

# METROLINK

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# A7.7

**St Stephen's Green Station  
Study – Alternative Station  
Location within St Stephens  
Green East Carriageway**



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## 1 Executive Summary

MetroLink is a major transport infrastructure project included in Project Ireland 2040. The high capacity, high-frequency service will provide sustainable, reliable, public transport for the growing population of Dublin, helping Ireland meet its climate change targets. Subject to approval of the Preliminary Business Case, expected to be submitted to Government in Q1 2021, Transport Infrastructure Ireland (TII) is preparing an application for a Railway Order to be submitted to An Bord Pleanála, currently estimated to be submitted in Q3 2021.

The eastern side of St Stephen's Green was identified as the optimum location for the MetroLink station as it would best serve passenger demand from the retail, commercial and cultural trip attractors in the vicinity. Further, the alignment from Tara Street Station (where MetroLink interchanges with DART and Irish Rail services) towards its terminus at Charlemont imposes turning constraints on the Tunnel Boring Machine that favour the eastern side of St Stephen's Green as an appropriate location.

The Emerging Preferred Route for MetroLink (March 2018) proposed locating the station mainly underneath the roadway and footpath on St Stephen's Green East, but with part of the construction zone extending into the park. St Stephen's Green is a designated national monument extending to the kerb line beyond the property boundary fence line.

As the design developed, the costs, complexity and constraints of this position became apparent and the station was moved slightly westwards to be partially located within St Stephen's Green Park and partially under the adjacent footpath/roadway, and this new station location was included in the Preferred Route for MetroLink (March 2019). Although there were construction impacts on the park in terms of nuisance, environmental and ecological impact and loss of amenity, much of this impact was temporary. Where there was permanent impacts these could be mitigated through sensitive design and appropriate reinstatement of vegetation. An options analysis of alternative options is included in the St Stephen's Green Station Study Location Assessment Report in Appendix B.

Moving the station to the location as identified in the Preferred Route significantly reduces the overall cost of the station (by 60%) and the time needed for its construction. It also substantially reduces potentially severe impacts on important heritage buildings adjacent to the station and helps ensure that some essential traffic movements are maintained while the station is being built.

### 1.1 Consultation with Office of Public Works (OPW) and Department of Culture, Heritage and the Gaeltacht (DCHG)

Following consultation with representatives of the Office of Public Works (OPW) and the Department of Culture, Heritage and the Gaeltacht (DCHG), the OPW formally informed TII (10 June 2020) that the MetroLink proposals are unacceptable and requiring that 'the project does not infringe on the boundary of St Stephen's Green or alter the historic landscape in any way'. Following receipt of OPW letter, TII undertook further analysis on a possible alternative option to construct the station entirely outside the boundary of St Stephen's Green Park and within the carriageway and footpaths of St Stephen's Green East. This analysis was developed from the original March 2018 proposal and provided a more detailed assessment of the practicalities of building the station at this location.



Subsequently, TII prepared a report, which provides a detailed appraisal of the construction feasibility of a station box situated wholly under St Stephen's Green East carriageway and outside the park boundary fence line, which is included as Appendix A.

It should be noted that this option would need to make use of the west footpath of St Stephen's Green East, which is within the designated national monument extents; without making use of this footpath, the station would not physically fit within the carriageway and east footpath.

## 1.2 Key Findings of Alternative Station location within Carriageway

The key findings of the analysis are as follows:

1. **Increased direct cost:** The overall relative direct cost comparison of the station will increase by about 67%
2. **Time delay:** The complexity of the alternative construction methodology and the necessity to carry out extensive service diversions will increase the overall construction programme by about 15 months. This is a higher risk approach, and an additional time risk allowance of 12 months is deemed appropriate. This results in an overall duration increase of 2 years and 3 months.
3. **Impact on buildings including protected structures:** St Stephen's Green East is bounded by buildings of architectural and historical significance. Between Merrion Row and Leeson Street Lower, 10 buildings are listed as protected structures. As the alternative station box is in close proximity to the buildings, protecting the buildings will require extensive strengthening of parts of the buildings in advance of construction works, necessitating the relocation of the occupants for considerable time periods, refer Fig. 5 & 6 showing proximity of station box, for proposed and alternative station box locations, relative to building line. As the construction footprint occupies the entire carriageway and footpath of St Stephen's Green East, it will not be possible to maintain access to the front of the buildings or to maintain utility service connections. Given the further impact of noise, dust and vibration on building occupants, it is extremely likely that the buildings will need to be vacated and the occupants relocated for much of the construction period.
4. **Impact on critical utilities:** Critical utilities services, which would otherwise not require diverting, will need to be diverted if the station box is to be located entirely within the carriageway, refer Fig. 3 & 4 showing typical cross sections of proposed and alternative station box locations relative to services. This will include the temporary diversion of existing large Victorian ovoid sewers (1.8 x 0.9m and 1.7 x 1.1m) to facilitate construction, with reinstatement in their current locations/depths; and a 1.2km diversion of an existing high voltage ESB cable away from the construction area. These are complex, difficult diversions which will cause extensive disruption while being undertaken. The gravity sewers will need to be replaced by pumping stations and rising mains with standby capacity to mitigate the risk of flooding. Other critical services (gas, water, communication) will also require diversion.
5. **Impact on traffic:** The closure of St Stephen's Green East and Hume Street during construction would require the diversion of all traffic and pedestrians including 384 bus services across multiple bus routes. As well as inconveniencing car traffic, these alterations will significantly increase journey times for many bus passengers across the city. These diversions, and resultant impacts, will be in place for several years – potentially up to five or more years. A double steel deck could be considered to allow some movement of vehicles and/or pedestrians for part of the construction period, but this would introduce significant health and safety risks that would need to be mitigated.



6. **Impact on St Stephen’s Green Park:** Locating the station in the road may still cause a great deal of damage to the trees on the eastern side of St Stephen’s Green due to the proximity of the temporary and permanent retaining wall structures impact on any root systems within the construction zone. Any tree with more than 40% loss of root ball is regarded as unlikely to survive, although this should be checked with an arboriculturist. Options for such trees may include felling, very heavy pruning or relocation. Trees which lose one side of their root system also become very unstable.

## 2 Comparing Proposed Location to Carriageway Location (Pros and Cons)

Figure 1 shows the proposed location of the station, shown by the shaded blue box with the dashed red line broadly indicating the extent of the construction site. Figure 2 shows the station location (extent shown by purple lines) if the station was to be constructed wholly under the carriageway, with associated access required from the current park entrance, with the dashed red line broadly indicating the extent of the construction site.

A comparison of the pros and cons of each location based on the analysis contained in this document is summarised in Table 1.

Area of Impact	Proposed	Alternative
Temporary Impact on Park	Impacted (boundary/trees)	Minimal impact to trees but roots and overhanging branches may be affected (Ref
Permanent Impact on Park	New entrance and vents within park	Minimal, new entrance on corner adjacent to the Wolfe Tone sculpture
Construction Duration	92 months	Longer by 27 months (Allowing 12 month time risk)
Relative Direct Cost	100%	+ 67%
Heritage Building Impact	<ul style="list-style-type: none"> <li>✓ Less impact due to noise, dust and vibration</li> <li>✓ Shorter construction period, access and services to front of buildings maintained</li> <li>✓ Bus, traffic and pedestrian access maintained</li> </ul>	<ul style="list-style-type: none"> <li>✓ Increased nuisance due to proximity of construction works including noise, dust and vibration</li> <li>✓ No accesses or services to front of buildings</li> <li>✓ No bus, traffic or pedestrian access</li> </ul>
Utilities	<ul style="list-style-type: none"> <li>✓ Single stage diversion from west carriageway to east carriageway</li> <li>✓ No effect on Hume Street</li> </ul>	<ul style="list-style-type: none"> <li>✓ More services affected</li> <li>✓ 3 stages of utility diversions in St Stephen’s Green East and Hume Street</li> <li>✓ No services to properties in St Stephen’s Green East during construction</li> </ul>
Traffic Impact	Critical traffic movements maintained	8-10 years ongoing disruption

Table 1 Pros/Cons summary



Figure 2 Station located partially within the R138 Carriageway/partially within St Stephen's Green (Proposed)

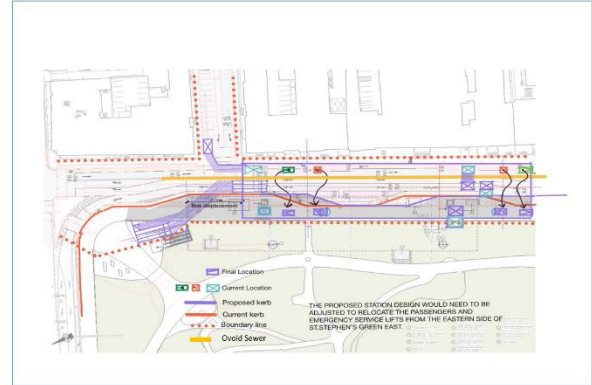


Figure 1 Station located within the R138 Carriageway (Alternative)

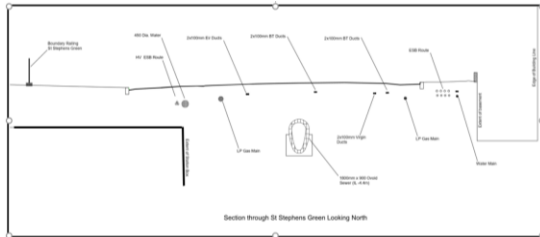


Figure 3 (Proposed) - Typical Cross Section showing services relative to station box

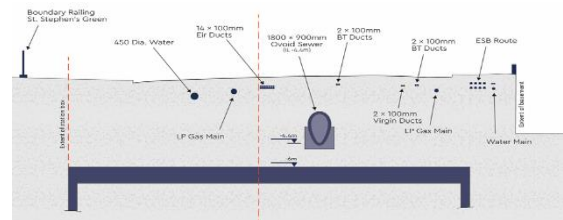


Figure 4 (Alternative) - Typical Cross Section showing services relative to station box

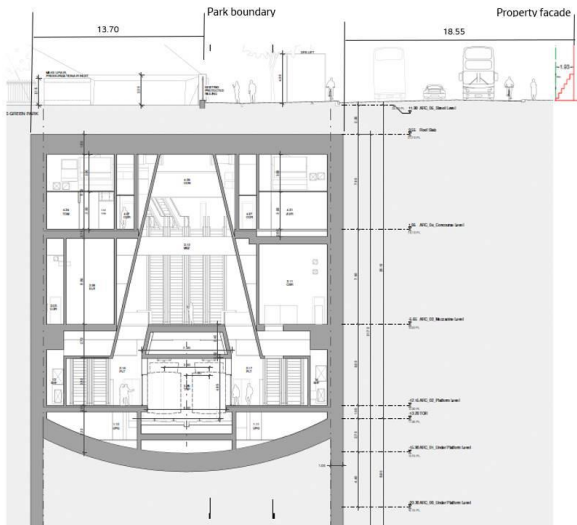


Figure 5 (Proposed) - Typical Cross Section through Station Box showing position relative to Park boundary, kerb line and properties including basements on East R108

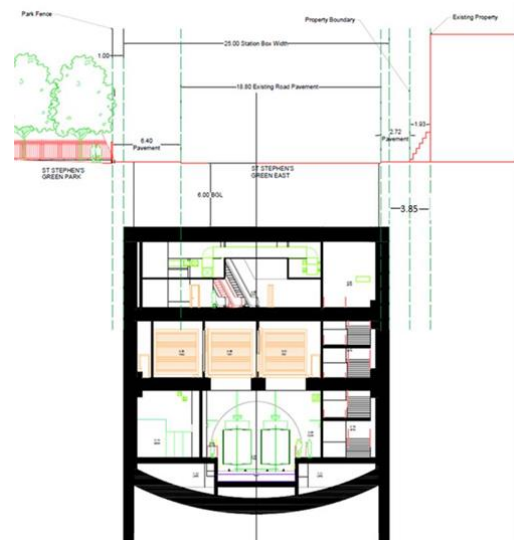


Figure 6 (Alternative) - Typical Cross Section through Station Box showing position relative to Park boundary, kerb line and properties including basements



**MetroLink**

**St Stephen's Green Station in Carriageway  
Construction Approach**

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## MetroLink

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## Executive Summary

Following consultation with the Office of Public Works (OPW) and the Department of Culture, Heritage and the Gaeltacht (DCHG), the OPW formally informed Transport Infrastructure Ireland (TII) (letter dated 10 June 2020; see Appendix A) that the current proposal for MetroLink is unacceptable, requiring that “the project does not infringe on the boundary of St Stephen's Green or alter the historic landscape in any way. MetroLink would require a Railway Order to proceed, and OPW may be an Objector under whatever legislation sets out the Railway Order decision-making process.

This report discusses the feasibility of constructing a station entirely within the carriageway of St Stephen's Green East thereby avoiding the historic landscape of St Stephen's Green entirely and the impacts this would have on the area as well as the impacts on the Project compared to the 'base case'. The repeated relocation of utilities including the Victorian sewer, the proximity of historic buildings and the disruption to traffic are the biggest impacts of this option.

An outline architectural appraisal has been produced for the alternative location. The increased depth of the station in the new location means that a second flight of stairs and escalators will be required outside the station. To obtain space for this the station box needs to be relocated approximately 25m further south and means a longer stair/escalator run outside of the box than the preferred location.

The draught relief shaft (no.3) has been relocated from SSG East into Hume Street. The shaft will need to pass under the large ovoid sewer that runs down Hume Street and then joins the main sewer running along SSG East, immediately north of the station entrance cut and cover tunnel. This adds to the construction complications of this option.

The relocation of the station to St Stephen's Green East will have an impact on the construction programme, principally due to the increased duration for the utility deck and phased diversions. This will also increase construction costs significantly due to additional direct costs of managing the utilities, protecting the historic buildings as well as the costs of prolongation. An order of magnitude estimate indicates that the cost of this alternative is 67% higher than the baseline cost estimate.

The indicative programme for construction of the St Stephen's Green Station within the St Stephen's Green East carriageway is shown in Appendix B. The overall programme for this alternative option would start 30 August 2022 and finish 30 June 2031, compared with a baseline finish of 02 April 2030, i.e. an increase of approximately 15 months. However, it should be noted that the construction methods are higher risk, so a time risk allowance – assessed at 12 months - should be made for this.

Although constructing a station in the carriageway in St Stephen's Green East is possible, this location is extremely challenging and will have an increased impact and higher risk than other locations that have been previously considered

## Limitation Statement

- It is assumed that there will be minimal impact during construction from karstic features in the limestone rock.
- To support the utility deck, plunge columns will be installed. These may need to form part of the permanent works design because the deck cannot be removed until construction is complete.
- Rising main pumping stations will be constructed in St Stephen's Green East and Hume Street to remove the Victorian ovoid sewer. These will be replaced on completion of the station box backfill.
- St Stephen's Green is a designated National Monument which incorporates the adjacent footway up to the kerb line. Consent will be required as the station will not physically fit in St Stephen's Green East without making use of both footways and the carriageway, although the construction proposal assessed will avoid impact on the existing park railings
- This report is intended as a standalone document to review the feasibility of constructing a station within St Stephen's Green East and as such a Multi Criteria Assessment analysis has not been carried out.
- A mined station alternative with access shafts has been considered but discounted due to the complexity of the construction method and resulting increase of risk, programme and costs. Construction of access shafts both for construction purposes and for permanent operational needs (back of house facilities, access) would impact on St Stephen's Green East and potentially within the park.

## 1 Introduction

This report has been prepared to describe the sequencing, methodology and feasibility of constructing St Stephen's Green Station wholly within the footway and carriageway of St Stephen's Green East. This report explains why constructing a station entirely within the carriageway has been reconsidered before explaining the present situation in this location regarding traffic, geology and utilities.

The body of this report considers how a station might be constructed in this location. The working area in this location is highly constrained, and this poses significant challenges in how to carry out the construction and mitigate the impacts. Temporary works to manage utilities and construction traffic would be significant and will require changes to the standard station design.

The construction programme is then discussed, including details of the production rates assumed, before comparing the relocated solution with the base case.

The report concludes with conclusions and recommendations.

### 1.1 Background

The Emerging Preferred Route for MetroLink (March 2018)<sup>1</sup> proposed locating the station mainly underneath the carriageway and footpath on St Stephen's Green East, but with part of the construction zone extending into the park. As the design developed, the costs, complexity and constraints of this

position became apparent, so the station was moved slightly westwards to be partially located within St Stephen's Green Park and partially under the adjacent footpath/carriageway. The revised station location was included in the Public Consultation on the Preferred Route (March 2019)<sup>2</sup>. A detailed Location Assessment Report (Jacobs IDOM 01/2020)<sup>3</sup>, which assessed several station options for the location of a station at St Stephen's Green East was produced. The Location Assessment Report was shared with the Office of Public Works (OPW) in January 2020.

## 1.2 Preferred Proposal – St Stephen's Green Park

The preferred location for the station is at St Stephen's Green East as illustrated in Diagram 1.1. The station would be located partially within St Stephen's Green Park and partially within the existing carriageway. This location would minimise traffic impacts on St Stephen's Green East, avoid the need to divert several critical utilities (sewer, gas, water, electricity) and ensure that the construction works are not immediately adjacent to the historic buildings to the east of the carriageway. This is the current MetroLink proposal which the Project is proceeding with and is the Base Case for comparison of the alternative proposal.



Diagram 1.1: Current Preferred Station Location

### 1.3 Consultation with Office of Public Works and Department of Culture, Heritage and the Gaeltacht

Following consultation with the OPW and the Department of Culture, Heritage and the Gaeltacht, the OPW formally informed TII (10 June 2020) that the current MetroLink proposal is unacceptable, requiring that “the project does not infringe on the boundary of St Stephen's Green or alter the historic landscape in any way”.

On receipt of the OPW letter (see Annex A), TII undertook further analysis to identify the feasibility of constructing a station box entirely outside the boundary of St Stephen's Green Park. This analysis was developed from the original March 2018 proposal and provided a more detailed assessment of the practicalities of building the station at this location. Transport Infrastructure Ireland (TII) issued the report Relocating Metrolink Station Box within SSG East Carriageway (TII, 11/2020)<sup>5</sup>.

### 1.4 Preliminary Design

The current preliminary design for the station at St Stephen's Green East carriageway is illustrated in Diagram 1.1. The station would be 115.90m long and 25m wide. The station would be over 32m deep to formation level with the ‘top of rail’ approximately 25.10m beneath surface level.

### 1.5 Locating the Station within St Stephen's Green East Carriageway

Diagram 1.2 shows an indicative plan of the alternative station. It can be seen from the cross-section (Diagram 1.3) that the boundary of St Stephen's Green Park would remain in place during construction and that the eastern side of the station box would be near the facades and the cellars of the existing historic buildings. Diagram 1.4 shows the location of reinstated utilities above the completed station box.

It is assumed that the station design would need to be adjusted to avoid the placing of lifts (passenger and for emergency services) along the eastern side of St. Stephen's Green East as there would need to be footway widening for access to the lifts and space to pass by with associated permanent loss of road space to accommodate this.



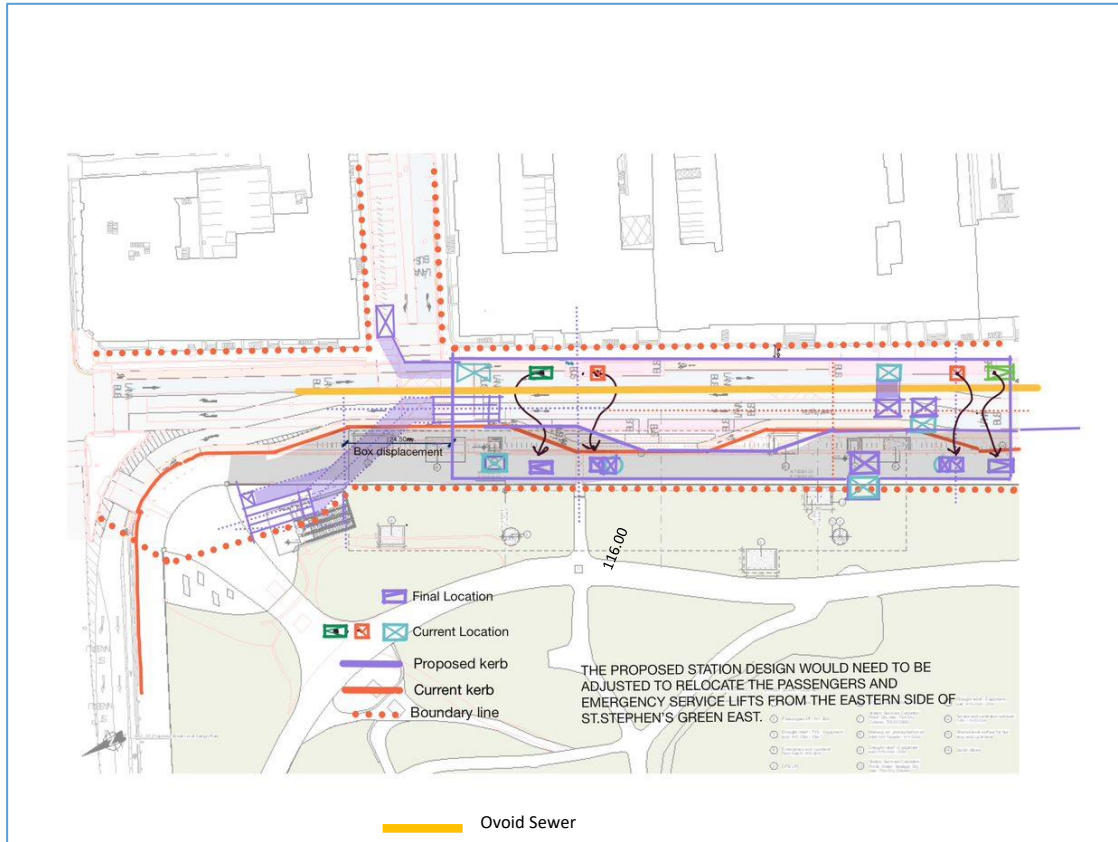


Diagram 1.2: Alternative Station Plan

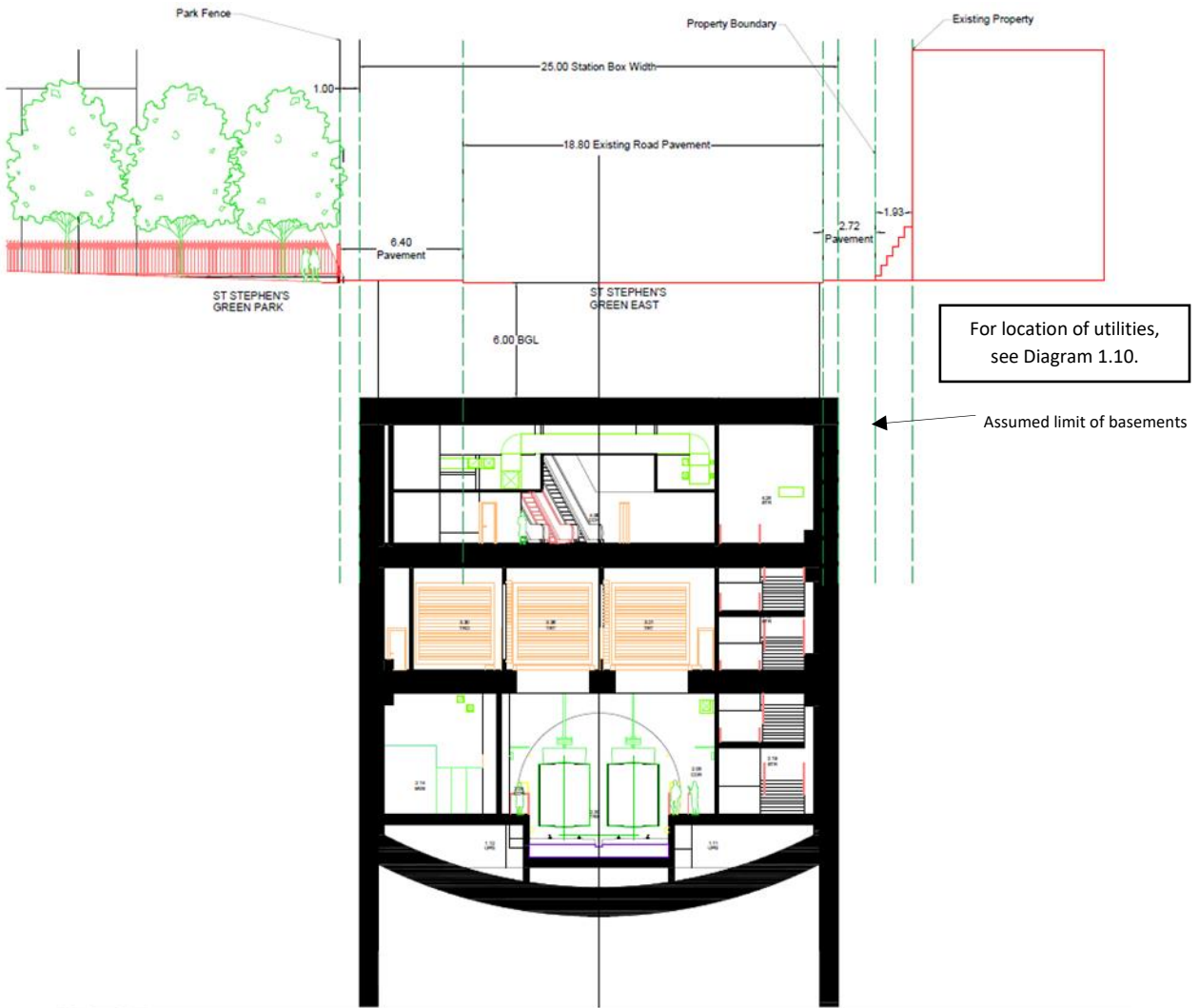
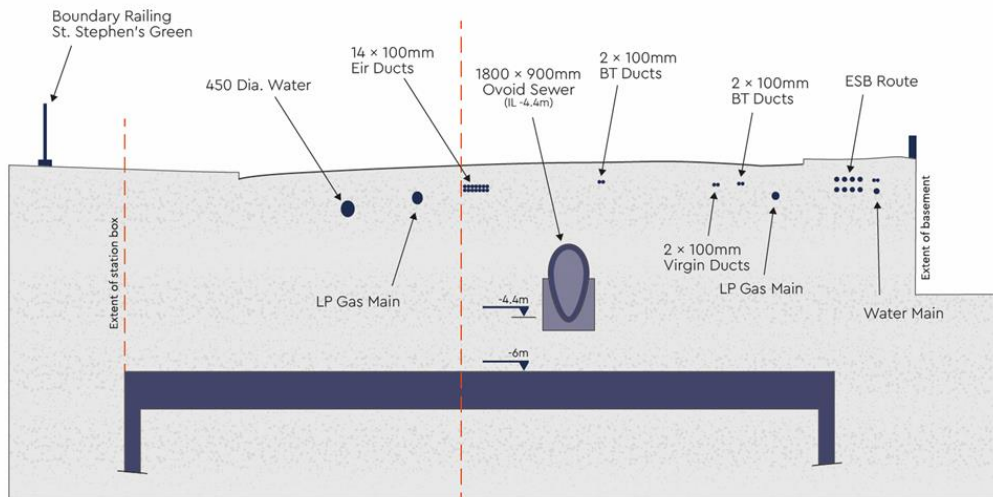


Diagram 1.3: Alternative Station Cross-Section



**Diagram 1.4: Utility locations relative to completed station box**

The station box would sit entirely within the carriageway and occupy both the adjoining east and west footpaths. The western extent of the box would be situated approximately 2.5m from the eastern fence line of St Stephen's Green Park. The eastern extent of the box would be situated in line with the footpath on the eastern side, whilst the northern end of the station would be located across the junction between Hume Street and St Stephen's Green East. The depth to the top of the station roof slab from the surface would be 6m.

For the purpose of comparison Diagram 1.4a shows the position of the reinstatement utilities over the station box as currently designed and partially within St. Stephen's Green Park.



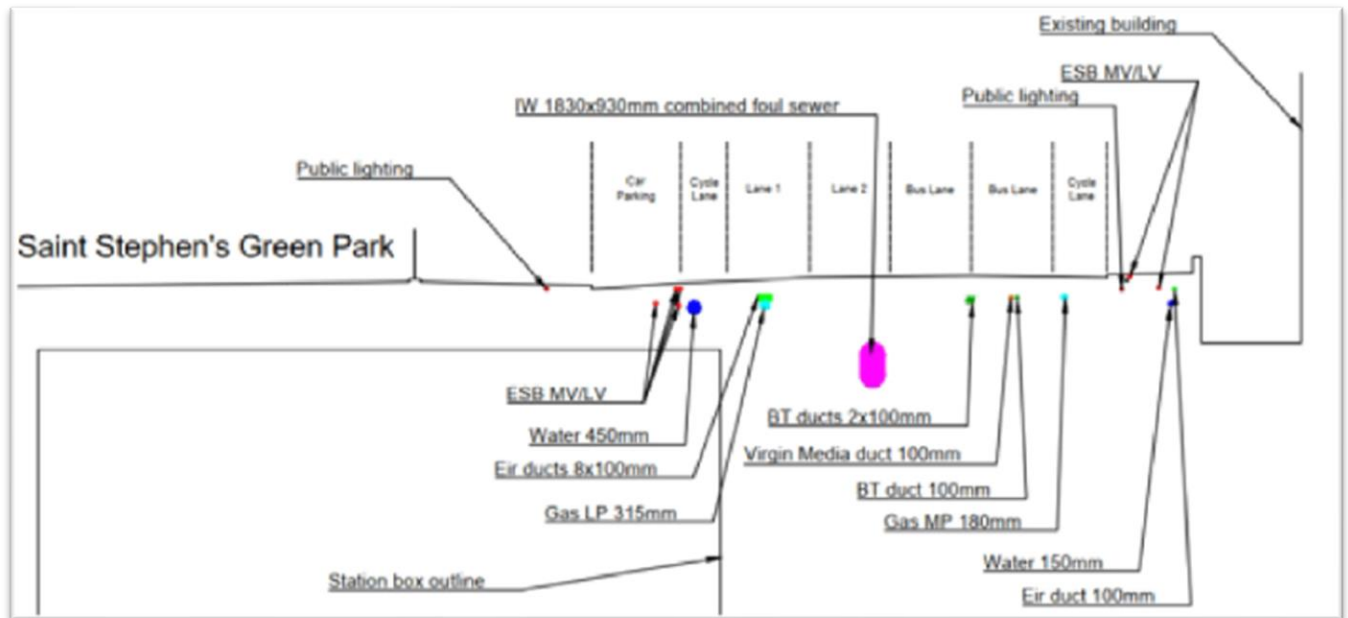


Diagram 1.4a: Utility Reinstatement

## 1.6 Station Access

The potential station accesses for this alternative could be as shown in Diagram 1.2. The long section of this alternative station location is shown in Diagram 1.5. Annex C illustrates the relative difference of this deeper station compared to the proposed station layout.

The depth of the preferred station option is approximately 2.5m below ground level, however the depth of the station in this alternative location is 6m below ground level to accommodate the Victorian ovoid sewer. This means that a second flight of access stairs and escalators would be required outside the station box. To obtain space for this, the station box needs to be relocated approximately 25m further south to allow the station entrance to be located towards the corner of the park.

There is no longer space for draught relief shaft (no.3) in St Stephen's Green East and this has been relocated into Hume Street. The shaft will need to pass under the Hume Street sewer that joins the main sewer running along SSG East, immediately north of the station entrance cut and cover tunnel. This adds to the construction complications of this option.

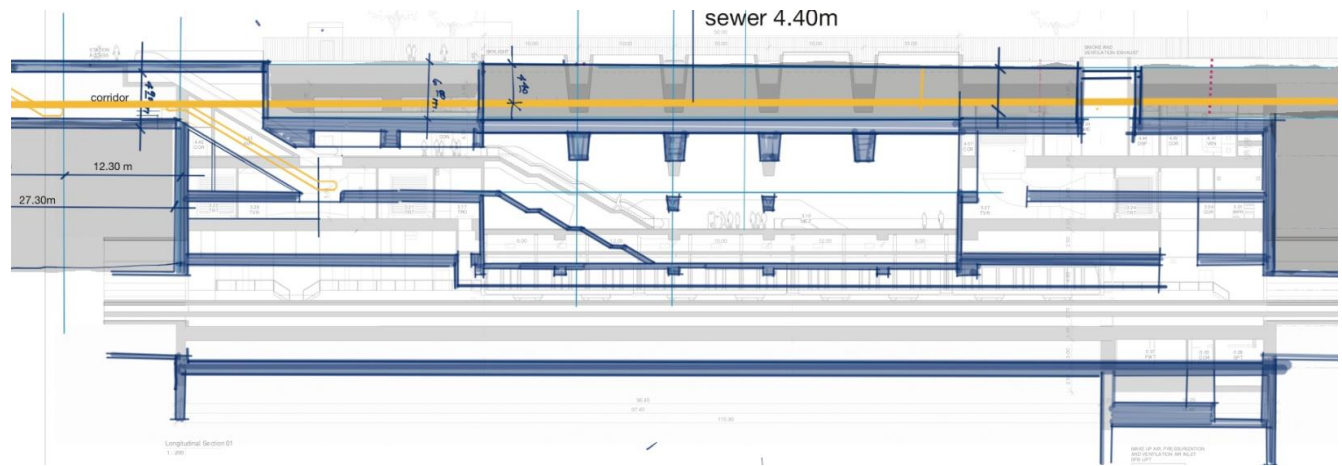


Diagram 1.5: Alternative Station Access Arrangement Long Section

## 1.7 Relocation of the Station within St Stephen’s Green East Carriageway

### 1.7.1 Construction Site

In Diagram 1.6, the dashed red line indicates the outline of the required construction site, and the blue rectangle the station box. The key shows the current occupants of the buildings and it is likely that these will need to be relocated during construction.

