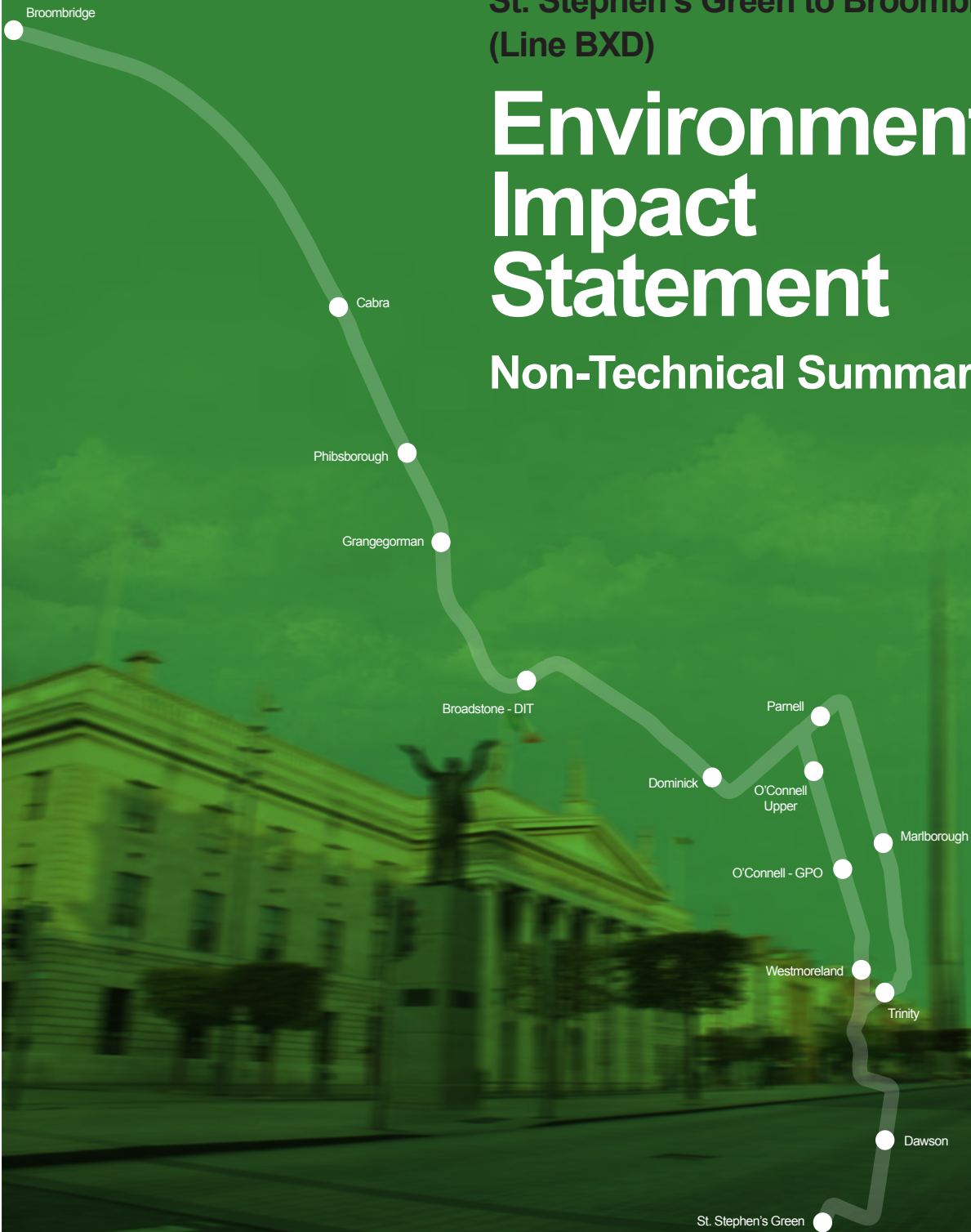


Luas Broombridge

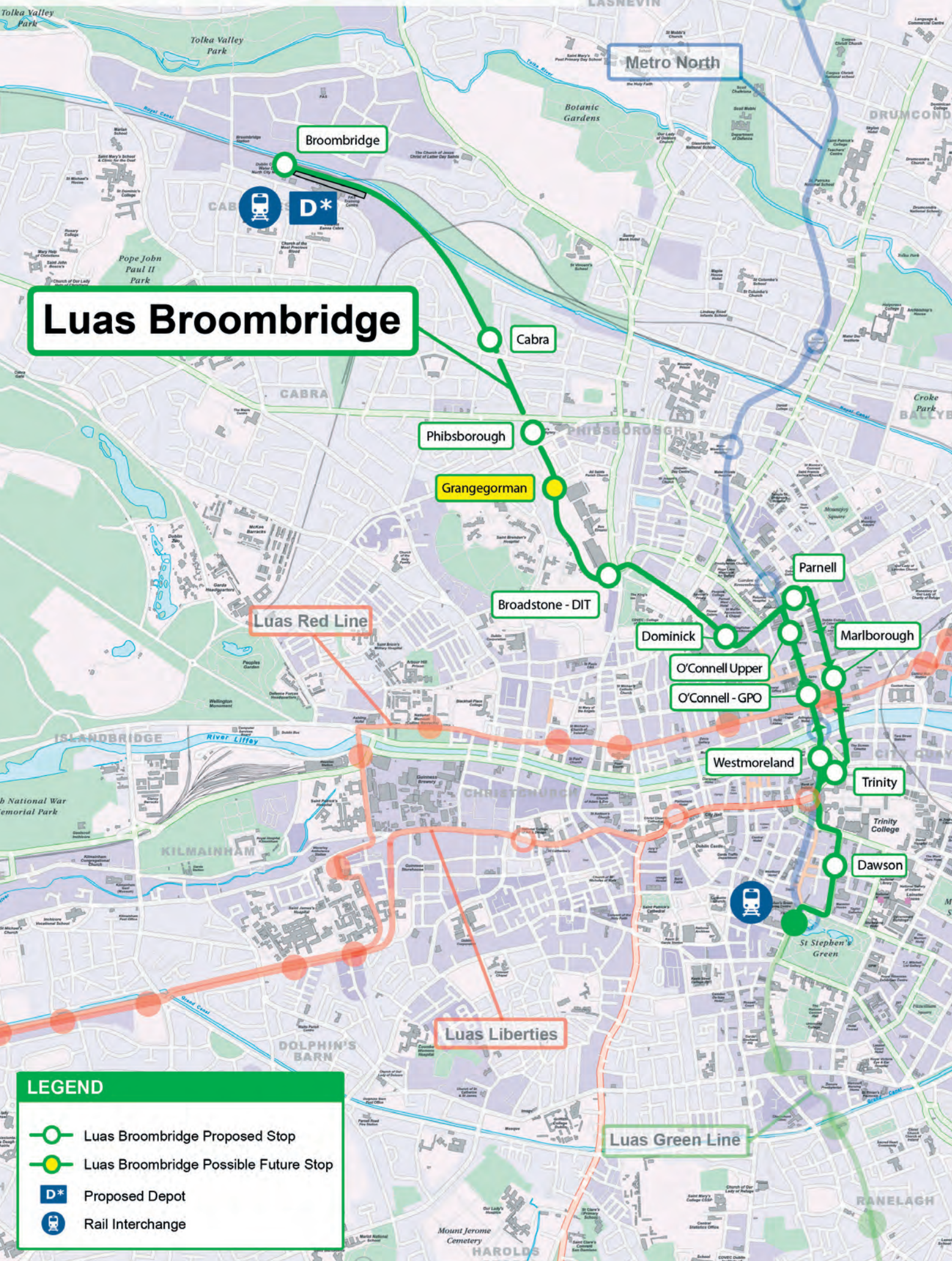
St. Stephen's Green to Broombridge
(Line BXD)

Environmental Impact Statement

Non-Technical Summary







Luas Broombridge



Luas Broombridge

LEGEND

-  Luas Broombridge Proposed Stop
-  Luas Broombridge Possible Future Stop
-  Proposed Depot
-  Rail Interchange

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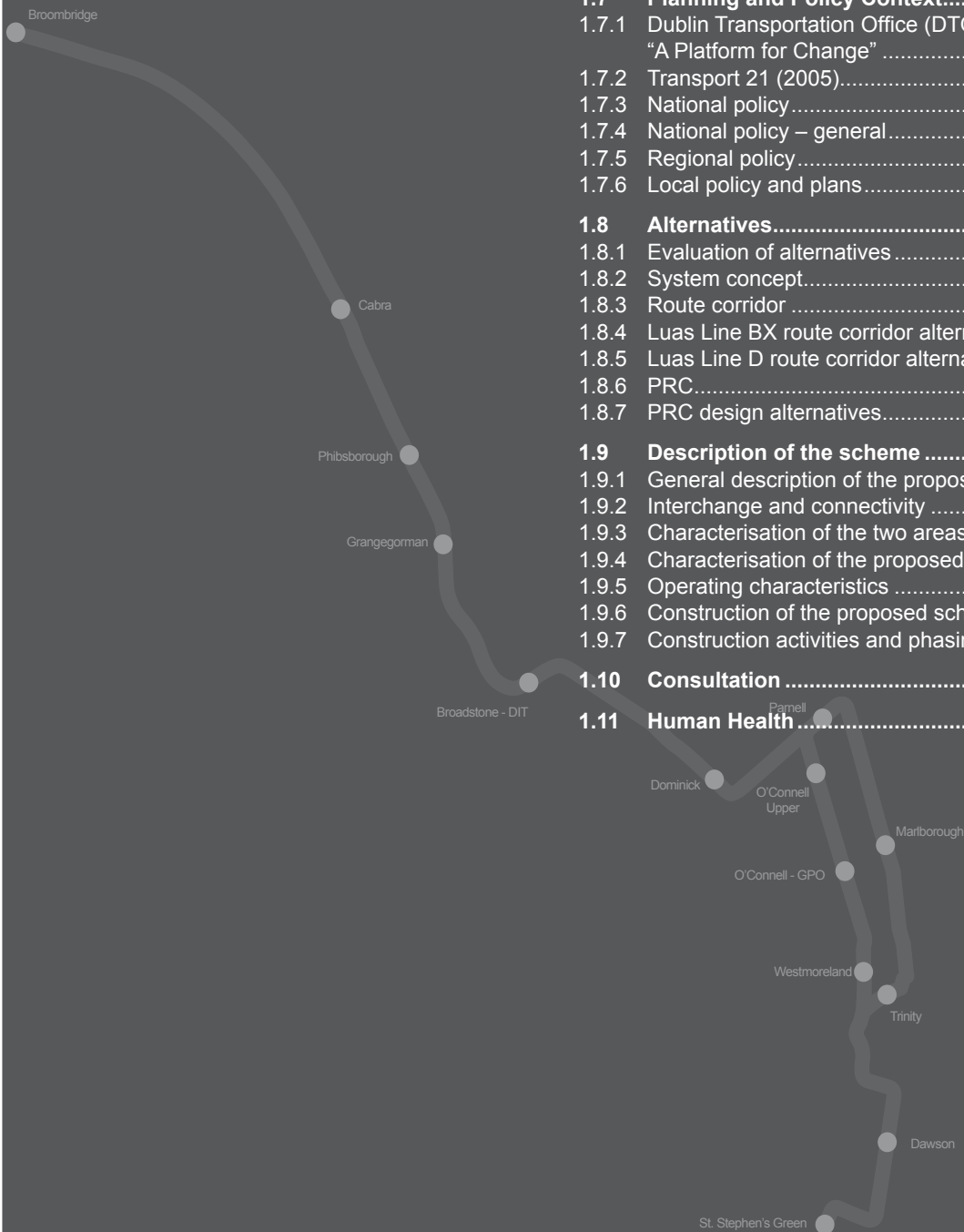


Photo 1.1 GPO on O'Connell Street



Photo 1.2 College Green



1.1 INTRODUCTION

Luas Broombridge is the next phase of Dublin's integrated light rail network. The proposed scheme will serve a 5.6km long corridor from the Luas Green Line at its current terminus (St. Stephen's Green West) to the Iarnród Éireann Broombridge Station on the Maynooth railway line.

The Environmental Impact Statement (EIS) for Luas Broombridge is being published as five separate books and a Non-Technical Summary (NTS) as follows:

Book 1 Introduction and Baseline Environment

- General introductory chapters of the EIS including a section describing the methodology used, the nature of the development, the means by which alternatives were considered, and an assessment of potential impacts on human health (Chapters 1–10)
- Description of the baseline environment for the proposed scheme with respect to all environmental topics (Chapters 11–26)
- A list of abbreviations and a glossary of terms

Books 2 and 3 Impact Assessment

Books 2 and 3 contain the impact assessments with respect to all environmental topics (Chapters 1–18). For the purposes of this EIS and for ease of local identification and interest, the 5.6km proposed scheme has been divided into two areas: Area 29 and Area 30. Book 2 contains the impact assessment for Area 29 and Book 3 covers Area 30.

Book 4 Maps

Book 4 contains all baseline and impact assessment maps of this EIS relating to the chapters in Books 1–3.

Book 5 Annexes

Book 5 contains all baseline and impact assessment annexes of this EIS. These provide additional and supporting information to the chapters in Books 1–3.

Non-Technical Summary (NTS)

The NTS has been prepared as part of the Luas Broombridge Railway Order (RO) application. Written in non-technical language, it presents the key findings in respect of the construction and operation of the Luas Broombridge scheme. The detail in relation to all of the topics outlined in this book is presented in the main EIS, Books 1–5 inclusive.

1.2 AVAILABILITY OF THIS EIS

This EIS is available to download for free through the Railway Procurement Agency (RPA) website at www.dublinluasbroombridge.ie

Copies of this EIS including the NTS may be purchased by any member of the public during normal office hours at the following location:

Railway Procurement Agency (RPA)
Parkgate Business Centre
Parkgate Street
Dublin 8

The EIS may be purchased as a complete document for the sum of €145.00.

The EIS can also be purchased as individual books:

- Copies of Book 1 may be purchased for €50.00 each
- Copies of Book 2 may be purchased for €20.00 each
- Copies of Book 3 may be purchased for €20.00 each
- Copies of Book 4 may be purchased for €30.00 each
- Copies of Book 5 may be purchased for €20.00 each
- Copies of the NTS may be purchased at the above location for €5.00 each.

A DVD version of the whole EIS may be purchased for €15.00. This includes Books 1–5 and the NTS.

1.3 NOTE ON STAGE OF DESIGN

This EIS is based on the RO design as set out in the drawings which accompany the RO application. All proposed mitigation measures described in this EIS and shown on drawings are also based on this design. Deviations from this design may occur provided these have no significant adverse environmental effect in order to facilitate on-site construction or maintenance and to allow a limited degree of flexibility to react to on-site circumstances which are unforeseeable at this stage. The deviations contained in the draft RO are as follows: lateral deviations of up to 2.5m are permitted where the works are situated in a public road, and 5m elsewhere; vertical deviations of up to 1m upwards or downwards where the works are situated in a public road and up to 2m upwards or downwards elsewhere; and longitudinal deviations up to 20m.

1.4 INTRODUCTION TO THE PROPOSED SCHEME

In November 2005 the Government launched Transport 21, a capital investment framework under the National Development Plan (NDP) designed to meet Ireland's current and evolving transportation needs. Under Transport 21, RPA has been mandated to deliver two new metro lines and seven new light rail

lines. Transport 21 specifically proposes the extension of the Luas Green Line through the city centre, termed BX, and onwards to Broombridge (Liffey Junction) to interchange with suburban rail line services. En route, the cross city penetration of the Luas Line would serve Broadstone and the planned Dublin Institute of Technology (DIT) campus at Grangegorman. This latter segment is referred to as Luas Line D. Luas Line BX and D are together referred to as Luas Broombridge in this EIS.

The Transport (Railway Infrastructure) Act, 2001, as amended, hereafter referred to as the 2001 Act, sets out the process under which statutory authority for new railway projects is to be granted. A RO is the statutory authority required under the 2001 Act to construct, operate and maintain a light railway. As part of this application for a RO it is necessary to undertake an Environmental Impact Assessment (EIA) of the proposed Luas Broombridge scheme (hereafter referred to as the “proposed scheme”). The findings of the process taken to inform the EIA are then presented in an EIS, prepared in accordance with Section 39 of the 2001 Act and submitted with the RO application.

