge and Memorial Road (B-4)
- Between Memorial Road and South Circular Road Junction (B-4)

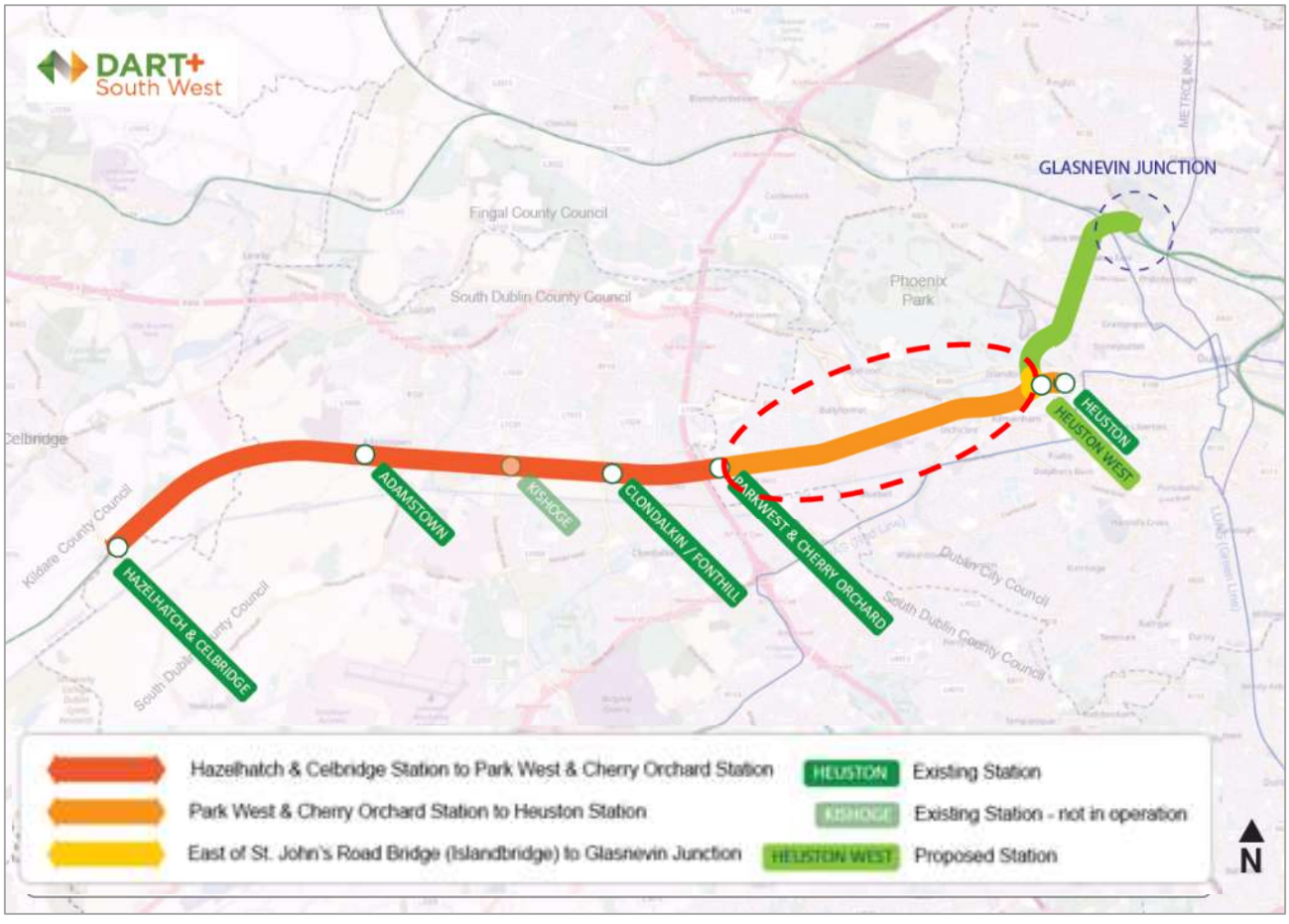

Figure 5-42 Construction Zone 2 Park West to Heuston Station

5.4.2. Works between Park West and Le Fanu Road Bridge

5.4.2.1. Modification to Bridges

The existing Le Fanu Road Bridge (OBC7) is a single span masonry arch bridge carrying a narrow two lane road with substandard road geometry both vertically and horizontally. It cannot accommodate the rail corridor widening works and needs to be replaced. The proposed bridge solution is a single span beam and slab bridge on piled or bankseat abutment walls.

Following the installation of a temporary bridge for vulnerable users, the demolition of the bridge will commence. The abutment walls will be constructed in safe zones on either side of the existing bridge; with the northern side being constructed during the day and the southern side requiring night works for up to two weeks. Beams, slab concreting and parapets will then be placed during night-time possessions.

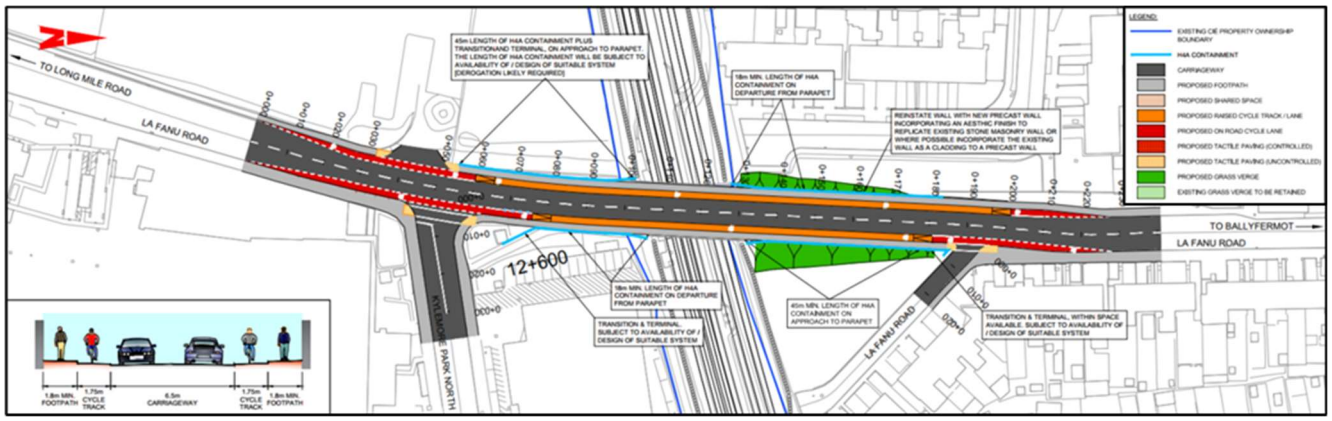

Figure 5-43 Le Fanu Road Bridge Works

New parapets which meet current containment standard for bridges crossing railways will be provided on this new bridge. This requires the parapets to have a H4a containment level with a minimum height of 1.8m with no handrails and a 45-degree symmetrical steeple coping. This will be a full-height H4a precast concrete parapet with a masonry-type cladding finish on the roadside face to be in keeping with the local environment.

5.4.2.2. Modifications to Roads

Le Fanu Road reconstruction associated with Le Fanu Road Bridge (OBC7) reconstruction will require a full closure of Le Fanu Road. The approach road construction can commence as soon as bridge is demolished. The road works are not complex and can be carried out relatively unhindered between the Le Fanu Road cul-de-sac and the Le Fanu Road Bridge (OBC7). Much of the work south of the bridge will be delayed until the end of the bridge construction period to provide ease of access for bridge construction and because of the interface with the temporary vulnerable user diversion.

5.4.2.3. Modifications to Walls and Other Structures

This zone begins to the west of Le Fanu Road Bridge (Ch13+300) continuing east for 680m (approx. Ch12+620).

The proximity of the adjacent domestic and industrial/commercial properties and height of the cutting slope to be retained, necessitates a piled wall solution with the inclusion of soil nails or ground anchors, and cantilever walls along both south sides of the rail corridor, west of Le Fanu Road Bridge (OBC7).

To facilitate the widening along the northern and southern perimeters to form the northern (slow) and southern (fast) track cess edges and retain the slopes of the cutting, bored secant pile wall and king post retaining wall solutions will be adopted for this section of retaining wall.

- Northern Wall - The existing cut slope will be widened towards adjacent houses on Clover Hill Road.
- Southern Wall - The existing cut slope will be widened towards the industrial estate and currently brownfield site.

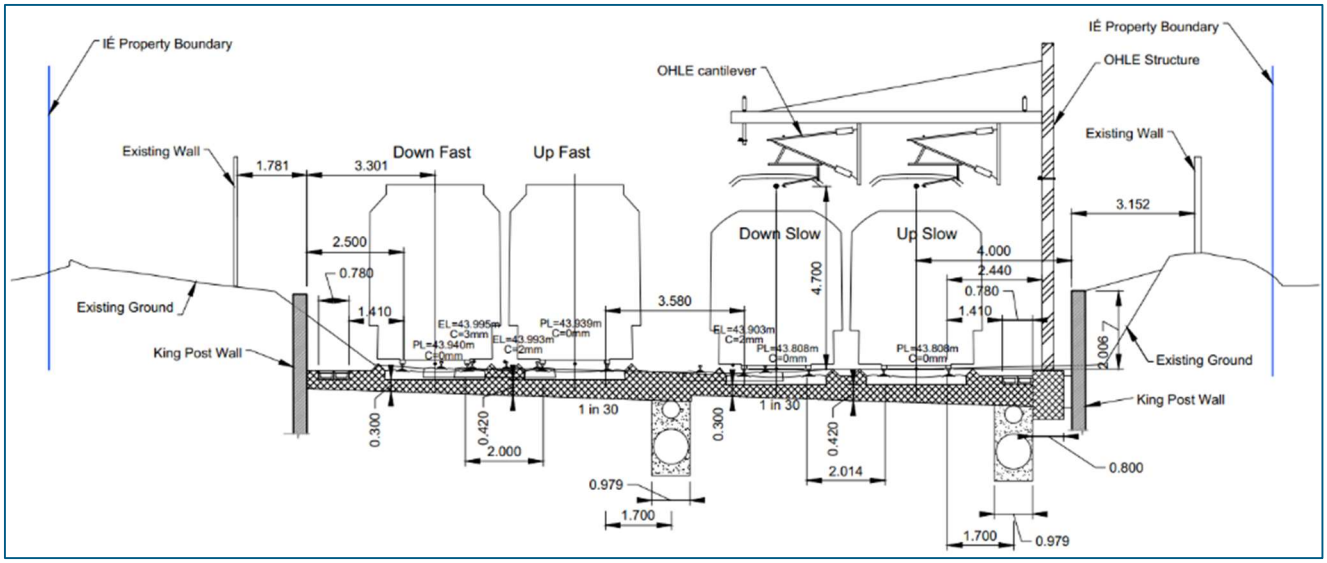

Figure 5-44 Cross Section at Ch 12+898 - West of Le Fanu Road Bridge (OBC7) - Facing West

Details of the retaining walls in Zone B are outlined in theTable 5.5 and Table 5.6. The retaining walls will be constructed utilising access from track side within CIÉ property boundary. Sections of the retaining walls will require soil anchors to provide additional stability to the retaining walls, the anchors will extend into the existing slope on both the northern and southern side of the rail corridor. In some instances, the soil anchors will extend below the CIÉ property boundary and under third party properties. The ground anchors will be installed utilising access from track side within CIÉ property.

Table 5.5: New / Replacement Retaining Walls (Northern Perimeter)

Chainage	Location	Proposed Retaining Wall	Height	New/Replaced
13+100	Rear of 18 Cherry Orchard Drive	Secant Wall	0.8m high	New
13+060 –12+660	Rear of 7 Cherry Orchard Drive to rear of 33 Cloverhill Road	King Post Wall	0.5m - 2.0m high	New
12+660 – 11+700	Rear of 33 Cloverhill Road to rear of 421 Landen Road (including Le Fanu and Kylemore Road Bridge)	Secant Wall + Secant wall anchors	2.0m - 7.2m high	New

Table 5.6: New / Replacement Retaining Walls (Southern Perimeter)

Chainage	Location	Proposed Retaining Wall	Height	New/Replaced
13+330 - 12+700	Friel Avenue	King Post Wall + Wall anchors	0.3m – 4.4m high	New

There are no building demolitions proposed in this sub-zone.

5.4.2.4. Substations

There are no sub-station sites in this sub-zone.

5.4.2.5. Utility Diversions

5.4.2.5.1. ESB

The existing overhead 38kV twin circuit south of the tracks will require a diversion to enable works for Le Fanu Road Bridge (OBC7) and retaining wall / piling works. As illustrated in Figure 5-45 below, the sections in grey show the existing electrical infrastructure to be relocated as part of the DART+ South West Project. The sections highlighted in yellow are to be relocated by a third party, the diversions are associated with a proposed new housing development.

Figure 5-45 Existing ESB Infrastructure To Be Diverted

5.4.2.5.2. Stormwater and Foul / Combined Sewers

The existing foul sewer crossing the rail corridor west of Le Fanu Road Bridge (OBC7) is currently too shallow beneath the tracks to accommodate the proposed track lowering and must be diverted to enable works in the area. The crossing to be relocated approx. 100m west to allow for retaining wall and piling works.

5.4.2.5.3. Watermain

There are two watermain pipes within the existing Le Fanu Road Bridge (OBC7). The permanent diversion will be located within the beams of the bridge. Water supply to all properties will be maintained at all times except for when flushing operations are required at the end of diversion works (usually lasting 1-2 hours).

5.4.2.6. Temporary Traffic Management

Le Fanu Road reconstruction associated with Le Fanu Road Bridge (OBC7) reconstruction will require a full closure of Le Fanu Road (Refer to Figure 5-46). A temporary pedestrian bridge is to be provided on the western side of the bridge. This will cater for all pedestrian movements across the rail line during the construction period.

During the road closure the southbound and northbound vehicular traffic is anticipated to be distributed onto the surrounding network via the Kylemore Road Bridge. Heavy Good Vehicles (HGVs) will be restricted from using Kylemore Avenue and will be required to travel via Ballyfermot Road instead. The proposed diversion routes for Light Vehicles (LVs – which include normal private home/recreational vehicles and light commercial vehicles (with gross weight of less than 3 tons) are shown in Figure 5-47 while HGVs (greater than 3.5 tons) traffic diversion routes are shown in Figure 5-48.

To cater for the additional traffic volumes, it is anticipated that temporary traffic signals will be required at existing priority junctions at Kylemore Road and Kylemore Avenue and at Kylemore Park Road and Le Fanu Road as shown on Figure 5-49.

The piled wall directly below the temporary vulnerable user bridge will be constructed in advance of the temporary bridge and vulnerable user route. Overall pedestrian and cycling connectivity will be

maintained throughout the closure period and, as a result, it is expected to maintain a high level of service. No bus routes are known to utilise Le Fanu Road and will therefore not require any diversions.

Vehicular users are anticipated to experience initial congestion at the start of the closure, followed by a gradual decrease in total vehicle volumes and congestion, owing to the lengthy duration of this closure.

Figure 5-46 Le Fanu Road Full Closure

Figure 5-47 Le Fanu Road Traffic Diversions – Light Vehicles

Figure 5-48 Le Fanu Road Traffic Diversions – Heavy Good Vehicles

Figure 5-49 Temporary Traffic Signal Locations

5.4.2.7. Construction Compounds

Several construction compounds are required in the zone between Park West and Le Fanu Road Bridge (OBC7), the proposed locations are shown in Figure 5-50 below.

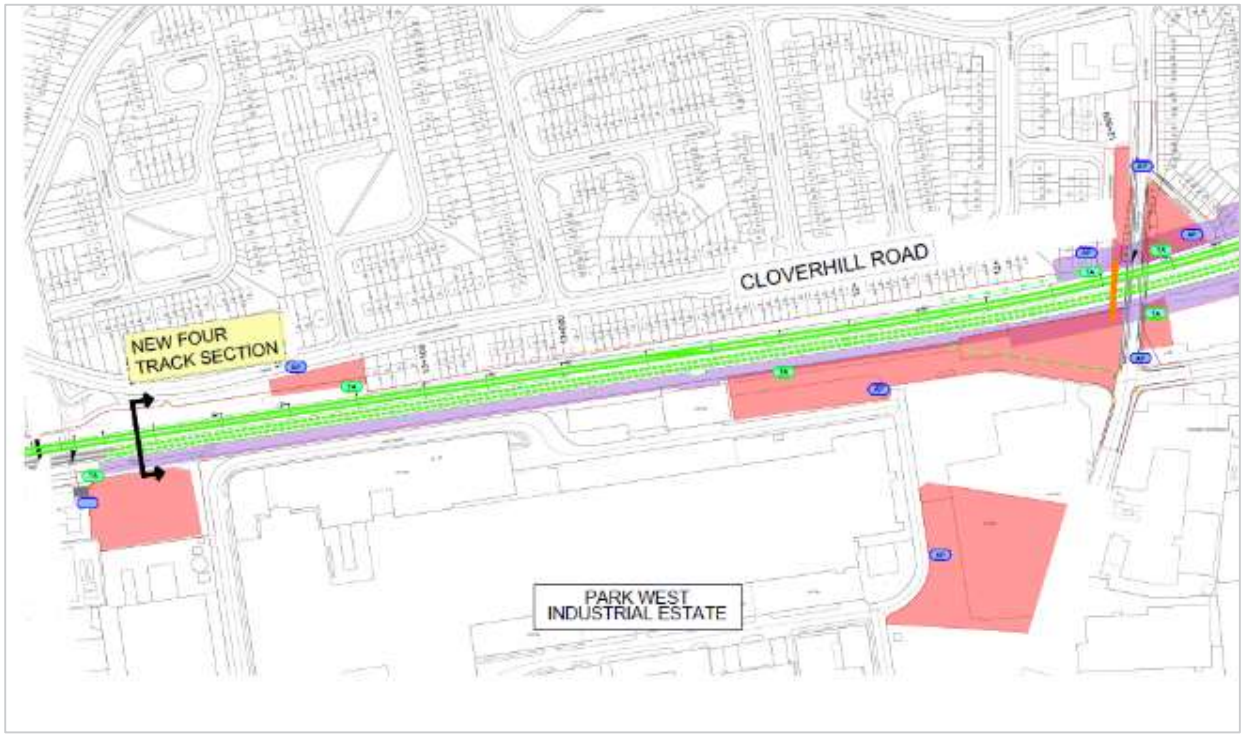

Figure 5-50 Proposed Construction Compounds Locations

5.4.2.7.1. Friel Avenue Construction Compound

The works in this area include the excavation and widening of the rail corridor. This requires a suitable construction compound on the south side of the corridor adjacent to the rail line and Friel Avenue. This compound will facilitate access to the site, transfer of materials and plant for the construction of the new retaining wall, for materials transfer and to provide the necessary support infrastructure for the works.

Access from the compound to the road network is proposed via Lavery Road. There is 2-3m difference in level between the track and the land above, with access from track proposed to the northeast of the plot but this access route will be modified as construction of the retaining walls progresses.

The site is privately owned commercial property, currently greenfield, and will need to be temporarily acquired for the duration of the works. The site will be reinstated following completion of the works.

The Compound will include:

- Compound facilities: Site offices, welfare facilities, security, car park and footpath, cranes, temporary bridge, permanent bridge, storage, laydown.
- Compound access to main road network: Access would be achieved via Lavery Road, Park West Road, Le Fanu Road, New Nangor Road to Naas Road. To provide access off Friel Avenue will require the removal and reinstatement of a 4m high gabion retaining wall to the east of the site.

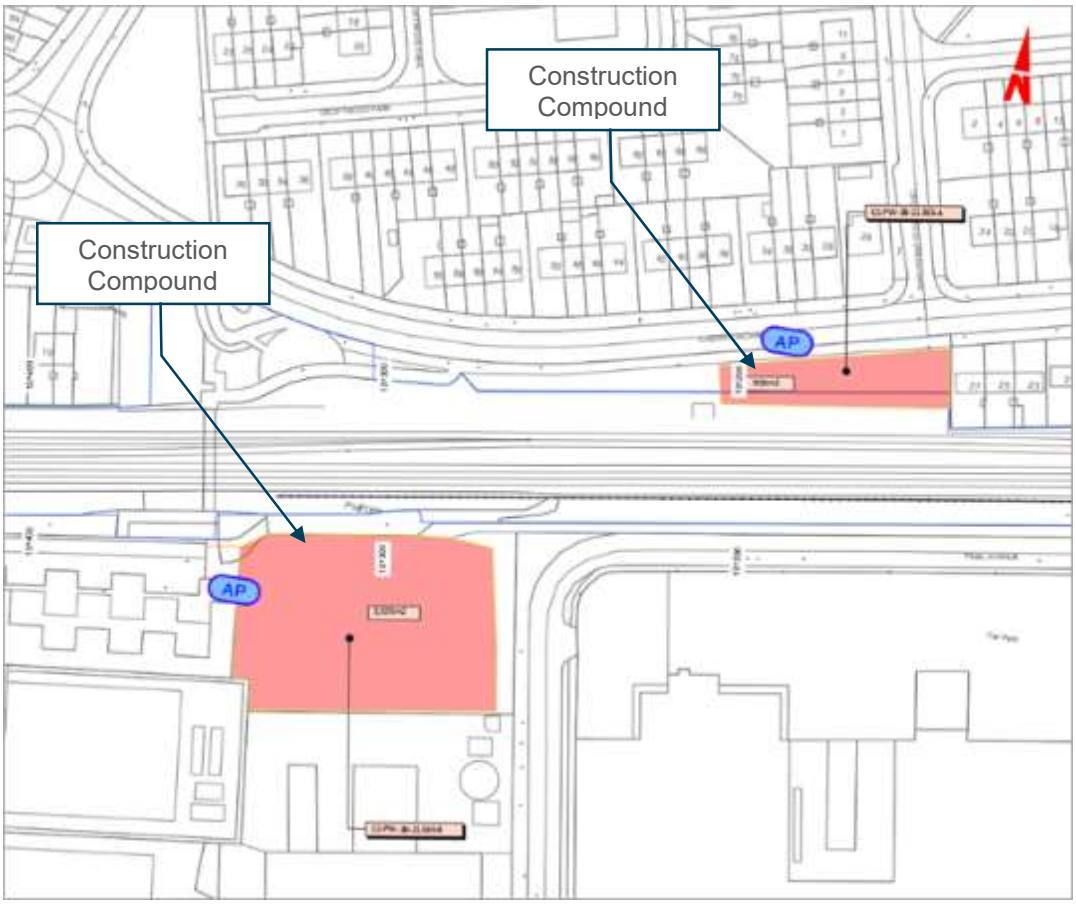

Figure 5-51 Proposed Construction Compounds –Friel Avenue & Cherry Orchard Avenue

5.4.2.7.2. Cherry Orchard Avenue Construction Compound

The works in this area include the excavation and widening of the rail corridor and to facilitate this work, a suitable construction compound is proposed on the north side of the corridor adjacent to the rail line at Cherry Orchard Avenue. This compound will facilitate access to the site, transfer of materials and plant for the construction of the new retaining wall and provide the necessary support infrastructure for the works.

Access is via Cherry Orchard Avenue, Le Fanu Road, Kylemore Road to the Chapelizod Bypass. The proposed site is currently a greenfield area with direct access to the rail corridor. The site is owned by DCC and would need to be temporarily acquired for the duration of the works.

The Compound will include site offices, welfare facilities, security, car park and footpath, storage, laydown.

5.4.2.7.3. Le Fanu Bridge Construction Compounds

There is a requirement for construction compounds at each corner of Le Fanu Road Bridge (OBC7) to facilitate the bridge reconstruction works and also to provide access to the rail corridor for construction of the new retaining wall structures (Refer to Figure 5-52).

To the northeast corner of the bridge, there is a triangular green space, and this area is required to facilitate the reconstruction works to the bridge and also the construction of the northern retaining wall between Le Fanu and Kylemore bridges. In the northwest corner an access point and transfer area will be required to facilitate construction of the wall between Le Fanu and the Cherry Orchard compound.

To the southeast, an access point and transfer area is required to facilitate construction of the walls from Le Fanu Bridge to Kylemore Bridge on the southern side. This site is located in the car park of a commercial unit and would require temporary land acquisition. There would be a potential impact on the operations of the business for the duration of the works.

The Compounds will include:

- Compound facilities: Site offices, welfare facilities, security, car park and footpath, prefabrication warehouse, cranes, material storage, workers accommodation, laydown.

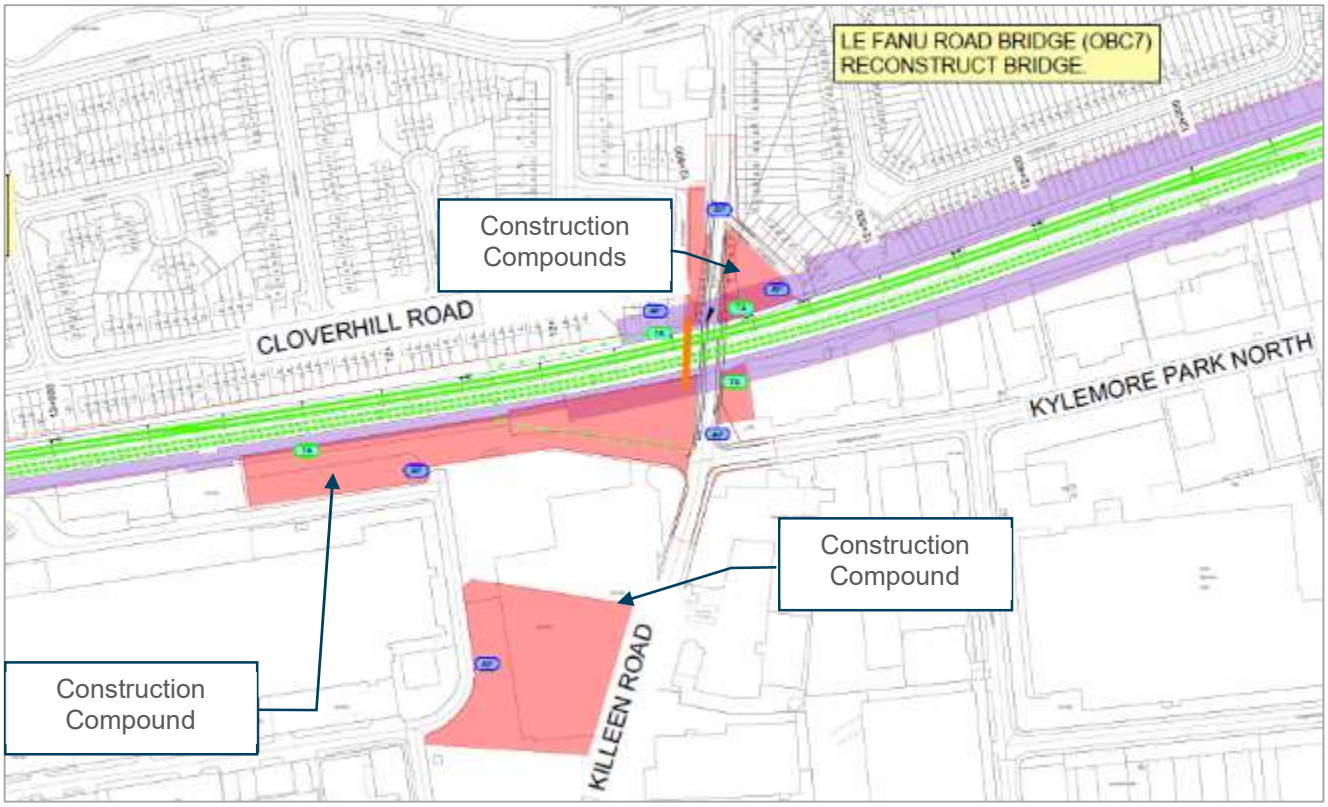

Figure 5-52 Le Fanu Bridge Construction Compounds

It is proposed to locate the contractor's main construction compound and project management office in an area adjacent to Kylemore Bridge and south of a working truck parking site. The site will accommodate offices for the contractor and client teams, storage facilities, recycling facilities, parking for cars and plant and potentially fabrication areas. The site will be fully serviced with electricity, water, sewerage and telecoms and will have good access to the public road network.

An area running along the track is also proposed to accommodate a construction compound for piling and permanent way activities. This segregates the main contractor offices from the construction works area but they remain in the immediate vicinity of each other and can be configured to have vehicular linkage. The location for the construction compound will require temporary land acquisition but it limits the requirement for temporary relocation of the existing truck parking at the site

The construction compound will include offices for the contractor and client teams, storage facilities, recycling facilities, parking for cars and plant, and potentially fabrication areas.

5.4.2.8. Haul Routes

5.4.2.8.1. External Haul Routes

External haul routes will be required in Zone B as per Figure 5-53 below and the following descriptions.

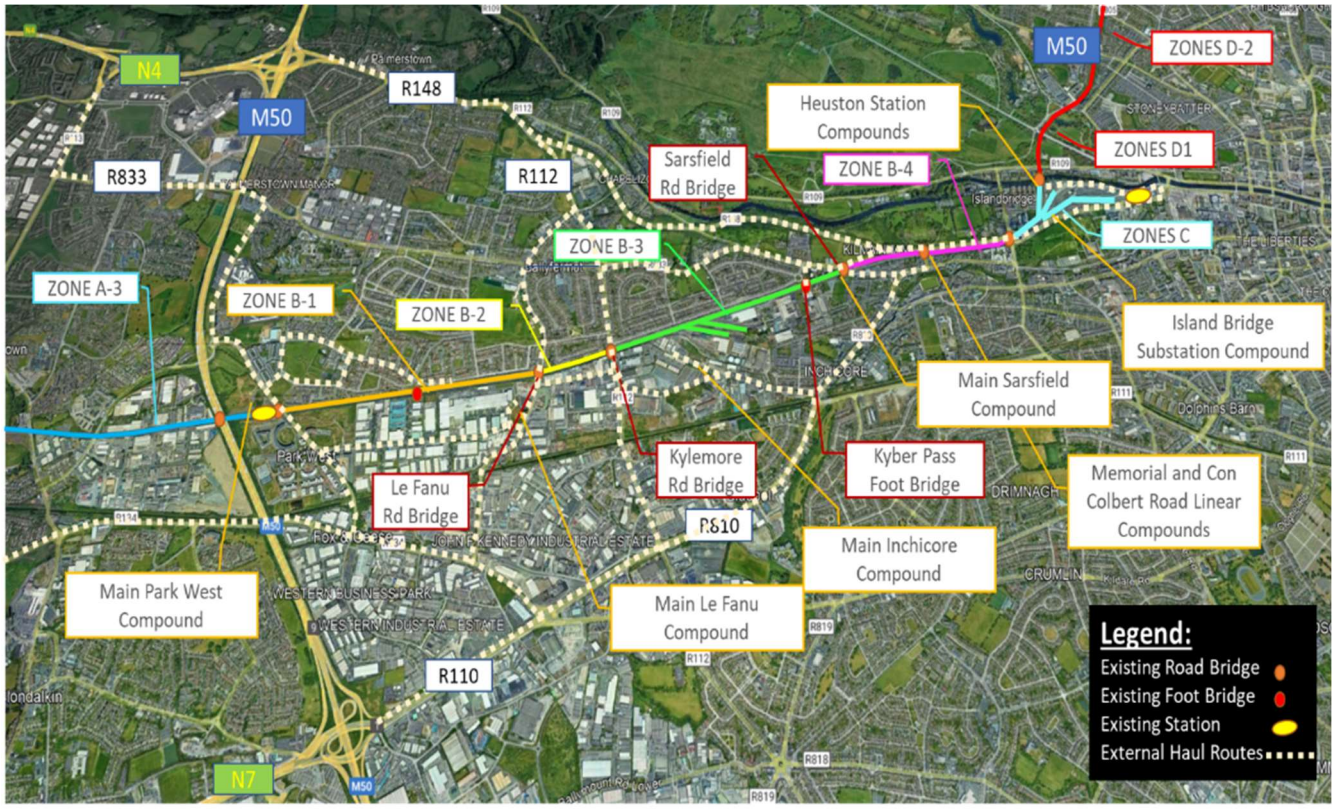

Figure 5-53 Sub-Zone B-1: External Haul Routes

Sub-Zone B-1: Park West Avenue to Le Fanu Road Bridge (incl. Le Fanu Road)

Construction traffic associated with sub-zone B-1 will typically arrive from the N4 or N7 (northern side of the railway line) as well as the N7/R110 (southern side of the railway line). The southern compounds at Friel Avenue and Lavery Road have access to main road networks with routes via Killeen Road, New Nangor Road, Naas Road to the M50; and/or Park West Road & Ave, Cloverhill Road, Cold Cut Road, Font Hill Road and finally on to N7 and N4 respectively.

The northern compounds will require the use of Cherry Orchard Avenue and Ceder Brook Way to get to Park West Avenue and continue on to Fonthill Road. The bridge and road works can also be accessed via Ballyfermot Road and on to Le Fanu Road (or vice versa). The haul routes are shown in Figure 5-54.

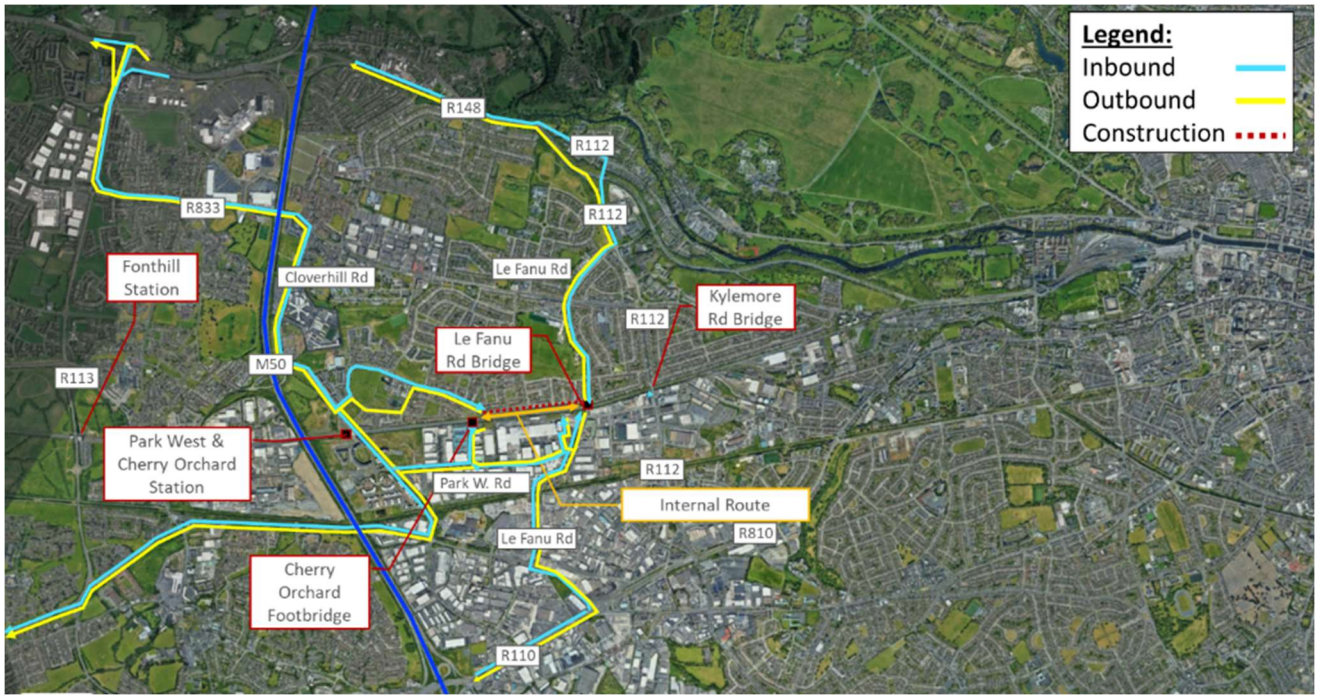

Figure 5-54 Sub-Zone B-1: Park West Avenue to Le Fanu Road Haul Routes

5.4.2.8.2. Site Haul Routes

Access points have been identified off Cloverhill Road, Lavery Road and Friel Avenue to the compounds and provide haul routes between these compounds and also those compounds located at Le Fanu Road. The northern site haul route will be predominantly from west to east and vice versa for the southern route; bi-directional movements could be accommodated subject to adequate site control.

5.4.3. Works between Le Fanu Road Bridge and Kylemore Road Bridge

5.4.3.1. Modification to Bridges

Kylemore Road Bridge (OBC5A) is located over the railway at a high cutting location, with the railway being approximately 5m below road level. It is not wide enough to accommodate two new tracks and needs to be replaced with a new bridge. The works in this area will comprise the demolition of the existing bridge, the local widening of the corridor and the construction of a two-span concrete beam and slab bridge, with adequate width to accommodate the potential new platform arrangement of a new station.

A key consideration at construction stage will be traffic management. A temporary single lane road will be constructed to the east of the existing bridge to facilitate northbound traffic during bridge reconstruction. Southbound traffic would be routed through a diversion across Le Fanu Bridge. As the existing Le Fanu Bridge is substandard and a low-capacity bridge, it is proposed to upgrade Le Fanu Bridge in advance of Kylemore Road Bridge.

Another key consideration at this site is the utilities that cross the existing bridge. In advance of the bridge demolition, the utilities will need to be diverted to a temporary utility bridge to the east of the existing bridge. This bridge will also act as a temporary pedestrian and cyclist bridge during the construction period (Refer to Figure 5-55).

The construction methodology for the works would follow the steps:

1) Erect temporary road and footbridges;
2) Divert utilities;
3) Pile new abutments behind existing abutments;
4) Demolish bridge;
5) Lift bridge beams into place;
6) Install bridge ducting and piping;
7) Place deck slab and parapet;
8) Reconstruct road and finalise for traffic;
9) Decommission temporary bridges.

Steps 1 to 3 will be undertaken during night-time closures of the road to limit the additional time required to divert traffic during the day. Kylemore Road will be a main access point to undertake the wall construction to the east and west of the bridge, with track access points required on both north and south sides. The works will need to be phased so that access is maintained to residential landowners whilst these works are ongoing.

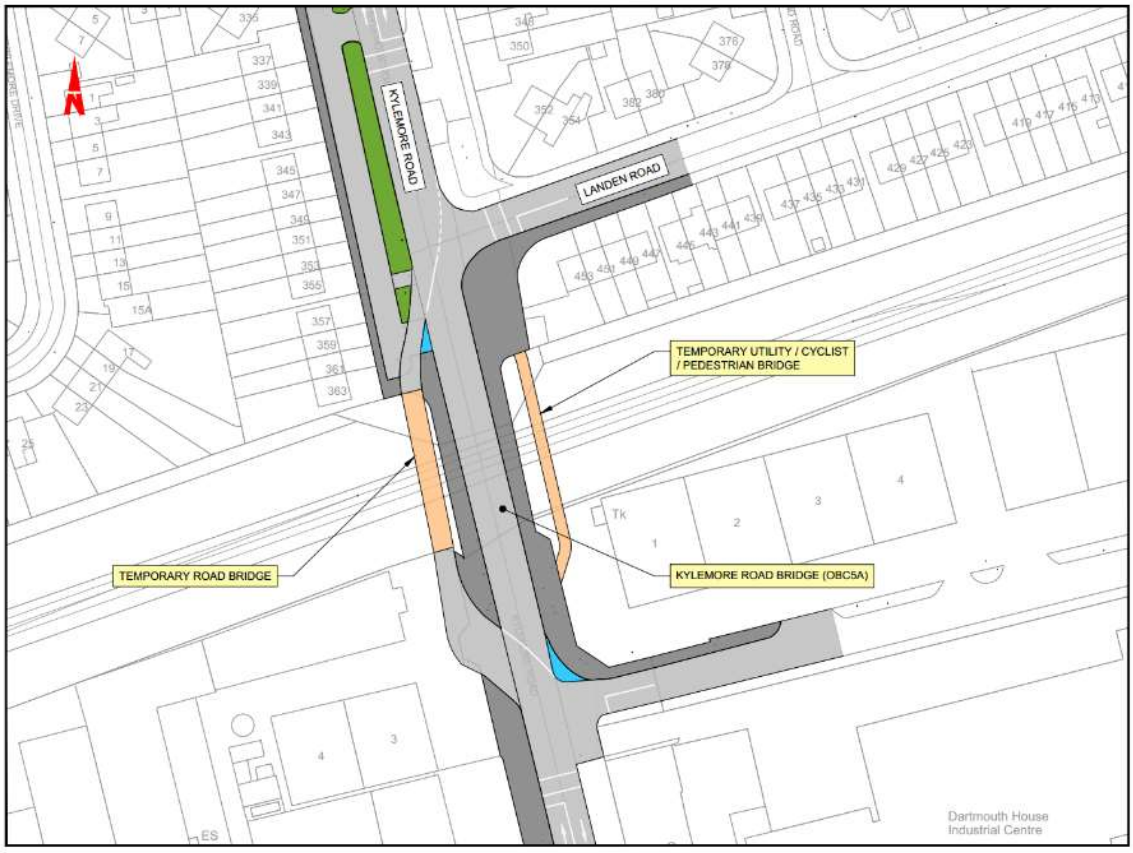

Figure 5-55 Kylemore Road Temporary Road and Utility/Vulnerable User Bridges

New parapets which meet current containment standards for bridges crossing railways will be designed and constructed on this new bridge. This requires the parapets to have a H4a containment level

protection with a minimum height of 1.8m with no handrails and a 45-degree symmetrical steeple coping. This will be a full-height H4a precast concrete parapet with a masonry-type cladding finish on the roadside face to be in keeping with the local environment.

