

FINGAL / NORTH DUBLIN TRANSPORT STUDY

STAGE ONE APPRAISAL REPORT

November 2014



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INTRODUCTION



1.0 Introduction

1.1 Study Objectives

The overall objective of this Fingal/North Dublin Transport Study is to identify the optimum long term public transport solution to connect Dublin City Centre, Dublin Airport and Swords.

The study area for the project covers a large proportion of the Fingal and Dublin City local authority areas with the three core areas, or nodes, to be served running north/south within the area, as shown in Figure 1.1.

Figure 1.1: Study Area for the Fingal/North Dublin Transport Study



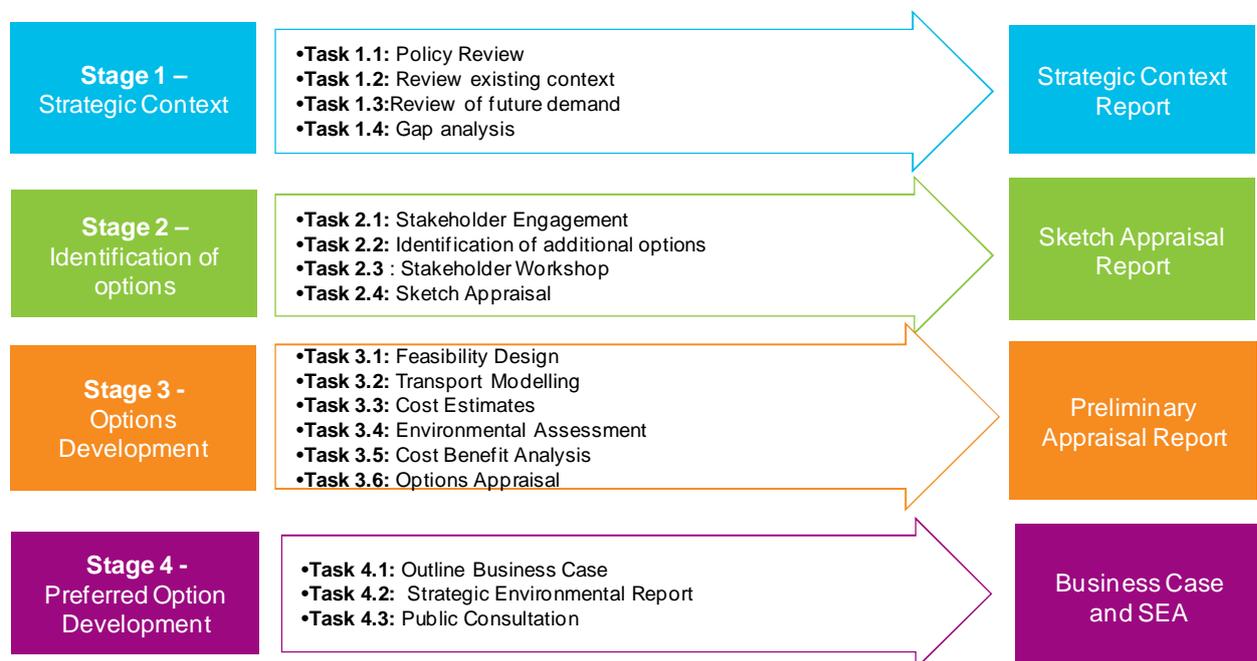
The study is being developed to ensure that the public transport needs of this Swords/Airport to City Centre corridor are adequately addressed in the study horizon year of 2035. In undertaking this study other proposals of relevance to the study area include:

- **DART Expansion Programme:** The DART Expansion Programme consists of the DART Underground Tunnel in the city centre. The scheme consists of a new underground DART line through the heart of Dublin City running some 8.6km from the Docklands to Inchicore. Further details on the scheme are set out in Section 2;
- **Luas Cross City:** The Luas Cross City project is currently under construction and when completed in 2017 will provide an extension of the Luas Green Line from St. Stephen's Green to Broombridge via Dublin City Centre, Broadstone and Cabra. Further details on the scheme are set out in Section 3; and
- **Swiftway Bus Rapid Transit (BRT):** The Swiftway BRT system for Dublin is a proposal for a Bus Rapid Transit network for Dublin, planning and design is progressing on this network which would consist of the following corridors: Swords to City Centre; Blanchardstown to UCD; and Clongriffin to Tallaght. Further details on the BRT BRT Proposals are set out in Section 4.

1.2 Methodology

To ensure development of the study was undertaken in logical, methodical manner and not biased towards any particular mode of transport or scheme, a four stage approach to delivery of the study was adopted, as summarised in Figure 1.2.

Figure 1.2: Study methodology



The following principles have guided the conduct of the study:

- Land use planning, employment and population forecasts form the basis of identifying a strategic need for an expanded public transport network in the area. As a result, AECOM has worked closely with the NTA, Dublin Airport Authority, Fingal County Council and Dublin City Council to understand future forecasts for the area and plans for spatial development;

- Ultimately, estimated travel demand will determine the most effective and efficient public transport solution for the area. As such transport modelling and economic analysis are critical components of our methodology;
- In addition to investigating schemes previously proposed for the study area, AECOM has been tasked to undertake a gap analysis to suggest any further schemes which might meet the study objectives;
- The appraisal of projects proposed should be on the basis of Government guidelines for appraisal as outlined in the The Public Spending Code¹ and the Common Appraisal Framework for Transport Projects and Programmes²;
- The technical feasibility of schemes will be investigated further as the study progresses with shortlisted schemes being developed to a more advanced level to support economic analysis in Stage 3 of the study; and
- Stakeholder engagement is a critical component of overall delivery. Consultation undertaken to date is set out in Section 1.4.

At this stage of project delivery, Stages 1 and 2 of this methodology have been completed. AECOM has set out the strategic context for the study in a separate report and consulted with all key stakeholders. A long list of potential public transport schemes for the study area has been developed and are the subject of a preliminary appraisal as presented in this report. Pending approval of the proposed options for further delivery, Stage 3 of the project will commence and include more detailed development of each shortlisted option.

1.3 Strategic Context

A summary of the strategic context for the public transport infrastructure development within the study area has previously been developed and is summarised as follows:

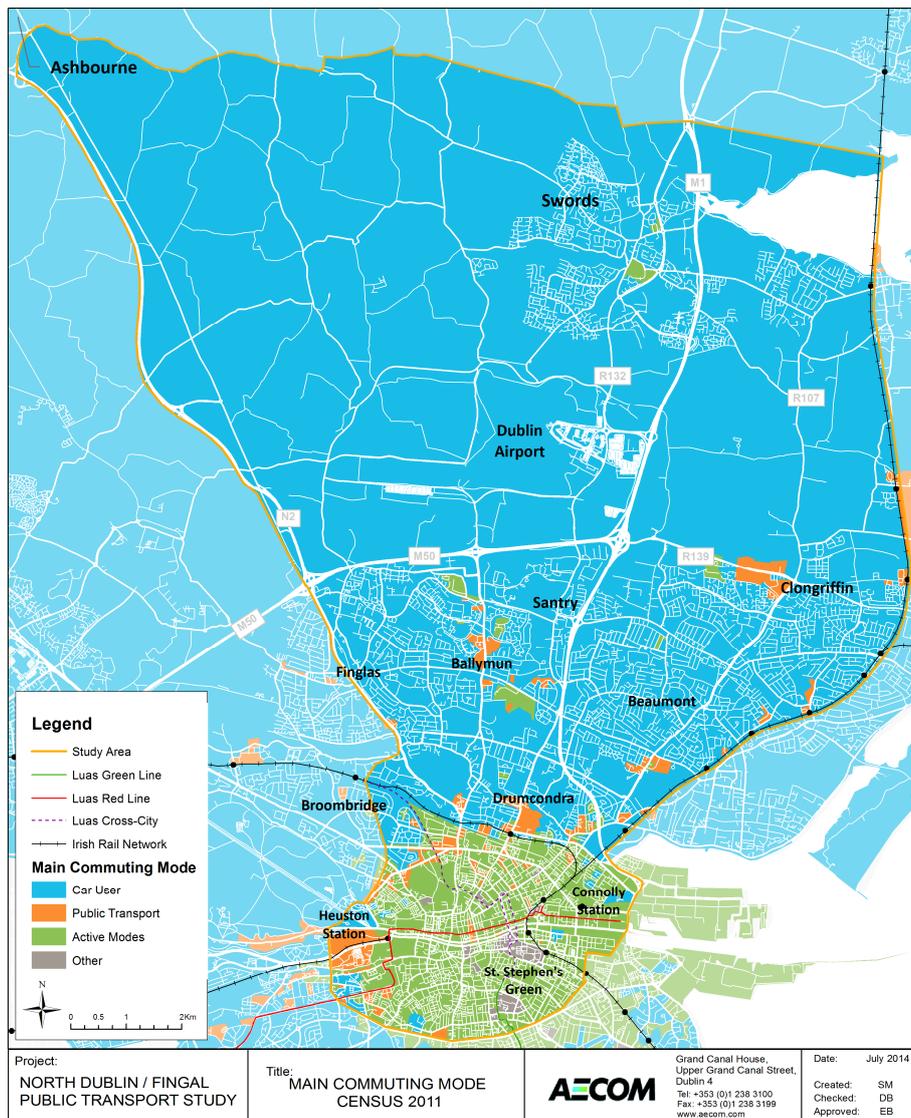
- The population of the Dublin region is anticipated to grow by approximately 23% by 2035. A more numerous and wealthier population will stimulate increased travel across the region over the medium term that requires a response in terms of the development of transport and other economic and social infrastructure;
- Car travel is currently the dominant mode of travel within the Study Area with car dependency in areas north of Drumcondra particularly high, see Figure 1.3. However, some urban centres such as Ballymun and Swords have a higher take-up of sustainable modes, principally the bus mode. Similarly, residential areas adjacent to the DART have higher use of public transport. This suggests a potential for public transport modes to capture a larger mode share, where settlement densities are high or high quality public transport services are provided;
- Government policy favours modal shift away from private car use and promotion of public transport, walking and cycling modes. Future demand for travel and the potential for the increased use of public transport and other sustainable modes within the study area are dependent, in part, on future settlement patterns. The Regional Planning Guidelines (RPGs) envisage a consolidation of land uses within the region via a settlement hierarchy;
- At the top of the hierarchy, a 'Gateway Core' of Dublin City Centre and its immediate suburbs is defined as the international business core with high density population, retail and cultural activities. Within Fingal, Swords is designated as a Metropolitan Consolidation Town to function as part of a wider Gateway for the Dublin region and is envisaged to grow to a relatively large scale as part of the consolidation of the metropolitan area. In addition to this

¹ Department of Public Expenditure and Reform "The Public Spending Code" available at publicspendingcode.per.gov.ie

² Department of Transport, Tourism and Sport "Common Appraisal Framework for Investment in Transport Projects and Programmes" October 2009.