The principal objectives of the EIS are summarised as follows:

- To identify the likely significant environmental impacts of the proposed scheme during the construction and operational phases, having regard to the characteristics of the local environment
- To evaluate the magnitude and significance of likely impacts and to propose appropriate measures to mitigate potential adverse impacts

1.5 EIS STUDY TEAM

This EIS was prepared by RPA which was responsible for the overall assessments management and co-ordination as well as for the specific topics of Human Beings: Landuse, Human Beings: Socio-economics, Material Assets: Property and Material Assets: Utilities. Other members of the study team are identified in Table 1.1.

1.6 NEED AND OBJECTIVES

The selected route for the proposed scheme will serve a number of key destinations within Dublin city centre and beyond. By achieving greater access into the city

Table 1.1 EIS study team

INPUT	CONTRIBUTOR
Human Health	EHA Consulting Group
Human Beings: Landuse Human Beings: Socio-economics	RPA and Simon Clear and Associates
Human Beings: Noise Human Beings: Vibration Air and Climatic Factors	ACCONuk
Human Beings: Radiation and Stray Current	Compliance Engineering Ireland
Human Beings: Traffic	AECOM
Flora and Fauna	Natura
Soil and Geology (including waste) Groundwater Surface Water	Fehily Timoney & Company
Landscape and Visual	Mitchell & Associates and Modelworks Architectural Presentation
Material Assets: Archaeology and Cultural Heritage	Headland Archaeology (Ireland)
Material Assets: Architectural Heritage	David Slattery Architects & Historic Buildings Consultants
Material Assets: Property	RPA
Material Assets: Utilities	RPA

centre area, the proposed scheme will offer increased accessibility to places of employment, education, and retail centres as well as cultural and historic quarters.

The proposed scheme is a key element in the development of a fully integrated public transport network as envisaged in Transport 21 which aims to increase accessibility, ensure sustainability, expand capacity, increase use and enhance the quality of public transport.

The proposed scheme will offer interchange between the existing Luas Red and Green Lines and also the proposed Metro North line at a number of locations: St. Stephen's Green, O'Connell Street, Westmoreland Street and in the vicinity of Parnell Square. The proposed scheme will interchange with the Iarnród Éireann Maynooth railway line at the existing suburban railway station at Broombridge and the future Iarnród Éireann Dublin Area Rapid Transit (DART) Underground at St. Stephen's Green. Furthermore, the proposed scheme represents a platform for a future extension to Finglas and interchange with Metro West, the proposed orbital route linking Metro North at Dardistown with Tallaght Town Centre, via Blanchardstown, Liffey Valley and Clondalkin.

At present there is a considerable demand for cross city trips which is not adequately catered for by the existing public transport provision within the city centre. For example, a passenger wishing to complete a cross city trip on the Luas Red or Green Line has to transfer between modes to complete this journey. In January 2005, RPA conducted an attitudinal survey of Luas passengers using the Luas Red and Green Lines. The results of this survey indicated that there was strong support for the cross city extension of Luas. Further surveys carried out in 2009 also indicated that there is a demand for services which further penetrate the city centre. Demand modelling undertaken as part of the scheme assessment indicates that the introduction of the proposed scheme alone will add 10 million passenger boardings per annum to the Luas network.

In the absence of the proposed scheme, the city's Luas system will not achieve its ultimate potential and all of the opportunities that would be afforded through transport integration will not be realised. Furthermore, the extension of Luas services to a wider catchment will provide much needed accessibility, particularly for areas of the northwest city and the communities of Cabra and Phibsborough, and will assist in the regeneration of Dominick Street, Parnell Street and Marlborough Street.

With the full build-out of Transport 21 public transport projects, an additional 12.7 million passenger boardings are added to the Luas network when the proposed scheme is implemented. On this basis alone, the need for the proposed scheme is significant in the context of an expanding public transport network for Dublin.

The proposed scheme presents an opportunity to radically enhance the urban realm of Dublin city centre through attractive and sympathetic integration into the streetscape and a reallocation of road space with greater emphasis on sustainable modes of transport.

1.7 PLANNING AND POLICY CONTEXT

The proposed scheme accords with the objectives of all local, regional and national planning policy and to the goals of social and environmental policy pertaining to the area as outlined in the following sections. It will allow for greater sustainable development and social inclusion through the provision of an environmentally friendly and integrated public transport system.

1.7.1 Dublin Transportation Office (DTO) Strategy – “A Platform for Change”

In November 2001 the DTO published “A Platform for Change – Final Report – An integrated transportation strategy for the Greater Dublin Area 2000–2016”. The strategy sets out a vision of an integrated multi-modal transportation strategy for the Dublin area and identifies a Luas system as a key element of the transport network.

The strategy sets out proposals for a Luas and metro networks and includes a metro link from Dublin city centre to Dublin Airport via the disused Broadstone rail alignment. The strategy envisaged “a new North–South Luas Line from Ballymun via Whitehall, city centre, Harold's Cross, Terenure and Rathfarnham to Dundrum”.

The proposed scheme accords with the overall objectives of “A Platform for Change”.

1.7.2 Transport 21 (2005)

Transport 21 was announced in November 2005 and details the Government's capital investment framework for rail infrastructure in the Greater Dublin Area (GDA).

The proposed scheme is an essential part of and is fully compliant with Transport 21.

1.7.3 National policy

The proposed scheme also conforms to the objectives of the following national strategies, plans and agreements:

- Department of Transport (DoT) Statement of Strategy 2008–2010
- National Spatial Strategy (NSS) 2002–2020 (2002)
- National Development Plan (NDP) 2007–2013 (2007)
- Sustainable Development – A Strategy for Ireland (1997)
- National Climate Change Strategy (NCCS) 2007–2012 (2007)

1.7.3.1 Department of Transport (DoT) Statement of Strategy 2008–2010

The overriding objective of the Department’s strategy as embraced in its Mission Statement is “... to underpin Ireland’s economic growth and competitiveness and contribute to social development through the efficient and effective delivery of an appropriately regulated sustainable, safe and integrated transport system”.

Specifically, the department seeks to increase the number of people using public transport; to increase the modal share of public transport; and to adopt an integrated approach to public transport provision. The proposed scheme conforms to the above objectives and provides for an appropriately regulated sustainable, safe and integrated transport system.

1.7.3.2 National Spatial Strategy (NSS) 2002–2020

The NSS for Ireland was published by the Department of the Environment, Heritage and Local Government (DoEHLG) in 2002. The strategy is a 20-year planning framework designed to achieve a better balance of social, economic and physical development and population growth between regions.

With regard to public transportation in the GDA, the NSS states: “The physical consolidation of Dublin, supported by effective landuse policies for the urban area itself, is an essential requirement for a competitive Dublin. Consolidation is also required for public transport to function effectively. In turn, investment in public transport will assist in promoting a more efficient and competitive GDA”. The proposed scheme therefore supports and facilitates the achievement of the goals of the NSS.

1.7.3.3 National Development Plan (NDP) 2007–2013

The NDP was published by the Irish Government in 2007. The plan sets out the economic, infrastructural and social investment priorities of the State. The

priority of direct relevance to the proposed scheme is “Economic Infrastructure” and one of the key objectives under this priority is “to deliver a radically upgraded public transport system in line with the timetable in Transport 21, especially in the Greater Dublin Area (GDA)”.

The NDP further notes that “the following projects will be advanced in line with the timetable in Transport 21” and the projects that are listed include the “enhancement and extension of the Luas network”. The proposed scheme therefore accords with and is supported by this policy plan.

1.7.3.4 Sustainable Development – A Strategy for Ireland (1997)

The sustainable development strategy for Ireland was published by the DoEHLG in 1997. The overall aim of the strategy is to ensure that the economy and society in Ireland can develop to their full potential within a well-protected environment without compromising the quality of that environment and having regard for present and future generations as well as the wider international community.

This strategy sets out an agenda to render Irish transport more environmentally acceptable and to “improve public transport systems and infrastructure with a view to increasing their market share”. The strategy states that funding for improvements in rolling stock, signalling and track network will further encourage commuters to switch from road to rail. The proposed scheme supports the principles of this strategic policy by encouraging modal shift to a more sustainable form of transport.

1.7.3.5 National Climate Change Strategy (NCCS) 2007–2012

The NCCS 2007–2012 was published by the DoEHLG in 2007. The NCCS outlines the measures by which Ireland will meet its commitment to limit its greenhouse gas emissions over the 2008–2012 period to 13% above 1990 levels.

The NCCS recognises that one of the key ways of reducing transport-based greenhouse gas emissions is encouraging a modal shift away from private car use and towards public transport systems. The proposed scheme supports the principles of the NCCS by encouraging modal shift to a form of public transport that is associated with less emissions/capita than private car use.

1.7.4 National policy – general

The following national policy documents have also been considered in the relevant chapters of this EIS:

- Towards 2016 – Ten-Year Framework Social Partnership Draft Agreement 2006–2015 (2006)
- National Action Plan for Social Inclusion 2007–2016: Building an Inclusive Society (2007)
- National Heritage Plan (2002)
- National Biodiversity Plan (2002)
- Smarter Travel – A Sustainable Transport Future – A New Transport Policy for Ireland 2009–2020

1.7.5 Regional policy

1.7.5.1 Regional Planning Guidelines for the GDA 2004–2016

The Dublin Regional Authority and Mid-East Regional Authority published the Regional Planning Guidelines for the GDA 2004–2016 (commonly referred to as the RPGs) in July 2004. These RPGs aim to give regional effect to the NSS and to guide the development plans for the counties within the GDA. The key objectives of the RPGs relate to consolidation of the urban centres located within the metropolitan area based on provision and facilitation of an integrated public transport system. The RPGs also promote greater use of sustainable transport modes through the integration of landuse and transport planning.

The proposed scheme supports largely the objectives of the RPGs through the provision of a public transport service to provide better access to public institutions and centres of employment and encourages a modal shift to public transport.

1.7.5.2 Other regional policy

The Draft RPGs for the GDA 2010–2022, are currently in preparation, and were also considered as part of this EIS.

1.7.6 Local policy and plans

1.7.6.1 Dublin City Development Plan (DCDP) 2005–2011

The DCDP 2005–2011 was adopted by DCC and came into effect in March 2005. The overall vision for the city as outlined in the plan is to enhance the quality of life and experience of the city for the residents, workers, commuters and visitors and to consolidate the urban form of the city.

Paragraph 7.4.0 states “Dublin City Council support the measures currently being implemented or proposed by the RPA, Iarnród Éireann, DTO and other agencies to enhance capacity on existing lines/services and provide new infrastructure including ... extension of Luas to the Point Depot and further extension to Luas”.

The proposed scheme complies with and supports the policies detailed in the DCDP 2005–2011.

The DCDP is currently under mandatory review which is to be completed by 2011. The new plan will incorporate a core strategic vision. The Draft Plan supports implementation of Transport 21 projects, and together with the proposed Metro North and DART Underground, considers that the BX line will significantly enhance connectivity within the city centre and between the city centre and the region.

1.7.6.2 Additional local policy and plans

Local policy, masterplans and area plans that have been considered in the design of the proposed scheme include:

- Dublin – A City of Possibilities; Economic, Social and Cultural Strategy 2002–2012 (2002)
- Dublin City Heritage Plan 2002–2006 (2002)
- Dublin City Biodiversity Action Plan 2008–2012 (2008)
- O’Connell Street Integrated Area Plan (1998)
- Framework Plan for Parnell Square (2005)
- Phibsborough/Mountjoy LAP (2008)
- Grangegorman Masterplan (2008)
- Dublin City Council’s (DCC’s) Draft Culture Strategy 2010

1.8 ALTERNATIVES

Section 39(1)(d) of the 2001 Act requires that an EIS contains an outline of the main alternatives studied by the applicant and an indication of the main reasons for its chosen option, taking into account the environmental effects.

1.8.1 Evaluation of alternatives

The Department of Finance “Guidelines for the Appraisal and Management of Capital Expenditure Proposals in the Public Sector” provides advice in relation to the manner in which projects including transport schemes are to be assessed.

These guidelines suggest projects should be assessed under the following high level criteria:

- Economy
- Safety

- Environment
- Accessibility and social inclusion
- Integration

The main alternatives considered for the proposed scheme were evaluated using a multi-criteria analysis. RPA's objectives with respect to the proposed scheme are:

- Compliance with transport and landuse strategy
- Minimising environmental impacts including congestion and associated pollution problems
- Generating social and economic benefits
- Delivering good quality transport integration
- Optimising capital and operating costs
- Delivering a safe and operationally efficient system
- Achieving efficiency and minimising risk during construction

The main alternatives considered as part of the proposed scheme were considered under the following headings:

- System concept
- Route corridor
- Preferred Route Corridor (PRC)

These are outlined in the following sections and further detail is presented in the Alternatives chapter of this EIS (Book 1, Chapter 6).

1.8.2 System concept

A number of concept alternatives were considered for the proposed scheme as follows:

- The light rail concept
- The metro concept and with reference to the proposed Metro North project
- Bus-based concepts

It was concluded that the light rail concept would meet best with the objectives of the proposed scheme. A metro alternative with its greater spacing between stops would not offer the same degree of city centre

permeability as light rail and would not lead to the development of a Luas network. A review of a bus-based alternative to the proposed scheme was conducted by the DoT and was rejected for the following reasons:

- It was considered less attractive to passengers than light rail as it would require a transfer between bus and light rail in the city centre to complete a journey
- A light rail solution would have a greater effect on commercial decision making in the city centre
- A light rail solution would contribute more positively to use of public transport for journeys to work

1.8.3 Route corridor

The study of alternative route corridor options generally concerned itself with the identification and evaluation of the broad route corridors and principal destinations that the proposed scheme will serve, rather than precise stop locations or detailed track alignment. In the case of the proposed scheme, this was a two-staged approach focusing in the first instance on Luas Line BX from St. Stephen's Green to O'Connell Street and then on Luas Line D, an extension of Luas Line BX to Broombridge.

In line with the proposed scheme's objective of providing a link between the two existing Luas Lines with further penetration of the Luas Green Line into the city centre, a broad range of route corridor options was identified for Luas Line BX and Luas Line D.

1.8.4 Luas Line BX route corridor alternatives

Following the elimination of some of the broad range of route corridor options, five initial route corridor options (A–E) were selected to carry forward for more detailed assessment and early public consultation. These options are illustrated in Figures 1.1–1.5 inclusive.

A detailed appraisal of the five route corridor options was carried out based on the methodology outlined in Section 1.8.1, and Route Option A performed better than other options on the basis of transport integration and connectivity, townscape, construction duration and economic criteria. On this basis it was brought forward for further consideration.