5.4.3.2. Modification to Roads

Kylemore Road Bridge (OBC5A) reconstruction will require a full closure of the existing Kylemore Road in the vicinity of the works. Unlike Le Fanu Road the approach road construction can only commence in full once the bridge nears its final deck and parapet curing phase. This is primarily because of the working space constraints which are exacerbated by the need to provide the temporary north bound road bridge to the west and the vulnerable user/utility diversion bridge to the east.

The H4a approach road and retaining walls between the bridge and Landen Road will need to be completed in advance of the carriageway and footpath works. The road works (incl. H4a containment walls), excluding traffic signal commisioning and surface finishing works associated with final utility diverisons will take up to 3 months to complete.

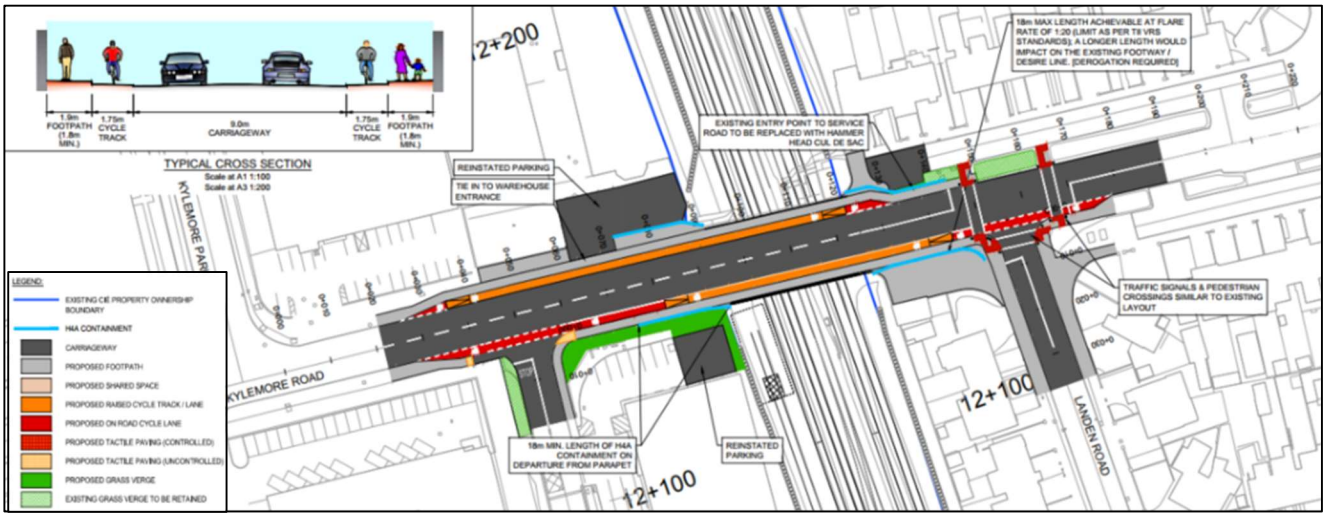

Figure 5-56 Kylemore Road Bridge and Road Layout

5.4.3.3. Modification to Walls and Other Structures

The over steepened nature of the existing cutting slopes, proximity of the adjacent domestic and industrial properties and height of the cutting slope to be retained, necessitates a piled wall solution along both the north and south sides of the rail corridor between Le Fanu and Kylemore section.

Additional minor retaining or earthwork structures will be required at road level surrounding Kylemore Road Bridge (OBC5A) to facilitate the proposed road level raising.

To provide additional stability to the retaining walls and to ensure the integrity of the infrastructure beyond the crest of the retained slope, portions of the retaining walls along this section will need be anchored, with the anchors extending into the existing slope beneath the properties on both the northern and southern side of the rail corridor. The length of the ground anchors will vary based on the height of the cutting slope to be retained and are anticipated to be approximately 10 to 15 m in length. The ground anchors will be installed utilising access from track side within CIÉ lands. Retaining walls are proposed along both sides of the corridor.

Table 5.7: New / Replacement Retaining Walls (Northern Perimeter)

Chainage	Location	Proposed Retaining Wall	Height	New/Replaced
12+660 – 11+700	Rear of 33 Cloverhill Road to rear of 421 Landen Road (including Le Fanu and Kylemore Road Bridge)	Secant Wall + Secant wall anchors	2.0m - 7.2m high	New

Table 5.8: New / Replacement Retaining Walls (Southern Perimeter)

Chainage	Location	Proposed Retaining Wall	Height	New/Replaced
12+700 – 11+940	Le Fanu Bridge, Kylemore Park North, Kylemore Bridge and West Link Industrial Estate	Secant pile wall + Secant pile anchors	4.2m – 4.6m high	New

5.4.3.4. Building / Structures Demolitions

There are no building demolitions proposed in this sub- zone.

5.4.3.5. Substations

There is no substation site in this section.

5.4.3.6. Utility Diversions

5.4.3.6.1. BT

There is one BT diversion beneath Kylemore Road Bridge at the south west abutment. The service will be diverted across the proposed temporary bridge prior to works on the new Kylemore Road Bridge. The permanent diversion will be located in the footpath of the newly constructed bridge.

5.4.3.6.2. Eir

There are several Eir services that are located in Kylemore Road Bridge. These will be temporarily diverted across the proposed temporary bridge prior to works on the new Kylemore Road Bridge. The permanent diversions will be located in the footpath of the newly constructed bridge.

5.4.3.6.3. ESB

There are two ESB services that are located in Kylemore Road Bridge. The services will be temporarily diverted across the proposed temporary bridge prior to works on the new Kylemore Road Bridge. The permanent diversions will be located in the footpath of the newly constructed bridge.

5.4.3.6.4. Gas Networks Ireland

There is a significant network of gas mains situated north of Kylemore Road Bridge, with connections through the road bridge to various commercial properties south of the tracks. The services in the road bridge will be temporarily diverted across the proposed temporary bridge prior to works on the new Kylemore Road Bridge. The permanent diversion will be located between the beams of the newly constructed bridge. Temporary connections to commercial properties on the south will be required.

A distribution regulator installation (DRI) is located north of the Kylemore Road / Landen Road junction. The DRI reduces pressure in connected pipes to be distributed to neighbouring properties. Discussions are ongoing with GNI regarding diversions connected to this component.

5.4.3.6.5. Watermain

There is one watermain diversion located in Kylemore Road Bridge. There is sufficient resilience in the existing water network locally to allow a temporary shutdown of this service to facilitate construction without affecting supplies to customers in the area. Therefore, works on the new Kylemore Road Bridge as a temporary diversion is not required. The permanent diversion will be located between the beams of the newly constructed bridge.

5.4.3.6.6. Virgin Media

There are two Virgin Media diversion located in Kylemore Road Bridge. These will be temporarily diverted across the proposed temporary bridge prior to works on the new Kylemore Road Bridge. The permanent diversion will be located in the footpath of the newly constructed bridge.

5.4.3.7. Temporary Traffic Management

Kylemore Road Bridge (OBC5A) reconstruction requires a full closure of the existing bridge on Kylemore Road. The temporary traffic management solutions being considered at this time are set out below:

Private Vehicles

- The provision of a temporary northbound single directional vehicle bridge on the western side of the proposed new permanent bridge structure. This bridge will accommodate northbound traffic while southbound traffic will be required to be re-routed. The bridge will also provide a 1.5m footpath to cater for pedestrians on the western side of Kylemore Road.

The southbound traffic is anticipated to be distributed onto the surrounding network via the Le Fanu Road Bridge (OBC7). Heavy Good Vehicles (HGVs) will be restricted from using Kylemore Avenue and will be required to travel via Ballyfermot Road instead. The proposed diversion routes for light traffic are shown in Figure 5-57 while heavy traffic diversion routes are shown in Figure 5-58.

In order to cater for the additional traffic volumes, temporary traffic signals will be required at the following existing priority junctions,

- Kylemore Road & Kylemore Avenue; and
- Kylemore Park Road & Le Fanu Road.

The junction locations are shown in Figure 5-59 below.

Figure 5-57 Kylemore Southbound Traffic Diversions – Light Vehicles

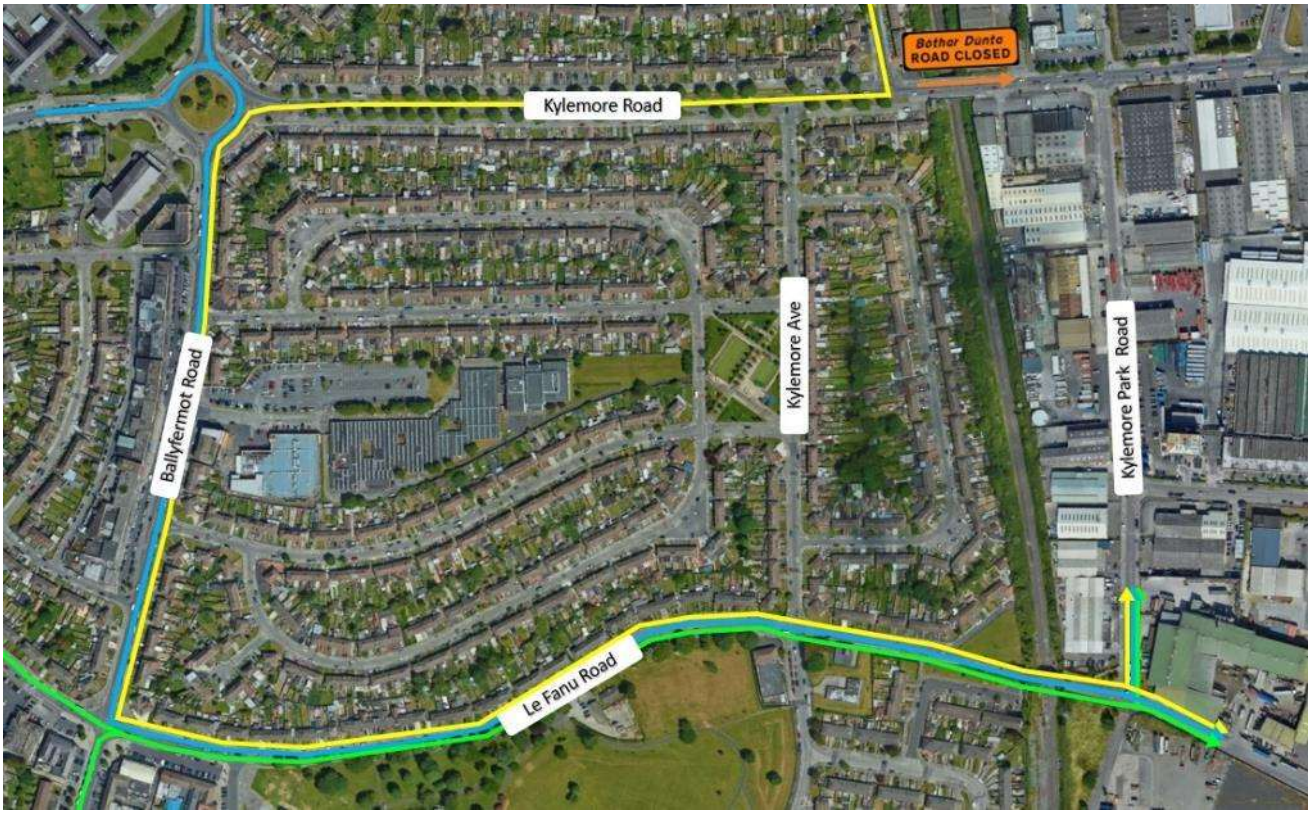

Figure 5-58 Kylemore Southbound Traffic Diversions – Heavy Good Vehicles

Figure 5-59 Temporary Traffic Signal Locations

Owing to the lengthy duration of this closure; vehicular users will experience initial congestion at the start of the closure, followed by a gradual decrease in total vehicle volumes and congestion.

5.4.3.7.1. Vulnerable Users (Pedestrians, Wheelchair users and Cyclists)

Overall pedestrian and cycling connectivity will be maintained throughout the closure period and, as a result, is expected to maintain a high level of service. Pedestrian facilities will be provided on both sides of the construction area via two temporary bridges.

5.4.3.7.2. Public Transport

Bus routes anticipated to be affected by the Kylemore Road bridge closure will be the Dublin Bus Route 18 - Hollyville Lawn to Dromard Terrace, Express Bus Route 860 - Aston Quay to Park West Avenue and Dublin Bus Routes 79 - Aston Quay to Spiddal Avenue and 79A - Aston Quay to Park West Avenue. The Bus 18 route will be diverted via Kylemore Park & Kylemore Avenue as shown in Figure 5-60. The Landen Road stop (ID: 2702) will also need to be temporarily relocated further north on Kylemore Road in order to serve the revised Route 18.

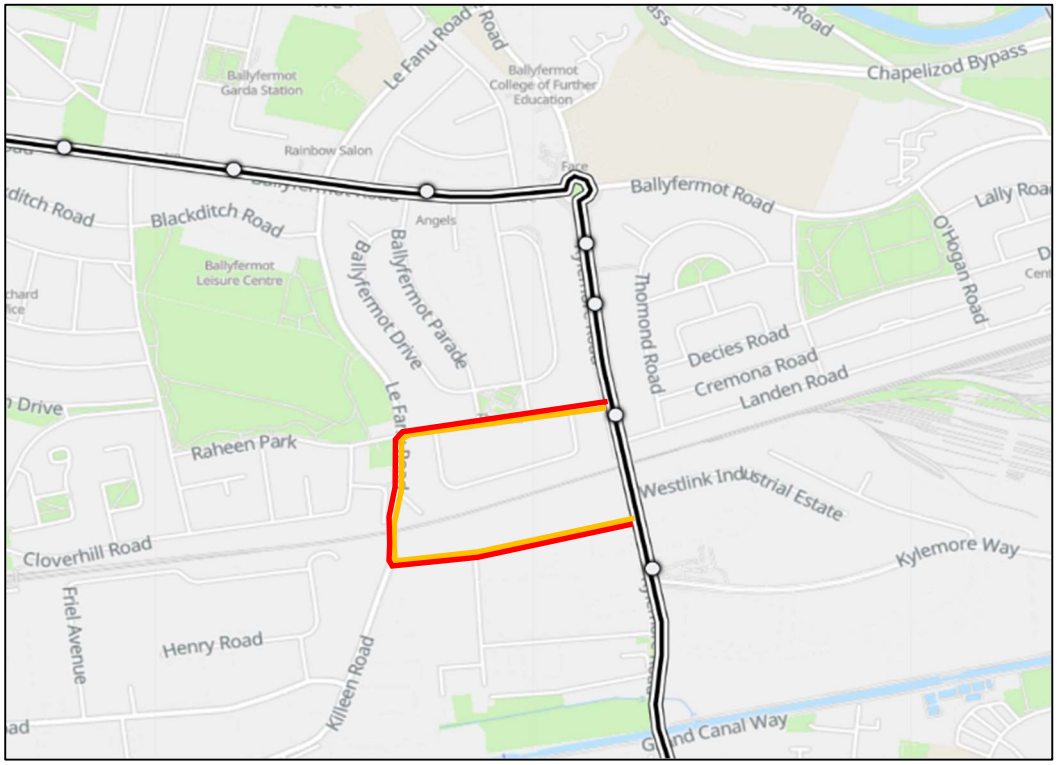

Figure 5-60 Route 18 Hollyville Lawn to Dromard Terrace

The Express Bus Route 860; as shown in Figure 5-61, will be diverted via Kylemore Avenue rather than using its existing route via Kylemore Park to get between Kylemore Road and Le Fanu Road. The Bus 79 & 79A routes will be required double back east after exiting Thomond Road onto Landen Road before turning up Garyowen Road and continuing to Ballyfermot Road. They will then proceed down Kylemore Road to the temporarily relocated stop (ID: 2702) before turning into Kylemore Avenue. Finally proceed right up Ballyfermot Avenue, returning to the original route in Ballyfermot Road, as shown in Figure 5-62.

Figure 5-61 Route 860 Aston Quay to Park West Avenue

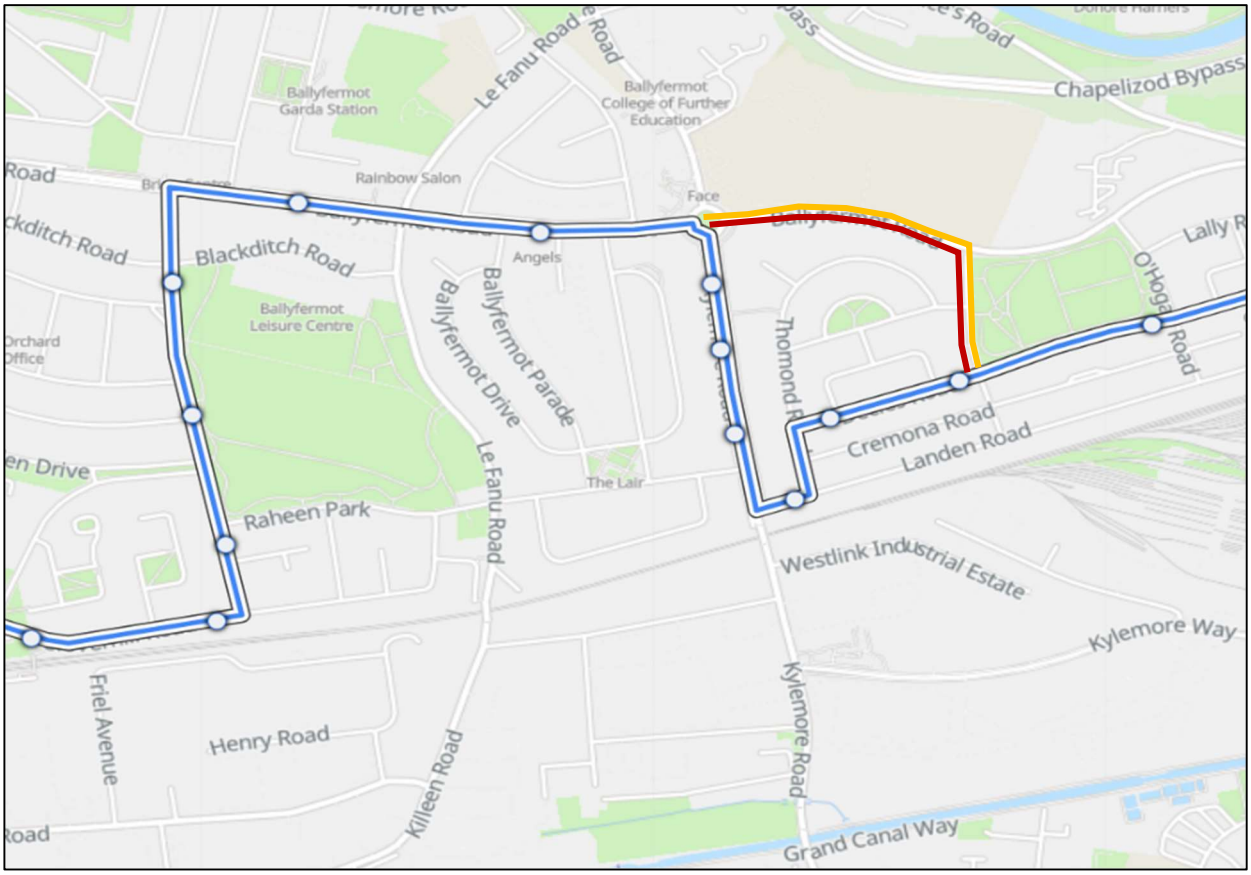

Figure 5-62 Routes 79 Aston Quay to Spiddal Ave & 79A (to Park West Avenue)

5.4.3.8. Construction Compounds

5.4.3.8.1. Kylemore Bridge Construction Compound

As part of the rail corridor widening works, new retaining walls will be constructed, requiring plant access and construction materials processing. To facilitate the reconstruction of Kylemore Road Bridge (OBC5A) and localised works associated with widening of the rail corridor, construction compounds/access points will be required. Due to the nature of the works, the construction compounds are required in the immediate vicinity of the bridge.

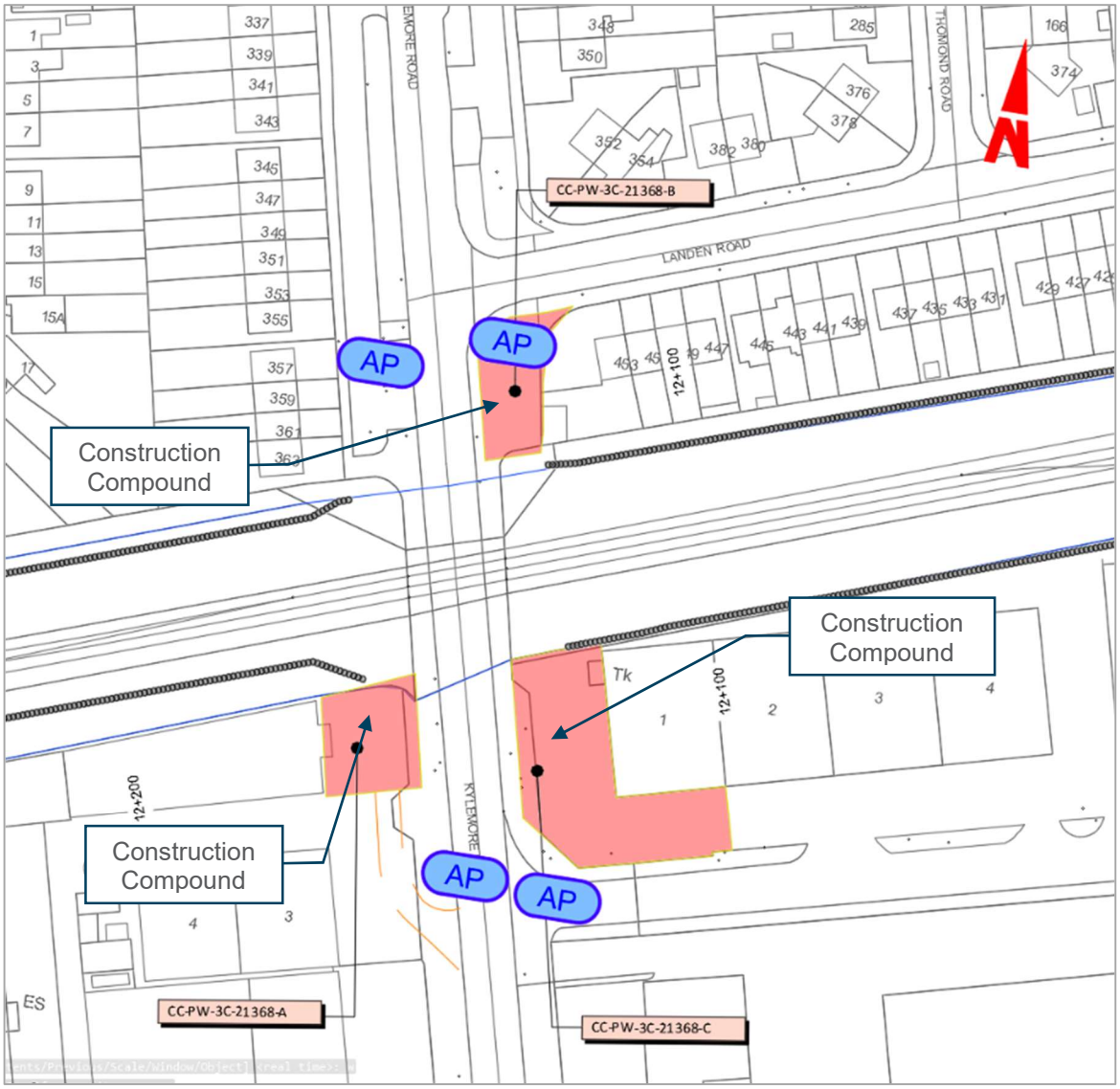

Figure 5-63 Kylemore Proposed Construction Compound Location

On the north east side of the bridge, it is proposed to utilise the existing open space in this area. To the south east, the construction of a new retaining wall necessitates access from Kylemore Road and the Inchicore works via a haul road. A construction compound will be required at the south east corner of the bridge to serve as an access point, storage and transfer area for materials and plant.

To the southwest corner of the bridge, access will be required to facilitate construction of the retaining wall between Kylemore and Le Fanu.

The two construction compounds located to the south are located in existing car parks belonging to adjacent commercial units and alternative accommodation may be required for the duration of the associated works.

The construction compound sites are located on third party lands and will require temporary acquisition for the duration of the works. There is also an advertising billboard that will need to be temporarily removed for the duration of the works.

The compounds will include site offices, welfare facilities, security, concrete pipe storage, equipment storage, laydown and material crushing, bridge prefab yard warehouse, processing crushing and screening, material stockpile. The compound access to main road network on the northern side is via Kylemore Road to the Naas Road. Access to the southern compounds is via Kylemore Road to the Chapelizod Bypass.

5.4.3.9. Haul Routes

5.4.3.9.1. External Haul Routes

The external haul routes required to facilitate works in sub-zone B-2 are as outlined in Section 5.2.9 and the following descriptions.

Sub-Zone B-2: Le Fanu Road Bridge to Kylemore Road Bridge (incl. Kylemore Road)

Construction traffic associated with Sub-Zone B-2 is anticipated to typically emanate from the N4 (northern side of the railway line) as well as the R110 (southern side of the railway line). The inbound and outbound routes are facilitated via Park West Avenue and Kylemore Ave (R112). The construction haul routes are shown in Figure 5-64.

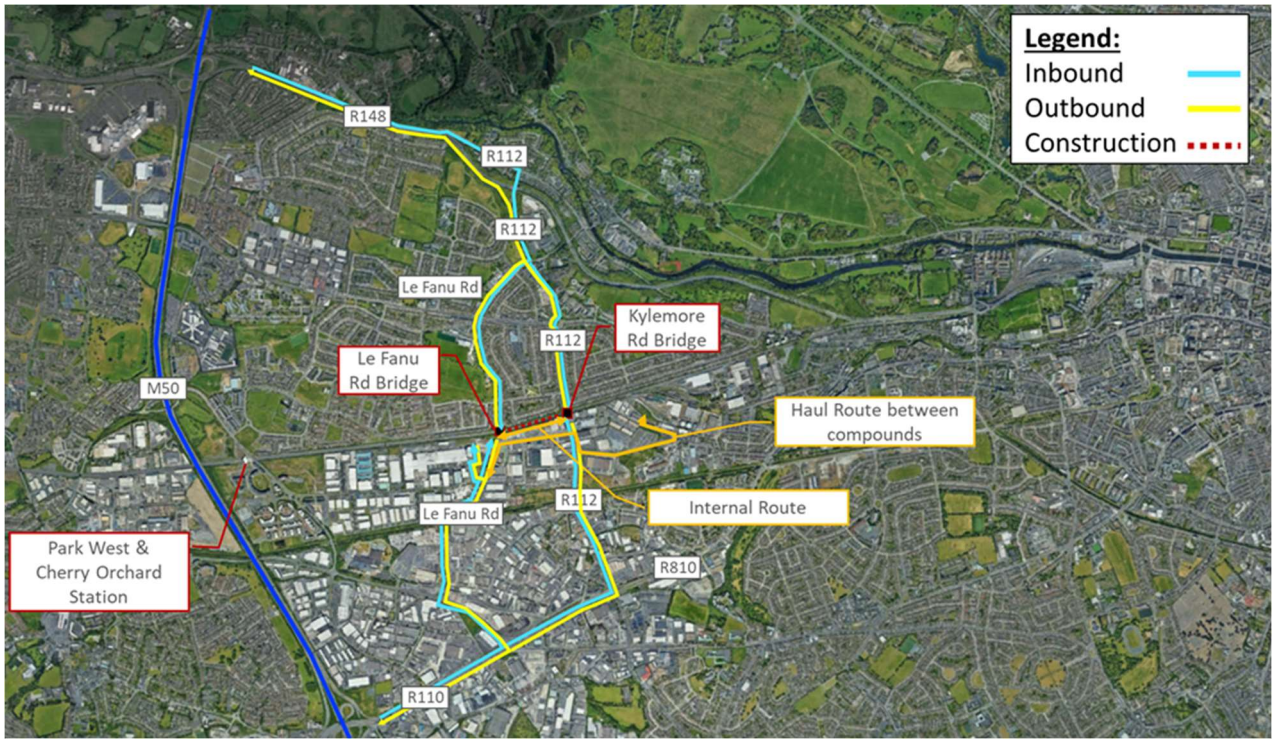

Figure 5-64 Sub-Zone B-2: Le Fanu Bridge to Kylemore Road Bridge Haul Routes

5.4.3.9.2. Site Haul Routes

Site haul routes are required along both the northern and southern track boundaries between Le Fanu and Kylemore Bridges to facilitate the track corridor widening and construction of the retaining walls. The site haul routes will be required at different stages in accordance with the phasing and staging of the works.

5.4.4. Works between Kylemore and Sarsfield Road (Including Inchicore Works)

5.4.4.1. Modification to Bridges

The Khyber Pass Footbridge provides access to the Inchicore Depot from the residential areas north of the existing corridor. As the corridor is being widening at this location the existing footbridge needs to be replaced.

It is proposed to replace the existing bridge with a prestressed beam and slab bridge including new piers and ramps/stairs. All works can take place in safe zones adjacent to the works until such time as the main bridge span is lifted into place. This main span lift will require night-time possession.

The pedestrian parapet will be in line with the existing arrangement with a full enclosure placed over the footbridge deck. The parapet will be formed using the proposed U-Shaped pre-cast sections which will form the bridge deck. The enclosure will be constructed from a fine unclimbable mesh and shall have a minimum vertical clearance envelope of approx. 2.3m.

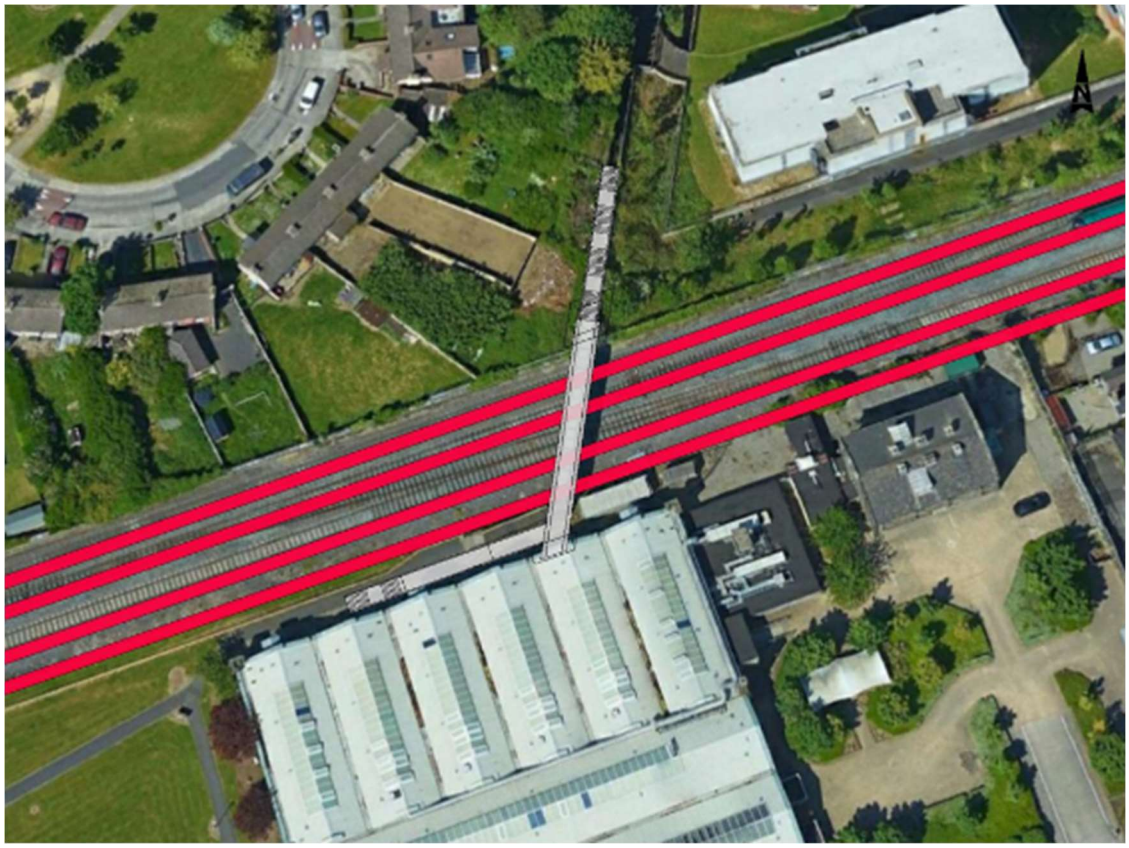

Figure 5-65 Khyber Pass Footbridge Works

5.4.4.2. Modification to Walls and Other Structures

To facilitate the widening along the northern and southern perimeters to form the northern (slow) and southern (fast) track cess edges and retain the slopes of the cutting, cantilever wall solutions are proposed for this sub-zone of retaining wall. This section begins at Kylemore Bridge and extends to Inchicore Depot . This sub-zone includes retaining walls along both the north and south sides of the rail corridor east of Kylemore Road Bridge.

Retaining walls are required immediately east of Kylemore Road Bridge along the perimeters to form the northern and southern tracks cess edge. The retaining walls vary between 4 to 6 m in height and will be constructed utilising access from track side within CIÉ lands.

- Northern Wall - The existing cut slope will be widened toward Landen Road and the top of the wall will be approximately 4m from the road once complete.
- Southern Wall - The existing cut slope will be widened toward the industrial estate and the top of the wall will be approximately 3m from the adjacent buildings once complete.

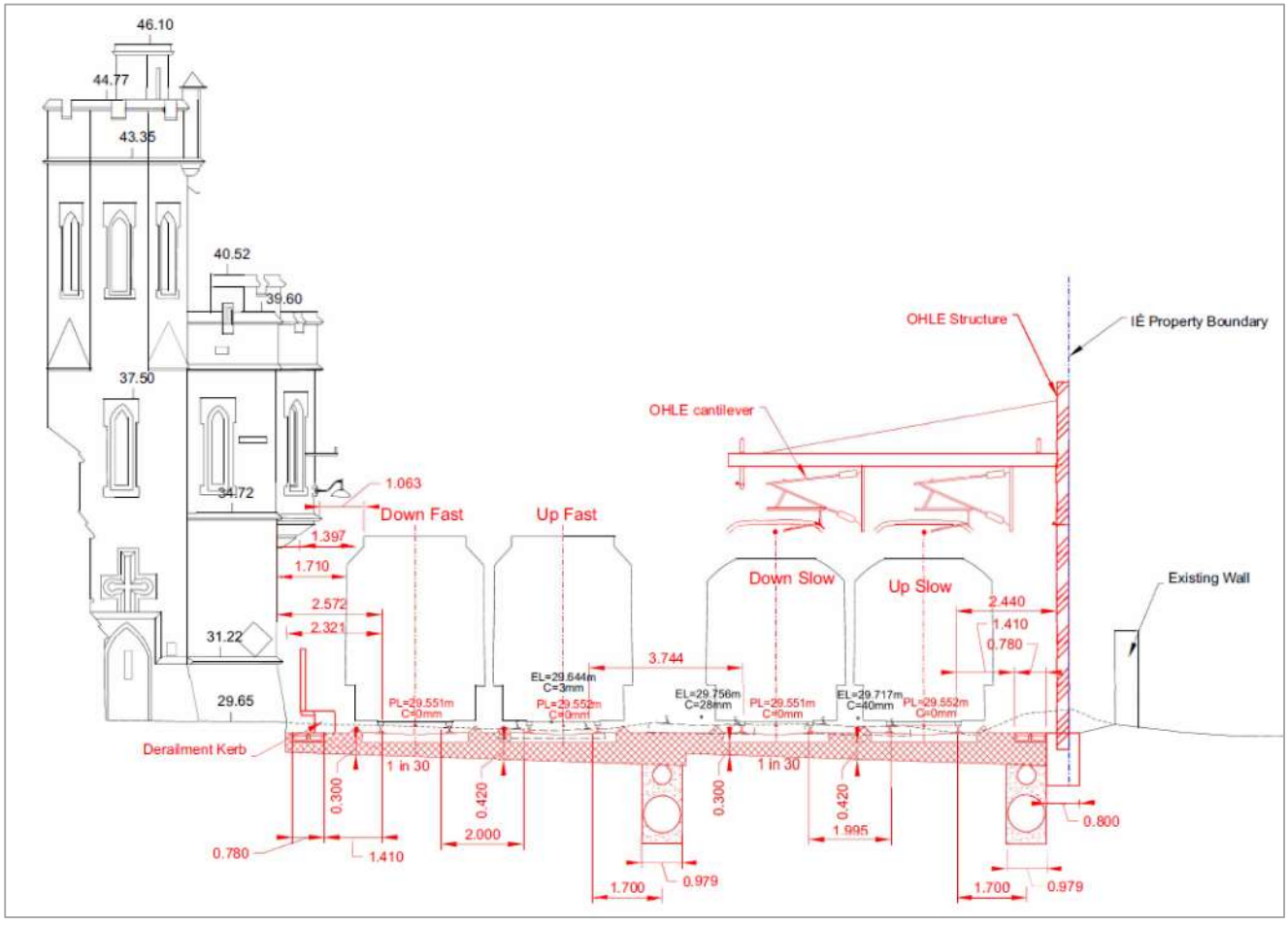

Figure 5-66 Cross Section at Ch 11+000 - Inchicore - Facing West

To provide additional stability to the retaining walls and to ensure the integrity of the infrastructure beyond the crest of the retained slope, portions of the retaining walls along this section will need be anchored, with the anchors extending into the existing slope beneath the properties on both the northern and southern side of the rail corridor. The length of the ground anchors will vary based on the

height of the cutting slope to be retained and are anticipated to be approximately 10 to 15m in length. The ground anchors will be installed utilising access from track side within CIÉ lands.

Existing nearby walls, buildings, structures and earthworks may require monitoring (e.g., vibration monitoring) during any nearby piling works for new structures to ensure no structural damage or instability is caused.

Table 5.9: New / Replacement Retaining Walls (Northern Perimeter)

Chainage	Location	Proposed Retaining Wall	Height	New/Replaced
12+660 – 11+700 (as outlined previously in Table 5.7)	Rear of 33 Cloverhill Road to rear of 421 Landen Road (including Le Fanu and Kylemore Road Bridge)	Secant Wall + Secant wall anchors	2.0m - 7.2m high	New
11+700 - 11+320	Rear of 315 Landen Road to rear of 183 Landen Road	Soil anchors	2.0m - 4.6m high	New
11+320 - 11+270	Rear of 183 Landen Road to rear of 167 Landen Road	Secant Wall + Secant wall anchors (half length)	0.5m – 2.0m high	New

Table 5.10: New / Replacement Retaining Walls (Southern Perimeter)

Chainage	Location	Proposed Retaining Wall	Height	New/Replaced
13+330 - 12+700	Friel Avenue	King Post Wall + Wall anchors	0.3m – 4.4m high	New
12+700 – 11+940 (as outlined previously in Table 5.8)	Le Fanu Bridge, Kylemore Park North, Kylemore Bridge and West Link Industrial Estate	Secant pile wall + Secant pile anchors	4.2m – 4.6m high	New
11+940 – 11+760	Inchicore Works	Secant pile wall + Secant pile anchors	2m – 3m high	New
11+760 – 11+680	Inchicore Works	King Post Wall	0.3m – 2m high	New

5.4.4.3. Building / Structures Demolitions

Within this zone, several buildings and structures will need to be demolished and / removed in their entirety as shown in Table 5.11.

Westlink Business Park (Unit No.1) is a portal frame structure (adjoining Unit Nos 2-4) and includes offices, sales cordon, stock rooms and paint mixing areas. The headshunt piled retaining wall proximity to the north western corner of the unit building is too close to guarantee that it won't be damaged during piling works (at least in part) and as such will be demolished. In addition, a proportion of the small car park associated with the unit will be closed for multiple years to facilitate bridge, retaining and boundary wall construction.

Table 5.11: 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+717	No	Signalling gantry	Multitrack signalling gantry to be removed, located within proposed enlarged railway corridor.
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 (proposed)	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.

Structure	Location Chainage	Heritage	Description	Conflict
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.

The structure attached to the maintenance shed at Inchicore Works must be removed to provide room for the Long Siding (Refer to Figure 5-67). This extension has offices, toilets, lockers, and plant rooms which house tanks and pumps for the train wash.

Figure 5-67 Lean Back Portion to be Removed (Highlighted in Yellow)

Additionally, the shunter building (Refer to Figure 5-68), located west of the maintenance shed, will be removed.

Figure 5-68 Shunter Building to be Removed

An old signal box (see Chapter 21 of the EIAR for further details on this heritage feature) is located on the north side of the corridor and will be impacted by the works to widen the rail corridor (Refer to Figure 5-69). It is proposed to carry out a detailed survey of the existing building, record all details of the building structure and fabric, before carefully disassembling and labelling the building for storage in a secure location until a suitable alternative location for the feature can established.