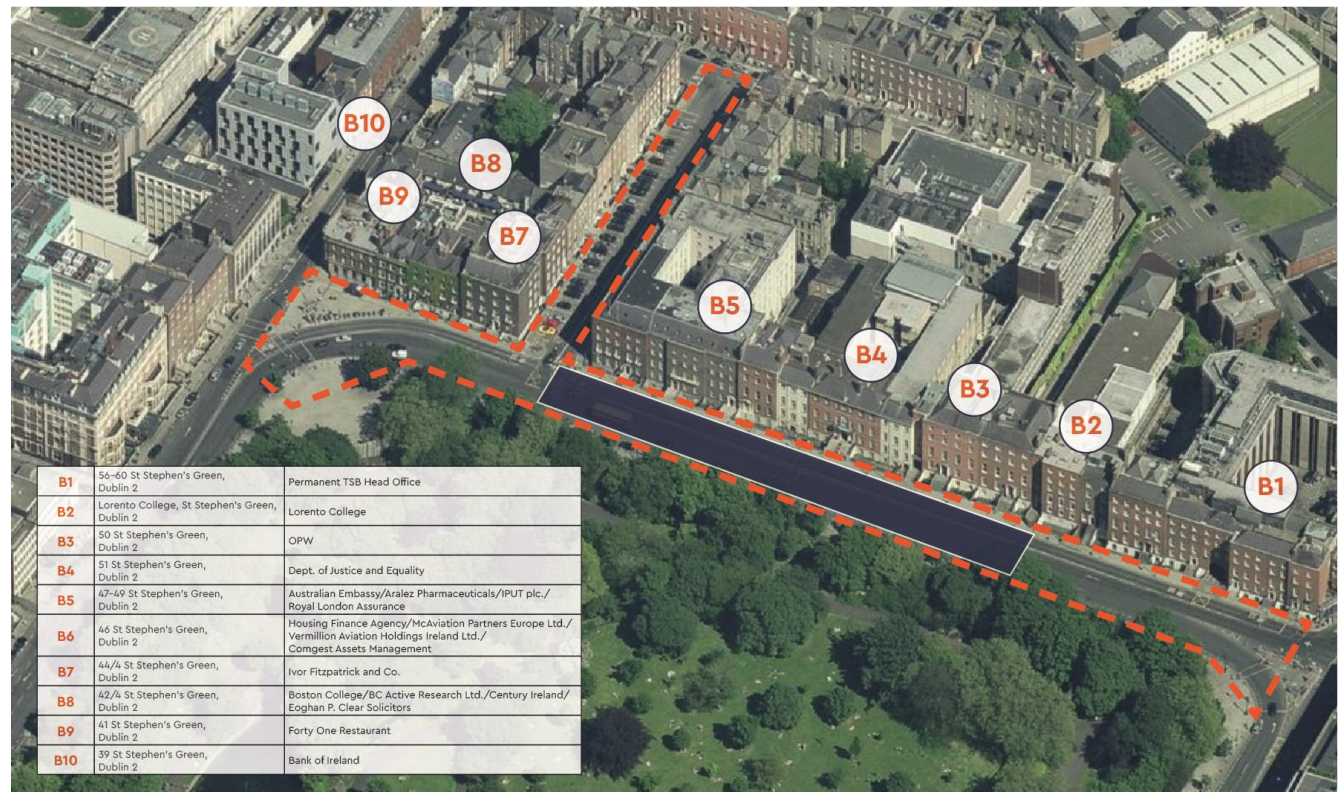


Diagram 1.6: St Stephen’s Green Alternative Station Location

The St Stephen's Green Station construction site would be on the east side of St Stephen's Green, taking land within footways and carriageway and part of Hume Street.

The proposed construction site is extremely small, so it would be necessary to augment this by renting local office space for site office and welfare facilities. The site offices and main welfare would be best positioned in the buildings along the east of SSG, avoiding tying up valuable site area and requiring several location moves. It would then be possible to provide only toilets and hand washing facilities on site.

The station occupies almost the entire width of the site, and therefore site entrances and welfare facilities would be required at both ends of the site, the layout will also be subject to alteration at construction phase changes.

To minimise the need for reversing vehicles and construction plant a turntable will be required at each entrance. The use of turntables is described more fully in Chapter 5.

Diagram 1.7 is a photograph of the site at Charlemont where the developer, Hines, has commenced part of the piling works for the future station there. This shows the typical site set-up required to construct a station of this size. Note that the Charlemont construction site is wide enough for a haul route on one side of the station. This would not be possible at St Stephen's Green.





**Diagram 1.7: Charlemont Station Construction Site Set-up**

Traffic can only be routed through the site by providing a temporary steel deck, but there will be phases where this will not be possible and construction traffic will need to use public roads to travel from one end of the site to the other.

Welfare facilities will be needed at each entrance to the site, but it may be necessary to stack these because the site is so confined.

Diagram 1.6 indicates the required site area (which is bounded by the red line).

A small additional site is likely to be required as a lorry holding area, to control the flow of Heavy Goods Vehicles into the site (preventing queuing on the public carriageway). The location for this would need to be determined in coordination with Dublin City Council.

The anticipated geology for the St Stephen's Green Station is shown in Diagram 1.8, which is an extract from the Geological Long Section drawing ML1-JAI-GEO-ROUT-XX-DR-Y-00007.

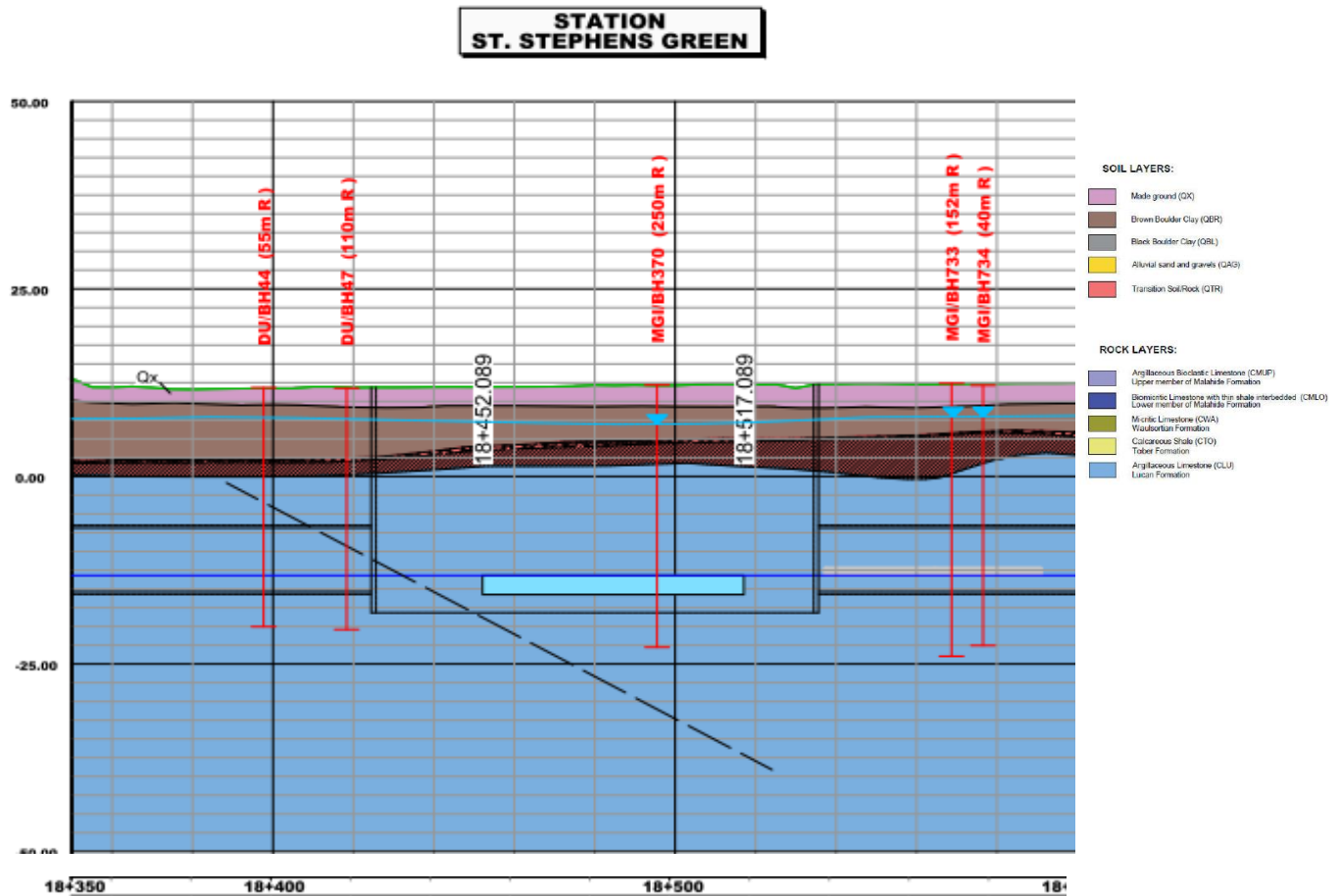


Diagram 1.8: Anticipated Geology of St Stephen’s Green Station

In the diagram, the solid black line denotes the proposed (preliminary design) station box, and the light blue rectangle indicates the platforms. The top of the light blue rectangle shows the top of rail position for the planned station, which is approximately 25.1m from street level. The alternative station location within St Stephen’s Green East would be some 4.5m lower than this. The bottom 75% of the station box excavation is anticipated to be within rock. A description of the soil anticipated to be encountered within the station box is provided in Table 1.1. This information is taken from the project Geotechnical Design Report.

Table 1.1: Typical Geotechnical Section at St Stephen’s Green Station

Depth (m)	Description
0.00–2.00	Made Ground ( <b>QX</b> )
2.00–8.00	Brown Boulder Clay ( <b>QBR&lt;10m</b> )
8.00–10.00	Base of Drift Deposit and Top of Weathered Rock (BoD/UWR)
>10.00	Lucan Formation ( <b>CLU</b> ), Dark grey to black argillaceous limestone with interbedded calcisiltite and calcilutite

## 1.8 Groundwater

The monitoring records in the Geotechnical Design Report show that the groundwater in the St Stephen's Green area ranges from 5.0mbgl to 6.0mbgl. The fluctuation in groundwater levels at individual locations ranged from 0.1m to 1.2m.

However, the station is to be constructed within a diaphragm-walled cofferdam which will cut off any potential water path. Local sump pump dewatering to local sewer will be required

## 1.9 Utilities

### 1.9.1 Present Situation

Multiple utilities beneath the carriageway at St Stephen's Green East are within the footprint of the station excavation, so they will need to be either temporarily or permanently diverted – see Figure 1.9. Some utilities will require major diversions. In particular, a 1,820mm high brick “ovoid” Victorian sewer under St Stephen's Green East and a 1,710mm high Victorian ovoid sewer situated underneath Hume Street would need to be diverted. Diversion and works associated with these utilities could extend the construction period by at least 12 months or more, causing significant impacts.

There is no longer space for the draught relief shaft (no.3) in St Stephen's Green East and this has been relocated into Hume Street. The shaft will need to pass under the Hume Street sewer that joins the main sewer running along SSG East, immediately north of the station entrance cut and cover tunnel. This adds to the construction complications of this option.

Other utilities, including water mains, gas mains, telecommunications cables, and high voltage Electricity Supply Board (ESB) cables along St Stephen's Green East, would need to be diverted to allow construction of the station box. Diagram 1.8 is an indicative plan of the utilities in the area of the station box.

The utilities requiring diversion are listed below:

- Sewer 1,820 x 920 ovoid combined; and 1,710 x 1,000 ovoid combined;
- ESB high-voltage power supply cable and ESB Low voltage cable;
- Ductile Iron Watermain 450mm 400mm and 150mm diameter;
- Eir Telecommunications 14x100;
- Gas mains 300mm Cast Iron Low Pressure and 180mm Medium Pressure;
- BT Telecom 4x100, Virgin Media 100, Public Lighting; and Private connections.

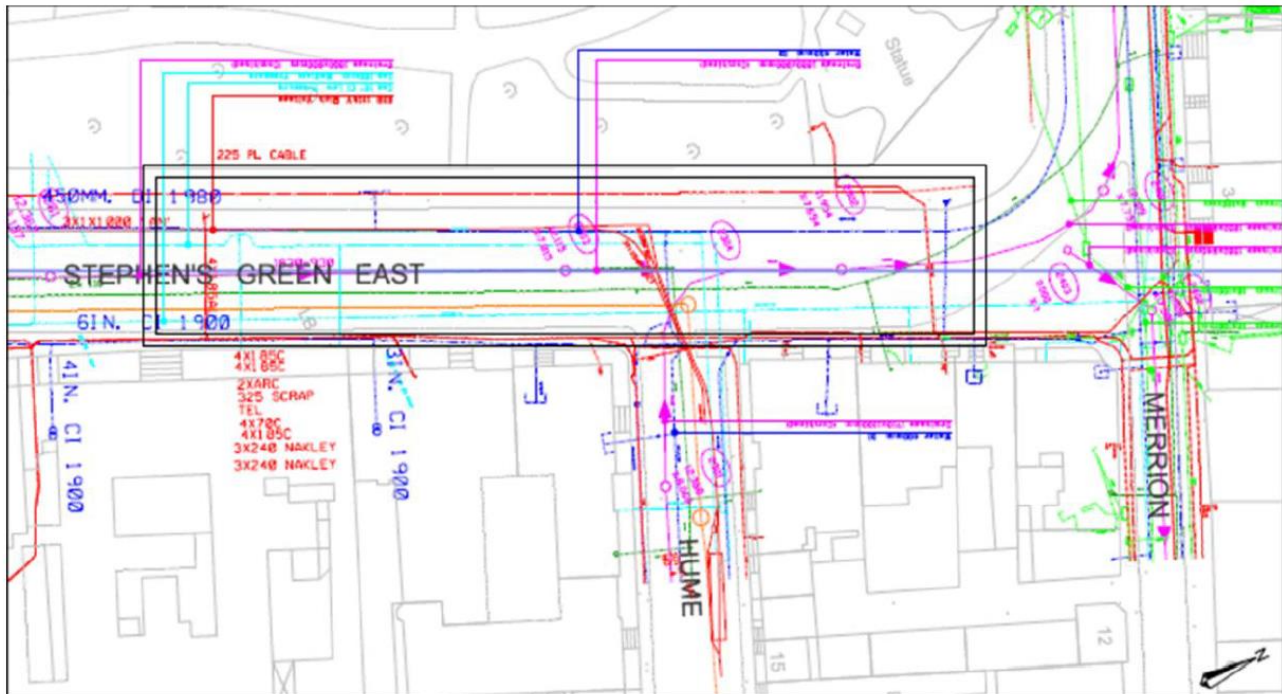


Diagram 1.9 Existing Services Requiring Diversion

The existing utilities will need to be relocated in several stages to allow for the construction of the station box.

Rising main pumping stations will be constructed in St Stephen's Green East and Hume Street in order to remove the Victorian ovoid sewers in these locations. This will be replaced on completion of the station box backfill.

Due to safety reasons, it is not possible to move the existing ESB high-voltage power supply cable during construction. As a result, approximately 1.2km of ESB diversion will be required.

#### 1.9.2 Temporary Diversions and Protection during Construction

Temporary utility diversions will require the closure of St Stephen's Green East between Earlsfort Terrace (R138)/St Stephen's Green South (R110) and Merrion Row (R138).

With the draught relief shaft in Hume Street consideration would have to be given to the following:

- Hume Street sewer 1,710mm and connection into the St Stephen's Green East ovoid sewer: over-pumping;
- Cross-connection from Hume Street to the 450mm water main in St Stephen's Green East;
- Eir telecom ducting and joint box (located in the yellow box junction) at Hume Street junction: split here as some go to Hume Street and some towards No 44 & 45 St Stephen's Green;
- 315mm low-pressure gas main turns into Hume Street;



- Traffic signal loops will have to be reinstated upon completion at the Hume Street/St Stephen's Green East junction;
- Removal of traffic signals (four pavement-mounted and two overhead-mounted);
- Pedestrian crossing point to be removed (Hume Street and St Stephen's Green East);
- Surface water connection to the combined sewer; and
- There is a high-voltage cable that will have to be diverted out of Hume Street – the proposed length of this diversion is approx. 1.2km and would have to be done prior to any works starting on station.

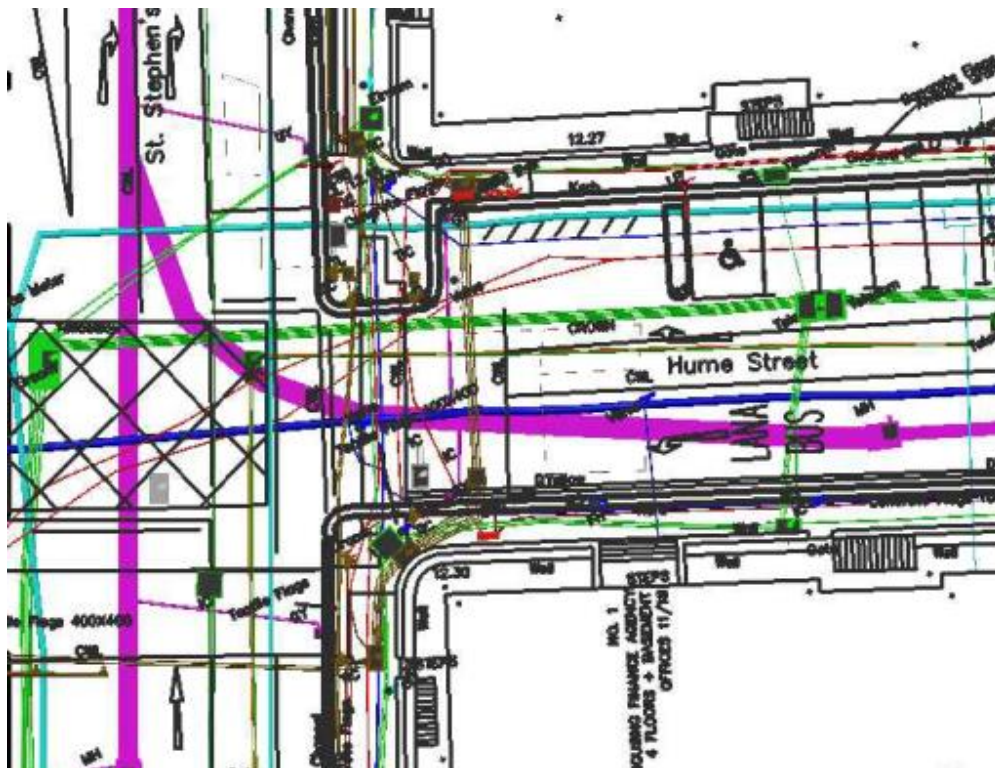


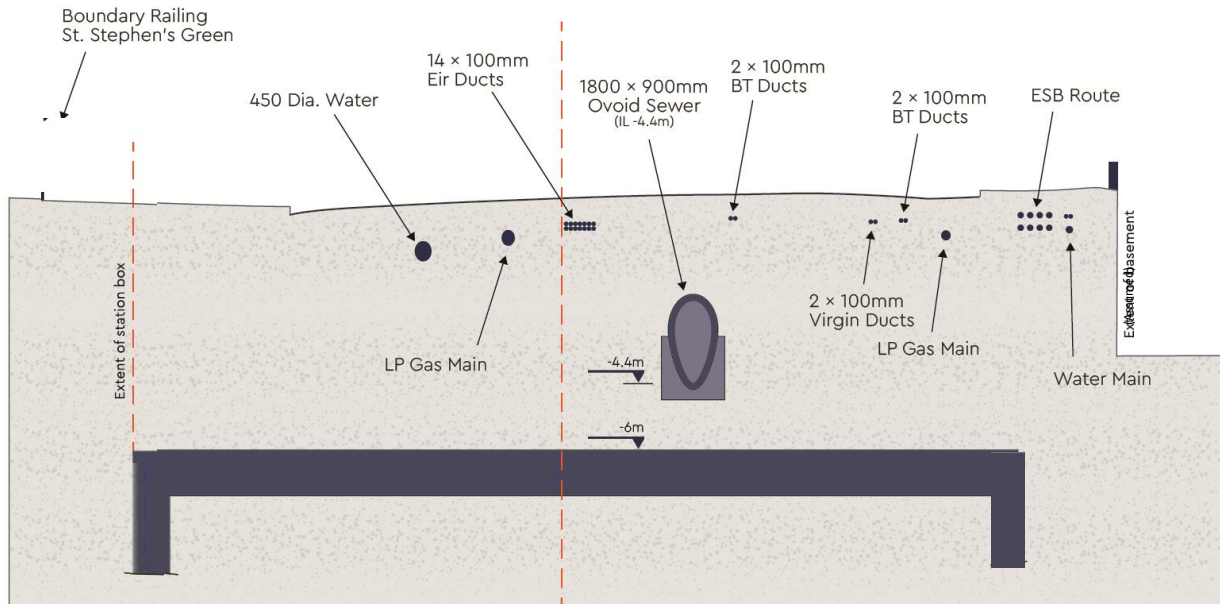
Diagram 1.10: Junction of Hume Street and St Stephen's Green East

Diversion of the water connection from Hume Street to St Stephen's Green East (Diagram 1.10) would involve introducing a series of bends which could affect the flow rates. This would need to be discussed with Irish Water to determine what would be acceptable.

### 1.9.3 Final Configuration

The utilities would be placed within the carriageway of St Stephen's Green East as shown in the cross-section Diagram 1.11 below. The Hume Street utilities will be left in the phase 2 configuration in the south side of street to accommodate the draught relief shaft (No.3).





**Diagram 1.11: Cross-Section of Utilities Within Carriageway**

#### 1.9.4 Ovoid Sewers

The construction footprint occupies the complete width of the carriageway and footway in St Stephen's Green East and part of Hume Street. It is not possible to divert the existing gravity sewers in these locations and over-pumping will be necessary for extended periods. This is a major element of work and would need detailed design to ensure that the risks are mitigated to an acceptable level.

Whilst over pumping is feasible, there will be increased risk of problems occurring during extended periods of pumping which would be of significant concern to Irish Water over continuity of service. To mitigate this risk permanent type pumping installations with standby capability would be required.

## 1.10 Traffic

### 1.10.1 Present situation

St Stephen's Green East plays an important role in the city's transport network for all modes of transport. It is part of the pedestrian and cyclist strategic networks, and forms part of the Bray to City Centre Core bus corridor. St Stephen's Green East also provides access for deliveries and goods to the Grafton Street area. It is a busy artery for public transport services, used by over 50 different bus routes.

Diagram 1.12 represents one of several traffic diversion options for a closure of St Stephen's Green East. Other options need to be explored, as well as the impacts on businesses, car parks and access to the wider network, and the effects on public transport and emergency vehicles in the area.

The traffic management shown is high level and will need to be subject to the full range of impact assessments to determine feasibility. This assessment will include cross-sectional assessment and pedestrian movement assessment.

The option shown primarily consists of bridging the pedestrianised gap on St Stephen's Green West and providing a one-way traffic flow along St Stephen's Green West and St Stephen's Green North (outlined in the yellow box on Diagram 1.12). The primary benefit of a one-way system is to better accommodate traffic volumes using this route for general traffic, deliveries, public transport and construction vehicles.

Linking St Stephen's Green West to allow for two-way movements would provide access to the area north-west of St Stephen's Green. Under existing traffic management, during construction the east to west and south to north movements would be severed.

There will be significant disruption to bus services in the area during construction because St Stephen's Green is a very busy public transport corridor. Disruption will include the relocation of bus stops, alteration of service routes and changes to service timetables.

The full closure of St Stephen's Green East and Hume Street will impact pedestrian and cycle movements. Diversion options could include the use of St Stephen's Green or a range of indirect options using the existing road and footway network resulting in significant diversion times.

Construction traffic entering and exiting the site would use the existing routing options to the strategic route network via M50 Junction 7 (N4) or M50 Junction 9 (N7).

Construction traffic utilizing the road network to move between different areas of the site would utilize the clockwise routing around St Stephen's Green, Merrion Row, Pembroke Street and Leeson Street.

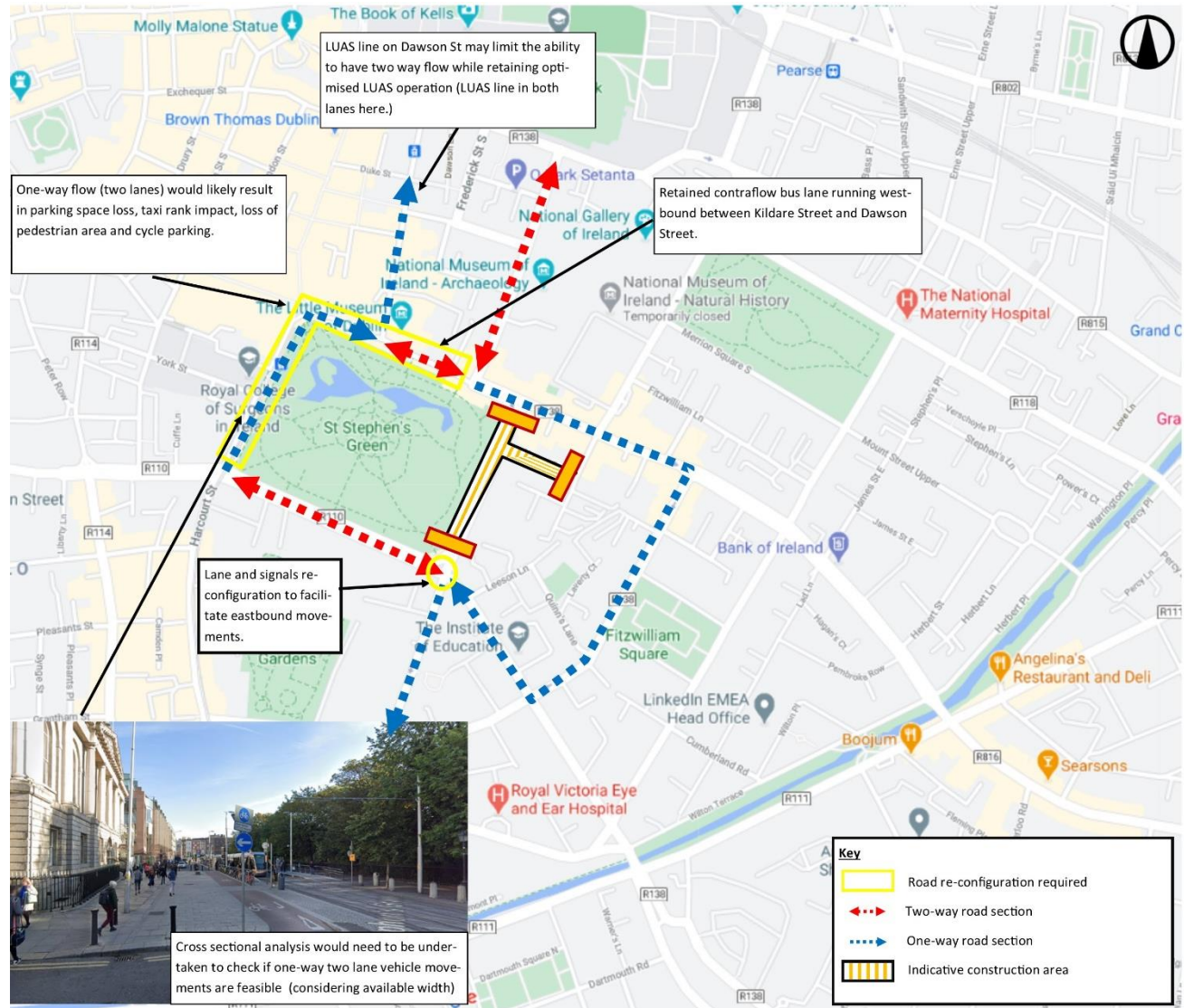
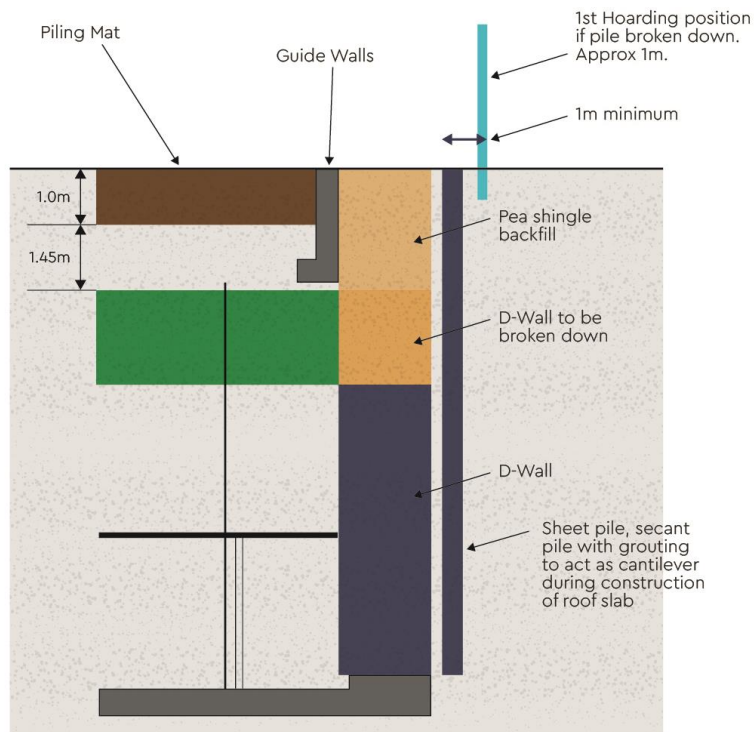


Diagram 1.12: Traffic Diversion Options

## 2 Construction Methodology and Sequencing

The external dimensions of the station would be 115.90m long by 25m wide. The width between property boundaries is 27.91m. Allowing for 1.3m from the outside of the diaphragm walls allows less than 0.2m clearance between the outside face of the diaphragm to the property boundaries. This is insufficient even for a pedestrian walkway around the structure during some phases of construction and presents significant construction challenges and risks.

Allowance must be made for guide walls and clearance to hoardings. In the original construction report, a minimum of 1m was assumed from the outside of the guide wall, so an allowance of 1.3m has been made from the outside of the diaphragm wall for the purpose of this report (see Diagram 2.1).



**Diagram 2.1: Minimum Clearance to Site Hoardings**

The lack of space around the structure means that the utilities will need to be supported at high level within the site footprint as construction proceeds. This will require plunge columns that will form part of the permanent design, departing from the standard design model.

## 2.1 Site Establishment

### 2.1.1 Prepare Site

- Relocate occupants of properties within site boundary until completion of 'top-down' construction. Access to properties will be required for monitoring, protection works and any remedial works required.
- Closure of St Stephen's Green East between Earlsfort Terrace/St Stephen's Green South (R110) & Merrion Row (R138) including footpaths.
- Assume welfare access is via Hume Street. Muck away via north entrance.
- Erect hoardings.
- Install site welfare and temporary site comms/drainage/water supply and power.
- Lop over-hanging branches from mature trees in St Stephen's Green.
- Remove street trees.
- Street/public lighting will be cut and capped and reinstated upon completion of station.
- Remove traffic signals from Hume Street and St Stephen's Green.
- Remove and store lampposts and any other street furniture to be retained.
- Relocate hire cycle stands.
- Divert high voltage route out of St Stephen's Green East, this relocation. Proposed length of diversion length approx. 1.2km and would have to be done prior to any works starting on St Stephen's Green.
- Remove road surface and create piling mat.

### 2.1.2 Divert Utilities – Stage 1 – Create Space for Plunge Columns and West Diaphragm Walls

The diversion and relocation of utilities will commence with the relocation of the utilities on the west half of the site to the east carriageway. These include:

- 450mm water main;
- BT ducting;
- Eir Telecom ducts 8 No. x 100mm;
- 315mm medium-pressure gas main; and
- ESB medium/low voltage power cable power cable (4No. cable runs.)

Utilities on the south side of Hume Street (see diagram 1.9) will need to be diverted to the north side of Hume Street. With station positioned across Hume Street, additional consideration would have to be given to the following:



- Set up over-pumping from the Hume Street sewer into the 1,710mm St Stephen's Green East ovoid sewer.
- Cross connection from Hume Street to the 450mm water main in St Stephen's Green East.
- EIR ducting and joint box (located in the yellow box junction) at Hume Street junction. The services will split here as some go to Hume Street and some towards No 44 & 45 St Stephen's Green.
- 315mm low-pressure gas main turns into Hume Street.
- Removal of traffic signals (four pavement-mounted and two overhead-mounted). Traffic signal loops will have to be reinstated upon completion at the Hume Street/St Stephen's Green East junction.
- Pedestrian crossing point to be removed (Hume Street and St Stephen's Green East).
- Surface water connection to the combined sewer.

Diversion of all utilities from Hume Street joining St Stephen's Green will have to be carried out prior to main works on the station box and in conjunction with those being diverted in St Stephen's Green, as some are tied by cross connections.