Figure 1.1 Route Option A

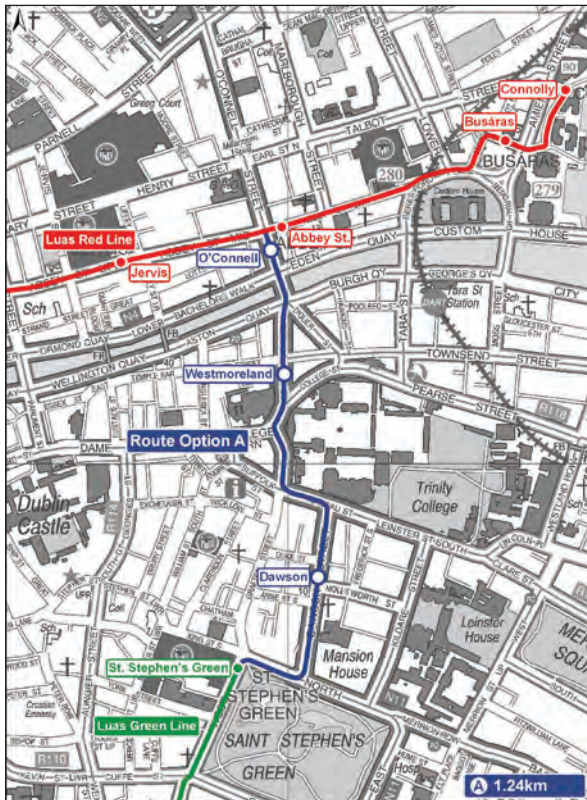


Figure 1.2 Route Option B

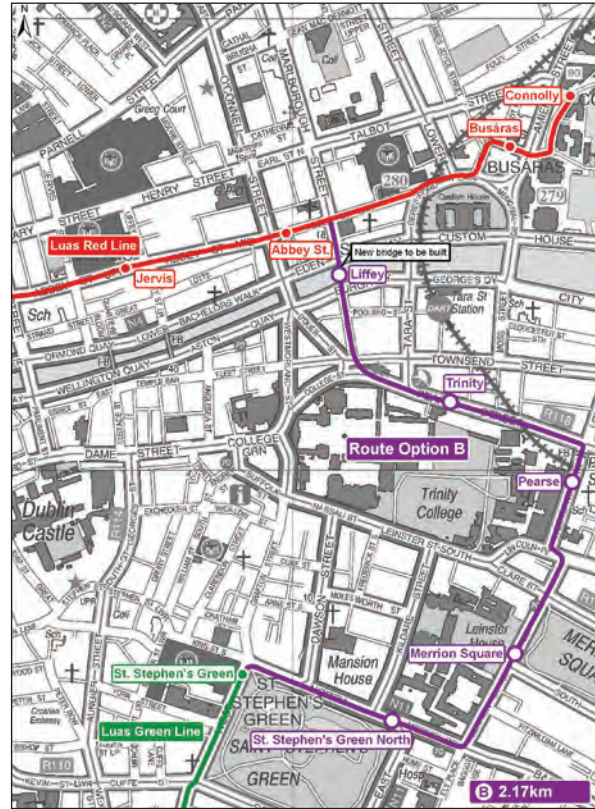


Figure 1.3 Route Option C

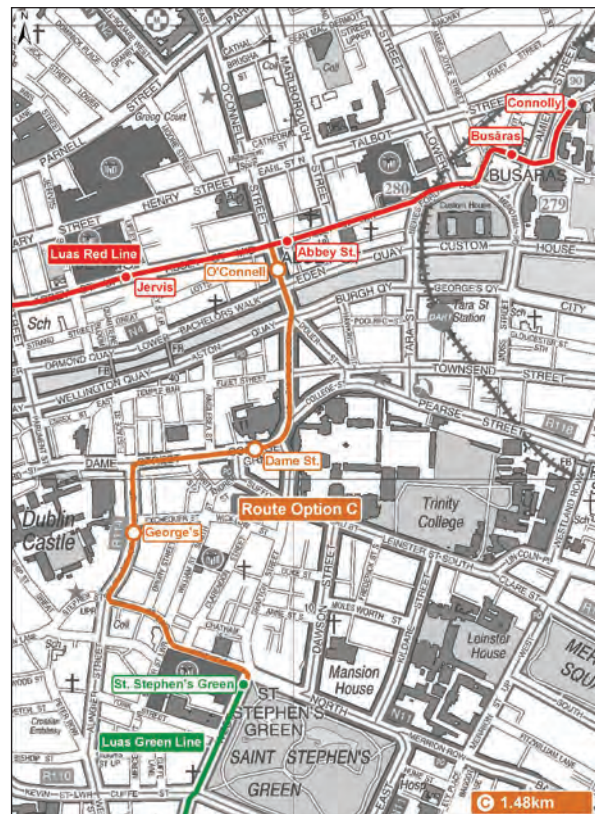


Figure 1.4 Route Option D

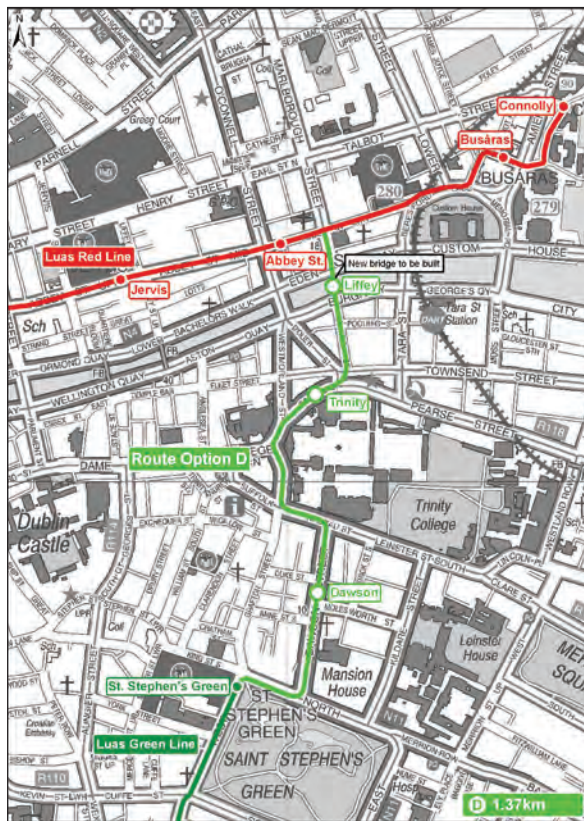
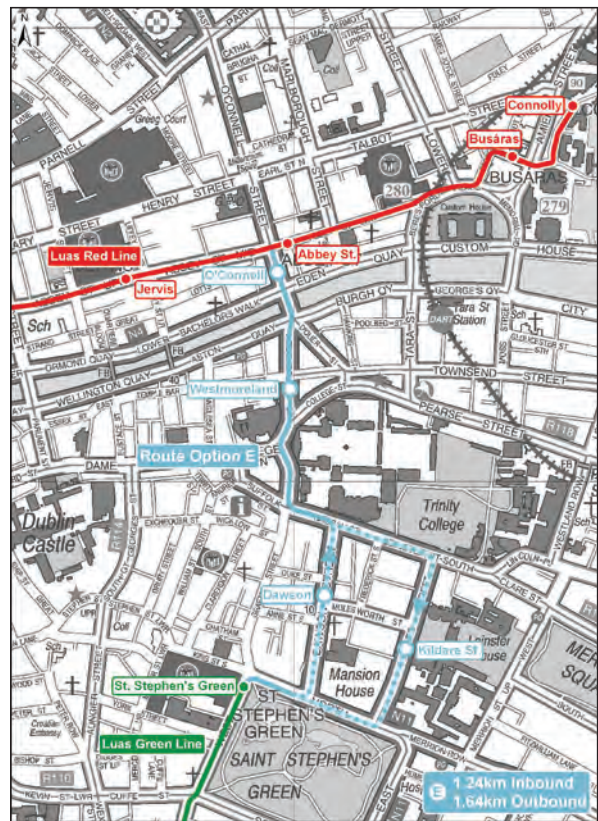


Figure 1.5 Route Option E



Two alternatives were considered for providing a link between the proposed scheme and the Luas Red Line: a track connection enabling through running of services from one line on to the other; or a “flat crossing” interchange link whereby transfer between the two lines would be required. Both options were considered in the context of potential connection points at Marlborough Street and O’Connell Street Lower. A flat crossing was selected as the preferred form of link as it would not impact negatively on pedestrians; there would not be any requirement for demolition of any adjacent buildings; and options for end-to-end capacity provision on the Luas Red and Green Lines could be more effectively maintained.

As consultation progressed and in consideration of the impacts associated with Route Option A on

the O’Connell Street pedestrian amenity, a revised proposal for Route Option A together with a sixth route option, Route Option F was developed following consultation with DCC, Bus Átha Cliath (BAC) and other key stakeholders. These route options are illustrated in Figures 1.6 and 1.7, respectively.

This Route Option F and the revised Route Option A were assessed using the methodology as outlined previously. Route Option F performed better than the revised Route Option A under the assessment criteria and was thus selected as the PRC for Line BX. It represents a more feasible operating environment for a tramway and the wider accessibility to the system is of greater attraction to future users.

Figure 1.6 Revised Route Option A

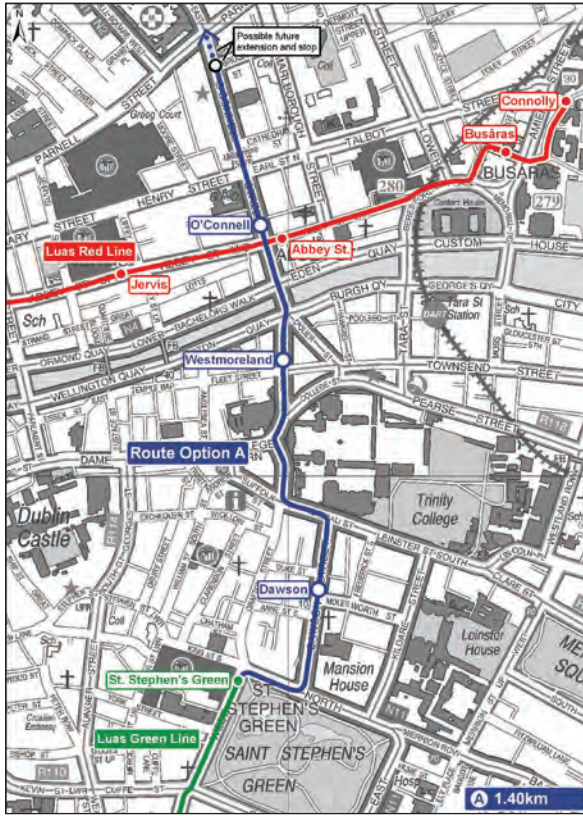
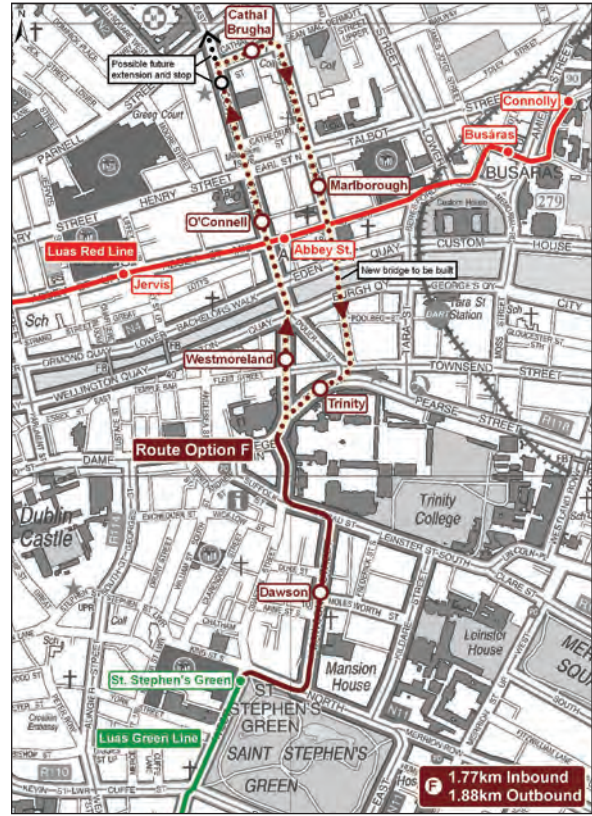


Figure 1.7 Route Option F



1.8.5 Luas Line D route corridor alternatives

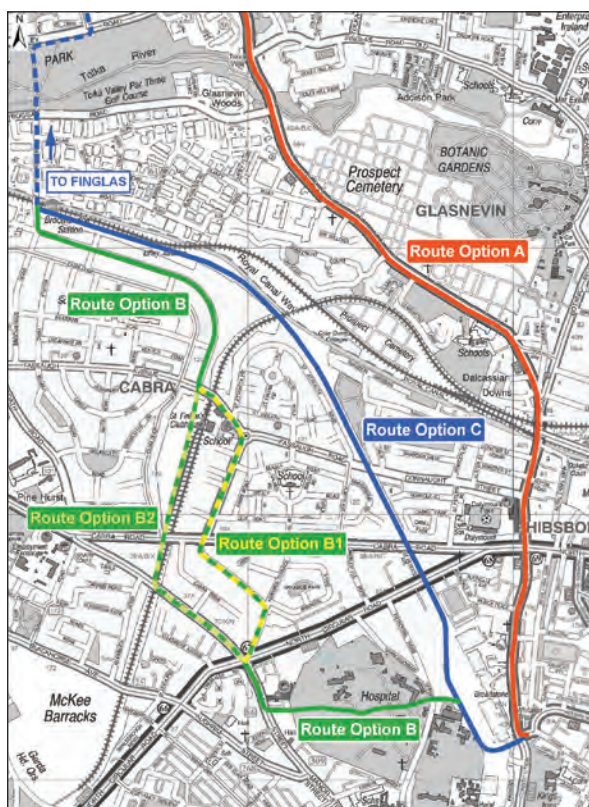
Luas Line D represented the extension of Luas Line BX from the city centre north to Broombridge where it would form an interchange with Iarnród Éireann services on the Maynooth railway line at the Broombridge railway station. Following the selection of a preferred route for Luas Line BX and in order to identify potential route corridors for analysis and consultation, Luas Line D was divided into two sections: Section 1 between Broadstone and Broombridge, and Section 2 between O’Connell Street Upper and Broadstone.

1.8.5.1 Section 1: Broadstone to Broombridge

Four route corridor options (see Figure 1.8) for this section of the line were considered with a common starting point at Constitution Hill/Western Way junction assumed for all.

Arising from this assessment it was decided to proceed to public consultation on Route Option C along the disused former Broadstone railway cutting, an existing corridor free of development. Other options were discounted due to absence of interchange with Maynooth railway line services; impacts on residential amenity; and excessive amounts of shared running.

Figure 1.8 Initial screening route options for Line D Section 1



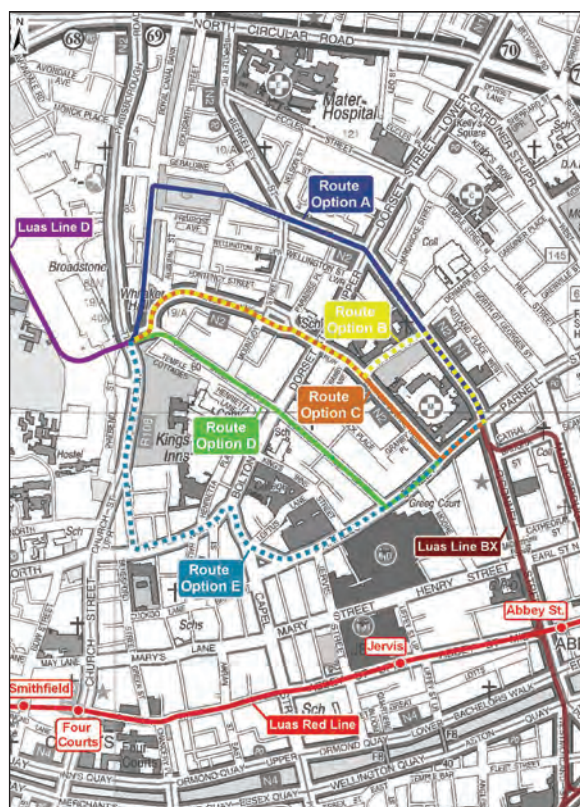
1.8.5.2 Section 2: O’Connell Street Upper to Broadstone

Five route options were assessed as part of this appraisal, as illustrated in Figure 1.9

Based on the assessment two route options, via Parnell Square West and Dominick Street Lower, respectively, were identified for the purposes of bringing forward to consultation and further evaluation. These options performed better on integration and accessibility, impacts on Protected Structures and on recreational amenity.

The decision to bring Luas Line D forward to RO application stage in tandem with Luas Line BX warranted that the connection between the lines be revisited to ensure the most effective route was selected. Therefore the option of extending the single track loop northwards from Cathal Brugha Street on to Parnell Street was considered giving rise to sub-options for the two main options of Parnell Square West and Dominick Street Lower, those sub-options being via either Parnell Street or Cathal Brugha Street.

Figure 1.9 Initial screening route options for Line D Section 2



The results of the assessment that followed indicated that the route via Dominick Street Lower, and providing a connection with Luas Line BX via Parnell Street, performed best and was selected as the PRC for Luas Line D. This route option offered greater opportunities for assisting in the regeneration of Dominick Street Lower and Parnell Street; avoided potential impacts on the Protected Structures of Parnell Square West; did not require the removal of substantial numbers of bus stops and termini on Parnell Square West; and via a stop on Parnell Street, facilitated better interchange with the planned Metro North station at Parnell Square East.