Figure 5-69 Old Signal Box to be Recorded and Removed (Highlighted in Yellow)

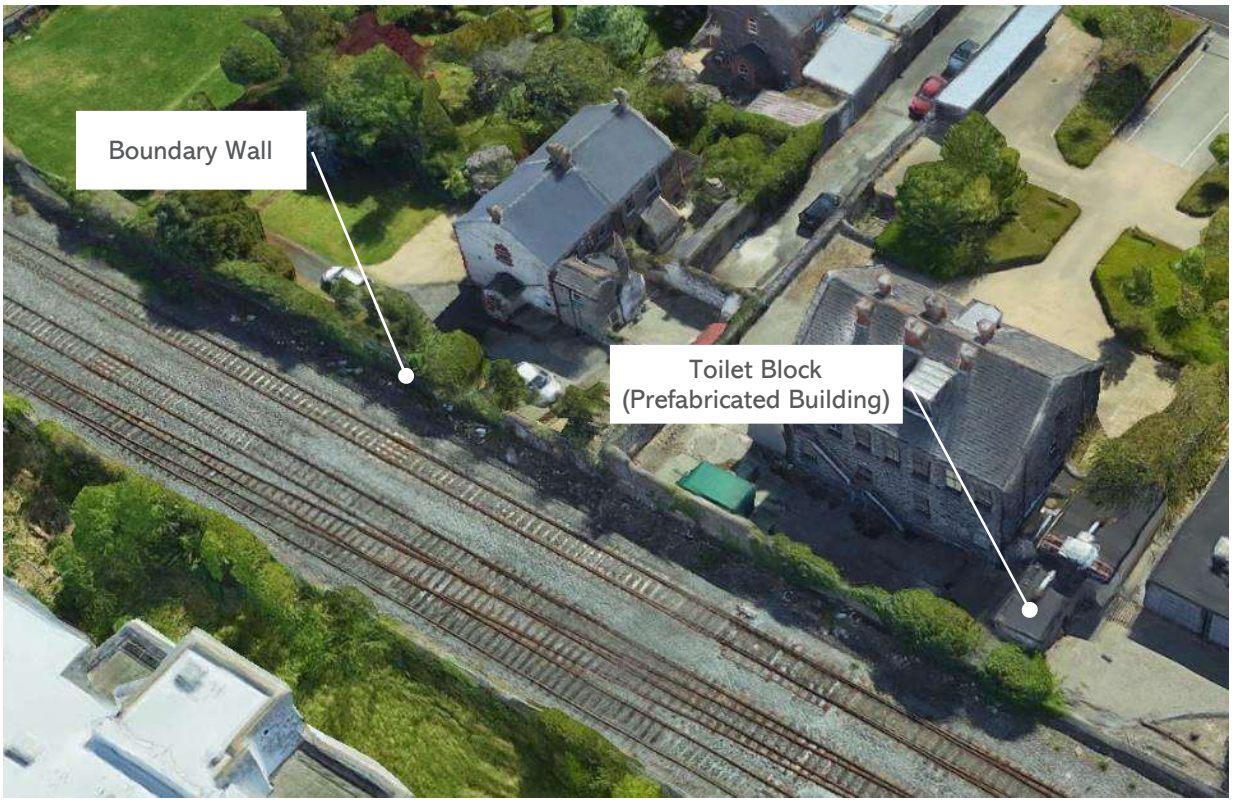

Figure 5-70 Boundary Wall and Toilet Block to be Removed

Figure 5-71 Section of Boundary Wall to be Removed

5.4.4.4. Substations

One substation is required for this section of the route, the proposed location for the substation is within Iarnród Éireann's Inchicore Rail Depot on the southern side of the railway as shown in Figure 5-72. Access to the site is from Jamestown Road via an existing access gate to the Inchicore Depot as shown

in Figure 5-73. 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 5-72 Kylemore Substation Location

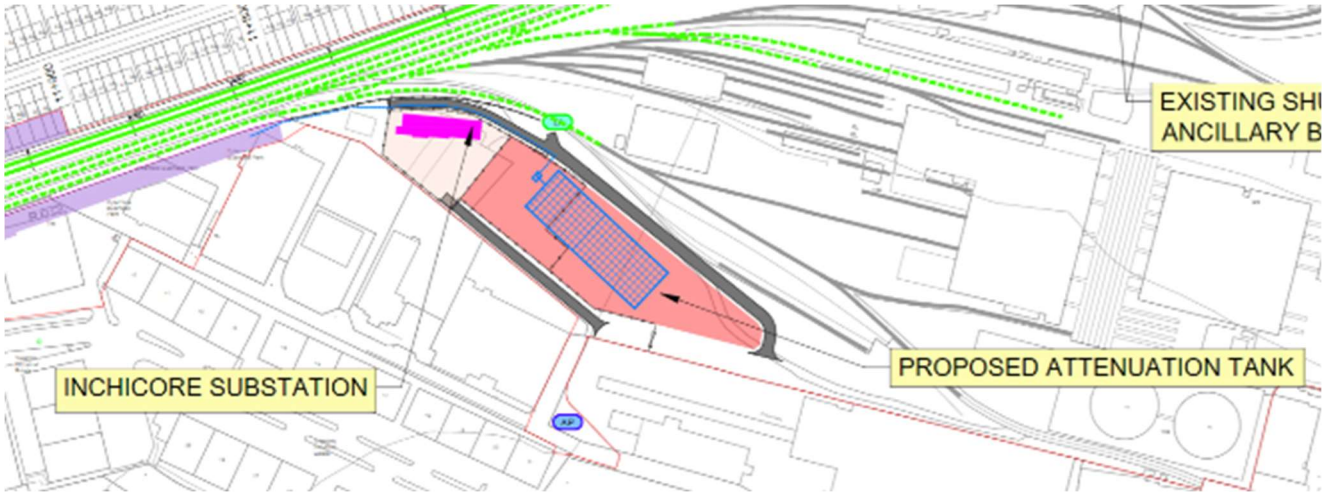

Figure 5-73 Kylemore Substation Layout

The proposed location for the substation is on the western boundary of the Inchicore Depot, adjacent to the Kylemore Industrial Estate. The area is a brownfield site currently used as a maintenance and storage area.

The proposed connection to the existing ESB 38kV network from the proposed substation is an existing underground circuit located within the ESB yard on Kylemore Way. The approximate length for each electrical circuit is 520m.

The route would initially connect to the existing Inchicore – Kimmage 38kV circuit within the Inchicore Power Station. Initially it would run northwards onto Kylemore Road leaving ESB lands, before turning west along Jamestown Road and turning northwards towards the Inchicore Works area, entering the

Inchicore Depot. It would then continue in a north-westerly direction running under / within a new access road to the substation and parallel to the boundary before connecting to the proposed substation as outlined in Figure 5-74.

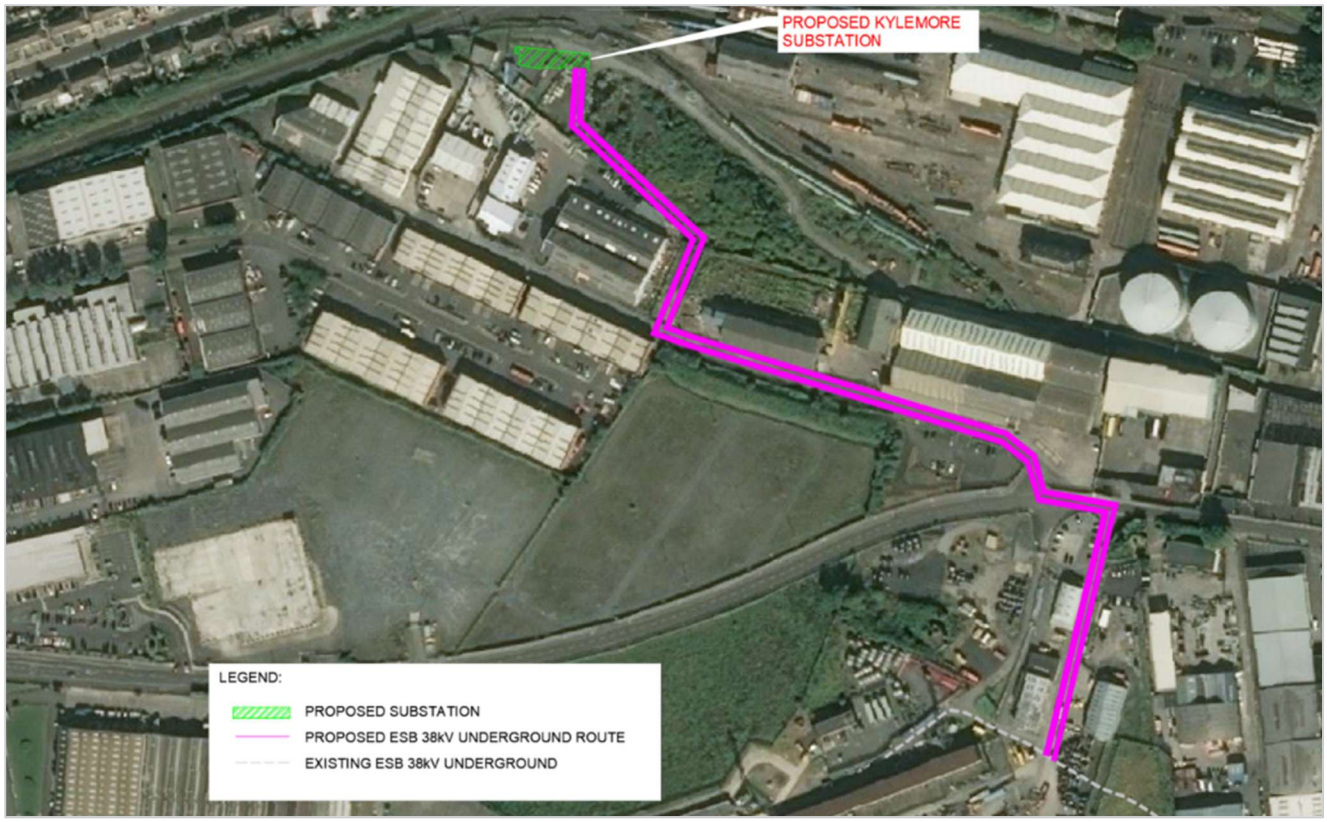

Figure 5-74 Kylemore Substation Proposed Grid Connection

5.4.4.5. Utility Diversions

5.4.4.5.1. Gas Networks Ireland (GNI)

The existing gas main located in Inchicore Depot, parallel to the tracks on the south side, will be removed. This utility currently serves a gas boiler located at the administration building adjacent to the CME works. It is proposed to change this boiler such that it is fed by alternative means of by alternative power source. Hence, this gas main may be removed to eliminate the conflict.

5.4.4.5.2. Stormwater and Foul / Combined Sewers

A combined sewer crosses the tracks where the proposed headshunt is located at Inchicore Depot. Retaining wall and piling works also necessitate a diversion. The permanent diversion route is to be confirmed and is being discussed internally between relevant disciplines. However, as there is no track lowering proposed at this location, the existing utility crossing under the tracks will be retained.

5.4.4.5.3. Attenuation Tanks

Two storm water attenuation tanks are proposed. The first is located to the west of the Inchicore yard in the location of the construction and materials sorting compound as outlined in Figure 5-75. The second attenuation tank is located east of Inchicore yard, adjacent to an existing attenuation facility as outlined in Figure 5-76.

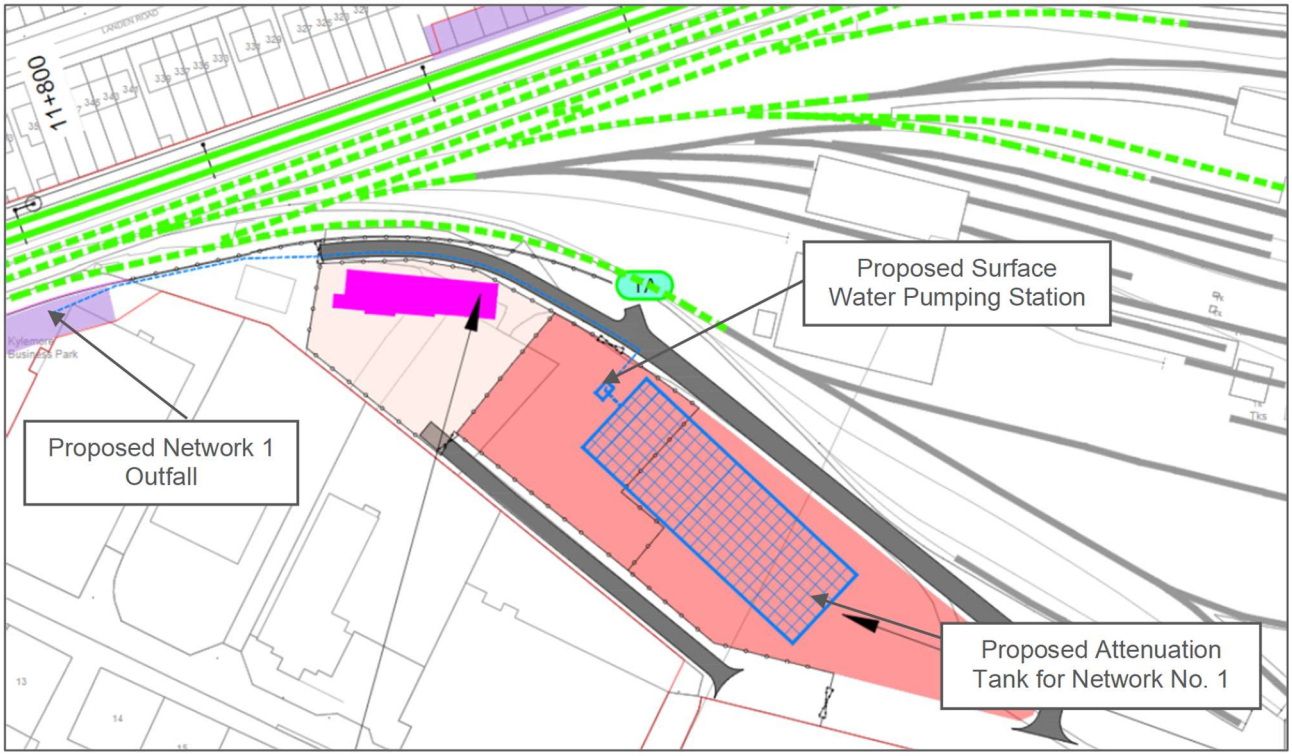

Figure 5-75 Network 1 Attenuation Tank Layout

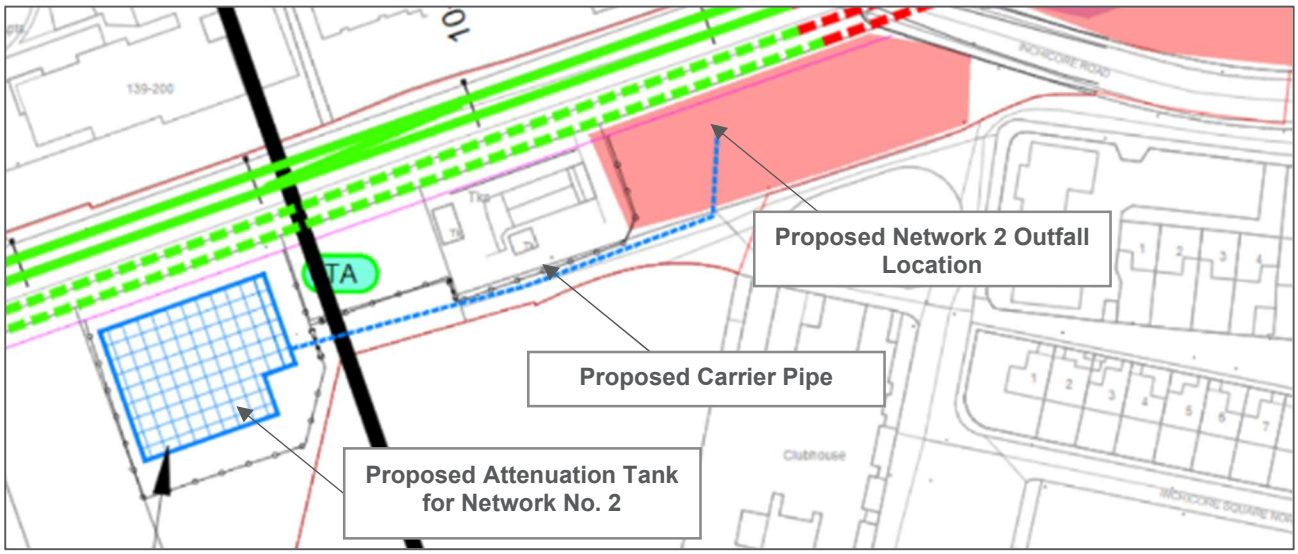

Figure 5-76 Network 2 Attenuation Tank Layout

5.4.4.6. Temporary Traffic Management

While no major public road diversions or closures are envisaged for this section of railway construction; there are a number of compounds earmarked as critical for the area. Traffic diversions noted herein relate to construction traffic routing. Greater detail of anticipated traffic categories and volumes are considered within Chapter 6 Traffic and Transportation of the EIAR.

Private Vehicles

No additional diversions are currently anticipated for public road users as a result of works in this section between Kylemore Road and Sarsfield Road that have not already been covered elsewhere in this chapter, however as a result of access and egress points noted below, local traffic control will be required. This will include the need for local merge and diverge arrangements to protect local road users and reduce exacerbating the traffic already impacted by Kylemore Road closure. The referred to access and egress points north of the railway corridor are listed below:

- North western side adjacent to Kylemore Road Bridge (OBC5A) and the ESB substation. This will be in advance of the Kylemore Road temporary bridge installation and bridge reconstruction. This is required in order to construct piling platforms and retaining walls along the northern boundary to the railway corridor (track side of the Landen Road properties).
- In addition, the Khyber Pass Footbridge (OBC5) 'pan-handle' access road (running along the western boundary of the Seven Oaks Apartment Complex) will be required as an exit point from the railway corridor for material delivery and heavy works vehicles entering the railway corridor at Kylemore Road. This 'pan-handle' is also required for a period to provide access to the compound and works associated with the construction of the Khyber Pass Footbridge (OBC5). Most of the vehicular movements will be out of this access road and directed to the Con Colbert Road/Chapelizod Bypass.

The compounds and works located south of the railway corridor, in and around the Inchicore Depot, will include materials storage and administrative buildings for road works teams (along with bridge and permanent way works); and accordingly the following impacts if any on the public are noted as follows:

The access roads are outlined in Figure 5-77. Construction traffic will be required to travel through the Inchicore Depot to Jamestown Road and Kylemore Way and via Tyrconnell Road and Kylemore Road to the Naas Road. It is not proposed that either of these be used by any construction HGV's but occasionally controlled use by LDV's operating during the limited reconstruction of the Sarsfield Road Under-Bridge (UBC4); as many of the works in the area will be taking place concurrently.

Inchicore South Terrace will continue to be used by normal operations associated with the Inchicore Yard, along with the Yards equally constrained access (more egress) point of Tyrconnell Park. These will also remain as the primary emergency evacuation routes, if necessitated. The main HGV and general construction traffic route between the compounds will be through the Inchicore Yard from the Access/Egress point at Jamestown Road (in the industrial area to the west to Sarsfield Road Under-Bridge (UBC4) in the east).

The routes for construction and Inchicore Depot operational vehicles are outlined in Figure 5-78.

Figure 5-77 External Haul Routes to the Inchicore Compound

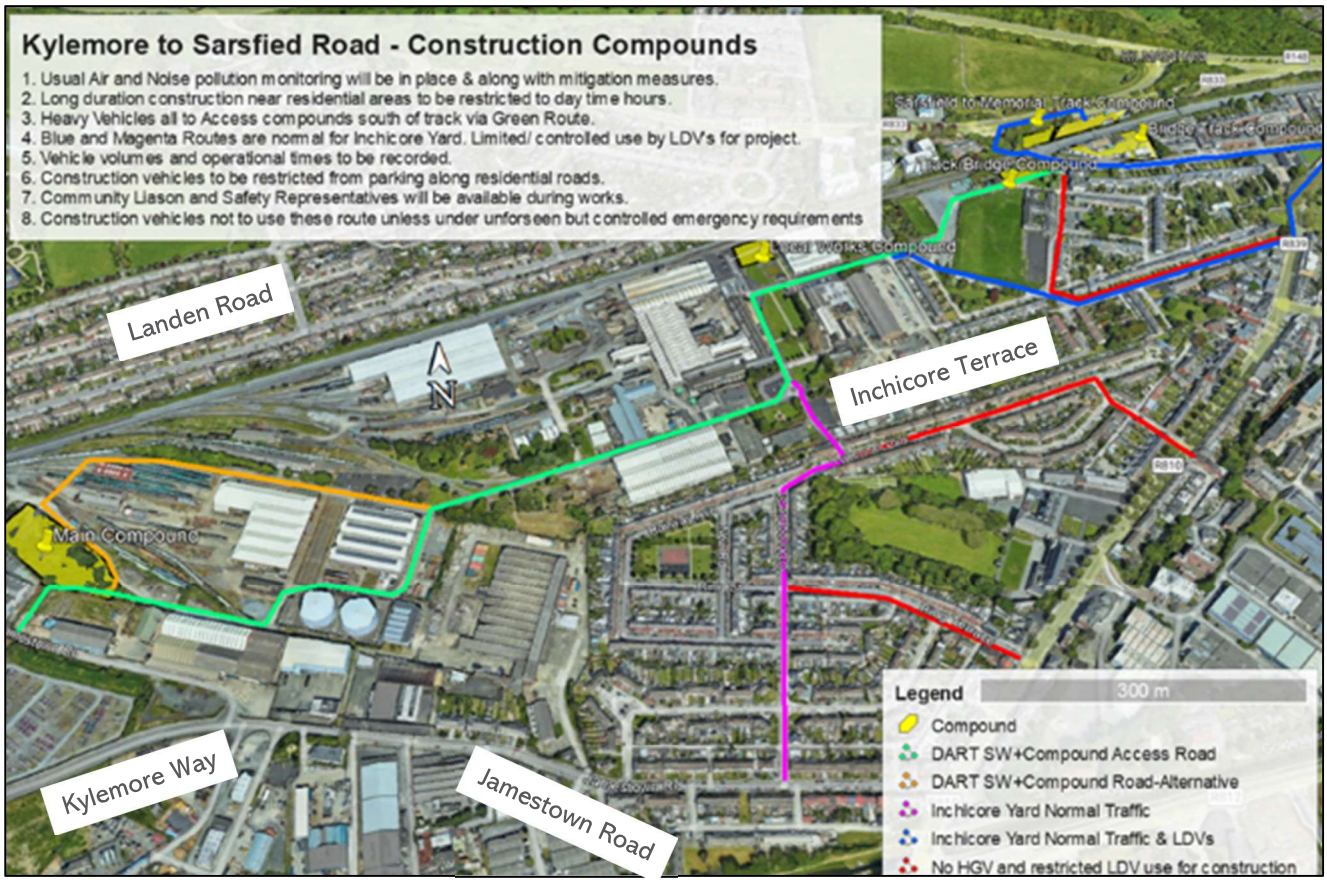

Figure 5-78 Routes for Construction and Inchicore Yard Operational Vehicles

Vulnerable Users (Pedestrians, Wheelchair users and Cyclists)

The Inchicore Depot's operational personnel, that currently use Khyber Pass Footbridge (OBC5), will need to be temporarily diverted via Sarsfield Road Under-Bridge (UBC4); and onwards to the main entrances of the Inchicore Depot; or alternative transport arrangements made.

Public Transport

Currently it is not anticipated that any public bus routes will require diversion because of works in this section of the Project. Consultation with Public Transport stakeholders is still required to discuss the occasional validity of the shared use and or temporary closure of bus lanes, particularly at access and egress points. The road proposed as a construction site egress point at the Khyber Pass Footbridge (OBC5) is a designated fire tender truck route for the adjacent apartments. Contractors working in this road will be required to facilitate access for emergency vehicles at all times.

5.4.4.7. Construction Compounds

A number of construction compounds have been identified in the vicinity of Kylemore Road Bridge and Sarsfield Road. The Sarsfield Road Compound is also required for the works in the next sub-zone and as such have been described in detail in Section 5.4.5.

5.4.4.7.1. Inchicore Construction Compound

A construction compound is required at Inchicore to facilitate the construction works in this area including the construction of the new electrical substation, widening of the rail corridor, construction of retaining walls and installation of new track work (Refer to Figure 5-79). The construction compound will be used as the main materials storage and transfer area on this part of the line of the route.

The site is located on CIÉ owned property. Following completion of construction activities, the area will be used for the permanent substation compound and the remaining section will be used as permanent maintenance compound to support maintenance activity related to the OHLE.

Personnel and machinery access to the railway on the south side of the works will use this construction compound. Access to the site is through the Inchicore Depot to Jamestown Road, Kylemore Way, Kylemore Road to the Naas Road. This area will also be used for a proposed underground attenuation tank.

The Compound will include:

- Compound facilities: Site offices, welfare facilities, security, material storage and transfer, equipment storage, laydown.
- Compound access to main road network: Access to the site is through the Inchicore Depot to Jamestown Road, Kylemore Way, Kylemore Road to the Naas Road.

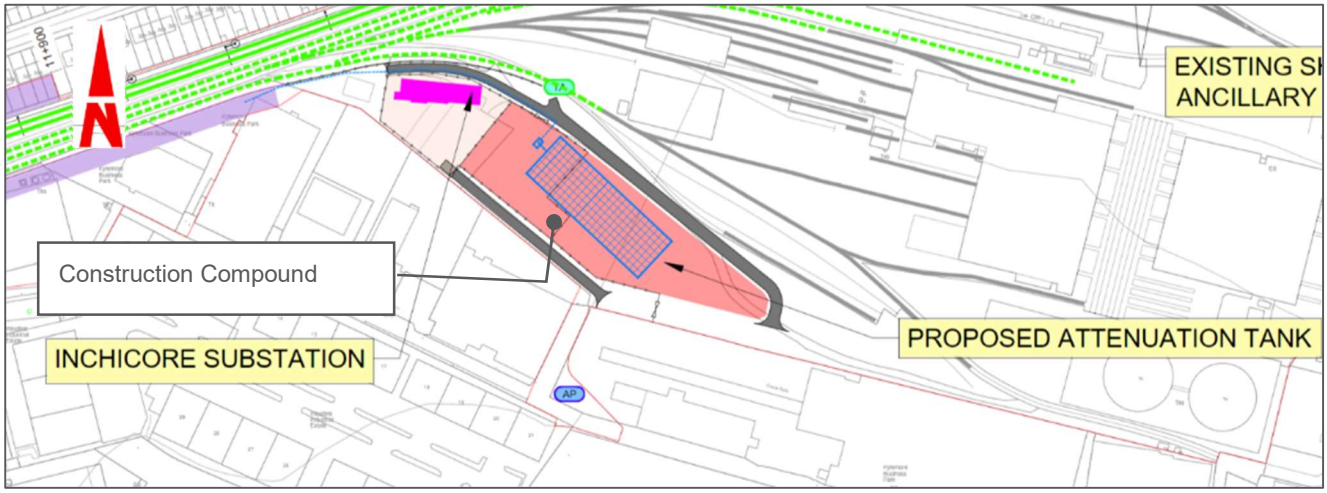

Figure 5-79 Proposed Construction Compound Locations – Inchicore

5.4.4.7.2. Khyber Pass Construction Compound

To facilitate the reconstruction of the Khyber Pass Footbridge in Inchicore Depot, two construction compounds (one either side of the tracks) will be required (Refer to Figure 5-80). The works required in this area include the demolition of the existing footbridge the construction of the new bridge, ramps and stairs.

On the southern side there is a green space on CIÉ Property in Inchicore Depot, adjacent to the bridge. This area has been identified as a suitable location for a construction compound. The site located to the south will accommodate offices, parking for workers vehicles and site vehicles and a materials storage and laydown area. The site is located within Inchicore Depot, on CIÉ Property. Construction traffic can travel through the Inchicore Depot to Inchicore Terrace, Sarsfield Road, and on to Con Colbert Road.

A suitable working space is also required on the north side of the tracks to facilitate the bridge reconstruction. On the north side, access is restricted by a narrow pedestrian footpath which is bounded by private property on both sies. Access will be needed to and from Sarsfield Road. The existing pedestrian access route will need to be temporarily widened to facilitate material movement and equipment access. The Compound will include:

- Compound facilities: site offices, welfare facilities, security, crane platform, parking.
- Compound access to main road network: Access to the southern compound would be through Inchicore depot Jamestown Road, Kylemore Way, Kylemore Road to the Naas Road or via Inchicore Terrace (narrow), Grattan Crescent, and Sarsfield (or Memorial) Road. Access to the Northern compound would be through a widened temporary road to Con Colbert Road.

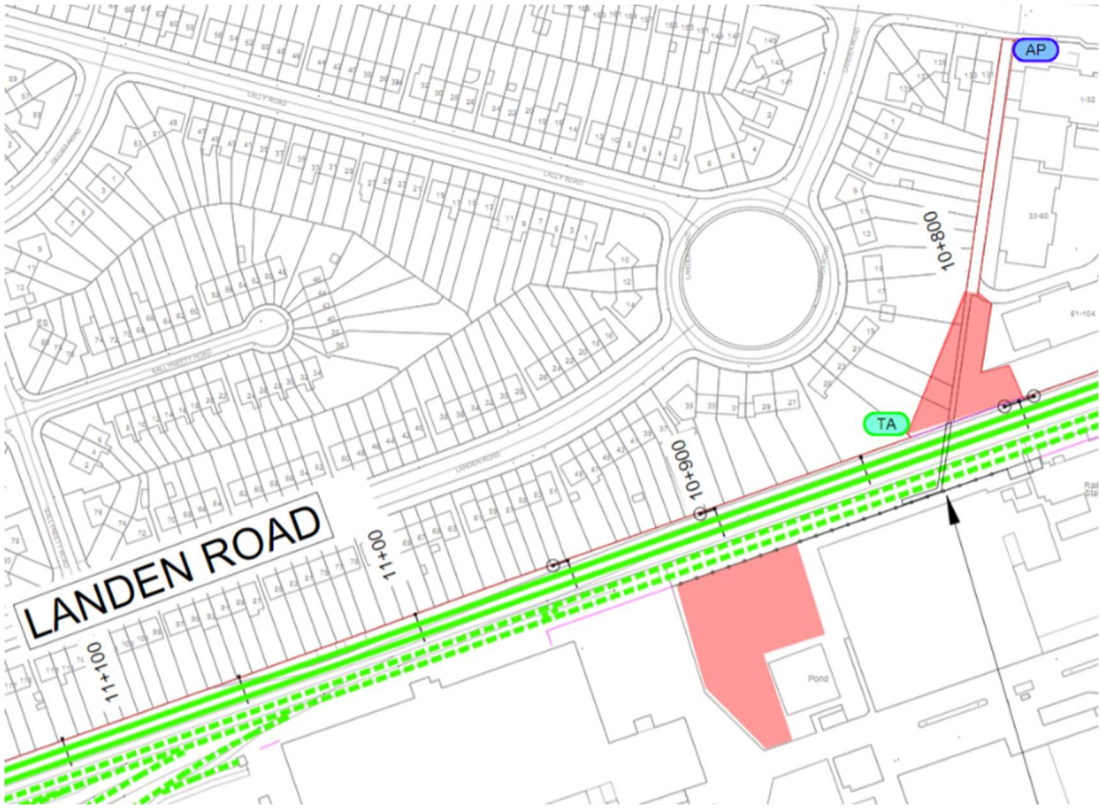

Figure 5-80 Khyber Pass Proposed Construction Compound Locations

5.4.4.8. Haul Routes

5.4.4.8.1. External Haul Routes

The external haul routes required to facilitate works in sub-zone B-3 are as outlined in Section 5.2.9 and the following descriptions.

Sub-Zone B-3: **Kylemore Road to Sarsfield Road**

Construction traffic associated with sub-zone B-3 is also via from the R148 and the R110. The inbound and outbound routes are facilitated via Kylemore Ave (R112), Kylemore Way, Landen Road as well as an exit route via the existing pedestrian right of way associated with the Khyber Pass Pedestrian Bridge (and Seven Oaks apartments fire tender exit). The exiting traffic will be required to turn left only and utilise the Landon Road roundabout in order to exit. Internal haul traffic is expected to be contained within the existing rail reserve and will not utilise external roads. The anticipated construction haul routes are shown in Figure 5-81 below.

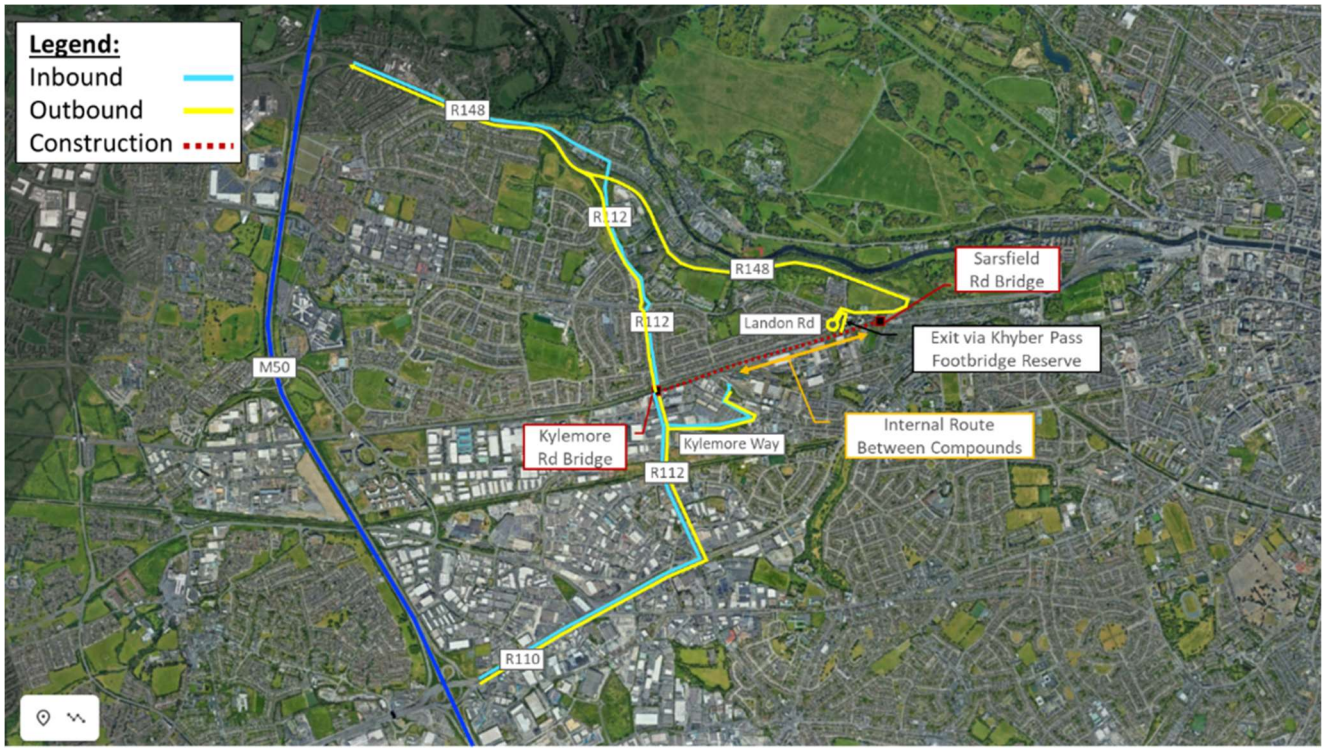

Figure 5-81 Sub-Zone B-3: Kylemore to Sarsfield Haul Routes

5.4.4.8.2. Site Haul Routes

A site haul route is required along the northern boundary of the rail corridor, to the rear of properties on Landen Road, the haul route extends from Kylemore Road Bridge to Khyber Pass footbridge. The haul route is required to facilitate the corridor widening and construction of retaining walls along the northern track boundary. A haul road is also required along the southern track boundary from Kylemore Road Bridge into Inchicore works, again to facilitate corridor widening and construction of the retaining walls in this area.

5.4.5. Works between Sarsfield Road Under-Bridge and Memorial Road

5.4.5.1. Modifications to Bridges

Sarsfield Road Under-Bridge is a high skew steel beam with concrete deck bridge carrying three existing tracks over the Sarsfield Road and needs to be widened to four tracks. The bridge has a height restriction and predominantly acts as a one-way road except for buses and cyclists which act contraflow to the main flow. The existing bridge has 3 main longitudinal beams, each supporting the tracks above.

It is proposed to replace the whole bridge deck with two. new decks covering a wider corridor. The widening of the corridor for the additional track will predominantly occur to the south and therefore the works to the south will be undertaken first, leaving the two. northern tracks operational. The existing southern beam will be craned out and widening works undertaken. The new southern half of the new bridge will then be craned into place. Rail operations will then shift to the new southern tracks and similar works undertaken on the northern side.

It is envisaged that Sarsfield Road will remain open for most operations with some night-time closures required to remove and place decks. A diversion will be placed during road closure periods. Most works outside that of the bridge superstructure works can be undertaken within safe zones to avoid working at night-time under possession. Access to both sides of the track will be required.

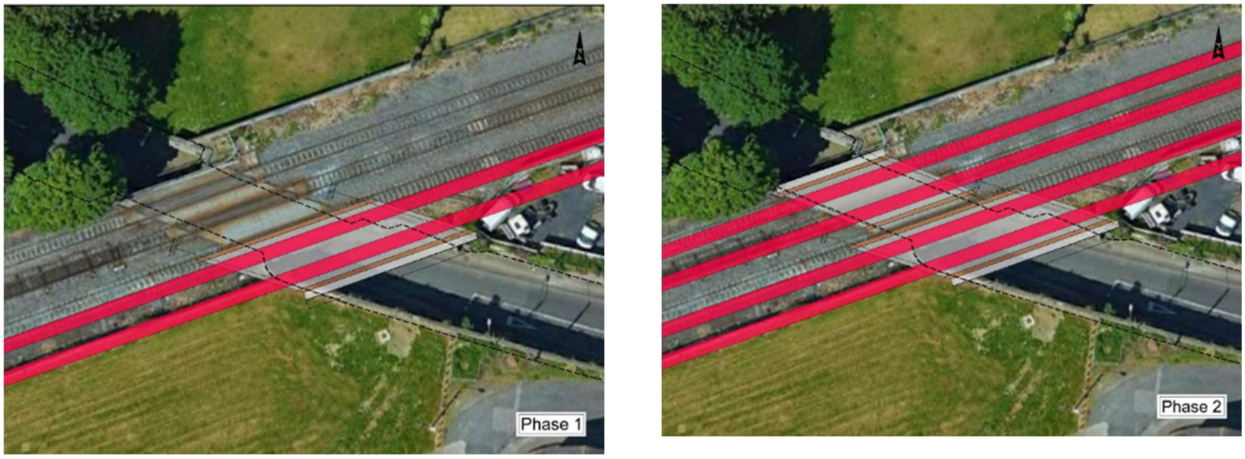

Figure 5-82 Sarsfield Road Bridge Works Showing 2 Phase Implementation

An access platform with associated metal parapets will be attached to the edge of the main girders. This will be supported on cantilever beam supports connected to the main girders. The access platform and parapets can be prefabricated and lifted into place along with the main girders.

5.4.5.2. Modifications to Roads

Localised alterations will be made to the road including resurfacing and minor kerb line alterations, which will be required is as a result of temporary utility diversions to facilitate abutment piling. Nominal crossfall improvements may be introduced as part of the resurfacing and footways will be fully reinstated along the area of the service diversions along with kerb replacement works. These works will provide a nominal improvement for pedestrians.

The NTA's BusConnects scheme appears to propose some footway works beneath the railway bridge at this location, to provide a wider footway on the eastern side – discussions with the NTA and DCC will continue in order to align implementation of the DART+ and BusConnects schemes where feasible. The junction of Sarsfield Road and Con Colbert Road is to be reconfigured as part of the BusConnects scheme but not DART+ South West.

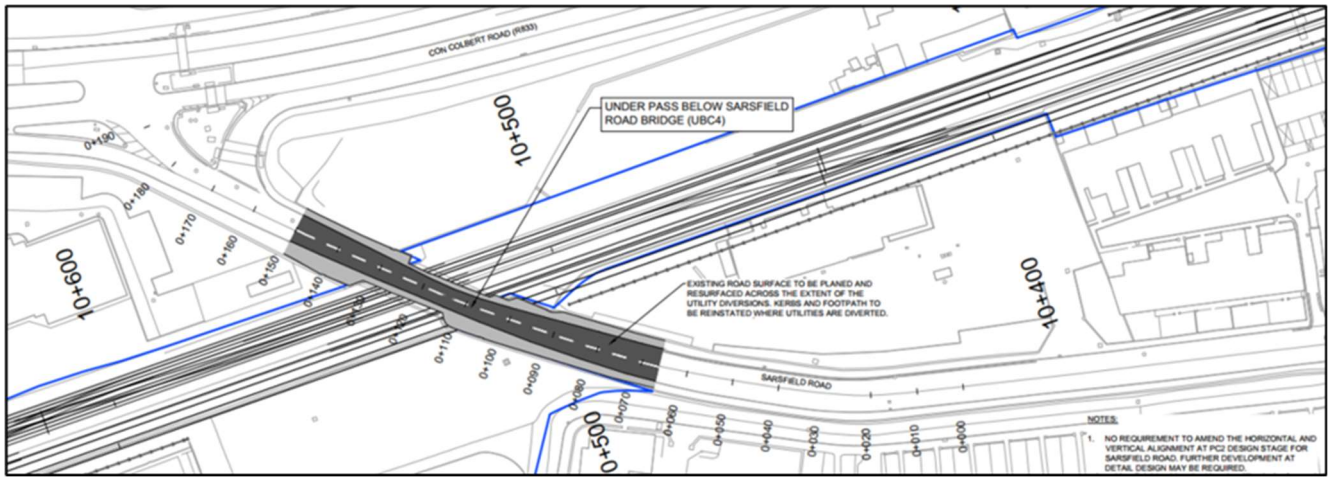

Figure 5-83 Sarsfield Road - Area of Road and Footpath Resurfacing

5.4.5.3. Modifications to Walls and Other Structures

The nature of the existing cutting slopes and walls, proximity of the adjacent domestic and other properties and height of the cutting slopes to be retained between Sarsfield Road and Memorial Road Bridge (OBC3), necessitates the construction of retaining walls along both the north and south sides of the rail corridor east of Sarsfield Bridge towards Memorial Road Bridge which are outlined in Table 5:12 and Table 5:13. This sub-zone begins at Memorial Road Bridge to the east and extends to the Sarsfield Road to the west.