Diversion of the water connection from Hume street to St Stephen's Green East will involve introducing a series of bends which could affect the flow rates. This would need to be discussed with Irish Water to see what would be acceptable.

#### 2.1.3 Construction of West Side Diaphragm Walls and West Utility Deck

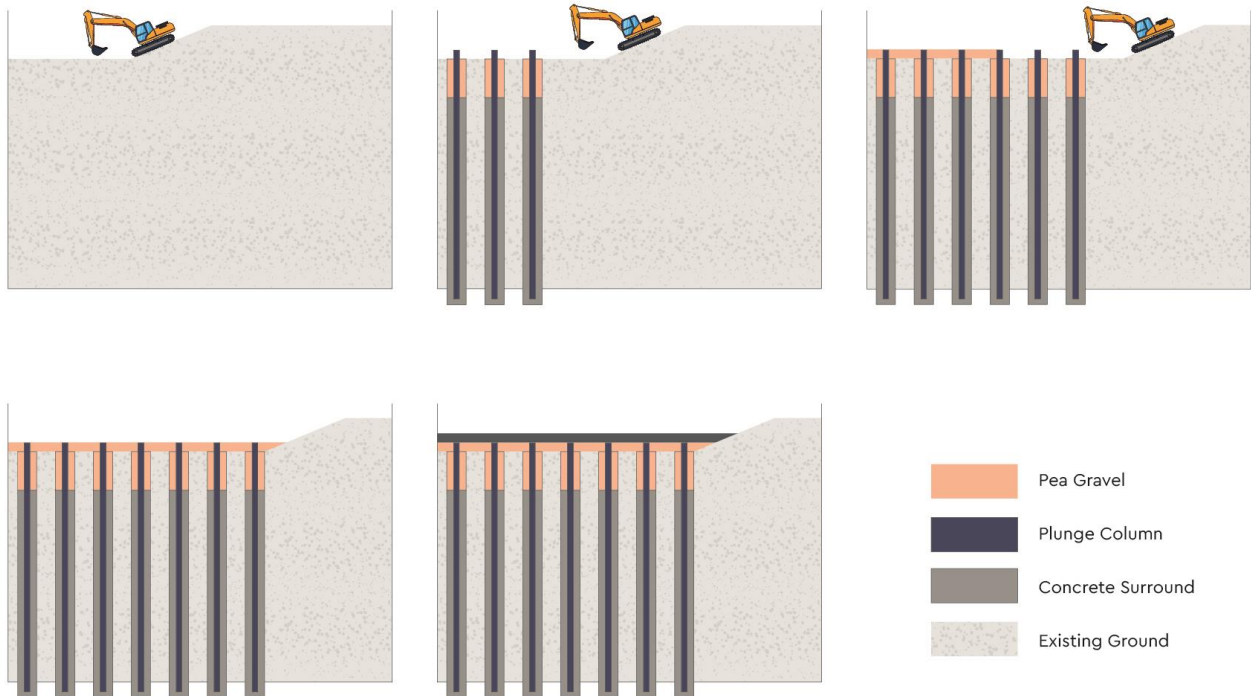
- Install west diaphragm walls;
- Install diaphragm wall across south side of Hume Street only (6m width);
- Install plunge columns in the west side to support the utility deck;
- Install plunge columns to support the Hume Street utilities bridge;
- Excavate to 6mbgl, exposing west side plunge columns to support the utility deck;
- To facilitate later excavation, the beams will be laid on a layer of pea gravel;
- Install supporting beams – it is assumed connections will be bolted to facilitate later removal of the steel beams; and
- Install the PCC planks.

#### 2.1.4 Temporary Utilities Deck

The deck will be approximately 8m wide, less than half the width of the station box. It may be possible to use part of this deck for construction traffic to avoid the need for plant to use the public carriageway if a double deck is installed. Diagram 2.2 shows the construction sequence for installing the utility deck on plunge columns, which is as follows:

- Install plunge columns in desired locations;

- Install steel sheet pile cofferdam around utility deck;
- Excavate to 0.5m below deck beam soffit level;
- Fill with pea gravel to soffit level and fix beams in place – this will assist in excavating under the structure without causing damage to the steel work; and Install beams and planks working towards the north end of the station box.



**Diagram 2.2: Plunge Column Construction Sequence**

### 2.1.5 Divert Utilities - Stage 2 – Divert Services to Steel/Precast Concrete Utility Deck

The 1,710mm ovoid sewer will be the biggest issue for the construction of the east diaphragm walls and roof because there is no room to divert this out of the way of the station construction. Over-pumping will have to be introduced until station construction is completed and the sewer can be replaced. There are also surface water connections to be picked up as they are connected to the combined sewer.

Clear east side for installation of east diaphragm wall:

- 450mm water main;
- BT ducting;
- EIR Duction 8 No. x 100mm;
- 315mm medium-pressure gas main; and
- ESB medium/low voltage (4 No. cable runs).

The following services need to be relocated from the east footway:

- 150mm water main;
- EIR 100mm duct;
- ESB medium/low voltage;
- Street/public lighting; and
- Private connections.

Relocate the utilities that are on the north side of Hume Street to the south side of Hume Street over the south section of diaphragm wall installed in phase one. The services will need to be supported on a steel deck supported by the plunge columns to the centre of St Stephen's Green East (approximately 15m) to permit excavation for the roof slab below the services following a similar construction sequence to the west utilities deck

#### 2.1.6 Construction of East Side Diaphragm Walls

- Install building protection. It is assumed that this will be done concurrently with west roof slab.
- Install diaphragm walls (see Diagram 2.3).

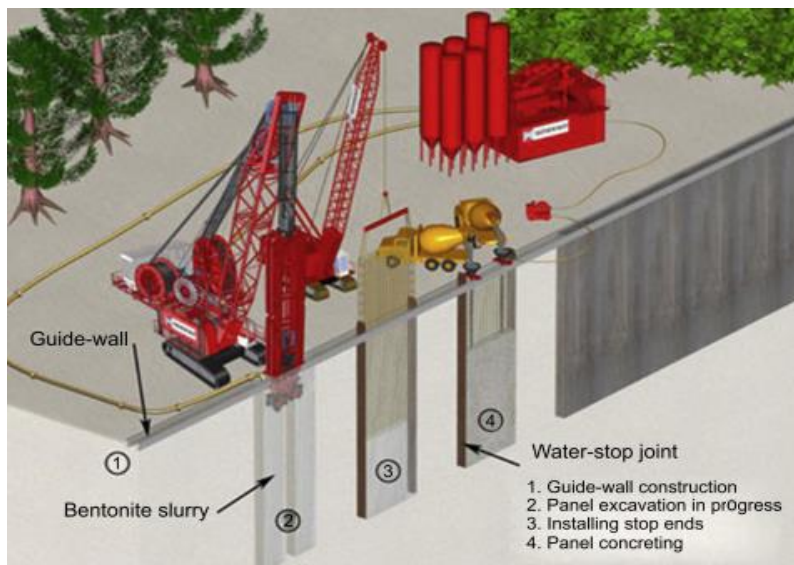


Diagram 2.3: Stage 2 Diaphragm Walls East

A utility deck is not needed on the east side other than the bridge to support the Hume Street utilities. This side will need to be kept open to permit muck away from the top-down construction, and a ramp will need to be installed to allow muck away lorries to enter and leave the excavation.

#### 2.1.7 Excavation within Cofferdam

Excavate to roof slab formation level. Construction plant will need to dig a ramp in at the south of the station box and dig it out as the dig completes and excavate under the west utility deck.



Muck away via north of Hume Street out to Merrion Row (R138) and south on St Stephen's Green to Leeson Street Lower/St Stephen's Green South (R110).



- As excavation proceeds, support can be installed, and the roof slab can be cast in situ.



- At the north end of the station box, the excavator will dig itself out of the excavation and the roof slab can be completed



- Following completion of the excavation, roof and deck, the Stage 2 utility diversions can take place.

## 2.2 Top-Down Cut and Cover Construction

The station will be constructed by top-down methodology using diaphragm walls. It is envisaged that the diaphragm walls for the station are placed from a level at (or just below) the existing ground surface, and the guide walls will be constructed at the level of the piling mat. A typical construction sequence for the installation of diaphragm walls for an underground station is illustrated in Diagram 2.4.

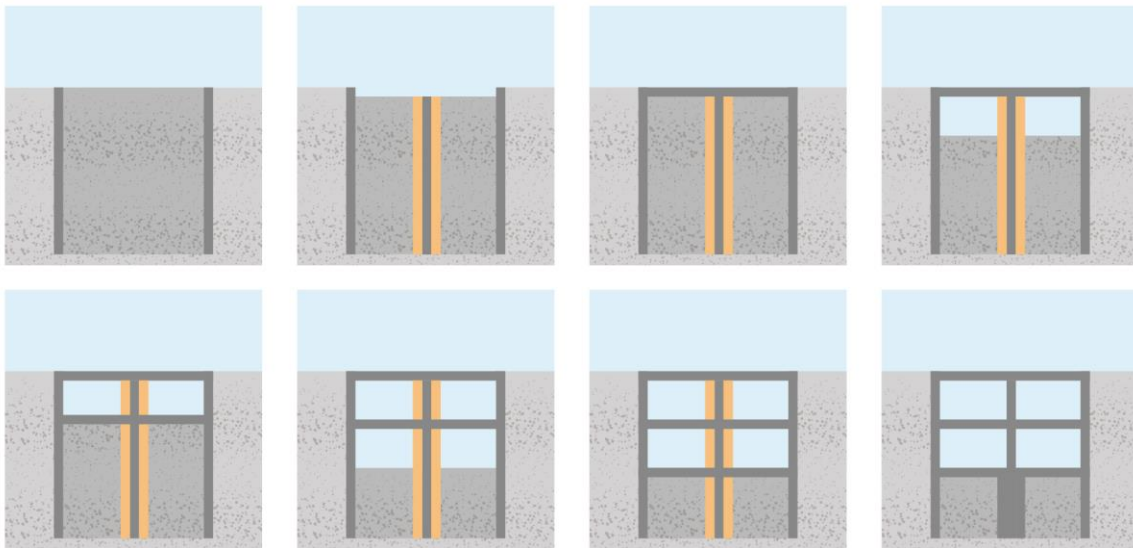


Diagram 2.4: Typical Top-Down Construction Sequence

### 3 Mining (Alternative Option)

In consideration of the severe difficulties in constructing a station wholly within St Stephen's Green East, alternative mined station options within the roadway have also been considered. Whilst these can provide less surface disturbance due to some of the works being contained underground, construction needs incur surface works as well. All of the mined tunnel options considered in the following sections are not considered to have advantages over the proposed station location or the station constructed wholly under St Stephen's Green East. All would have surface interventions to facilitate construction, either with significant impacts within the Park and adjacent roads, or with disruption to St Stephen's Green East itself for access shafts for construction use and permanent station facilities afterwards, significantly impacting utilities, pedestrian and traffic access.

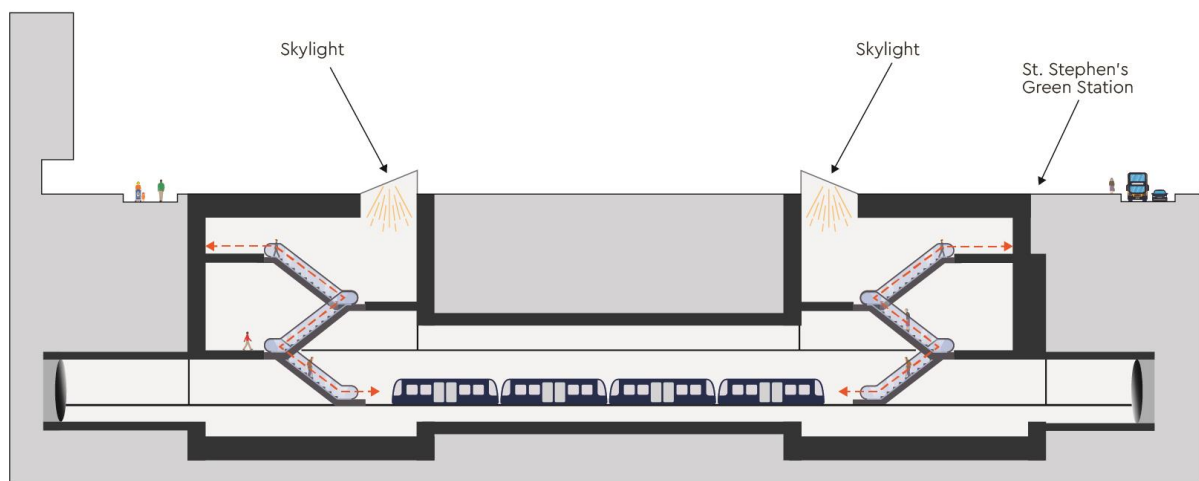
Any mined station option is technically challenging and would require an extended construction period of up to approximately 24 months with significantly increased cost for the station construction and delay to opening of the metro. In all cases, mined construction is considered higher risk than construction of a station box, both due to the increased need for underground working by construction personnel and due to the size of the mined tunnel required which would bring the roof level close to the sound rock/weathered rock boundary with associated increased risks of spalling or water ingress during construction.

A mined solution would involve mining a gallery (or cavern) in rock between two access shafts, which would be placed at both ends of the station box (see Diagram 3.1). These shafts at each end of the station end would enclose the escalators, stairs, lifts, and back-of-house facilities so would be substantial interventions in their own right.

The side platforms would be inside the excavated gallery between shafts at track level. A similar sized gallery or cavern is shown in the photograph in Diagram 3.6. It should be noted that this method of construction typically carries higher construction safety risks than the open-box construction.

Various options have been considered for construction of a 'mined station':

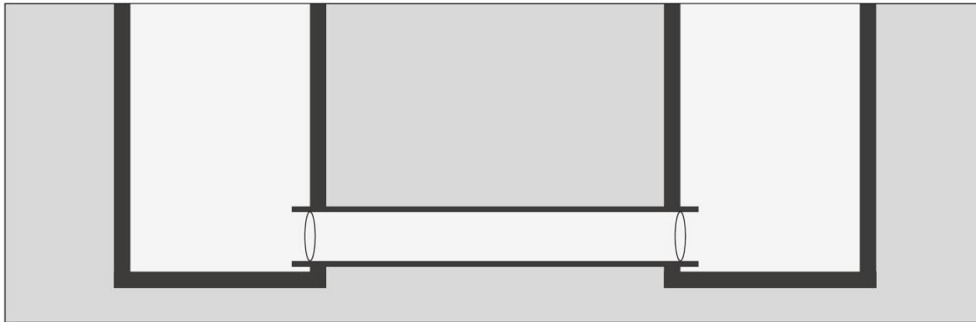
- Option A: Mined platform cavern between rectangular 'vertical circulation' boxes at either end
- Option B: Mined platform cavern between a rectangular 'vertical circulation' box and an intervention 'type' shaft
- Option C: Mined platform cavern 'enlarged' from the TBM bored tunnel
- Option D: Mined station from offline construction shafts



**Diagram 3.1: Typical Mined Station Arrangement**

### 3.1 Option A – Mined Platform Cavern Between 'Vertical Circulation' Boxes at Either End

For this option, rectangular cut and cover boxes are located at either end of a mined platform cavern. These provide the vertical circulation elements in the permanent configuration.



**Diagram 3.2: Option A Section**

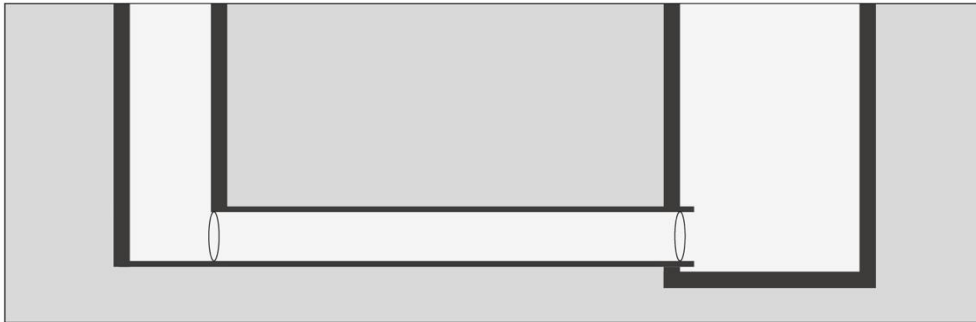
The rectangular boxes would be bounded by diaphragm walls that are the same width as the original cut and cover station (25m) and are 25m long. As an alternative, the rectangular boxes could be bounded with secant piles rather than diaphragm walls. As a further alternative, the pile foundations (diaphragm wall or secants) for the boxes could terminate within competent rock and then be supported with Sprayed Concrete Lining (SCL) down to formation level. The platform cavern would be 70m long (approx.). The cavern would be excavated by drill and blast, ideally from both ends, creating two faces for the SCL works.

Although the length of the carriageway occupied for the construction works would be less than in the case of full open cut along the whole length of the station, there would be several disadvantages to this option:

- Although a shorter length of carriageway would be occupied, the shafts would still take up the full width of the carriage as in the case of full open cut along the whole length of the station, so many of the same disadvantages remain, such as the need to divert traffic and utilities.
- The mining of the cavern is relatively high risk.
- The bulk of the construction works must be completed prior to the arrival of the TBMs so the overall programme is not impacted.

### 3.2 Option B – Mined Platform Cavern Between ‘Vertical Circulation’ Box and Intervention ‘Type’ Shaft

This is a variation on the option described previously in Section 3.1. The vertical circulation in the permanent configuration would be provided by one full-width rectangular cut and cover box at one end and an intervention ‘type’ shaft located at opposite end.



**Diagram 3.3: Option B Section**

This option consists of a rectangular cut and cover box at one end of an approx. 95m long mined platform cavern with a vertical circulation box, similar to an intervention 'type' shaft, at the other. The 25m x 25m box would be the same as in the previous configuration. The intervention shaft 'type' box would be offset, similar in length (25m) and around 10m wide with the cavern extended alongside; however, whilst this could support construction excavation, it is unlikely that appropriate tunnel ventilation facilities during operation could be provided in this small shaft and alternative space would need to be provided. The cavern would be excavated by drill and blast, ideally from both ends, creating two faces for the SCL works.

As an alternative, the rectangular boxes could be bounded with secant piles rather than diaphragm walls. As a further alternative, the pile foundations for the boxes (diaphragm wall or secants) could terminate within competent rock and then be supported with SCL down to formation level.

Although a shorter length of carriageway would be occupied, one shaft would still take up the full width of the carriageway as in the case of full open cut along the whole length of the station, so many of the same disadvantages would remain, such as the need to retain road space for construction working, divert traffic and address utility diversions. The disadvantages of this option are:

- The mining of the cavern is relatively high risk and there would need to be more of it.
- The bulk of the construction works must be completed prior to the arrival of the TBMs so the overall programme is not impacted.
- With the full carriageway width required for the box supporting construction and the subsequent vertical circulation there would be no provision for utility diversions within the roadway and these would have to be diverted through the Park or adjacent streets
- The permanent access to the station would need to be provided via cut and cover tunnel access similar to the top-down box construction to avoid permanent access being required in the roadway; emergency stairways etc would also need to be incorporated within the cut and cover box.

- Feasible tunnel and station ventilation requirements would need further investigation, but the space provided by this mined option would not support the present tunnel ventilation strategy or required Back of House requirements.

### 3.3 Option C – Mined Platform Cavern ‘Enlarged’ from the TBM Bored Tunnel

This option is unlike those described previously. Vertical circulation in the permanent configuration would be provided by two intervention ‘type’ shafts located at opposite ends. The station itself would be a 125m long platform cavern enlargement formed by enlarging the TBM bored tunnel.

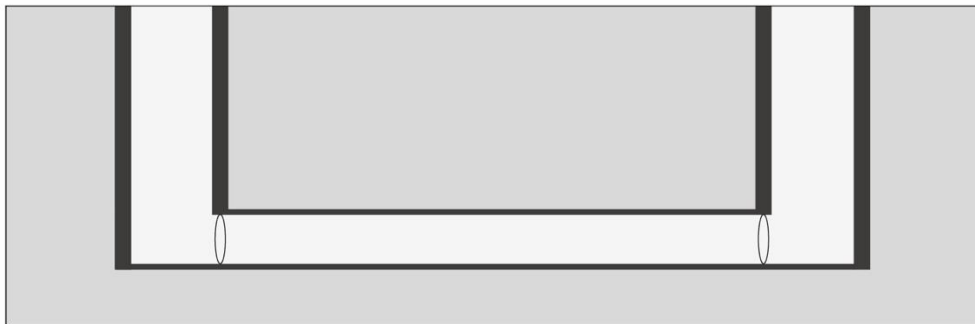


Diagram 3.4: Option C Section

The advantages of this arrangement are:

- The length of the carriageway occupied for the construction works would be less than the case of full open cut along the whole length of the station and the other mined options.
- The width occupied by the shafts would be less than in the case of full open cut along the whole length of the station and the other mined options, so there are advantages with respect to temporary traffic arrangements and the need to divert utilities.
- Diversion of the ovoid sewer could be avoided.

The disadvantages of this option are:

- the mining of the cavern is relatively high risk as with other mined options;
- Feasible tunnel and station ventilation requirements would need further investigation, but the space provided by this mined option would not support the present tunnel ventilation strategy or required Back of House requirements without further space being provided.
- the enlargement works can only start once the TBM has reached Charlemont Station and all the tunnel activities have been completed. This would cause unacceptable delays to the overall construction programme for MetroLink,

The above concerns and in particular the significant delay associated with this mined option means it is not considered a viable option and so has been discounted.

### 3.4 Option D – Mined Station from Offline Construction Shafts

In this option, vertical circulation in the permanent configuration would be provided by two ‘intervention type’ shafts located at opposite ends of the station.



Diagram 3.5: Option D Plan

The station itself would be a 125m long platform cavern. This would be mined from one or more offline shafts in Hume Street and St Stephen's Green in addition to the ‘intervention’ type shafts at station ends to support construction speed. However, permanent access to the station and tunnel/station ventilation requirements may require additional space to be created.

Whilst the offline shafts would allow more faces to be worked and, because they are independent from the permanent structures, these could provide several advantages to the overall construction programme:

- The length of the carriageway occupied for the construction works would be less than in the case of full-width open cut along the whole length of the station and the other mined options, but construction works would impact additional areas in Hume Street and the Park.
- The width occupied by the shafts and time impact on road use would be less than in the case of full open cut along the whole length of the station and the other mined options, so there are advantages with respect to temporary traffic arrangements.
- Some utilities could be maintained along St Stephen's Green East and diversion of the ovoid sewer could be avoided by careful management of the works.
- The bulk of the construction works can be completed prior to the arrival of the TBM, so the overall programme would not be impacted.

Disadvantages:

- The construction site area would result in closure to all through traffic although access to buildings and for pedestrians may be possible.
- There will be need for significant construction works and space within St Stephens Green for the off-line western construction shaft.
- The shaft in Hume Street would close that road and introduce significant construction disturbance to adjacent properties.
- The Hume Street utilities would need diversion, including the large sewer, affecting adjacent connections in St Stephen's Green East.
- The shafts in the road would need to be sufficiently large to accommodate necessary stairs, lift, ventilation and back of house facilities and would need permanent access.
- The mining of the cavern is relatively high risk.





Diagram 3.6 Mining a Cavern Station

## 4 Construction Impacts

There are several significant challenges associated with the construction of the station box wholly within the road at this location. These are summarised as follows:

- St Stephen's Green East and Hume Street will be closed to through traffic; footpaths in St Stephen's Green East will not be accessible during the construction.
- In advance of the main construction works of the station, the historical/protected buildings and the basements lining the eastern side will potentially require extensive strengthening. This is due to the depth and proximity of the station box excavation, movement of the retaining walls, ground movements, de-watering and the closer passage of the TBM.
- The deeper depth of the station makes stair/elevator access more difficult and would require a separate cut and cover structure to provide appropriate access into the station. It is assumed that the entrance would be retained in a similar location to the Preferred option as the existing footway outside the park fence line is not wide enough to accommodate an entrance and retain space for pedestrians. Some construction impacts would therefore encroach inside the park fence line.
- Due to the extreme proximity of the diaphragm wall to the curtilage of the historic buildings, the occupants may need to be relocated for the duration of construction activity.

- Approximately 1.2km of ESB diversion will be required in advance of the construction works. Due to the lead time and duration of this activity, consideration will need to be given to carrying this out in advance of the Rail Order.
- All bus, car and pedestrian traffic would need to be diverted from this location resulting in significant impacts, with extensive traffic diversions as a result of construction works.
- The location of the station box would require the removal and replacement of the existing Victorian ovoid sewer and diversion of other utility services. The existing utilities would need to be diverted in several stages to allow for the construction of the station box.
- Although the park perimeter fence and wall would be protected during construction, all structures or monuments, traditional-style lampposts and the bollards along the outer edge of the pavement would have to be removed prior to construction and appropriately replaced as part of completion.
- Rising main pumping stations would need to be constructed in St Stephen's Green East and Hume Street in order to divert/relocate the Victorian ovoid sewer.
- The tunnel and the station box structure would need to be further lowered in order to accommodate the existing services within the carriageway.
- The proposal to support utilities on plunge columns and a steel/pre-cast concrete deck during construction will require these to be incorporated in the permanent works design.
- On completion, there would be permanent elements of the station present on both east and the west footpaths along the station at ground level. These would include Intervention shafts, pedestrian entrances, and lifts for passenger and emergency access lifts for Dublin Fire Brigade.

#### 4.1 Impacts on Protected Structures

The St Stephen's Green East carriageway is bounded by the park to the west and commercial properties to the east. The properties are a mixture of Georgian and modern buildings and have a variety of uses including office space, educational facilities and an embassy. There are 10 protected buildings along St Stephen's Green East between Merrion Row and Leeson Street Lower (see Diagram 4.1) within the station box and construction zone. These will potentially require extensive strengthening in advance of station construction works.



**Diagram 4.1: St Stephen's Green East Protected Buildings**

The proximity of the large station box to the buildings along the eastern side of St Stephens's Green East will result in high risks of building damage from settlement damage. This may occur for example from movement of the diaphragm wall panels as the station is excavated. The foundations of these buildings should be investigated, but it should be assumed that some form of under-pinning or compensation jacking will be required.

The lack of space between the property boundary and the building foundations may require underpinning or compensation from within the building cellars but investigation work will be needed to confirm that this is possible.

All structures within a zone of influence of the works are considered at risk. The zone influence is defined as a standard corridor around the underground works. An average depth of -30mbgl has been considered with an influence area of 30m width on each side of the tunnel axis. This approach has been calculated considering an affected underground area inside a 45° line from the tunnel edges to the surface.

Given the proximity of the buildings to the station box, detailed settlement analyses, including Building Damage Assessments and surveys will need to be carried out. Depending on the level of damage predicted, mitigation measures need to be considered prior or during the construction.

The main forms of protective measures currently available, which directly influence the response of buildings, are summarised below.



- Strengthen the ground by means of grout injections (cement or chemical) or by ground freezing. Their primary purpose is to increase the stiffness of the ground or to prevent loss of ground during excavation, particularly in granular water-bearing materials.
- Compensate for settlements by injecting grout into the ground between the tunnel and the overlying building. This technique is known as 'compensation grouting'. Detailed instrumentation is installed to monitor the movements of the ground and the buildings. Compensation grouting is an expensive operation, and the installation of equipment can be highly disruptive in built-up areas.
- The introduction of an alternative foundation may eliminate relative ground movement that could affect the buildings. These techniques are generally referred to as 'underpinning'.
- Structural jacking may also compensate for settlement.

In many instances, such measures may be limited to the protection of unusually sensitive features of a building. Great care is needed in implementing such measures as the damage caused by some invasive measures can far exceed any damage that might result from ground movement.

The introduction of an alternative foundation may eliminate relative ground movement that could affect the buildings. These techniques are generally referred to as underpinning and two possible approaches are shown in diagram 4.2. Pre-emptive interventions are intrusive and may lead to greater impact on the historic fabric.

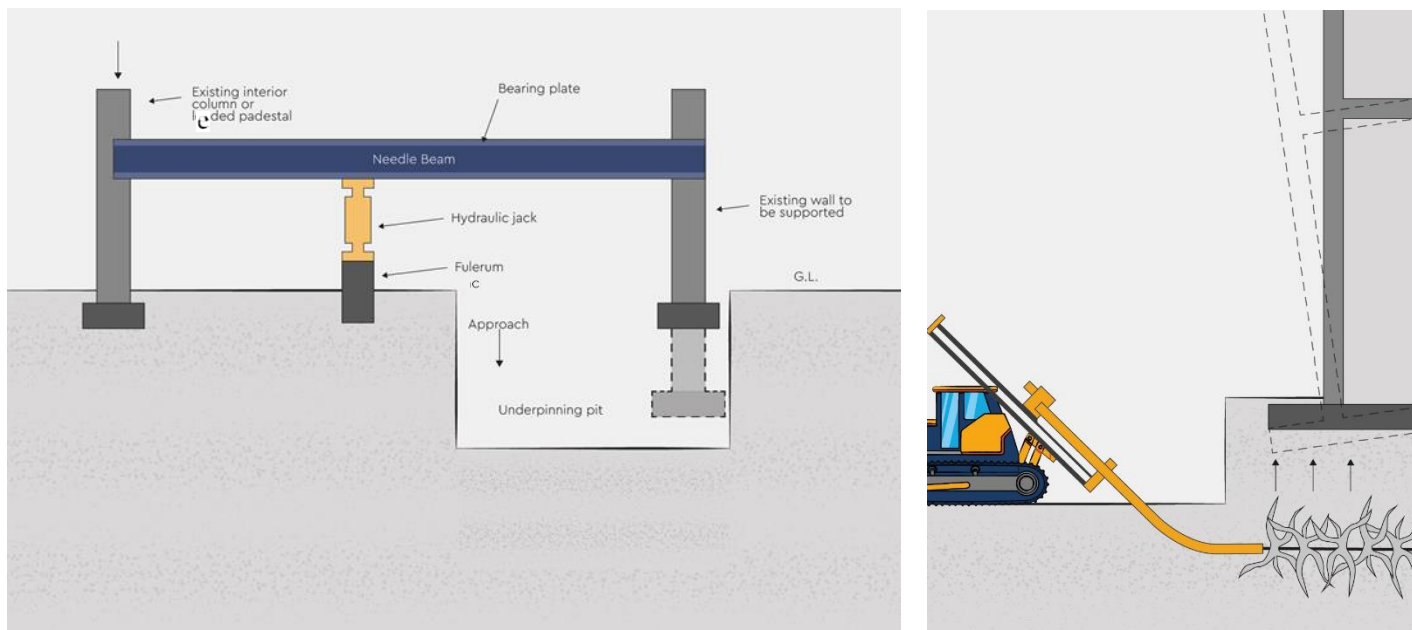


Diagram 4.2: Grouting and underpinning

Most of these buildings originate in the 17th century and some have been rebuilt. However, they were not removed to 'foundation' level, but rather were rebuilt in part or from the ground floor up, relying on the historic basement level. In addition, these buildings did not have foundations as such, but rather thicker basement walls and footings. Due to its scarcity, wood was often irregularly scarfed together in

order to provide lengths long enough for joists, floorboards and internal walls. The wood is therefore often non-standard or sub-standard. The joists are usually tied directly into the walls themselves, so it is not always possible to remove joists. The facades will probably have to be strengthened by tying the back and front of the buildings together using tensioned metal rods. This entails drilling holes through the joists (to maintain strength) and threading the helifix rods through holes.

Repairs to decorative ceilings must be done from the floor above. Holes are drilled at regular intervals between the joists; piano wire is then inserted into the holes, tied by metal straps to the joists and the floor reinstated. As the floors will no doubt have deformed, leading to the unstable ceilings below, these will also have to be repaired. Any plaster/mortar/painting/woodwork repairs will have to be done by specialist contractors using traditional materials that are costly and time consuming.

It is extremely likely that the occupants on these buildings will need to be relocated for extended periods during construction due to:

- The noise and vibration impact on residents during construction
- Dust generated by construction activities
- Settlement risk and protection measures
- Access to the buildings will only be from the rear of the properties as it will not be possible to provide access from the front. The reduction of emergency exits will hamper the evacuation of the buildings in the event of emergency such as fire.
- Service connections will need to be relocated to enter the buildings from the rear of the properties as service connections to the front of the properties will need to be severed during construction

## 4.2 Impact on Architecture

The importance of St Stephen's Green Park is as an historical public park which maintains its Victorian layout and features extensive tree, shrub and flower planting that enhance the architectural features of the park. The park is one of the most important green spaces in the centre of Dublin and attracts significant numbers of visitors each year. The architectural heritage of the area has particular regard to St Stephen's Green Park, which is designated as a National Monument (RMP DU018-020334) and is listed on the Dublin City Council Record.

High-quality design of station 'pop-ups' would allow for the development of a high-quality urban environment in the north-eastern corner of St Stephen's Green. The architectural design of the station pop ups and entrances will need to be carefully considered, and these will need to be accommodated within the footway adjacent to the boundary with St Stephen's Green. The fundamental driver for the design of the station accesses and popups will be to protect and evacuate the station in emergencies including fires. This will be more challenging in the footway given the limited space available and the presence of pedestrians on the footway.

### 4.3 Impact on Trees

The station in the road may still cause a great deal of damage to the trees on the Eastern side of St Stephen's Green. It is possible to derive an approximate extent of the major roots which support a tree from the diameter of the tree trunk. This should be carried out for all of the trees along the eastern edge of SSG.