1.8.6 PRC

The PRC for Line BXD is presented in Figure 1.10 and described below in Section 1.9.3.

1.8.7 PRC design alternatives

Following the selection of a preferred route, the engineering and architectural design stage concerned itself with the identification and evaluation of detailed design options for individual stops, and the associated track alignment between stops, along the PRC.

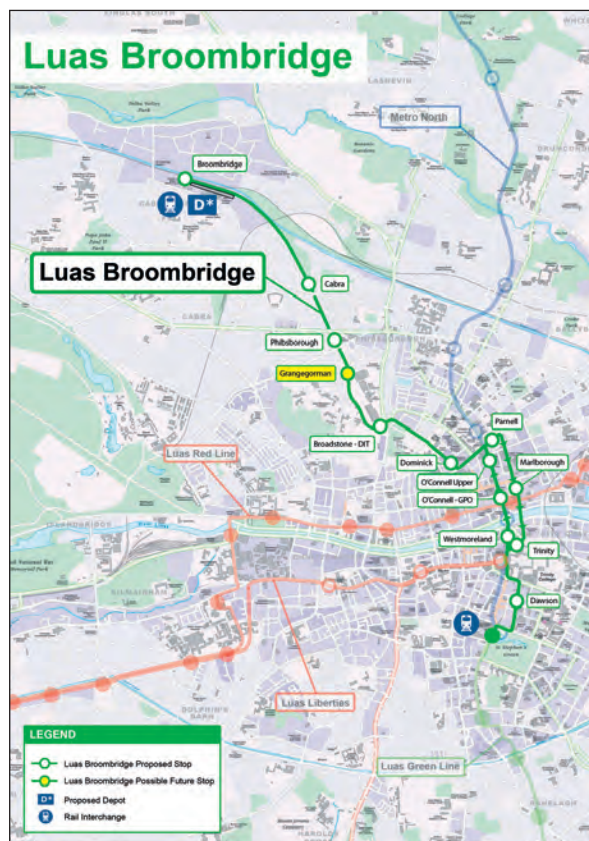
During this process of engineering and architectural design, environmental assessment and consultation continued and more local alternatives were studied and evaluated to optimise the design of the proposed scheme and mitigate potential significant negative environmental effects. This iterative process was also informed by feedback from consultation.

The following categories of design alternatives studied were:

- Proposed stop locations, access and design
- Horizontal and vertical track alignment between stops
- Location of crossovers and turn backs between tracks
- Power supply systems
- Depot location and design

An outline of the EPRC design alternatives considered is presented in the Alternatives chapter of this EIS (Book 1, Chapter 6).

Figure 1.10 PRC



1.9 DESCRIPTION OF THE SCHEME

1.9.1 General description of the proposed scheme

The proposed scheme will serve a 5.6km long corridor from the Luas Green Line at its current terminus (St. Stephen's Green) to the Iarnród Éireann Broombridge Station on the Maynooth railway line.

The forecast journey time between St. Stephen's Green and Broombridge is expected to be approximately 24 minutes. The initial service pattern is likely to be 20 trams per direction per hour during the peak periods, or one tram every 3 minutes in each direction. This service pattern will provide capacity for 6,200 passengers per direction per hour, based on 43m long trams with each tram having a maximum capacity of 310 persons.

The proposed scheme will integrate with the existing and proposed Luas and metro systems.

1.9.2 Interchange and connectivity

The proposed scheme will link Dublin city centre to Phibsborough and Cabra via Broadstone and Grangegorman and will provide a fast and reliable commuter service to the city centre, greatly enhancing the connectivity of the whole rail based public transport network.

Interchange with the Luas Red Line will be at the Abbey Street Stop and with the proposed Luas that runs from Lucan to the city centre, at Westmoreland and Trinity Stops.

The proposed scheme will provide direct interchange with the proposed DART Underground at St. Stephen's Green. As well as convenient interchange with Iarnród Éireann suburban rail and the proposed DART services at Broombridge Station on the Maynooth railway line.

Interchange with the bus will be facilitated throughout the system, with convenient access to bus stops from the proposed Luas stops. Furthermore, a number of proposed stops are conveniently located close to various "dublinbikes" stations provided as part of Dublin's bicycle sharing scheme.

1.9.3 Characterisation of the two areas of the alignment

For ease of local identification, in this EIS the proposed scheme has been divided into two areas. These areas are Area 29 and Area 30. The EIS in each of these areas is set out in individual books which collectively make up Books 1–3 of this EIS. A description of the proposed scheme with reference to each of these two areas is set out in the following sections.

1.9.3.1 Area 29: St. Stephen's Green to former Broadstone railway cutting

The proposed scheme begins at the existing terminus of the Luas Green Line at St. Stephen's Green West. The twin track arrangement travels northwards from this point and turns east along St. Stephen's Green North. A single track turn back facility with related crossover will be provided on the south side of St. Stephen's Green North, and east of Dawson Street to facilitate operational flexibility. The double track then turns north on to Dawson Street. A stop will be provided on Dawson Street with offset lateral platforms. The northbound platform is proposed to be located on the west side of the street between Anne Street South and Duke Street and at the exit from Royal Hibernian Way. The southbound platform will be located on the east side of the street and north of Dawson Lane.

The route turns west on to Nassau Street and travels northwards on to Grafton Street (lower) and then traverses College Green in front of Trinity College Dublin (TCD). At this point the tracks diverge, with a single line track proceeding north on to Westmoreland Street and occupying a position on the east side of the street with the Westmoreland Stop proposed to be located between Fleet Street and Aston Quay.

The single track crosses O'Connell Bridge and then travels along the west edge of the centre median on O'Connell Street Lower. The route crosses the Luas Red Line tracks at Middle Abbey Street where an engineering link is provided between the two lines. The proposed O'Connell - GPO Stop will be located on the median between Prince's Street North and Middle Abbey Street, affording interchange opportunities between the proposed scheme and the Luas Red Line.

The route continues northwards along the west edge of the median passing the GPO and The Monument of Light ("The Spire") on to O'Connell Street Upper and then moving into the median. The proposed O'Connell Upper Stop will be located within the median south of the junction with Cathal Brugha Street.

From this point the route then proceeds east on to Parnell Street for journeys returning southbound towards St. Stephen's Green, and also west on to Parnell Street for the journey northbound to Broombridge.

From Parnell Street to St. Stephen's Green West

Exiting out of O'Connell Street Upper, the route moves onto Parnell Street to the proposed Parnell Stop. The route then turns south and on to Marlborough Street. The proposed Marlborough Stop will be located on the east side of the street and north of the junction with Abbey Street Lower. The route then crosses the existing Luas Red Line track (where an engineering link is provided between the two lines) and proceeds south and on the west side of Marlborough Street to Eden Quay. From there the track crosses the River Liffey on the proposed Marlborough Street Public Transport Priority Bridge which is being progressed by DCC. On the south side of the river the single track route crosses Burgh Quay on to the west side of Hawkins Street. Emerging out of Hawkins Street the single track route crosses Townsend Street and Pearse Street and proceeds in a southwesterly direction along the south side of College Street where the proposed Trinity Stop will be located. The single track route then rejoins the double track line at College Green and proceeds south onto the lower part of Grafton Street, Nassau Street, Dawson Street, St. Stephen's Green North and returning to the Luas St. Stephen's Green Stop.

From Parnell Street to former Broadstone railway cutting

From the north end of O'Connell Street Upper, the proposed scheme turns west onto Parnell Street where it runs adjacent to the northside footpath in front of the Rotunda Hospital. The double track route

passes through the junction with Parnell Square West and remains on the north side of the street as far as the junction with Dominick Street Lower. The route turns north on to Dominick Street Lower running along the west side of the street with the centre platform of the proposed Dominick Stop located close to the junction with Parnell Street. A crossover is proposed to be located south of the junction with Dominick Lane to enable services from the Broombridge direction to turn back at this point. The route crosses Dorset Street and continues along Dominick Street Upper to Western Way and then traverses Constitution Hill to enter the Broadstone environs. The proposed Broadstone Stop will be located in front of and at a lower level than the former railway terminus building which is in use as Broadstone Bus Garage offices. The line passes along the west side of the Broadstone Bus Depot complex, where provision is made for a future stop called Grangegorman, before entering the former Broadstone railway cutting at the north end of the bus depot.

1.9.3.2 Area 30: Former Broadstone railway cutting to Broombridge

Area 30 begins at the existing entrance to the former Broadstone railway cutting. The route runs along the disused railway cutting passing under the existing road bridges at North Circular Road, Cabra Road and Fassaugh Road. The proposed Phibsborough Stop will be located within the railway cutting between North Circular Road and Cabra Road. A second stop, also within the railway cutting, will be located north of Fassaugh Road bridge. From Fassaugh Road the line continues along the disused railway cutting and passes over the Iarnród Éireann Phoenix Park railway line tunnels, before terminating at the proposed Broombridge Stop alongside the Broombridge Station on the Maynooth railway line. A depot will be located at Broombridge as well as additional tracks and ancillary structures for the stabling and maintenance of trams.

1.9.4 Characterisation of the proposed scheme

1.9.4.1 Stop locations

A total of 13 new stops are planned as part of the proposed scheme. The platforms on each of the stops will all be 53m in length to allow for the possible future provision of greater length trams than the 43m (nominal) vehicles that are currently in use on the Luas Green Line. The existing St. Stephen's Green terminus stop will be lengthened as part of the proposed scheme in order to facilitate this future provision.

Photo 1.3 Heuston Stop on the Luas Red Line



1.9.4.2 Track

Single and double track is provided along the route. The spacing between the tracks varies between 2.9 and 3.3m depending on the location. The track gauge is 1,435mm, which is the same as the Luas Red and Green Lines. The maximum speed will be 70km/h, which will be confined to the off-street sections north of Broadstone. Derailment containment is provided where appropriate.

Photo 1.4 Embedded track on the Luas Red Line



1.9.4.3 Substations

The trams operate on 750V direct current (DC). Substations are required to house the necessary equipment to transform and rectify the ESB 10kV supply from the national electricity grid and output to the traction system at 750V DC.

Four substations are required to serve the route. Two of these substations will be new Medium Voltage (MV) substations located above ground, one at Broadstone along the western perimeter of the Broadstone Bus Depot, and the other at the east end of the proposed Broombridge Depot. The existing Luas Green Line underground substation at St. Stephen's Green West

Photomontage 1.1 Dawson Street Year 15



Photomontage 1.2 Trinity Stop Year 15



will be upgraded to meet the additional requirements for the proposed scheme. The fourth substation will be provided for at O'Connell Street Lower as part of the Metro North project, or as a separate substation should the proposed scheme implementation precede Metro North.

1.9.4.4 Traction power and signals

The power for the proposed scheme will be supplied at a nominal voltage of 750V DC fed to the trams through an Overhead Conductor System (OCS). The overhead power lines will be, at a minimum height of 6.0m above the ground in areas where road traffic can run directly on or across the alignment, supported by poles positioned either alongside or between tracks, or by cables fixed to building façades.

1.9.4.5 Depot

The depot site at Broombridge occupies an area of approximately 1.85ha. The depot includes: maintenance and stabling facilities for trams, a vehicle wash plant and sanding shed, and an operator's building which will house materials storage for operations and maintenance requirements in addition to driver welfare facilities and local depot control.

1.9.4.6 Vehicles

The proposed scheme will be operated using trams which are similar to those currently in operation on the Luas Green Line. The trams are approximately 43m long comprised of articulated units with flexibility to permit expansion through the insertion of additional modules to 53m in length. The trams are bi-directional with a driver's cab at each end and are 2.4m wide. Seats for approximately 80 passengers and designated on-board facilities for mobility impaired persons will be provided.

1.9.4.7 Structures

In addition to the construction of a depot at Broombridge and the provision of Luas stops and substations, other structures to be provided include:

- An underpass at Broadstone within Area 29
- A crossing of the Phoenix Park railway tunnel in Area 30
- Construction of a pedestrian bridge and associated lifts over the Maynooth railway line at Broombridge Station

1.9.5 Operating characteristics

The initial service pattern is likely to be 20 trams per direction per hour during the peak periods, or 1 tram every 3 minutes in each direction. This service

pattern will provide capacity for 6,200 passengers per direction per hour, based on 43m long trams with each tram having a maximum capacity of 310 persons. Services will generally operate between 5am and 12.30am on weekdays. Saturday and Sunday service levels are anticipated as being similar to off-peak levels with some enhancement to cover peak shopping periods and sporting events. Additional late night services will be operated to facilitate seasonal (e.g. Christmas) and special events.

1.9.6 Construction of the proposed scheme

All construction work in connection with the proposed scheme will be carried out in accordance with relevant health and safety legislation and best practice.

Construction compounds will be established at designated locations along the proposed scheme for the storage of materials, plant and equipment and for site offices. The main construction compound will be provided on the depot site at Broombridge with smaller compounds provided in the city centre areas. The main construction compound at Broombridge will be used as the primary location for storage of materials, plant and equipment, site offices and worker welfare facilities. The city centre compounds will primarily consist of site offices and worker welfare facilities with smaller storage units for handheld and small plant. The location of the construction compounds are:

- St. Stephen's Green North
- Cathal Brugha Street
- Western Way
- Broadstone
- Grangegorman (Broadstone Bus Depot)
- Broombridge

1.9.7 Construction activities and phasing

Construction is expected to start at the same time at various locations along the route, including stop locations. Duration is expected to take approximately 33 months. A period for testing and commissioning of the new system will be required in addition to the above referenced time period. The first phase of construction involves the diversion of utilities and other advance works including: archaeological testing and excavations, temporary removal of statues and other heritage items and junction reconfigurations to facilitate traffic management. Following these works, construction of the stops, structures and track is completed. Throughout the construction phase,

monitoring of noise, vibration and air quality will be carried out. Opportunities for working on a 24 hour basis will be explored with DCC in efforts to expedite the works duration, although such opportunities may be limited in city centre residential areas.

The indicative timelines and phasing of the proposed construction works has considered the potential for simultaneous construction of other major infrastructure projects and major developments which are proposed within the city centre. These proposed projects include: Metro North, DART Underground, Arnotts “Northern Quarter” development and the “Dublin Central” (Carlton site) development. In developing a construction strategy for Luas Broombridge, cognisance has been taken of the potential interactions and cumulative impacts during the construction of all projects.

Subject to receipt of an enforceable RO for the proposed scheme within the procurement timelines for Metro North, it is proposed that elements of the proposed scheme infrastructure (trackbed, rail, stop platforms, pole foundations, etc.) would be included within the Metro North scope of works for the main works contract at St. Stephen’s Green West, St. Stephen’s Green North, Westmoreland Street, and O’Connell Street Lower between Bachelor’s Walk and Henry Street.

1.10 CONSULTATION

RPA has consulted widely in relation to the proposed scheme, including: consulting with residents, residents’ associations, businesses, business representative bodies and elected representatives. Stakeholder statutory bodies, bodies with environmental responsibility and interest and other interested parties were also consulted in relation to the proposed scheme. Consultation started in 2005 and focused on the following topics:

- Alternatives: This focused initially on route corridor options and then progressed to include: stop locations, detailed alignment and associated infrastructure designs and locations
- Scoping: The EIS scoping exercise represented the beginning of the EIA for the PRC. The purpose of the scoping exercise was to establish the scope and methodology for the EIS and to provide the public and relevant bodies with environmental responsibility and other interested parties with information on the proposed scheme and to invite their input to the EIA process
- Impacts and mitigation: Where the potential

for significant effects was identified, detailed consultation with key stakeholders was undertaken in order to minimise the effects

- Consultation evolved with the project design and environmental assessment from general topics to more specific topics as the design of the proposed scheme progressed

Various approaches were used to facilitate consultation on the project. These included:

- Newsletters direct to peoples’ homes including free post comment cards
- Open days in local civic centres, community halls and hotels
- Meetings with residents’ associations, businesses, and other groups
- Public meetings
- Direct correspondence and meetings with individual residents
- Detailed discussions and workshops with stakeholders
- Written correspondence including: letters, e-mails and faxes
- Presentations and detailed discussions with local public representatives
- RPA website, including: maps, drawings, newsletters, responses to frequently asked questions (FAQs) and an e-mail address to facilitate questions and information requests

A summary of some of the issues raised to date during consultation are outlined in the following points and are dealt with in the main EIS. Concerns were raised in relation to the following:

- The construction impact of the proposed scheme on local business especially in the city centre
- Potential for negative health effects associated with the proposed scheme, in particular during the construction phase
- Anti-social behaviour at stops
- Potential for nuisance and disturbance associated with the proposed scheme due to noise and vibration

- The potential to negatively effect hedgerows, nesting birds, badgers, otter, bats and the Royal Canal
- Potential visual impacts resulting from lighting and overhead wires
- Potential for negative effects on air quality
- Potential impact on known and previously unknown archaeological material
- Potential for a negative effect on St. Stephen's Green
- Cumulative impacts
- Potential for a negative effect on O'Connell Street
- Traffic disruption
- Potential impacts on bus stops, routes and services
- Potential impact of construction and operation on properties and property value

1.11 HUMAN HEALTH

As part of the consultation process feedback from the general public included concerns regarding human health. As a result, a human health assessment has been undertaken of the proposed scheme.