Table 5:12: New / Replacement Retaining Walls (Northern Perimeter)

Chainage	Location	Proposed Retaining Wall	Height	New/Replaced
10+370 – 10+320 10+320 – 10+250	Con Colbert Road	King Post Wall + Secant Wall and anchors	2.2m – 4.6m high	New
10+240 – 9+510	Con Colbert Road to South Circular Road Bridge	Secant Wall + Secant wall anchors	4.6m – 10.2m high	New

Table 5:13: New / Replacement Retaining Walls (Southern Perimeter)

Chainage	Location	Proposed Retaining Wall	Height	New/Replaced
10+615 – 10+580	Inchicore Attenuation Facility	King Post Wall	2.0m	Replaced

Chainage	Location	Proposed Retaining Wall	Height	New/Replaced
10+500 – 10+310	West of Sarsfield Road Under-Bridge to rear of Woodfield Cottages	King Post Wall + Wall anchors	1.0m – 2.2m high	Replaced existing retaining wall at new location
10+310 – 10+160	West of Sarsfield Road Under-Bridge to rear of Woodfield Cottages	Secant pile wall + Secant wall anchors	2 – 3m high	Replaced existing retaining wall at new location

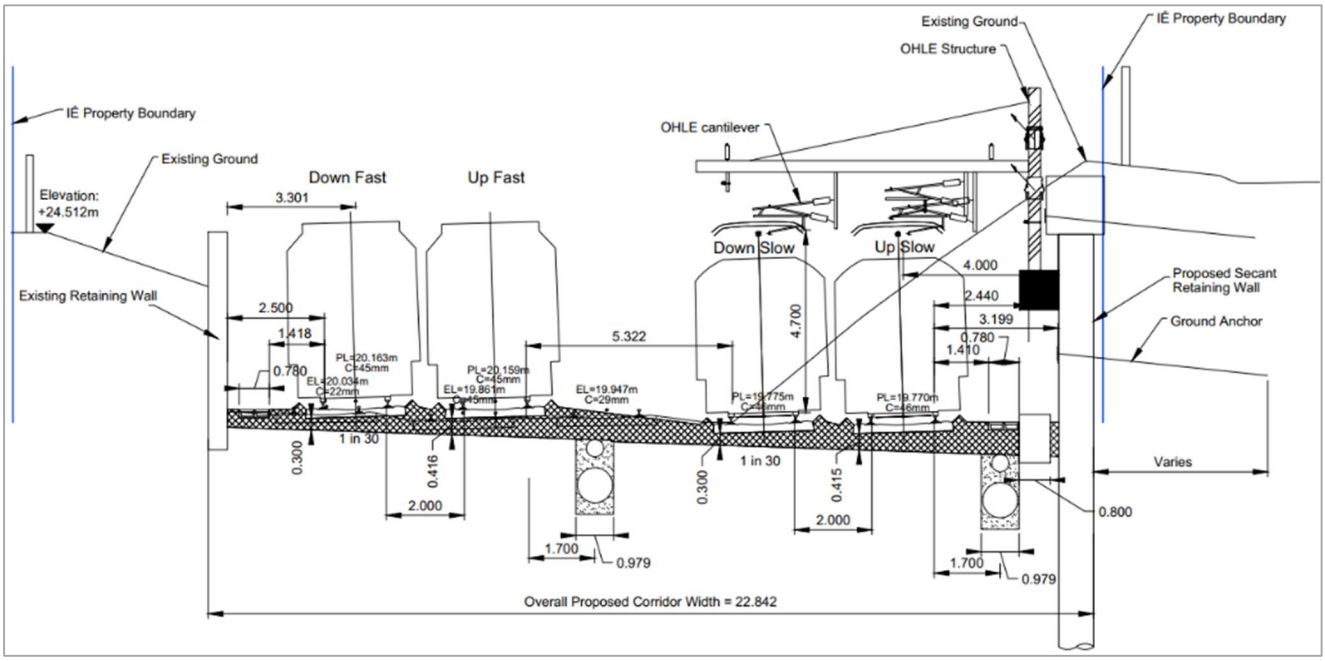

Figure 5-84 Cross Section - Between Sarsfield Road and Memorial Road - Looking West

5.4.5.4. Building/Structures Demolitions

The following demolitions are required as outlined in Table 5.14.

Table 5.14: Summary of Proposed Demolitions / Removal

Structure	Location Chainage	Heritage	Description	Conflict
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.

5.4.5.5. Substations

Thera are no substations proposed in this sub- section.

5.4.5.6. Utility Diversions

5.4.5.6.1. BT

One BT service will require a diversion in this area as it crosses under the tracks west of Memorial Road Bridge. Diversion routes are to be confirmed at detailed design stage with the SET team.

5.4.5.6.2. ESB

The existing LV cable under Sarsfield Road under-Bridge will be diverted due to works for the bridge. A temporary diversion will not be required; the permanent diversion will follow the same path as existing.

5.4.5.6.3. Gas Networks Ireland

Three gas mains running beneath Sarsfield Road Under-Bridge will require diversions due to the proximity to piling works for the bridge. Temporary diversions may be necessary while piling works are ongoing to ensure safety of existing gas mains in close proximity to the proposed piling operations.

5.4.5.6.4. Stormwater and Foul / Combined Sewers

There is a stormwater service located immediately west of Sarsfield Road Under-Bridge. It is likely that the Creosote Stream runs through it, however, as no significant lowering is planned at this location, it is unlikely that this culvert is required to be diverted.

5.4.5.6.5. Watermain

There are two watermain pipes beneath Sarsfield Road that require a permanent local diversion due to the close proximity of piling works for the bridge.

5.4.5.7. Temporary Traffic Management

Temporary utility diversions within 30-50m of the bridge will require localised traffic management that keeps the existing single lane yield system but likely requiring automated or manual control to improve the flow of traffic and give priority to public transport. The same will be used for the construction of the southern deck abutments to accommodate scaffold and shoring protection to the existing wall on the side of the abutment being constructed. Sarsfield Road Under-Bridge (UBC4) reconstruction itself requires two main types of closure of Sarsfield Road underpass and are described below.

- 24-72hr for existing deck demolition and portal frame installation, restricted to off-peak periods e.g. weekends.
- 30mins-2hrs for material cranage or concrete pours, restricted to off-peak hours e.g. 10am-2:30pm or late night subject to other noted considerations. Half day closures may be considered more manageable/practical. They will be subject to review and consultation with DCC. In all cases adequate forewarning will be given to residents and industry, through road closure licensing notice criteria.

Private Vehicles

The typical route for south/east bound traffic (using the Sarsfield Road underpass) will generally turn into Grattan Crescent and then either turn into Emmet Road or continue along Tyrconnell (R810) Road; both of which direct the vehicle towards the Royal Canal and/or the City Centre, and even onwards to the N7/Naas Road.

Diversion routes will be required by private vehicles including but not limited to: back to M50 via N4/Chapelizod Bypass; west via Kylemore or Le Fanu or Park West crossings; east along Con Colbert Chapelizod Bypass and into South Circular Road. The longest closures will be over weekend periods, it is anticipated that users will be distributed onto the surrounding network over those limited periods.

Many HGVs are already restricted from using Sarsfield Road due to the existing 4.37m constrained bridge clearance.

Vulnerable Users

Cyclists currently use vehicular lanes, and this is not intended to change during construction works associated with the abutments. Pedestrians will divert well in advance of the bridge to the opposite side of the road to which the abutment piling is taking place. Safety bracing will be in place on the works side of the road. The footpath along the eastern abutment is particularly narrow and will require stop/go control, as will the vehicles.

The number of full road closures will be limited, and duration will also be limited to a few days or half days at a time, over a period of 6 months (approx.). These short duration closures will be planned and communicated in advanced and require the necessary lane closure approvals. They will typically be off-peak closures.

For pedestrians this will require them using footpaths along Con Colbert Road and then re-joining their route via Memorial Road Bridge (OBC3). It is intended that the proposed temporary bridge at Memorial Road will be installed and in use if pedestrian access to the existing bridge is closed. Vehicular closure of the same, as previously stated, is not planned concurrently with Sarsfield Road. The proposed pedestrian diversion routes are shown in Figure 5-85 and Figure 5-86.

The cyclist diversion for eastbound routes (Refer to Figure 5-88) will be nominally longer than the westbound route (Refer to Figure 5-87) as it will require cyclists from the junction of Con Colbert/Sarsfield Road to proceed to the Con Colbert Road/Chapelizod Bypass junction and join the east bound cycle lane, before re-joining their original route via Memorial Road Bridge (OBC3).

Figure 5-85 Proposed Diversion Pedestrian (Westbound)

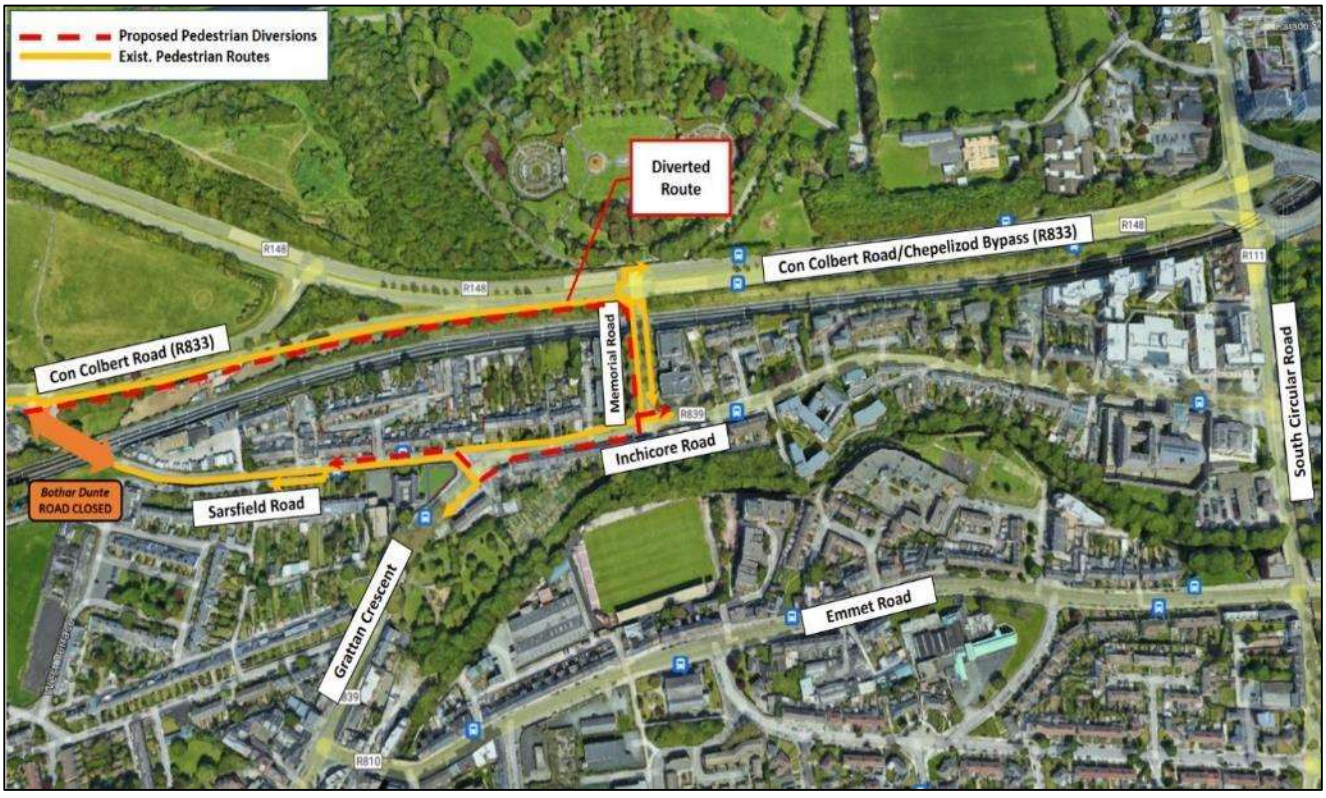

Figure 5-86 Proposed Diversion Pedestrian (Eastbound)

Figure 5-87 Proposed Diversion Cycle (Westbound)

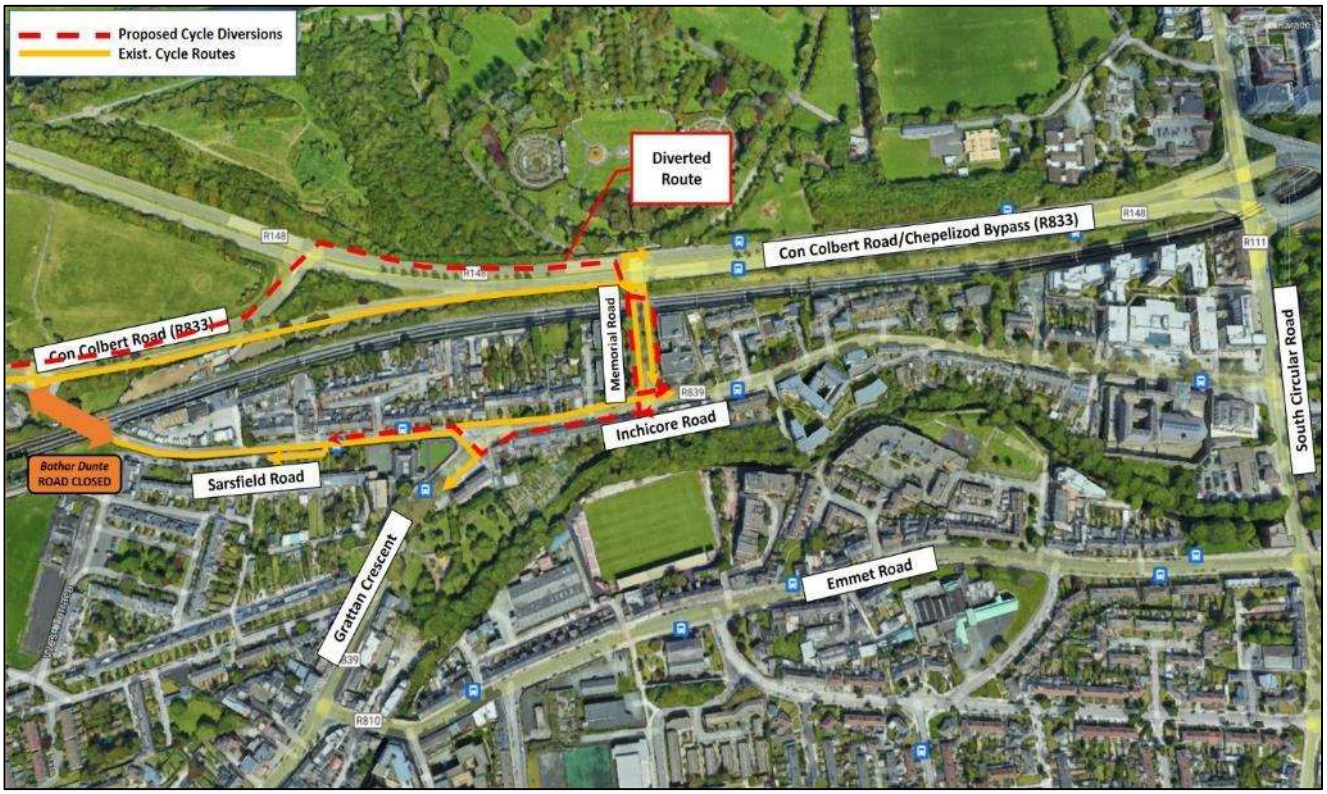

Figure 5-88 Proposed Diversion Cycle (Eastbound)

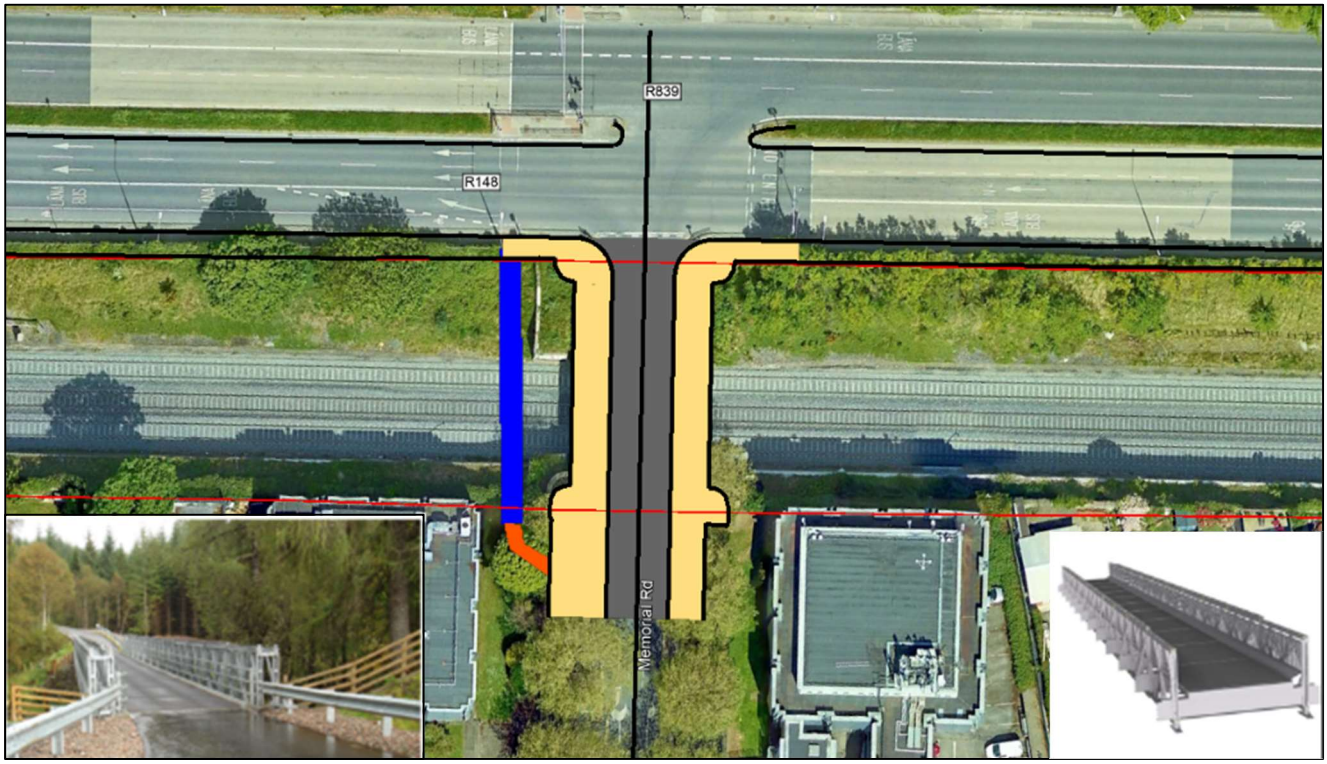

Figure 5-89 Proposed Temporary Vulnerable User Diversion (incl. Bridge)

Public Transport

Sarsfield Road (westbound lane) currently is designated for bus use only. Dublin Bus (Route Nos. G1 G2, 69 and 60) typically use the westbound lane of Sarsfield Road, passing through the underpass. These routes will be diverted, as shown in Figure 5-90 and Figure 5-91. This will be via Inchicore and Memorial Roads and on to Con Colbert Road/Chapelizod Bypass (R148), before taking the Con Colbert slip road and re-joining Ballyfermot Road (R833).

The same Dublin Bus Routes (noted above) that use the eastbound lane of Sarsfield Road passing under (UBC4) will be diverted, as shown in Figure 5-92 and Figure 5-93. Bus Route No. G2 will not be able to stop at the Woodfield Place Stop 2719 and as such bus users wishing to access or exit the Inchicore area will have to use Memorial Gardens Stop 7435. Bus Route No. G1 will also miss Woodfield Place Stop 2719 and all its eastbound stops in Emmet Road between Sarsfield Road and South Circular Road.

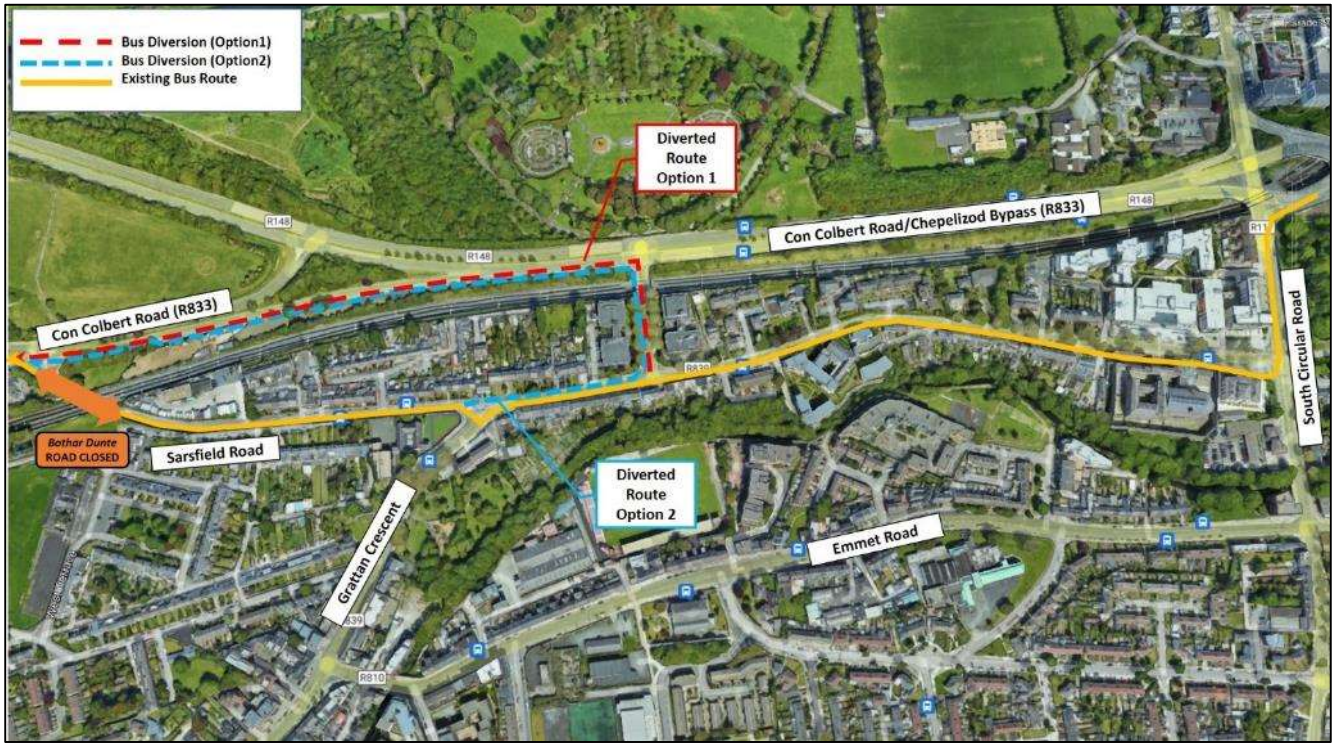

Figure 5-90 Proposed Diversion Dublin Bus Route G2 (Westbound)

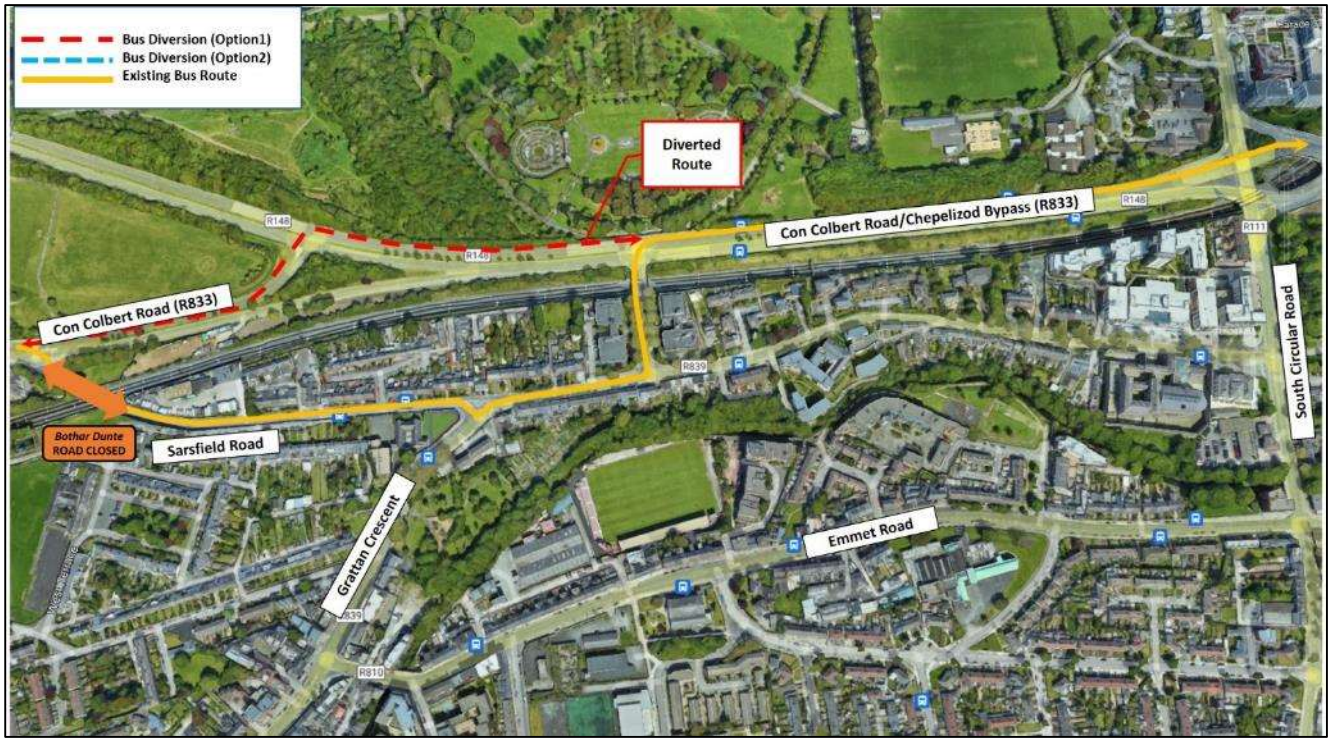

Figure 5-91 Proposed Diversion Dublin Bus Route G2 (Eastbound)

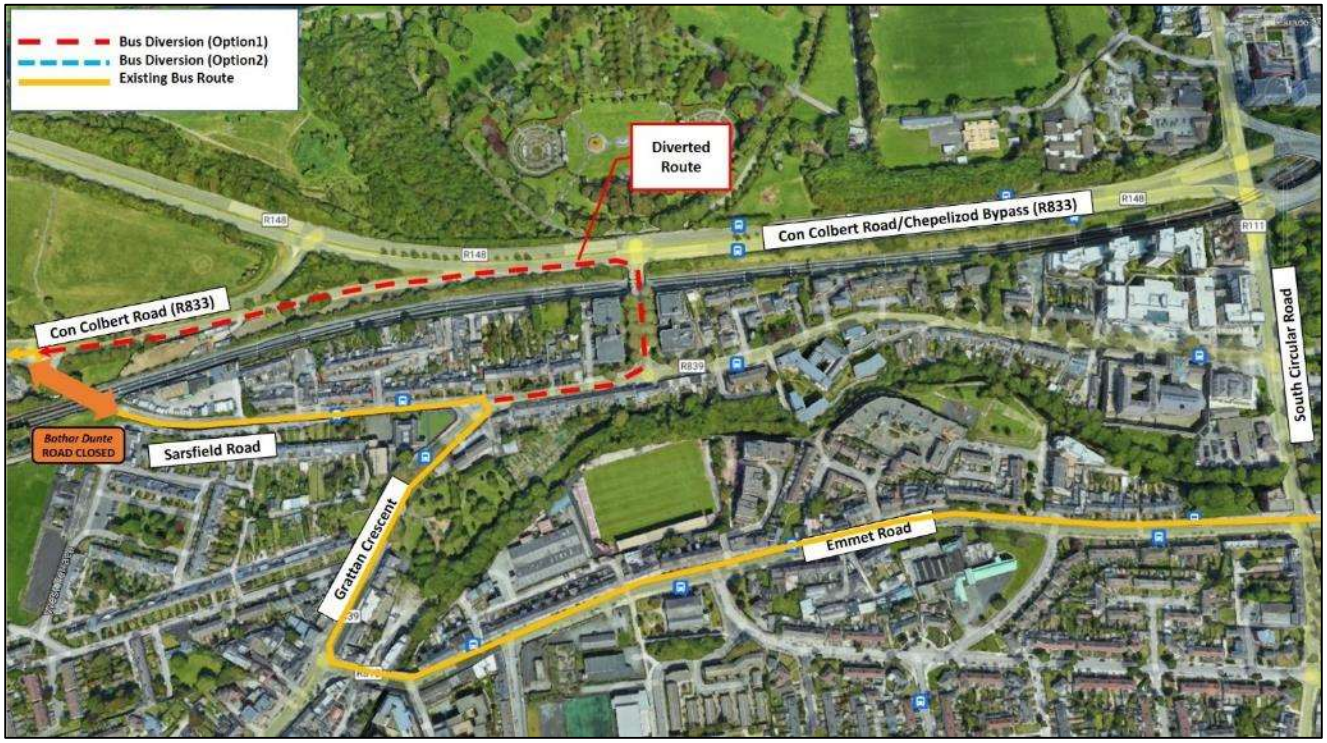

Figure 5-92 Proposed Diversion Dublin Bus Route G1 (Westbound)

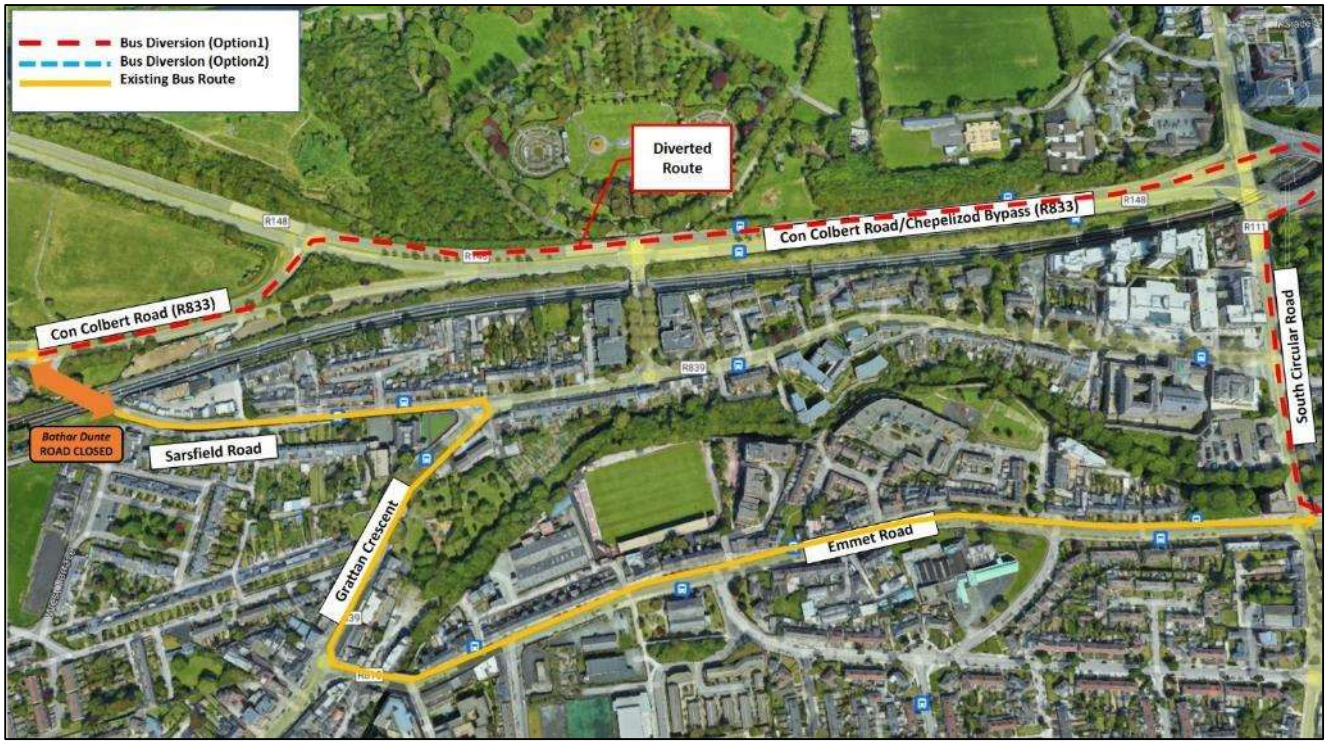

Figure 5-93 Proposed Diversion Dublin Bus Route G1 (Eastbound)

5.4.5.8. Construction Compounds

5.4.5.8.1. Sarsfield Road Construction Compound

The Sarsfield Road construction compound consists of three discrete sites proposed to facilitate the bridge reconstruction, underground attenuation tank installation, and localised works in the rail corridor (Refer to Figure 5-94). The general principle is to provide access to each corner of the bridge to facilitate the construction works.

The railway underbridge at Sarsfield Road will be widened to accommodate the widened track corridor. A new underground attenuation tank is also required in this area, as part of the modifications to the drainage system. The new tank will be located adjacent to the car park at the entrance to the CIÉ Inchicore Depot.

The Dan Ryan Truck Rental site which is located on the south side of the corridor, adjacent to Sarsfield Road Bridge will be impacted by the works in this area, primarily due to the widening of the rail corridor. The site is also the main access point for the construction of the southern retaining walls between Sarsfield Road and Memorial Road. As such, the site has been identified as a potential location for a construction compound. This site will provide access to the works on the south eastern corner of the Sarsfield Road Bridge and the boundary wall to the south of the corridor. A crane platform will be required to accommodate a crane which will be used to move materials to their permanent locations including the installation of bridge beams.

To the south west of the bridge is an existing flat grassed area and is required for access to the works on the south west of the bridge and for craning in of bridge beams. This area will be used to provide site offices, welfare facilities and storage, this section of the construction compound extends to the east to facilitate construction of the new underground attenuation tank.

The compound will include site offices, welfare facilities, security, material storage, earthworks and aggregate store, crane platform, precast beam and fabrication area.

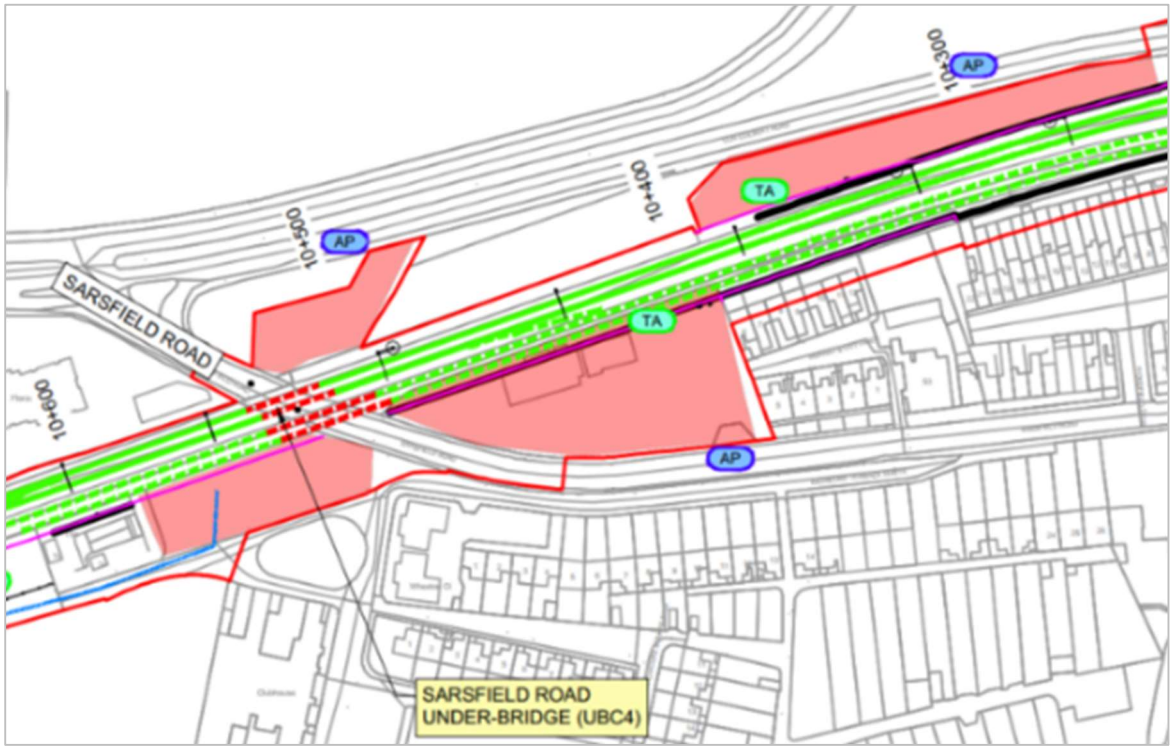

Figure 5-94 Sarsfield Proposed Construction Compound Locations

5.4.5.9. Haul Routes

5.4.5.9.1. External Haul Route

The external haul routes required in the Zones B-3 & B-4 can be identified in the Zone B haul routes Figure 5-95 below and are described in the following section along with localised haul routes for Zone B-3 and B-4 identified in Figure 5-96 and Figure 5-97.

Figure 5-95 Construction Zone B: External Haul Routes

Kylemore Road to Sarsfield Road (incl. Sarsfield Road Bridge)

Construction traffic associated with this area is also via from the R148 and the R110. The inbound and outbound routes are facilitated via Kylemore Avenue (R112), Kylemore Way, Landen Road as well as an exit route via the existing pedestrian right of way associated with the Khyber Pass Pedestrian Bridge (and Seven Oaks apartments fire tender exit). The exiting traffic will be required to turn left only and utilise the Landen Road roundabout in order to exit. Internal haul traffic is expected to be contained within the existing rail reserve and will not utilise external roads. The anticipated construction haul routes are shown in Figure 5-96.

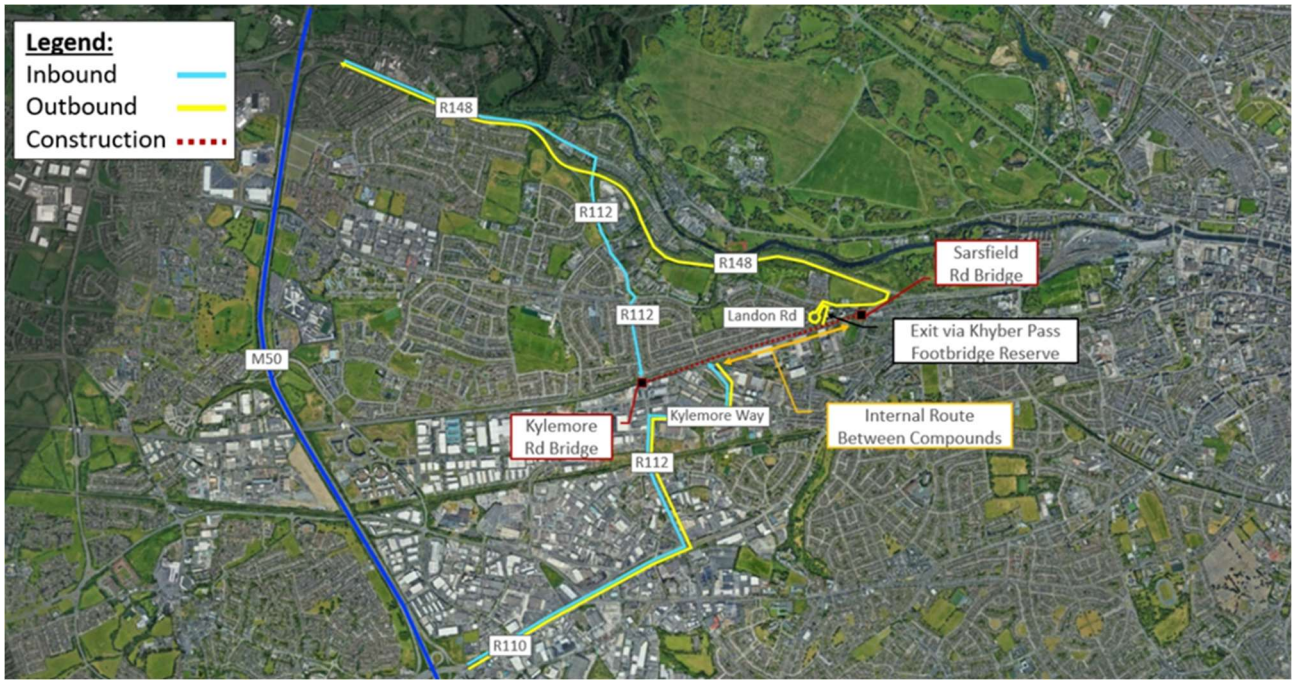

Figure 5-96 Kylemore Road to Sarsfield Road Haul Routes

Sarsfield Road to South Circular Road Junction

Construction traffic associated with this location is anticipated to be derived from the R148 and Ballyfermot Road (R833). Internal haul traffic is expected to be contained within the existing rail reserve and will not utilise external roads. The haul routes are outlined in Figure 5-97.