- hierarchy, Swords and the airport are identified as a combined cluster, with activity in aviation infrastructure and airport related services, and transport and logistics. The Guidelines envisage Dublin city and Fingal as the two administrative areas within the Greater Dublin Area that will experience the largest increase in housing provision;
- This broad approach to land use development is supported by the Fingal Development Plan and the Dublin City Development Plan and underpins the National Transport Authority's Draft Greater Dublin Area Transport Strategy 2011-2030. Development of the Draft Strategy considered two different development scenarios with varying density and distribution of population and employment. Scenario A was developed to reflect the minimum targets set out in the RPG settlement strategy for distribution of growth in the Dublin Metropolitan Area and designated hinterland towns up to 2022. Scenario B provides for a greater level of consolidation within the metropolitan area and in selected large growth towns close to rail and in particular the proposed Metro North. To further develop the strategic context for the study, the population distribution pattern of Scenario A will be applied with growth projections taken from the Central Statistics Office (CSO) M2 F2. This modelling work will be used to forecast demand for the options shortlisted as result of this sketch appraisal.

Figure 1.3: Main mode of commuting within the study area



1.4 Stakeholder Consultation

AECOM has consulted with a range of stakeholders to understand the various public transport schemes previously proposed for the Study Area. Seven schemes which were previously proposed for the area are set out in Table 1.1. Information on each of these schemes was collated and put forward for appraisal.

In addition to these proposed options by stakeholders, AECOM has developed a range of other schemes on the basis of:

- Outcomes of the Strategic Context Report in relation to existing/future travel demand;
- Additional schemes proposed historically for the study area;
- Serving three key destinations within the study area, namely: the city centre, Dublin Airport and Swords (which not all the schemes proposed by the interested stakeholders achieved); and
- Opportunities to optimise value of the existing public transport network.

Table 1.1: Public Transport schemes promoted by the stakeholders

Promoter	Scheme
Irish Rail	Northern line spur from Clongriffin to the airport
Railway Procurement Agency	Metro North Optimised Metro North Luas Line D1 from Broombridge to Finglas Luas Line D2 from Cabra to Swords
Metro Dublin	Metro Dublin Rail Network
“Drumcondra 2005”	City Access Transit (CAT)

The indicative alignment, technical feasibility, and environmental constraints of all options was investigated and presented to key stakeholders at a workshop, held on the 27th August 2014. The purpose of the workshop was threefold, as follows:

- To ensure AECOMs representation of stakeholder public transport schemes was accurate;
- To report on options developed by AECOM for consideration and appraisal; and
- To understand whether there were any other additional potential options that could be considered as part of the appraisal process.

Attendees at the workshop included representatives from: Fingal County Council, Dublin City Council, Irish Rail, Railway Procurement Agency, Dublin Airport Authority and the NTA. Feedback on the presented schemes was received from attendees and as a result, new scheme options / combinations of options were considered. Ultimately, each of the options outlined in this report have been reviewed by the stakeholders although it is acknowledged that the precise nature of infrastructure for each option is subject to more detailed development.

1.5 Schemes Presented for Appraisal

In total, 25 public transport scheme options have been included in this sketch appraisal, including:

- 10 Heavy Rail options;
- 8 Light Rail options;
- 5 BRT options; and
- 2 options combining different transport modes.

Some of these options, for example Metro North, have been the subject of extensive study and development by stakeholders. Others are at an earlier stage of development and investigation. In all cases, AECOM assembled sufficient information about schemes to ensure that they could be fairly subjected to the preliminary sketch appraisal described in this report.

A summary table of the proposed scheme options is presented below and presented in further detail in Sections 2 to 5 of this report.

Table 1.2: List of considered scheme options

HEAVY RAIL	
HR1	Clongriffin to Airport
HR2	Extension of HR1 to Swords
HR3	Malahide to Airport via Swords
HR4	North Malahide Estuary to Airport via Swords West
HR5	Combination HR1 + HR3
HR6	Combination HR1 + Spur Malahide to Swords
HR7	Maynooth Line (Broombridge) to Swords via Airport
HR8	Maynooth Line (Drumcondra) to Airport-Swords, under Glasnevin
HR9	Heuston to Swords via Phoenix Park Tunnel, under Glasnevin
HR10	Metro Dublin (scheme as proposed from St James's Hospital to Malahide)
LIGHT RAIL	
LR1	Broombridge to Finglas (Luas D1)
LR2	Broombridge to Swords via Airport and Finglas
LR3	LCC to Swords via Airport, under Glasnevin (Luas D2)
LR4	LCC to Swords via Airport, via Phibsborough (Luas D2)
LR5	LCC to Swords via Airport, via Drumcondra (Luas D2)
LR6	Metro North
LR7	Optimised Metro North
LR8	Dublin CAT
BUS RAPID TRANSIT	
BRT1	Clongriffin to Airport via Malahide
BRT2	Clongriffin to Airport
BRT3	City Centre to Airport via Ballymun
BRT4	Docklands to Swords via Tunnel
BRT5	Combination of BRT2, BRT3, BRT4.
MODE COMBINATION	
C1	Combination of HR1 and LR3
C2	Combination of HR1 and high-capacity BRT Swords-Airport

Each of the proposed schemes is presented in a similar format in the report as follows:

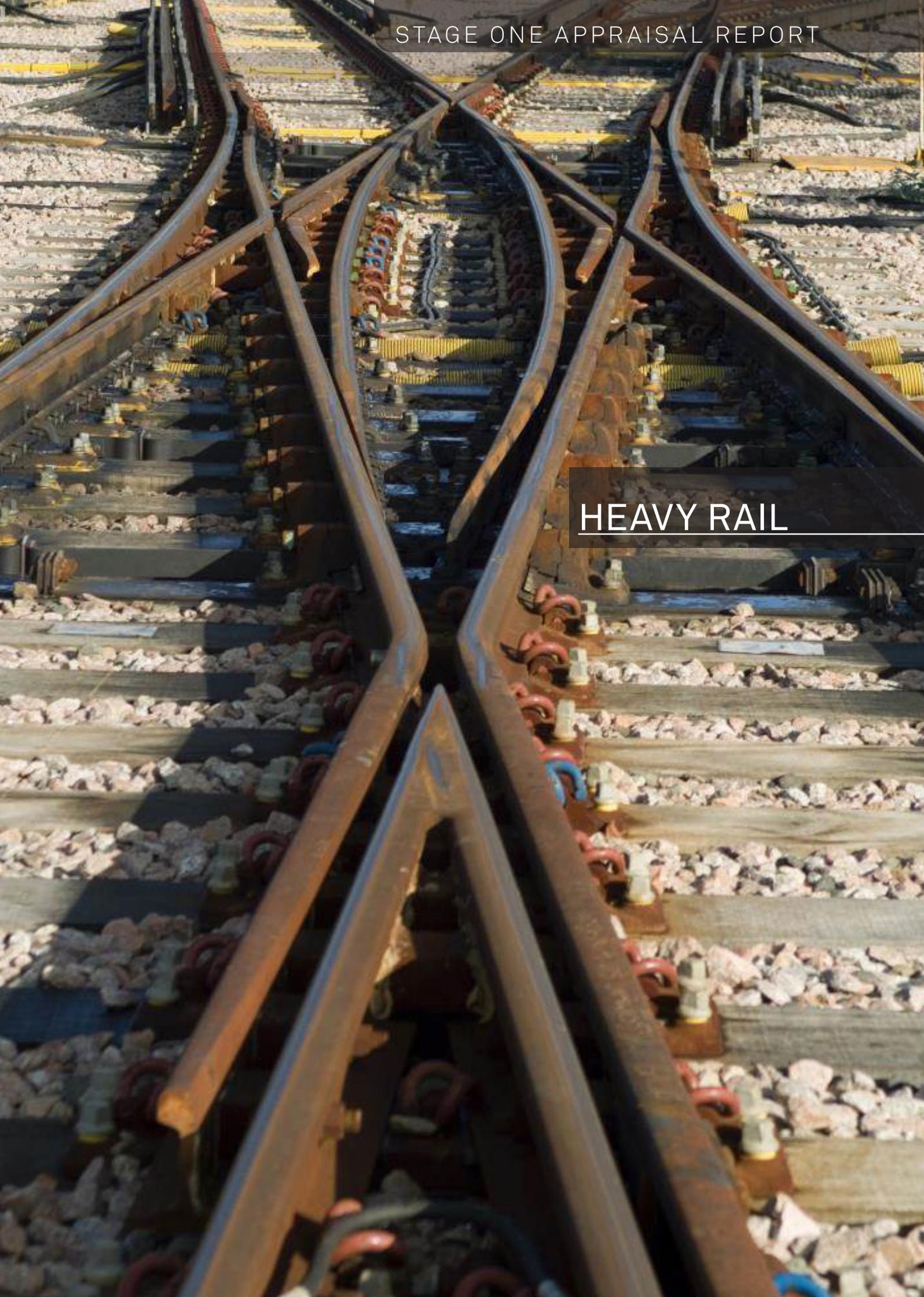
- Details of the scheme promoter or developer;
- A general description of the scheme including alignment and areas served. Where cost estimates and projected benefits have been calculated previously by scheme promoters this is also highlighted;
- Infrastructure considerations to be taken into account which may have an impact on the cost or deliverability of the scheme;
- Impacts of the construction of the scheme at a conceptual level are presented;
- Environmental issues based on a conceptual proposal of the scheme; and
- A summary of considerations arising for this appraisal process.