The plan of the sheet piles should be superimposed over the trees, to show the damage that will be caused to the tree roots from the excavation. Any tree with more than 40% loss of root ball is regarded as unlikely to survive although this should be checked with an arboriculturist.

Options for such trees may include felling, very heavy pruning, or relocation. Trees which lose one side of their root system also become very unstable.

### 4.4 Impact on Utilities

The methodology relies on utilities being diverted up to three times. Detailed planning is required to define the connection locations and the methods and sequences of connection, with manholes, valve cambers, etc... detailed to meet the required 'transfer of flows' needs. Only following this will it be possible to be confident that there is sufficient room to follow the overall phasing.

This work also needs to take into account the worst case predicted settlement from the tunnelling (outside and inside the station, as the station is presumed to be a 'TBM first' station), which may affect some of the connection chambers

It will not be possible to maintain the utility connections to the front of the properties in St Stephen's Green East and new connections will need to be made to the rear of the properties if they are to remain occupied.

### 4.5 Impact on Tunnel Alignment

The tunnel will need to be lowered by 3.5m compared to its current depth and there would need to be a small horizontal realignment to the east to suit the alternative station location under St Stephen's Green East. This could affect the tunnel alignment for several hundred metres in either direction and may introduce new construction or operational impacts compared to the preferred option.

## 5 Construction Traffic – Access and Egress

Access and egress to the site for construction traffic will be primarily via the north entrance. However, as there will be no route through the site, entrances will also be required in Hume Street and to the south of St Stephen's Green East.

Traffic can only be routed through the site by providing a temporary steel deck, but there will be phases where this will not be possible and construction traffic will need to use public roads to travel from one end of the site to the other.

Welfare facilities will need to be provided at each entrance to the during some phases of the construction work, but it may be necessary to stack these.



It will not be possible to turn vehicles around within the construction site, and it may be necessary to use a turntable. These were used on the Sydney Metro project to turn vehicles around in a confined site (see Diagram 5.1)

The excavation of material from the station box and the placement of concrete takes a coordinated approach with excavators and spoil drivers. Turntables are proven to improve efficiencies of getting vehicles on and off the site in a safer manner, while also improving public safety and reducing congestion impacts to city traffic.



Diagram 5.1: Sydney Metro Turntable

## 6 Construction Programme

The key dates are given for the construction of St Stephens Green in the table (see Diagram 6.1).

The complexity of the new construction methodology and the need to carry out extensive service diversions would increase the St Stephens Green Station construction programme by about 15 months. A high-level construction programme is provided in Annex B.

This programme does not include any allowance for time risk which will need to be assessed should this option be developed further.

Activity ID	Activity Name	Original Duration	Start	Finish
<b>MetroLink - SSG What If</b>		2168	30-Aug-22	30-Jun-31
<b>M401 Southern Works</b>		2168	30-Aug-22	30-Jun-31
<b>St Stephens Green Station</b>		2168	30-Aug-22	30-Jun-31
SSG-1010	St Stephens Green Station: Notice to treat	60	30-Aug-22	22-Nov-22
LoE-SSG-1730	St Stephens Green Station E&AW	305	30-Aug-22	23-Nov-23
LoE-SSG-1740	St Stephens Green Station	1611	28-Nov-23	01-Jul-30
LoE-SSG-1750	St Stephens Green Station (MEP)	200	01-Jul-30	21-Apr-31
<b>A&amp;EW Utility Work</b>		783	27-Sep-22	04-Dec-25
<b>A&amp;EW</b>		245	23-Nov-22	23-Nov-23
<b>Site Preparation Works</b>		40	28-Nov-23	05-Feb-24
<b>Diaphragm Walling</b>		656	06-Feb-24	01-Oct-26
<b>Roof Slab</b>		607	13-Dec-24	16-Jun-27
<b>Excavation and Propping (Pre-TBM)</b>		227	16-Jun-27	22-May-28
<b>Concourse Slab</b>		346	26-Oct-27	03-Apr-29
<b>Excavation and Propping (Post-TBM)</b>		216	24-Nov-28	15-Oct-29
<b>Base Slab</b>		129	25-Apr-29	30-Oct-29
<b>TBM</b>		325	30-Jul-27	23-Nov-28
<b>Mezzanine Slab</b>		513	05-Oct-27	08-Nov-29
<b>Lining Walls</b>		176	08-Nov-29	29-Jul-30
<b>Internal Walls</b>		80	26-Feb-30	19-Jun-30
<b>Finishing Works</b>		94	04-Mar-30	15-Jul-30
<b>Architectural</b>		50	21-Apr-31	30-Jun-31
<b>MEP Works (Deep Station)</b>		320	18-May-30	21-Apr-31

Diagram 6.1: Programme Key Dates

## 7 Construction Costs

An 'order of magnitude estimate has been prepared for the construction of St Stephen's Green Station in the carriageway. The analysis concludes that locating the station within the carriageway rather than partially within St Stephen's Green Park, as currently planned, would increase the direct cost of the station by about 67% and will increase the overall duration of the St Stephens Green Station construction works by about 15 Months.

This estimate is for direct construction costs only and does not include Client costs, risk, VAT, or inflation past the project estimate base date of Q4 2019. The associated risk will be higher for this option, but this will need to be assessed along with costs for any time risk allowance as discussed in Section 6.

This allowance includes allowances of approximately €15m for strengthening the affected properties and €25m for relocating affected businesses but are approximate. The costs are higher than the baseline estimate due to the deeper excavation, multiple utility moves, utilities deck, sheet piling and over pumping allowances.

No allowance has been made for impacts resulting from the corresponding change to the tunnel alignment.

## 8 Conclusions and Recommendations

This report considered the construction of a 116m long by 25m wide station box within the carriageway and footways of St Stephen's Green East using diaphragm walls and top-down construction techniques. It has also considered alternative mined tunnel options under St Stephen's Green East.

The site is extremely constrained with the property boundaries of St Stephen's Green to the west and historic Georgian properties to the east. Allowing space for site hoardings and guide walls behind the diaphragm walls means that there is approximately 200mm to the property boundaries on either side.

It is likely that the buildings will have disused coal cellars in the east footway which would be impacted by the deep excavation in this location. This will need to be investigated prior to construction.

Construction of a station box wholly within the roadway would have a greater impact in terms of noise and vibration on the buildings along the east side of the road compared with the preferred option. In order to ensure works remain within the carriageway, and facilitate diversion and retention of utilities along the road, requires the station to be set substantially deeper than the current proposed option, with substantially increased construction challenges and periods of working.

There is insufficient space to maintain building access from St Stephen's Green East and access will need to be from the rear of the buildings. Consideration would need to be given to evacuation of the buildings and access for emergency services in the event of fire or other emergencies.

Building protection measures would be required to mitigate damage to high-status buildings and remedial measures to repair damage are likely. It is possible that several properties would need to be vacated for at least part of the construction period.

Vehicle and pedestrian traffic would be severely affected, and public transport seriously disrupted, for around 8 years of the construction period, expected to start in August 2022 and finish in June 2031 – some 15 months longer than the current proposed option construction programme with associated cost increases.

There are a large number of underground utilities in Hume Street and St Stephen's Green East that would need to be diverted. As the station would occupy the entire width of the carriageway, the services would need to be diverted in two phases onto a temporary support deck to permit the installation of the diaphragm walls, and then diverted back to their original locations. The utility deck would be supported by plunge columns, which would need to be carefully coordinated with the permanent works design. The depth of the sewer precludes construction of the station roof underneath it, and this would need to be over-pumped for an extended period until the roof has been completed. This presents a risk of sewer flooding which may be unacceptable. A 1.2km High Voltage cable diversion would also be needed prior to commencement of the works.

In consideration of the severe difficulties in constructing a station wholly within St Stephen's Green East, alternative mined station options within the roadway have also been considered. Whilst these can provide less surface disturbance due to some of the works being contained underground, construction needs incur surface works as well. All of the mined tunnel options considered are not considered to have advantages over the proposed station location or the station constructed wholly under St Stephen's Green East. All would have surface interventions to facilitate construction, either with significant impacts within the Park and adjacent roads, or with disruption to St Stephen's Green East itself for access shafts for construction use and permanent station facilities afterwards, significantly impacting utilities, pedestrian and traffic access. Programme benefits are slight or would significantly increase anticipated construction times. In all case, mined construction is considered higher risk than construction of a station box.

In conclusion, the additional construction challenges, increased risk of damage to buildings, to utilities, and disruption to local residents, pedestrians, bus services and general traffic flows in the area do not support the option of trying to contain all the construction works outside of the Park and wholly under the roadway. In addition, the significant cost and programme implications of this option are not warranted in comparison the proposed option.

## 9 References

1. Emerging Preferred Route for MetroLink (March 2018)
2. Public Consultation on the Preferred Route (March 2019)
3. Jacobs IDOM )1/2020 St Stephen's Green Station Study: Location Assessment Report ML1-JAI-EGN-MS15\_XX-RP-Y-00001| P02
4. Transport Infrastructure Ireland (TII) 10/2020, Relocating Metrolink Station Box within SSG East Carriageway
5. Jacobs IDOM 04/2020 Geotechnical Design Report P04.1 ML1-JAI-GEO-ROUT\_XX-RP-Y-00004
6. London Bridge Associates 11/2019 Metrolink Constructability Report St Stephen's Green Station D574-RPT-CT-MS15-0018



ANNEX A: OPW LETTER

**OPW** Oifig na  
nOibreacha Poiblí  
Office of Public Works



Mr Michael Nolan  
CEO  
Transport Infrastructure Ireland  
Parkgate Business Centre  
Parkgate Street  
Dublin 8

Dear Michael,


I am writing to you on behalf of the Commissioners of Public Works in relation to TII's proposals for Metrolink and specifically how such proposals would impact on St. Stephen's Green.

As you know, there have been extensive consultations in this regard culminating in a recent detailed presentation by TII to the Office of Public Works and the Department of Culture Heritage and the Gaeltacht. The Commissioners are fully supportive of the Metrolink project, generally, and we recognise the benefits that it will bring to the city of Dublin and to the country. However, we also have statutory and other responsibilities relating to the protection and preservation of nationally important State properties and National Monuments, including St. Stephen's Green.

We have given the most serious consideration to the TII proposals for St. Stephen's Green and have concluded that the proposals would have an unacceptably severe, negative and permanent impact on the character and heritage value of the Green. I appreciate that over the past year or more, TII has presented a number of options culminating in the current proposal, but I must inform you that none are acceptable to the Commissioners of Public Works for the reasons stated.

We strongly urge you to revise your design such that the project does not infringe on the boundary of St. Stephen's Green or alter the historic landscape in any way.

Yours sincerely,



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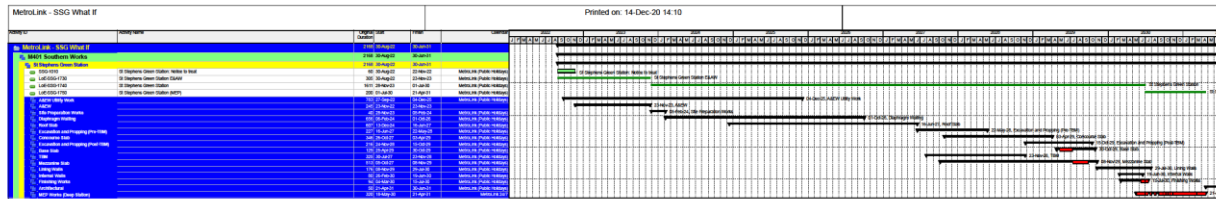
John McMahon  
Commissioner  
10 June 2020

c.c. Peter Walsh, Director of Capital Programmes  
Niall Ó Donnchú, Assistant Secretary, Department of Culture, Heritage and the Gaeltacht

52 Faiche Stiabhna, Baile Átha Cliath, D02 DR67  
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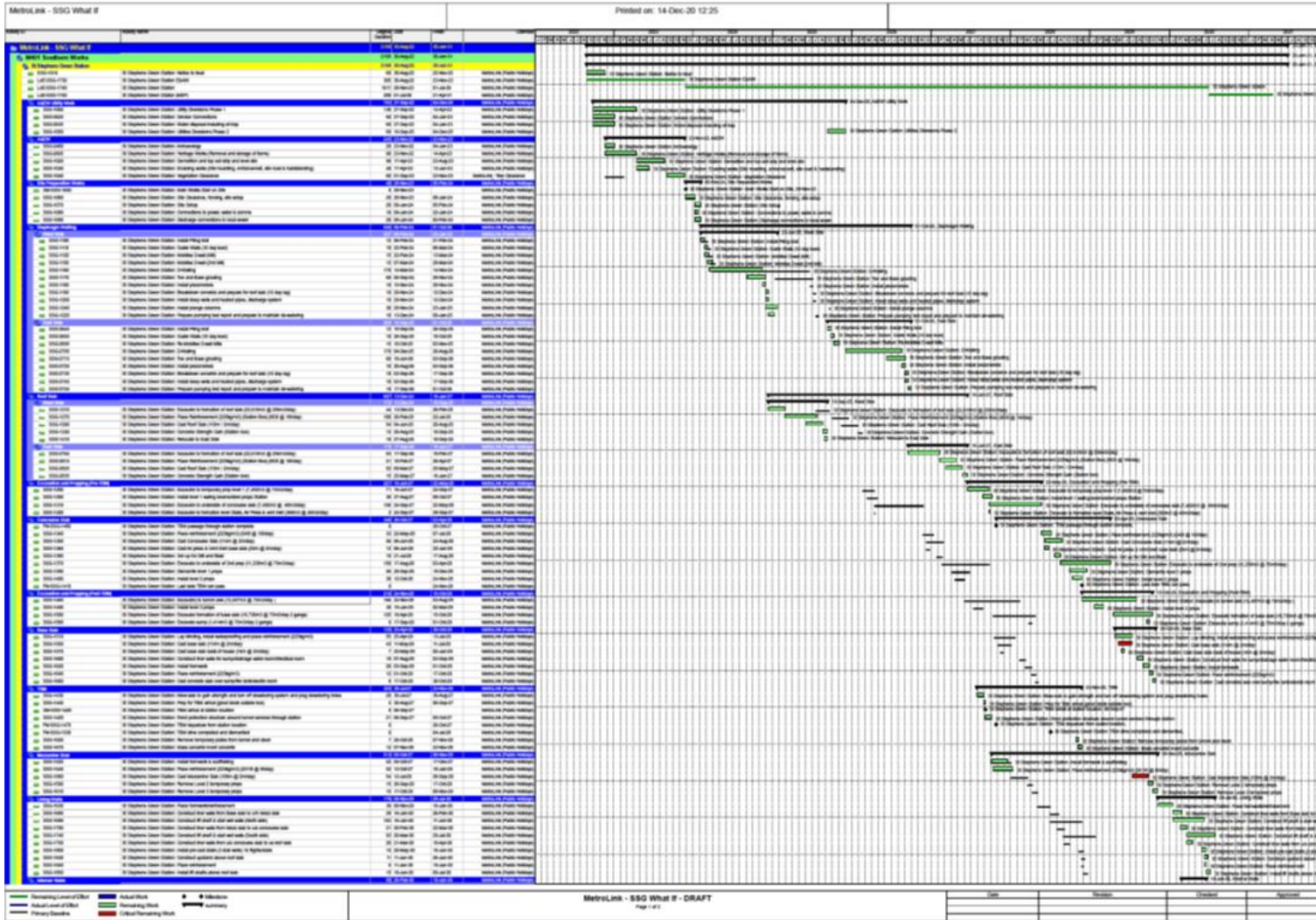
ANNEX B: PROGRAMMES

High Level Programme

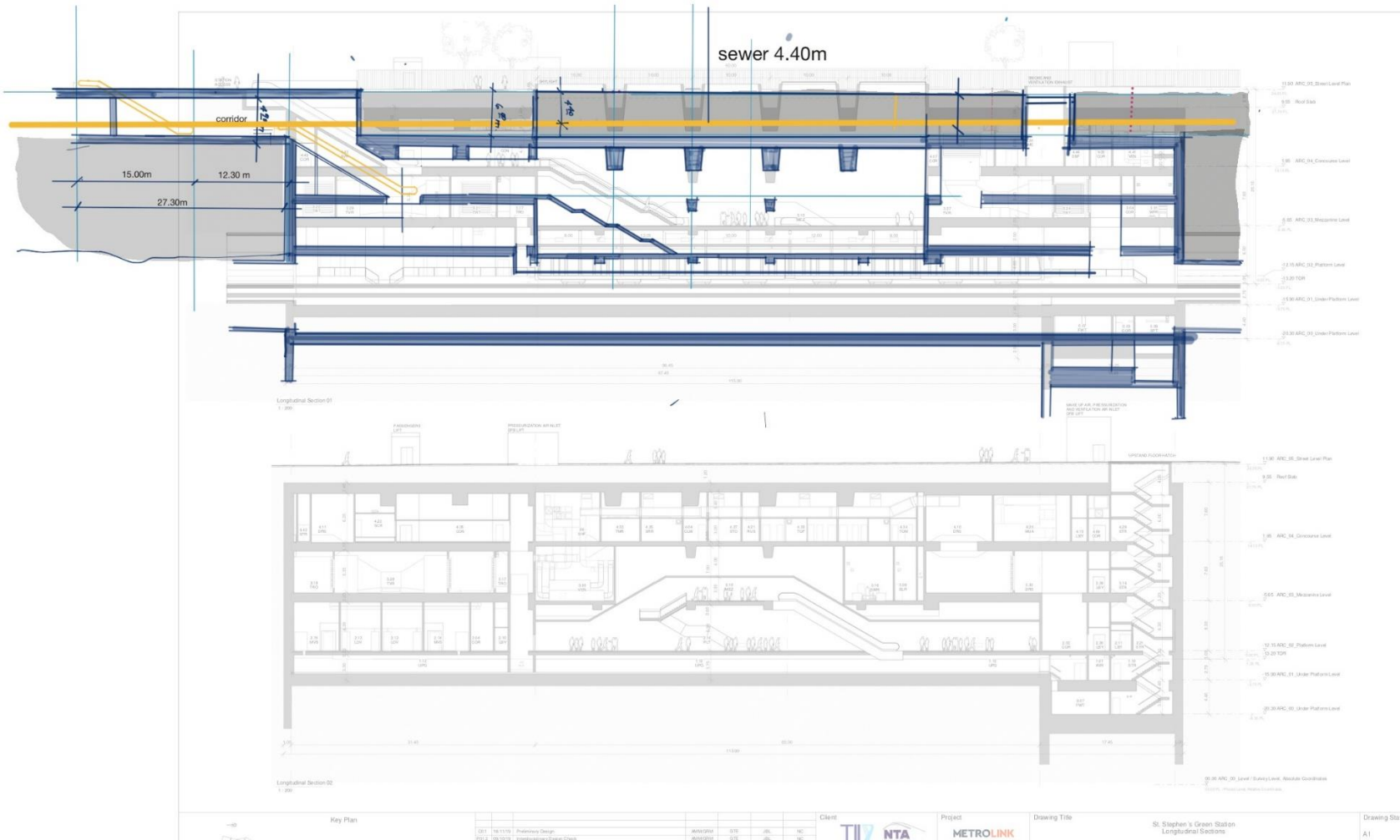




# Construction Programme



ANNEX C: ALTERNATIVE STATION - LONG SECTION COMPARISON WITH PROPOSED STATION





**St Stephen's Green Station Study: Location Assessment Report**

ML1-JAI-EIA-MS15\_ZZ-RP-Z-00001 | P02



2019/11/29

**MetroLink**

Project No: 32108600  
 Document Title: St Stephen's Green Station Study: Location Assessment Report  
 Document No.: ML1-JAI-EIA-MS15\_ZZ-RP-Z-00001  
 Revision: P02  
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 Client Name: TII / NTA  
 Client No:  
 Project Manager: Neil Cowie  
 Author: A. DOONEY  
 File Name: ML1-JAI-EIA-MS15\_ZZ-RP-Z-00001.docx

Revision	Date	Description	Author	Checker	Reviewer	Approver
P02	29/11/19		AD	RH	RH	NC
P01	22/10/19		AD	RH	RH	NC

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## Executive Summary

The objective of this report is to identify the preferred location for the future MetroLink station at St Stephen's Green East. The report outlines the assessment undertaken of potential station locations undertaken and the evolution from the proposed station location presented as part of the Emerging Preferred Route (EPR). The EPR station was identified in the New Metro North Alignment Options Report (ARUP, 2018) commission by Transport Infrastructure Ireland (TII) and completed by ARUP Consulting Engineers.

St Stephen's Green is a 10.9 hectare 17<sup>th</sup> century park situated at the southern end of Grafton St in the city centre of Dublin. In its current form the park has been used as a public park since 1880, following re-development it is enclosed by a plinth wall with railings next to which are planted a variety of trees including large mature specimens. The perimeter fence and vegetation acts as a barrier from the busy road and urban environment outside to the green space inside. The park interior has a Victorian layout which includes a lake, children's playground and numerous monuments. St Stephen's Green Park is a National Monument (RMP DU018-020334-). Included within the National Monument curtilage is the footpath to the road edge surrounding the park. This area incorporates fence railings, a plinth wall, bollards and lampposts all of which are protected structures.

St Stephen's Green East is bordered on one side by St. Stephen's Green Park and on the other by a mixture of Georgian and modern buildings. The carriageway of St Stephen's Green East includes three northbound traffic lanes and a cycle lane and a southbound bus lane and cycle lane.

The EPR route was developed via a two stage Multi Criteria Analysis (MCA) which divided the route between Estuary and Charlemont into three study areas. St Stephen's Green East Station (as it was called) was in Study Area A and its location was determined primarily as an intermediate station location between two critical interchange points at Charlemont (tie in with Luas Green Line) and Tara St (DART interchange). Alternative route options were considered that included a St Stephen's Green West Station, but these failed to pass Stage 1 of the MCA process due to a lack of interchange options with other rail services.

In order to identify the preferred station location at St Stephen's Green a four-stage assessment process has been undertaken. This involved the following stages:

- Stage 1: Review of the receiving environment;
- Stage 2: Development of Station location options;
- Stage 3: Preliminary appraisal: Appraisal against assessment criteria including Economy, Environmental and Engineering discarding options that were not considered feasible;
- Stage 4: Conducting an MCA of remaining options to ascertain preferred location.

The assessment process was undertaken by comparing the proposed station locations against a set of criteria. The criteria were developed having regard to the Project Appraisal Guidelines for National Roads Unit 7.0 – Multi Criteria Analysis (TII 2016) and the Common Appraisal Framework for Transport Projects and Programmes,

DTTAS (2016). This involved undertaking a qualitative assessment of environmental impacts, engineering constraints and considering costs associated with each proposed station location.

The receiving environment was described and used to inform the development of potential station locations. Six locations in total were developed in Stage 2 which were then subjected to preliminary assessment under Stage 3. The assessment criteria utilised were Economy, Environment and Engineering. This assessment allowed a decision to be made to narrow the six locations down to two which were then subjected to an MCA in Stage 4.

Station locations 1, 2 and 3 (as shown in drawings for each location in Section 6: Description of Locations) were identified as being more than 1000m from Tara St Station meaning an intervention shaft would be required<sup>1</sup>. Locations for an intervention shaft were considered to be either at Trinity College or Merrion Square due to significant spatial constraints along the alignment in this area. Both locations are considered as very sensitive locations. The need for an intervention shaft resulted in locations 1-3 performing poorly against several criteria in the preliminary assessment. In particular the locations performed poorly against Economy and Environmental criteria due to the increased capital cost and environmental impacts associated with constructing an intervention shaft at the identified sensitive locations. These locations also delivered poor performance against the relevant Project Objectives of Design Integration and Sustainable Construction and Operation. Overall these factors combine to mean Locations 1-3 were not progressed to Stage 4.

Location 4 has the station box situated beneath the road at St. Stephen's Green East. An 1800mm Victorian sewer situated beneath St. Stephen's Green East and another on Hume St would need to be diverted which is considered very technically challenging. This Locations also performs poorly against the Environmental criteria as a result of the requirement to close St Stephen's Green East and Hume St to through traffic during construction. Also, despite being within the carriageway of St Stephen's Green East there would be direct impacts on the St Stephens Green Park. In terms of the Economy criteria, the cost of utility diversions are significant and this caused this Location to perform moderately. As a result of the poor performance against the Engineering (Constructability) and Environmental criteria, Location 4 was not progressed to Stage 4.

Locations 5 and 6 were progressed to Stage 4 and subjected to an MCA. The assessment criteria used included Economy and Environment criteria having full regard to the environmental factors outlined in Directive 2014/52/EU amending Directive 2011/92/EU on the Assessment of the Effects of Certain Public and Private Projects on the Environment (EIA Directive).

Location 5 had a moderate performance against the economic criterion due to its position being partially within St Stephen's Green East carriageway and the park. This is due to the Victorian sewer being maintained and less roadway disturbance during the construction phase than for other Locations. However, this option performed poorly against environmental sub-criteria for architectural heritage and archaeology due to the direct impacts on St Stephen's Green Park and on the protected structures within the National Monument curtilage. Furthermore, the construction phase impacts on mature trees meant Location 5 performs poorly against architectural heritage, archaeology, biodiversity and landscape and visual sub-criteria. There are some impacts

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<sup>1</sup> See Section 6.2 which details why an Intervention shaft is required

on traffic and transport criteria, but these can be managed so overall performance is considered moderate under these criteria.

Location 6 performed well against the economy criterion as it would be constructed fully within St Stephen's Green Park, which would significantly lower the construction, reinstatement of roadway and utility diversion costs. However, as it is located entirely within St Stephen's Green Park it performed poorly overall against environmental sub-criteria. Poor environmental performance is driven by the number of trees to be removed at this location to facilitate construction of the station, which has potential impacts on architectural heritage, archaeology, biodiversity and landscape and visual criteria. The operational phase requires station related "pop ups" to be situated within St Stephen's Green Park creating permeant visual impacts.

Conversely, Location 6 does not directly impact traffic and transport during construction and does not require utility diversion meaning this option performs well against the traffic and transport sub criteria.

Location 5 has been selected as the preferred location overall for a station at St Stephen's Green as it performed best against the criteria in both the Stage 3 and 4 assessments. The assessment has shown that Location 5 impacts directly on St Stephens Green East and St Stephen's Green Park but avoids the most significant impacts when compared to Location 6 having particular regard to landscape and visual impacts and impacts on transport and traffic and the requirement for utility diversions. Furthermore, it is considered the potential impacts arising from this Location can be mitigated during design development. The potential impacts of this Location and identified mitigation measures to ameliorate the impacts will be detailed in the EIAR.

## **2 Introduction**

This report is required to present in full the robust decision-making process that led to the choice of the proposed station location at St Stephens Green. It also identifies alternative options considered during the process and the rationale for choosing the preferred location.

The identification of a preferred station location was achieved by employing a four-stage assessment process which includes:

- Stage 1: Review of the receiving environment
- Stage 2: Identification and description of potential station locations
- Stage 3: Preliminary analysis
- Stage 4: Multi Criteria Assessment

Once the receiving environment was reviewed and potential station locations identified and described, TII (2016) sub criteria were utilised for the Stage 3 preliminary assessment process. Relevant Project Objectives were also used to inform the assessment process, and these were:

- To be designed to integrate appropriately into the existing public realm;

- To be planned, constructed and operated in an environmentally sustainable manner.

The Stage 3 Preliminary Analysis was utilised to undertake an initial sift of options against criteria and discount locations whose impacts were too significant to warrant further investigation.

Stage 4 utilised selected DTTAS (2016) sub criteria as the basis to undertake an MCA to ascertain a preferred option for St Stephen's Green Station. Further details of the process undertaken can be found in Section 4: Methodology.

## 2.1 Proposed Study Area

The study area extends from Trinity College Dublin (TCD) to just south of the intersection of St Stephen's Green East and Baggot Street Lower. TCD has been chosen as the northern boundary of the study area as it is the potential location of an intervention shaft. Merrion Square is also included as has also been provisionally identified as a location for an intervention shaft.

The proposed Study Area is shown in Figure 1.1 over.

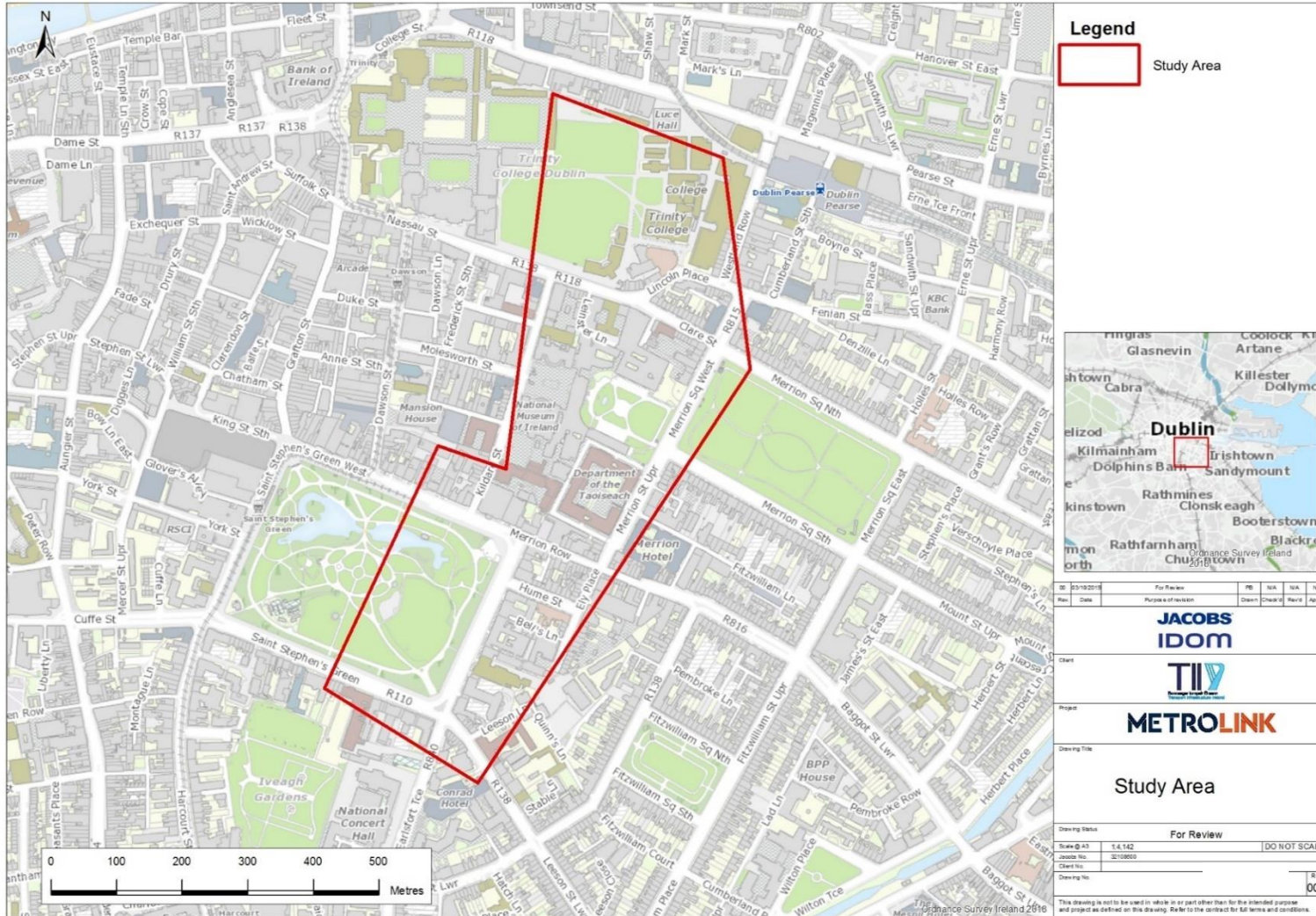


Figure 1.1 Study Area



## 2.2 Background to MetroLink

Dublin Metro North (DMN) was the project name of the original proposal for a metro railway system connecting Swords and Dublin Airport with Dublin City Centre at St Stephen's Green. This scheme was developed by the Railway Procurement Agency and granted a Railway Order by An Bord Pleanála (ABP) in 2010. The global economic downturn intervened, and in 2011 the Government postponed the Dublin Metro North project.



Figure 1.2 – MetroLink Route and Stations (2018)

The National Transport Authority's (NTA) Transport Strategy for the Greater Dublin Area, 2016-2035 (NTA 2016) identified a Metro service as the preferred public transport mode to address the transport needs of the Swords-Airport-City Centre corridor. It also envisaged the upgrading of the existing Luas Green Line between Ranelagh and Sandyford to a Metro level of service.

Project Ireland 2040 included the National Development Plan (2018-2027) (DHPLG 2017), which combined those two projects to form MetroLink. MetroLink will provide a fast, high capacity, high frequency, modern and efficient public transport service for people travelling along the Swords/Airport to City Centre corridor. In addition, the Scheme will ultimately interchange with the existing Luas Green Line in the South City area. The route length is approximately 19km and the completed system will have 15 new stations, 3,000 Park and Ride spaces, and a journey time of approximately 25 minutes from the City Centre to Swords.

The NTA/TII commissioned Arup Consulting Engineers to undertake an assessment of route options for the proposed Project (TII 2016). The objective of the study was to carry out a comprehensive route selection to identify an Emerging Preferred Route (EPR) for the Scheme. The study was completed at the end of February 2018 and it included a Concept Design for the EPR.