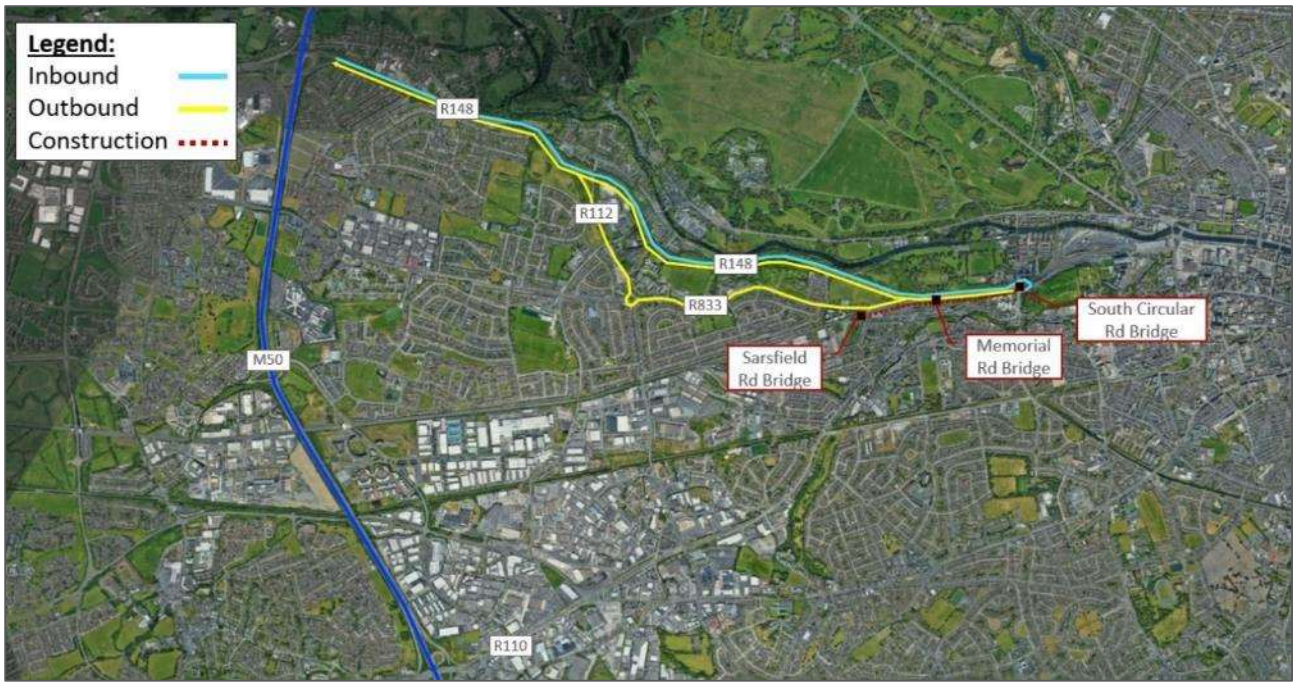

Figure 5-97 Sarsfield and SCR Junction Haul Routes

5.4.5.9.2. Site Haul Routes

Site haul routes are required along the southern boundary of the rail corridor, adjacent to Sarsfield Road Under-Bridge, the haul roads are required to facilitate the widening of the rail corridor in this section. The bus lane will become part of the site and be an additional site haul route during piling and

boundary wall reconstruction. The route of the proposed new electrified "Slow" lines to the north will be a haul route for embankment excavation that can't be done from road level, once piling works have reached an advanced stage.

5.4.6. Works between Memorial Road Bridge and South Circular Road Junction

5.4.6.1. Modification to Bridges

5.4.6.1.1. Memorial Road Bridge (OBC3)

Memorial Road Bridge (OBC3) is a short road that operates one way from Inchicore Road to Con Colbert Road. The bridge is required to be reconstructed to enable a greater span over the railway, with the number of tracks going from three to four. Memorial Road will not be constructed at the same time as South Circular Road or Sarsfield Road.

A temporary vulnerable user/ utility diversion bridge will be installed and utilities diverted prior to demolition of the existing bridge. Bored piled walls will be constructed along both sides to form abutments. Boring the piles on the south side will be done under night-time possession, but piles on the north side are far enough away from the live carriageway to enable daytime safe zone working. Where possible the northern abutment walls will also be piled at night in order to limit the duration of road closure. Following this work, the existing bridge will be demolished under possession. Seating beams and abutting precast concrete beams will be placed on each side using a crane. A deck slab will be poured over the beams and at the end diaphragms to tie the walls into the deck. Craning of precast beams will also be undertaken under possession, but deck slab and diaphragm stitches can be done during live operations.

5.4.6.1.2. South Circular Road (OBC1A)

The South Circular Road Junction is one of the busiest road junctions in Dublin. The junction occurs between the Con Colbert Road inbound from the M50 and the South Circular Road. The junction operates over capacity and queues occur at peak times in all directions.

The road operates on a one-way gyratory (circular) basis, controlled by traffic signals. Generally, there are 2-3 circulatory lanes and full pedestrian movement is catered for. On each boundary there are constraints:

- to the south of the rail corridor there is a high masonry wall with residential developments behind;
- to the north of the railways corridor there is a cut slope leading to the Con Colbert dual carriageway road;
- to the north east there is a large apartment development;
- To the north west of the junction a residential care home;
- To the south east is the demesne of Royal College of Kilmainham and immediate to the road is a cemetery;
- There are 2 existing bridges across the railway at this junction; South Circular Road Bridge and St Johns Road Bridge.

There are also significant utilities traversing the junction.

The proposed solution at this location is to construct a new cut and cover buried portal structure at South Circular Road Bridge (OBC1A). This structure will facilitate tracks at a lower level to that of the existing tracks to enable the OHLE to pass under the existing road with greater clearance. The proposed concrete structure will be constructed using cut and cover method. This means boring piled walls on either side working from ground level and then excavating between and placing a reinforced or prestressed concrete roof across from one wall to the other. The soil between the walls will then be excavated to formation level and the track placed.

The major constraint to the cut and cover method is the large piling equipment and support vehicles required to place the piles and remove the soil in such a tight working space. It is envisaged that this work will be done during normal daytime hours using a phased approach. This means restricting vehicle movements around the gyratory (circular) system using lane closes for site access and egress.

As the track levels will be different between the old and the new tracks, a retaining wall will be required between the fast and slow tracks. As this work is close to the operating railway, this wall will need to be constructed under possession. Most other tasks are offline from the railway so can be undertaken in a safe zone during railway operational times and less impact to local residents in terms of noise.

The construction of (OBC1A) will require a minimum of 2no. main phases of traffic management and associated construction works:

- Construct new western section of the structure (offline, but necessitates access using the first lane (Bus Lane) of the Con Colbert Road;
- Divert all utilities and traffic to the new western section;
- Construct remaining part of the box structure to the east of the new section; and
- Either leave utilities in place on the western section or divert back to road corridor.

H4a Containment Parapets will be installed to a height of approximately 2.4m above the footpath to the eastern end (exit) of the structure to match the existing height of parapet wall.

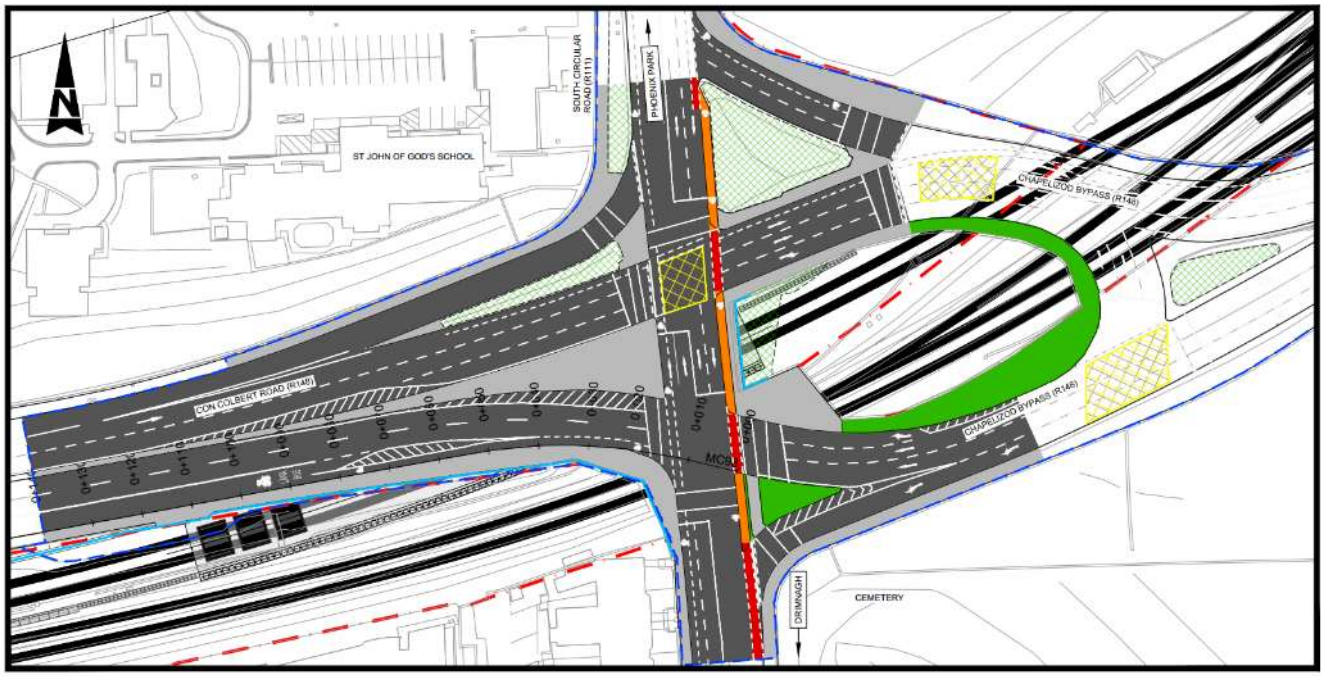

Figure 5-98 South Circular Road Junction Works

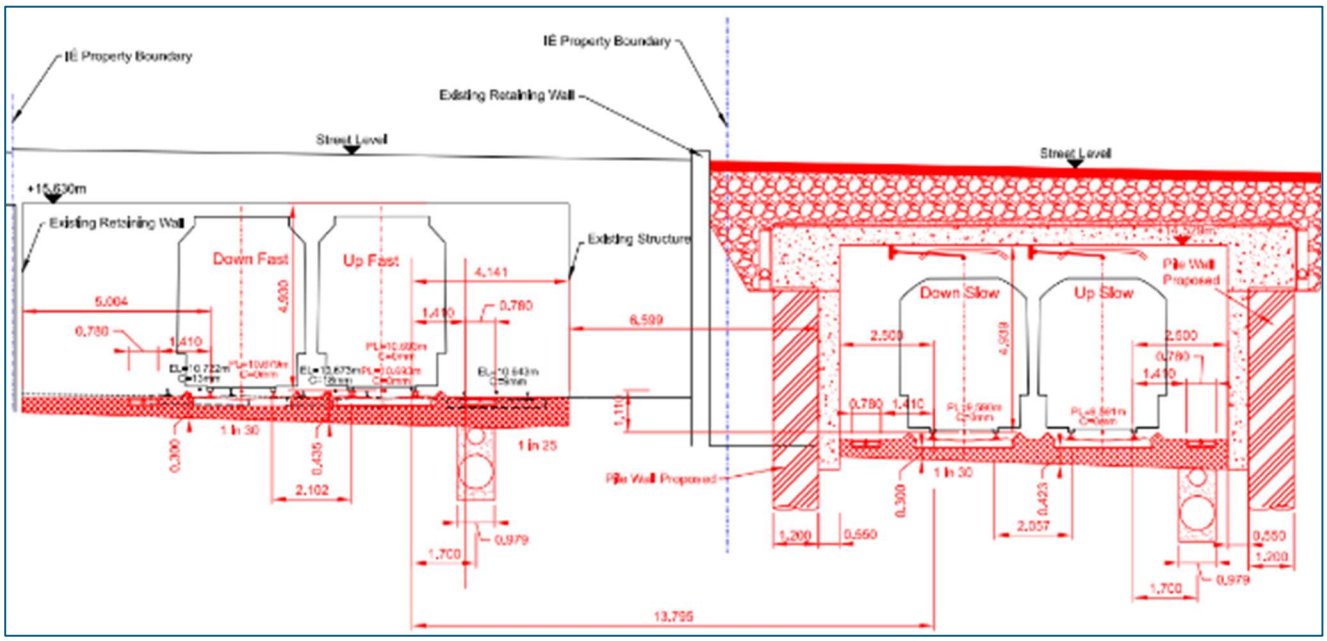

Figure 5-99 South Circular Road Bridge (OBC1) and New Cut and Cover Structure (OBC1A) – Cross section at Ch 9+401, View Facing West

5.4.6.2. Modification to Roads

5.4.6.2.1. Memorial Road

The road works requirement for Memorial Road will extend 10-15m from the bridge abutments by way of tie-ins to Con Colbert Road/Chapelizod By-pass and down Memorial Road footpaths. The bridge will be closed for 3 - 4 months after the abutment walls (which will require night/weekend works) are complete on the north side. The construction will include full depth road reconstruction for both the carriageway and the adjacent footpath and cycle way arrangement.

The road works outside the bridge footprint can commence during the bridge deck and parapet curing phase to minimise the duration of the road closure. The signal installation will also follow suit but may remain operational under temporary signalisation until full commissioning can take place.

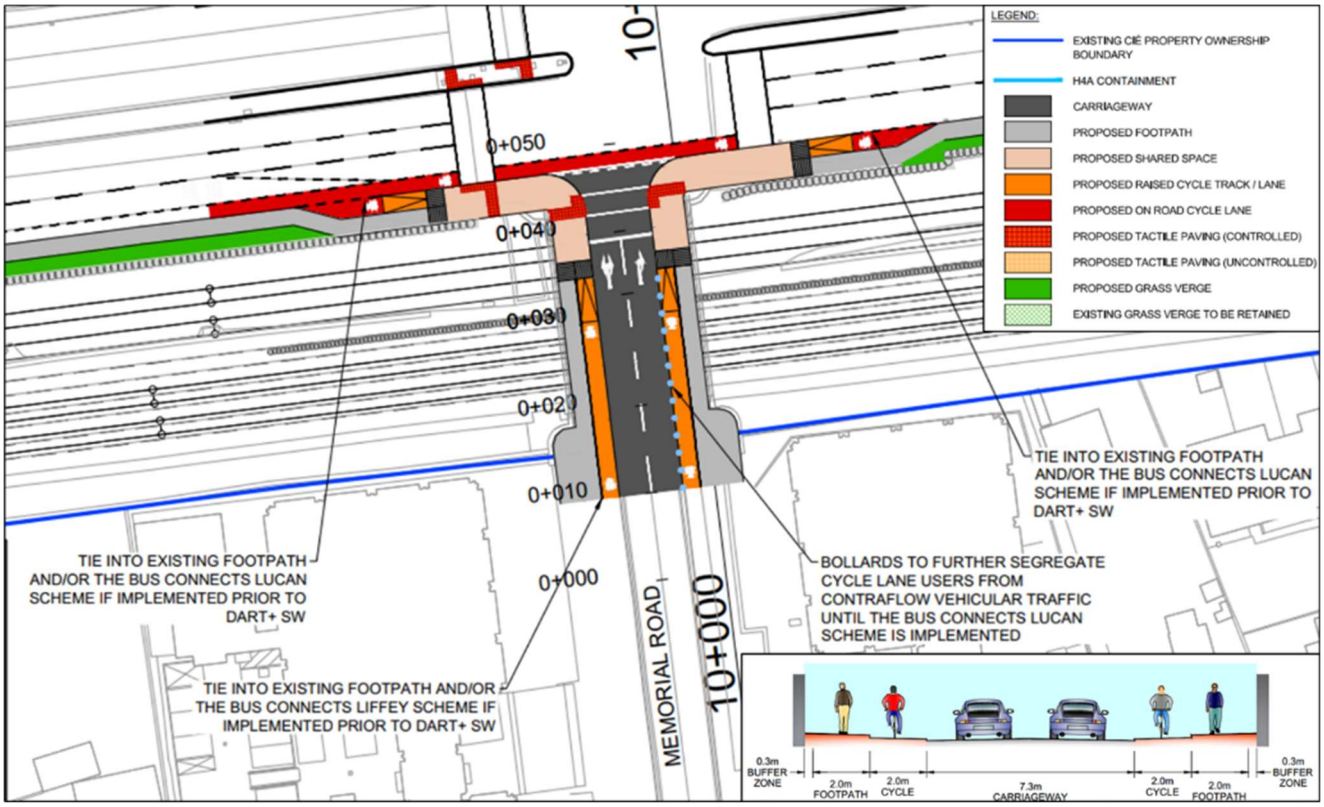

Figure 5-100 Memorial Road - Area of Road and Footpath Resurfacing

5.4.6.2.2. Con Colbert Road/Chapelizod By-pass and South Circular Road Junction

The new cut and cover buried portal structure at South Circular Road Bridge (OBC1A) will be constructed in phases, in order to manage the high volumes of traffic through the junction. Full depth road reconstruction will take place over the structure, once the slab construction has been completed for a specific phase.

In order to complete the Phase 1 section, the future track access maintenance parking area (Refer to Figure 5-101) and a portion of retaining wall will need to be constructed on top of the structure in advance of completing the full road reconstruction.

Con Colbert Road (west of South Circular Road) road levels will be amended slightly to facilitate the construction of the cut and cover portal structure.

The local diversions through the works area will result in will be fully re-kerbed and reconstructed to accommodate the new utility layouts and signal locations. Once all kerb lines are completed then the final surface and wearing course will be constructed in a phased manner.

If the BusConnects Lucan Scheme works are implemented before DART+South West, then the prevailing scheme in existence at the time will be reinstated accordingly.

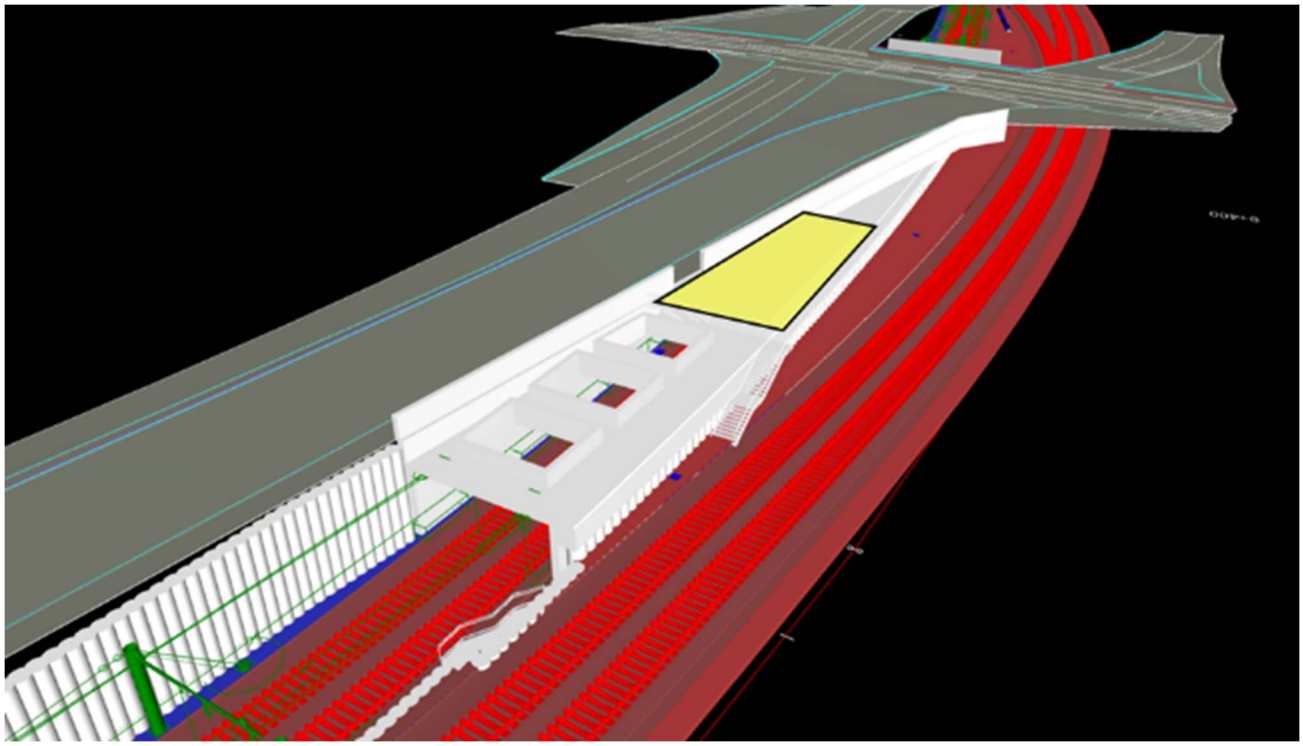

Figure 5-101 South Circular Road (OBC1A) – Track Access Maintenance Parking Area (Shaded in Yellow)

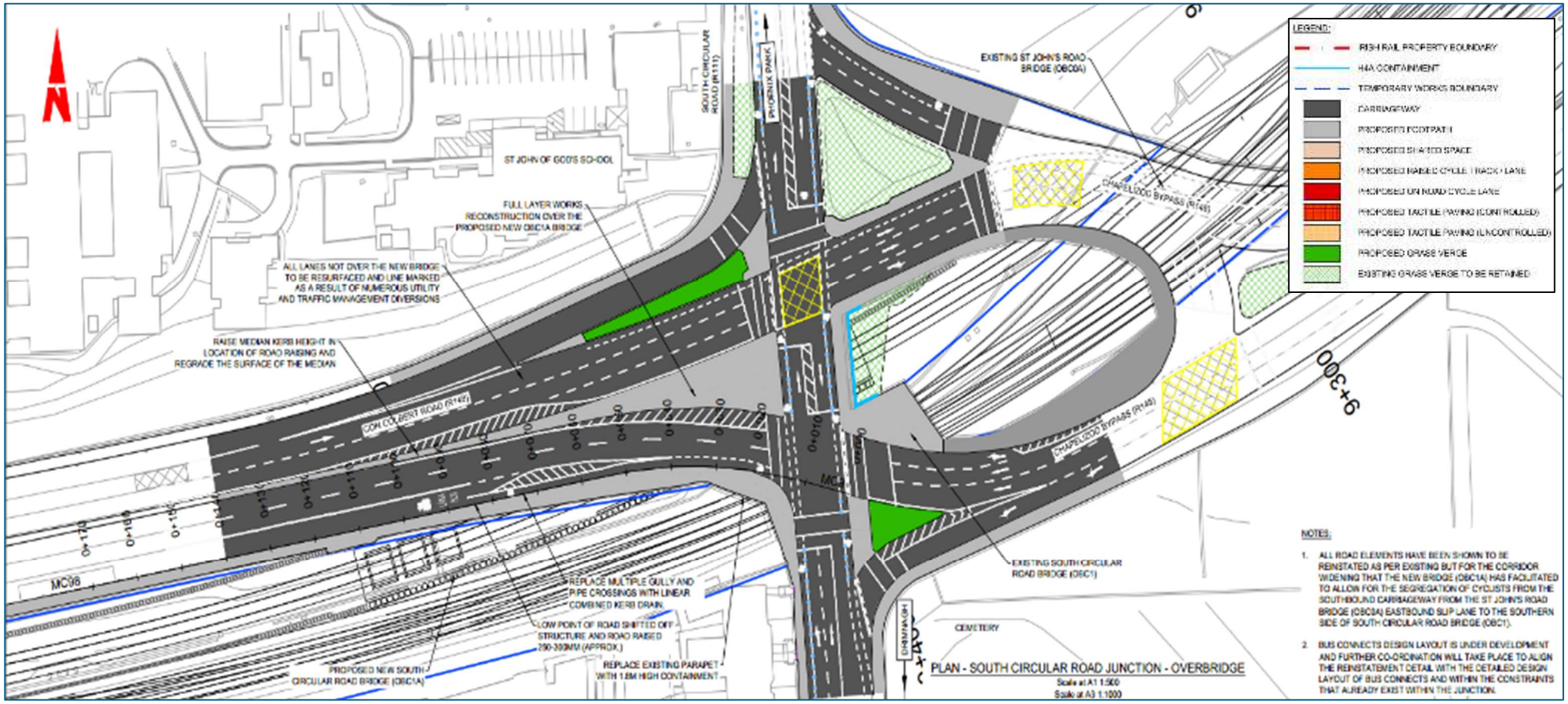

Figure 5-102 South Circular Road Junction – Proposed Road Works in Plan

5.4.6.3. Modification to Walls and Other Structures

5.4.6.3.1. Retaining Walls

This sub-zone begins to the east of Memorial Road Bridge and extends to the South Circular Road to the east. The existing cut slope will be widened toward Con Colbert Road and the top of the wall will be approximately 4m from the road once complete. To build the retaining wall, in this area, requires the existing road/rail corridor boundary wall to be demolished (see section on boundary walls in Table 5.15 below).

Table 5.15: New / Replacement Retaining Walls (Northern Perimeter)

Chainage	Location	Proposed Retaining Wall	Height	New/Replaced
10+240 – 9+510	Con Colbert Road to South Circular Road Bridge	Secant Wall + Secant wall anchors	4.6m – 10.2m high	New
9+400	South Circular Road	Secant Wall + Secant wall anchors	8.2m – 10.2m high	New

It is proposed that a bored secant pile wall solution will be adopted for the section of retaining wall along the northern perimeter. The retaining wall will be constructed utilising access from a combination of both road and rail side but mainly from the road. Suitable protection will be required to mitigate the potential for damaging the road kerb line and carriageway surface.

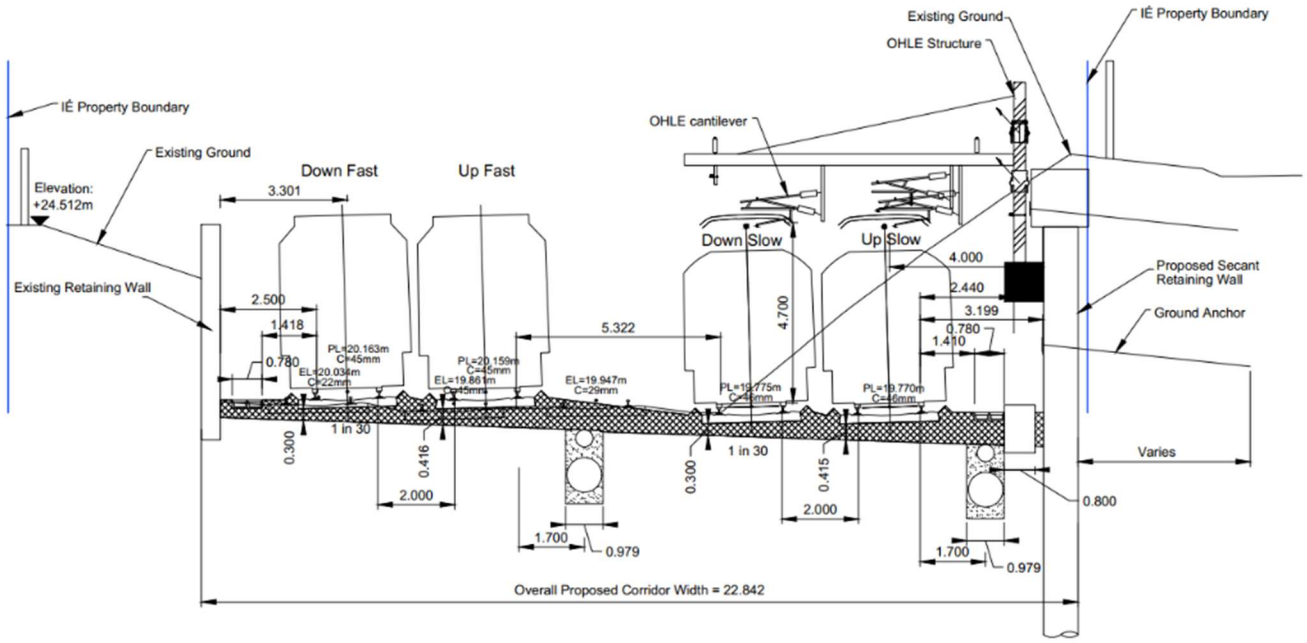

Figure 5-103 Cross Section West of Memorial Road Bridge (OBC3) - Facing West

To minimise the pile size and associated lateral movement of the walls, it is proposed to tie the walls using ground anchors that will extend beneath Con Colbert Road/Chapelizod By-pass (R148). The

length of the anchors will vary based on the height of the cutting slope to be retained and are anticipated to be approximately 15 to 20m in length. The ground anchors will be installed utilising access from track side within CIÉ lands.

To accommodate the proposed widening, track lowering along the northern slow lines will be required. To facilitate the level difference between the northern and southern lines, a retaining wall will be required between the slow and fast tracks. A bored pile solution is proposed..

5.4.6.3.2. Boundary Walls

The reinstated boundary walls along Con Colbert Road/Chapelizod Bypass are proposed to be relocated atop the edge of cess retaining walls. These walls will be required to provide H4a containment level protection to road traffic. A minimum total height of 1.8m with no handrails and a 45-degree symmetrical steeple coping will be provided. This will be a full-height H4a precast concrete parapet/wall with a masonry-type cladding finish on the roadside face to be in keeping with the local environment. Masonry cladding is not permitted to the rail side face of these parapets.

The foundation will be integrated into the pile cap with the containment wall extending above the finished footpath level by a minimum of 1.2m (in some locations this may also serve to retain the footway). It is proposed that the total boundary wall height above the footpath be 2.4m (the additional height above the H4a containment will be comprised of a 0.6m of concrete wall extension, with the upper 0.6m being an anti-scalable fence). The walls will be completed with a stone masonry finish in keeping with the walls at South Circular Road Junction (and the existing historical stone masonry boundary wall between Memorial Road and the Con Colbert Road slip to Ballyfermot. The footpath adjacent to the old wall will be reinstated once all the walls are completed.

5.4.6.4. Building/Structures Demolitions

The following demolitions are required as outlined in Table 5.16.

Table 5.16: Summary of Proposed Demolitions / Removal

Structure	Location Chainage	Heritage	Description	Conflict
Signalling Gantry	9+840	No	Signalling Gantry	Signalling Gantry to be removed and replaced with new gantry structures in similar area but accounting for the revised track layout/widening
Signalling Gantry	9+210	No	Signalling Gantry	Signalling Gantry to be removed and replaced with new gantry structures in similar area but accounting for the revised track layout/widening

5.4.6.5. Substations

No substations are proposed in this sub-section.

5.4.6.6. Utility Diversions

5.4.6.6.1. Aurora

Temporary and permanent diversions are required for one Aurora fibre optic cable within South Circular Road Bridge. The cable will be diverted in a phased approach; it will be diverted temporarily to the east during Phase 1 followed by a permanent diversion to the west to facilitate Phase 2.

An example of this phased approach is shown below; the principle is applicable to all service diversions for South Circular Road (with diversion routes differing for each utility).

5.4.6.6.2. Eir

There are three Eir services located in Memorial Road Bridge. These will be temporarily diverted across the proposed temporary bridge prior to works on the new Memorial Road Bridge. The permanent diversion will be located in the footpath of the newly constructed bridge.

Temporary and permanent diversions are required for several Eir assets within South Circular Road Bridge. The cables will be diverted in a phased approach; all cables will be diverted temporarily to the east during Phase 1 followed by a permanent diversion to the west to facilitate Phase 2.

5.4.6.6.3. ESB

There is one ESB diversion located in Memorial Road Bridge. The service will be temporarily diverted across the proposed temporary bridge prior to works on the new Memorial Road Bridge. The permanent diversion will be located in the footpath of the newly constructed bridge.

Temporary and permanent diversions are required for four ESB cables within South Circular Road Bridge. The cables will be diverted in a phased approach; all cables will be diverted temporarily to the east during Phase 1 followed by a permanent diversion to the west to facilitate Phase 2.

5.4.6.6.4. Gas Networks Ireland

Temporary and permanent diversions are required for one gas main within South Circular Road Bridge. The gas main will be diverted in a phased approach; it will be diverted temporarily to the east during Phase 1 followed by a permanent diversion to the west to facilitate Phase 2.

5.4.6.6.5. Watermain

There are three watermains present in Memorial Road Bridge, two of which are large trunk mains. The service will be temporarily diverted across the proposed temporary bridge. The permanent trunk main diversions will be located between the beams of the newly constructed bridge while the other smaller watermain will be laid in the footpath.

A permanent diversion will be required for one watermain within South Circular Road Bridge. The watermain will not be diverted in a phased approach as the service can be turned off for the duration of the works for South Circular Road Bridge. The permanent diversion will follow the same route as the existing and will be installed after Phase 2 is complete.

5.4.6.6.6. Virgin Media

Temporary and permanent diversions are required for one Virgin Media fibre optic cable within South Circular Road Bridge. The cable will be diverted in a phased approach; it will be diverted temporarily to the east during Phase 1 followed by a permanent diversion to the west to facilitate Phase 2.

5.4.6.6.7. Vodafone

Temporary and permanent diversions are required for one Vodafone fibre optic cable within South Circular Road Bridge. The cable will be diverted in a phased approach; it will be diverted temporarily to the east during Phase 1 followed by a permanent diversion to the west to facilitate Phase 2.

5.4.6.7. Temporary Traffic Management

5.4.6.7.1. Memorial Road Bridge (OBC3) Closure

Memorial Road Bridge (OBC3) reconstruction requires a full closure of the crossing from Inchicore Road to Con Colbert Road. The temporary traffic management solutions are set out below.

Sarsfield Road's (westbound lane) currently is designated for bus use only but it is acknowledged that other forms of transport do use the lane. It is anticipated that these traffic patterns will be retained with no additional traffic as a result of the diversions. The R833 (Ballyfermot Rd) / Sarsfield Road junction is restrictive (only allows a left-turn) and is therefore not anticipated to serve as a practical diversion route for Memorial Road Traffic.

Traffic from Naas Road via Tyrconnell Road (all the R810) through Grattan Crescent that will typically use Memorial Road to head east into the City Centre or down South Circular Road are expected to divert initially using Emmet Rd as well as the R111 (South Circular Road) as represented by the yellow route in Figure 5-104.

Road users which originate from the areas surrounding Inchicore Road, Sarsfield Road and Grattan Crescent are anticipated to follow a similar routing to the vehicles originating from the south. Vehicles will travel northwards along Grattan crescent before making a left-turn onto Emmet Road. They will then travel onto South Circular Road and redistribute at the Chapelizod Bypass / South Circular Road Junction. The routing is represented by Cyan in Figure 5-105. It should however be noted that, based on the existing configuration of the Chapelizod Bypass / South Circular Road Junction, eastbound vehicles will be required to travel into the city via Conyngham Road unless a short-term right turn movement can be facilitated to the northbound direction on the South Circular Road Bridge. This adjustment is consistent with the proposed configuration of the junction following the implementation of BusConnects. The BusConnects layout is shown in Figure 5-106.

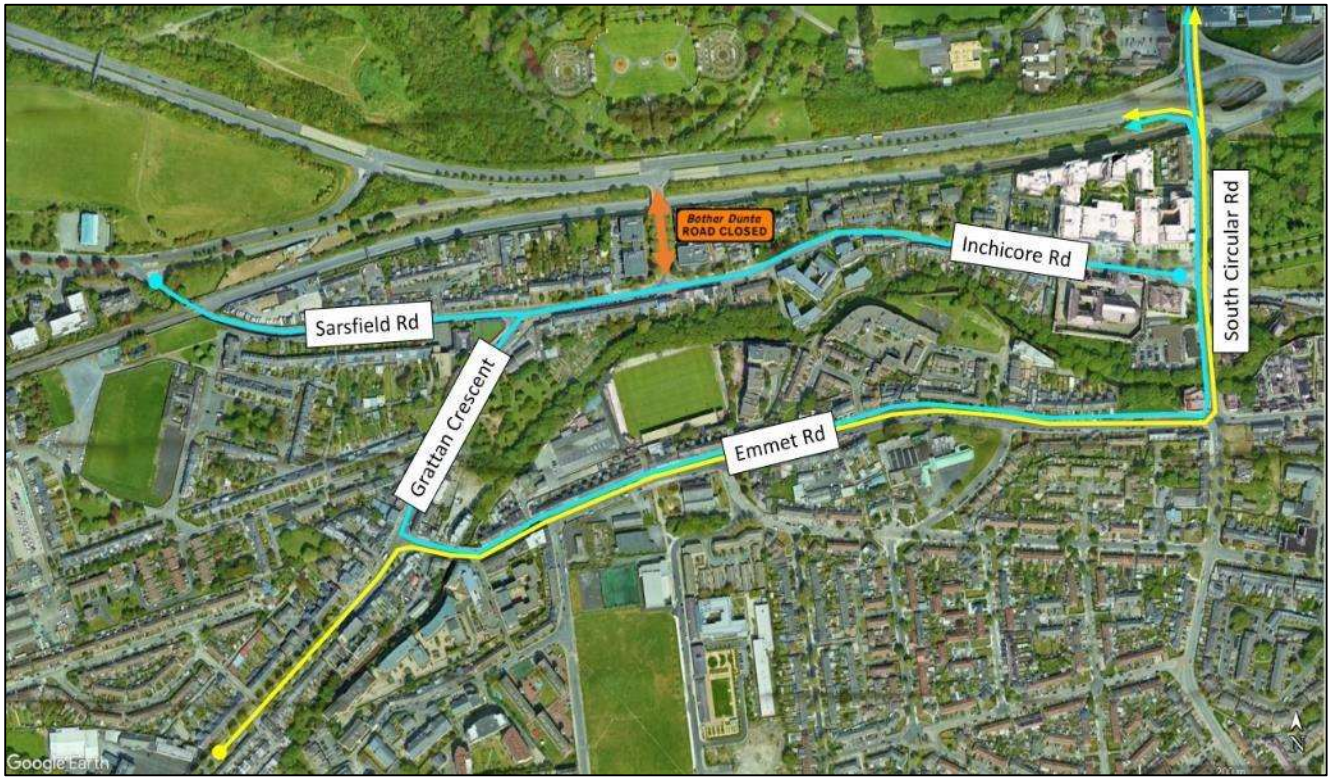

Figure 5-104 Proposed Vehicular Diversion Routes and/or Indicative Dispersion Patterns

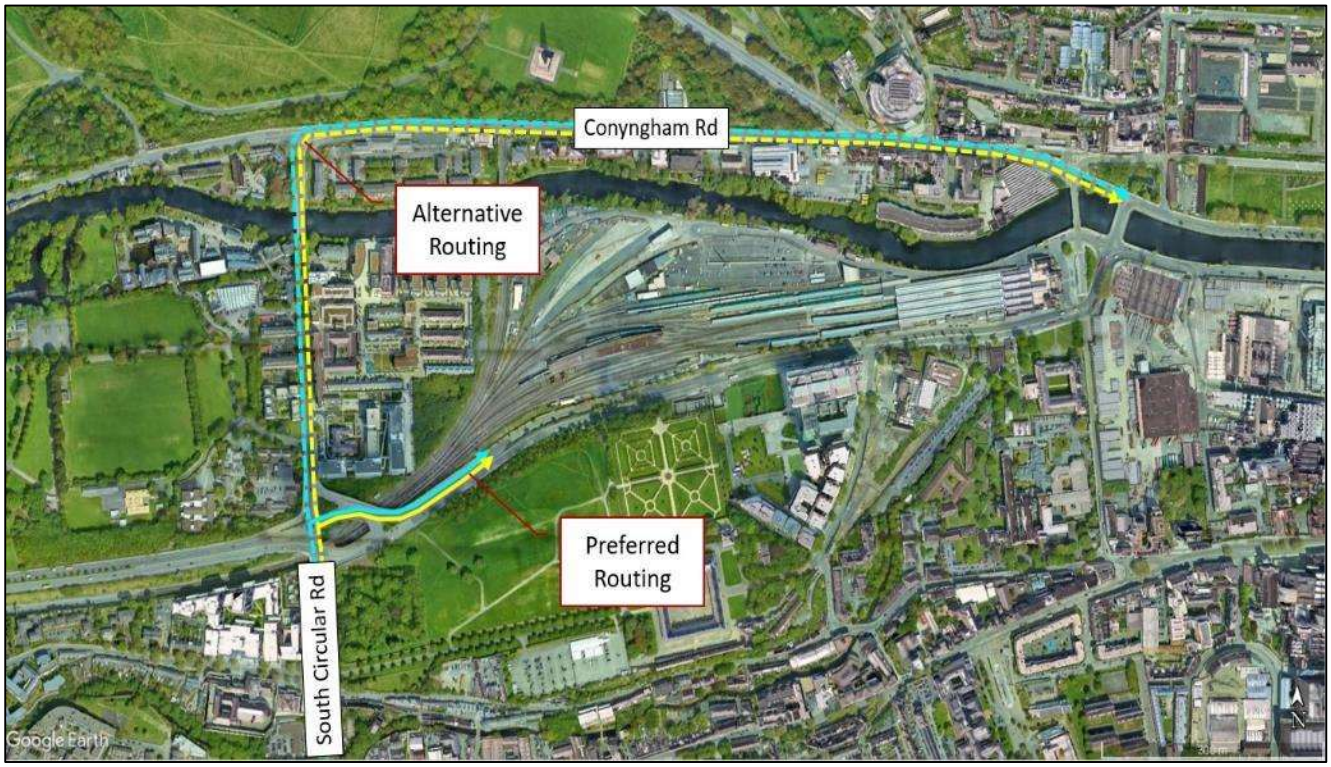

Figure 5-105 Eastbound Traffic Routing

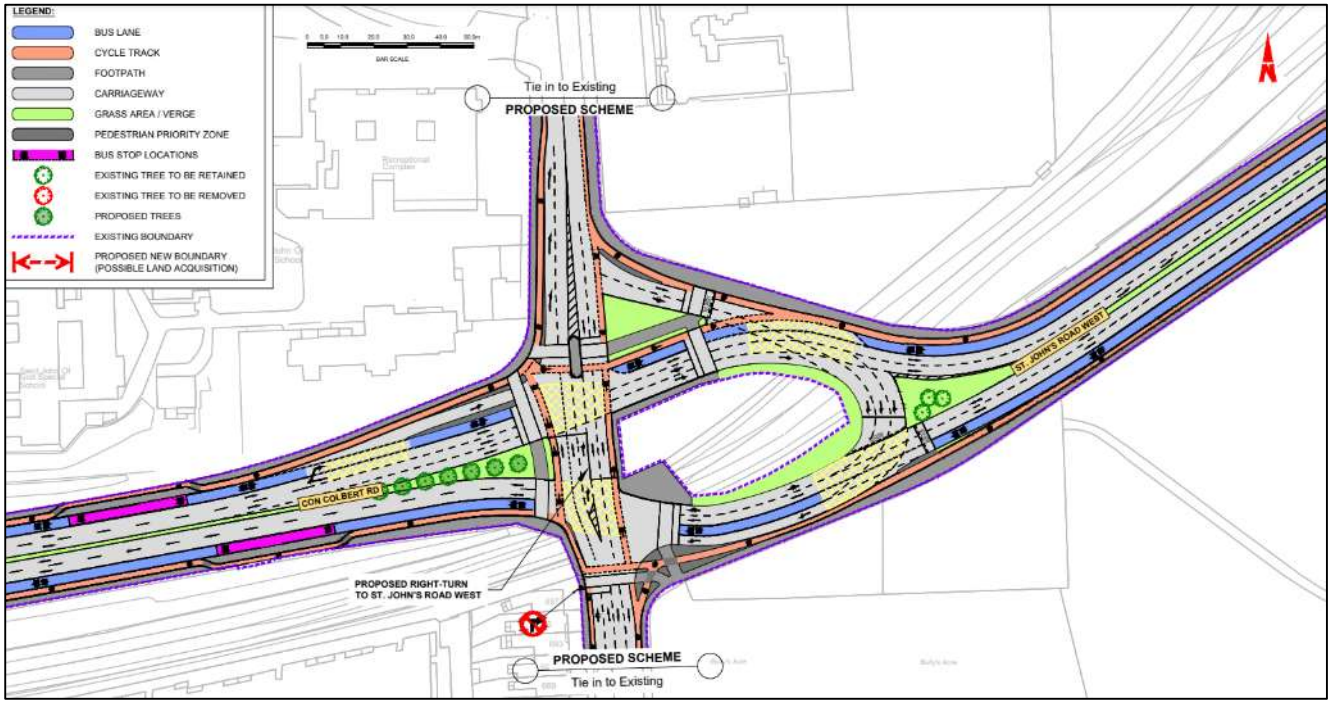

Figure 5-106 Proposed Junction Layout BusConnects

Vulnerable User Diversion

Traffic approaching from the south west along Grattan Crescent can use Sarsfield Road (currently no left turn and will require a change by Dublin City Council) and traffic approaching from the west can either use the South Circular Road or continue to Sarsfield Road. Note that Sarsfield Road has height restrictions (4.37m) so signage would be required in advance to divert high vehicles away from this road. Sarsfield Road also only permits buses and cyclists travelling south and has one way working under the bridge so will require a change by Dublin City Council and it may lead to queueing at peak times. An alternative to Sarsfield Road for those travelling west will be to divert traffic to Ballyfermot to reach the Chapelizod bypass via Kylemore Road.