1.6 Report Structure

The remainder of this report sets out the results of the stage 1 appraisal of these options, and is laid out as follows:

- Section 2 presents each of the heavy rail options for consideration in the sketch appraisal;
- Section 3 presents each of the light rail options for consideration in the sketch appraisal;
- Section 4 presents the bus rapid transit options for consideration in the sketch appraisal;
- Section 5 presents a combination of options to be considered in the sketch appraisal;
- Section 6 sets out the principles used to shape the appraisal criteria and the approach that has been taken to applying them in assessment;
- Section 7 presents results of the appraisal and recommends options for further development; and
- Finally, in Section 8, a summary of the overall recommendations is provided.

HEAVY RAIL



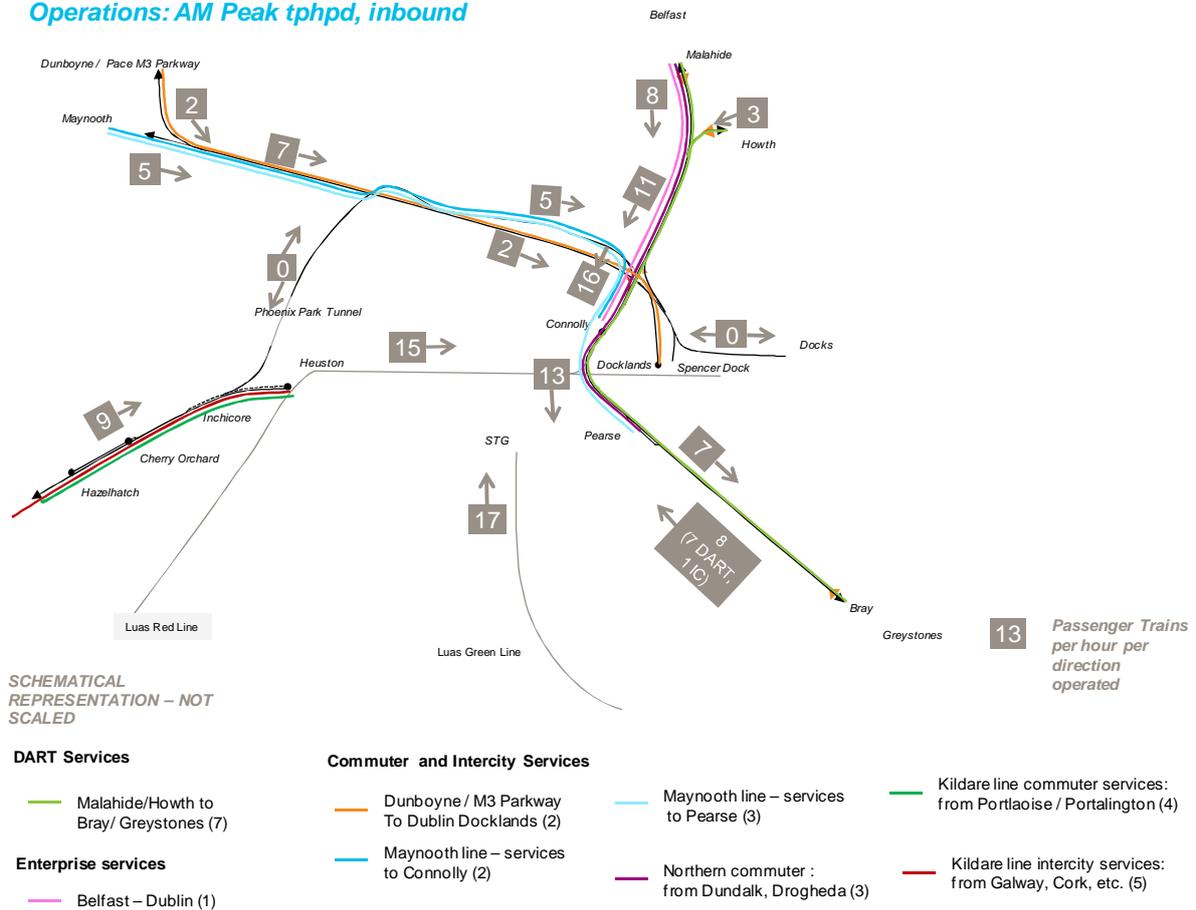
2.0 Heavy Rail

Understanding the potential for expansion of the heavy rail network within the Study Area to respond to the project objectives was an important priority in developing scheme options. The current heavy rail network within the area is relatively dense and includes DART services and commuter services on the Northern Line, Western Line and Kildare Line as well as the Intercity Rail Network.

DART is likely to be of most relevance for the current study given its function in responding to commuter demand within the Greater Dublin Area. The network is 53km in length and runs on a track gauge of 1,600mm, powered by 1500VDC. Services run every 15 minutes between Howth Junction and Bray off peak, with an extension to Greystones every half-hour. An additional number of trains run on the network at peak times to the city centre, see Figure 2.1. Trains north of Howth Junction serve either Malahide or Howth unevenly with Malahide Station supplemented by Northern Commuter trains.

Figure 2.1: Current Operations, Heavy Rail

Operations: AM Peak tphpd, inbound



The capacity of the DART system varies depending on the number of carriages on the service. While all DART platforms have been recently upgraded to allow eight carriage services, services normally run as six or eight carriage trains in peak periods, reducing to four or two carriage trains at other times. The overall capacity of the network is also largely dependent on the possible number of services per hour which is dependent on existing infrastructure, notably: the number of tracks, signalling, number of level crossing junctions and track profiles. Ultimately,

the maximum capacity per hour is limited to 20 trains per hour which generates a maximum of 32,000ppdph (ppdph=passengers per direction per hour) on the network. The DART currently carries more than 55,000 passengers daily³ with some overcrowding on peak hour services. In addition, commuter services in the Greater Dublin Area carry around 44,000 passengers daily, leading to a total number of daily heavy rail journeys in the GDA of 100,000.

The major benefit of the existing heavy rail network is its integration within the City Centre and key trip generators across the network. Future developments of the rail network around Dublin include:

- The city centre re-signalling project, which will increase the Northern Line capacity and will allow more services to run to Grand Canal Dock where a reversing facility will be implemented;
- The use of Phoenix Park tunnel for commuter services; and
- The DART Expansion Programme including proposed DART Underground project.

This last project is the main proposal for the heavy rail network within the study period. As outlined in Section 1, the scheme is projected to form part of the 'Do Minimum' network for the study area in 2035. The scheme, which will be approximately 7.6km in length, will connect the Northern and Kildare lines, with underground stations strategically located at Spencer Dock, Pearse, St. Stephen's Green, Christchurch and Heuston, as well as a new surface DART station at Inchicore. As such, DART Underground and DART Expansion would link all rail systems - DART, Commuter, Intercity, Luas and potentially Metro - to form an accessible integrated transport network for Dublin.

The following schemes will also be undertaken as part of DART Underground/Expansion delivery:

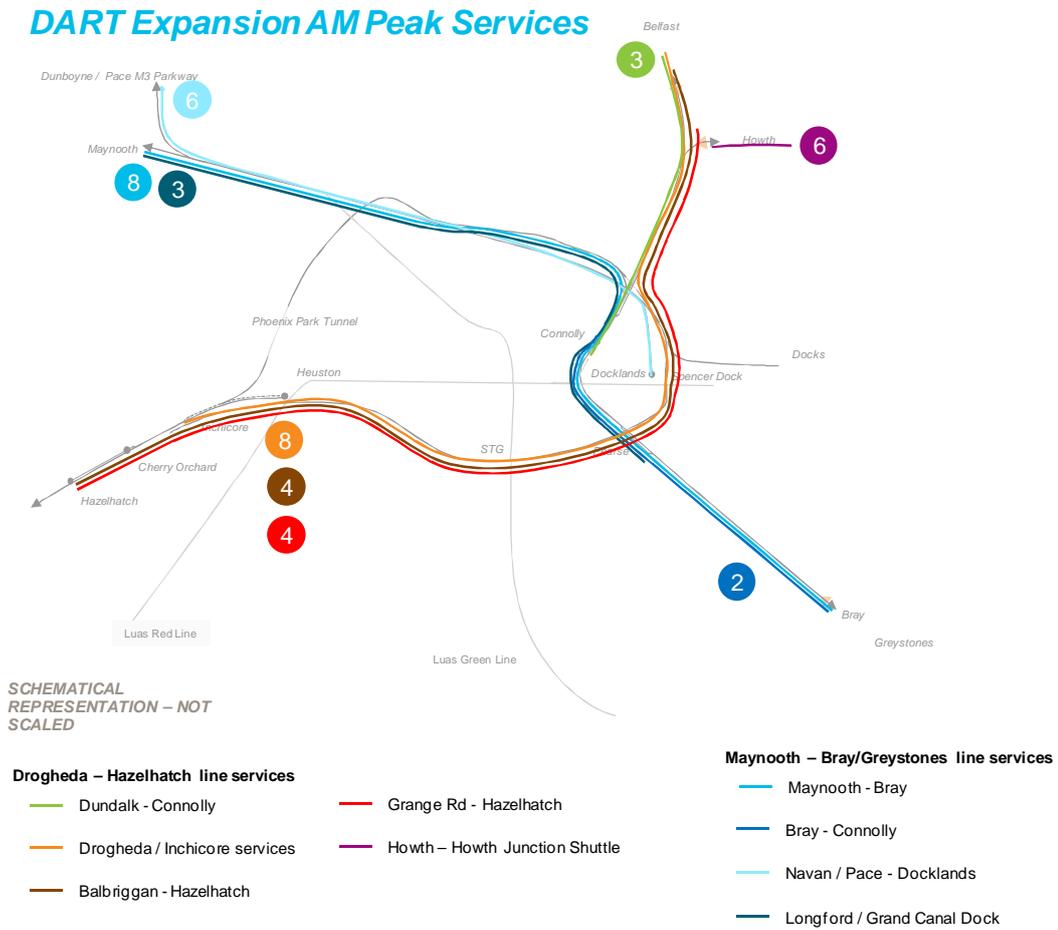
- Electrification of lines to extend the DART towards Drogheda, Maynooth and Hazelhatch;
- Signalling and track capacity enhancements to allow more trains to run more frequently; and
- Significant expansion of the fleet and train depot facilities.