In January 2018, the NTA/TII commissioned Jacobs and Idom JV (Jacobs/Idom) to provide ongoing engineering design services through to scheme completion. As the design developed, it became apparent that the construction phase of the project would result in significant disruption to the LUAS Green Line. In order to mitigate this impact a decision was made to defer the upgrade of the Green Line to a later date and that the MetroLink project would comprise the development of the section between Swords and Charlemont.

### 2.3 Structure of this Report

This report is structured to build on work undertaken which identified St Stephens Green East an appropriate location for a proposed station ARUP (2018). A number of potential station locations on St Stephens Green East were analysed in order to identify the preferred station location in the area. This document is therefore structured as follows:

- Section 2 provides a brief description of the process which identified the EPR including a station location at St Stephen's Green East;
- Section 3 briefly describes the Preferred Route Station location at St Stephen's Green;
- Section 4 defines the four-step assessment methodology which is:
  - Stage 1: A description of the receiving environment at St Stephen's Green;
  - Stage 2: A description of station locations;
  - Stage 3: A summary of the preliminary assessment of locations;
  - Stage 4: An MCA of the options taken forward from Stage 3.
- Section 5 is the review of the receiving environment (Stage 1 above);
- Section 6 provides a description of the locations developed and includes drawings developed (Stage 2 above);
- Section 7 includes the preliminary assessment of locations (Stage 3);
- Section 8 provides the MCA and an analysis (Stage 4);
- Section 9: Conclusion and recommendation of the preferred station location; and
- Section 10 References.

### **3 Emerging Preferred Route St Stephen's Green Station**

#### **3.1 Introduction**

The Emerging Preferred Route (EPR) including a proposed underground station at St. Stephens Green East was identified based on an in-depth multidisciplinary analysis presented in ARUP (2018). The EPR is shown in Figure 2.1 below. A public consultation on the EPR was undertaken in May 2018 with submissions received.

#### **3.2 Methodology used in the Identification of EPR**

In order to determine the EPR for MetroLink all possible route options within a defined study area were assessed against a set of criteria. The first step in this study was to define the study area extent to ensure that all possible options are considered. The study area was split into three areas as follows and shown in Figure 2.2:

- Study Area A: City Centre (within which St Stephen's Green Station is located);
- Study Area B: Area B: Ballymun/Dublin Airport;
- Study Area C: Swords.

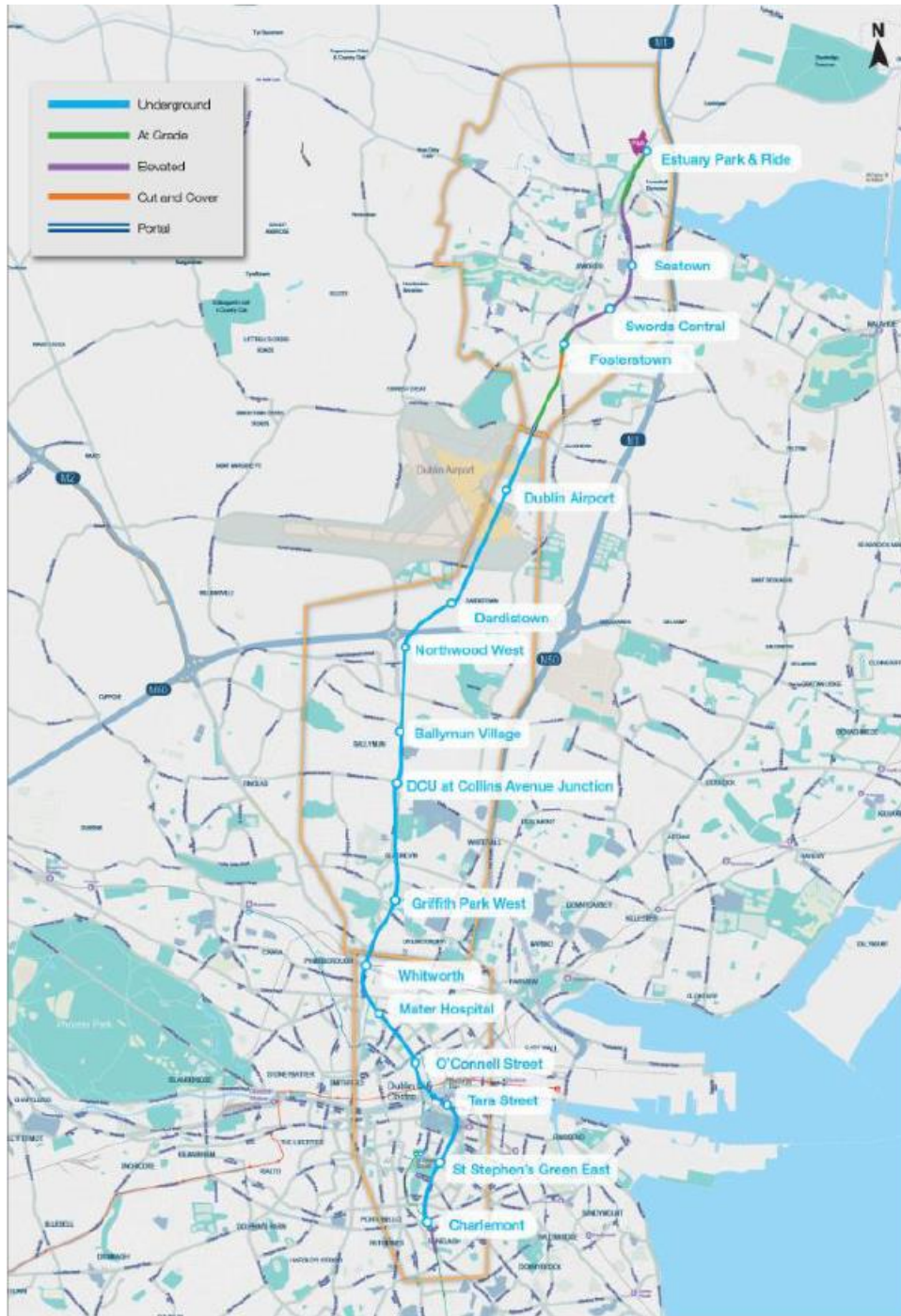


Figure 2.1 EPR Map

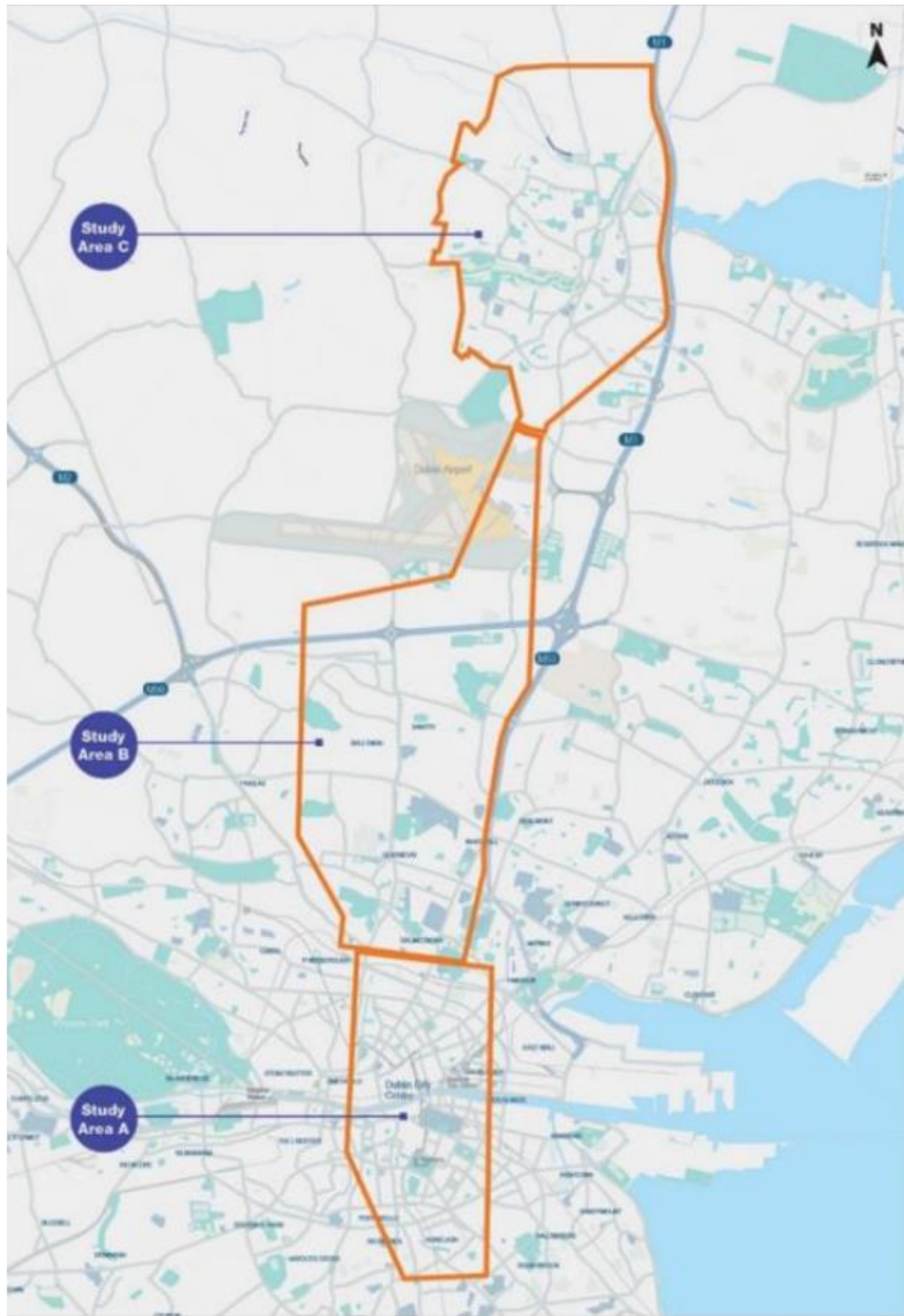


Figure 2.2: EPR Study Areas

All possible route options within each study area that best served the scheme objective were identified and screened using a Pass/Fail Preliminary Assessment. Then the remaining route options were assessed using a two stage Multi Criteria Analysis (MCA) against a defined set of criteria. The criteria used are in line with the criteria outlined in the DTTAS (2016).

The preliminary assessment of possible options was carried out which identified twenty assessment options across the study areas which merited further consideration and analysis. In order to enhance the analysis concept designs were developed for each of these options to allow for more a detailed assessment.

Following the first stage MCA a total of eight options within the overall study area were identified for further consideration; three in Study area A, three in Study area B and two in Study area C. These options were combined to form ten end-to-end route options, each running from Estuary to the tie-in location at Charlemont. The ten end-to-end route options were then subjected to a second stage MCA. This MCA included a full transport demand and cost benefit analysis for each of the ten options. Following the second stage MCA the EPR for NMN was identified.

The EPR compared most favourably to other options as overall it:

- Best served demand along the corridor;
- Provided interchange with other public transport modes;
- Integrated comparably better with current planning policy;
- While it created environmental impacts, the report stated these could be mitigated during design.

### 3.3 Options assessed for St Stephens Green

Six routes in Study Area A were developed and assessed for the first stage MCA as shown in Table 2.1 below. It can be seen in this table how the route options took a different path through Study Area A impacting the location of a station at St Stephen's Green (or its absence altogether). Note that A0 is the previously permitted Old Metro North.

<b>Route Option</b>	<b>Metro Stations</b>
A0	Charlemont – St. Stephen's Green West – O'Connell Street – Parnell Square – Mater Hospital – Drumcondra
A1	Charlemont – College Green – O'Connell Street – Mater Hospital – Drumcondra
A2	Charlemont – St. Stephen's Green East – Tara Street - O'Connell Street – Mater Hospital – Drumcondra
A4	Charlemont – St. Stephen's Green East – Tara Street – O'Connell Street – Mater Hospital – Whitworth



<b>Route Option</b>	<b>Metro Stations</b>
A8	Charlemont – St. Stephen's Green East – Tara Street – Mountjoy Square – Drumcondra
A14	Charlemont – St. Stephen's Green West – O'Connell Street – Mater Hospital – Drumcondra

Table 2.1: Study Area A route options from the EPR Report

The CAF criteria used in the Stage 1 MCA were:

- **Economy:** Capital cost, transport reliability, journey time, transport demand;
- **Integration:** Land use policy, public transport integration, integration with other modes;
- **Accessibility & Social Inclusion:** Key trip attractors, deprived geographic areas;
- **Environment:** Archaeology, architectural, cultural heritage, solid and geology.

The MCA assessment found route options in Study Area A that featured an interchange with the DART line at Tara St to performed well against the Public Transport Interchange criteria. Locating a station at Tara St constrains the possible tunnel alignments e.g. Tunnel Boring Machine turning constraints and operational considerations for curvature of tunnel. This means Tara St Station was a key driver for the location of a station on St Stephen's Green East.

The Route Options A0 (station at College Green) and A14 (station at St Stephen's Green West) did not have an interchange with DART services. This primarily resulted in them being discarded as Public Transport Interchange was a key differentiator. EPR Route Option A14 has St Stephen's Green West station located in a central position within St Stephen's Green Park, close to where Dawson St intersects with St Stephen's Green North. This is shown in Figure 2.3 below:



Figure 2.3 Route Option A14 station location at SSG

The first stage MCA identified Study Area A Route Options to A1, A2 and A4 as being suitable for progression to Stage 2 MCA and more detailed consideration.

### 3.4 Identification of the Emerging Preferred Route option

The EPR Report identified three route options for further consideration in Study Area A as outlined in Section 2.3. These were inserted into a mix of end to end options incorporating options in Study Areas B and C and subjected to Stage 2 of the MCA process. The Stage 2 Criteria were:

- **Economy**
  - Benefit cost ratio
  - Total cost
  - Patronage
  - Journey time
- **Integration**
  - Land use policy integration
  - Public transport integration

- **Accessibility:**
  - Key trip attractors
- **Environment:**
  - Landscape and visual
  - Archaeology, architecture and cultural heritage
  - Soils and geology

Ultimately Option 9 was selected via the Stage 2 MCA process as the preferred end to end route and EPR. Option 9 incorporated Route Option A4 and provided a station at St Stephen's Green East as shown in Figure 3.1 below.

The EPR was ultimately selected via the MCA process as it:

- Had the highest benefit cost ratio;
- Performed best in public transport usage (see earlier comments on Tara St interchange);
- Has better integration with wider public transport network including heavy rail;
- Integrated with Land Use policy particularly at Ballymun and Swords;
- Had environmental impacts including landscape, architecture, and cultural heritage but these could be mitigated through design.

Specifically, Route Option A4 performed well in terms of public transport usage and integration with the wider public transport network as it links with the DART, Luas Cross City and Greenline. While having environmental impacts it and Route Option A2 were assessed as having less impact than other alternatives in Study Area A.

#### 3.4.1 Consultation on EPR:

Public consultation on the EPR occurred between 22 March and 11 May 2018. Submissions were received following this consultation with one specific comment on St Stephen's Green. This related to the proximity of school children in the area to noise and construction phase impacts on St Stephen's Green and difficulties reinstating the park post construction.

### 3.5 Description of Proposed EPR at St Stephen's Green East

The alignment at St Stephen's Green that was presented as part of the EPR is shown on Figure 2.4 EPR alignment and St Stephen's Green Station.

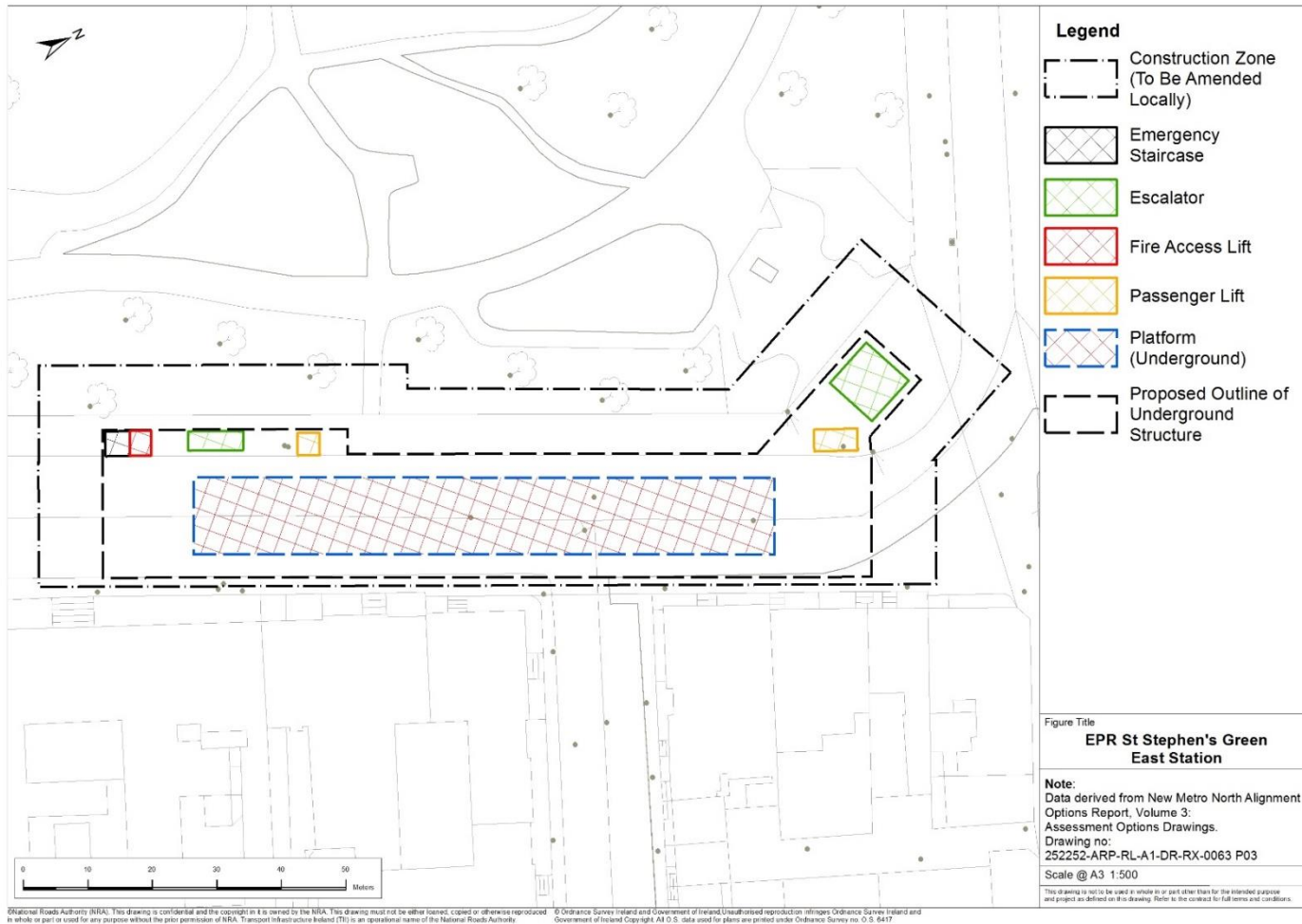


Figure 2.4: EPR alignment and St Stephen's Green East Station

For the EPR the station at St Stephen's Green was developed to the point of an indicative station box location with some station elements shown. This station location was primarily created as a function of the route selection methodology described above to define the EPR.

The station is located within the roadway and footpath of St Stephen's Green East. The construction area directly impacts St Stephen's Green East and St Stephen's Green Park. The station has been situated to make use of the footpath and open area adjacent to the Wolfe Tone statue on the eastern corner of St Stephen's Green for:

- Ingress and egress and station (adjacent to the Wolfe Tone statue);
- Emergency lifts and stairs (footpath);
- Ventilation shafts (footpath).

These elements are labelled in Figure 2.4 above.

#### **4 Identification of a Preferred Route**

In January 2018, the NTA/TII commissioned Jacobs and Idom JV (Jacobs/Idom) to provide ongoing engineering design services to develop the scheme from concept stage, through Preliminary Design, preparation of documents for a Railway Order submission including the Environmental Impact Assessment Report and subsequent support through to scheme completion.

A programme of public consultation led by the NTA/TII was conducted between 22nd March and 11th May 2018, during which members of the public and other stakeholders were invited to submit their views and observations of the EPR. Many submissions were made during this process, including suggestions for alterations to the scheme or expressing concerns about different aspects. This process has resulted in several important changes proposed to the EPR leading to the current Preferred Route, which was the subject of a second round of Public Consultation events held between 26th March to 21 April 2019.

St Stephen's Green Station design was not fully developed at the time of the Preferred Route Public Consultation. On this basis the station presented to the public in the Preferred Route Design Development Report (Jacobs Idom 2019) was stated as being "currently developed".

Several project wide changes were made for the Preferred Route which have an impact on St Stephen's Green Station design. In summary these changes are:

- The change from twin bore tunnel in the EPR to a single bore tunnel;
- The need for intervention shafts where the distance between stations is greater than 1000m due to the change in tunnel boring methodology. The Safety in Railway Tunnels document, SRT-TSI (EU Legislation), establishes a maximum distance between lateral and/or vertical emergency exits of 1000m for single bore tunnels.



- Reduction in station box size from the EPR;

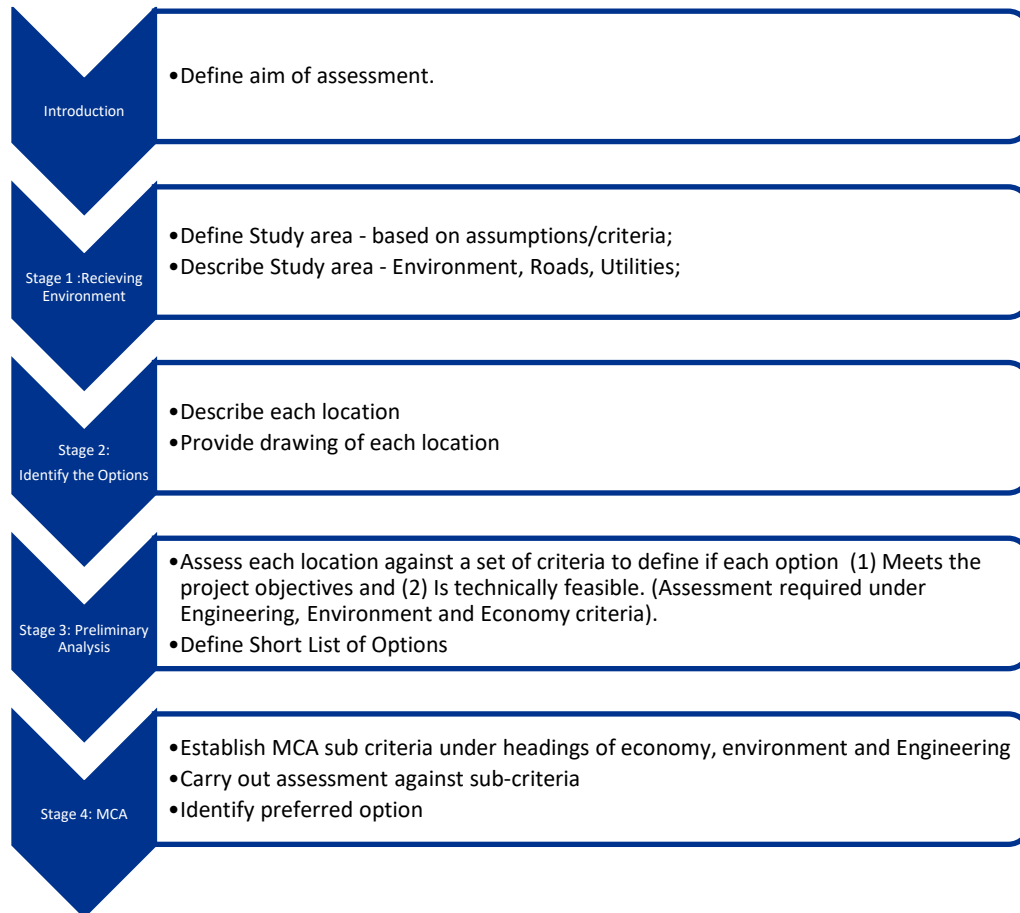
These design changes have been factored into the options developed in this report.

## 5 Methodology

### 5.1 Assessment Methodology

A four-stage options analysis assessment was undertaken to review six station locations at St Stephen's Green East. These options are described in detail in Section 6. The analysis was undertaken in line with the Project Appraisal Guidelines (TII, 2016) and The Common Appraisal Framework (DTTS 2016) to provide a robust framework for comparing options. The principle stages are as follows:

- **Stage 1:** Review of the receiving environment to identify constraints to the provision of a proposed station location;
- **Stage 2:** Identify and describe potential station locations;
- **Stage 3:** Preliminary Analysis to assess the feasibility of the proposed options having regard to the Project Objectives, Engineering, Economic and Environmental constraints.
- **Stage 4:** Multi Criteria Analysis: Analysis of the short-listed options having regard to following criteria: Economy, Environment and Engineering



### 5.1.1 Stage 1: Review of the Receiving Environment

TII (2018) identified an emerging preferred route alignment connecting Tara Street and Charlemont with a station location at St Stephens Green East. (Refer to Chapter 2 for further information on the assessment undertaken). On the basis of providing a station location on St. Stephens Green East, a study area was identified having regard to the alignment and potential station locations in the vicinity of the alignment. Refer to Figure 1.1 for an outline of the study area.

A desk top study was undertaken of the receiving environment to identify the principle constraints that should be considered when identifying the preferred location for a station on St Stephens Green East.

### 5.1.2 Stage 2: Identification and description of potential station locations.

The project team held a series of internal workshops to review the outputs of the desk top assessment of the receiving environment to develop a number of station location options, as described in Section 6 of this report.

### 5.1.3 Stage 3: Preliminary Analysis

The preliminary analysis undertaken consists of a qualitative assessment of potential station locations based on the criteria identified in the TII 2016 as set out in Table 4.1. Environmental criteria suggested in the TII 2016

reflect those topics that are required to be assessed under EIA Directive when preparing an Environmental Impact Assessment Report.

An assessment was also made against relevant Project Objectives to ensure the options developed are in line with them. The two relevant Project Objectives are that the project:

- Be designed to integrate appropriately into the existing public realm;
- Be planned, constructed and operated in an environmentally sustainable manner.

The remainder were not deemed relevant for the assessment of options at St Stephen's Green as they primarily relate to the entire scheme or aspects of the project that do not relate to St Stephen's Green East.

For the purpose the preliminary assessment key topics were also identified and used as sub-criteria for the assessment. These sub criteria were identified as key constraints within the study area or topics were impacts would be differentiated between station box location.

TII 2016 identifies a series of criteria that were utilised for this stage of the assessment process. However, some of these were not used in the assessment primarily because the proximity of the various station location options to each other made criteria to be neutral or the same for each option. There are small variances in the same location for the options. In terms of transport planning, there are no differences between the options for the criteria network legibility, key trip attractor and demand.

Table 4.1 describes shows criteria found to be relevant and explains why certain criteria were not utilised.

Appendix A of this report details the key sub criteria assessed and details of the assessments undertaken. These assessments are summarised in Section 7.

<b>Criteria</b>	<b>Sub-Criteria</b>	<b>Criteria Description</b>	<b>Note</b>
Environmental	Potential for adverse impacts	Minimise the potential for adverse impact on the natural and built environment and the community.	Environmental criteria were assessed given the potential for differing impacts of the options developed.
Engineering	Constructability	This criterion considers if the station option can be constructed having regard to the identified constraints and	The constructability criterion was assessed given the potential differentiation between locations.

		opportunities within the study area	
Economy	Cost	This criterion considers the cost of each of the proposed station options.	This criterion was assessed given the cost implications of differing locations.

Table 4.1: Criteria used for Stage 3 Assessment

All locations identified in Stage 2 have been assessed against the relevant sub criteria identified above with the intention to identify the locations that are feasible and worthy of being subjected to a more rigorous MCA process in Stage 4. The outcomes of the full assessment can be found in Appendix A: Preliminary Assessment Table and is summarised on Section 7.2: Appraisal of Options.

The options identified for preliminary assessment have been assessed against the criteria using a three-point scale, ranging from an overall good performance to an overall poor performance. This three-point scale is colour coded as presented in Table 4.2, with advantageous routes graded to 'green' and disadvantaged routes graded to 'red'.

Colour	Description
	Overall good performance against the criteria
	Overall moderate performance against the criteria
	Overall poor performance against the criteria

Table 4.2 Preliminary appraisal colour coding system

#### 5.1.4 Stage 4: Multi Criteria Assessment

Stage 4 involved taking the locations which remained following the Stage 3 preliminary assessment and subjecting them to a more detailed MCA analysis to decide on a preferred station location.

The characteristics and potential environmental impacts of each station location have been assessed against the following criteria:

<b>Economy</b>	<b>The impacts of a transport investment on economic growth and competitiveness are assessed under the economic impact and economic efficiency criteria</b>
Safety	Safety is concerned with the impact of the investment on a number of transport related activities

Physical Activity	This relates to the health benefits derived from using different transport modes
Environment	Environment embraces a range of impacts such as emissions to air, noise and ecological and architectural impacts.
Accessibility and Social Inclusion	Accessibility and social inclusion embrace the notion that some priority should be given to benefits that accrue to those suffering from social deprivation, geographic isolation and mobility and sensory deprivation
Integration	Integration considers the extent to which the project being evaluated promotes integration of transport networks and is compatible with a range of Government policies, including national spatial and planning policy

Table 4.3: Stage 4 MCA sub criteria

The outcome of Stage 4 is presented in Section 5 which summarises the results of the MCA and Appendix B which contains a full assessment table.

5.1.4.1 Economy

For this assessment, it is assumed that the operating and maintenance cost of each station option is equal. However, the construction costs may vary depending on the location of the station having regard to the following;

- Indicative station construction costs;
- Ground level reinstatement costs;
- Major utility diversion costs;
- Other project infrastructure required at each location.

Estimates of these costs for each station location are used to differentiate between each station option.

5.1.4.2 Environment

The MCA assessment has regard to all the environmental sub-criteria identified in Table 4.3 below. As identified in Table 4.3 some criteria were not considered to differentiate between options as the environmental impacts were deemed similar.

	Included as a sub-criterion	Rationale	Assessment
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<p>Air &amp; Climate</p>	<p>Yes</p>	<p>It is considered that the project will have a largely positive impact on air quality and climate during the operational phase of the project due to modal shift from private vehicles to the MetroLink and the resultant reduction in emissions. However, there is potential for impacts on sensitive receptors during the construction phase due to emissions. Emissions of relevance during this phase include NOx and Particulate Matter (PM10).</p> <p>Each differentiator arose during construction phase and not operational phase.</p>	<p>Sensitive receptors identified within 100m of each station box location was considered for the purposes of this analysis to identify the potential impacts.</p> <p>St Stephens Green is considered as a single sensitive receptor. However, the degree of impact on St Stephen's Green is considered in this analysis as a proxy for the impact on the immediate environment during the construction phase.</p>
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	<b>Included as a sub-criterion</b>	<b>Rationale</b>	<b>Assessment</b>
Noise & Vibration	Yes	<p>It is not considered that the project will have a significant impact in terms of noise and vibration during the operational phase of the project due to modal shift from private vehicles to the MetroLink and the resultant reduction in noise. However, there is potential for impacts on sensitive receptors during the construction phase.</p> <p>Each differentiator arose during construction phase and not operational phase.</p>	<p>Sensitive receptors identified within 100m of each station box location was considered for the purposes of this analysis to identify the potential impacts.</p> <p>St Stephens Green is considered as a single sensitive receptor. However, the degree of impact on St Stephens Green is considered in this analysis as a proxy for the impact on the immediate environment during the construction phase.</p>
Resource & Waste Management	No	<p>For the purposes of this analysis the station box and excavation area required for each of the options assessed is assumed to be the same. As a result, the quantity of spoil material and/or waste generated will be similar for each option and is not considered to be a differentiator.</p>	Not applicable.
Biodiversity	Yes	<p>Each station box location will have potential to impact on local biodiversity within St Stephens Green.</p> <p>Each differentiator arose during construction phase and not operational phase.</p>	<p>The assessment undertaken for each of the station box locations is qualitative and entails the identification of the potential direct impacts on biodiversity within and surrounding St. Stephens Green Park.</p>
Agriculture	No	<p>The location of the station box is fully located within an urban setting with no potential impact of agricultural activity.</p>	Not Applicable
Non-Agricultural Properties	Yes	<p>Potential for direct impacts on a number of land holdings and properties.</p> <p>Each differentiator arose during construction phase and not operational phase.</p>	<p>The assessment consists of a count of the land holdings directly impacted by each station box location.</p>

	<b>Included as a sub-criterion</b>	<b>Rationale</b>	<b>Assessment</b>
Architectural Heritage	Yes	<p>Potential for direct impacts on several elements of architectural heritage during the construction and operational phases.</p> <p>Each differentiator arose during construction phase and not operational phase.</p>	A qualitative assessment of potential direct impacts from on elements of architectural heritage from each station box and associated construction works.
Archaeology	Yes	<p>Potential for direct impacts on several elements of archaeology arising from the construction phase and the location of station elements.</p> <p>Each differentiator arose during construction phase and not operational phase.</p>	The assessment consists of an analysis of directly impacted known archaeology and potential subsurface archaeology. It includes impacts on vegetation which forms part of the cultural heritage value of the park.
Landscape & Visual	Yes	<p>Potential for significant impacts on the landscape and visual amenity at St Stephens Green East.</p> <p>Each differentiator arose during construction phase and not operational phase.</p>	Assessment involved the qualitative assessment of visual impacts and includes an identification of significant tree loss within each location's construction area.
Soils & Geology	No	All station box locations potentially impact on the Urban soil association to the same geographical extent. All station box locations impact on Dark limestone and shale bedrock of the Lucan Formation to the same geographical extent.	Not Applicable.
Hydrology	No	There are no surface water features potentially impacted by any of the station box locations. There is known to be an historical channel crossing the east of St Stephens Green to the lakes in the green. However, OPW identified that this channel does not act as a water source for the lakes at St Stephens Green.	Not Applicable

	<b>Included as a sub-criterion</b>	<b>Rationale</b>	<b>Assessment</b>
Hydrogeology	No	There are no known groundwater wells or springs impacted by any of the station box locations. All station box locations impact on a locally important aquifer to the same geographical extent.	Not Applicable
Traffic and transport	Yes	<p>Potential for significant impact on traffic and transport during construction depending of station box location for each option. Long term operational impacts were not considered a differentiator. Provision of location has similar positive impacts in the long term.</p> <p>Each differentiator arose during construction phase and not operational phase. Reestablishment was not considered to have long term traffic impacts.</p>	Assessment consists of modelling of impacts on surrounding road network. It also assesses impacts on public transport and the Dublin City Council Heavy Goods Vehicles (HGV) strategy, cyclists and pedestrians.
Utilities	Yes	<p>Potential for impacts on several utilities that require diversion to construct the station box.</p> <p>Each differentiator arose during construction phase and not operational phase.</p>	The assessment involved identifying the utilities present that are potentially affected by each option.
Population and Human Health	Yes	<p>Potential Socio-Economic impacts for each option.</p> <p>Each differentiator arose during construction phase and not operational phase.</p>	The assessment involved a qualitative classification of negative impacts, largely during the construction phase. An assessment of the operational benefits was also undertaken.
Radiation and Stray Current	No	Not a differentiator as there is no potential for impacts on sensitive receptors.	Not Applicable.