There is remarkably little in the medical literature overall about the human health effect of railway lines. Most information that is available about transport noise indicates rail travel causes fewer problems in comparison to other transport modes.

Some very limited effects of night time noise and noise close to educational establishments have been identified in the EIS related to periods of time within the construction phase. Given the defined time period of the construction phase no adverse human health impacts are predicted.

Once mitigation measures described in the Human Beings: Noise impact assessment chapter of this EIS (Books 2 and 3, Chapter 4) are in place, no ongoing adverse noise affecting human health are predicted during the operational phase.

The overall impact of the proposed scheme in the operational phase on psychosocial health is considered to be beneficial.

There are potentially great benefits for society, including therefore general health and well being benefits, with the development of the proposed scheme, particularly for people living along the route.

Photomontage 1.3 O'Connell Street Lower – GPO Year 1



Photo 1.5 Dominick Street Lower



Photo 1.6 Former Broadstone railway cutting



2 LUAS BROOMBRIDGE IMPACTS

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Photomontage 2.1 College Green Year 15



Photomontage 2.2 Marlborough Street Year 15



2.1 INTRODUCTION

The baseline environment and the associated environmental impacts related to the proposed scheme are summarised under the following environmental topics:

- Human Beings: Landuse
- Human Beings: Socio-economics
- Human Beings: Noise
- Human Beings: Vibration
- Human Beings: Radiation and Stray Current
- Human Beings: Traffic
- Flora and Fauna
- Soils and Geology
- Groundwater
- Surface Water
- Air and Climatic Factors
- Landscape and Visual
- Material Assets: Archaeology and Cultural Heritage
- Material Assets: Architectural Heritage
- Material Assets: Property
- Material Assets: Utilities

Further details regarding each of these environmental topics are provided in the following sections.

2.2 HUMAN BEINGS: LANDUSE

There are a variety of landuses along the proposed scheme in Area 29, including: residential, green open space, community, offices, industrial, commercial, and sports and leisure as well as lands dedicated to transport infrastructure. The impacts associated with landuse are landtake and severance. Landtake has the potential to change how the land is used, particularly in terms of the remaining area outside the landtake. Severance is where access to an area becomes more circuitous or is completely closed. An indirect landuse impact of this scheme is where a stop is located on suitable zoned land, which would enhance the development potential of the site.

There will be impacts on landuse as a result of the construction of the proposed scheme. Some temporary or short-term landtake will occur to facilitate the construction of the alignment, stops and associated features. In Area 29, there will be landtake from the existing streetscape along the length of the proposed scheme, at St. Stephen's Green and at Constitution Hill and Broadstone. In all instances the minimum amount of land necessary will be taken and provisions will be made for redirecting traffic. In Area 30 there will be a small area of temporary landtake from residential gardens at Cabra Road and Mount Bernard Park to facilitate access to construct the Phibsborough and Cabra Stops, respectively. Residual impacts are impacts that are still considered significant after mitigation. There are no residual landuse construction impacts in Area 29 and Area 30 as short-term or temporary landtake can be successfully mitigated by restoring the areas post construction.

In addition to the above construction impacts, some areas of land will be severed by the proposed scheme.

The entire site of the petrol filling station and adjacent derelict buildings are to be taken at Constitution Hill, to facilitate the provision of the stop. This area will be replaced by public open space thereby providing a more appropriate landuse adjacent to the stop.

There will be permanent severance of green urban lands to the north of Mount Bernard Park. During the operational phase this land will be visible to passengers as the trams go past requiring that the area be maintained. It is proposed to mitigate this impact by agreeing alternative access to the land with an adjacent landowner in order to maintain the area.

Operational impacts are long-term impacts associated with the proposed scheme. In Area 30 there will be permanent landtake of the former Broadstone railway cutting from Broadstone to Broombridge. Restoring the use of the cutting as a transport corridor is a positive impact. Iarnród Éireann lands adjacent to the Maynooth railway line will also be acquired to facilitate the provision of the proposed scheme. To mitigate potential landuse impacts the existing boundary will be relocated.

Most of the impacts in Area 29 and Area 30 can be successfully mitigated by relocating the boundary of the affected lands or by agreeing an alternative with the landowner.

2.3 HUMAN BEINGS: SOCIO-ECONOMICS

There are numerous factors which affect the socio-economic profile of areas along the proposed scheme. These include: unemployment levels, education levels, travel characteristics, the presence of regeneration areas and economic activity in the area.

Relevant construction impacts include: temporary diversions to pedestrian/traffic flows, the visual impact of construction works and the creation of construction jobs. The construction phase of the proposed scheme will lead to both the direct employment of construction workers and indirect employment creation through construction workers' wage expenditure and purchase of materials.

In terms of the effect on business along the proposed scheme, the construction phase will lead to temporary pedestrian/traffic diversions, which may decrease footfall in some areas close to the construction works. There may be a similar effect on tourist attractions close to the proposed scheme, with the additional visual impact of construction fencing and the obstruction or short-term relocation of well-known landmarks.

The construction phase will have a negative effect of moderate significance on businesses. Mitigation measures to reduce the significance of this effect include the development of a Construction Traffic Management Strategy (CTMS) dealing with all road user categories to ensure that access to businesses is maintained. After mitigation measures have been implemented, the significance of the impact on businesses is deemed to be slight.

All other negative construction impacts are deemed to be slight and thus no mitigation measures are proposed.

Operational impacts are long-term impacts associated with the proposed scheme. All socio-economic impacts as a result of the proposed scheme are positive, there are therefore no specific mitigation measures.

Long-term impacts include changes in the accessibility of areas along the proposed scheme together with the creation of jobs related to its operation and maintenance. The proposed scheme will greatly assist in increasing the employment opportunities for residents along the alignment in areas where there are currently high levels of unemployment. This will also assist with the ongoing regeneration and renewal projects in these socially disadvantaged areas.

The proposed scheme will assist with increasing the overall accessibility to a range of nearby social and community facilities, and (via the wider rail network) across the wider GDA. Examples of these facilities include: town centre facilities, such as post offices, local shops, professional services, medical facilities, third level institutions (e.g. DIT Grangegorman, TCD), and key retail and commercial areas (e.g. Dublin city centre).

In terms of economic activity, the proposed scheme will greatly improve the connectivity between key retail areas in Dublin city centre (Grafton Street and Henry Street areas). This will serve to enhance the city centre's retail environment. Tourism-based activities will also be aided with improved connectivity between some of Ireland's most popular tourist attractions.

2.4 HUMAN BEINGS: NOISE

Noise is often defined as sound that is unwanted by the recipient and has the potential to cause disturbance, discomfort or psychological stress to the recipient. The level of noise, in terms of "loudness", is used to determine if humans are affected by noise. The proposed alignment extends from St. Stephen's Green to Broombridge and passes through both commercial and residential areas. In Area 29 the existing noise levels are high and are typical of a city centre area where the noise environment is dominated by the large volume of bus and other transport movements. In Area 30 the existing noise levels range from high noise levels near busy roads to low in low-traffic residential areas, which follow the typical noise levels for such areas. The highest noise levels are experienced during the daytime and late night measurement periods and the lowest noise levels are experienced during the early morning measurement periods.

To minimise any noise impacts during the construction stage of the proposed scheme good site management practices will be implemented, which will include: carefully selecting and positioning equipment, only working during prescribed hours, and monitoring noise levels at prescribed sensitive locations. With these mitigation measures in place the residual construction noise impacts, from both utility diversions and main infrastructure construction activities should only be imperceptible or slight. It should be noted that the existing noise levels within Area 29 are relatively high, so any additional construction noise would have less impact than in a quieter area. Also humans are less sensitive to short-term noise impacts, such as during construction, and therefore temporary higher noise levels are more acceptable than long-term lower noise levels.

Mitigation measures during the operational phase focus on track design and installation and maintenance of the proposed scheme. This will include:

- Continuously welded rails
- Monitoring and minimising defects such as wheel flats
- Ensuring there is a smooth rail through a maintenance regime of grinding the rails
- Lubrication systems on the vehicle to minimise squeal on curves.

Overall the residual operational noise impacts, which occur from both operational tram noise and permanent traffic diversions, should have no more than a moderate significance.

2.5 HUMAN BEINGS: VIBRATION

When two objects come into contact through movement (such as a wheel and rail), the mechanical energy from the movement causes vibrations in the vicinity of the two objects. These vibrations can pass through the ground or other structures and can affect humans, buildings and sensitive equipment by causing annoyance, minor damage or interference. The proposed alignment extends from St. Stephen's Green to Broombridge and passes through both commercial and residential areas with low levels of vibration that are unlikely to cause annoyance or damage. Area 29 contains humans, buildings and sensitive equipment that can all be affected by vibration. Area 30 contains both humans and buildings that can be affected by vibration.

To minimise any vibration impacts during the construction stage of the proposed scheme good site management practices will be implemented. This will include: carefully selecting and positioning equipment, only working during prescribed hours, and monitoring vibration levels at particularly sensitive locations, such as St. Patrick's Well. With these mitigation measures in place the residual construction vibration impacts, from both utility diversions and main infrastructure construction should only be imperceptible or slight for humans, buildings and sensitive equipment. It should also be noted that humans are less sensitive to short-term vibration impacts, such as during construction, and therefore temporary higher vibration levels are more acceptable than long-term lower vibration levels.

Operational vibration impacts can be mitigated as appropriate by reducing vibration transmission from the interaction between wheels and rails to the

ground, vibration isolation techniques, the trackbed design, and an appropriate maintenance regime. The vibration assessment assumes the standard track design used on other parts of the Luas network. Vibration monitoring will be carried out at locations that are particularly sensitive to vibration.

Due to the distance between the track and receptors within Area 30 additional mitigation measures should not be required and there should only be imperceptible or slight vibration impacts on humans and buildings during operation.

2.6 HUMAN BEINGS: RADIATION AND STRAY CURRENT

In order to facilitate detailed investigation of electromagnetic compatibility (EMC), representative exposed locations along the route were selected and predicted levels for these areas were estimated. The locations that were selected covered the range of different infrastructure configurations that occur in the proposed scheme including alignment and with or without stops.

Areas which are dominated by open greenfield or areas where sensitive receptors such as houses and schools are very rare are considered to be of low to medium sensitivity. Locations such as medical facilities are assumed to have sensitive equipment and therefore are considered to be of very high sensitivity.

There are no radiation and stray current impacts anticipated for the construction of the scheme. Therefore there are no specific mitigation measures required during the construction phase of the proposed scheme.

Potential levels of electromagnetic interference (EMI) and stray current during the testing and commissioning of the trams and traction power supply system are expected to be within those provided for the operational phase.

Measures to minimise stray current have been incorporated into the design specifications and will be implemented during the construction and operation of the proposed scheme. These measures may include the use of a stray current collector system, together with other design measures such as resilient insulating polymer around the rails. The system contractor will be required to ensure that the electrical systems and equipment associated with the proposed scheme comply with relevant legislation. With regard to some types of sensitive electric appliances, relocation of the affected appliance (even a short distance from a railway boundary) may be possible.

The potential for significant impacts to occur due to stray current is considered to be low provided the mitigation measures detailed previously are put in place. The technical design of the proposed scheme conforms to current best practice. During normal scheme operations, the expected electromagnetic (EM) effects have been evaluated and were found to be less than 50% of the field strength of the Earth's natural magnetic field. In the majority of instances these levels are unlikely to pose a threat to the normal operation of receptors such as EM equipment located along the alignment. The described impacts can thus be regarded of low significance and do not present any significant risk.

2.7 HUMAN BEINGS: TRAFFIC

The study area required to assess the traffic and transportation impact of the proposed scheme covers the area within which impacts are anticipated as a result of the construction and operation of the proposed scheme (and which require traffic management measures).

In Area 29 the proposed scheme is located within Dublin city centre and travels along a number of the key routes in the city centre road network. These city centre routes cater for a variety of functions including vehicular and delivery access routes, bus routes and kerbside activities such as: provision of bus stops, loading, parking and taxi rank provision, as well as providing for pedestrian and cycle movement.

Within Area 30 the proposed scheme routes along the former Broadstone railway cutting and as such the traffic impacts anticipated are minimal.

In order to establish baseline transportation conditions a comprehensive programme of data collection was undertaken to record and quantify transport activity throughout both areas with detailed traffic and on-street activity surveys undertaken. In addition an inventory of existing kerbside space for buses, taxis, vehicle loading and parking was also undertaken.

The implementation of the proposed scheme will provide increased accessibility to public transport and greater connectivity to and within the city centre which is likely to result in increased public transport use, a reduction in car use and car dependency. Although the proposed scheme will contribute to broader environmental benefits as the share of public transport increases, there will nevertheless be local impacts along the alignment that will result from reallocation of existing road space and resulting diversion of traffic onto alternative roads.

This assessment addresses such local impacts and their significance on relevant user categories which include all modes of transport including: pedestrians, cyclist, road traffic, construction traffic, all forms of public transport and the associated transport infrastructure. Detailed transportation analysis has been undertaken to assess the likely impact during the construction and operational phases of the proposed scheme.

During the construction of the proposed scheme within Area 29 there will be a requirement to temporarily occupy road space for construction works resulting in lane closures, turn bans and associated traffic diversions. In this context the importance of maintaining accessibility to the city centre during the construction works for servicing and deliveries to premises, access to city centre car parks, pedestrian access and access to public transport (including bus and coach tours) is recognised.

During the construction phase it is likely that average traffic speeds will reduce on areas where works are undertaken and also on diversion routes. A key factor in the continued accessibility of the city centre is to ensure that access to public transport (including public and private bus services, coach and bus tours) and a good level of service is maintained. The traffic management measures implemented during construction will require local diversion of bus services and relocation of bus stops and layover facilities, resulting in a negative impact on bus services. In many cases the relocation of stops implemented at the commencement of construction will be retained as a long-term permanent measure for the operation of the proposed scheme. There will also be a requirement to remove or relocate a variety of kerbside activities on the affected streets including: on-street car parking, loading bays and taxi ranks.

Where possible, existing footpath widths will be maintained on all affected streets and access to premises will be maintained throughout the course of the works.

In order to mitigate the potential negative impacts of the traffic management measures required for construction within the city centre a CTMS has been prepared.

The CTMS provides a basis for the preparation by the contractor of detailed traffic management plans for the works. Prior to their implementation, all traffic management plans will be agreed with DCC following detailed consultation with An Garda Síochána and other statutory stakeholders. Where permanent

changes to traffic routings are envisaged for the operational phase of the proposed scheme, these will be introduced as early as possible during the construction phase where practicable.

The proposed scheme works will be coordinated with other developments including the construction of Metro North, DART Underground, Arnotts “Northern Quarter” development and the “Dublin Central” (Carlton site) development.

For the operation of the proposed scheme a variety of traffic management measures will be required due to the reductions in roadspace resulting from implementation of the scheme. Furthermore, as there are some areas of shared running with other road traffic it will be necessary to reduce traffic volumes to ensure reliability of the system. The traffic management measures proposed include: turning restrictions, diversions, conversion of streets to one-way flow, removal/relocation of kerbside facilities such as loading bays, on-street parking and taxi ranks.