The DART Underground project is set to be developed with a capacity for up to 20 trains each direction per hour, allowing up to 64,000 commuters to use the line hourly. The DART Expansion would result in a dramatic increase of frequency and capacity for commuters on DART Northern, Maynooth and Kildare lines and relieve congestion at Connolly Station.

In terms of available capacity on the heavy rail network, the City Centre re-signalling project coupled with the DART Underground project will create more capacity especially on the Northern Line and around Connolly Station, which is currently a bottleneck on the network. However, the DART Expansion programme will make use of most of this available capacity; therefore precise operational patterns will have to be looked at in detail in the next stage of the study.

³ Rail Census 2013, Table 5

Figure 2.2: Do Min Suburban Rail Operations, with Dart Expansion (as per Dublin Underground Business Case, 2010)



New heavy rail options outlined in the following sections have been proposed in consultation with key stakeholders and include spurs from the existing mainlines as well as new lines connecting to main stations on the network. The scheme options are presented on a conceptual basis with further work required in developing shortlisted options at the next stage of project delivery.

2.1 HR1: Clongriffin to Airport

2.1.1 Scheme promoter or developer

This option was proposed by Irish Rail as part of the 2030 Strategic Rail Review. Thereafter, it formed the basis for more detailed development and a preliminary business case for the scheme was developed in 2011 (Dublin Airport Rail Link Preliminary Business Case, August 2011).

2.1.2 General description of the scheme

The scheme involves the development of a 7.5km spur almost directly west from the existing DART line at Clongriffin Station to Dublin Airport. The route would pass through mostly agricultural land. Irish Rail had proposed one new station at the airport but with potential for a future Park and Ride station between the Airport and Clongriffin. Various options have been proposed for the connection to the airport terminals which are subject to further investigation.

The scheme would provide connectivity to the City Centre and the Airport but not to Swords and therefore does not fully respond to the objectives of this study.

The Preliminary Business Case prepared for HR1 by Irish Rail estimates delivery costs in the region of €200m although this is depending on the final selected route and station location. The service was envisaged to run every 15 minutes. This could be facilitated by converting some existing Howth services to a shuttle arrangement. On this basis, there remains substantial additional capacity of a minimum of 7 trains per hour (green running) and 11 trains per hour (double yellow running) to cater for other potential Northern Line services⁴.

Appraisal of the scheme in the business case prepared by Irish Rail indicates that it would provide substantial benefits of up to approximately €1 billion in Net Present Value terms, with an Internal Rate of Return of 24%. It is noted that a review of the Preliminary Business Case by the NTA concluded that the costs were likely to be significantly higher than the amount put forward by the promoter and the benefits would be likely to be less than half of the amount stated in the Preliminary Business Case.

2.1.3 Infrastructure considerations

The rail junction at Clongriffin is likely to require a grade separated junction with a flyover for the new inbound line. The proposed route would be mostly elevated crossing local and regional roads, such as the R107.

A major bridge structure will be required to carry the rail over/under the M1 motorway. The precise nature of this infrastructure will be determined based on proposals for the Airport station and will be looked at in more detail at the next stage of the study if necessary.

2.1.4 Impact during construction

As much of this alignment is across farmland, construction for these sections should cause minimal disruption. The disruption will be of short duration for the elevated crossings of the M1 motorway and local roads.

There would also be short term disruption as the new railway flyover at Clongriffin is installed. To accommodate the new railway viaduct at the airport would likely result in delays and disruptions to traffic.

⁴ Estimates without DART Underground/Expansion in place

2.1.5 *Environmental issues*

An assessment of environmental constraints along the alignment has been undertaken. The proximity of Baldoyle Bay, approximately 0.5km to the proposed rail junction at Clongriffin and several other Natura Sites, would most likely require an Appropriate Assessment screening report, in accordance with Habitats Directive, to be undertaken to investigate the likely effect of the scheme.

The alignment is proposed to pass through G3 zoned areas designated in the Fingal County development Plan. These areas have been designated to protect and enhance high amenity area and protect and provide for a greenbelt. Requirements of this zoning would need to be raised with Fingal County Council.

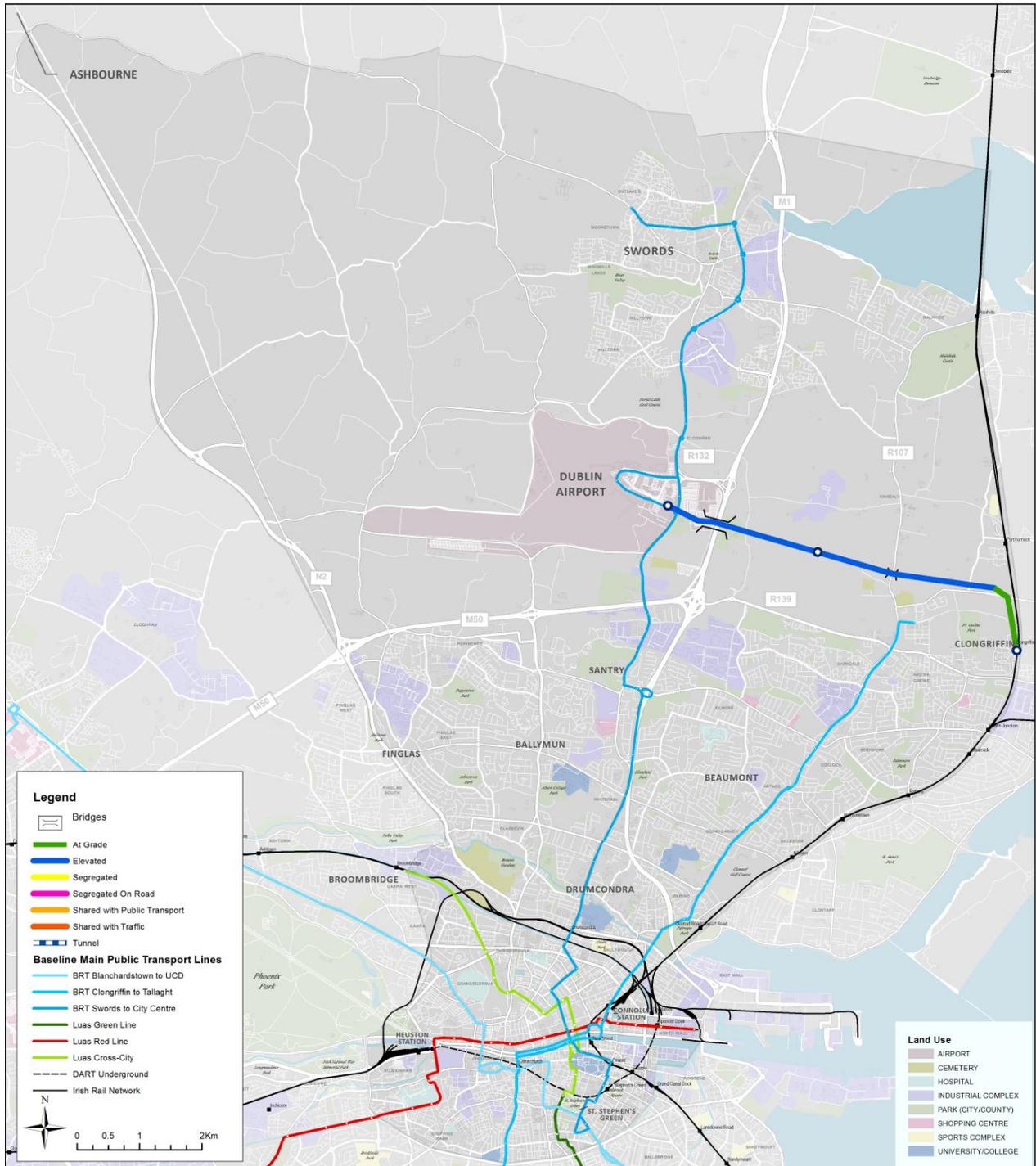
Should this alignment be taken forward, further more detailed investigations would be required to satisfy Strategic Environmental Appraisal requirements.

2.1.6 *Considerations for the appraisal process*

The following considerations should be taken into account during the appraisal process:

- This scheme can be delivered from a technical perspective;
- The scheme does not meet the fundamental requirement of the study, to: 'identify the optimum medium to long term public transport solution connecting Dublin City Centre, Dublin Airport and Swords';
- The station location at Dublin Airport would need further investigation and discussion with Dublin Airport Authority to develop the best solution;
- Implications of DART Underground and DART Expansion on the scheme in terms of journey times and capacity would need to be studied in more detail;
- Although the scheme integrates with current commuter services, it does not serve an extensive new catchment area as there is little residential development between Clongriffin and the Airport;
- This scheme could possibly connect to BRT or Light Rail at the airport to provide a link to Swords; and
- The possibility of extending the scheme to Swords should be investigated.

Figure 2.3: HR1 - Clongriffin to Airport



<p>Project: NORTH DUBLIN / FINGAL PUBLIC TRANSPORT STUDY</p>	<p>Title: HR1 - CLONGRIFFIN TO AIRPORT</p>	<p>AECOM Roughan & O'Donovan</p> <p>Grand Canal House, Upper Grand Canal Street, Dublin 4 Tel: +353 (0)1 238 3100 Fax: +353 (0)1 238 3199 www.aecom.com</p>	<p>Date: Sept 2014</p> <p>Created: SM Checked: DB Approved: EB</p>
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2.2 HR2: Extension of HR1 to Swords

2.2.1 Scheme promoter or developer

This scheme was proposed to connect HR1 to Swords. The scheme would operate as an integrated component of the DART Network.

2.2.2 General description of the scheme

This heavy rail option builds on the Irish Rail proposal for an Airport DART spur from Clongriffin as per HR1, by proposing an extension to the railway and services to Swords.