Table 4.3: Environmental MCA Sub-Criteria

#### 5.1.4.3 Sub-criteria not assessed

DTTAS 2016 contains to criteria for Safety, Accessibility, Social inclusion, Physical Activity and Integration. These were not assessed as the study area is within a relatively small geographical area and the operational similarities of the options under consideration would most likely result in the assessment results being neutral.

The Safety sub-criterion is primarily included in DTTS 2016 to allow an assessment between modes of transport and has a focus on collision reduction. As this report focusses on station locations within a metro system this criterion is not relevant.

Physical Activity is considered neutral in the context of the Stage 4 appraisal as all options use the same transport mode and will deliver similar health benefits for users.

The criterion for Accessibility & Social Inclusion focusses on the role public transport plays in respect to vulnerable groups and deprived geographical areas. Typically, this criterion is relevant at project level where route selection can play a role in providing public transport access to those who need it most. This report focusses on a small geographical area where assessment options will not differentiate and therefore the sub criteria was not assessed.

For the purpose of this assessment public transport Integration was not considered as a key criterion. Each station location is not considered to differentiate in terms of integration as it focusses on a small geographical area.

For each criterion, the options were compared against how well they deliver on the criteria description using a five-point scale, ranging from an overall very good performance to an overall very poor performance. This five-point scale is colour coded as presented in Table 4.4, with advantageous options being marked green and disadvantaged options marked red.



Colour	Description
	Overall very good performance against the criteria
	Overall good performance against the criteria
	Overall moderate performance against the criteria
	Overall poor performance against the criteria
	Overall very poor performance against the criteria

Table 4.4 Options assessment colour coding description

## 6 Stage 1: Review of the Receiving Environment

### 6.1 Introduction

The overall study area for this assessment is presented in Figure 1.1. This chapter presents a description of the study area having regard to both constraints and opportunities to the provision of a station in the general area of St Stephens Green East having regard to the proposed alignment defined in ARUP (2018). The principal constraints and opportunities to the development of a proposed MetroLink station at this location are as follows:

- St Stephens Green Park;
- Traffic and Transport;
- Utilities;
- Archaeology;
- Architectural Heritage;
- Streetscape and Visual Amenity, and;
- Buildings.

These constraints were selected by utilising Table 4.3 which identified impacts relevant to options selection.

### 6.2 St Stephen's Green Park

St. Stephen's Green Park is a busy green space situated at the southern end of Grafton St. Historically the name St Stephen's Green originates from a church called St Stephen's in the area that existed in the thirteenth century.

Attached to the church was a leper hospital. Around this time the area was a marshy piece of common ground, which extended as far as the River Dodder and was used by the citizens of the city for grazing livestock.

In 1663 the City Assembly decided that the plot of ground could be used to generate income for the city and a central area of twenty-seven acres (10.9 hectares) was marked out which would define the park boundary, with the remaining ground being let out into ninety building lots. Rent generated was to be used to build walls and paving around the Green. Each tenant also had to plant six sycamore trees near the wall, in order to establish some privacy within the park. In 1670 the first paid gardeners were employed to tend to the park. The layout was altered and re-landscaped in the late 1880's and made available to the public. The layout that was achieved during this period is largely what is in place today. The perimeter of the eastern side of the park is vegetated by a combination of mature trees (including several significant specimens of Oak, London Plain and Elm) and shrubs.

St Stephen's Green Park is a designated National Monument (RMP DU018-020334-) and is governed by the St Stephen's Green (Dublin) Act, 1877 which gives responsibility to the Office of Public Works to manage the park.

The eastern boundary of the National Monument is the edge of the footpath where it meets St Stephen's Green East. Protected structures within the curtilage of the National Monument are discussed in Section 5.6 below. This is the focal point of the park impacted by the proposed Project.

### 6.3 Utilities

There are several utilities known to be situated within the road corridor and footpath of St Stephen's Green East. These include:

- An 1800mm brick "egg shaped" Victorian sewer situated in central position running north south 3.m beneath the road surface;
- A 1710mm reinforced plastic mortar egg shaped sewer situated beneath the surface of Hume Street that joins the St Stephen's Green East sewer described above where the streets intersect;
- Water mains beneath the cycle lane on the western side of St Stephen's Green East;
- ESB high voltage cable beneath the cycle lane on the western side of St Stephen's Green East;
- Gas mains, Eir and ESAT/British Telecom cables beneath the traffic lanes of St Stephen's Green East;
- Water mains, ESB High Voltage and Eir cables beneath the eastern footpath of St Stephen's Green East.

There are no utilities under the western footpath of St Stephen's Green East which is within the National Monument boundary of St Stephen's Green Park.

### 6.4 Transport and Transport

St. Stephen's Green East plays an important role in the city's transport network. It's designated as secondary street in the city's strategic pedestrian routes, and as a primary cycle route in the Greater Dublin Area Cycle Network Plan. It is also a busy route for vehicular traffic and is one of the designated HGV routes within the city

centre, which forms the City Centre HGV movement strategy for heavy goods vehicles. It is a busy artery for public transport services from the southeast of the city and further afield and is used by over 50 different PSO and commercial bus routes.

The role and importance of this street in the city's transport network is also expected to increase over the coming years. Under the BusConnects Core Bus Corridor Project, it will form part of the Bray to City Centre Core Bus Corridor, which will be upgraded to provide continuous bus priority in each direction. Under the Draft Network Redesign, it would be served by the high frequency cross-city E Spine between Ballymun and Stillorgan and F Spine between Finglas and Kimmage, as well as frequent route 7 between Charlestown and Dun Laoghaire.

## 6.5 Cultural Heritage: Archaeology

There is the potential for the subsurface remnants of a 17th Century perimeter wall and drainage ditch to be present at St Stephen's Green Park. These are likely to be near or on top of the existing perimeter wall of St Stephen's Green Park. Inside the park there are not expected to be significant archaeology present as the area has either been used for grazing or as park space.

Historical tramlines may also be present beneath the surface of St Stephen's Green East and these trams lines once operated on St Stephen's Green North, West and East.

## 6.6 Cultural Heritage: Architectural Heritage

As mentioned in Section 5.2 St Stephen's Green Park is a National Monument, an RMP and an RPS (RMP DU018:020334: RPS 7751-7761). The perimeter of the National Monument extends to the kerb line of the surrounding footpath.

Within the National Monument on its eastern boundary are several protected structures. These include:

- The fence railings and plinth (RPSs 7751);
- The bollards and lampposts which line the footpath (RPSs 7752);

The Wolfe Tone Monument, and the Hungry Heart Famine Memorial is situated on the south western edge of the plaza area that makes up the north eastern corner of St Stephen's Green Park. These are not protected structures but are significant and form part of the architectural heritage of the park.

There are ten protected buildings between Merrion Row and Leeson St Lower on St Stephen's Green East. These are also listed in Table 2.1. The primary constraint relating to the protected buildings is the potential for coal cellars to be present under the eastern footpath and carriageway of the St Stephen's Green East.

A complete list is provided in Table 5.1.

Building and Address	RPS number	reference
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39-40 St Stephen's Green East	7780
41 St Stephen's Green East	7781
42-43 St Stephen's Green East	7782
50 St Stephen's Green East	7783
51 St Stephen's Green East	7784
52 St Stephen's Green East	7785
53 St Stephen's Green East	7786
54 St Stephen's Green East	7787
55 St Stephen's Green East	7788
56 St Stephen's Green East	7789
Railings, gates and plinth walls of perimeter boundary on St. Stephen's Green	7751
Surrounding bollards and traditional-style lamp-posts	7752

Table 5.1 Protected structures on St Stephens's Green East

The mature vegetation, specifically the trees make up an important element of the cultural heritage value of St Stephen's Green Park which is viewed separately from biodiversity value.

## 6.7 Streetscape and Visual Amenity

The streetscape on St Stephen's Green East is dominated on the eastern side by a mixture of Georgian architecture and modern buildings. The protected buildings along St Stephen's Green East are listed in Section 5.6 above. St Stephen's Green Park lines western side of St Stephen's Green East.

The footpath on the western side of St Stephen's Green East is within the curtilage of the National Monument and contains:

- 17 street trees the eastern side of the park's perimeter fence. 13 of which are within the indicative construction areas for the proposed Project station locations.
- Protected structures as detailed in Section 5.6 which are situated on the footpath of St. Stephen's Green within the curtilage of the National Monument:
  - Railings, gates and plinth walls of perimeter boundary on St. Stephen's Green (RPSs 7751);
  - Surrounding bollards and traditional-style lamp-posts (RPSs 7752).

The area next to the perimeter fence of the park vegetated by an unbroken line made up of a mixture of trees and shrubs. These provide a visually impermeable barrier between the urban environment and the green space inside St Stephen's Green Park. A tree survey completed on the eastern side of St Stephen's Green Park identified a number of mature specimens present including dominant specimens including Oak, London Plane, Elm and Horse Chestnut.

## 6.8 Buildings

The buildings on the eastern side of St Stephens Green East are utilised for a range of uses. These include:

- Commercial office space including government departments
- An embassy;
- A bank;
- Hotels, and;
- Education facilities such as a secondary school and a college.

An art gallery and medical clinic are located on Ely place and Hume St respectively. Lower Baggot Street contains a variety of retail business, restaurants and bars.

As listed in Table 5.1 several the buildings on St Stephen's Green East are listed as protected structures primarily due to be example of Georgian architecture.

## 7 Stage 2: Identification and description of potential station locations

### 7.1 Introduction

Feasible station location options were developed for St. Stephens Green East having regard to the constraints identified in Stage 1 Review of Receiving Environment.

### 7.2 Outline Construction Methodology

The station box construction methodology employed is the same for each option. This is as follows:

- Establishment of the works area/site, site offices, compounds and security required;
- Site preparation including vegetation clearance required within the construction area;
- Removal of park elements including railings, bollards, lamp posts and monuments for storage;
- Utilities diversion;
- Excavation and construction of the station box;
- Construction of tunnels and associated structures such as lifts, escalators and sky lights;
- Installation of railway tracks;
- Installation of operating equipment;
- Fitting out of stations; and
- Finishing and landscaping including the replacement of any protected structures, monuments and vegetation.

The primary construction activity is to create an underground station box into which the tunnel connects, with an entrance located at the surface above the station. The station box will be constructed using the “top-down” cut and cover method. Cut and cover involves excavating the area required for the station from the surface down to the desired level before constructing the station and covering to reinstate the surface to the desired finish. Specifically, for St Stephen's Green Station this will involve the reinstatement of elements in a National Monument as detailed above including protected structures and trees.

For all locations in this report the station will have the following design elements:

- The station box size for St Stephen's Green is 113.5 long by 24.5m wide;
- An entrance/exit at the northern end of the station in the form of an escalator and canopy;
- Two lifts shafts one for passengers and one for the fire brigade;
- Seven ventilation or draught relief shafts;
- A line of five skylights on the surface.

An indicative construction area utilised for this report is 24.5 m and 172 m long. However, the construction area may alter as preliminary design and construction methodology is developed further. The construction areas will exclude the public and absorb affected footpaths, park area and roadways.



### 7.3 Intervention shaft

The tunnel design for the proposed Project must comply with appropriate fire safety standards. The single bore tunnel configuration requires evacuation shafts to allow safe egress from the tunnel. In an emergency, surface level is reached by evacuation shafts that are connected to the tunnel including, if necessary, an interconnection between the tunnel and the evacuation shaft. The Safety in Railway Tunnels document, SRT-TSI (EU Legislation), establishes a maximum distance between lateral and/or vertical emergency exits of 1000m.

Due to this requirement, a number of station location assessed in this report with a distance between Tara St and St Stephen's Green Station of more than 1000m require an intervention/ventilation shaft.

The works required to construct an intervention shaft, while less than the construction of a station box still require a significant engineering effort involving mobilisation of a substantial quantity of heavy machinery, materials and other equipment.

The size of the shaft would be between 10-15m diameter for the emergency access.

The availability of suitable locations for a shaft to be constructed and operated between St Stephen's Green and Tara St stations is limited given the built-up nature of the area. The tunnel alignment under the current design runs beneath public buildings including the National Museum of Ireland, Leinster House (House of the Oireachtas), Trinity College. There are also commercial and residential buildings between Pearse Street and Tara Street which the tunnel runs beneath that are of a density that limits open space for constructing a shaft.

Locating a suitable place to construct an intervention shaft in this section of the proposed Project is also challenging given the type of land use and potentially sensitive receptors in the vicinity. For the purposes of this report the most appropriate locations for the intervention shaft would be in open areas at the eastern end of Trinity College or on Merrion Square.

### 7.4 Summary of Proposed Station Locations

The locations below were developed having regard to the identified constraints within the study area as identified in Stage 1 Review of Receiving Environment detailed in Section 2 and 3 above and subjected to an initial assessment.

#### 7.4.1 Location 1

Location 1 is situated primarily within the carriageway of St Stephen's Green East as shown in Figure 6.1. The station box positioning has the following features:

- The station box western extent is situated directly in line with St Stephen's Green East Park's eastern fence;
- The eastern extent is situated in line with the footpath on the eastern side of St Stephen's Green East.

The indicative construction zone as shown in Figure 6.1 takes in the entire footpath of the eastern side of St Stephen's Green and encroaches approximately 12 m into St Stephens Green Park.

The Victorian sewer described under Section 5.3 under St Stephen's Green East will require diversion east (away from St Stephen's Green Park) to be situated under the footpath on the street's eastern side. The sewer situated under Hume Street joins the sewer running north/south under St Stephen's Green East. The station box has been located far enough south to avoid the point where these two sewers join. However, situating the station box to avoid the sewer makes the distance between Stephen's Green and Tara Street Stations greater than 1000m resulting in the need for an intervention shaft at either Trinity College or Merrion Square.

By locating the station further south the station entrance/exit can be situated so it does not clash with the Hume St junction with St Stephen's Green East.

For this location St Stephen's Green East would be closed to through traffic and pedestrians during construction. The entire area within the indicative construction area shown in Figure 6.1 will be closed to the public including areas of St Stephen's Green Park. Vegetation will be cleared within the construction area and elements of the park including railings and bollards will be removed and stored for replacement.

The proposed construction methodology as described in Section 6.1 will involve full reinstatement of the road surface and all elements of the park boundary and footpath including protected structures as detailed in Section 5.6.

On completion there would be permanent elements of the station present on the surface. These include lifts for passengers and the fire brigade. Ventilation shafts and sky lights would be present and the entrance to the station including elevators and signage. Where possible the lifts and shafts would be located on the footpath outside of the park. The skylights would be situated within the perimeter of the park as will some ventilation shafts.

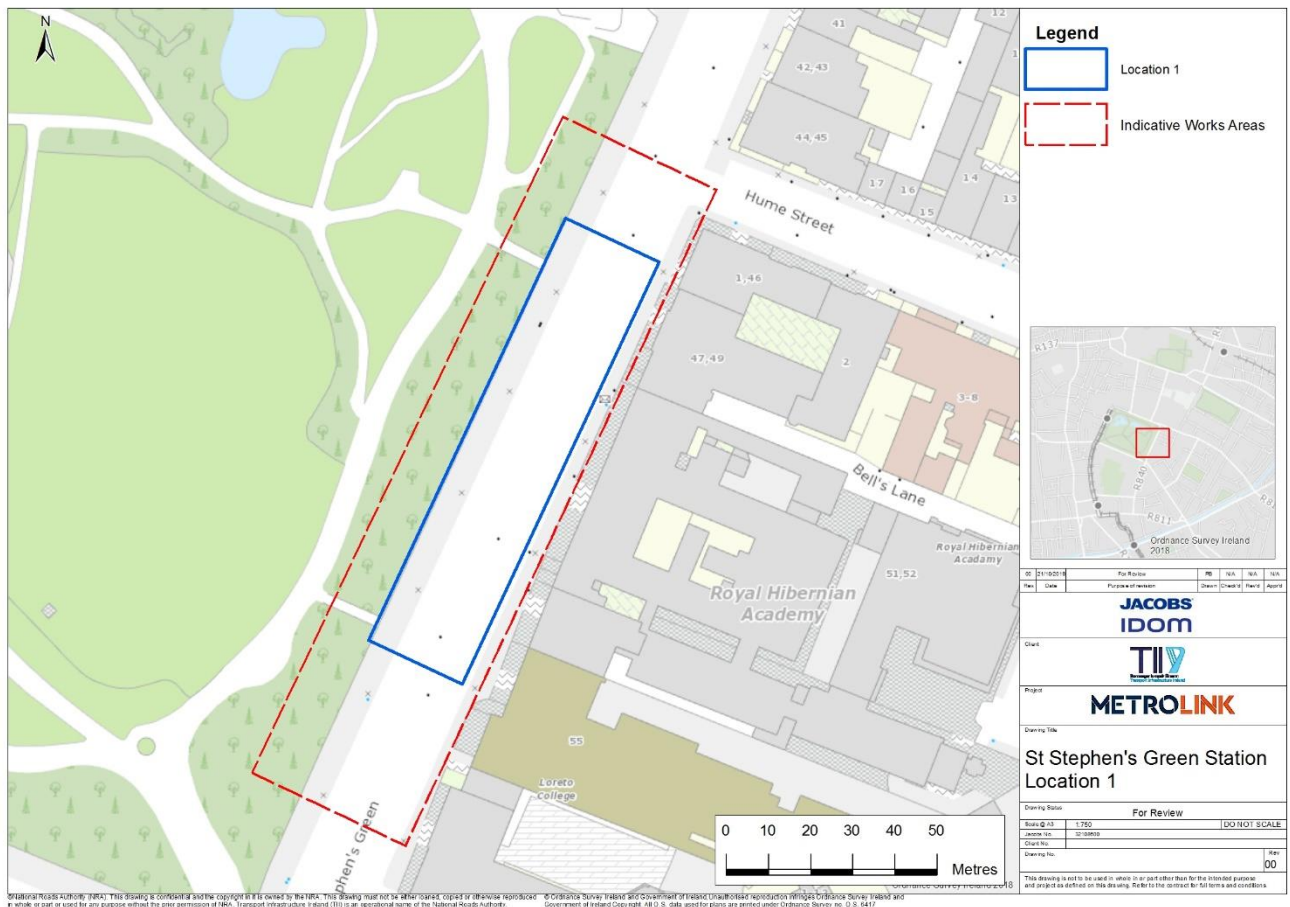


Figure 6.1: Location 1 Station box and indicative construction zone

### 7.4.2 Location 2

The potential station Location 2 station box is situated further west than Location 1. While it is situated partially within St Stephen's Green East and partially within St Stephen's Green Park the location allows for an additional lane of traffic to remain open during construction. This position is shown in Figure 6.2 and the station box location therefore has the following features:

- The central axis and the tunnel sit slightly west of the eastern perimeter fence of St Stephen's Green Park;
- The western extent is situated approximately 17m west of the perimeter fence of St Stephen's Green Park;
- The station box eastern extent is situated so it aligns with the closest traffic lane to St Stephen's Green Park.

The indicative construction zone as shown in Figure 6.2 is situated so its eastern boundary is west of the centre of St Stephen's Green East's carriageway and encroaches approximately 27m into St Stephen's Green Park.

Location 2 does not require the sewer under St Stephen's Green East to be diverted. The sewer situated under Hume Street which joins this sewer is also not impacted.

The station box is situated far enough south to avoid the sewer junction at Hume St but the distance between Stephen's Green and Tara Street Stations is greater than 1000m resulting in the need for an intervention shaft at either Trinity College or Merrion Square.

During construction St Stephen's Green East would be partially closed to through traffic with two northbound traffic and one southbound bus lane remaining open. Using the indicative construction area pedestrian access along the eastern footpath would remain open. The entire area within indicative construction area shown in Figure 6.2 would be closed to the public including St Stephen's Green Park. Vegetation would be cleared within the construction area and elements of the park including railings and bollards will be removed and stored for replacement.

The proposed construction methodology would involve full reinstatement of the road surface and all elements of the park boundary and footpath including protected structures as detailed in Section 5.6 and 6.1.

On completion there would be permanent elements of the station present on the surface. These include lifts for passengers and the fire brigade. Ventilation shafts and sky lights would be present within the park and the entrance to the station including elevators and MetroLink signage. Where possible the lifts and shafts would be located on the footpath outside of the park. The skylights would be situated within the perimeter of the park as will some ventilation shafts.

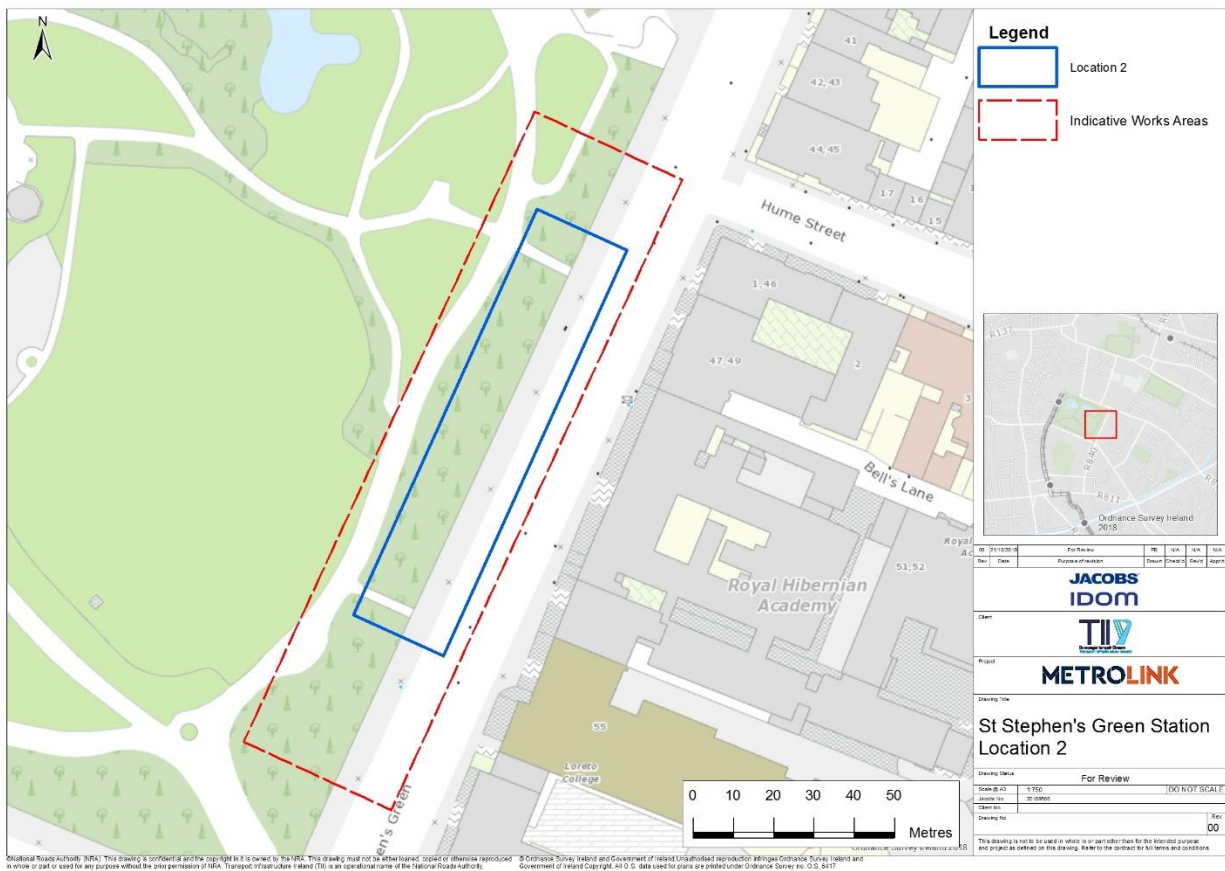


Figure 6.2: Location 2 Station box and indicative construction zone

### 7.4.3 Location 3

Potential Station Location 3 would be situated entirely within St Stephen's Green Park as shown in Figure 6.3 and is, in turn, located further west than Location 2. This location is designed to avoid St Stephen's Green East carriageway and the footpath and protected structures that are situated there. This position is shown in Figure 6.3 and the station box location therefore has the following features:

- The station box central axis and the tunnel sit approximately in line with the pathway that runs in a north-south direction within the north-eastern portion of St Stephen's Green Park;
- A southern extent positioned north of a pathway that leads to a secondary park exit;
- A northern extent that is situated where there is a junction in the internal pathway between the path that circumnavigates the park and the path leading to the plaza containing the Wolfe Tone statue;

The indicative construction zone as shown in Figure 6.3 is situated so its eastern boundary is just within park's perimeter fence and encroaches approximately 40m into St Stephens Green Park.

As Location 3 is situated within St Stephen's Green Park it is situated far enough west to not require the diversion of utilities within the carriageway of St Stephen's Green East.

The station box and indicative construction area are situated far enough south avoid the north eastern plaza and the monuments situated there. However, this means the distance between St. Stephen's Green and Tara Street Stations is greater than 1000m resulting in the need for an intervention shaft. at either Trinity College Dublin or Merrion Square.

During the construction phase, St. Stephen's Green East will remain open. Using the indicative construction area pedestrian access along the eastern and potentially the western footpaths of St. Stephen's Green East would remain open. The entire area of park within indicative construction area shown in Figure 6.3 would be closed to the public for the construction phase. Vegetation would be cleared within the construction area and elements of the park including railings and bollards would be removed and stored for replacement on completion. The proposed construction methodology would involve full reinstatement of the park surface and all elements of the park boundary impacted detailed in Section 5.6 and 6.1.

On completion there would be permanent elements of the station present within the park. These include lifts for passengers and the fire brigade. Ventilation shafts and sky lights would be present and the entrance to the station including elevators and MetroLink signage. The station box is situated too far west for lifts to be located on the footpath so these would need to be all within St. Stephen's Green Park.



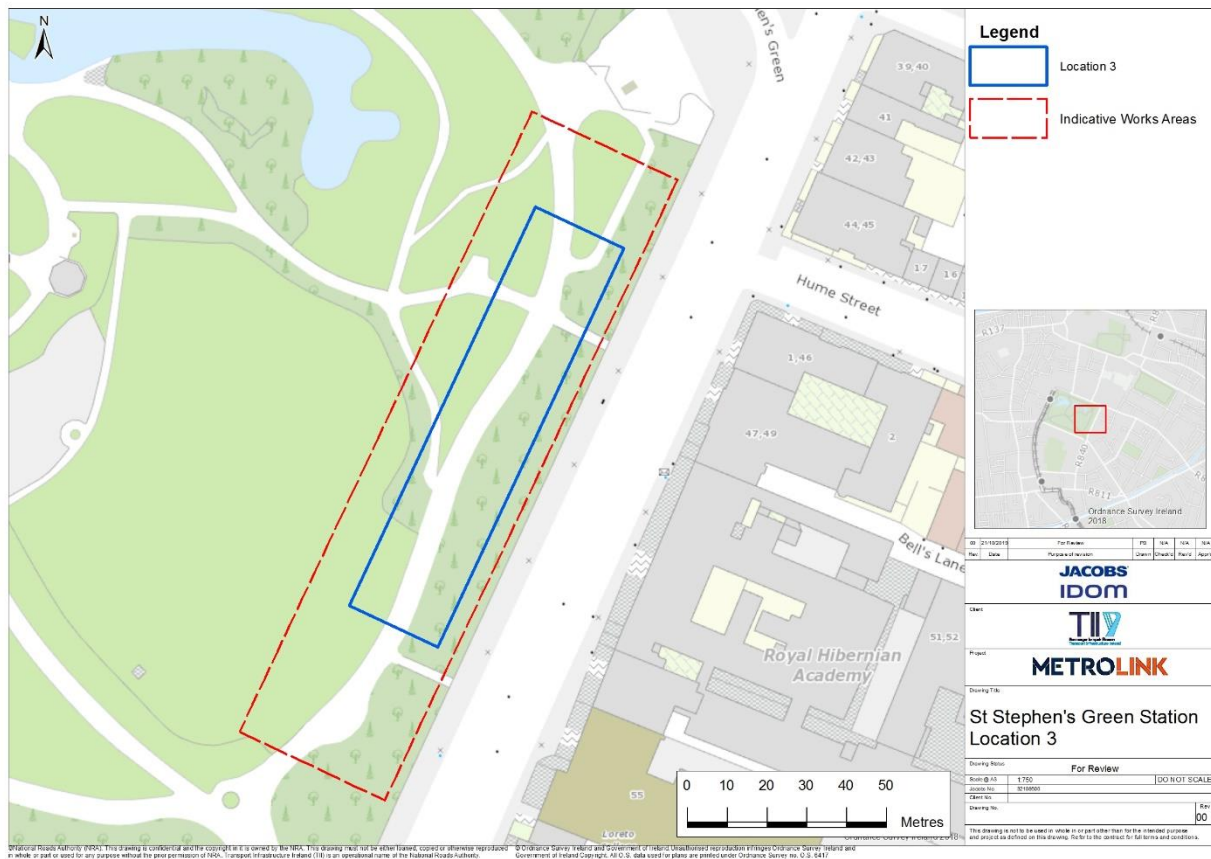


Figure 6.3: Location 3 Station box and indicative construction zone

#### 7.4.4 Location 4

Potential station Location 4 station box is situated in a similar east/west axis to Location 1 but is located 31m north. It is situated primarily within the carriageway of St Stephen's Green East as shown in Figure 6.4. This position is shown in Figure 6.4 and the station box location therefore has the following features:

- The station box western extent is situated directly in line with St. Stephen's Green East Park's eastern fence;
- The eastern extent is situated in line with the footpath on the eastern side of St. Stephen's Green East but also takes in the front steps of several properties on St. Stephen's Green East;
- The northern extent of the station box is located across the junction between Hume St and St. Stephen's Green East.

The indicative construction area as shown in Figure 6.4 takes in the entire footpath of the eastern side of St Stephen's Green and encroaches approximately 12 m into St Stephens Green Park. The north eastern corner of the construction area takes in the steps and accessways for several buildings on St Stephen's Green East.

The Victorian sewer described under Section 5.3 under St. Stephen's Green East would require diversion east (away from St. Stephen's Green Park) to be situated under the footpath on the street's eastern side. The sewer situated under Hume Street joins the sewer running north/south under St. Stephen's Green East. The station box is located at the point where these two sewers join meaning the Hume St sewer will also require diversion east.

As discussed in Section 6.1 St. Stephen's Green East would be closed to through traffic and pedestrians during construction. The right turn from Hume St to St. Stephen's Green East would also be closed to through traffic. The entire area within the indicative construction area shown in Figure 6.4 would be closed to the public including areas of St. Stephen's Green Park. Vegetation would be cleared within the construction area and elements of the park including railings and bollards would be removed and stored for replacement. Location 4 construction area is situated on the eastern side of plaza that makes up the north eastern corner of St. Stephen's Green Park.

The proposed construction methodology would involve full reinstatement of the road surface and all elements of the park boundary, footpath and steps including protected structures as detailed in Section 5.6 and 6.1.

On completion there would be permanent elements of the station present on the surface. These include lifts for passengers and the fire brigade. Ventilation shafts and sky lights would be present and the entrance to the station including elevators and signage. Where possible the lifts and shafts would be located on the footpath outside of the park. The skylights would be situated within the perimeter of the park as will some ventilation shafts.