The works will cater for pedestrians / cyclists and utilities during construction, and it is proposed that a temporary bridge will be constructed adjacent to the existing/ proposed bridge to accommodate these.

Vulnerable Users (Pedestrians, Wheelchair users and Cyclists)

Memorial Road is also a well-used pedestrian route providing connectivity between Memorial Park (north of Con Colbert Road) for those residing working or visiting Kilmainham and Inchicore areas. In addition, it provides a safer and shorter route for vulnerable users attending the St John of God's special needs school (rather than crossing at South Circular Road junction).

The Con Colbert Road pedestrian crossing is currently only 2.1m wide (controlled by median pedestrian safety fencing) to the west of the junction. It is proposed to provide a 3.15m width temporary bridge for continuous vulnerable user access to their original route. This is compliant for facilitating passing movements between wheelchair users, cyclists and/or pedestrians.

While this is not as wide as that currently available for use by pedestrians and cyclist, it is the best available alternative due to the area being space constrained. In addition, as mentioned above, the footpath along Con Colbert Road and its crossing both have less width than the 3.15m proposed. The

Con Colbert Road pedestrian crossing is currently only 2.1m wide (controlled by median pedestrian safety fencing) to the west of the junction.

The eastern footpath of Memorial Road will be closed for the duration of the works as well as the southern footpath of Con Colbert Road (east of Memorial Road), while the footpath to the west of the temporary bridge up to the slip road leading towards Sarsfield Road will also be closed until such time as the railway/road corridor boundary wall has been reinstated onto the new piled retaining wall. Those that will normally use this section of footpath to access Memorial Park will need to walk via Sarsfield Road and cross the temporary bridge referred to above.

The southern footpath on Con Colbert Road will be closed during construction of this section. Alternative routes for pedestrians using this path are shown in Figure 5-107.

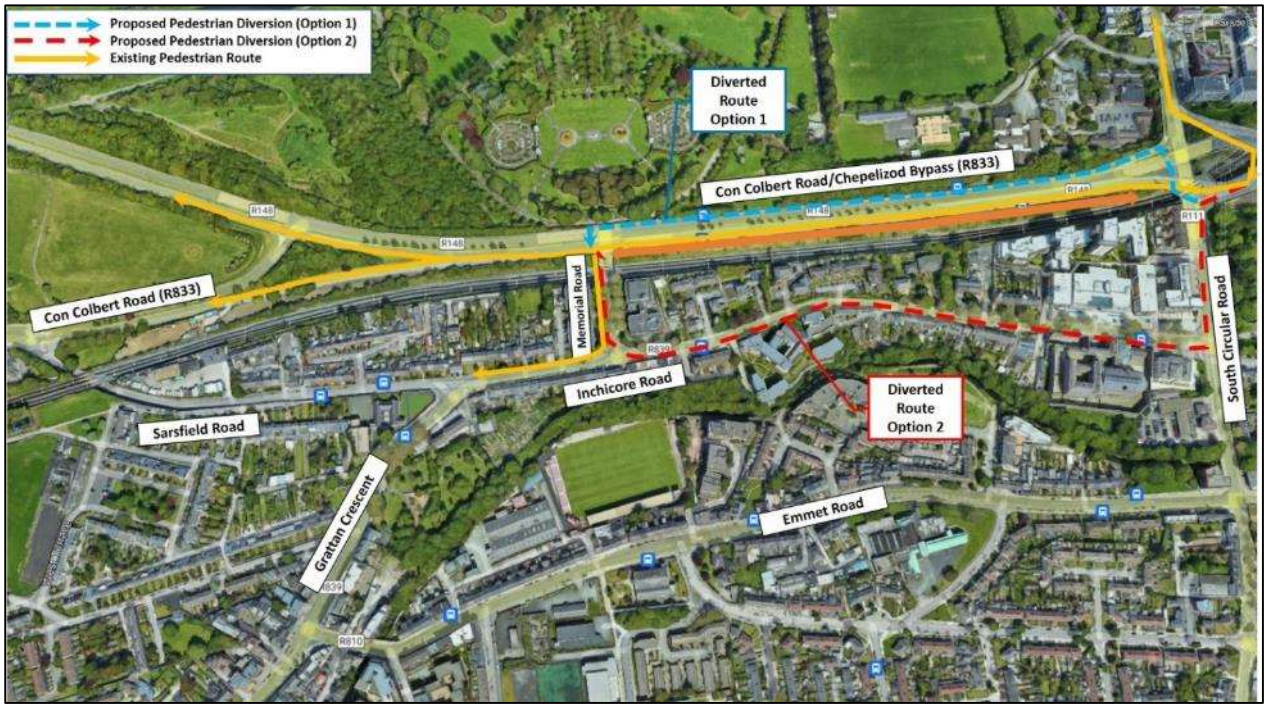

Figure 5-107 Proposed Pedestrian Diversion Routes (Westbound)

Public Transport

The only bus routes currently utilising Memorial Road are Dublin Bus Routes 60 & 69. The full closure of Memorial Road will require a diversion of both routes via Emmet Road and South Circular Road, or alternatively divert Route 60 before it enters Sarsfield Road. The proposed diversion is shown in Figure 5-108.

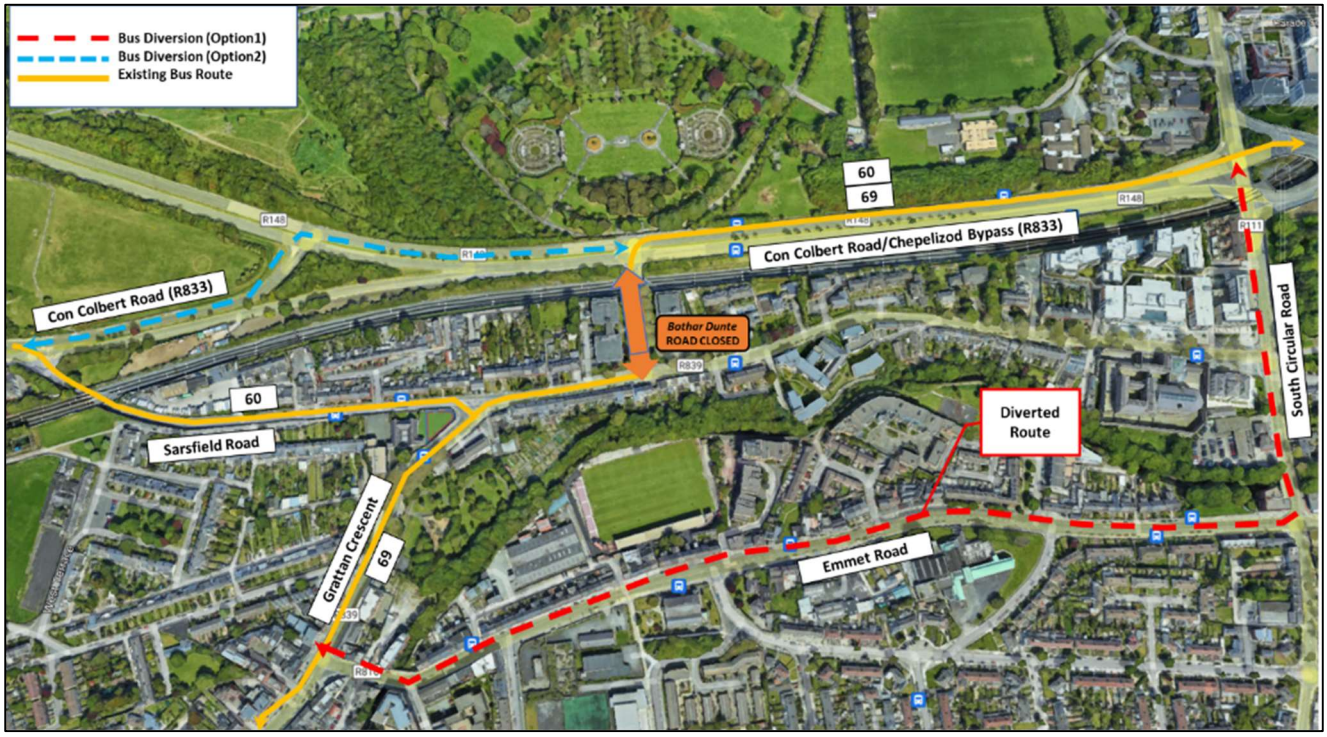

Figure 5-108 Proposed Bus Route Diversion Dublin Bus Routes 60 & 69

5.4.6.7.2. South Circular/ Con Colbert Road/Chapelizod Bypass Diversions

The construction of the new cut and cover structure at South Circular Road Bridge (OBC1A) requires a minimum of two significant traffic management diversions, plus numerous shorter duration localised diversions, to facilitate temporary utility diversions in advance of these traffic management phases. The two major temporary traffic management layouts are shown in Figure 5-109 and Figure 5-110.

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

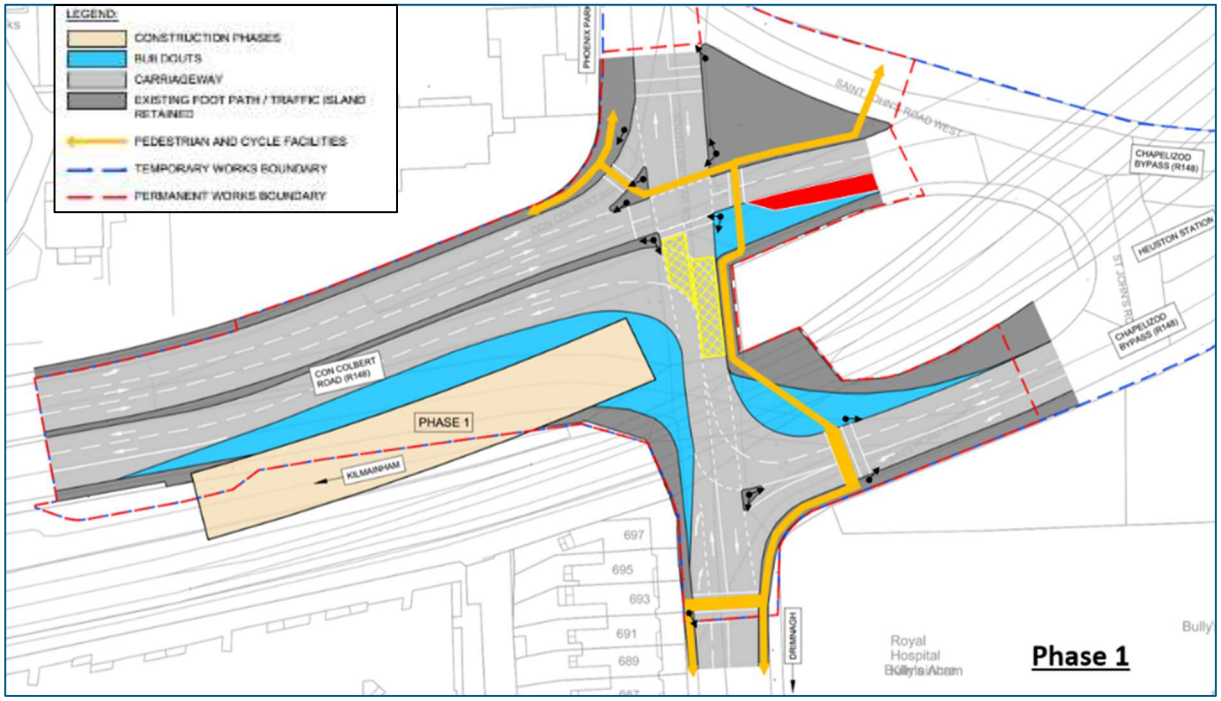

Figure 5-109 Proposed Temporary Traffic Management for OBC1A – Phase 1

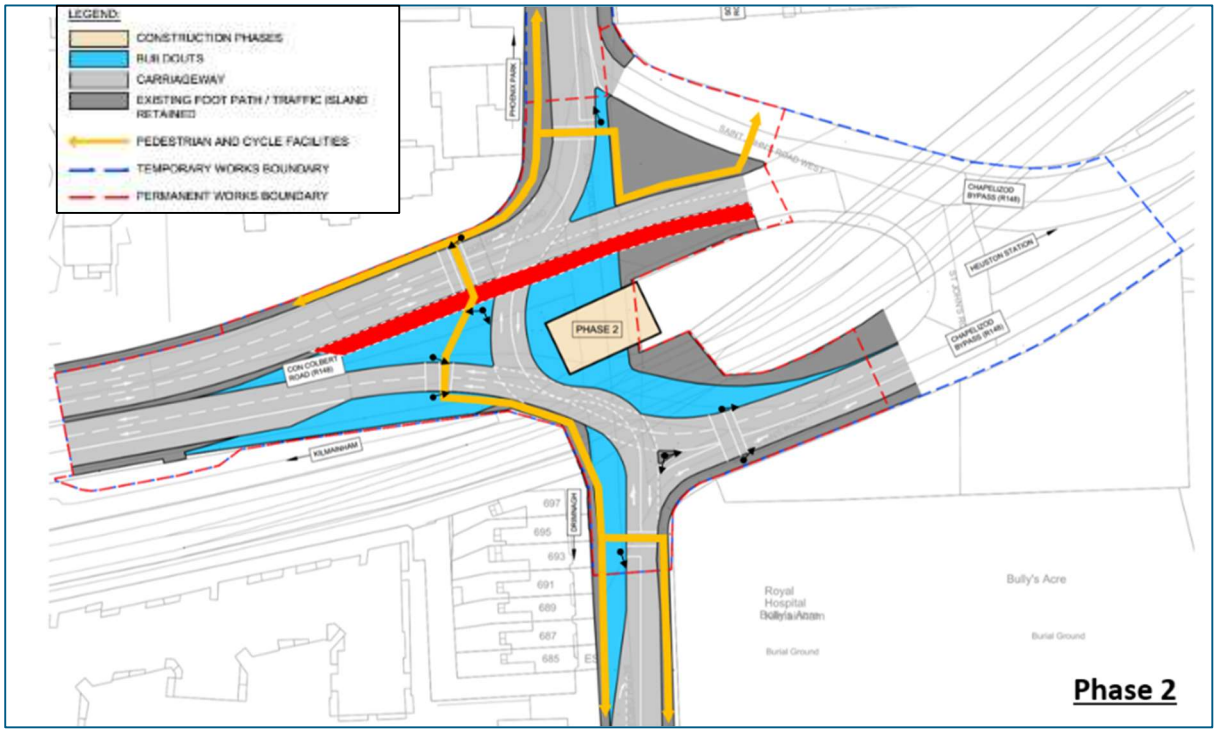

Figure 5-110 Proposed Temporary Traffic Management for OBC1A – Phase 2

Private Vehicle Users

The phased approach is anticipated to result in additional congestion, but by maintaining two circulatory lanes it is not expected to be significantly greater than that currently experienced.

Vulnerable Users (Pedestrians, Wheelchair users and Cyclists)

Vulnerable users are not restricted from passing through South Circular Road Junction during the construction of the new cut and cover structure at South Circular Road Bridge (OBC1A). They are proposed to be accommodated in local diversions for safety.

During the construction of this section of the railway, the southern footpath of Con Colbert Road will be closed, and alternative routes will be required as shown in Figure 5-111.

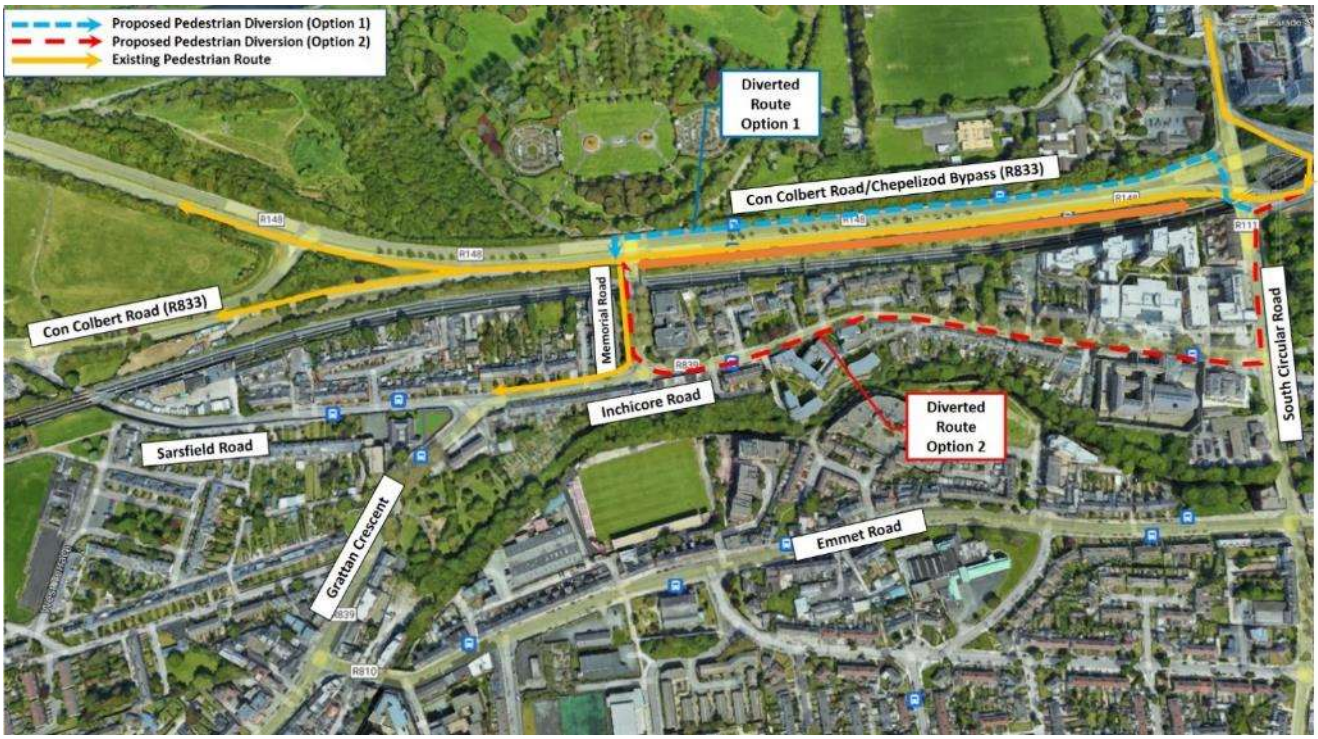

Figure 5-111 Proposed Pedestrian Diversion Routes (Westbound)

Public Transport

To construct the section of northern retaining wall, between the western face of the proposed new cut and cover structure at South Circular Road Bridge (OBC1A) and Memorial Road Bridge (OBC3), will require the closure of the entire bus lane over this section for a period of at least 1 year. It is considered safer to close this facility than to mix pedestrian and bus movements with construction traffic. This lane will be used as dedicated local haul route for the large volume of trucks anticipated to receive the track construction excavated material and for the delivery of certain materials.

The Dublin Bus Stops and routes that will be affected by the temporary closure of the bus lane are:

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

Subject to the further confirmation of the peak boarding and alighting times for the various services, it is proposed to divert a portion of the buses for a specific westbound route (or all) via South Circular Road to the Inchicore Road, stop (2640) adjacent to Kilmainham Goal (opposite the Hilton Hotel) this can then proceed to Memorial Road and across Memorial Road Bridge (OBC3) to re-join its old route.

In this case the Camac Court, stop (2641) will replace the Memorial Gardens stop (7012). The proposed diversion is shown in Figure 5-112.

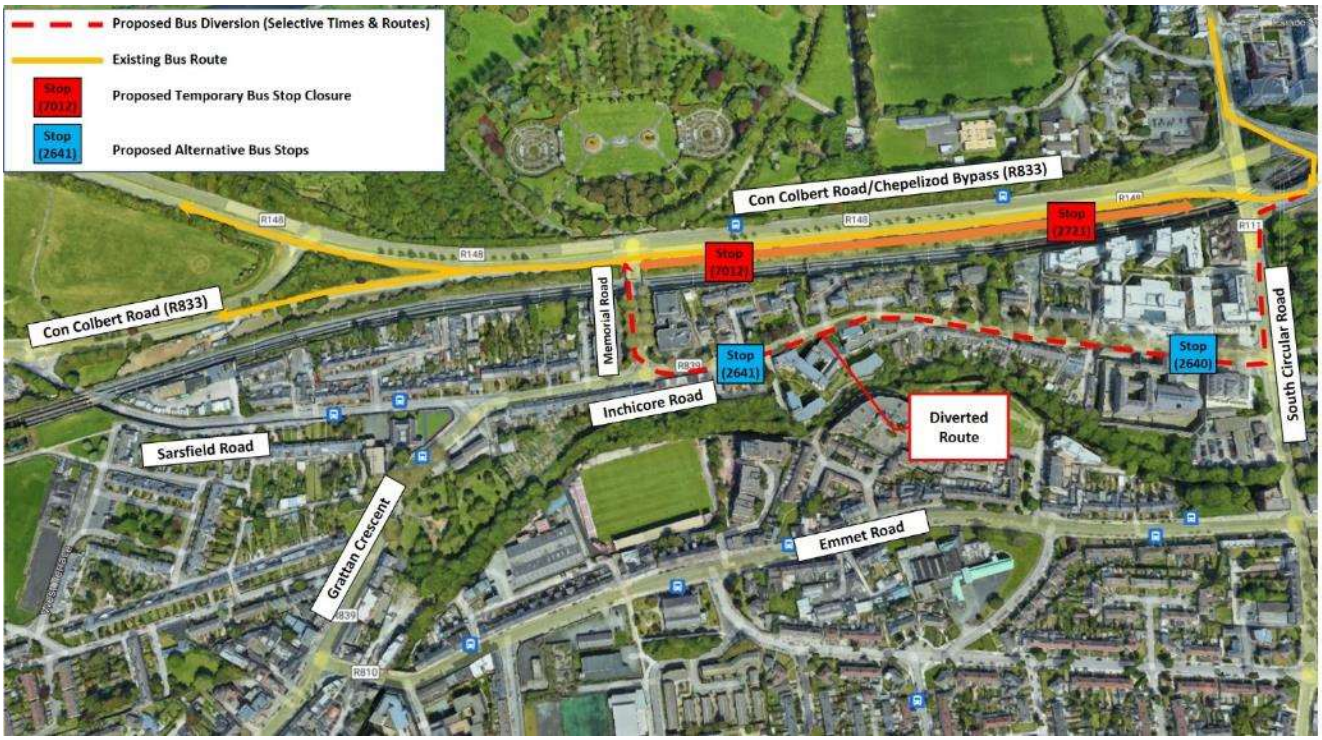

Figure 5-112 Proposed Bus Route Diversion via South Circular and Inchicore Roads

5.4.6.8. Construction Compounds

5.4.6.9. Memorial Road Bridge Construction Compound

Memorial Road Bridge is being replaced with a wider structure. There is insufficient space to provide for the diversion of the road traffic on to a temporary adjacent bridge therefore Memorial Road will need to be closed for a period of time. It is therefore proposed to utilise the remainder of Memorial Road as a construction compound (Refer to Figure 5-113). A single semi mature tree in the avenue will be lost during construction. Trees to be retained in the works area will be suitably protected as necessary.

The Compound will include:

- Compound facilities: Site offices, parking for workers vehicles and site vehicles, and a materials storage and laydown area.
- Compound access to main road network: This part of the construction compound is adjacent to the Con Colbert Road which leads directly to the M50 by means of a dual carriageway. The part of the site on Memorial Road will need to gain access to the Con Colbert Road by means of Sarsfield Road.

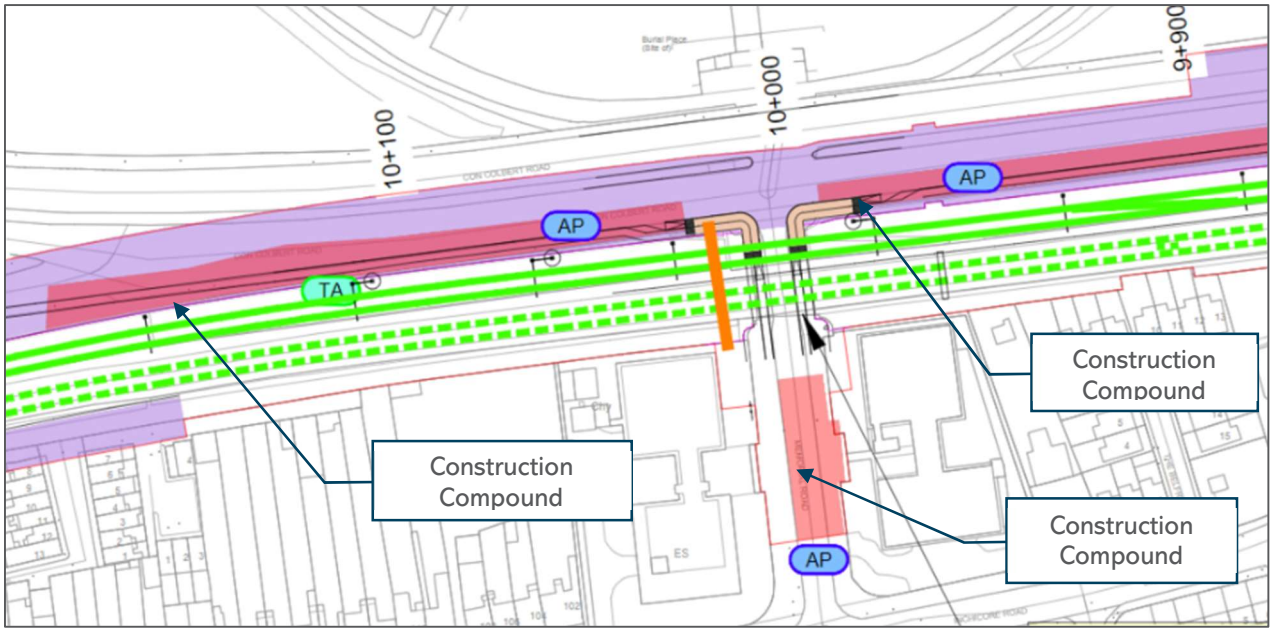

Figure 5-113 Memorial Construction Compound Indicative Site Layout

5.4.6.10. South Circular Road/Con Colbert Road Construction Compound

A construction compound is required to service the major South Circular Road junction works and the widening of the rail corridor along this sub-zone (Refer to Figure 5-114). The construction compound will also act as the facility for moving materials from roadside to trackside and vice versa by means of steep ramps. The proposed works at South Circular Road will require significant space for either in-situ or precast concrete works, excavations and retaining walls.

The first lane (bus lane) of Con Colbert Road will be required to provide access to the rail corridor to facilitate the excavation works and construction of the new retaining structures along the northern side of the rail corridor. The first lane from the South Circular Road junction to beyond Memorial Road will therefore need to be closed to utilise this space as a construction compound and for access.

The site provides good access to the road network, located adjacent to Con Colbert Road which leads directly to the M50 by means of a dual carriageway. The compound will include Site offices, access for dump trucks, pre-cast elements, storage, craneage, piling equipment, security and car parking.

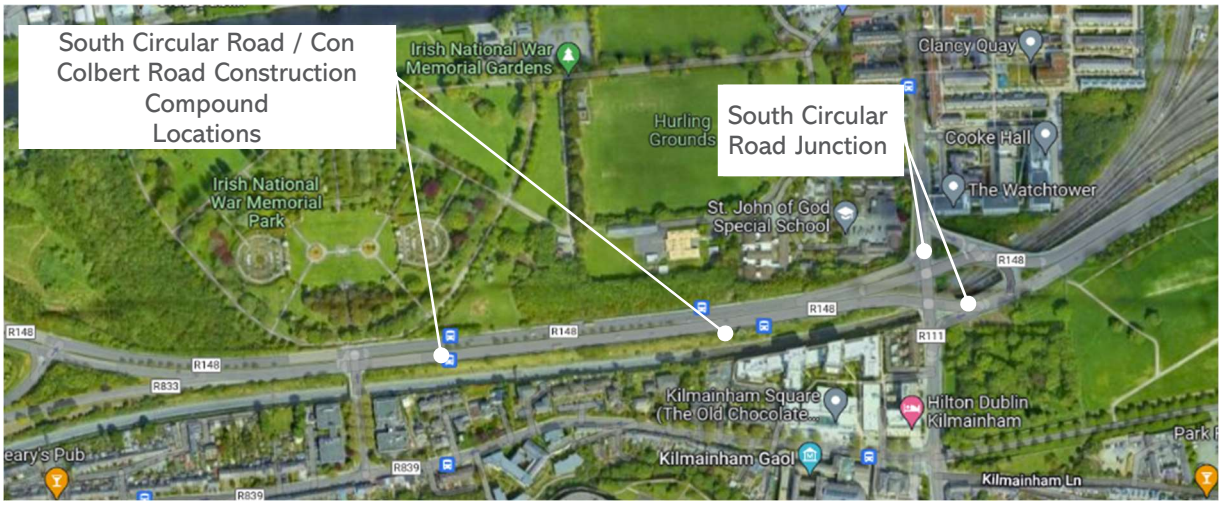

Figure 5-114 Proposed Chapelizod Bypass Construction Compound Site Location

5.4.6.11. Haul Routes

5.4.6.11.1. External Haul Routes

The external haul routes required to facilitate work in Zone B-4 are as outlined in Figure 5-115 and the following descriptions.

Sub-Zone B-4: Sarsfield Road Bridge to South Circular Road Bridge

Construction Traffic associated with sub-zone B-4 is anticipated to be derived from the R148 and Con Colbert Road (R833). The proposed material delivery and removal haul routes are shown in Figure 5-115.

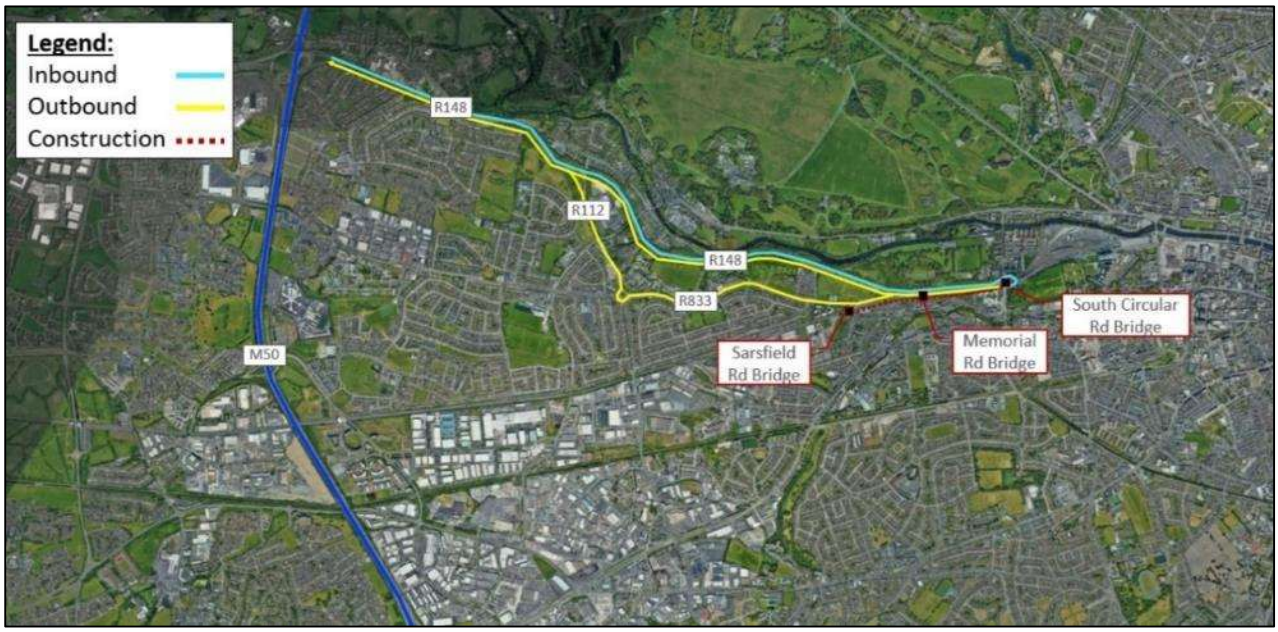

Figure 5-115 Sub-One B-4 : Col Colbert Road and SCR Junction Haul Routes

5.4.6.11.2. Site Haul Routes

This area of works requires two haul routes for different stages:

- Phase 1 - During the piling and boundary wall construction phase the route will be the Con Colbert Road/Chapelizod By-pass (R148) bus lane. It will be barriered off with discrete site entry/exit points along the slow lane of By-pass.
- Phase 2 - During the earthworks removal, track and OHLE construction phase it will be a combination of both the above road level haul route and one at track level.

5.5. Description of Construction Works in Zone C & D – East of St. Johns Road Bridge (Islandbridge) to Glasnevin Junction

This zone extends from east of St. John's Road Bridge (Islandbridge) and includes Heuston Yard and Station (incorporating New Heuston West Station). The main works within Zone 3 is the provision of a new station at Heuston West, and the electrification of the existing twin track onward to Glasnevin Junction as part of the Phoenix Park Tunnel Branch Line as shown in Figure 5-116.

Figure 5-116 East of St John's Road Bridge (Islandbridge) to Glasnevin Junction

5.5.1. Heuston West Station

The new Heuston West Station will be located west of the existing Heuston Station. It is proposed that the station construction works will be undertaken during a wider shutdown of the Phoenix Park Tunnel Branch Line and PPT (approximately 6 months) to facilitate the necessary works on the PPT and the other works along the branch line. The station works will be coordinated with the alterations to the track layout and the attenuation tank which are to be installed in the area.

5.5.1.1. Modifications to Heuston Station

A new platform will be constructed to the west of the existing Platform 10. On the eastern side, the existing Platform 10 at Heuston Station will be reconstructed including platform widening and extension to improve track alignment through the new station section as well as platform capacity.

A bridge with both stairs and ramps will be constructed above the tracks to provide connectivity between Islandbridge (Clancy Quay), the new platforms and the existing Heuston Station. The bridge will provide a segregated cycle and pedestrian access. The bridge will be constructed using precast slab sections supported by precast concrete beams. Bridge piers and other columns for ramps and stairs will be supported on foundations made from reinforced concrete bored piles and in-situ pile caps. Refer to Figure 5-117 to Figure 5-119.