The total length of this option would be 12 km (an additional 4.8km to HR1). The scheme would consist of 10km of railway at-grade and 2.0km of tunnel which would take the railway line underneath the Airport and the R132.

The proposal would include four new stations as shown in Figure 2.4. The alignment between Clongriffin and the Airport would be identical to the HR1 option. At the airport, the rail line would need to turn almost due north and enter Swords along the alignment of the R132. Alternatively, should a turning movement at the Airport prove technically difficult, an alignment to the west of Swords may be required. The exact alignment will be subject to more detailed investigation if the scheme was to progress to the next stage of the study.

Although the initial costs for the rail connection from Clongriffin to the Airport were relatively cost effective, the connection to Swords is likely to add substantial additional costs to the project.

In terms of integration with land use planning, this alignment supports future Airport and Swords expansion satisfactorily but does not provide a connection to the North Dublin City/Ballymun corridor.

2.2.3 Infrastructure considerations

There is some uncertainty about the exact details of this option for two reasons:

- i) Development constraints at Dublin Airport may influence land available for the alignment; and
- ii) Complexity in providing a turning movement for the rail line at the airport, north to Swords.

It may be possible, that two interconnecting lines could be built which would require some level of interchange between the two lines. However the introduction of an interchange requirement is unlikely to be attractive to passengers from Swords travelling to the City Centre, or from an airport operations perspective.

Infrastructure considerations for the Clongriffin section of the alignment have already been set out under HR1. Between Swords and the Airport the railway could be elevated on either viaduct or embankment. The alignment shown in Figure 2.4 serves the east of Swords, this may require construction of underground tunnels due to development constraints. However, should the alignment serve the west of Swords an at-grade alignment may be possible.

2.2.4 Impact during construction

As much of the Clongriffin section of the alignment is across farmland, construction of these sections should cause minimal disruption. The disruption will be of short duration for the elevated crossings of the M1 motorway and the local roads. There would also be short term disruption also as the new railway flyover at Clongriffin is installed.

To accommodate the new railway viaduct at the airport would result in delays and disruptions to traffic.

In addition, there will be short term disruption if a tunnel is constructed under the R132 north of the Airport.

2.2.5 Environmental issues

The environmental impacts for this option are similar to those set out for HR1.

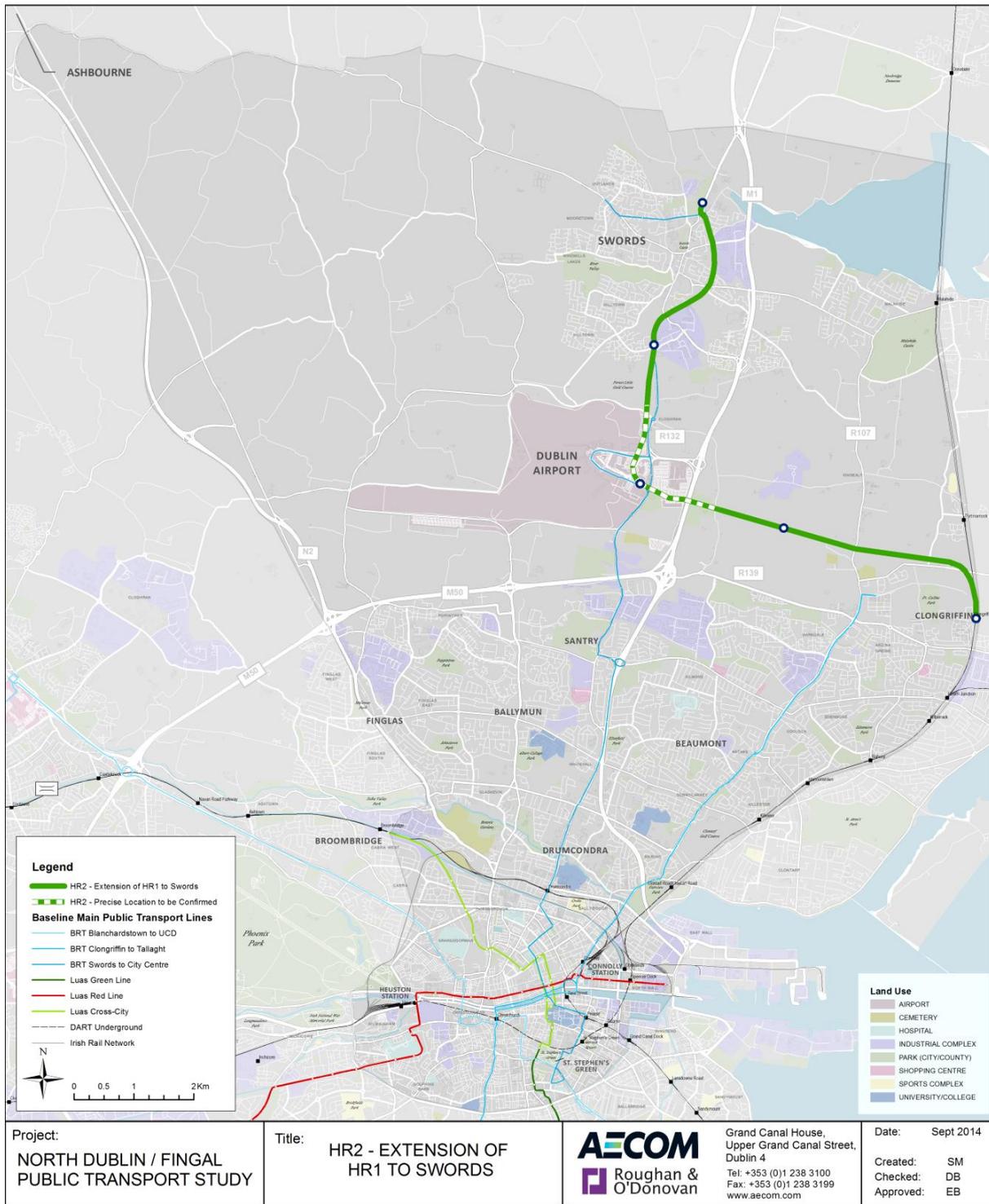
On the route section north of the airport towards Swords, there are no concerns for the historical environment or natural heritage. However, consideration will have to be given for zoning policies of the Fingal Development Plan as the scheme follows the line of the R132. Issues such as visual impact and noise will need to be considered.

2.2.6 Considerations for the appraisal process

The following considerations should be taken into account during the appraisal process:

- This scheme can be delivered from a technical perspective;
- The station location at Dublin Airport would need further investigation and discussion with Dublin Airport Authority;
- Implications of DART Underground and DART Expansion on the scheme in terms of journey times and capacity would need to be studied in more detail; and
- The precise alignment to connect with Swords is dependent on technical feasibility of the Airport turning movement.

Figure 2.4: HR 2 - Extension of HR1 to Swords



2.3 HR3: Malahide to Airport via Swords

2.3.1 Scheme promoter or developer

This option was developed by AECOM as an alternative means of connecting the Northern Rail Line to Swords and the Airport. The scheme would operate as an integrated component of the DART Network.

2.3.2 General description of the scheme

This heavy rail option provides a spur off the Northern Line at Malahide to Dublin Airport via Swords, passing through Swords on the R132. The route is 8.5km in length and will provide a rail link from Dublin Airport and Swords to the wider public transport network linking to the Northern Rail Line.

Due to the extent of residential density along the alignment, it is estimated that 5km of tunnelled sections would be required through Malahide and Swords.

At least three new stations are proposed on the line, including one at the Pavillions with potential for an additional station west of Malahide. The existing Malahide Station would also require upgrade.

In terms of integration with land use planning, this alignment supports future Airport and Swords expansion satisfactorily but does not provide a connection to the North Dublin City/Ballymun corridor.

2.3.3 Infrastructure considerations

The railway junction at Malahide would likely require grade separating with a dive-under for the new inbound line. The space available to accommodate new infrastructure is constrained at the existing Malahide station; therefore, the station may need to be relocated further south.

Between Swords and the Airport, the railway would be elevated with short bridges to cross over local and regional roads. A major bridge structure would be required to cross the M1 motorway to the east of Swords. Further investigation would be needed to determine station requirements at the Airport. This may be constrained by existing infrastructure and development plans.

2.3.4 Impact during construction

A large compound for tunnelling operations would be required near Malahide, which could be disruptive.

There would be a short term closure of the M1 motorway to accommodate installation of a bridge.

The new railway dive-under at Malahide could be installed during a short term closure or tunnelled at a lower level to reduce disruption further.

Short term disruptions to the railway at Malahide are also likely in order to install new switches and crossings.