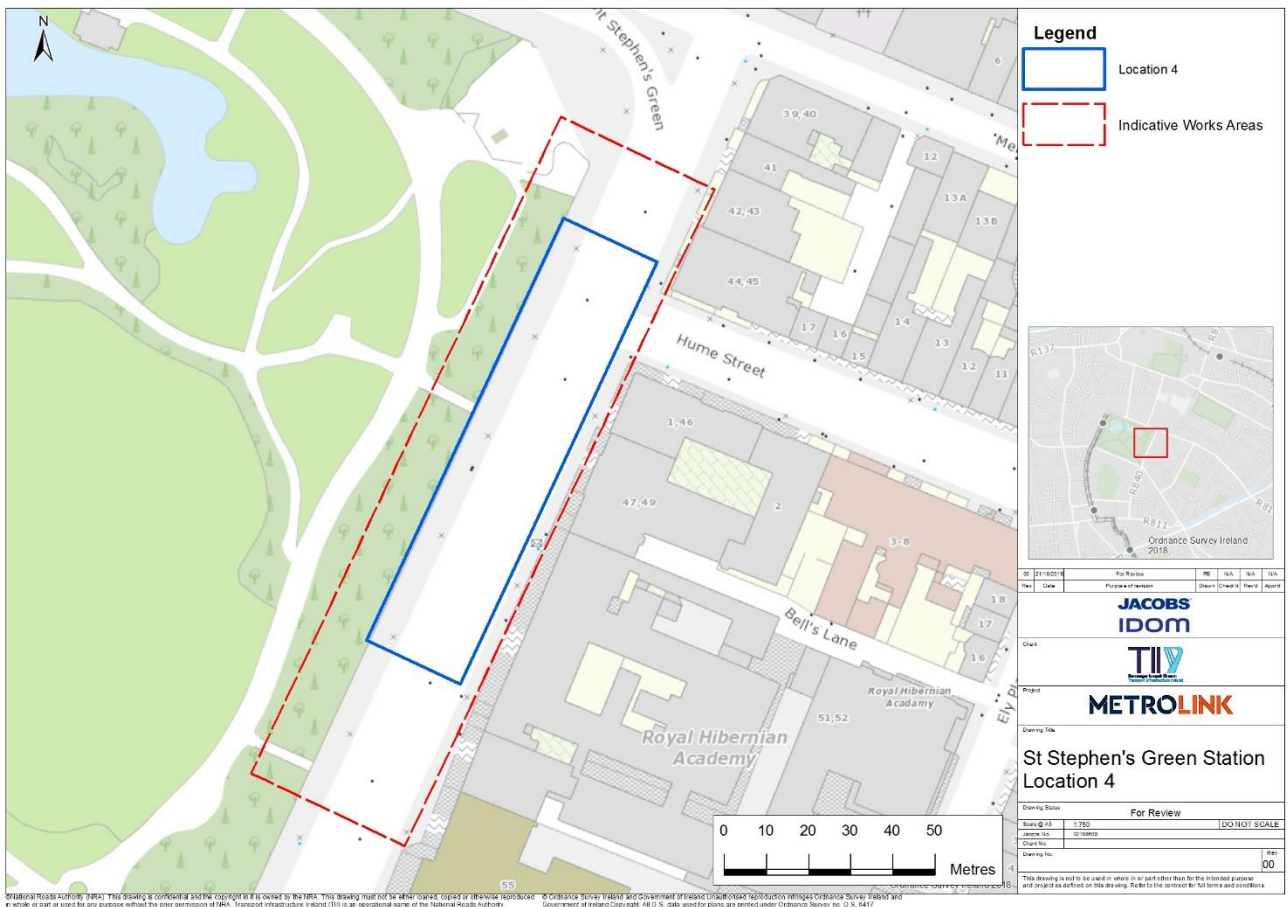


Figure 6.4: Location 4 Station box and indicative construction zone

### 7.4.5 Location 5

Location 5 is situated partially within St. Stephen's Green East and partially within St. Stephen's Green Park. However, the location allows for three lanes of traffic to remain open during construction. This position is shown in Figure 6.7 and the station box location therefore has the following features:

- The central axis and the tunnel sit slightly west of the eastern perimeter fence of St. Stephen's Green Park;
- The western extent is situated approximately 17m west of the perimeter fence of St. Stephen's Green Park;
- The station box eastern extent is situated so it aligns with the closest traffic lane to St. Stephen's Green Park.

The indicative construction zone as shown in Figure 6.5 is situated so its eastern boundary is west of the centre of St Stephen's Green East's carriageway and encroaches approximately 27m into St Stephens Green Park. It takes in the Wolfe Tone statue and Hungry Heart memorial locations.

Location 5 does not require the sewer under St Stephen's Green East to be diverted. The sewer situated under Hume Street which joins this sewer is also not impacted.

During construction St Stephen's Green East would be partially closed to through traffic with two northbound traffic and one southbound bus lanes remaining open. Using the indicative construction area pedestrian access along the eastern footpath would remain open. The entire area within indicative construction area shown in Figure 6.5 would be closed to the public including St Stephen's Green Park. Vegetation would be cleared within the construction area and elements of the park including railings and bollards will be removed and stored for replacement. The Wolfe Tone statue and Hungry Heart memorial are located within the indicative construction area.

The proposed construction methodology would involve full reinstatement of the road surface and all elements of the park boundary and footpath including protected structures as detailed in Section 5.6 and 6.1.

On completion there would be permanent elements of the station present on the surface. These include lifts for passengers and the fire brigade. Ventilation shafts and sky lights would be present and the entrance to the station including elevators and MetroLink signage. The entrance would be situated on the southern edge of the plaza that makes up the north eastern corner of St Stephen's Green Park and incorporated into the park entrance on completion. Where possible the lifts and shafts would be located on the footpath outside of the park. The skylights would be situated within the perimeter of the park as will some ventilation shafts.

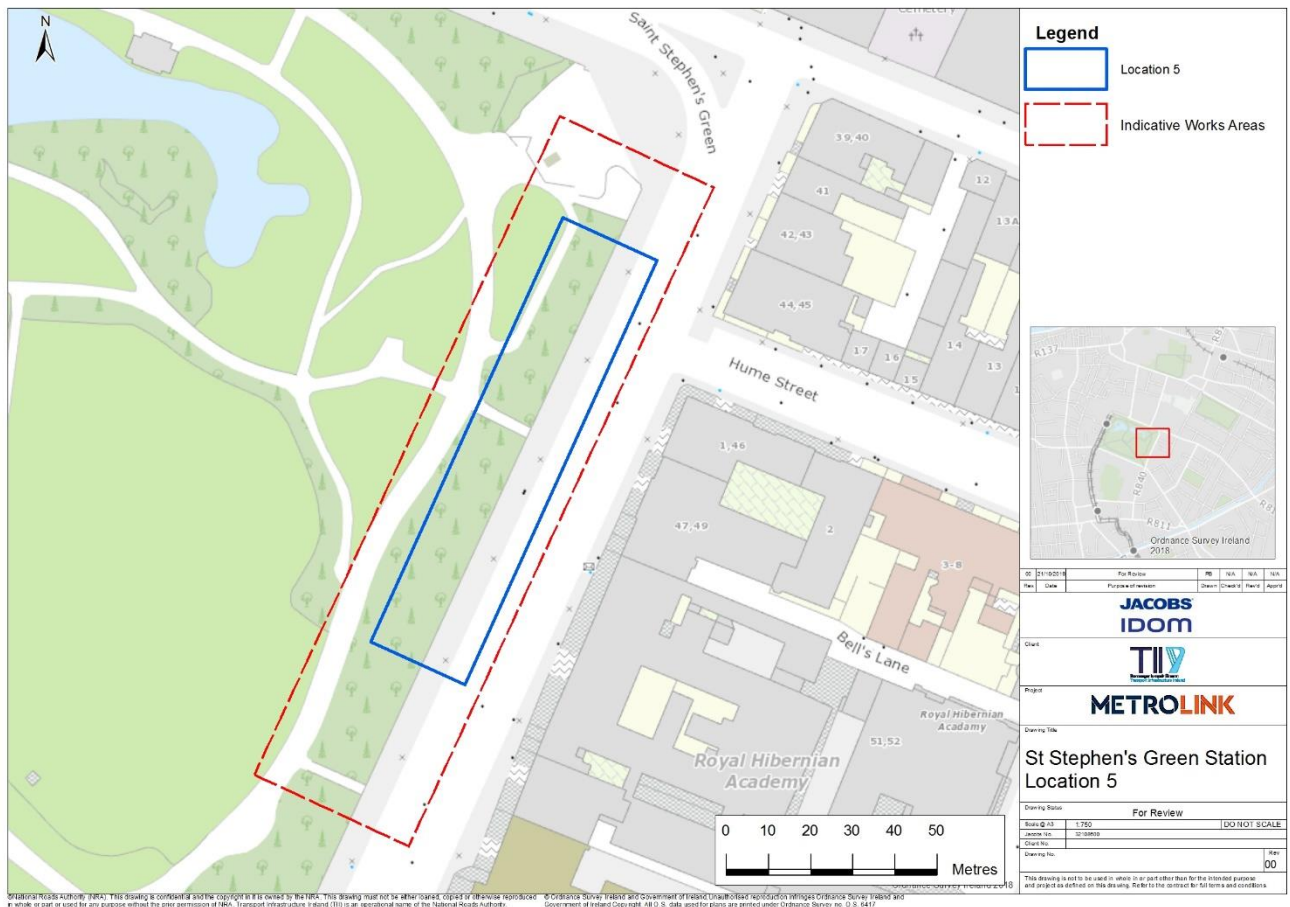


Figure 6.5: Location 5 Station box and indicative construction zone

### 7.4.6 Location 6

The station box for this option is situated entirely within St. Stephen's Green Park as shown in Figure 6.6. This location is designed to avoid St. Stephen's Green East road, the footpath and protected structures that are situated there. The station box location therefore has the following features:

- The station box central axis and the tunnel sit approximately in line with the pathway that runs in a north-south direction within the north-eastern portion of St. Stephen's Green Park;
- A southern extent positioned north of a pathway that leads to a secondary park exit;
- A northern extent situated next to southern edge of the Hungry Heart memorial.

The indicative construction zone as shown in Figure 6.6 is situated so its eastern boundary is just within park's perimeter fence and encroaches approximately 40m into St Stephens Green Park. The station box and indicative construction area envelop the north eastern plaza and the monuments situated there.



As Location 6 is situated within the St Stephen's Green Park and does not require the diversion of any utilities.

During construction St. Stephen's Green East would remain open. Using the indicative construction area pedestrian access along the eastern and potentially the western footpaths of St. Stephen's Green East would remain open. The entire area of park within indicative construction area shown in Figure 6.6 would be closed to the public. Vegetation would be cleared within the construction area and elements of the park including railings and bollards would be removed and stored for replacement as necessary.

The proposed construction methodology would involve full reinstatement of the park surface and all elements of the park boundary impacted detailed in Section 5.6 and 6.1.

On completion there would be permanent elements of the station present within the park. These include lifts for passengers and the fire brigade. Ventilation shafts and sky lights would be present and the entrance to the station including elevators and MetroLink signage. This location would affect the interior concept design of the station as skylights would potentially not be feasible so far into the park. Accesses could be moved away to the north corner but still the potential to require changes to the north eastern access to St Stephen's Green.



Figure 6.6: Location 6 Station box and indicative construction zone



## 8 Stage 3: Preliminary Analysis

### 8.1 Introduction

The six options described in Section 6 have been subjected to a preliminary analysis to ascertain if they are feasible and should be subjected to further assessment. The methodology used to undertake the preliminary “sift” against the relevant sub-criteria is described in full in Section 3: Methodology. The full results of the preliminary analysis are shown in Appendix A: Preliminary Analysis which should be read in conjunction with the summary outputs presented here.

### 8.2 Appraisal of Options

#### 8.2.1 Location 1

As described in Section 6.5 and shown in Figure 6.1, Location 1 is situated primarily within the road corridor of St Stephen's Green East.

##### 8.2.1.1 Project Objectives

Location 1 performs poorly against the Project Objective which requires the “design to integrate appropriately into the existing public realm”. This is due to the requirement to construct an additional intervention shaft between location 1 and Tara St. Due to the sensitive nature of potential intervention shaft locations at Trinity College and Merrion Square an intervention shaft would be intrusive on the urban realm at these locations and should be avoided where possible.

At this station location the need for significant utility diversions and traffic diversions during construction means that this location performs poorly against the project objective requiring “the project to be planned, constructed and operated in an environmentally sustainable manner”.

##### 8.2.1.2 Economy

Constructing the station at this location would increase the construction cost of a typical station box by approximately 10%. These additional costs are associated with requirements to reinstate the road surface and divert utilities. The need to construct an additional intervention shaft, would increase the overall cost by approximately 25% above the cost of a typical station box. These additional costs result in this option performing poorly against the economy criteria.

##### 8.2.1.3 Environment

This location requires the full closure of St. Stephen's Green East road during the construction phase, including its junction with Hume Street. This would prevent existing traffic movements from St Stephen's Green East to Kildare Street and Merrion Row during the construction phase.

The 1800mm Victorian sewer situated below St. Stephen's Green East would need to be diverted into the eastern footpath during construction. This would be technically difficult to achieve and result in potential impacts on

cellars of protected buildings situated below St Stephen's Green East and the footpath. It would also result in a longer construction period and associated impacts on sensitive receptors due to noise & vibration and air quality impacts.

This option would require an intervention shaft resulting in additional environmental impacts at the intervention shaft location.

There is potential for long term effects related to landscape and visual impacts due to the felling of trees at St Stephens Green East. This is due to the period required to re-establish trees and other vegetation following construction at St Stephens Green East. Furthermore, a number of station elements such as ventilation and lift shafts would be located within the footpath along St Stephens Green East which could impact the visual amenity.

#### 8.2.1.4 Engineering

The relevant engineering criterion is constructability. As this option requires an additional intervention shaft significant additional construction risk would be associated with the provision of this station location.

The characteristics of the Victorian sewer to be diverted including age and depth make a diversion of this to allow the construction of the station box technically challenging.

#### 8.2.1.5 Conclusion

Due to the significance of potential impacts particularly due to the need for an additional intervention shaft, significant utility diversions and traffic impacts Location 1 performed poorly against the environmental criteria. The engineering challenges associated with the intervention shaft construction and sewer diversion mean this option performs poorly against the engineering criteria also. Furthermore, there would be potential for additional costs of up to 35% of the total cost due to the requirement for an intervention shaft and significant utility diversions. Therefore, it was not considered to be a viable option and was not progressed to the Stage 4 MCA.

### 8.2.2 Location 2

The station Location 2 shown in Figure 6.1 allows the 1800mm existing sewer to be maintained in its current location which is an advantage over Location 1 which requires its diversion.

#### 8.2.2.1 Project Objectives

Location 2 performs poorly against the Project Objective requiring the "design to integrate appropriately into the existing public realm". This is due to the requirement to construct an additional intervention shaft at a sensitive location between location 3 and Tara St that could be avoided.

The requirement for an additional intervention shaft combined with direct impacts on St. Stephen's Green also results in poor performance against the project objective requiring "the project to be planned, constructed and operated in an environmentally sustainable manner".

#### 8.2.2.2 Economy

Constructing the station at this location increases the construction cost of a typical station box by approximately 7%. These additional costs are associated with factors such as reinstating road and footpath surfaces, park landscaping and diversion of minor utilities. The need to construct an additional Intervention Shaft, would increase the overall cost by approximately 25% above that of a typical station and therefore results in poor performance against the economy criterion.

#### 8.2.2.3 Environment

St. Stephen's Green East road would be partially closed during construction. While there would be impacts to traffic flows due to reduced capacity along St. Stephen's Green East, existing bus routes and the designated HGV route integrity could be maintained. There would also be minimal impact on pedestrian and cyclist movements.

This station location is partially located within the road corridor and St Stephen's Green Park. However, the station box and indicative construction area would have a direct impact on St Stephen's Green Park to a greater extent than Location 1. The protected structures directly impacted include railings and plinth (RPSs 7751) and bollards and lampposts (RPSs 7752). Undiscovered subsurface archaeology would also be potentially impacted.

There would be direct impacts on existing trees and vegetation within St Stephen's Green East including the requirement to remove mature trees. This would have potential biodiversity impacts arising from the loss of habitat within the park, specifically bat and bird habitat. Furthermore, tree removal would also have landscape and visual impacts.

#### 8.2.2.4 Engineering

As this option would require an intervention shaft resulting in impacts on potential intervention shaft sites. These will be inevitably be constrained, sensitive locations adding significant construction risk and reducing performance against the constructability criterion.

However, the Victorian sewer is maintained allowing this location to achieve a moderate performance against the engineering criteria.

#### 8.2.2.5 Conclusion

Despite a moderate performance against the engineering criteria, the failure to deliver against the environment and economy criteria particularly due to the intervention shaft and direct impacts on St Stephens' Green Park means Location 2 was not considered to be a viable option.

### 8.2.3 Location 3

The station box for Location 3 would be constructed entirely within St. Stephen's Green Park as described in Section 6.7 and therefore primary impacts relate to the station footprint impacts on the park.

#### 8.2.3.1 Project Objectives

Location 3 performs poorly against the Project Objective requiring the “design to integrate appropriately into the existing public realm”. This is due to the requirement to construct an additional intervention shaft at a sensitive location between Location 3 and Tara St that could be avoided.

The requirement for an additional intervention shaft combined with direct impacts on St. Stephen's Green also results in poor performance against the objective requiring the project to be planned constructed and operated to be environmentally sustainable.

#### 8.2.3.2 Economy

Constructing the station within the St. Stephens Green is the most economical of Locations 1-3, as none of the additional construction costs associated with road and utility reinstatement would be incurred. The need to construct an additional Intervention Shaft, would increase the overall cost by approximately 25% which results in poor performance against the economy criteria.

#### 8.2.3.3 Environment

Traffic flows on St. Stephen's Green East would not be directly impacted during construction.

As the station box and indicative construction area are located entirely within St. Stephen's Green Park there would be more significant direct impacts than for other options including:

- Potential for protected structures to be impacted including railings and plinth (RPSs 7751) and bollards and lampposts (RPSs 7752). Any undiscovered subsurface archaeology would be potentially impacted.
- Direct impacts on vegetation within St. Stephen's Green East including removal of mature trees. This would have biodiversity impacts arising from the loss of habitat within the park, having specific regard to suitable habitat for bat and bird species.
- Landscape & visual impacts due to the felling of a number of trees.
- The impacts on St. Stephen's Green Park overall are more significant for this option as the station box and indicative construction area would take up a larger part of the park than Locations 1 and 2. This coupled with the requirement for an intervention shaft deliver a poor performance against the environment criteria.

#### 8.2.3.4 Engineering

As this option requires an additional intervention shaft to be provided creating impacts on potential sensitive locations between this location and Tara St Station it delivers poor performance against the engineering criterion of constructability. These locations are constrained and sensitive adding significant construction risk

#### 8.2.3.5 Conclusion

This option performs moderately against the engineering criteria. However, due to the overall poor performance against the environment and cost criteria this location was not considered to be viable overall.

#### 8.2.4 Location 4

As described in Section 6.8, Location 4 is situated within the road corridor of St Stephen's Green East. It is similar to Location 1, but is moved further north along St Stephens Green East to avoid the requirement for an Intervention Shaft between St Stephens Green East and Tara St.

##### 8.2.4.1 Project Objectives

Location 4 performs poorly against the Project Objective that requires the project "to be planned, controlled and operated in an environmentally sustainable manner". This is primarily due to construction phase impacts associated with the diversion of the Victorian Sewer under St. Stephen's Green East and Hume St and associated traffic disturbance.

Location 4 performs moderately against the Project Objective requiring the "design to integrate appropriately into the existing public realm". Initial design would require integration with the protected features of the National Monument. Sensitive design of station "pop ups" and other elements to ensure appropriate replacement of protected structures would be required.

##### 8.2.4.2 Economy

Constructing the station under St. Stephen's Green East increases the construction cost of a typical station box by approximately 10%. These additional costs are associated with factors such as reinstating the road surface and diversion of utilities. This additional cost delivers a moderate performance against the criteria.

##### 8.2.4.3 Environment

This location would require the full closure of St. Stephen's Green East during the construction phase, including its junction with Hume Street. This would prevent existing traffic movements from St Stephen's Green East to Kildare Street and Merrion Row.

The 1800mm Victorian sewer situated below St. Stephen's Green East would need to be diverted into the eastern footpath during construction. The sewer under Hume Street that joins the sewer under St. Stephen's Green East would also require diversion. This would be technically difficult to achieve and result in impacts on cellars of protected buildings situated below St. Stephen's Green East and the footpath. The sewer diversion would also result in a longer construction period and associated impacts such as noise and air quality.

The eastern extent indicative construction area would have direct impact on the steps and accessways of several protected structures on St. Stephen's Green East during the construction phase. These are:

- 42-43 St. Stephen's Green East (RPSs 7782)

- 50 St. Stephen's Green East (RPSs 7783)

The proximity of construction to these properties has potential exacerbate impacts such as those related to noise and vibration and air quality. These factors all trigger a poor rating against the environment criteria.

#### 8.2.4.4 Engineering

The characteristics of the Victorian sewer make the required diversion to allow the construction of the station box technically challenging and therefore it performs poorly against engineering criterion of constructability. It is an old, relatively large egg-shaped sewer constructed of brick buried 3.5m below St. Stephen's Green East. Further risk exists in relation to traffic management, public safety and management of protected structures in a National Monument.

#### 8.2.4.5 Conclusion

This location offers poor performance against all criteria due to the significance of potential impacts on St. Stephen's Green Park, utilities, and traffic. Therefore, this location was not considered to be a viable and did not proceed to the Stage 4 MCA.

### 8.3 Location 5

As described in Section 6.9 Location 5 is situated partially within the road corridor of St. Stephen's Green East. It is similar to Location 2, but is moved further north along St Stephens Green East to avoid the requirement for an Intervention Shaft between St. Stephens Green East and Tara St.

#### 8.3.1.1 Project Objectives

Location 5 has a moderate performance against the project objective requiring the project to be planned, constructed and operated in an environmentally sustainable manner. The construction phase impacts could be significant on St. Stephen's Green Park particularly architectural heritage, archaeology, biodiversity and landscape impacts. This is balanced by the reduction in impacts on utilities and on traffic during the construction phase.

Location 5 performs moderately against the Project Objective requiring the "design to integrate appropriately into the existing public realm". Sensitive design of station "pop ups" and other elements is required to ensure integration into the sensitive receiving environment.

#### 8.3.1.2 Economy

Constructing the station partially under St Stephen's Green East increases the construction cost of a typical station box by approximately 7%. These additional costs are associated with factors such as reinstating the road surface and diversion of minor utilities and reinstatement of the park.



### 8.3.1.3 Environment

This location requires the partial closure of St. Stephen's Green East road. The carriageway that can be kept open to traffic will be enough to maintain flows of existing bus routes and other modes of road traffic. The DCC HGV Management Strategy in this part of the city would be maintained.

The 1800mm Victorian sewer situated below St. Stephen's Green East would not need to be diverted.

The station box and indicative construction area for this Location would also have a direct impact on St Stephen's Green Park including:

- The protected structures including railings and plinth (RPSs 7751) and bollards and lampposts (RPSs 7752)
- Undiscovered subsurface archaeology present;
- The plaza in the north eastern corner of St Stephen's Green Park including the Wolfe Tone statue and Hungry Heart memorial there.

There would be direct impacts on vegetation within St. Stephen's Green Park including removal of mature trees. This would have biodiversity impacts from the loss of habitat within the park, specifically bat and bird habitat.

Tree removal would also have visual impacts as the trees form a perimeter barrier between the park and the urban environment outside.

### 8.3.1.4 Engineering

This option performs well against the engineering sub-criteria for constructability as no major utility diversion is required.

### 8.3.1.5 Conclusion

While there are potential impacts on the receiving environment, utilities and traffic impacts, Location 5 was deemed to have performed sufficiently against the assessment criteria to warrant further assessment under the Stage 4 MCA process.

## 8.3.2 Location 6

As described in Section 6.10 Location 6 is situated entirely within the boundary St. Stephen's Green Park. The primary impacts during construction relate to archaeological and architectural heritage and visual impacts.

### 8.3.2.1 Project Objectives

Location 6 performs poorly against the Project Objective requiring construction and operation to be environmentally sustainable. The construction phase impacts would be very significant on St Stephen's Green Park particularly potential impacts on architectural heritage, archaeology, biodiversity and the landscape and

visual amenity. This is balanced by a reduction in impacts on traffic during the construction phase and construction phase impacts associated with the utility diversions required for other options.

Location 6 performs poorly against the Project Objective requiring the “design to integrate appropriately into the existing public realm”. Integrating station elements entirely within the park environment of St. Stephen's Green Park would be difficult to achieve without significant landscape and visual impacts.

#### 8.3.2.2 Economy

Constructing the station under St Stephen's Green East increases the construction cost of a typical station box by approximately 7%. These additional costs are associated with factors such as reinstating the road surface, the diversion of utilities and reinstatement of St Stephens Green.

#### 8.3.2.3 Environment

This location does not directly impact on St. Stephen's Green East road and as a result there would be no impacts on traffic or public transport arising from this option.

The 1800mm Victorian sewer situated below St. Stephen's Green East will not need to be diverted and as a result, potential construction phase impacts associated with this option would not occur.

As the station box and indicative construction area are entirely within St Stephen's Green Park there would be significant direct impacts on existing vegetation including mature trees. Additional potential impacts would include the following:

- The eastern extent of the indicative construction area would directly impact protected structures including: railings and plinth (RPSs 7751), bollards and lampposts (RPSs 7752) and St. Stephen's Green Park as a National Monument (DU018-020334-);
- Undiscovered subsurface archaeology present;
- The plaza in the north eastern corner of St Stephen's Green Park including the Wolfe Tone statue and Hungry Heart memorial there.

There would be direct impacts on vegetation within St Stephen's Green Park including the removal of mature trees. This would have biodiversity impacts from the loss of habitat within the park, specifically bat and bird habitat.

Tree removal would also have visual impacts as the trees form a perimeter barrier between the park and the urban environment outside.

#### 8.3.2.4 Engineering

This option performs well against the engineering sub-criteria of constructability but there is construction risk associated with working entirely within St Stephen's Green Park.

### 8.3.2.5 Conclusion

While there are potentially very significant impacts on St Stephens' Green Park, this option has advantages in not impacting traffic and utilities on St Stephen's Green East and lower costs of reinstatement post construction. Therefore, Location 6 was deemed to have performed well enough against the assessment criteria to warrant further assessment under the Stage 4 MCA process.

### 8.3.3 Stage 3 Preliminary Assessment Outcome

An appraisal table has been prepared and is shown below in figure 7.1. The table collates and summarises the appraisal of every option, under each of the assessment criteria.

The Overall Appraisal Summary Table for each option is presented in Appendix A.

Location	1	2	3	4	5	6
Project Obj	Red	Red	Red	Red	Yellow	Red
Economy	Red	Red	Red	Yellow	Yellow	Green
Environment	Red	Red	Red	Red	Yellow	Red
Engineering	Red	Yellow	Yellow	Red	Red	Yellow
Overall	Red	Red	Red	Red	Yellow	Yellow

Table 7.1: Summary of results of Stage 3 assessment

The results indicate Locations 1 to 3 perform poorly against the Economy appraisal criteria due to the need for an interventions shaft Locations 1-4 perform poorly against the Environmental appraisal criteria for the same reason but Location 4 also performs poorly against the this criteria due to impacts on traffic and utilities.

Location 5 performs moderately against all criteria specifically because it does not require an intervention shaft or the diversion of the Victorian sewer. While there are no appraisal criteria that this option performs well against it avoids the more severe constraints which is explained in more detail Section 7.2 and Appendix A. It is an "intermediate" option as it avoids more significant impacts on the sewer and traffic and the significant impacts on St. Stephen's Green Park that Locations 4 and 6 has respectively. On this basis it is recommended that Location 5 proceed to Stage 4 assessment.

Location 6 performs well against the Economy criterion as it is located entirely within the St Stephens Green Park and therefore avoids the more expensive reinstatement costs associated with road surfaces and utility diversions. The location within the park and associated direct impacts however drives poor performance against the Environmental criteria. However, it performs moderately well against the Engineering criterion as it does not

require utility and traffic diversions. This coupled with good performance against the Economy criteria means that location 6 will proceed to Stage 4 assessment.

The nature of the constraints in the study area mean that options 5 and 6 perform poorly against certain criteria but are advanced for further assessment because they are considered more feasible from a cost, engineering and environmental perspective than Locations 1-4.

It is therefore recommended that Options 5 and 6 are progressed to the Stage 4 MCA process.

## 9 Stage 4 MCA Assessment of Locations

### 9.1 Introduction

A Multi- Criteria Analysis (MCA) was undertaken as part of the Stage 4 assessment process detailed in Section 4.1.4. Stage 4 allowed an analysis of economic, technical and environmental criteria. The overall Stage 4 Summary Appraisal table is located in Appendix B.

### 9.2 Assessment summaries

The proposed station locations are assessed here having regard to their potential impacts. It is considered that appropriate measures can be adopted to mitigate the identified environmental impacts, and these will be developed and analysed in the Environmental Impact Assessment Report for the proposed Project.

#### 9.2.1 Location 5

##### **Economy**

As detailed in the Stage 3 assessment the Location 5 is deemed to have an additional capital cost of 7% above that of a typical station box for the proposed scheme.

Location 5 requires the diversion utilities such as water and gas that are situated under the northbound traffic lanes of St. Stephen's Green East. It does not require the diversion of the sewer under St. Stephen's Green East which improves its performance against the economy criteria.

Location 5 requires works within the carriageway of St. Stephen's Green East incurring costs associated with staged construction and operating in a constrained environment. Traffic management would be necessary during works within the road and on completion road surface reinstatement would be required.

These factors add to the capital cost of the location and reduce its performance against the economy criteria. Overall performance was assessed to be moderate.

##### **Environment**

The location was appraised against the relevant environmental sub-criteria outlined in Section 4.1.4.

Construction phase air quality impacts were assessed for receptors within 100m of the indicative construction zone. The receptors that may potentially be impacted include commercial premises, a college and a secondary school on the eastern side of St. Stephen's Green East. A hotel is situated on the northern side St. Stephen's Green North and a medical clinic and art gallery are also within 100m of the indicative construction zone.

Potential noise and vibration impacts on sensitive receptors within 100m were also assessed. There is potential for noise and vibration impacts during construction due to the advancement of the TBM and station box works. Receptors situated on St. Stephen's Green East have potential to be impacted as they are situated in close proximity to the construction zone.

The western edge of the station box and indicative construction area would have direct impacts on mature trees and other vegetation on the eastern edge of St. Stephen's Green Park. Potential bat tree roosts have been identified within this area as have one red-listed (Herring Gull) and four amber-listed (i.e. robin, mistle thrush, starling and swift) bird species during breeding bird surveys. Tree and vegetation removal would have potential for a direct impact on habitat and species present.

The eastern edge of the station box and construction area directly impact protected structures within the National Monument boundary. These structures include railings, the plinth wall, bollards and lampposts. These impacts would occur for the length of the station box and indicative construction area. Loss of mature trees will also be a architectural heritage impact due to their importance in the makeup on the park and their placement in the original park layout in the 1880's.

There is potential for very significant impacts on unrecorded sub-surface archaeology within park including a 17th Century perimeter wall and ditch. The impacts on subsurface archaeology could be for the length of the construction area but particularly for the area where the station box is excavated, and wall constructed.

As discussed for biodiversity criteria above, tree and vegetation removal will be necessary. This would also create a very significant visual impact due to the removal of mature, dominant trees for the length of the indicative construction zone on the western side of St. Stephen's Green East.

Location 5 allows two northbound and one southbound lane of St Stephen's Green East to remain open during construction. The traffic assessment found that impacts on traffic and bus movements at the AM peak would create some delays but are acceptable. The HGV route could also be maintained.

The socioeconomic impacts assessed are to commuter flows and traffic around the St Stephen's Green and access for pedestrians through the North-Eastern entrance. There would be impacts due to the proximity of construction to Merrion Row and the hospitality and retail businesses there.

Overall performance against the Environmental criteria was deemed to be poor based primarily on the significance of impacts associated with mature tree loss within the park.

## 9.2.2 Location 6

### **Economy**

Location 6 is deemed to incur an average capital cost associated with constructing a station box. Surface reinstatement of park or green space is relatively economical when compared with road surface or utility diversions.

Location 6 does not require the diversion of any utilities as it is located within St. Stephen's Green Park and not the adjacent road. It does not require the diversion of the sewer under St. Stephen's Green East which improves its performance against the economy criteria.

By avoiding the road of St. Stephen's Green East this option does not require as intensive traffic management aside from vehicles leaving site during construction.

These factors improve Location 6's performance against the economic criteria when compared to Location 5. Overall performance was assessed to be moderate.

### **Environment**

Location 6 was appraised against the relevant environmental criteria outlined in Section 4.1.4.

Construction phase air quality impacts were assessed for receptors within 100m of the indicative construction zone. The receptors that may be impacted including commercial premises, a college and a secondary school on the eastern side of St Stephen's Green East. A hotel is situated on the northern side St Stephen's Green North and a medical clinic and art gallery are also within 100m of the indicative construction zone. Because Location 6 is located entirely within St Stephen's Green Park the potential for air quality impacts is exacerbated due to being in close proximity to receptors within the park such as the children playground.

Potential noise and vibration impacts on sensitive receptors was also assessed. There is potential for noise and vibration impacts during construction due to the advancement of the TBM and station box construction works. By being located entirely within St Stephen's Green Park the width of St Stephen's Green East carriageway is located between the indicative construction zone and properties on the eastern side of the road.