The presence of the proposed scheme and associated stops will result in a requirement to relocate bus stops and bus layover facilities; however, diversion of services would be limited. In order to mitigate the potential negative impacts on bus services, alternative bus stop locations and layover facilities have been proposed. Any such revision to bus services would be agreed with the relevant bus operator, and in the case of BAC would be undertaken in the context of their on-going network review. On O’Connell Street Upper, the proposed scheme alignment has been fashioned in such a way as to minimise potential impacts on the extensive array of bus stops at this important city centre bus location.

In general in Area 29 the impact of the traffic management measures required for the operation of the proposed scheme have a local negative impact but will not significantly impact the operation of the city centre road network. The proposed scheme is considered to have a local negative impact on bus services but in the context of the current bus network review which, in association with the planned new public transport bridge over the Liffey on the Marlborough–Hawkins axis, opportunities for mitigation are presented with potential for development of new routing structures in the core city centre area.

Within Area 30 the interaction with other traffic and transport networks are minimal due to the segregated nature of the route within the former Broadstone railway cutting.

It is considered that the proposed scheme will have a positive impact on the development of an integrated public transport network with interchange provided with the Luas Red Line, the proposed Luas Lucan Line at College Green/Dame Street, Metro North at St. Stephen’s Green, O’Connell and Parnell Stops. The proposed scheme will also provide direct interchange with the proposed DART Underground at St. Stephen’s Green and convenient interchange with Iarnród Éireann suburban rail and proposed DART services at Broombridge Station on the Maynooth railway line.

Interchange with the bus will be facilitated throughout the system, with convenient access to bus stops from the proposed Luas stops.

Within the context of the major infrastructure and other developments to be implemented within Area 29, including the proposed scheme, it is considered desirable that an overarching traffic strategy be implemented by DCC to complement the provision of these and other projects. This strategy would set out its vision for the city centre and incorporate a citywide transport plan to facilitate the construction and operation of these projects. This will bring a coherence, understanding and certainty to a long-term traffic routing for the city which will inspire confidence and ensure reliability of access thereby maintaining the vitality and economy of the city centre throughout and beyond the construction phase.

An effective, intensive and coordinated major communications campaign which has the support and active involvement of all key stakeholders will be fundamental to the successful implementation of such a citywide transport plan.

2.8 FLORA AND FAUNA

The proposed Area 29 alignment passes through a densely urban environment. The habitats recorded along the alignment are predominantly of low to moderate ecological value. Occasional areas of higher value occur at the River Liffey and at St. Stephen’s Green. There are a number of sites designated for their national or international nature conservation importance in the surrounding area. There are no candidate Special Areas of Conservation (cSAC) or Special Protected Areas (SPAs), proposed Special Protected Areas (pSPA), within the study area or potentially affected by the proposed scheme.

The fauna species of interest recorded were predominately located in the area of the River Liffey corridor, which supports salmonid fish species and

otter. There is limited suitable habitat for badgers within the study area and no badger setts or signs of badger were recorded. No evidence of bat use was found in any of the surveyed structures or trees. A wide range of common bird species, typical of the urban environments occur within the study area.

The proposed Area 30 alignment passes through an urban environment. The habitats recorded along the alignment are predominantly of low to moderate ecological value. Areas of higher value occur along the Royal Canal. There are a number of sites designated for their national or international nature conservation importance in the surrounding area. There are no pSPAs, cSAC or SPAs, within the study area or potentially affected by the proposed scheme.

The fauna species of interest recorded were predominately located in the area of the corridor, which supports salmonid fish species and otter. No evidence of protected species was found along the route. A number of protected species are known to occur in nearby habitats along the Royal Canal. A wide range of common bird species, typical of the urban environments occur within the study area.

The proposed alignment in Area 30 overlaps with the Royal Canal proposed Natural Heritage Area (pNHA) (002104) for c. 90m². There will be a permanent loss of a small area of dry meadow and grassy verge and scrub habitat. However, this habitat is of moderate ecological value and is confined to a small area where the designated site boundary extends into the former Broadstone railway cutting. The habitat loss does not affect the conservation status or integrity of the proposed designated site. Consequently it is not to be considered as a significant adverse effect.

The construction of the proposed scheme will result in the loss of dry meadow and grassy verge, scrub habitat and two small ponds of stagnant water at Broombridge and within the former Broadstone railway cutting. There will also be an eradication/control of the invasive species Japanese knotweed (*Reynoutria japonica*) on the site constituting a positive impact. These sites have a low baseline rating and the loss of habitat is not considered significant.

No protected species will be impacted upon and no specific mitigation or licensing is required for the removal of these structures or trees. Some temporary disturbance to a range of common fauna species will occur. No significant impacts on habitats or species are predicted as a result of the proposed alignment.

The construction of the proposed scheme in Area

29 will result in the temporary loss of a small area of treelines at St. Stephen's Green resulting in a slight/minor negative impact. Following mitigation and the reinstatement of trees the slight/negative impact will diminish over time and become an imperceptible/neutral residual impact. The proposed scheme will result in the loss of a number of trees along the alignment resulting in a slight/minor negative impact.

Following mitigation and the reinstatement of trees the slight/negative impact will diminish over time and become an imperceptible/neutral residual impact. Impacts on protected species such as Atlantic salmon that occur within the River Liffey will be avoided once comprehensive surface water management and best practice mitigation measures are implemented to avoid water pollution during construction.

The proposed scheme will involve temporary loss of predominantly urban habitat (buildings and artificial surfaces) along the alignment, which will be reinstated following construction. The proposed scheme will cross the River Liffey on existing structures at two points upstream of the Dublin Bay designated sites. Comprehensive surface water management and best practice mitigation measures will be implemented to avoid water pollution during construction. There will be no impact on the aquatic environment or downstream on designated sites. No mature trees will be impacted at St. Stephen's Green or elsewhere along the route. A number of young and semi-mature treelines and individual trees will be removed for construction. These will typically be reinstated on completion of the works. No protected species will be impacted upon and no specific mitigation or licensing is required for the removal of these structures or trees. Some temporary disturbance to a range of common fauna species will occur. No significant impacts on habitats or species are predicted as a result of the proposed alignment.

There will be no residual impacts associated with the operation of the proposed scheme.

2.9 SOIL AND GEOLOGY

Available soil mapping produced by Teagasc, the National Agriculture and Food Development Agency, indicates that with the exception of an area of relatively undisturbed soil around the Royal Canal at Broombridge, the natural soil cover has been removed, altered, degraded and/or sealed by urban development everywhere along or in the vicinity of the proposed scheme.

The underlying mineral subsoil along the proposed scheme is generally described as sandy gravelly clay

with stones. This material, known as glacial till, was deposited during the last Ice Age at the base of a moving ice sheet. Around the River Liffey crossings, the underlying subsoil locally comprises mixtures of river deposited sand, silt and clay, known as alluvium.

The rock which extends beneath the proposed scheme largely comprises interbedded limestone and shale/mudstone formations. There are no rock exposures along or in the vicinity of the proposed scheme, nor are there any working quarries or sites of geological interest.

Radon is a naturally occurring radioactive gas produced by the radioactive decay of uranium and is present in small quantities in all soil and rock. The area along and in the vicinity of the proposed scheme is not identified as a high radon area on radon hazard maps published by the Radiological Protection Institute of Ireland (RPII).

Although there are no recorded geological hazards along or in the vicinity of the proposed scheme, a walkover survey of the former Broadstone railway cutting and Broombridge identified some evidence of instability in existing soil slopes.

Available ground investigation data suggests that slightly elevated levels of contamination occur locally in road pavement foundations and underlying subsoil across the city centre. Pockets of contamination are also present in subsoil around Constitution Hill, the Broadstone Bus Depot, and North Circular Road bridge. The contamination encountered is principally associated with fossil fuels or emissions resulting from their combustion.

Japanese knotweed is an invasive plant which dominates other plants and, where it occurs, it leads to a marked reduction in floral diversity. It occurs at a number of locations along the slopes of the existing railway cutting in Area 30. The presence of roots and seeds in the underlying soil and/or subsoil markedly reduces their quality and value as a growing medium or landscaping/construction material.

The principal construction impact of the proposed scheme on the soil and geology environment is the potential increase in soil and/or subsoil erosion by surface water runoff. During the construction phase, a surface water management system will be implemented in order to minimise erosion and limit the concentration of particulate material in surface water runoff. Hardcore materials will also be placed over bare soil and/or subsoil to minimise erosion and rutting by site traffic. The implementation of these measures

will ensure that soil and subsoil erosion should only be minor, and possibly almost unnoticeable.

Excavation and handling of any existing soil or subsoil during construction may result in mobilisation of existing contaminants in the ground, increasing the extent or the degree of contamination in surrounding ground. In order to avoid increased contamination in the ground or adverse human health impacts, it is proposed to:

- Identify and delineate the extent of any soil and/or subsoil contamination by further ground investigation and soil quality testing prior to construction
- Capture all surface water and groundwater in contact with contaminated soil or subsoil in order to limit contamination
- Develop a contaminated soil and/or subsoil excavation and handling strategy as part of an overall Waste Management Plan and project-specific Health and Safety Plan
- Undertake environmental monitoring of all excavations for potential contamination and/or gas emissions during the construction phase

The storage and handling of fuels and lubricants and solid or liquid wastes during the construction phase increases the potential risk of localised soil or subsoil contamination as a result of an accident, spill or leak. Measures will be implemented during the construction phase to control the storage and handling of fuels, lubricants and waste. It is proposed to:

- Store fuels, chemicals, liquid and solid wastes on impermeable surfaces
- Undertake refuelling of plant on paved surfaces where feasible
- Ensure all storage tanks and drums are fully bunded
- Provide spill kits at high risk sites

Implementation of these measures will reduce potential pollution risks to acceptable levels and should ensure that only minor environmental impacts will arise during construction.

In order to limit the potential for the further spread of Japanese knotweed along the railway cutting during construction, it is proposed to spray areas affected by the plant before construction works commence in order

to control and/or kill it. During the construction phase, it is proposed to place soil and subsoil cover over affected areas in order to further inhibit the spread of the plant and ensure that any additional degradation of the soil and/or subsoil resource is minor.

The export of road foundation and/or excess earthworks material off-site during construction has the potential to degrade soil and/or subsoil at off-site locations. This indirect impact is controlled by ensuring that all materials removed off-site are only forwarded to licensed or permitted waste sites where adequate environmental protection measures are in place to ensure that no contamination of soil or water will result.

A Waste Management Plan will be developed in accordance with the Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects DoEHLG as part of the construction environmental management plan to ensure that all construction waste is managed, stored and disposed of in an appropriate manner by appropriate contractors in accordance with all relevant waste legislation.

When operational, surface water runoff from the proposed scheme has the potential to cause long-term erosion of soil and/or subsoil. This impact will essentially be eliminated by installing and maintaining a surface water drainage system along the rail track.

Operation and maintenance activities and/or accidental leakages have the potential to cause some slight contamination of soil or subsoil. These risks will be effectively eliminated by installing and maintaining a surface water drainage system along the rail track and by undertaking tram maintenance over a sealed concrete surface at the depot site. There is some evidence of instability in existing soil slopes along the former railway cutting and there is potential for further instability to arise when the proposed scheme is operational. The risks of slope instability will be effectively eliminated by regrading slopes within the available landtake, installing drainage, constructing low-rise retention structures, and/or undertaking specialist slope stabilisation works.

2.10 GROUNDWATER

An extensive review of the baseline groundwater environment underlying the route of the proposed scheme in Area 29 and Area 30 was undertaken. Information was gathered by undertaking field surveys, consultation with relevant stakeholders and a study of relevant and available information with regard to groundwater quality in the study area.

The proposed scheme is underlain by a locally important aquifer with moderate to high vulnerability. Groundwater quality is likely to be impacted to some extent by historical urban activity and there is potential for existing localised contamination of the aquifer due to historical land use.

The groundwater baseline assessment indicated that the underlying groundwater environment in the area along the proposed scheme is not highly sensitive with regards to potential impacts from the construction and operation of the proposed scheme.

During the construction phase, various activities have the potential to pollute the groundwater environment in Area 29 and Area 30.

These potential pollutants can originate from:

- Leakages or spillages of fuels from construction vehicles
- Oil or other chemical spillages during refuelling or maintenance of construction vehicles
- Leakages or spillages from fuel or chemical storage areas or the inappropriate disposal of chemicals on-site
- Suspended solids or chemicals from overburden soils which have been exposed to erosion during construction activities

A range of impact mitigation measures will be implemented at all work areas during the construction phase including: the appropriate handling, use and storage of all fuels or chemicals required on-site, the control and appropriate disposal of all concrete washwaters, the storage of potential polluting materials within bunded areas, and the assignment of designated refuelling areas for construction vehicles. Spill kits and hydrocarbon adsorbent packs will be stored in the designated refuelling area and in the cab of each vehicle and operators will be trained in their use.

During the operational phase, the likelihood of groundwater contamination from the operation of the proposed scheme in Area 29 and Area 30 is considered low as the scheme is electrically powered and there will be no discharge to groundwater from the proposed scheme.

Mitigation measures that will be implemented during the operational phase include:

- Installation of hydrocarbon interceptors and silt traps at the Broombridge Depot

- Storage of potentially polluting substances such as residual waste, fuel oils and cleaning chemicals within designated bunded areas
- Control of wastewater discharge from the depot

Providing the mitigation measures outlined are implemented, residual impacts due to construction activities are assessed as being of very low magnitude and the significance of impacts has been assessed as slight.

2.11 SURFACE WATER

Surface water features in the Area 29 study area of the proposed scheme include:

- St. Stephen's Green Ponds
- River Liffey
- Blessington Basin

Surface water features in the Area 30 study area of the proposed scheme include:

- Royal Canal
- River Tolka

These surface water features were characterised with reference to the following:

- Environmental Protection Agency (EPA) water quality database, mapping and reports
- Water quality sampling carried out in January, May and June 2009
- Office of Public Works (OPW) historical flooding data

The St. Stephen's Green Ponds are artificial water bodies that are not crossed by the proposed scheme and were thus assigned a very low baseline rating.

The River Liffey is classed as moderately polluted but the section of the river crossed by the proposed scheme is a transitory route for migratory salmon. In light of this all negative impacts on water quality should be avoided. There has been some historical flooding in the study area but flood defences have since been put in place. The River Liffey was assigned a medium baseline rating.

The Blessington Basin exhibited good water quality and it is a feature of high local amenity value. For

this reason, the basin was assigned a high baseline rating, although given its distance from the proposed scheme, no impact is expected.

The water quality in the Royal Canal is generally classified as good and there is no historical evidence of flooding. The canal is a pNHA and thus has been assigned a high baseline rating.

The Tolka River is generally classed as moderately to seriously polluted and flooding has occurred on the Tolka, although outside of the study area. The river discharges into the Tolka Estuary which is both an SPA and an SAC. The Tolka River is not crossed by the proposed scheme and was assigned a low baseline rating.

During the construction phase, various activities have the potential to result in changes to drainage patterns and could lead to potential flooding. These include the construction of temporary compounds or uncontrolled discharge of sediment-laden runoff to surface water or foul drains.

There is the potential for contaminated or sediment-laden surface water runoff to arise during the construction phase. If uncontrolled this has the potential to impact on the water quality of the River Liffey and the Royal Canal.

To mitigate against the above potential impacts, the following best practice controlled methods are proposed:

- There will be no discharge to surface water during the construction of the proposed scheme
- Runoff from temporary compounds and construction areas will be controlled and passed through a filtering system to remove silt and hydrocarbons prior to discharge.
- All storm water runoff will be managed on-site using a combination of management techniques to prevent flooding downstream of the proposed scheme
- Discharge licences will be obtained from the relevant local authority where required
- All equipment, fuels and chemicals (if required) will be stored within suitably bunded areas at each of the site compounds and refuelling of construction equipment will take place in designated bunded areas with spill kits and hydrocarbon packs made available

Providing the mitigation measures specified are implemented, residual impacts due to construction activities are assessed as being of very low magnitude and the significance of impacts has been assessed as slight.

During the operational phase, increased surface water runoff may arise from drainage of hardstanding surface areas associated with the Broombridge Depot.

In relation to water quality, the discharge of untreated wastewater and contaminated runoff from the depot site could potentially impact on the quality of the receiving waters if untreated.