2.3.5 Environmental issues

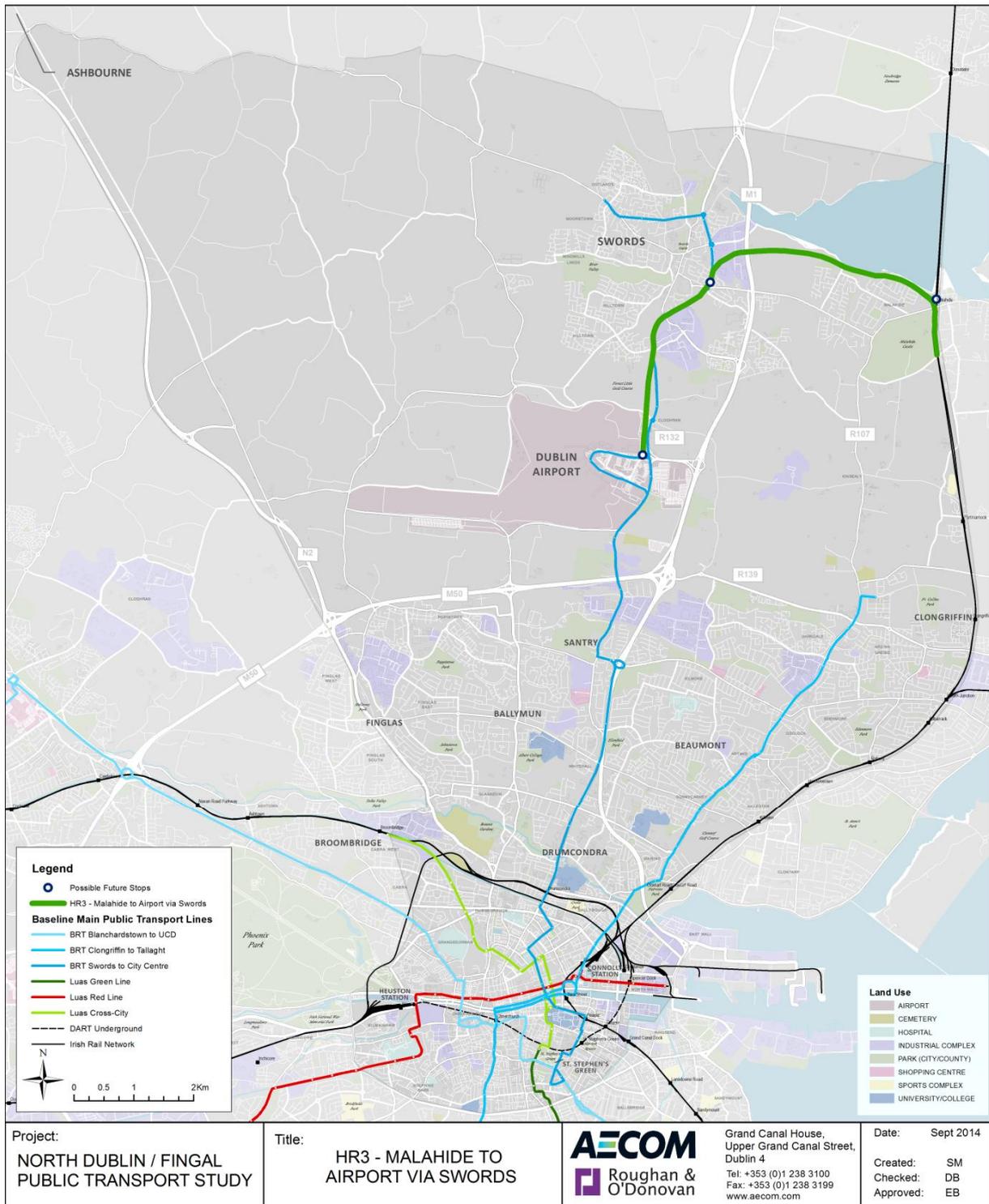
There are a number of possible impacts on the historical and cultural heritage adjacent to the existing Malahide station. There are a number of sites and monuments near to this station, which include churches, earthworks and holy wells and if sub-surface works took place, there would likely be an impact on these. Construction of a new underground station would have to take consideration of the nearby Malahide Estuary Special Protection Area (SPA) and Special Area of Conservation (SAC).

2.3.6 *Considerations for the appraisal process*

The following considerations should be taken into account during the appraisal process:

- This scheme can be delivered from a technical perspective. However, geotechnical investigations would be required in relation to the tunnelling requirements to confirm tunnelling feasibility close to the Estuary;
- Although this scheme does meet the overarching objective of the study, it does not give a direct route from the Airport to the City Centre. Passengers would have to travel north to Swords then east to Malahide before continuing on to the City Centre. This will inevitably incur higher journey times compared with more direct routes or alternative modes of transport;
- As a significant amount of tunnelling is associated with this option, the scheme is relatively expensive on a cost per km basis;
- Implications of DART Underground and DART Expansion on the scheme in terms of journey times and capacity would need to be studied; and
- Moderate disruption during construction is likely due to the various roads that need to be crossed and the extent of the residential area it runs through.

Figure 2.5: HR3 Malahide to Airport via Swords



2.4 HR4: North Malahide Estuary to Airport via Swords West

2.4.1 Scheme promoter or developer

This option was proposed as an alternative means of serving the Airport and Swords using a spur off the Northern Rail Line. The scheme would operate as an integrated component of the DART Network.

2.4.2 General description of the scheme

This scheme is similar to HR3 but it runs off the Northern Line at the north of Malahide Estuary and then runs to the West of Swords.

This scheme involves a 13.5km heavy rail spur from the Northern Line, north of Malahide Estuary. The line runs to the western side of Swords, then south towards the Airport.

A large proportion of this route could be delivered at-grade, with a connection to the Airport possibly requiring a tunnel.

Three new stations are proposed on the line: one north of Swords, one to the west of Swords and one at the airport.

2.4.3 Infrastructure considerations

A grade separated railway junction would be the preferred solution to integrate the new railway line at Malahide. The rail line west of Malahide would be at-grade so either a flyover or dive-under could be constructed for the new inbound line.

Between Malahide and the Airport, the railway line will be mostly at-grade. A number of level crossings or small bridge structures would be provided to cross local and regional roads. A long span bridge structure would be required to cross the M1 to the north east of Swords.

Two options for the station at the Airport, which would require further detailed investigation and consultation would be either at-grade and based around the perimeter of the airport, or in a tunnel underneath the terminals.

2.4.4 Impact during construction

Based on conceptual proposals for this scheme, there would be short term closure of the M1 to accommodate installation of a bridge. The new railway dive-under at Malahide could be installed during a short term closure or tunnelled at a lower level to reduce disruption further. Short term disruptions to the railway at Malahide are also likely in order to install new switches and crossings.

2.4.5 Environmental issues

In the area north of Malahide Estuary, there is a high concentration of recorded sites and monuments. The proposed route would have to take account of the zones of influence of certain archaeological sites in the area, in particular, the church and graveyard site near the route option.

West of the R132, there are further concentrations of recorded sites and monuments. The area is zoned in the current Fingal Development Plan as RU – to protect and promote in a balanced way, the development and agricultural and rural related enterprise, biodiversity, the rural landscape and the built and cultural heritage.

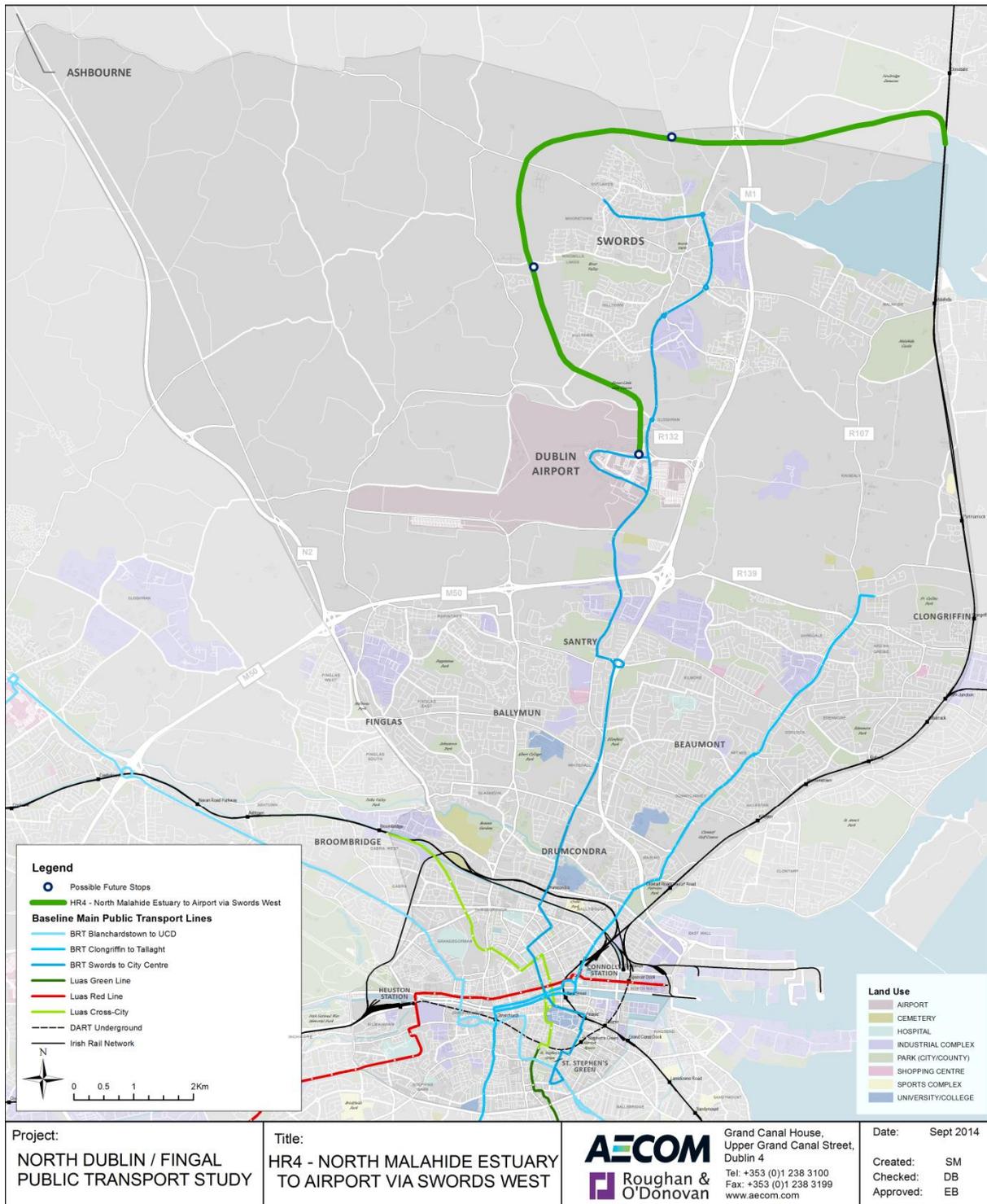
There are two rivers to cross along this alignment, the Broad Meadow River and the Ward River, which may impact on the natural heritage.

2.4.6 *Considerations for the appraisal process*

The following considerations should be taken into account during the appraisal process:

- This scheme could be delivered from a technical perspective;
- As most of the alignment is at-grade, the cost is low compared to other options requiring tunnelled sections;
- There are many environmental issues to consider on the route alignment that would need to be investigated in further detail;
- Implications of DART Underground and DART Expansion on the scheme in terms of journey times and capacity would need to be studied; and
- Journey times to the airport would be higher than other heavy rail options as the rail line extends further north and west connecting to the City.