The station box and indicative construction area would have a direct impact on mature trees and other vegetation on within St Stephen's Green Park. Common and potential bat tree roosts have been identified within this area as have one red-listed (Herring Gull) and four amber-listed (i.e. robin, mistle thrush, starling and swift) bird species during breeding bird surveys. Vegetation removal would have direct impact on habitat and the species present.

The eastern edge of the station box and construction area directly impact protected structures within the National Monument boundary. These structures include railings, the plinth wall, bollards and lampposts. These impacts would occur for the length of the station box and indicative construction area. Loss of mature trees would also be a architectural heritage impact due to their importance in the makeup on the park and their



placement in the original park layout in the 1880's. Location 6 requires significant tree removal due to being positioned completely within the park.

There is potential for very significant impacts on unrecorded sub-surface archaeology within park including a 17th Century perimeter wall and ditch. The impacts on subsurface archaeology could be for the length of the construction area but particularly for the area where the station box is excavated.

As discussed for biodiversity criteria above, tree and vegetation removal would be necessary. This would also create very significant visual impacts due to the removal of dominant trees for the length of the indicative construction zone on the western side of St Stephen's Green East.

Location 6 performs well against traffic and transport criteria as it does not require the closure of St. Stephen's Green East. The assessment has found there would be no direct impact on traffic and bus movements at the AM peak and HGV route is maintained.

There are also potential impacts associated with effects on commuter flows and traffic around the St Stephen's Green and access for pedestrians through the North-Eastern entrance. There would be impacts due to the proximity of construction to Merrion Row and the hospitality and retail businesses there.

Overall performance against the Environmental criteria was deemed very poor primarily due to impacts arising from the felling of trees and the removal of vegetation.

### 9.3 Stage 4: MCA outcomes

An appraisal summary table has been prepared which collates and summarises the MCA of Locations 6, 7 and 8 in Figure 8.1 below.

CRITERIA	LOCATION 5	LOCATION 6
<b>ECONOMY</b>		
Cost	Yellow	Green
<b>ENVIRONMENTAL</b>	Orange	Orange
Air Quality and Climate	Yellow	Yellow
Noise and Vibration	Orange	Orange
Biodiversity	Orange	Red
Non-Agricultural Properties	Orange	Yellow
Architectural Heritage	Red	Red
Archaeology	Red	Red
Landscape and Visual	Red	Red
Traffic and Transport	Orange	Green
Material Assets: Utilities	Yellow	Green
Population	Yellow	Orange
<b>ENGINEERING</b>		
Constructability	Yellow	Orange

Figure 8.1: Stage 4 MCA table

## 10 Conclusion and recommendation

In conclusion, Location 5 is recommended as the preferred location for a MetroLink Station at St Stephen's Green. This recommendation is made on the basis of an options assessment process that built on earlier completed work in ARUP (2017)

The Stage 3 assessment ruled out Locations 1 to 4 due to poor performance against Project Objectives, Cost, Environmental and Engineering sub-criteria. While the analysis identified that Locations 5 and 6 performed poorly or moderately under some criteria these were brought forward to an MCA in Stage 4.

The Stage 4 assessment found Location 5 to be second most economical of the locations assessed. The capital cost was identified to be 7% greater than the standard cost of a station box for the project due to the need to reinstate St Stephen's Green East road surface and manage traffic and construction within the carriageway. Overall Location 5 was assessed to have moderate performance against the Economy criterion.

In terms of the environment criteria, primary negative impacts for Location 5 were associated with potential architectural heritage, archaeology, biodiversity and landscape & visual impacts. The station box and indicative construction area have a direct impact on St Stephen's Green Park, a National Monument. This includes the requirement to remove structures and monuments during construction and reinstatement on completion of the construction phase. The loss of a significant number of mature trees within the indicative construction area would have landscape and visual impacts. Overall Location 5 was assessed to have poor environmental performance overall, however it is considered that design development and identification of mitigation measures in the EIAR can ameliorate many of the potential effects.

Location 6 which was also subject to the Stage 4 MCA did not perform well against the environmental sub criteria. Location 6 requires more trees to be felled and has more potential impacts within St Stephen's Park than Location 5.

Overall, considering the overall performance of the locations assessed against the economic and environmental criteria Location 5 was identified as the preferred option. This option will be subject to preliminary design development and potential impacts and mitigation measures to ameliorate those impacts will be presented in the EIAR.

## 11 References

Archaeological monitoring of Metro North Utility Slit Trenching at St. Stephens Green, Dublin. Headland Archaeology (Ireland) Ltd 2009

ARUP (on behalf of the NTA) (2018). New Metro North - Alignment Options Report.

Department of Housing, Planning and Local Government (DHPLG) (2017); Project Ireland 2040: National Planning Framework.

Department of Transport, Tourism and Sport (DTTAS) (2016); Common Appraisal Framework for Transport Projects and Programmes.

European Union (2014). Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (EIA Directive)

Jacobs Idom (2019); Preferred Route Design Development Report.

National Transport Authority (NTA) (2016); Transport Strategy for the Greater Dublin Area 2016-2035.

Transport Infrastructure Ireland (TII) (2016); Project Appraisal Guidelines for National Roads Unit 7.0 - Multi Criteria Analysis.

APPENDIX 1: STAGE 3 PRELIMINARY ANALYSIS SUMMARY TABLE

Assessment Criteria	Assessment Sub-Criteria	LOCATION 1	LOCATION 2	LOCATION 3	Notes
Project Objectives	<p><b>Design to Integrate appropriately into the existing public realm.</b></p>	<p>This station location requires the provision of surface elements of the project into the existing public realm which is within the curtilage of the National Monument.</p> <p>The construction of an intervention shaft structure between Location 1 and Tara St Station would result in an impact having regard to public realm integration.</p> <p>Overall impacts arising from required station infrastructure would be difficult to integrate into the public realm impacting performance against this Project Objective.</p>	<p>This station location requires the provision of surface elements of the project into the existing public realm which is within the curtilage of the National Monument.</p> <p>The construction of an intervention shaft structure between Location 2 and Tara St Station would result in an impact having regard to public realm integration.</p> <p>Overall impacts arising from required station infrastructure would be difficult to integrate into the public realm impacting performance against this Project Objective.</p>	<p>This station location requires the provision of surface elements of the project into the existing public realm which is within the curtilage of St Stephens Green Park.</p> <p>The construction of an intervention shaft structure between Location 3 and Tara St Station would result in an impact having regard to public realm integration.</p> <p>Overall impacts arising from required station infrastructure would be difficult to integrate into the public realm impacting performance against this Project Objective.</p>	<p>The Station location options are assessed against the Project Objectives here.</p>
	<p><b>Rank</b></p>				
	<p><b>Planned, constructed and operated in a sustainable manner.</b></p>	<p>Construction phase impacts of Location 1 would result in poor performance against this Project Objective. These are detailed further in the Environmental criteria assessment below.</p> <p>The project provides a sustainable transport option to St Stephen’s Green station which will have positive impacts and is aligned with this Project Objective.</p> <p>Overall Location 1 has Poor performance against this Project Objective.</p>	<p>Construction phase impacts of Location 2 would result in poor performance against this Project Objective. These are detailed further in the Environmental criteria assessment below.</p> <p>The project provides a sustainable transport option to St Stephen’s Green station which will have positive impacts and is aligned with this Project Objective.</p> <p>Overall Location 2 has a Poor performance against this Project Objective.</p>	<p>Construction phase impacts of Location 3 would result in poor performance against this Project Objective. These are detailed further in the Environmental criteria assessment. Impacts from station location are entirely within St Stephen’s Green Park.</p> <p>The project provides sustainable transport to St Stephen’s Green station with positive impacts aligned with this Project Objective.</p> <p>Overall Location 3 has a Poor performance against this Project Objective.</p>	
	<p><b>Rank</b></p>				

<b>Economy</b>	<b>Capital Cost</b>	<p>Constructing the station at this location would increase the construction cost of a typical station box by approximately 10%.</p> <p>The additional costs arise from staged and constrained construction in the road carriageway, associated traffic management and significant utility diversions.</p> <p>The need to construct an additional Intervention Shaft, would increase the overall cost by approximately 25%.</p>	<p>The station is located at the edge of the road carriageway and as a result has a more limited impact on utility diversions, less traffic management and less potential mitigation requirements. Based on this, constructing the station at this location would increase the construction cost of a typical station box by approximately 7%.</p> <p>The need to construct an additional Intervention Shaft, would increase the overall cost by approximately 25%.</p>	<p>Constructing the station within the St Stephens Green is the most cost effective of options 1-3, as construction can be completed more quickly and there are no requirements for utility diversions or significant traffic management.</p> <p>The need to construct an additional Intervention Shaft, would increase the overall cost by approximately 25%.</p>	<p>This criterion considers the cost of each of the proposed station options.</p>
	<b>Rank</b>				
<b>Environmental</b>		<p>This option has an overall poor performance against the environmental objective.</p> <p>This location requires the closure of St. Stephen's Green East road during the construction phase, including its junction with Hume Street. This would disrupt existing traffic movements from St Stephen's Green East to Kildare Street and Merrion Row. This includes bus routes, and HGV access.</p> <p>The 1800mm Victorian sewer situated below St. Stephen's Green East would need to be diverted under the eastern footpath during construction. This would be technically difficult and may directly impact protected cellars situated below St Stephen's Green East and the footpath.</p> <p>While this option is primarily within the road corridor the station box and construction zone would have a direct significant impact on St Stephen's Green Park which is a National Monument and (RMP DU018-020334-). There would be a direct impact on eastern perimeter fence railings and plinth wall (RPS 7751) and</p>	<p>This option has an overall poor performance against the environmental objective.</p> <p>This location requires the partial closure of St. Stephen's Green East during construction. Three lanes can be kept open to traffic which are adequate to maintain flows resulting in moderate impacts on existing bus and the HGV routes with some delays but no diversions.</p> <p>The 1800mm Victorian sewer below St. Stephen's Green East would not require diversion.</p> <p>While this option is primarily within the road corridor the station box and construction zone would have a direct very significant impact on St Stephen's Green Park which is a National Monument and (RMP DU018-020334-). There would be a direct impact on eastern perimeter fence railings and plinth wall (RPSs 7751) and bollards and lampposts (RPSs 7752).</p>	<p>This option has overall poor performance against the environmental objective.</p> <p>Traffic and transport impacts are not significant as the station box and construction areas do not directly impact St Stephen's Green East.</p> <p>This location would have a direct very significant impact on St Stephen's Green Park which is a National Monument and (RMP DU018-020334-). There would be a direct impact on eastern park railings and plinth wall (RPSs 7751). However, bollards and lampposts (RPSs 7752) may be able to be protected and not directly impacted. Subsurface archaeology would potentially be impacted. The position of the station box is entirely within the park and requires a large amount of tree removal. Street trees are outside the indicative construction area so may be able to be retained.</p> <p>This location requires an intervention shaft between St Stephen's Green and Tara Station resulting in very significant impacts</p>	<p>Minimise the potential for adverse impact on the natural and built environment and the community. Selected key constraints identified.</p>



		<p>bollards and lampposts (RPS 7752). Subsurface archaeology would potentially be impacted.</p> <p>Street trees on St Stephen's Green East would need to be removed.as would a number of mature trees within St Stephen's Green Park.</p> <p>This location requires an intervention shaft between St Stephen's Green and Tara Station resulting in very significant impacts on potential sites at Trinity College or Merrion Square.</p>	<p>Subsurface archaeology would potentially be impacted.</p> <p>Street trees on St Stephen's Green East would need to be removed as would a number of mature trees within St Stephen's Green Park</p> <p>This location requires an intervention shaft between St Stephen's Green and Tara Station resulting in very significant impacts on potential at Trinity College or Merrion Square. The intervention shaft requirement is the primary reason for this location's poor environmental performance.</p>	<p>on potential at Trinity College or Merrion Square.</p>	
	<i>Rank</i>				
<b>Engineering</b>	<b>Constructability</b>	<p>This option has an overall poor performance against the constructability objective.</p> <p>The characteristics of the sewer make a diversion to allow the construction of the station box technically challenging. It is a an old, relatively large (1800mm) egg-shaped sewer constructed of brick buried 3.5m below St Stephen's Green East.</p> <p>The construction of an intervention shaft would be challenging given the potential site locations which have limited space and significant environmental constraints. This is due to both Trinity College and Merrion Square being sensitive locations.</p>	<p>This option has an overall moderate performance against the constructability objective. While the 1800mm sewer is maintained other utilities require diversion.</p> <p>The construction of an intervention shaft would be challenging given the potential locations which have limited space and significant environmental constraints. This is due to both Trinity College and Merrion Square being sensitive locations.</p>	<p>This option has overall moderate performance against the constructability objective.</p> <p>The station box would be constructed within St Stephen's Green Park. Construction phase constraints include undertaking the construction work in close proximity to park users and the requirement to minimise construction impacts on the park including on trees and other park features and subsurface archaeology.</p> <p>The construction of an intervention shaft would also be challenging given the potential locations which have limited space and significant environmental constraints. This is due to both Trinity College and Merrion Square being sensitive locations.</p>	<p>This criterion considers if the station option can be constructed having regard to the identified constraints and opportunities within the study area</p>
	<i>Rank</i>				

<b>Conclusion</b>		Due to a poor performance against all sub-criteria this option will not proceed to MCA stage.	Due to a poor performance against economic and environmental criteria this option will not proceed to MCA stage.	Due to poor performance in economic and environmental criteria this option will not proceed to MCA stage	
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<b>Assessment Criteria</b>	<b>Assessment Sub-Criteria</b>	<b>Location 4</b>	<b>Location 5</b>	<b>Location 6</b>	<b>Notes</b>
<b>Project Objectives</b>	<b>Design to Integrate appropriately into the existing public realm.</b>	<p>Initial design considers station integration into the existing public realm which is within the curtilage of the National Monument. Design features that assist in achieving this include sensitive design of station “pop ups” and to ensure appropriate replacement of protected structures impacted during construction e.g. perimeter fence railings. This station location allows entrance/egress to form part of the plaza area at the North Eastern corner of St Stephen’s Green Park improving integration.</p> <p>Overall ongoing impacts from station infrastructure will be challenging to integrate into the public realm impacting performance against this Project Objective.</p>	<p>Initial design considers station integration into the existing public realm which is within the curtilage of the National Monument. Design features that assist in achieving this include sensitive design of station “pop ups” and to ensure appropriate replacement of protected structures impacted during construction e.g. perimeter fence railings.</p> <p>This station location allows entrance/egress to form part of the plaza area at the North Eastern corner of St Stephen’s Green Park improving integration.</p> <p>Overall ongoing impacts from station infrastructure will be challenging to integrate into the public realm impacting performance against this Project Objective.</p>	<p>Initial design considers station integration into the existing public realm which is within the curtilage of the National Monument. Design features that assist in achieving this include sensitive design of station “pop ups” and to ensure appropriate replacement of protected structures impacted during construction e.g. perimeter fence railings.</p> <p>Location 8 is entirely within St Stephen’s Green Park so pop ups must also be placed within the park creating operation impacts.</p> <p>Overall ongoing impacts from station infrastructure will be challenging to integrate into the public realm impacting performance against this Project Objective.</p>	These Project Objectives are those relevant to the St Stephen’s Green Station assessment.
	<i>Rank</i>				
	<b>Planned, constructed and operated in a sustainable manner.</b>	Construction phase impacts of Location 4 will result in poor performance against this Project Objective. These are detailed further in the Environmental criteria assessment below. This primarily relates to utility diversions and traffic impacts.	Construction phase impacts of Location 5 will result in moderate performance against this Project Objective. These are detailed further in the Environmental criteria assessment below.	Construction phase impacts of Location 6 will result in poor performance against this Project Objective. These are detailed further in the Environmental criteria assessment below. Impacts from station location being entirely within St Stephen’s Green Park.	

		<p>The project provides a sustainable transport option to St Stephen's Green station which will have positive impacts and is aligned with this Project Objective.</p> <p>Overall Location 4 performs poorly against this Project Objective</p>	<p>The project provides a sustainable transport option to St Stephen's Green station which will have positive impacts and is aligned with this Project Objective.</p> <p>Overall Location 5 has a Moderate performance against this Project Objective.</p>	<p>The project does provide a sustainable transport option to St Stephen's Green Station which will have positive impacts and is aligned with this Project Objective.</p> <p>Overall Location 6 performs poorly against this Project Objective.</p>	
	<b>Rank</b>				
<b>Economy</b>	<b>Cost</b>	<p>Constructing the station at this location increases the construction cost of a typical station box by approximately 10%. The additional costs arise from staged and constrained construction in the carriageway, associated traffic management, significant utility diversions work as well as a higher degree of mitigation during the works, due to the proximity of existing buildings.</p>	<p>Constructing the station at this location increases the construction cost of a typical station box by approximately 7%. The station is located at the edge of the carriageway and so has more limited impact on utility diversions, less traffic management and less potential mitigation requirements.</p>	<p>Constructing the station within the St Stephens Green is the most economical of all the options, as none of the previously stated additional construction impacts occur.</p>	<p>This criterion considers the cost of each of the proposed station options.</p>
	<b>Rank</b>				
<b>Environmental</b>		<p>This option has overall poor performance against the environmental objective.</p> <p>This location requires the closure of St. Stephen's Green East during the construction phase, including its junction with Hume Street. This would disrupt existing traffic movements from St Stephen's Green East to Kildare Street and Merrion Row. This includes bus routes, HGV access.</p> <p>The 1800mm sewer situated below St. Stephen's Green East would need to be diverted into the eastern footpath during construction. A 1710mm sewer beneath Hume St that joins the St Stephen's Green East sewer would also require diversion. This would be technically difficult and may directly impact protected</p>	<p>This option has overall poor performance against the environmental objective.</p> <p>This location requires the partial closure of St. Stephen's Green East during construction. Three lanes can be kept open to traffic which are adequate to maintain flows resulting in moderate impacts on existing bus and the HGV routes with some delays but no diversions.</p> <p>The Victorian sewer below St. Stephen's Green East would not require diversion.</p> <p>While this option is primarily within the road corridor the station box and construction zone would have a direct significant impact on St Stephen's Green</p>	<p>This option has overall poor performance against the environmental objective primarily relating to the significance on impacts on the St Stephen's Green Park.</p> <p>Traffic and transport impacts are not significant as the station box and construction areas do not directly impact St Stephen's Green East.</p> <p>This location would have a direct very significant impact on St Stephen's Green Park which is a National Monument and (RMP DU018-020334-). There would be a direct impact on East park railings and plinth wall (RPSs 7751). However, the bollards and lampposts (RPSs 7752) located on the footpath may be retained. Subsurface</p>	<p>Minimise the potential for adverse impact on the natural and built environment and the community. Selected key constraints identified.</p>

		<p>cellars situated below St Stephen's Green East and the footpath.</p> <p>While this option is primarily within the road corridor the station box and construction zone would have a direct very significant impact on St Stephen's Green Park which is a National Monument and (RMP DU018-020334-). There would be a direct impact on eastern perimeter fence railings and plinth wall (RPSs 7751) and bollards and lampposts (RPSs 7752). Subsurface archaeology potentially impacted, and tree removal would be necessary.</p> <p>There would be a direct impact on the steps in front of several protected structures on St Stephen's Green East which are:</p> <ul style="list-style-type: none"> <li>• 42-43 St Stephen's Green East (RPSs 7782)</li> <li>• 50 St Stephen's Green East (RPSs 7783)</li> </ul>	<p>Park which is a National Monument and (RMP DU018-020334-). There would be a direct impact on eastern perimeter fence railings and plinth wall (RPSs 7751) and bollards and lampposts (RPSs 7752). Subsurface archaeology potentially impacted.</p> <p>Street trees on St Stephen's Green East would need to be removed.as will a number of mature trees within St Stephen's Green Park.</p>	<p>archaeology potentially impacted. The position of the station box is entirely within the park and therefore requires a large amount of tree removal. Street trees are outside the indicative construction area so may be able to be retained.</p>	
	<b>Rank</b>				
<b>Engineering</b>	<b>Constructability</b>	<p>This option has overall poor performance against the constructability objective.</p> <p>The characteristics of the sewer make a diversion to allow the construction of the station box technically challenging. It is an old, relatively large egg-shaped sewer constructed of brick buried 3.5m below St Stephen's Green East.</p> <p>Risk exists in relation to traffic management, public safety and management of monuments and other architectural features within the National Monument.</p>	<p>This option has overall moderate performance against the constructability objective. While the 1800mm sewer is maintained other utilities require diversion</p> <p>Risk exists in relation to traffic management, public safety and management of monuments and other architectural features located within the National Monument. Mitigation risks exist in terms of suitable reinstatement of St Stephen's Green Park.</p>	<p>This option has overall moderate performance against the constructability objective.</p> <p>The scale of the construction required to build the station box is technically challenging within St Stephen's Green Park, which is designated as a National Monument.</p> <p>However, there is no requirement for the diversion of a significant sewer and traffic management requirements are minimised.</p>	<p>This criterion considers if the station option can be constructed having regard to the identified constraints and opportunities within the study area.</p>

	<i>Rank</i>				
<b>Conclusion</b>		Due poor performance against environmental and constructability sub-criteria this option will not proceed to MCA stage.	Due moderate performance against all sub-criteria with the exception of Environment, this option will be taken forward and subjected to an MCA.	Due to moderate performance economic and environmental sub-criteria this option will be taken forward and subjected to an MCA.	

<b>Colour</b>	<b>Description</b>
	Overall good performance against the criteria
	Overall moderate performance against the criteria
	Overall poor performance against the criteria

APPENDIX 2: STAGE 4 APPRAISAL SUMMARY TABLE

Assessment Criteria	Assessment Sub-Criteria	LOCATION 5	LOCATION 6	Notes
Economy	Cost	Constructing the station at this location increases the construction cost of a typical station box by approximately 7%. The station is located at the edge of the carriageway and so has more limited impact on utility diversions, less traffic management and less potential mitigation requirements.	Constructing the station within the St Stephens Green is the most economical of all the options, as none of the previously stated additional construction impacts occur.	This criterion considers the cost of each of the proposed station options.
	Rank			
Environmental	Air Quality and climate	<p>Potential for impacts on sensitive receptors during the construction phase due to emissions. Emissions of relevance during this phase include NOx and Particulate Matter (PM10). Receptors within 100m of the indicative construction zone include commercial premises, a college and a secondary school on the eastern side of St Stephen's Green East. A hotel is situated on the northern side St Stephen's Green North. A medical clinic and art gallery are also within 100m of the indicative construction zone.</p> <p>During construction the park next to the indicative construction zone will continue to function as a public park and resulting in potential air quality impacts on park users.</p> <p>Climate related impacts are potentially GHG emissions from construction traffic and embodied energy from construction materials.</p> <p>Positive impact on air quality and climate during the operational phase of the project due to modal shift</p>	<p>Potential for impacts on sensitive receptors during the construction phase due to emissions. Emissions of relevance during this phase include NOx and Particulate Matter (PM10). Receptors within 100m of the indicative construction zone include commercial premises, a college and a secondary school on the eastern side of St Stephen's Green East. A hotel is situated on the northern side St Stephen's Green North. A medical clinic and art gallery are also within 100m of the indicative construction zone.</p> <p>During construction the park next to the indicative construction zone will continue to function as a public park and resulting in potential air quality impacts on park users. Location 6 is entirely within the park and has more potential impacts on park users but is also further away from receptors on St Stephen's Green East.</p> <p>Climate related impacts are potentially GHG emissions from construction traffic and embodied energy from construction materials.</p>	Minimise the potential for adverse impact on the natural and built environment and the community. Selected key constraints identified.



	from private vehicles to the MetroLink and the resultant reduction in emissions.	Positive impact on air quality and climate during the operational phase of the project due to modal shift from private vehicles to the MetroLink and the resultant reduction in emissions.	
<b>Rank</b>			
<b>Noise and Vibration</b>	<p>Potential for noise impacts during construction due to close proximity of sensitive receptors including schools, hotels, office space and recreational/greenspace (including a children's playground).</p> <p>Potential for vibration impacts during construction due to the advancement of the TBM and station box works near sensitive receptors.</p> <p>Potential for operational impacts from train movements on buildings north of station.</p>	<p>Potential for noise impacts during construction due to close proximity of commercial properties and users of St Stephens Green. This option is further away from receptors on St Stephens Green but closer to park users including children's playground.</p> <p>Potential for vibration impacts during construction due to the advancement of the TBM and station box works near sensitive receptors.</p> <p>Potential for operational impacts from train movements on buildings north of station location including a hotel for this option.</p>	
<b>Rank</b>			
<b>Biodiversity</b>	<p>In the context of the surrounding environment, the impacted area is of local ecological importance (higher value).</p> <p>Potential impacts on the Common pipistrelle and Leisler's bat recorded along this tree line; and potential bat tree roosts identified within this area.</p> <p>One red-listed (Herring Gull) and four amber-listed (i.e. robin, mistle thrush, starling and swift) bird species recorded during breeding bird surveys.</p> <p>In absence of mitigation, residual significant impact of a local importance (higher value) due to a direct loss of habitat; and, indirect impact on bats and birds (due to increases in light, noise and human disturbance).</p>	<p>In the context of the surrounding environment, the impacted area is of local ecological importance (higher value).</p> <p>Impacts on Common pipistrelle and Leisler's bat recorded along this treeline; and potential bat tree roosts identified within this area. As described in visual impacts above direct impact on mature trees in an area of scattered trees and parkland and ornamental/non-native shrub.</p> <p>One red-listed (Herring Gull) and four amber-listed (i.e. robin, mistle thrush, starling and swift) bird species recorded during breeding bird surveys.</p> <p>In absence of mitigation, residual impact of local importance (higher value) due to a direct loss of</p>	

		habitat; an indirect impact on habitats because of habitat degradation/reduction in air quality; and, indirect impact on bats and birds (due to increases in light, noise and human disturbance). The station position entirely within the park exacerbates significance of impacts on St Stephen's Green Park and biodiversity.	
	<b>Rank</b>		
<b>Non-Agricultural Buildings</b>	<p>100m buffer from construction area has identified potential impacts on sensitive receptors including an art gallery, a college, a secondary school, and a medical clinic.</p> <p>Potential construction impacts include noise, vibration and air quality.</p>	<p>100m buffer from construction area has identified potential impacts on sensitive receptors including an art gallery, a college, a secondary school, and a medical clinic.</p> <p>Potential construction impacts include noise, vibration and air quality. This location is further west than Locations 4 and 5 allowing better performance against this criterion.</p>	
	<b>Rank</b>		
<b>Cultural Heritage: Architectural Heritage</b>	<p>Direct impact on St Stephens Green Park which is a National Monument, an RMP and an RPS (RMP DU018:020334: RPS 7751-7761). Direct impact on railings and plinth (RPSs 7751) and bollards and lampposts (RPSs 7752).</p> <p>Potential direct impact on the Wolfe Tone statue, and the Hungry Heart Famine memorial during construction as these structures fall within the indicative construction area.</p> <p>Potential for a direct short-term moderate visual impact on St Stephens Green East at construction phase and a direct permanent moderate visual impact on the street at operation phase due to location of station infrastructure including lifts, skylights and ventilation.</p>	<p>Direct impact on St Stephens Green Park which is a National Monument, an RMP and an RPS (RMP DU018:020334: RPS 7751-7761). Direct impact on railings and plinth (RPSs 7751) and bollards and lampposts (RPSs 7752).</p> <p>Potential direct impact on the Wolfe Tone statue, and the Hungry Heart Famine memorial during construction as these structures fall within the indicative construction area. For this location the northern extent of the station box is in very close proximity to the Hungry Heart memorial increasing impacts.</p> <p>Potential for a direct short-term moderate visual impact on St Stephens Green East at construction phase and a direct permanent moderate visual impact on the street at operation phase due to location of station infrastructure including lifts,</p>	

		Potential for a direct short-term moderate visual impact on St Stephens Green East at construction phase and a direct permanent moderate visual impact on the street at operation phase due to location of station infrastructure including lifts, skylights and ventilation.	skylights and ventilation. Potential for a direct short-term moderate visual impact on St Stephens Green East at construction phase and a direct permanent moderate visual impact on the street at operation phase
	<b>Rank</b>		
	<b>Cultural Heritage: Archaeology</b>	Potentially very significant impacts on unrecorded sub-surface archaeology area within park including a 17th Century perimeter wall and ditch for the length of the station box and indicative construction area. Potential impacts on subsurface remains of historic tramline on St Stephen's Green East.	Potentially very significant impacts on unrecorded sub-surface archaeology area within park including a 17th Century perimeter wall and ditch for the length of the station box and indicative construction area.
	<b>Rank</b>		
	<b>Landscape and Visual</b>	<p>Very significant direct on/loss of vegetation of eastern side of St. Stephen's Green Park. 75 trees are within the construction zone including 55 that are mature. Of these 4 are A2, 1 is A3 and 33 are B2 trees. Of these one is a London Plane, one is a "dominant" Wych Elm. 15 are Holly which are not notable individual specimens but when grouped together provide a screening function on the eastern park boundary.</p> <p>Operational impacts while trees planted at reinstatement mature.</p> <p>Operational visual impacts from station related infrastructure (lifts, escalators and ventilation) within St Stephen's Green Park and footpath of St Stephen's Green East which is within the National Monument boundary.</p>	<p>Very significant direct impact on/loss of vegetation of eastern side of St. Stephen's Green Park. 98 trees are within the construction zone including 70 that are mature. Of these 16 are A2, 1 is A3 and 35 are B2 trees. Of these four are London Plane, one is a "dominant" Wych Elm. 13 are Holly which are not notable individual specimens but when grouped together provide a screening function.</p> <p>The significance of impacts are exacerbated by the station position entirely within St Stephen's Green Park and the amount of mature tree removal necessary.</p> <p>Operational impacts while trees planted at reinstatement mature.</p> <p>Operational visual impacts from station related infrastructure (lifts, escalators and ventilation) within St Stephen's Green Park. As this option is</p>

			located completely within the park boundary there is less ability to locate pop ups on the footpath on St Stephen's Green East.	
	<b>Rank</b>			
	<b>Traffic and transportation</b>	<p>The following potential impacts were identified during the construction period:</p> <ul style="list-style-type: none"> <li>• Closure of the footpath on the western side of St. Stephen's Green East will interfere on north and southbound movements of 361 pedestrians in the AM Peak hour;</li> <li>• Reduced east and westbound pedestrian permeability through the St Stephen's Green Park;</li> <li>• 292 cyclists (AM Peak hour) will be affected by the capacity reduction on St. Stephen's Green East;</li> <li>• Existing dedicated cycle lanes are potentially compromised by width reduction. Alternative routes to northbound cyclist movements (279 cyclists in the AM Peak) would be necessary;</li> <li>• Removal of existing Dublin Bike station at St. Stephen's Green East;</li> <li>• Slight impact on existing bus routes. No bus stops need to be re-located or removed;</li> <li>• Removal of on street parking on St. Stephen's Green East, between R110 St. Stephen's Green and Merrion Row;</li> </ul>	<p>The following potential impacts were identified during the construction period:</p> <ul style="list-style-type: none"> <li>• Pedestrian movements to and from St. Stephen Green Park would be affected by the closure of two existing pedestrian access points on St. Stephen's Green East.</li> </ul>	

		<ul style="list-style-type: none"> <li>Slight impact on wider traffic due to the reduction of one northbound lane, however, the remaining lanes have the capacity to absorb the traffic.</li> </ul>		
	<b>Rank</b>			
	<b>Utilities</b>	Water mains, Telecoms, Gas and HV ESB impacted by station box location. No sewer diversion required on St. Stephen's Green East or Hume St due to more western location compared to option 6	Minimal impact on utilities as box located inside park.	
	<b>Rank</b>			
	<b>Population and Human Health</b>	This option maintains a balance between impacts to commuter flows and traffic around the green and access for pedestrians through the North-Eastern entrance (though reduced). However, its proximity to Merrion Row's restaurants, cafes, hotel, shops and bars will significantly impact on their operation during the construction phase but will greatly benefit them post-construction.	<p>Decreased or eliminated access to the memorial entrance which serves as a meeting point and events venue at present, will impact park amenity and tourism in the area.</p> <p>This option heavily impacts upon the amenity and accessibility of the park. However, in doing so it minimises disruption to commuting, traffic and access to businesses and institutions along St. Stephen's Green East. It eliminates access via the North-Eastern park entrance, which is critical to the flow of people during the day (business viability). Furthermore, due to its placement requiring a route realignment, it is will have impacts both north and south of St. Stephen's Green.</p>	
	<b>Rank</b>			
<b>Engineering</b>	<b>Constructability</b>	This option has overall moderate performance against the constructability objective. While the 1800mm sewer is maintained other utilities require diversion.	The scale of the construction required to build the station box is technically challenging within St. Stephen's Green Park, a National Monument.	This criterion considers if the station option can be constructed having regard to the identified constraints

		Risk exists in relation to traffic management, public safety and management of protected structures in a National Monument. Mitigation risks exist in terms of suitable reinstatement of St. Stephen's Green Park.		and opportunities within the study area
	<i>Rank</i>			

<b>Colour</b>	<b>Description</b>
	Overall very good performance against the criteria
	Overall good performance against the criteria
	Overall moderate performance against the criteria
	Overall poor performance against the criteria
	Overall very poor performance against the criteria



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