To mitigate against these potential impacts the following is proposed:

- All storm water runoff generated during the operation of the proposed scheme will be managed on-site using a combination of Sustainable Drainage System (SUDS) techniques and conventional pipe drainage systems. The total discharge from the site will be restricted to the appropriate limits under licence from the relevant local authority
- Areas at high risk of contamination such as fuel off-load and refuelling areas will take place in designated bunded areas where spill kits and hydrocarbon packs will be available
- Herbicides used during operation will be applied sparingly and in compliance with suppliers' guidance, and will be suitable for use in an environment in which receiving watercourses are present

Providing the mitigation measures specified are implemented, residual impacts due to construction activities are assessed as being of very low magnitude and the significance of impacts has been assessed as slight.

2.12 AIR AND CLIMATIC FACTORS

The proposed alignment extends from St. Stephen's Green out to the northern suburbs of the city at Broombridge and passes through areas where airborne concentrations of pollutants such as nitrogen dioxide and particulate matter (the pollutants of greatest (NO₂) concerns with respect to health) are at their highest anywhere in Ireland. All areas along the alignment currently experience air quality that is compliant with air quality standards.

The construction phase of the proposed scheme will have a greater impact on air quality than

the operational phase for two reasons. Firstly, construction activities have the potential to generate dust emissions and secondly, the changes to road traffic flows on the wider road network are greater for periods when traffic restrictions are in place than would be the case when it becomes operational.

It is not possible to eliminate the emission of dust from a construction site entirely; nevertheless, effective mitigation can be implemented to reduce substantially the impact on neighbouring residents and people in workplaces and community buildings. The impact of construction dust has been assessed by considering the proximity of people likely to be particularly sensitive to those places where construction activity will occur and where construction compounds are planned. Naturally, those people living or working closest to construction activities will be most likely to experience annoyance, should dust be deposited on prominent surfaces in sufficient quantities to make it noticeable. It is never possible in assessments of this kind to define impacts on individual properties in precise numerical terms. In general, it can be said, that people living and working within 50m of construction activity are likely to experience a residual impact the period of construction activities, whilst those at distances of 200m and greater are unlikely to be affected. Rather more people are likely to experience an impact from construction dust in the city centre than elsewhere, simply because the density of people living and working there is greater than for other parts of the scheme. Less people in Area 30 are likely to experience an impact from construction dust compared to the city centre because the density of people living and working in the suburbs is lower than the city centre and the relative distances are generally greater between the receptors and the construction activities.

The construction phase will lead to some route diversions and this in turn will affect road traffic flows on the road network across Dublin. The consequence for air quality will be greater for this period of time than in the future years when the proposed scheme is operational.

Once operational, any changes in local air quality will be associated with changes in traffic flows on the whole of Dublin's road network that are a direct result of the proposed scheme. Careful analysis and assessment has been made of the effect that projected changes in traffic flows will have on pollutant concentrations alongside roads. This analysis has shown that some roads within the vicinity of the proposed route within Area 29 will experience changes; these changes in air quality will mostly be beneficial. No locations will experience pollutant

concentrations above those defined in air quality standards. There will be a significant reduction in emissions of carbon dioxide (CO₂) from traffic using Dublin's road network, when the proposed scheme becomes operational. For Area 30 this analysis has shown that some roads within the vicinity of the proposed route will experience changes; these changes in air quality will all be beneficial. No locations will experience pollutant concentrations above those defined in air quality standards. There will be a small reduction in emissions of CO₂ from traffic using the local road network, when the proposed scheme becomes operational.

2.13 LANDSCAPE AND VISUAL

The landscape/townscape and visual impact assessment of the proposed scheme in Area 29 assesses the impacts on the landscape and townscape character and resources of the alignment through the urban areas of Dublin city from St. Stephen's Green to Broadstone Bus Depot. In addition, it assesses the visual impacts on people who live, work, travel, visit and enjoy the area through which the proposed scheme operates.

The assessment for the study area is dependent on the local landscape/townscape. In the city centre

the study area typically extends to the edges of the buildings on either side of the centre line of the proposed scheme having regard also to views in towards the alignment from adjacent streets, public spaces, along the alignment itself and also with regard to longer distance views along street alignments.

The landscape/townscape and visual impact assessment of the proposed scheme in Area 30 assesses the impacts on the landscape character of the area of land along the former Broadstone railway cutting, which typically extends to the rear boundaries of the houses on either side of the centre line of the alignment along the cutting when viewed from the road bridge crossings. The study area widens as the proposed scheme passes through the lands adjacent to the Royal Canal, terminating at Broombridge.

The assessment is restricted to a study area where the components of the proposed scheme are likely to be seen and the impacts are likely to be significant to the so called visual envelope.

Mitigation measures will include proper site management to ensure working areas are kept tidy, dust is kept to a minimum and all materials and plant are stored in a safe and proper manner. Lighting

Photo 2.1 Tram at the Museum Stop on the Luas Red Line



of compounds and work sites will be restricted to agreed working hours and that which is necessary for security. Tree protection measures and methods of excavation to avoid root damage will be implemented during the works.

On completion of the works all remaining spoil and construction material will be removed and work sites and other land occupied temporarily will be reinstated.

Given the nature of construction works the landscape and visual impact will normally be negative but the impact will be short-term and cease on the completion of the works.

The magnitude of change affecting landscape or visual receptors depends on the nature, scale and duration of the particular change that is envisaged, the location in which it is proposed, and the overall effect on a particular view. In a landscape/townscape, the magnitude of change will depend on the loss or change in any important feature, or change in the backdrop to, or outlook from, a townscape/urban landscape.

Primary visual mitigation of the proposed scheme insertion will be through the designed quality of the rolling stock, the tram stops and ancillary equipment, poles, and the OCS system. Further mitigation will be through the reinstatement of paving to a similar or higher quality, reinstatement of tree planting, street furniture and historic features. The proposed landscape treatments in Area 30 will complement the surrounding ecological network. A range of different habitats will be created to enhance local biodiversity including: grasslands, scrub, woodland plantings and hedgerows. Planting treatments that require minimal long-term maintenance and species that match or enhance the character of the surrounding area will be specified in the design.

The landscape and visual impact in Area 29 will generally be positive with the proposed scheme seen as an integral part of the city centre's transport system. The insertion of the proposed scheme in Area 30 will result in a visual impact which is significant and positive. The line insertion will function as a catalyst for the regeneration of the area which presents as a degraded, semi-derelict landscape with no visual amenity.

2.14 MATERIAL ASSETS: ARCHAEOLOGY AND CULTURAL HERITAGE

The baseline assessment included a desktop study, a field survey, and the allocation of archaeology and cultural heritage constraint numbers (AC#) to all sites of archaeological and cultural heritage significance.

Once the baseline was completed an impact assessment was made on the identified constraints.

Construction impacts on the baseline archaeology and cultural heritage environment will arise as a result of the following:

- Ground disturbance
- Total or partial demolition, removal, storage, relocation, reinstatement in original location, rebuilding, repair and rehabilitation of upstanding archaeology and cultural heritage monuments
- Visual impacts
- Severance of associated features
- Vibration impacts

The main mitigation measures proposed to ameliorate these impacts are as follows:

- Where there is an impact in the zone of archaeological potential for Dublin, an Archaeological Assessment (involving test excavation) after site clearance will take place. Should any deposits be shown to be present agreement on further mitigation will be sought from the DoEHLG and the National Museum of Ireland
- Where there is an impact on National Monuments, all mitigation measures will be agreed with the DoEHLG, the National Museum of Ireland and the OPW as appropriate prior to any works taking place
- Where there is an impact on Recorded Monuments (RMP sites), an Archaeological Assessment (involving test excavation) where possible prior to any site works will take place. Should any deposits be shown to be present then any further mitigation measures will be agreed with the DoEHLG and the National Museum of Ireland
- Where there is an impact on Sites of Archaeological Potential, an Archaeological Assessment (involving test excavation) where possible prior to any site works will take place. Should any deposits be shown to be present then any further mitigation measures will be agreed with the DoEHLG and the National Museum of Ireland
- Where there is an impact on a Protected Structure (that is also designated as an RMP), an upstanding Dublin City Industrial Heritage Record (DCIHR) site and/or an upstanding cultural heritage monument,

a full measured, drawn and photographic survey of the structure will take place prior to any works on the structure. The results of this survey will be lodged with the Irish Architectural Archive

- Where there is an impact on a DCIHR site for which no extant remains exist but where there is potential for the presence of associated subsurface remains, an Archaeological Assessment (involving test excavation) where possible prior to any site works will take place. Should any deposits be shown to be present then any further mitigation measures will be agreed with the DoEHLG and the National Museum of Ireland
- Where there is an impact on a Townland Boundary, a full drawn section and photographic survey of the affected section of the boundary will take place prior to removal.
- Construction works will be appropriately screened to mitigate visual impacts on the baseline archaeology and cultural heritage environment as appropriate
- Monitoring of vibration will be carried out at St. Patrick's Well

The proposed mitigation measures for construction impacts on the archaeology and cultural heritage baseline environment will be further developed and detailed by RPA project archaeologist in consultation with the DoEHLG. The mitigation measures as outlined above apply to pre-construction, enabling works and main construction works.

In summary there will be construction impacts with a significance level of significant, moderate and slight.

The proposed scheme has been designed to minimise visual impacts during the operational phases on upstanding features within the archaeological and cultural heritage baseline environment.

In relation to operational impacts, there will be impacts with a significance level significant, moderate and slight.

2.15 MATERIAL ASSETS: ARCHITECTURAL HERITAGE

The baseline architectural heritage assessment included a desktop study, consultation with relevant stakeholders and field surveys and the allocation of Architectural Heritage constraint numbers (AH#) to all sites of architectural heritage significance. Once the baseline was completed an impact assessment was made on the identified constraints.

The majority of impacts relating to architectural heritage will occur as a result of the construction phase of the proposed scheme. The major construction impacts are as follows:

- Visual impacts on Architectural Conservation Areas (ACAs), Conservation Areas (CAs) and Residential CAs arising from the installation of the proposed scheme and its associated street furniture
- Architectural heritage impacts on Broadstone CA (AH8) and Broadstone Railway Terminus (AH361) as a result of construction works associated with the proposed Broadstone - DIT Stop
- Architectural and visual impacts on St. Stephen's Green National Monument (AH10–AH13) from the proposed scheme
- Impacts on architectural heritage due to building fixings as part of the OCS
- Potential impact to basements/cellars of architectural heritage buildings due to construction works (utility diversions works and main infrastructure construction)
- Impacts on statues and monuments and other elements of architectural heritage due to the construction works and permanent landtake associated with installation of the proposed scheme
- Impacts and interventions at the former Midland Great Western Railway (MGWR) bridges at North Circular Road (AH369) and Cabra Road (AH378)

The following mitigation measures are proposed:

- RPA will appoint a Project Conservation Architect to manage and oversee all architectural heritage issues associated with the proposed scheme.

The Project Conservation Architect will as appropriate:

- Develop methodologies where possible for the retention and preservation *in situ* of features or elements of architectural heritage merit
- Review and approve the survey methodology for building fixings to be carried out by a qualified structural engineer in order to establish the suitability of the base material and to confirm the precise location of the fixing
- Develop appropriate methodologies for the removal to secure storage of statues and monuments and

other elements of architectural heritage such as street furniture and paving, lamp standards, etc. and for their subsequent reinstatement or re-erection as appropriate

- Complete a full measured, drawn and photographic survey of structures and features or elements of architectural heritage to be removed as a result of the proposed scheme. The surveys will be submitted to the Irish Architectural Archive
- Monitor the implementation of method statements during the construction phase to ensure that works conform to good conservation practice

RPA will ensure that a mitigation strategy for potential construction impact to basements/cellars is implemented which seeks firstly and through further detailed design to avoid impacts on basements/cellars altogether and where this is not possible to minimise the impact through a design which aims to retain as much architectural heritage fabric as possible. In the event that complete infilling is required the Project Conservation Architect will ensure that a full measured and drawn photogrpahic survey is carried out in advance of construction.

In relation to visual impacts during construction, good site management practices will be implemented and appropriate screening of construction works will be erected.

Once construction has been completed the operation of the proposed scheme will also have an impact on architectural heritage. This will principally be a visual impact on architectural heritage due to the fixed infrastructure and these impacts are dealt with under construction outlined previously. Indirect visual impacts may also arise as a result of the passing of trams although this must be considered in the context of existing and significant volumes of vehicular movements.

Potential vibration impacts during operation arising from the passing of trams will be within appropriate limits and will not lead to impacts on architectural heritage.

The potential for permanent impacts on architectural heritage was identified at an early stage in the environmental assessment process. For those impacts that could not be minimised through design a range of measures have been adopted to mitigate such impacts on the architectural heritage environment. In order to ensure the appropriate management of such measures, a suitably qualified and experienced

Conservation Architect (here after referred to as the Project Conservation Architect), will be appointed to the project team for the construction phase.

The implementation of the proposed mitigation measures for construction and operation will mitigate significant impacts on architectural heritage. Where loss of fabric or architectural heritage or visual impacts is anticipated, these are offset by the overall positive benefits of the proposed scheme.

In general there will be a permanent positive architectural heritage and visual impact as a result of the introduction of a high quality and modern transport system through the city that will enhance the amenity value and future viability of the city. This will lead to continuing environmental improvement, thereby strengthening the potential for protecting the character of the area. At St. Stephen's Green, there will also be permanent positive architectural heritage and visual impacts as a result of the design and installation of a reconfigured public realm between the junction of Grafton Street and Dawson Street. This will improve its setting and enhance its appreciation. At Broadstone the installation of the proposed scheme will enhance the amenity value and future viability of the Broadstone and Grangegorman area.

2.16 MATERIAL ASSETS: PROPERTY

Properties are considered to be valuable economic and social resources that, among other things, provide for residential amenity and business and commercial facilities.

The baseline assessment for the proposed scheme considers the existing property environment and assigns a baseline rating or categorisation for:

- Properties which may be acquired and permanently demolished under the proposed scheme
- Properties, a portion of which may be acquired on a permanent basis or a right of way or easement acquired
- Properties, a portion of which are to be acquired on a temporary basis

There are three types of construction impact on property associated with the proposed scheme:

- Acquisition of properties on a temporary basis
- Demolition (in whole or part) of properties
- Acquisition of properties on a permanent basis

In cases where parts of properties are acquired, and or property is acquired on a temporary basis, access to the remaining parts of the property will be maintained where it is possible and safe to do so. Protection such as hoarding and/or fencing will be used to ensure that the boundary of any construction site is maintained and damage does not occur outside of this boundary. Reinstatement of any natural boundaries will be carried out upon completion of the construction phase. Appropriate compensation will also be payable to owners of property that is subject to temporary acquisition. Mitigation measures will be put in place to avoid potential impacts on property due to vibration, ground settlement, dust or changes in visual amenity associated with the construction phase.

Property owners will be compensated in accordance with legislation dealing with compulsory acquisition of land and/or rights in land. Those properties to be demolished or acquired on a permanent basis are addressed under the construction impacts as these land areas are required to construct the proposed scheme.

The following properties will be demolished as part of the proposed scheme in Area 29:

- Petrol filling station on Constitution Hill
- Derelict houses in front of Broadstone Bus Depot
- Broadstone Bus Depot maintenance shed and temporary accommodation

Whereas the impact of the demolition of the vacant houses to the rear of the petrol filling station on Constitution Hill is considered to be slight in the context of their very low baseline rating, the demolition impact on the petrol filling station is deemed to be of profound significance. The mitigation proposed in the case of the derelict houses is to incorporate these lands into the design of the stop access and open space amenity area resulting in a moderately positive residual impact.

A moderate impact will arise in the context of the sheds and temporary accommodation within the Broadstone Bus Depot which after mitigation comprising a new bus layout configuration and relocation of the chassis wash building will result in a slight residual impact.

To facilitate the stabilisation of the existing stone wall within the former Broadstone railway cutting in Area 30, there may be a requirement to acquire substratum lands

in the vicinity of the Phibsborough Stop. This is deemed to be of medium impact magnitude. The baseline rating of the properties in this area has been assigned as very high thus the resulting impact is significant.

As the implementation of mitigation measures are initiated during the construction phase no additional mitigation measures are required with respect to the operational phase of the proposed scheme.

The residual impacts after mitigation vary from imperceptible to moderate in the case of private basement acquisitions, “private landings” and amenity space.