Figure 2.6: HR 4 North Malahide Estuary to Airport via Swords West



2.5 HR5: Combination HR1 and HR3

2.5.1 Scheme promoter or developer

This scheme was proposed as means of providing a looped spur from the Northern Rail Line to serve the Airport and Swords. This scheme is a combination of HR1 and HR3. The scheme would operate as an integrated component of the DART Network.

2.5.2 General description of the scheme

This scheme would create a railway loop from Clongriffin passing through the Airport, Swords and then on to Malahide before rejoining the Northern Line just south of the Malahide Estuary.

The proposed rail line would be 16.4km long and include five new stations, with the possibility to accommodate others for Park and Ride facilities or future development.

Alternate commuter services on the Northern Line would run via the Airport and Swords.

2.5.3 Other considerations

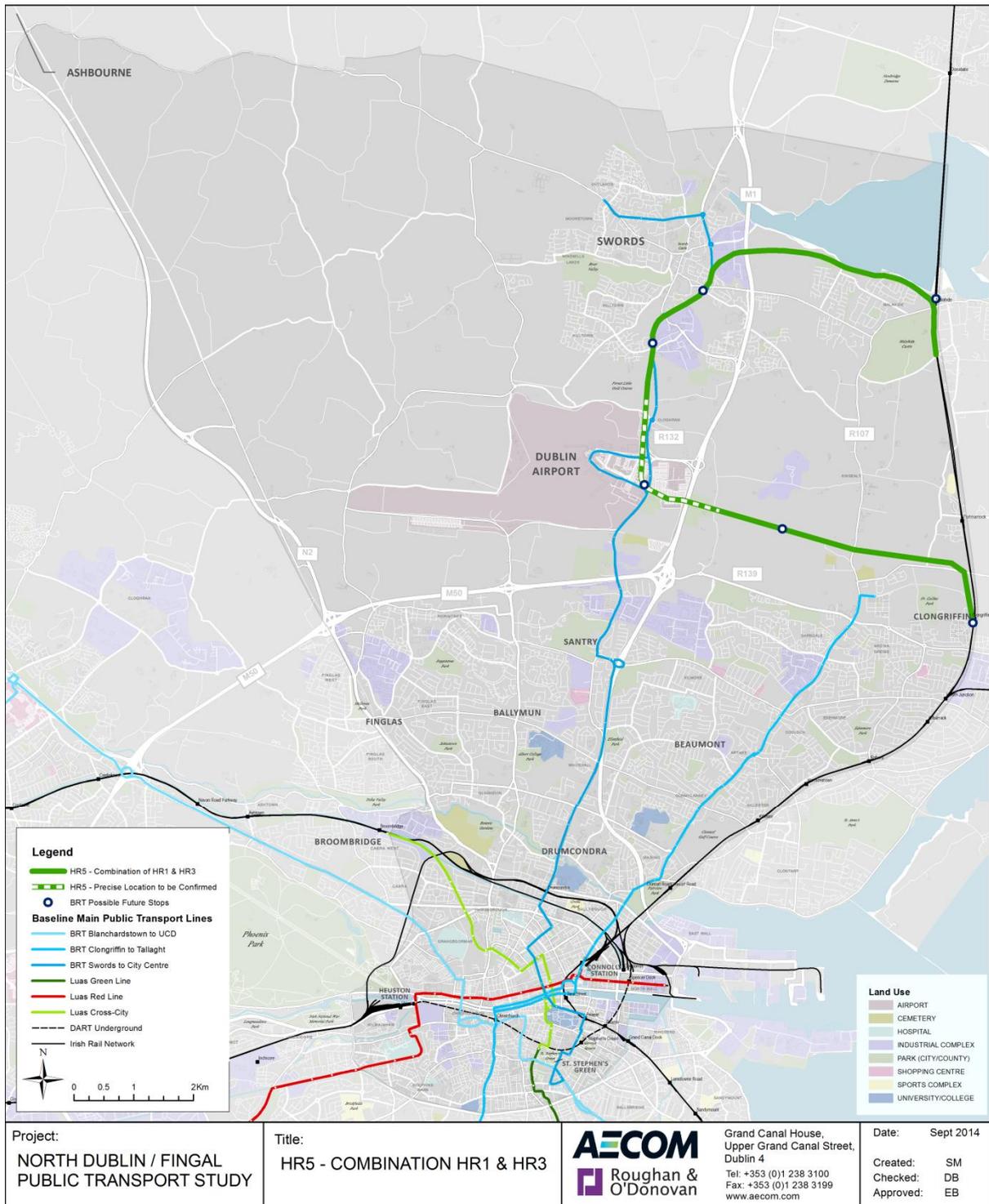
The considerations for infrastructure, disruption and environment will be the same as for the options HR1 and HR3 as this option is simply a combination of both proposals.

2.5.4 Considerations for the appraisal process

The following considerations should be taken into account during the appraisal process:

- This scheme can be delivered from a technical perspective, however, geotechnical investigations would be required in relation to the tunnelling requirements to confirm tunnelling feasibility close to the Estuary;
- As a significant amount of tunnelling is associated with this option, the scheme is relatively expensive on a cost per km basis;
- Moderate disruption during construction is likely due to the various roads that need to be crossed and the extent of the residential area it runs through.
- The station location at Dublin Airport would need further investigation and discussion with Dublin Airport Authority to develop the best solution;
- Implications of DART Underground on the scheme in terms of journey times and capacity would need to be studied; and
- Although the scheme integrates with current commuter services, it does not serve an extensive new catchment area as there is little residential development between Clongriffin and the Airport.

Figure 2.7: HR5 – Combination HR1 and HR3



2.6 HR6: HR1 with spur from Malahide to Swords

2.6.1 Scheme promoter or developer

This scheme was proposed as an alternative means of serving the Airport and Swords from the Northern Rail Line. The scheme would operate as an integrated component of the DART Network.

2.6.2 General description of the scheme

This scheme is composed of three elements as follows:

- A 7.5km spur off the Northern Line at Clongriffin as outlined in HR1;
- A second spur from Malahide to connect to Swords, similar to HR3; and
- Use of the planned Swiftway BRT between the Airport and Swords.

Collectively, the two rail spurs would include additional rail lines of 12.7km (7.5km from Clongriffin to the airport and 5.2 km from Malahide to Swords). An additional four stations would be proposed for this option, including an upgrade to Malahide Station.

Whilst this option can connect the Airport and Swords to the City Centre by heavy rail, an interchange would be required to connect Swords with the airport.

2.6.3 Other considerations

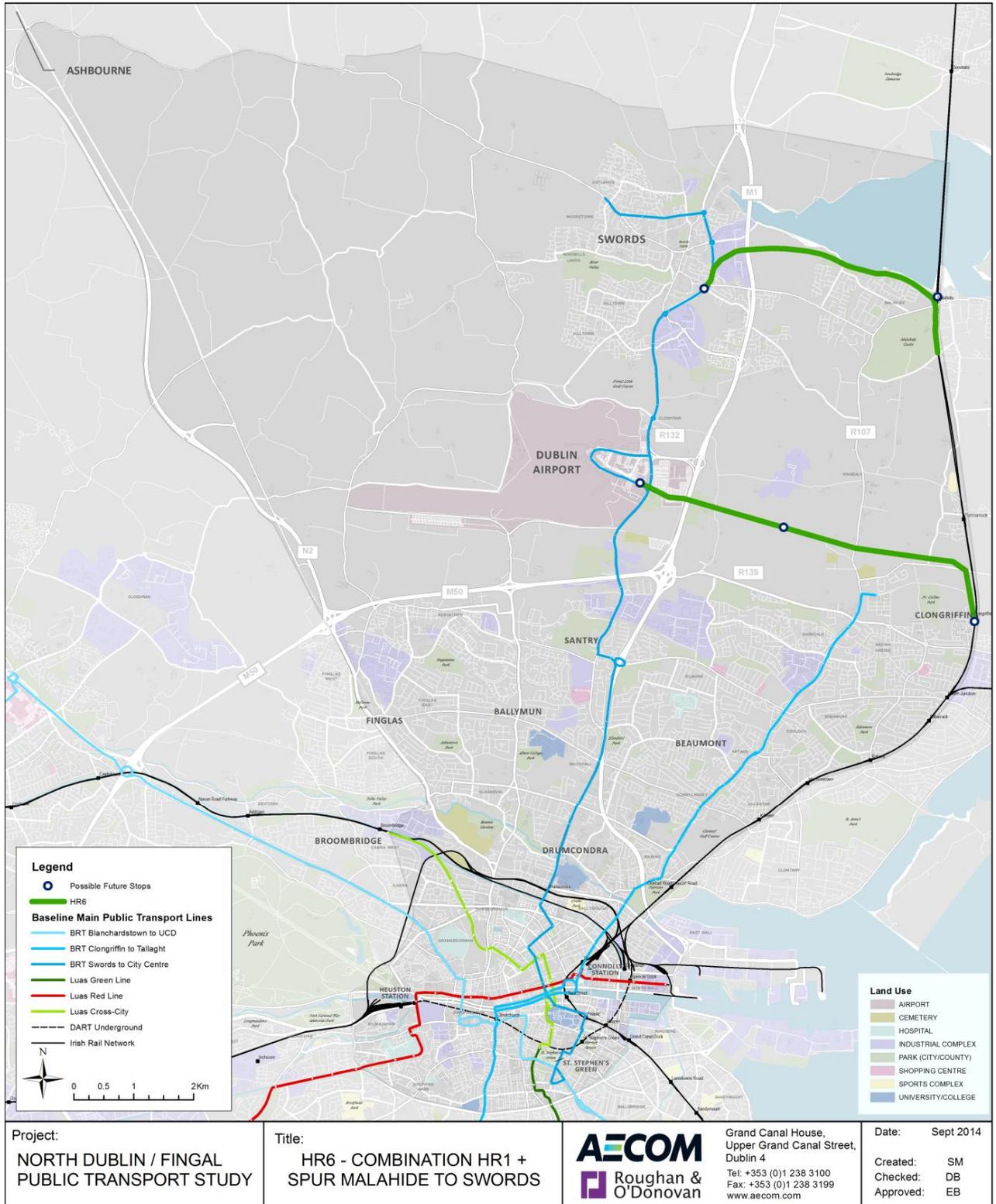
The considerations for infrastructure, disruption and environment will be the same as for the options HR1 and HR3 as this option is simply a combination of both, with the exception that unlike the HR3 option, the railway line will terminate at Swords and will not continue south to the airport.