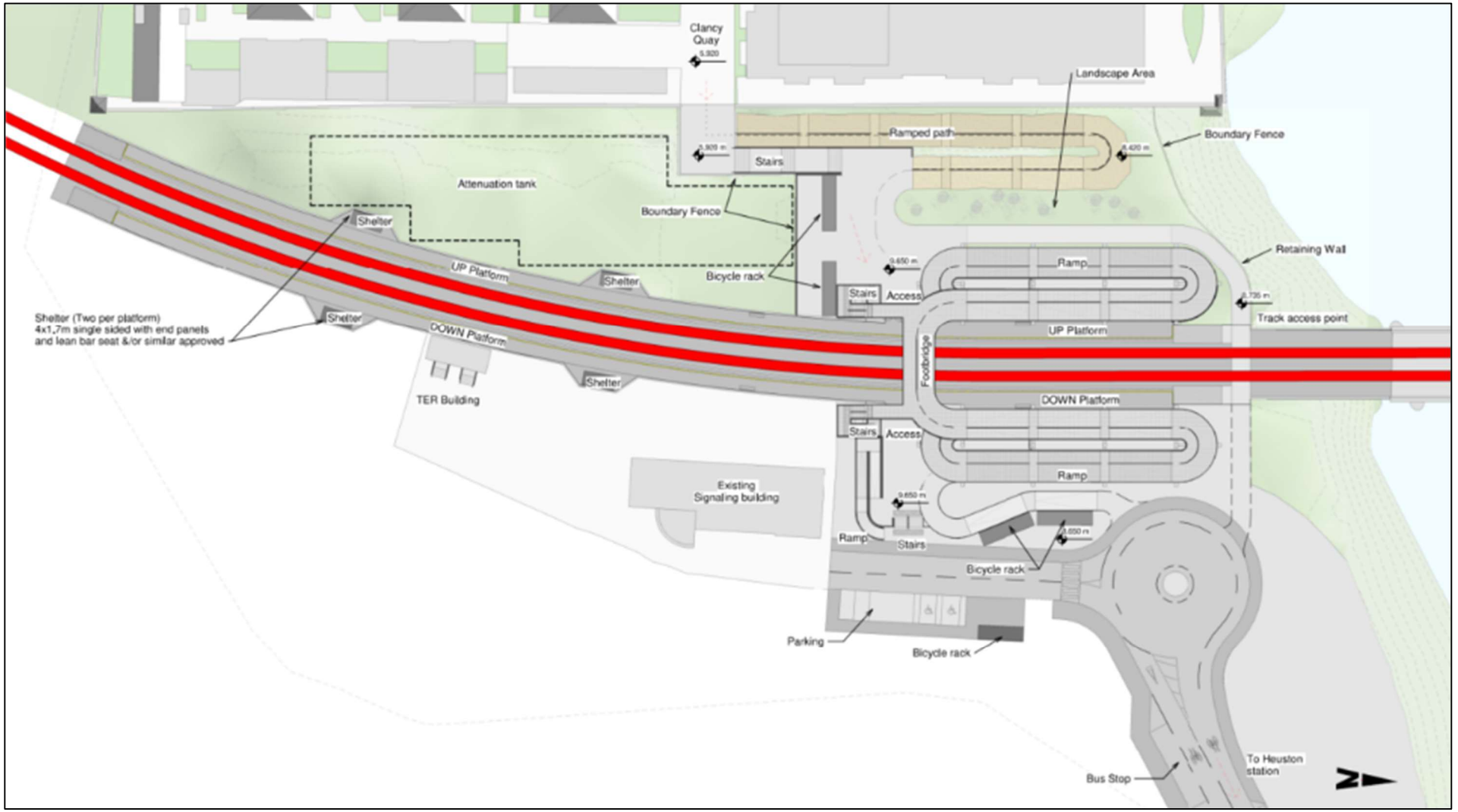

Figure 5-117 Proposed Heuston West Station Layout

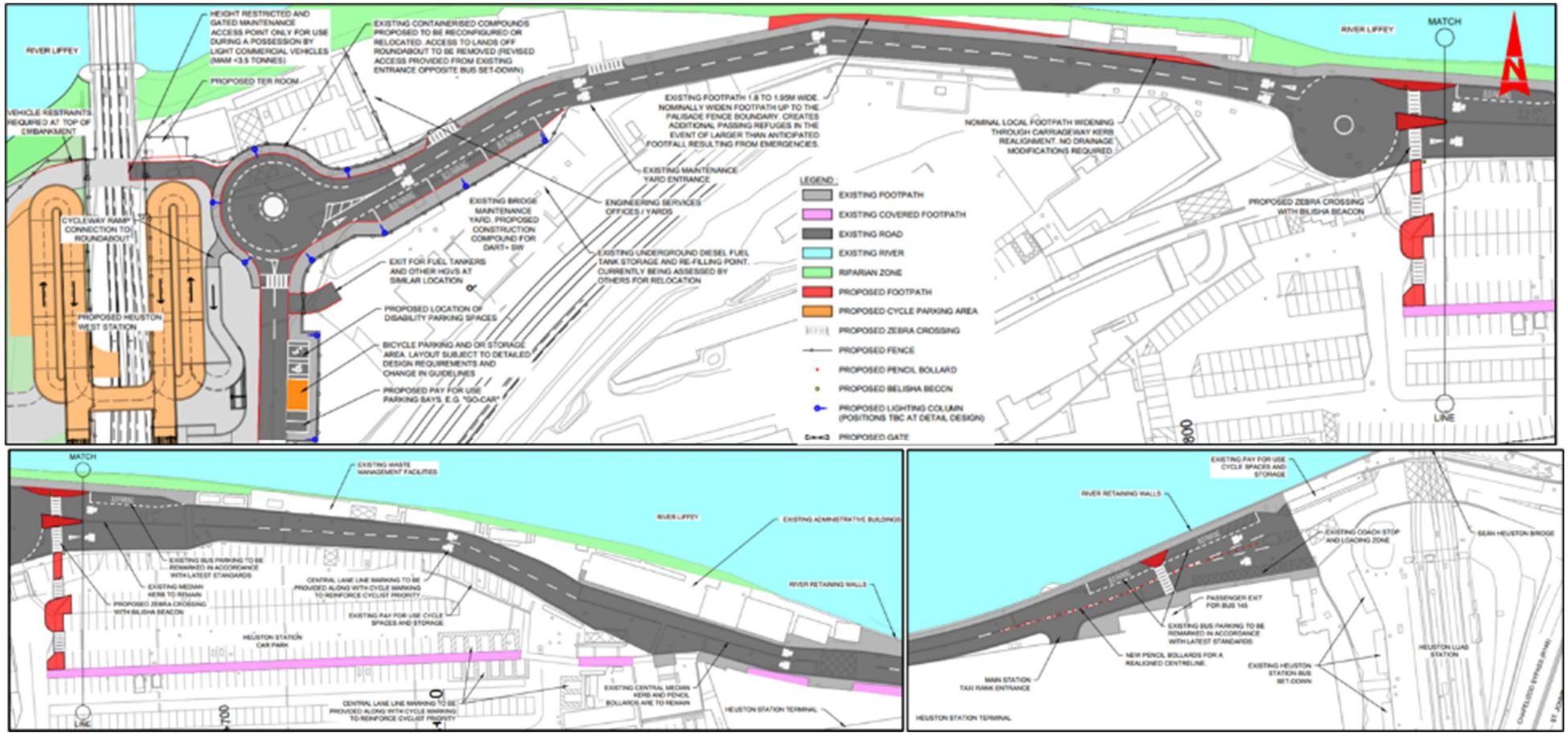

Figure 5-118 Pedestrian Transfer Route Upgrades

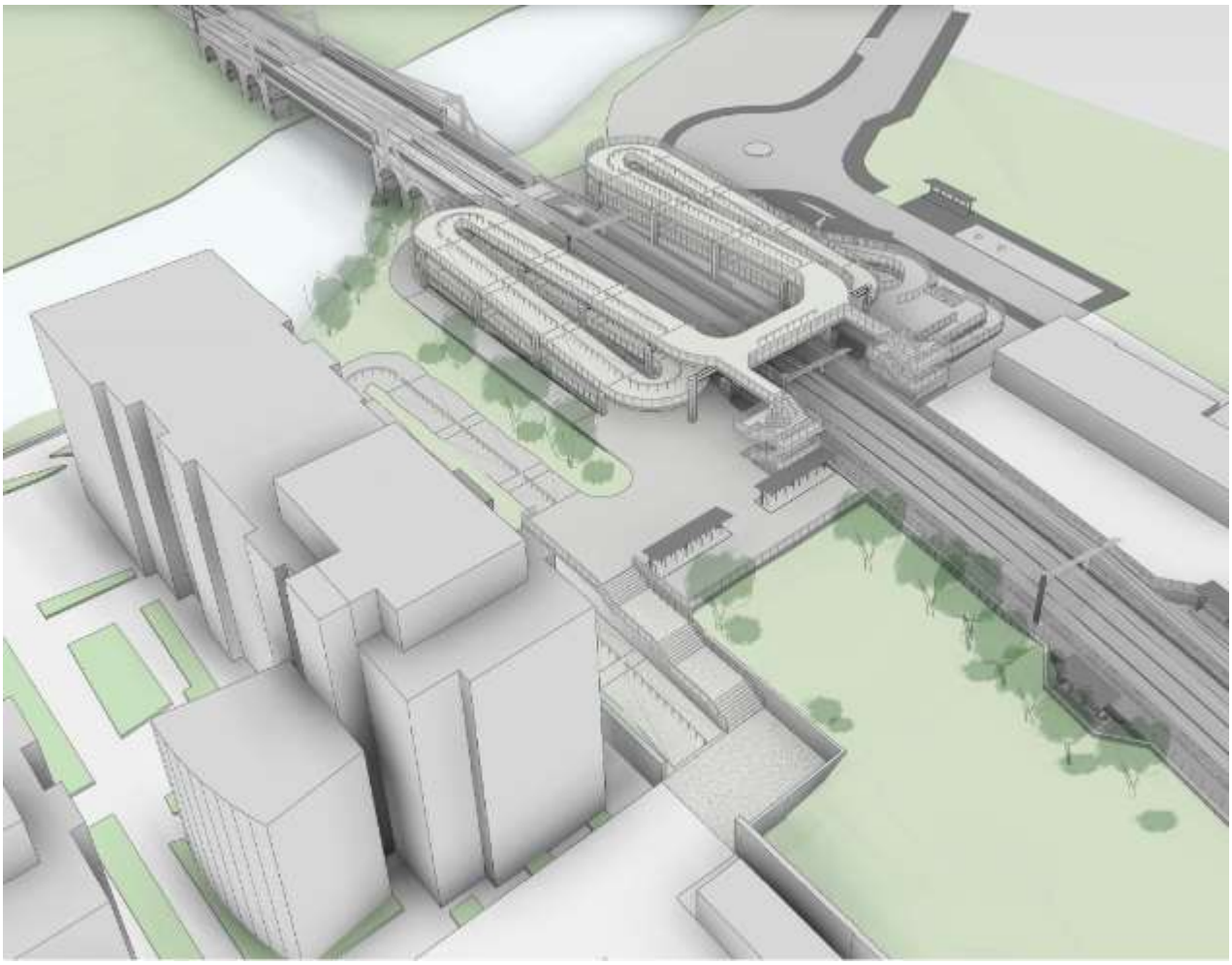

Figure 5-119 Heuston West Station

The proposed works associated with the construction of the station include:

- Preliminary and temporary works for diversion and management of existing services, access and traffic routes, construction compounds, environmental and monitoring activities;
- Track realignment to facilitate the construction of the platform and station structures;
- Demolition of existing structures;
- Excavate to sub grade level;
- Pile and excavate for the bridge, ramps, stairs and retaining wall foundations;
- Install foundations for the bridge, ramps, and stairs foundations, plus the retaining walls and bridge abutments;
- Install pre-cast pedestrian and cycle bridge, ramp and stair support columns by means of a suitable crane;
- Install and connect footbridge drainage to platform drainage;
- Install platform foundations. Platform foundation/coping line and level based on position of existing up and down roads;

- Install Platform;
- Install any services within the platform;
- Erect perimeter fencing;
- Install Platform shelters and platform;
- Construct new TER room;
- Install & commission platform lighting;
- Install Platform markings and platform signage;
- Replacement or re-routing of any underground service and utility along the station area, not part of those required by the rearrangement of the Permanent Way on this area;
- Landscaping and pathway construction, plus installation & commissioning of lighting within the external access area; and
- Realignment of track works and construction of track drainage as part of the Phoenix Park Tunnel Branch Line upgrade.

5.5.1.2. Modification to Bridges

A new pedestrian and cycleway bridge across the platforms will be required. This will be constructed during an extended closure of this part of the railway

5.5.1.3. Modification to Roads

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 in the main will not be altered as the road corridor as it is generally constrained. The road layout and roundabout adjacent to the new station will be modified to accommodate the new station. Most of the central median traffic calming in non-pedestrianised sections of the route will also remain as is. Additional works will include the erection of improved safety signage along with clearer and redefined line marking to the existing access road carriageway. Points where vehicular traffic lanes are to be crossed by pedestrians will be provided with zebra crossing with local kerb line amendments to improve the point of crossing and reinforce the pedestrian priority. This work will be of short duration.

5.5.1.4. Modifications to Walls and Other Structures

There is a requirement to re-align the Guinness sidings connections which necessitates reconstruction of part of an existing retention structure.

5.5.1.5. Buildings/Structures Demolitions

The following demolitions are required as outlined in Table 5.17.

Table 5.17: Summary of Proposed Demolitions / Removals

Location Chainage	Heritage	Description	Conflict
Ch.8+940	No	Existing containerised toilets	To be demolished to facilitate Heuston West Station footbridge and access.

Location Chainage	Heritage	Description	Conflict
Ch.8+963	No	Existing Signalling Gantry at Platform 10 (Heuston West)	To be demolished to facilitate track realignment and Heuston West Station
Ch.9+000	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+000	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

5.5.1.6. Substations

One of the six substations required to supply the route with electrical power is located in this section, at Islandbridge. The general construction methodology and elements for the substations is presented in Section 5.2.7

5.5.1.6.1. Islandbridge Substation

The Islandbridge substation will be located within the Heuston Yard area along the R148 (St John's Road). It is a brown field site in the ownership of CIÉ on the southern side of the railway yard (Refer to Figure 5-120 and Figure 5-121).

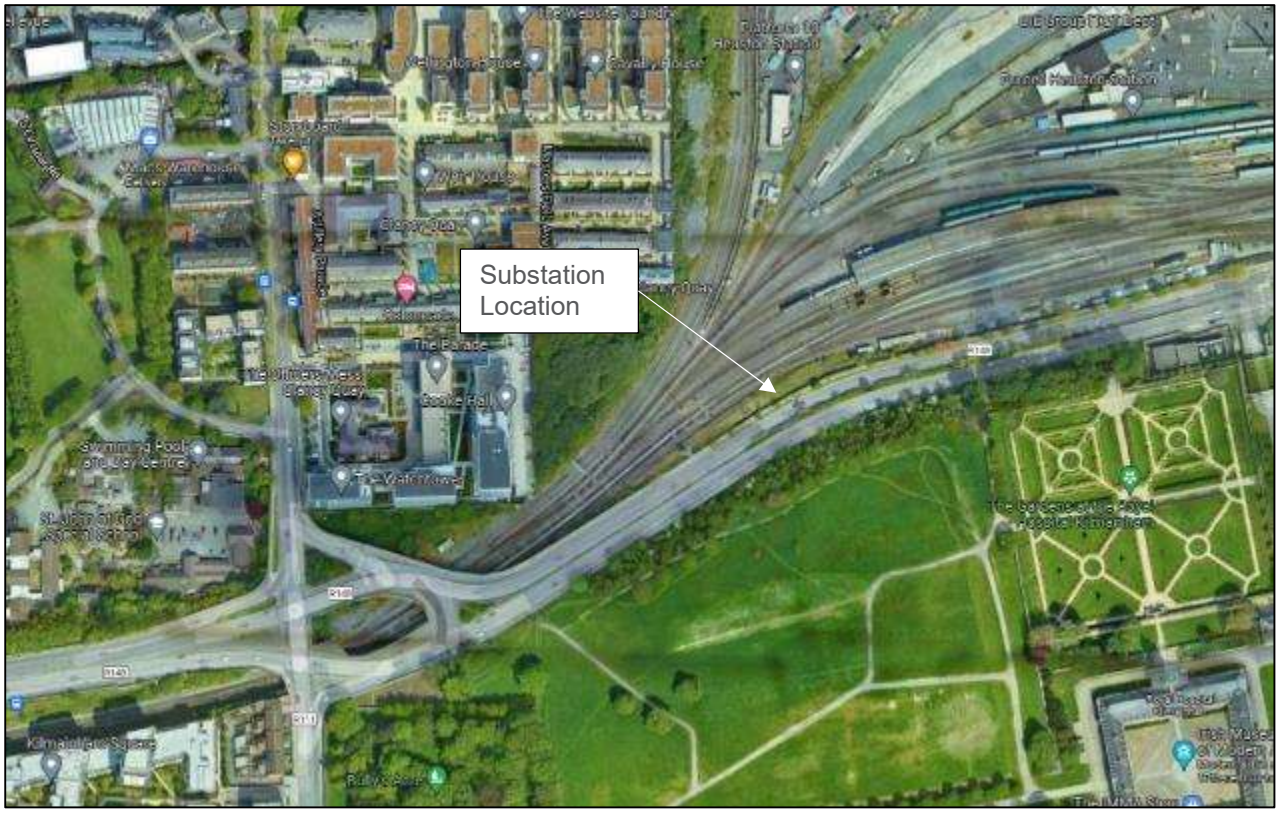

Figure 5-120 Islandbridge Proposed Substation Location

Figure 5-121 Islandbridge Indicative Substation Layout

The proposed site is at a lower level than the adjacent St. Johns Road, as such it will need to be raised to facilitate access and egress to the site, a retaining wall will be installed on the track side of the site. 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.

5.5.1.6.2. ESB Grid Connection

The route for the two proposed power supply circuits is approximately length is 30m for each circuit. This route would face existing services running perpendicular to it and it is expected that the work for this route will require a temporary disruption of the traffic on the road (Refer to Figure 5-122).

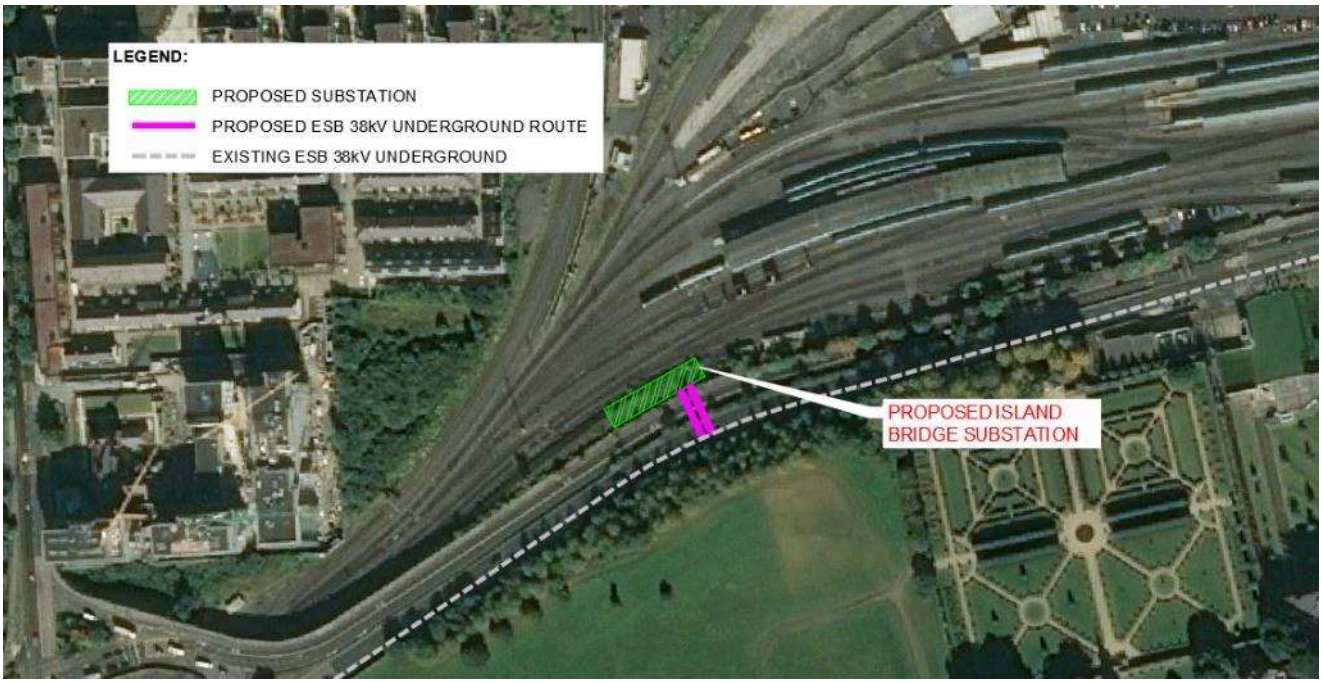

Figure 5-122 Islandbridge Substation Proposed Grid Connection

5.5.1.7. Utility Diversions

5.5.1.7.1. BT

The only utility diversion required in this area is located beneath the proposed Heuston West Station and attenuation tank (see Section 5.5.1.11). BT diversion works will be carried out in conjunction with the relocation of trackside SET cabling and associated fittings.

5.5.1.8. Temporary Traffic Management

Localised temporary traffic management will be required to deliver the Heuston West Station.

5.5.1.9. Construction Compounds

5.5.1.9.1. Heuston West Construction Compound

Three no. construction compounds are required to the west of Heuston Station for works to be undertaken to the Phoenix Park Tunnel (PPT) and the construction of the new Heuston West Station. These compounds will also be used for the Heuston Yard works. The proposed compounds are located on CIÉ property adjacent to the existing Platform 10 and the Clancy Quay residential development (Refer to Figure 5-123).

Compounds will be constructed on both sides of the existing railway as access on the western side is also required for the installation of an underground attenuation tank, which is to be located in this area. Works will be phased to allow the construction of the Heuston Station Yard works, PPT works and the construction of the new Heuston West Station.

The compounds will include:

- Compound facilities: site offices, welfare facilities, concrete pipe storage, car park and footpath, cranes, mobile concrete crusher, slab precast unit storage, temporary bridge and fabrication yard, attenuation tank, security.

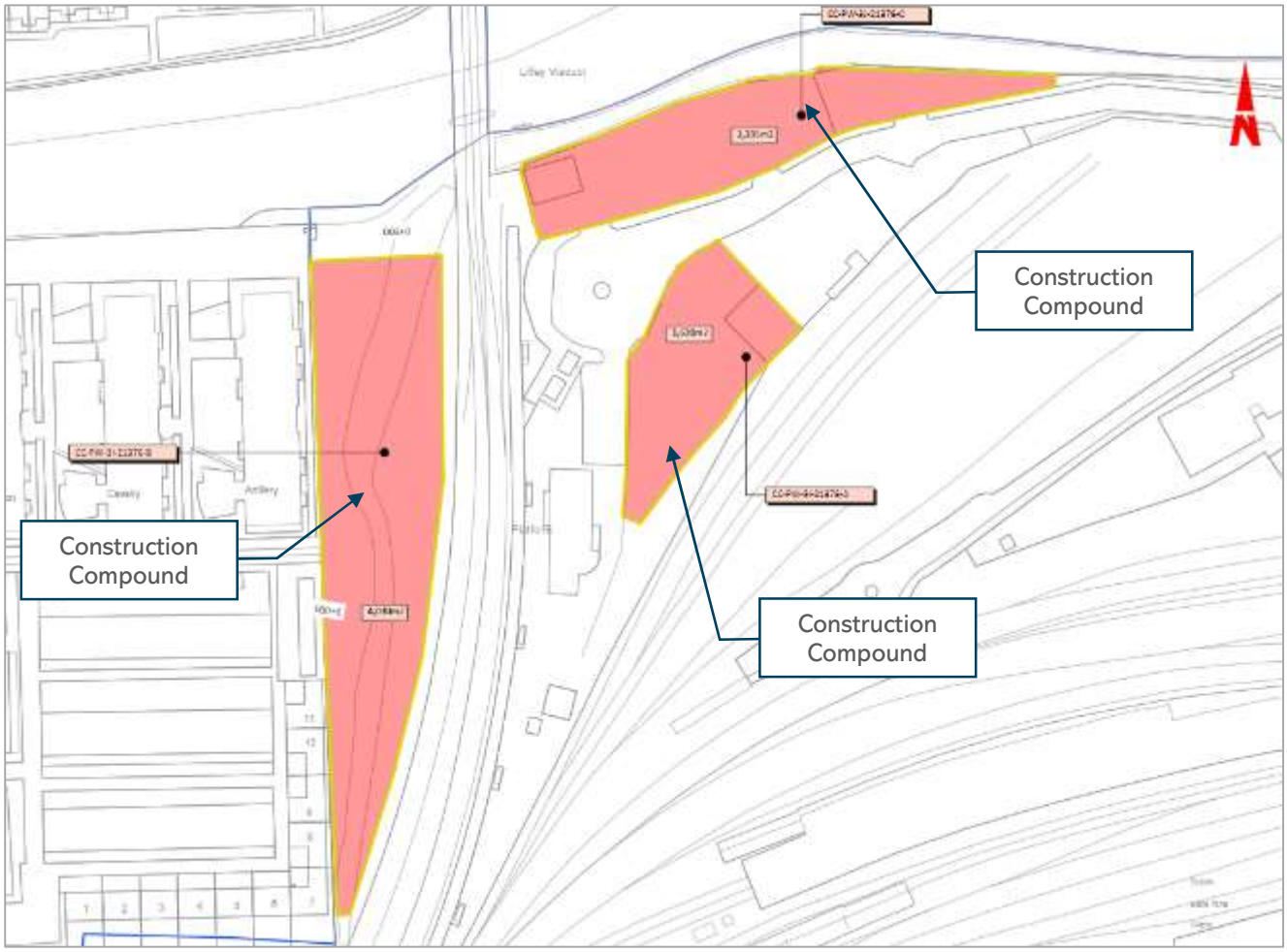

Figure 5-123 Heuston West Construction Compounds Site Location

5.5.1.9.2. Islandbridge Substation Construction Compound

A construction compound is required at Islandbridge to facilitate the construction of the new electrical substation. Following completion of construction activities, the area will be used for the permanent substation compound.

As noted previously, the site is located on CIÉ owned property and access to the site will be from St. Johns Road. The Compound will include site offices, welfare facilities, security, material storage and transfer, equipment storage, laydown.

5.5.1.10. Haul Routes

5.5.1.10.1. External Haul Routes

The main external haul routes required to facilitate access to the Heuston Station compounds and associated construction works sites are as follows and represented by the Zones B, C & D external Haul Route figures; namely (Figure 5-124 and Figure 5-125 below).

Figure 5-124 Construction Zone B: External Haul Routes

Figure 5-125 Construction Zones C - D: External Haul Routes

Heuston Station, Heuston West, Island Bridge Substation and Phoenix Park Tunnel

Construction traffic associated with the proposed works within the Greater Heuston Station will be required to use the R148 for both inbound and outbound trips. Direct access to the station is relatively constrained due to movement restrictions at the junctions in the immediate vicinity of Heuston Station.

Inbound traffic will utilise the R148 westbound before turning right in order to access the site from the east. Outbound traffic will utilise Conyngham Road (R109) and South Circular Road (R111) in order to access the R148. The anticipated inbound and outbound movements are shown in Figure 5-126.

Figure 5-126 All Heuston Yard and Heuston West as well as PPT External Haul Routes

5.5.1.10.2. Site Haul Routes

While the 2 no. main construction compounds are located immediately east of the tracks in existing operations and maintenance compounds; access is required across the tracks to the satellite construction compound located adjacent to Clancy Quay Development to facilitate construction of the new Heuston West Station and also the new connection to Clancy Quay. Access across the tracks is also required to facilitate construction of the new underground attenuation tank.

It is intended that the full rail corridor including the Liffey bridge/viaduct (UBO1) will be used as a haul route for the construction of the Slab Track (including the OHLE and SET systems) in the Phoenix Park Tunnel. It is envisaged that the tunnel works will be constructed simultaneously from both the southern and northern ends (using the Heuston and Cabra compounds respectively) but owing to space constraints that throughput of traffic between Cabra and Heuston Compounds will not be possible for extended periods.

The extensive length of lower level retaining wall construction at the toe of the Phoenix Park Tunnel Branch Line cutting and as well as the extensive soil nailing stabilisation of cutting embankments above requires the full closure of the Phoenix Park Tunnel Branch Line. Where possible the tunnel works haulage will be concurrent with soil nailing operations but options for the same are deemed to be limited, again owing to the space constraints.

5.5.1.11. Attenuation and Pumping Requirements

One attenuation tank will be located beside the future Heuston West Station (Refer to Figure 5-127). The proposed solution for this attenuation structure is a cellular tank, which present an average void ratio of 90%. Its modular nature enables it to fit into the specific site constraints in terms of space. The required tank depth is approx. 2.6m with a plan area of approx. 3,200m^2. The drainage network downstream of the attenuation tank will discharge by gravity to an outfall location at the River Liffey and will include a flow control unit to restrict outgoing flows.

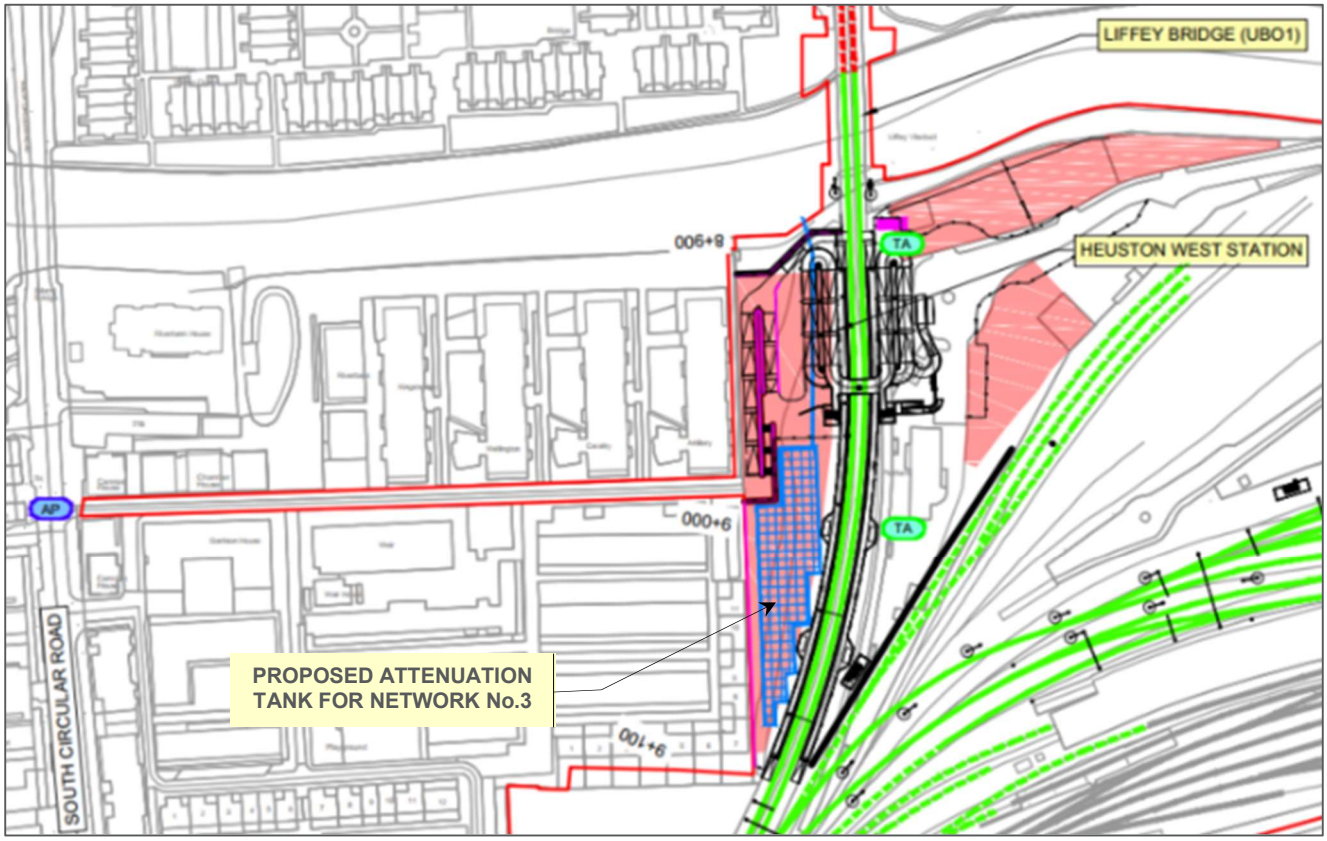

Figure 5-127 Heuston West Station Attenuation Tank Layout

The construction methodology for the attenuation works will follow the steps below:

1) Excavation and preparation;
2) Base protection layer of geotextile;
3) Geomembrane installation at the base;
4) Installation of geocellular units;
5) Place geomembrane at the sides and on top of the tank;
6) Place geotextile protection on the top and sides of the tank to protect the geomembrane;
7) Backfill and surface finishes.

5.5.2. East of St Johns Road Bridge to Glasnevin Junction

5.5.2.1. Modifications to Bridges

There are currently ten existing bridge structures within Zone D of the project. There are no major structural interventions currently proposed to the majority of these bridges, with one notable exception at Glasnevin Cemetery Road Bridge (OBO10). A new bridge deck will be installed on this structure's existing abutments to provide the required clearances to OHLE equipment. Track lowering will be carried out at five bridges to achieve the required clearance and the remaining five bridges will only require minor modification to facilitate electrification. Minor parapet modifications will also be required to ensure they meet the required standard of 1.8m in height. Table 5.18 provides a summary of the proposed bridge interventions.

Table 5.18: Bridge Interventions

Structure Ref	Structure Name	Intervention
OBO2	Conyngham Road Bridge	Track lowering & modify existing parapet.
OBO3	McKee Barracks Bridge	Modify existing parapets.
OBO4	Blackhorse Avenue Bridge	Remove gravity sewer & modify existing parapets.
OBO5	Old Cabra Road Bridge	Modify existing parapets.
OBO6	Cabra Road Bridge	Track lowering & modify existing parapets.
OBO7	Faussagh Road Bridge	Track lowering & modify existing parapets.
OBO8	Royal Canal and Luas Twin Arch	Track lowering.
OBO9	Maynooth Line Twin Arch	Track lowering.
OBO10	Glasnevin Cemetery Road Bridge	Deck and parapet replacement

There is a requirement to reconstruct the bridge deck of the Glasnevin Cemetery Road Bridge (OBO10). The proposed works at Glasnevin Cemetery Road Bridge (OBO10) will take place over a 4 month period (approx.). During this period, a temporary closure of the bridge will be required with vehicular access to the cemetery suspended for a 3 week period (approx.). A temporary pedestrian and wheelchair accessible bridge will be installed to the southeast of the existing structure. The bridge deck will be raised to accommodate the new electrification equipment and therefore slight ramp tie ins will be required on each side of the bridge.

The existing deck will need to be demolished (during the proposed full closure associated with the Phoenix Park Tunnel works). The old deck seating will be removed, and the area levelled in preparation for a larger seating beam. A new precast cill beam will be installed to raise the deck, the deck will then be installed.

Figure 5-128 Cemetery Road Bridge Works Showing Temporary Utility/ Footbridge

5.5.2.1.1. Bridge Clearance – Track Modifications

Track lowering will be required to facilitate the installation of the OHLE system, at the following locations:

- Conyngham Road Bridge (OBO2);
- Cabra Road Bridge (OBO6);
- Faussagh Road Bridge (OBO7);
- Royal Canal and Luas Twin Arch (OBO8);
- Maynooth Line Twin Arch (OBO9).

Blackhorse Avenue Bridge (OBO4) will also require the removal and relocation of the existing services which cross to the south side of the structure, which will necessitate the installation of a new pump station.

5.5.2.1.2. Bridge Parapets

A new parapet which is 1.8m higher than adjacent footpath will be installed on the new deck structure at Glasnevin Cemetery Road Bridge (OBO10). Four of the overbridges on the Phoenix Park Branch Line currently have railings which meet the height requirements but are not IP2X rated and will therefore also need to be replaced.

The bridges are:

- Blackhorse Avenue Bridge (OBO4);
- Old Cabra Road Bridge (OBO5);
- Cabra Road Bridge (OBO6);
- Faussagh Road Bridge (OBO7).

There are also two overbridges in this zone that do not meet the parapet height requirement. These are Conyngham Road Bridge (OBO2) and McKee Barracks Bridge (OBO3). The proposed solution is to install an infill panel to the top of these parapets to raise their height to a minimum of 1.8m.

The Royal Canal and Luas Twin Arch (OBO8) and the Maynooth Line Twin Arch (OBO9) which carry the Royal Canal and Maynooth Rail Line respectively, have full height palisade type fencing installed along their embankments and no further action or treatment is proposed to these parapets.

5.5.2.2. Modifications to Roads

Modifications to the road in the vicinity of Glasnevin Cemetery Car Park and access ramps over the bridge will be required to accommodate the current proposed Glasnevin Cemetery Road Bridge (OBO10) deck reconstruction. The existing road is a single carriageway that is a shared use crossing for both vehicles and vulnerable users.

As with all the other road works sites on the project the bridge works will need to be substantially complete before completing the road works. In the first instance, a temporary vulnerable user bridge will be constructed and new path access to the south-eastern side of the carpark provided. The approach road retaining walls and ramps will be constructed in advance of the road surfacing works.

Utilities will be diverted onto the temporary bridge and then rediverted into the main bridge during construction.

5.5.2.3. Modification to Walls and Other Structures

New retaining walls are required at various sections along both the north and south sides of the rail corridor on the Phoenix Park Tunnel Branch Line, 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. 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. A cross section showing typical retaining wall structures is shown in Figure 5-129.

Additional soil nailing 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 nails 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 nails will extend beyond the CIÉ property boundary and under third party properties. An example of soil nail installation is shown in Figure 5-130.

Soil nails will be constructed predominantly at the time of the closure of the Phoenix Park Tunnel Branch line, but due to its extensive nature, some construction works may continue beyond this period during night-time or weekend possessions.

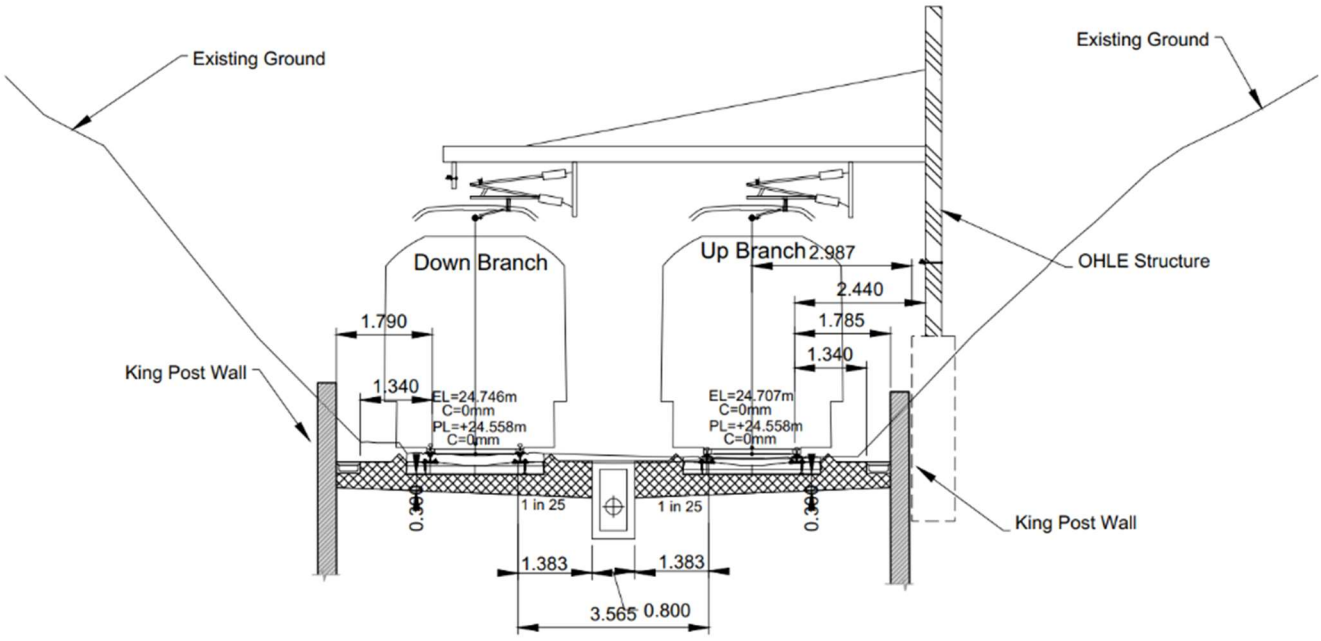

Figure 5-129 Cross Section Showing Typical Retaining Wall Structures

Figure 5-130 Example of Soil Nail Installation

5.5.2.4. Modifications to Phoenix Park Tunnel

The Phoenix Park Tunnel is a brick arch tunnel with brick invert over a distance of approximately 700m. Works are required in the tunnel to facilitate electrification of the line. The main construction activities in the Phoenix Park Tunnel include the following:

- Track lowering at the southern portal of the tunnel (approx. 350mm depth), involving modifications to the tunnel invert: temporary soil anchors will be installed during the construction works in this portion of the tunnel;
- Installation of a new slab track system which will involve the lowering of the track through the length of the tunnel;
- New tunnel drainage system will be incorporated into the slab track; and
- Installation of the OHLE system including attachments to the tunnel structure.

It is proposed that these works will be done under full closure of the tunnel. This means that no trains will operate on this line for an extended period of time (approximately 6 months). This provides an opportunity to undertake all of the works on the Phoenix Park Tunnel Branch Line simultaneously.

5.5.2.4.1. Civils Works on PPT

The Phoenix Park Tunnel has a brick invert (similar to floor level) and track lowering would necessitate the removal of part or all of the invert and the construction of a support slab in its place. This support slab will need to be continuous across the width of the track to properly support the arch.