Elsewhere the resulting impacts after mitigation are imperceptible or slight with the exception of the petrol filling station at Constitution Hill, deemed to be a significant impact and the temporary and permanent acquisition of land at the Phibsborough Bus Garage where the resulting impact will be moderate.

Within Area 30, all residual impacts will be no more than slight negative significance with a moderately positive impact accruing from the planned landscaping and surfacing treatment of the former Broadstone railway cutting.

2.17 MATERIAL ASSETS: UTILITIES

All utilities along the alignment that are operated by public and private utility companies and authorities have been assessed. Substantial consultation has taken place with all relevant utility companies and authorities to ensure that all services that are needed to provide continuity of service are known.

The information on existing services has been based on records provided by the public and private utility companies, supplemented by further investigations undertaken by RPA. It is provided in good faith and to the extent that the information can reasonably be provided at this stage of the RO application process having regard to current knowledge and methods of assessment. The evolving design and associated utility drawings which accompany the RO application are based on this information.

Utilities infrastructure ensures reliable provision of power (electricity/gas), water and other amenity services in accordance with service level agreements. RPA recognises the importance of ensuring that disruption to any utility service is minimised, and where necessary, alternative measures will be taken to ensure continuity of the service whilst diverted.

To ensure that the operation of the proposed scheme

is not affected by future utility maintenance or diversion activities, utility services will generally be diverted away from the track. All utilities that cross the track or the proposed scheme infrastructure will be protected or lowered, relocated or diverted as necessary and spare capacity may be provided for future maintenance or expansion.

A summary schedule of proposed utility diversions has been prepared which identifies infrastructure requiring diversion and includes information on the type and size of each utility. This schedule also identifies the necessary mitigation measures required by the utility company and the contractor to facilitate the implementation of works.

All works will be carried out in agreement and in ongoing consultation with the relevant statutory undertakers and local authority representatives and will be in compliance with their requirements (including health and safety) and relevant codes of practice. Agreement will be reached prior to any works taking place and relevant design documentations prepared. Through the application of the mitigation measures the residual impacts are considered to be of moderate impact.

No mitigation measures are required with respect to the operational phase of the proposed scheme.

Photo 2.2 Bank of Ireland

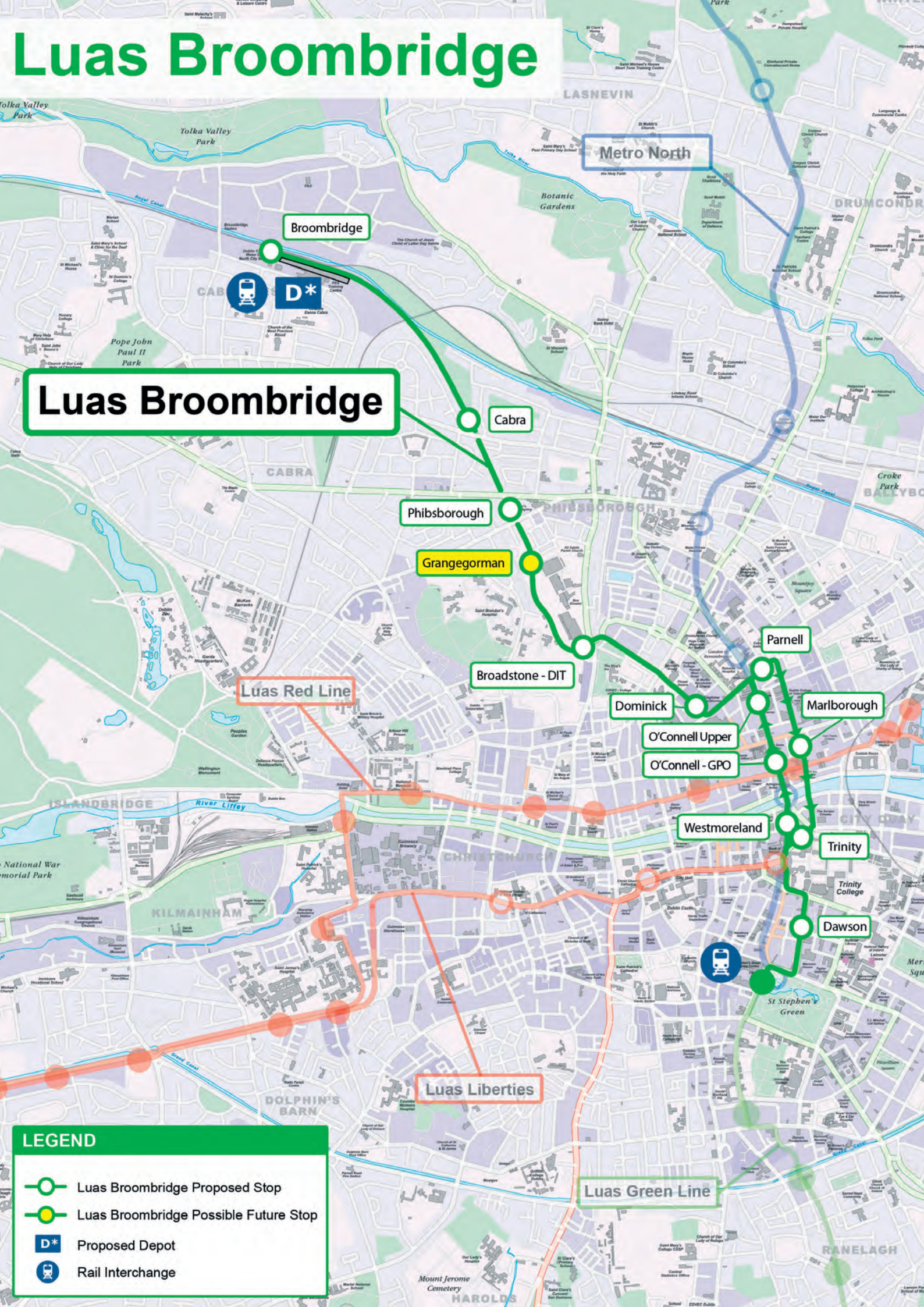


3 INTERRELATIONSHIPS, INTERACTIONS AND CUMULATIVE IMPACTS

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3.3	Cumulative impacts	46







Luas Broombridge



Luas Broombridge

LEGEND

-  Luas Broombridge Proposed Stop
-  Luas Broombridge Possible Future Stop
-  Proposed Depot
-  Rail Interchange

Broombridge

Cabra

Phibsborough

Grangegorman

Broadstone - DIT

Luas Red Line

Dominick

Parnell

Marlborough

O'Connell Upper

O'Connell - GPO

Westmoreland

Trinity

Dawson

Luas Liberties

Luas Green Line

Metro North

3.1 INTRODUCTION

Section 39(2)(b)(iv) of the 2001 Act specifies that an EIS must contain a description of the interrelationship between the likely significant impacts on the aspects of the environment listed in Section 39, namely human beings, fauna and flora, soil, water, air, climatic factors, landscape, material assets and cultural heritage.

This section summarises the interrelationships between the various affected environmental topics. This includes cumulative impacts (impacts which accumulate over space or time to generate a larger overall impact), cross-media impacts and other impact interactions.

Cumulative or combined impacts due to the combination of the proposed scheme and other projects in the same area are also examined.

3.2 METHODOLOGY

Impact interrelationships and interactions have been considered throughout the EIA process and in the preparation of the individual environmental impact assessments so that the EIA can take into account the broader picture of how the proposed development may affect the various environmental media.

All environmental topics are interlinked to a degree such that interrelationships exist on numerous levels. A summary matrix was developed to identify key interactions that exist with respect to this specific project. This does not represent a form of relative assessment of impacts and other interactions are recognised to exist and have been addressed in individual chapters of the EIS. The matrix is illustrated in Figure 3.1.

Key impact interrelationships and interactions are shown in Table 3.1.

Figure 3.1 Impacts interaction and interrelationship matrix*

	HUMAN HEALTH	LANDUSE	SOCIO-ECONOMICS	NOISE	VIBRATION	RADIATION AND STRAY CURRENT	TRAFFIC	AIR & CLIMATIC FACTORS	GROUNDWATER	SURFACE WATER	SOIL & GEOLOGY	LANDSCAPE & VISUAL	FLORA & FAUNA	ARCHAEOLOGY & CULTURAL HERITAGE	ARCHITECTURAL HERITAGE	UTILITIES	PROPERTY
HUMAN HEALTH																	
LANDUSE																	
SOCIO-ECONOMICS																	
NOISE																	
VIBRATION																	
RADIATION AND STRAY CURRENT																	
TRAFFIC																	
AIR & CLIMATIC FACTORS																	
GROUNDWATER																	
SURFACE WATER																	
SOIL & GEOLOGY																	
LANDSCAPE AND VISUAL																	
FLORA & FAUNA																	
ARCHAEOLOGY & CULTURAL HERITAGE																	
ARCHITECTURAL HERITAGE																	
UTILITIES																	
PROPERTY																	

* Green indicates interaction.

Table 3.1 Key impact interrelationships and interactions for Luas Broombridge

INTERACTION	DESCRIPTION
Human Health, Air and Climatic Factors and Traffic	<p>Impacts on air quality may occur due to emissions of dust from construction activities. Impacts on air quality may also occur due to changes in traffic levels and thus vehicle emissions. In some cases, particularly during the construction phase, both impacts occur at the same location. The potential for interactions was therefore considered, particularly when defining the relevant mitigation measures and carrying out the assessment of potential impacts on human health.</p> <p>The potential for traffic emissions to have an indirect impact on climate (in terms of climate change) has also been considered.</p>
Human Health, Noise and Traffic	<p>Noise impacts may occur due to construction or operation activities. Noise impacts may also occur due to changes in traffic levels. In some cases, particularly during the construction phase, both impacts occur at the same location. The potential for interactions was therefore considered, particularly when defining the relevant mitigation measures and carrying out assessment of potential impacts on human health.</p>
Vibration, Archaeology and Cultural Heritage and Architectural Heritage	<p>The potential for vibration impacts on features of archaeological or cultural importance and architectural heritage have been considered.</p>
Groundwater, Soil and Geology and Surface Water	<p>There are direct and physical links between surface water, groundwater and soil and geology. The impacts of the proposed scheme are therefore considered in the chapters that support all three environmental topics in recognition of the fact that impacts to one component of this complex system may have a knock-on or indirect effects on other components.</p>
Landscape and Visual and Flora and Fauna	<p>Mitigation measures for landscape impacts and ecological impacts were considered, in particular when defining the Landscape Insertion Plans in the Landscape and Visual impact assessment chapter of this EIS (Books 2 and 3, Chapter 13), in order to ensure that interactions between impacts were considered in an appropriate manner.</p>
Landuse and Socio-economics	<p>Impacts on commercial landuses can often have a knock-on effect in terms of socio-economics. Interactions between the two environmental topics were therefore considered to ensure that both direct and indirect impacts were considered and appropriate mitigation measures put in place.</p>
Traffic and Socio-economics	<p>Traffic impacts and mitigation measures have the potential to impact on socio-economic activity. The potential for indirect impacts of this nature has been considered when defining appropriate mitigation measures.</p>
Landuse, Landscape and Visual, Archaeology and Cultural Heritage and Architectural Heritage	<p>Cultural heritage comprises elements of the landscape which are important to individuals. Landscape elements which are important to individuals may include man-made buildings, traditional landuse, natural environmental features or features of archaeological or architectural importance. Impacts on all of these aspects of cultural heritage are considered in the relevant chapters of this EIS.</p>
Water, Soil and Geology and Flora and Fauna	<p>Direct physical links exist between these topics and potential impacts on surface water or soils were therefore also considered in the Flora and Fauna impact assessment chapter of this EIS (Books 2 and 3, Chapter 8).</p>
Landuse and Property	<p>Landtake required for the proposed scheme can have an impact on landuse and property. Changes in landuse affecting property have been assessed as part of the EIA and are described in the Material Assets: Property impact assessment chapter of this EIS (Books 2 and 3, Chapter 16).</p>

3.3 CUMULATIVE IMPACTS

Cumulative impacts occur when the addition of individual impacts results in compounding effects or when several effects interact with each other. These impacts may be cumulatively significant if they occur close together in terms of location and time.

The proposed scheme will inevitably cause a degree of disruption during the construction phase, as with most major infrastructure projects. The construction equipment and fencing are likely to be very visible. Road users and public transport users may also experience delays due to revised traffic management arrangements. The combination of these construction effects is likely to heighten the overall sense of disruption felt by those living and working close to the route of the proposed scheme. Such impacts have been assessed and reported in the relevant chapters of this EIS.

During the construction period of the proposed scheme several other projects are likely to take place within the study area. A review of planning applications has been undertaken (as described in the Human Beings: Landuse baseline chapter of this EIS (Book 1, Chapter 11)) to identify such developments. Examples include, but are not limited to:

- Grangegorman development
- “Dublin Central” (Carlton site) development
- Arnotts “Northern Quarter” development

The key stakeholders involved in these developments have been consulted and the indicative timelines and phasing of the construction works associated with these proposed projects have been considered by the study team. It has been determined that during the construction phase of the proposed scheme there will be no significant cumulative effects arising. During the operation of the proposed scheme, the scheme will interact with these developments through the location of stops on O’Connell Street, Parnell Street and at Broadstone providing enhanced accessibility.

In addition to the above developments for which planning permission has been granted or in the case of Grangegorman, the masterplan approved, other infrastructure projects are currently in the planning phase. Such developments include, but are not limited to:

- Metro North
- DART Underground

The indicative timelines and phasing of the proposed construction works associated with these projects have been considered. Consultations and discussions have been held with Iarnród Éireann in respect of DART Underground and with Metro North representatives and it was determined that simultaneous construction of the projects would be unlikely.

In respect of the Metro North project, the RPA has been conscious from an early stage of the need to phase the construction of the proposed scheme and Metro North projects such that disruption due to construction would be minimised. Therefore, subject to receipt of an enforceable RO within the procurement time-lines for Metro North, it is proposed that elements of the proposed scheme infrastructure (trackbed, rail, stop platforms, pole foundations, etc.) would be included within the Metro North scope of works for the main works contract at St. Stephen’s Green West, St. Stephen’s Green North (west of Dawson Street), Westmoreland Street from and including Fleet Street junction to Aston Quay, and O’Connell Street Lower between Bachelor’s Walk and Henry Street. The construction of these works as part of the Metro North project would reduce the impacts associated with the proposed scheme and would not give rise to any additional impacts on Metro North as these works are incorporated into excavation and reinstatement activities for that project.

A review of the potential for cumulative impacts has been completed by the study team. Based on the construction programmes for the proposed scheme and the other projects it is considered that the potential cumulative impacts would only be related to an extension of the overall duration of construction works within the city centre resulting in socio-economic impacts. The programming of the schemes means that construction activities will in all likelihood extend over a longer period of time in total resulting in lesser impacts than were construction of these projects to take place simultaneously, but over a longer period. All such impacts will in any case be mitigated by the implementation of good construction and environmental site management practices and will be intermittent and temporary in nature. In addition, appropriate information procedures will be put in place to cater for the resident, working and visiting populations.

While assumptions have been made in this EIS based on the construction programmes for all of the above projects, it is considered that given their current status within the planning process there is a possibility that the construction programmes may change as these projects develop. In such a scenario, it is possible

that the construction phases for Metro North, DART Underground and the other significant developments may overlap with the construction of the proposed scheme. In this context the cumulative effects identified during construction of the proposed scheme may change for certain environmental aspects.

These impacts would be associated with an increase in the level of disruption as more areas of the city centre are disrupted simultaneously as a consequence of overlapping construction. However, the nature of the construction activities are such that most of the cumulative impacts would be intermittent and temporary in nature. The overlap, in whole or part, with those works on Metro North and/or DART Underground would give rise to significant cumulative traffic impacts on certain road user categories thus impacting on city centre accessibility. Further cumulative impacts would arise in respect of other environmental aspects, however, following implementation of the appropriate mitigation measures outlined for Metro North and in this EIS for the proposed scheme, it is considered that these will not be significant.

Photo 3.1 Broombridge






Railway Procurement Agency
Parkgate Street
Dublin 8

 www.rpa.ie

 info@rpa.ie

 1800 67 64 64