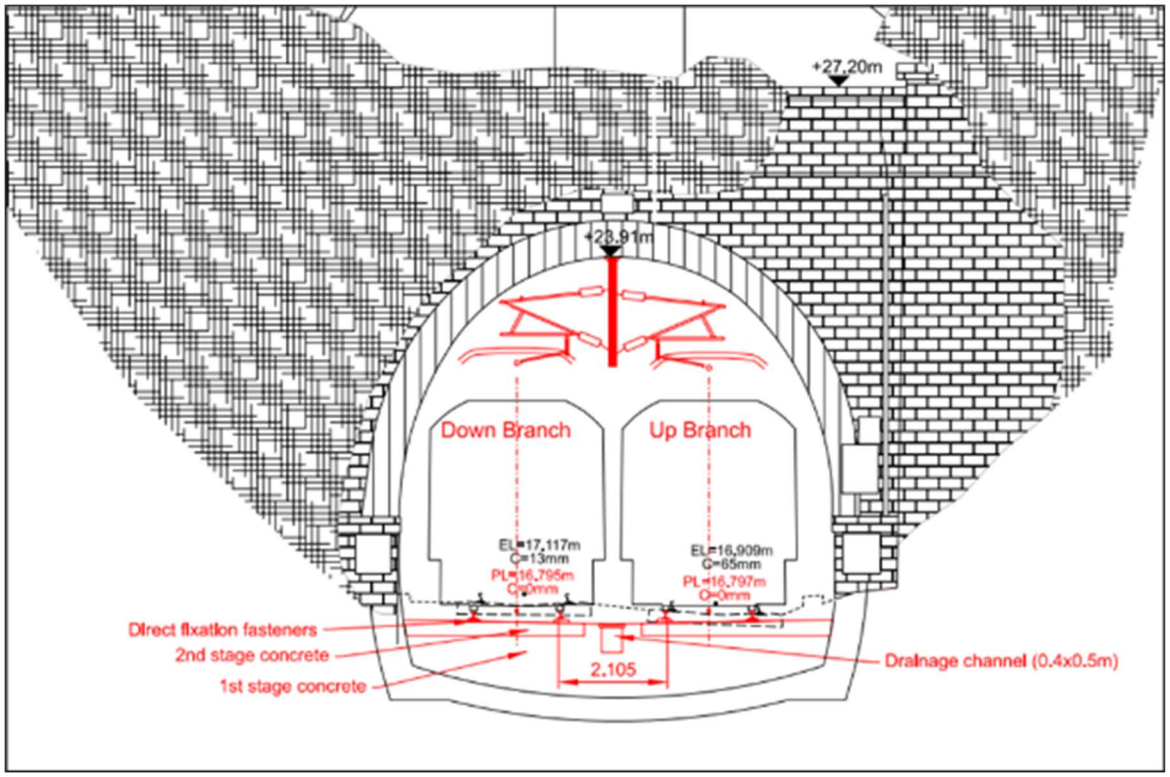

Figure 5-131 Typical Slab Track System in Phoenix Park Tunnel

5.5.2.4.2. Tunnel Closure

It is proposed to close the Phoenix Park Tunnel and hence the Phoenix Park Tunnel Branch Line for the duration of the works. To support the tunnel walls while the invert of the tunnel is removed, the following will be required:

- Temporary props and walers – walers will be placed along the prop line to provide uniform support of the tunnel. Props and walers would be removed after the invert is reconstructed.
- Tiebacks and walers – Anchors will be installed by drilling through lining and grouting the anchors in place. Walers will be used to spread the load across the wall of the tunnel.

The full track lowering/slab track construction method for full closure is detailed below:

- Divert drainage by over-pumping (bypassing working area);
- Divert any other services through tunnel;
- Install tiebacks and walers on both sides of the tunnel wall or props;
- Excavate whole of track bed construction and drainage system;
- Construct new track slab incorporating new drainage system.

5.5.2.4.3. Drainage

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. The existing collection system (perforated pipe) will be replaced by an in situ concrete channel drain placed between tracks, to collect any surface water runoff on the track and convey flows to the existing outfall at the River Liffey.

5.5.2.4.4. Line Side Utilities

Signalling, low voltage electricity supply and other services will be required to run through the tunnel. It is envisaged that these services will be fixed to the walls of the tunnel rather than routed under the slab track for maintenance and renewal purposes. They will be switched off for the duration of the closure, rerouted and then switched back on.

5.5.2.4.5. Overhead Line Equipment (OHLE)

To support the electrification through the tunnel, new OHLE is required. This infrastructure will be fixed to the tunnel at regular spacings rather than using gantries to support the equipment, due to lack of lateral space. The new equipment will be attached to the existing tunnel by anchor bolts.

5.5.2.5. Building/Structures Demolitions

The following demolitions are required as outlined in Table 5-19.

Table 5-19: Summary of Proposed Demolitions / Removals

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

Glasnevin Cemetery Bridge deck requires demolition.

5.5.2.6. Substations

There is no substation required in Zone D of the route.

5.5.2.7. Utility Diversions

5.5.2.7.1. ESB

One ESB LV cable requires a permanent diversion as it is located beneath a proposed combined sewer pumping station on the north bank of the tracks beside McKee Barracks. The permanent diversion will follow a similar path to the existing.

Two ESB cables located north east of the Glasnevin Cemetery bridge will require a permanent diversion due to the proposed works for the bridge. The permanent diversion will follow a similar path to the existing.

5.5.2.7.2. Stormwater and Foul / Combined Sewers

A significant permanent diversion of a combined sewer is required at Blackhorse Avenue Bridge (OBO4). The diversion route for this combined sewer comprises a new pumping station arrangement on the west side of the rail corridor with a rising main provided to cross through Blackhorse Avenue Bridge (OBO4) from west to east (Refer to Figure 5-132). It is proposed to discharge to the original gravity sewer located on the eastern side of the railway.

The new pump station will be almost entirely underground and will be constructed using a top-down methodology, i.e., sink large diameter precast concrete sections into the existing embankment, excavating as the sections are lowered. This work will be undertaken during the closure of the Phoenix Park Tunnel Branch Line.

The site for the pumping station will include a small compound/ lay down area to facilitate construction.

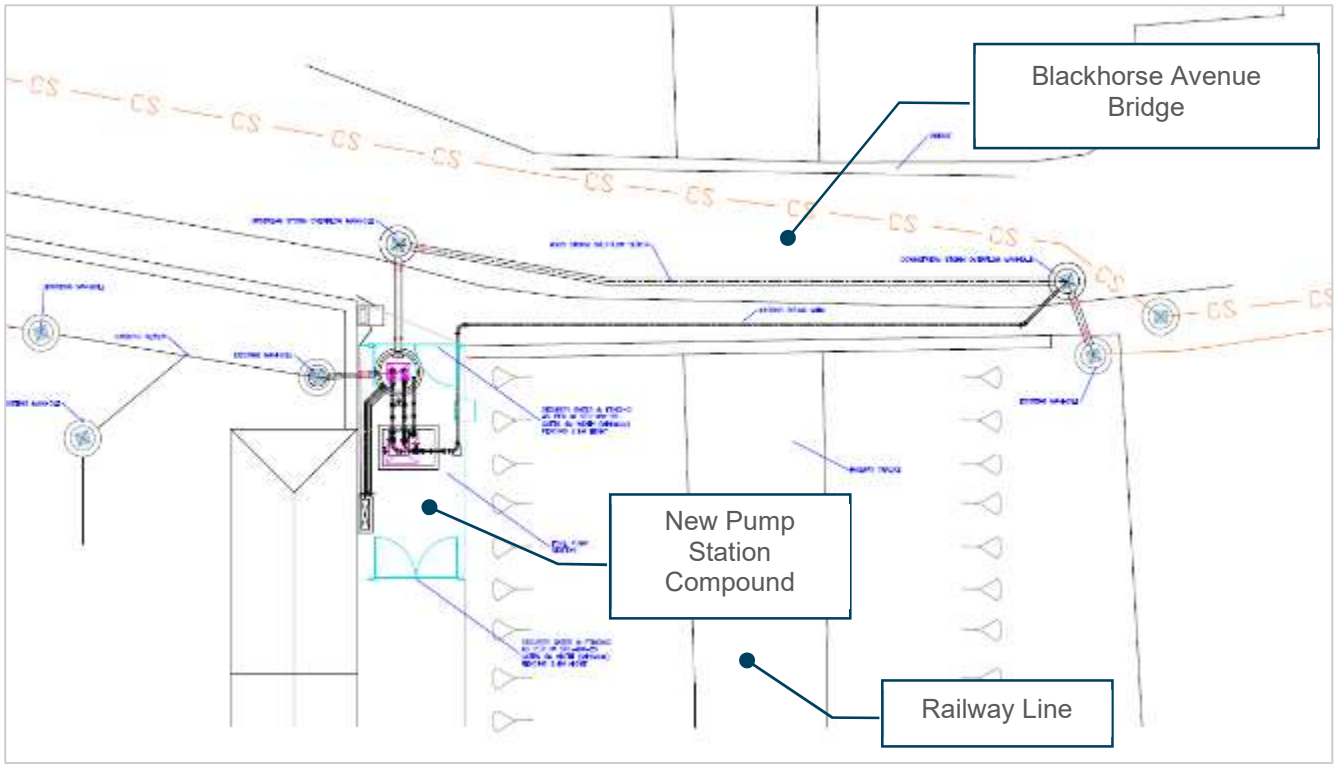

Figure 5-132 Proposed Pump Station - Blackhorse Ave Bridge

5.5.2.8. Construction Compounds

5.5.2.8.1. Cabra Construction Compound

The proposed construction compound at Cabra is located adjacent to the Cabra Road/Carnlough Road Junction. The works in this area involve track lowering at a number of locations along the project route between the River Liffey and the project connection just east of the Glasnevin Cemetery Bridge (OBO10), comprising of ballast removal, lowering of substrata, reinstallation of ballast where applicable and or construction of slab track within the Phoenix Park Tunnel and the transition track works just north of the tunnel. Soil nailing and construction of retaining structures will precede much of the above works in preparation of the. Lineside work including Permanent Way, Signalling, Electrification and Telecommunications installations will also take place.

The rail line from the Phoenix Park Tunnel to Glasnevin junction runs in a deep cutting with steep embankments on either side. The construction compound is located in an area where the ground levels off and opens up, providing good access to the rail corridor. The area is currently used by Irish Rail for track maintenance. The external haul routes to the existing entrances off Cabra/Carnlough Road and Faussagh Avenue, will primarily be via the Navan Road from the M50.

The proposed construction compound is located on CIÉ property with direct access to the rail line. A new residential development is currently under construction immediately adjacent to the site.

The compound will include site offices, welfare facilities, car park and footpath, concrete pipe storage, precast slab tracking units, aggregate ballast storage, potentially a temporary batch plant & security.

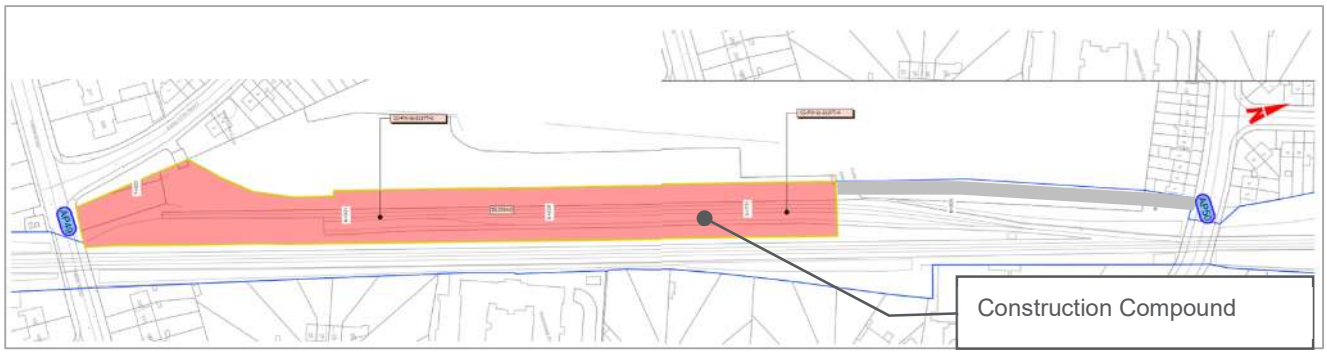

Figure 5-133 Cabra Construction Compound

5.5.2.8.2. Glasnevin Cemetery Construction Compound

A construction compound is required in this area, primarily to facilitate works to Glasnevin Cemetery Road Bridge (OBO10). The proposed location for the construction compound is in the parking area immediately adjacent to the bridge.

The site will need to facilitate continual access to the Cemetery by the public and Cemetery workers. A temporary pedestrian bridge will be installed alongside the existing bridge for this purpose.

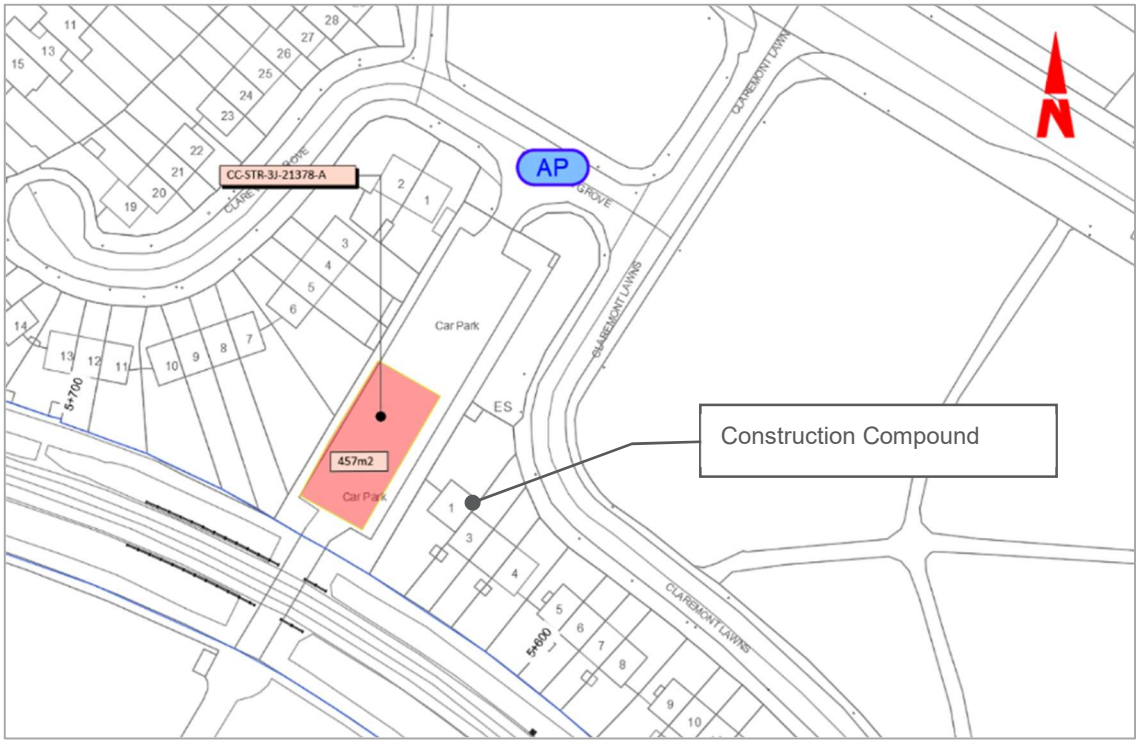

Figure 5-134 Glasnevin Cemetery Construction Compound Location

The compound will include site office with welfare facilities, parking, material storage and security. The external haul routes to the existing entrance off Claremont Lawns estate road, will primarily be via the Finglas Road from the M50. The automatic entrance booms will need to be removed during the site establishment, construction and rehabilitation works to accommodate cranes and large construction vehicles.

5.5.2.9. Haul Routes

5.5.2.9.1. External Haul Routes

The external haul routes required for Zone D, are to cover sub-zones as noted below and are represented in Figure 5-135:

- Zone D-1: Liffey Bridge to PPT (inclusive)
- Zone D-2: Phoenix Park Tunnel Branch Line (PPT to Glasnevin Connection inclusive)
- Zone D-3: Glasnevin Cemetery

Figure 5-135 Construction Zones C - D: External Haul Routes

Phoenix Park Tunnel Branch Line (Including Glasnevin Cemetery Bridge – Zones D-2 & D-3)

Construction traffic associated with the Phoenix Park Tunnel Branch Line construction will be required to use the R147 for both inbound and outbound trips. Direct access from the southern portion of the site will be provided from the existing CIÉ maintenance compound access of Cabra Road (R147). Access and egress to the northern portion of the site can be provided directly from Faussagh Road access to the Cabra Main Compound; these could be interchangeable to suit traffic demands on the road. However it is preferable that the Cabra Road entrance be adopted as the main entrance with the Faussagh Road access point used as an egress point; also providing direct access to the adjacent bridge for parapet modification works. The anticipated main inbound and outbound movements are shown in Figure 5-136.

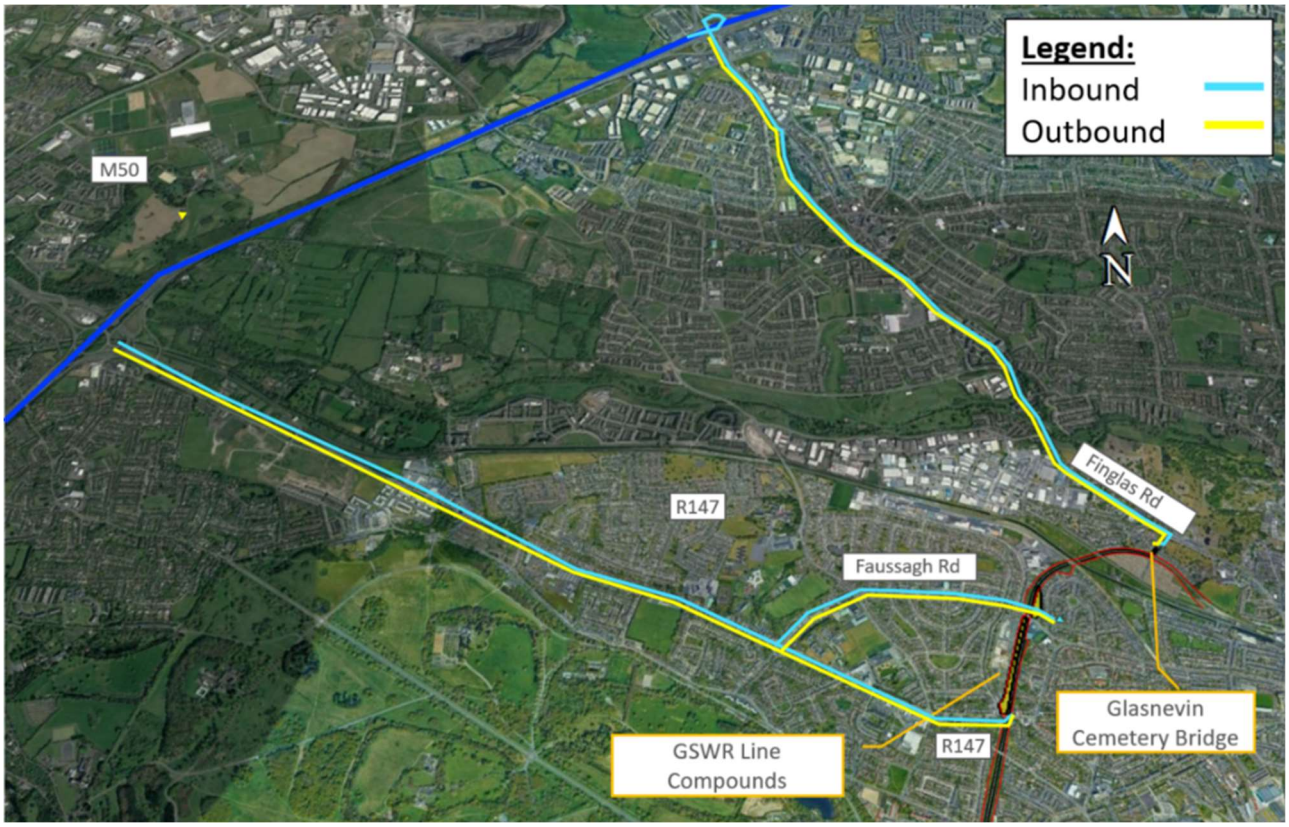

Figure 5-136 Zones D-2 & D-3: PPTBL & Glasnevin Cemetery Bridge Compound Haul Routes

5.5.2.9.2. Site Haul Routes

Track access will be provided from the Cabra Road compound, with the internal haul road serving the works fronts linearly along the rail corridor. No direct track access will be provided from Glasnevin Cemetery

There will be a period where connectivity between Heuston West and Cabra compound will be possible via the railway corridor. However, once the slab track works in the tunnel commence this connectivity will likely be severed, due to working space constraints, and access to the area north of the PPT will have to be from Cabra Road Compound.

5.5.2.10. Attenuation and Pumping Requirements

There is currently a pumping station that drains the excess of water on the cutting located between the Grand Canal and Luas Twin Arch (OBO8) and the Maynooth Line Twin Arch (OBO9). Lowering of this existing pumping station will be required with an enlargement of the existing wet well chamber. The proposed wet well will deal with the extra volume collected by the system while maintaining current pumping flows. This facility directs the inflows to an attenuation exfiltration tank to the northwest as shown in Figure 5-137 below.

Figure 5-137 Attenuation and Pumping Station

5.6. Testing and Commissioning of the System

5.6.1. Introduction

The Testing and Commissioning (T&C) of the System will consist of a set of tests to show that the system accomplishes its requirements. As the project is largely on an existing live railway line, some of the tests will be undertaken at night to minimise the impact on the live railway traffic.

The "system" is the railway, made of several subsystems: Signalling, Electrification, Telecoms (collectively SET), Permanent Way (perway), Civils, Stations, Depots and Power. Each subsystem will have its own tests, and there will be integration tests to ensure all the systems interact together, including external interfaces such as the rolling stock.

5.6.2. SET tests

The on-site acceptance tests (SAT) include:

- Telecom: tests of loudspeakers at stations can be undertaken during the day.
- OHLE: it is required to review the OHLE out of normal rail traffic hours with a special rail vehicle before the power-up and after power-up to adjust contact wire heights and staggers. These works will be undertaken at night and is not expected to have any significant impacts above those for normal maintenance on the existing railway.
- HV, LV: testing of the diesel generators at the substations can be done during normal hours.
- Signalling: the new signalling will be installed in parallel with the existing. In some cases, it is not possible to run the newly installed signalling live in parallel during train traffic hours, notably where it could distract diver attention or would interfere with the safe operation of the train, so some tests during the night can be expected with minor impact (noise and vibration impact similar to those experienced during the day, when trains are running). Some of the tests will be done in the depot testing track in order to minimise the impact on rail operations and these can be performed during normal daytime hours.

5.6.3. Integration tests

System integration tests include testing all the subsystems together to test the interaction between them. Rolling stock dynamic tests are part of these tests. Some of these tests are performed during the night, so they will have the impact of trains running outside of normal hours. These tests also include "TEST running".

5.7. Construction Environmental Management

The Construction Environmental Management Plan (hereinafter referred to as CEMP) has been prepared as an Appendix 5.1 to this Chapter and is presented in Volume 4 of this EIAR. It presents the approach and application of environmental management and mitigation for the construction phase of the proposed Project. It aims to ensure that adverse effects from the construction phase of the proposed Project, on the environment and the local communities, are avoided or minimised. It broadly replicates the construction stage mitigation included in Chapters 7-23 of this EIAR and as summarised in Chapter 27.

Post planning, the appointed contractor will take ownership of the Construction Environmental Management Plan (CEMP). Prior to any demolition, excavation or construction, a Construction Environmental Management Plan (CEMP) will be updated by the successful contractor. The CEMP will set out the Contractor's overall management and administration of the construction project

In addition to the EIAR mitigation measures already included in the CEMP, the Contractor will be required to include additional details under the following headings:

- Working hours and days;
- Emergency planning - in the event of a fire, chemical spillage, cement spillage, collapse of structures or failure of equipment or road traffic incident within an area of traffic management. The plan must include contact names and telephone numbers for Local Authority (all sections/departments); Ambulance; Gardaí and Fire Services;
- Details of chemical/fuel storage areas (including location and bunding to contain runoff of spillages and leakages);
- Details of construction plant storage, temporary offices and site security arrangements, measures will need to be identified in relation to security of the various sites during construction e.g. controlled access onto site, measures to secure rear gardens, access, etc;
- Traffic management plan (to be further developed in conjunction with the Roads Section of DCC, SDCC and KCC) including details of routing of network traffic; temporary road closures; temporary signal strategy; routing of construction traffic; programme of vehicular arrivals; on-site parking for vehicles and workers; road cleaning; other traffic management requirements;
- Truck wheel wash details (including measures to reduce and treat runoff);
- Dust management to prevent nuisance (demolition and construction);
- Site run-off management;
- Noise and vibration management to prevent nuisance (demolition and construction), Work practices, equipment noise control and screening shall be in compliance with BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise, and BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration (together referred to as B.S. 5228);
- Landscape management;
- Management of demolition of all structures and assessment of risks for same;

- Stockpile location and management;
- Project procedures and method statements for:
  - Demolition and removal of buildings, services, pipelines, ballast and other infrastructure (including risk assessment and disposal)
  - Diversion of services
  - Excavation and blasting (through peat, soils and bedrock)
  - Piling
  - Construction of pipelines
  - Temporary hoarding and lighting
  - Borrow pits and location of crushing plant
  - Storage and treatment of soils
  - Disposal of surplus material (peat, soils, rock etc.)
  - Earthworks material improvement; and
  - Protection of watercourses from contamination and silting during construction
- Site Compounds.

The working CEMP will also provide detail on areas of concern with regards to health and safety and any environmental issues that require attention during the construction phase. Adoption of good management practices on-site during the construction and operation phases will also contribute to reducing environmental impacts.

Before any buildings / structures are demolished, an assessment of infestation levels will be made by a pest control expert. Control measures will be in place prior to any construction commencing and will be monitored throughout with additional measures in place during earthworks and vegetation clearance. Good site management will be applied to include proper segregation and storage of wastes and the regular and prompt removal of all waste materials including organics and C&D waste. Old drains and other disused pipes will be either be filled with concrete, or alternatively dug out and the junctions with working drains sealed. Old foundations, cavities, etc., should be backfilled with suitable hardcore, well consolidated and covered with a layer of concrete or similar.

5.8. Construction Programme

The main considerations at this stage of the project development focuses on the proposed construction methodology for the works, with phasing to show the buildability of the proposed DART+ South West Project. The overall construction programme is expected to take 50 months and the current expectation is that construction will commence in mid-2025, subject to the necessary approvals. The indicative construction programme is provided in Figure 5-138.

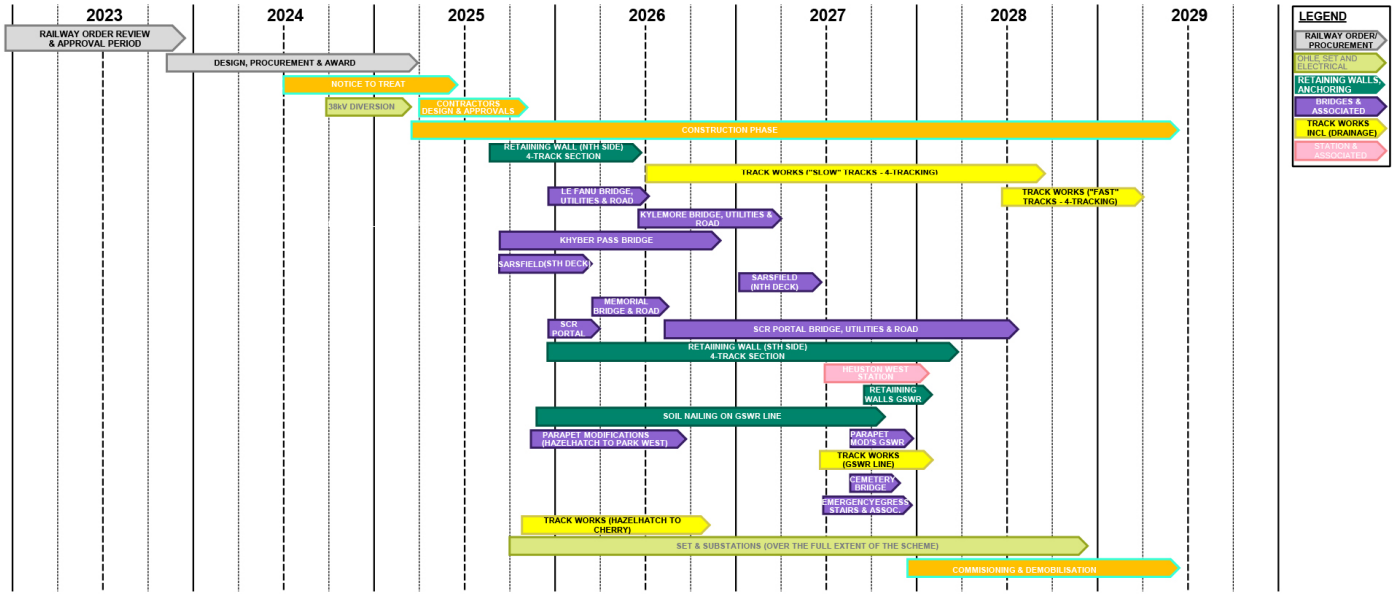

Figure 5-138 Indicative Construction Programme

5.8.1. Construction Programme Assumptions

A number of assumptions have influenced programme development, and these are outlined in the sections below.

5.8.1.1. General Staging

- Full closure of the line for extended periods of time will not be possible (except for the Phoenix Park Tunnel Branch Line) due to the significant disruption to operations and passengers.
- There is a requirement to limit the impact on the operation of the railway. This is particularly relevant on the four-tracking section of the Cork Main Line and the works in this area will need to be undertaken in a number of stages to ensure continuity of railway operations.
- To facilitate the widening of the railway corridor in the four-tracking section of the route, it is necessary to construct retaining structures at various locations. Due to the nature of this work, the preference is to carry out the associated construction activities during daytime hours by providing safe working zones, which will minimise nuisance to local residents
- The programming of works relating to the Phoenix Park Tunnel Branch Line is based on the assumption that the Phoenix Park Tunnel will be fully closed during construction. When the

tunnel is fully closed, the remaining works on the Phoenix Park Tunnel Branch Line can be coordinated so that they are undertaken simultaneously which would improve access, speed of construction (and hence nuisance).

- The works on the new Heuston West Station would also be undertaken during the closure of the Phoenix Park Tunnel.
- The strategy for installation of OHLE is to install bases at the same time as the track works. Masts are installed with the track or shortly afterwards. OHLE wiring would be added and energised as late as possible in the programme to support substation construction and commissioning. This could be done line by line with daytime possession of a single line or in night-time possession with wiring train(s).
- Substation installation will be as late as practicable to support OHLE wiring at the end of the project.

5.8.1.1.1. Construction Working Hours

The programme is based on a 10 hour working days, Monday to Friday. Specific construction activities will require variations from that, these include:

- Preparatory works that will require night-time working to create working platforms and safe zones of work;
- Piling: 8am to 6pm;
- Turnouts installation and removal: overnight hours;
- Heuston platforms 1 to 6: 9 days shutdown;
- Heuston platforms 7 and 8: 4 day shutdown;
- Wall between existing and new lines between South Circular Road junction and Memorial Road, undertaken over a series of night-time closures:
- Hazelhatch & Celbridge Station: 54/72 hour closure; and
- Tie in works: will require overnight work or blockades.

5.8.1.1.2. Construction Durations/ Production

The programme is based on the following assumed general construction durations:

- Temporary bridge 6 months, Minor temporary utility diversions 2 months, Abutment incl. piling 4 months, Deck Construction 2 months, Finishing Works 2 months, Inspection and Handover to Traffic 1 month.
- Piling production rates are assumed to be 2 no. per day per rig, if from road or safe zone within the corridor. Alternatively, 1no. pile per day per rig in locations where space is more restricted or where works are to be done under night possession.
- Track laying based on trucks and dozers not delivery by train at a rate of 1km per week incl. welding.

5.8.1.1.3. Other Assumptions

The programme does not fully take into account, at this stage of the programme development: seasonal construction calendars or abnormal weather events; and seasonal environmental calendars e.g. bird nesting season, and bat roosting.

5.9. Phasing of Works

A critical part of the construction of the works through the widening area is the phasing. As the corridor is narrow and full closure of the line cannot be permitted, the works will need to be phased so that only one side will be worked on at a time. A phase comprising one side of the works over a certain length will be completed in its entirety, including all track works and SET infrastructure before the opposite side can be commenced. All rail operations will be diverted to the newly widened section to enable works to be continued on the other side.

5.9.1. Staging Plans

Twelve stages have been identified for the construction phase to represent changes to track and signalling arrangements proposed to bring the construction to a final conclusion and this is outlined in Table 5.20. The stages will be evolved during the development of the construction stage of the development.

Table 5.20: Schedule of Railway Construction Management Stages

STAGE 0 – PRE-MAIN CONTRACT	
LINES IN OPERATION	- Normal Operations anticipated until DART+ South West commences.
TRACK WORKS	- No advanced works contract anticipated.
OPERATIONAL IMPACT	- 38kV advanced works diversion contract anticipated that may require limited possessions for safety owing to the proximity of the overhead structures and lines to the existing tracks.
SYSTEM	- No advanced works contract anticipated.
STAGE 1	
LINES IN OPERATION	- From Le Fanu to Heuston: Up Main, Down Main and Relief Line
OPERATIONAL IMPACT	- Only one track for both directions, 40m around Ch.12+000 (East Kylemore)
TRACK WORK	- Removal of existing Up Main between Heuston and East Kylemore (From Ch. 9+250 to Ch. 12+050), except Sarsfield bridge - Down Slow track installation from Ch.9+300 to Ch. 10+280 and from Ch. 11+000 to 12+850 - Up Slow track installation from Ch. 9+250 to Ch. 13+050, except Sarsfield bridge (slew in new track required to tie in with existing Up Main track)
SYSTEM	- SIG: LOC's HN01/18, 01/28, 01/54, 01/79, 02/04, 03/42, 03/15, 02/71 will be relocated from north side tracks to south side, including the cabling (power, LV and

	FO). Some equipment to be removed, routes must be cancelled from the interlocking (northern track will be removed in this section) HN253, HN256 to be removed; gantry to be removed, signals to be relocated: Speed restrictions expected
STAGE 2	
LINES IN OPERATION	- From Le Fanu to East Kylemore: Up Main and Down Main - From East Kylemore to Heuston: Down Main and Relief Line
OPERATIONS IMPACT	- Only one track for both directions, 40m around Ch.12+000 (East Kylemore)
TRACKWORK	- Removal of existing Up Main between Heuston and East Kylemore (From Ch. 9+250 to Ch. 12+050), except Sarsfield bridge - Down Slow track installation from Ch.9+300 to Ch. 10+280 and from Ch. 11+000 to 12+850 - Up Slow track installation from Ch. 9+250 to Ch. 13+050, except Sarsfield bridge (slew in new track required to tie in with existing Up Main track)
SYSTEMS	- SIG: LOC's HN01/18, 01/28, 01/54, 01/79, 02/04, 03/42, 03/15, 02/71 will be relocated from north side tracks to south side, including the cabling (power, LV and FO). Some equipment to be removed, routes must be cancelled from the interlocking (North track will be removed in the section) HN253, HN256 to be removed; gantry to be removed, signals to be relocated: Speed restrictions expected
STAGE 3	
LINES IN OPERATION	- From Le Fanu to East Kylemore: Up Main and Down Main - From East Kylemore to Heuston: Down Main and Relief Line
OPERATIONS IMPACT	- Only one track for both directions, 40m around Ch.12+000 (East Kylemore)
TRACKWORK	- Removal of two crossovers between Down Main and Relief Line between Ch. 10+800 to 11+000
SYSTEMS	- Crossover 705A/B 706A/B to be removed: Interlocking modification required; new troughing and niches to be constructed in the new north slow line
STAGE 4	
LINES IN OPERATION	- From Le Fanu to East Kylemore: Up Main and Down Main - From East Kylemore to Heuston: Down Main and Relief Line
OPERATIONS IMPACT	- Only one track for both directions, 40m around Ch.12+000 (East Kylemore) - Closure of PPTBL - Closure of northern yard area at Heuston station - Closure of platforms 6,7 and 8 at Heuston station
TRACKWORK	- Slew of the Down Main towards the South from Ch.10+400 to 11+000 to match with future Down Slow, except at Sarsfield Bridge. - PPTBL works - Removal of Heuston Station northern tracks tie-in (yard and platform 6, 7 and 8)

UTILITIES	- PPTBL
RETAINING WALLS	- PPTBL
DRAINAGE	- PPTBL - Construction of Attenuation Tank #3 (Heuston West) - Installation of northern pipe of network #3 (from SCR to Attenuation tank #3)
TRAFFIC MANAGEMENT	- Install TTM diversions for Glasnevin Cemetery & close road - Installation of TTM/Utility bridge - Glasnevin Cemetery - Removal of TTM/Utility bridge -Glasnevin Cemetery
BRIDGES	- PPTBL (Glasnevin Cemetery Road Bridge (OBO10) - Glasnevin bridge and PPT tunnel invert reconstruction)
SYSTEMS	- Crossover 705A/B 706A/B to be removed: Interlocking modification required; new troughing and niches to be constructed in the new north slow line.
STAGE 5	
LINES IN OPERATION	- From Le Fanu to East Kylemore: Down Main - From East Kylemore to Heuston: Down Main and Relief Line
OPERATIONS IMPACT	- Only one track for both directions, 1000m form Ch.12+000 (East Kylemore) to Ch. 13+000 - Closure of PPTBL - Closure of northern yard area at Heuston station - Closure of platforms 6,7 and 8 at Heuston station
TRACKWORK	- Removal of exiting Up Main from Ch. 12+000 to Ch. 13+450 - Installation of Up and Down Slow from Ch. 12+900 to Ch. 13+450 - Finish PPTBL - Finish Heuston Station northern tracks tie-in (yard and platform 6, 7 and 8) - Removal of crossover between Turnback siding and Fast Line beside Finnstown - Installation of crossover beside Finnstown R120 Road Bridge (OBC19) - Removal of crossover between Turnback siding and Fast Line East of Hazelhatch - Installation of crossovers East of Hazelhatch - Removal of existing Slow tracks West Hazelhatch - Installation of Slow tracks West Hazelhatch
SYSTEMS	'Existing Interlocking to be modified: No new cabling expected. Interfaces with: - Heuston South (existing Interlocking) - Adamstown to Hazelhatch.
STAGE 6	
LINES IN OPERATION	- From Le Fanu to East Kylemore: Up Slow and Down Main - From East Kylemore to Heuston: Up Slow and Relief Line
OPERATIONS IMPACT	- Closure of platform 6 at Heuston station
TRACKWORK	- Removal of existing Down Main from Ch. 9+500 to Ch. 11+900, except Sarsfield bridge

	- Installation of Down Slow from Ch. 10+300 to Ch. 11+000, except Sarsfield bridge
SYSTEMS	New interlocking in the NTCC: New cabling from the new OBJ to axle counters, signals an motor points (Heuston - Adamstown) Fibre optic to be connected and laid in new troughing (Slow line north) LV 650 lines connected to new LOCS through new troughing (North slow lines). Cabling to be laid from PK 13+000 to 25+000, after new troughing has been made
STAGE 7: (Refer to Construction Programme for Sequence of Works)	
LINES IN OPERATION	- From Le Fanu to East Kylemore: Up Slow, Down Slow and Down Main (only access to Inchicore Works from the West) - From East Kylemore to Heuston: Up Slow and Down Slow
OPERATIONS IMPACT	- Closure of platforms 1,2 and 3 at Heuston station - Closure of East access to Maintenance Shed at Inchicore
TRACKWORK	- Removal of existing Relief Line - Removal of southern tracks at Heuston Station to allow future tie-ins - Removal of East access to Inchicore Shed - Removal of sidings from Ch. 11+100 to 11+500 at Inchicore
SYSTEMS	- Projected LOC's to be commissioned, shifted LOCS to be removed from south track (Inchicore to Heuston). - Hazelhatch OB to be commissioned. - Cabling South fast track to be located in North slow track temporally
STAGE 8	
LINES IN OPERATION	- From Le Fanu to East Kylemore: Up Slow, Down Slow and Down Main (only access to Inchicore Works from the West) - From East Kylemore to Heuston: Up Slow and Down Slow
OPERATIONS IMPACT	- Closure of platforms 1,2 and 3 at Heuston station - Closure of East access to Maintenance Shed at Inchicore
TRACKWORK	- Installation of Fast tracks between Inchicore and Heuston - Tie-in between fast tracks and Heuston Station tracks
SYSTEMS	- Cabling running in south from Inchicore to PK 13*300 diverted to North
STAGE 9	
LINES IN OPERATION	- From Le Fanu to East Inchicore: Up Slow and Down Slow - From East Inchicore to Heuston: Up Slow, Down Slow, Up Fast and Down Fast
OPERATIONS IMPACT	- Closure of West access to Maintenance Shed and sidings at Inchicore
TRACKWORK	- Removal of existing tracks between Cherry Orchard and Inchicore (West access) - Removal of West sidings and access to Maintenance Shed tracks - Removal of existing Fast tracks West Hazelhatch
SYSTEMS	- Cabling running in south from Inchicore to PK 13*300 diverted to North

STAGE 10	
LINES IN OPERATION	- From Le Fanu to East Inchicore: Up Slow and Down Slow - From East Inchicore to Heuston: Up Slow, Down Slow, Up Fast and Down Fast
OPERATIONS IMPACT	- Closure of West access to Maintenance Shed and sidings at Inchicore
TRACKWORK	- Installation of Fast tracks between Cherry Orchard and Inchicore Works. - Installation of new sidings and west access to maintenance shed - Installation of new Fast tracks West Hazelhatch
SYSTEMS	- Minor cabling movements
STAGE 11	
LINES IN OPERATION	- Up Fast and Down Fast
OPERATIONS IMPACT	- Closure of Slow tracks
TRACKWORK	- Installation of Slow tracks at Sarsfield - Slew Slow tracks to tie-in with new tracks at Sarsfield
SYSTEMS	- Minor cabling movements
STAGE 12	
LINES IN OPERATION	- Full DART+ South West in Operation