2.6.4 Considerations for the appraisal process

The following considerations should be taken into account during the appraisal process:

- The scheme does not have a direct link between Swords and the airport, which therefore requires some form of interchange to connect the two destinations;
- This scheme can be delivered from a technical perspective, however, geotechnical investigations would be required in relation to the tunnelling requirements to confirm tunnelling feasibility close to the Estuary;
- As a significant amount of tunnelling is associated with this option, the scheme is relatively expensive on a cost per km basis;
- Moderate disruption during construction is likely due to the various roads that need to be crossed and the extent of the residential area it runs through;
- This scheme would present greater capacity constraints on the Northern Line as connections are required on two different sections of the line; and
- The station location at Dublin Airport would need further investigation and discussion with Dublin Airport Authority to develop the best solution.

Figure 2.8: HR6 - HR1 with spur from Malahide to Swords



2.7 HR7: Maynooth Line (Broombridge) to Swords via the Airport

2.7.1 Scheme promoter or developer

This scheme is an adaptation of an alignment previously investigated by Irish Rail. However, since this option was previously considered, extensive residential development along the corridor means it would not be possible to deliver the same scheme which was proposed at-grade. The alignment can still be considered, however with different infrastructure requirements.

2.7.2 General description of the scheme

This scheme would run from the Western Line close to Broombridge and run to the west of the M50 before running north to the Airport.

The scheme would require a new track of 16.4km in length, of which, 2.6km would be within a twin bored tunnel. Six new rail stations are proposed for this option, five at-grade and one underground at Dublin Airport.

From Broombridge, the railway line would continue west to Ashtown Station, at which point it would turn north and cross the canal. The line would run at-grade through agricultural land at Scribblestown. The line would cross Dunsink Lane, still heading north and enter the old Dunsink Landfill site.

Further north, the railway would cross the M50, before turning eastwards, following roughly the alignment of the M50. The line would then continue at-grade before crossing over the N2.

The line then runs north and into a tunnel underneath the Airport, emerging from the tunnel just north of Naul Road. It continues north, just to the west of the R132, before crossing over the R132.

The line runs at-grade for a short section along the east side of the R132 before being elevated to cross the Pinnockhill roundabout. At Swords, the station would be located at the Pavillions.

2.7.3 Infrastructure considerations

To connect with the Western Line near Ashtown, a new junction would need to be developed. This could be grade separated with a new flyover or dive-under for the outbound line. Major bridge structures would be required to cross the M50 motorway and the N2. This alignment also assumes that the railway line and station would be underneath Dublin Airport. A twin bored tunnel would be constructed to accommodate the railway line. To cross other local and regional roads, a combination of localised elevated sections, bridges or cut and cover tunnels will be constructed.

2.7.4 Impact during construction

There would be short term disruption to the Western Line while new switches and crossings are installed. There would also be short disruption to rail services while flyover or dive-under is installed as part of the grade separated junction for the connection. Similar to other options, delays would be expected while new bridge decks are put in place with short term road closures. Longer term disruptions are likely north of the Airport while new tunnels are constructed.

2.7.5 Environmental issues

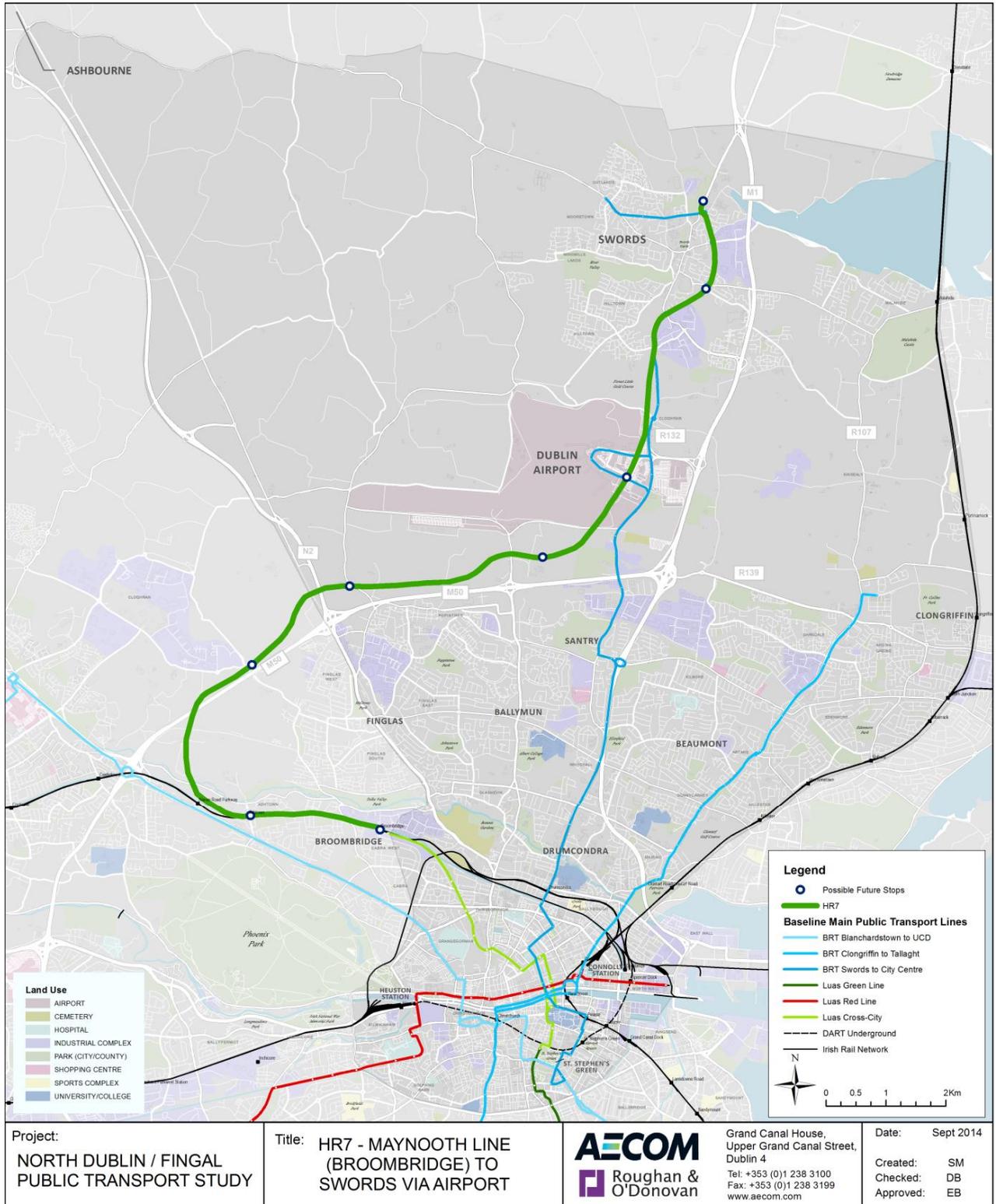
The new bridge crossing the Royal Canal will have to be sensitive to the historic significance of the canal. Further investigation of the impact of the canal crossing would be needed if this option were to go ahead, due to the wildlife using the canal. Any impacts on the landfill site will have to be carefully considered including the release of harmful gases such as methane during construction.

2.7.6 *Considerations for the appraisal process*

The following considerations should be taken into account during the appraisal process:

- Of the heavy rail options, this is one of the longest alignments, heading the furthest west of any of the options;
- Due to the alignment, the catchment is likely to be lower than other heavy rail options passing through more densely populated residential areas; and
- Journey times from Swords and the Airport are likely to be less favourable than some other heavy rail options.

Figure 2.9: HR7 Maynooth Line (Broombridge) to Swords via the Airport



2.8 HR8: Maynooth Line (Drumcondra) to Airport and Swords

2.8.1 Scheme promoter or developer

This scheme was proposed as an alternative means of connecting the Airport and Swords to the existing main line services. The scheme would operate as an integrated component of the DART Network.

2.8.2 General description of the scheme

This railway line is 12.6km in length linking the Western Line at Drumcondra to Dublin Airport and Swords. Just over half of its length (6.6km) is suggested to run underground with the remaining 6km at-grade. In total, eight new stations are proposed for this option, five at-grade and the remaining three underground.

Use of the existing rail line from Drumcondra Station is proposed before turning north into a tunnel under Glasnevin Cemetery.

North of Glasnevin Cemetery, the railway line would be aligned under the median of the Ballymun Road. A railway bridge would be required to cross the M50 motorway, before turning north east and underneath Dublin Airport.

Similar to earlier options, the tunnel would emerge just north of Naul Road and follow the same alignment as option HR7 into Swords.

2.8.3 Infrastructure considerations

The connection of heavy rail at Drumcondra would be preferably by a new grade separated junction with an underpass for the outbound line. The railway would be in a twin bored tunnel underneath Glasnevin Cemetery, the Botanic Gardens and Ballymun. A major bridge structure would be required to cross the M50 motorway. The railway would then revert back into a tunnel underneath Dublin Airport. North of the Airport the same alignment as HR7 would be used and would have the same infrastructure considerations north of the Airport to Swords.

2.8.4 Impact during construction

The railway line follows a large section of the Ballymun Road. This would require cut and cover tunnelling which would cause long term disruption to the highway.

Twin bored tunnels along the other sections would limit disruption to the area at the tunnel portals.

The new bridge deck to cross the M50 motorway could be constructed adjacent to the motorway and either launched or lifted into position during an overnight closure of the motorway.

Similarly, short term disruption would be caused by construction of crossings of local and regional roads north and south of the airport.

2.8.5 Environmental issues

Glasnevin Cemetery will be a sensitive issue to consider for this alignment. The route also passes through a highly populated residential area which may cause concerns for noise.

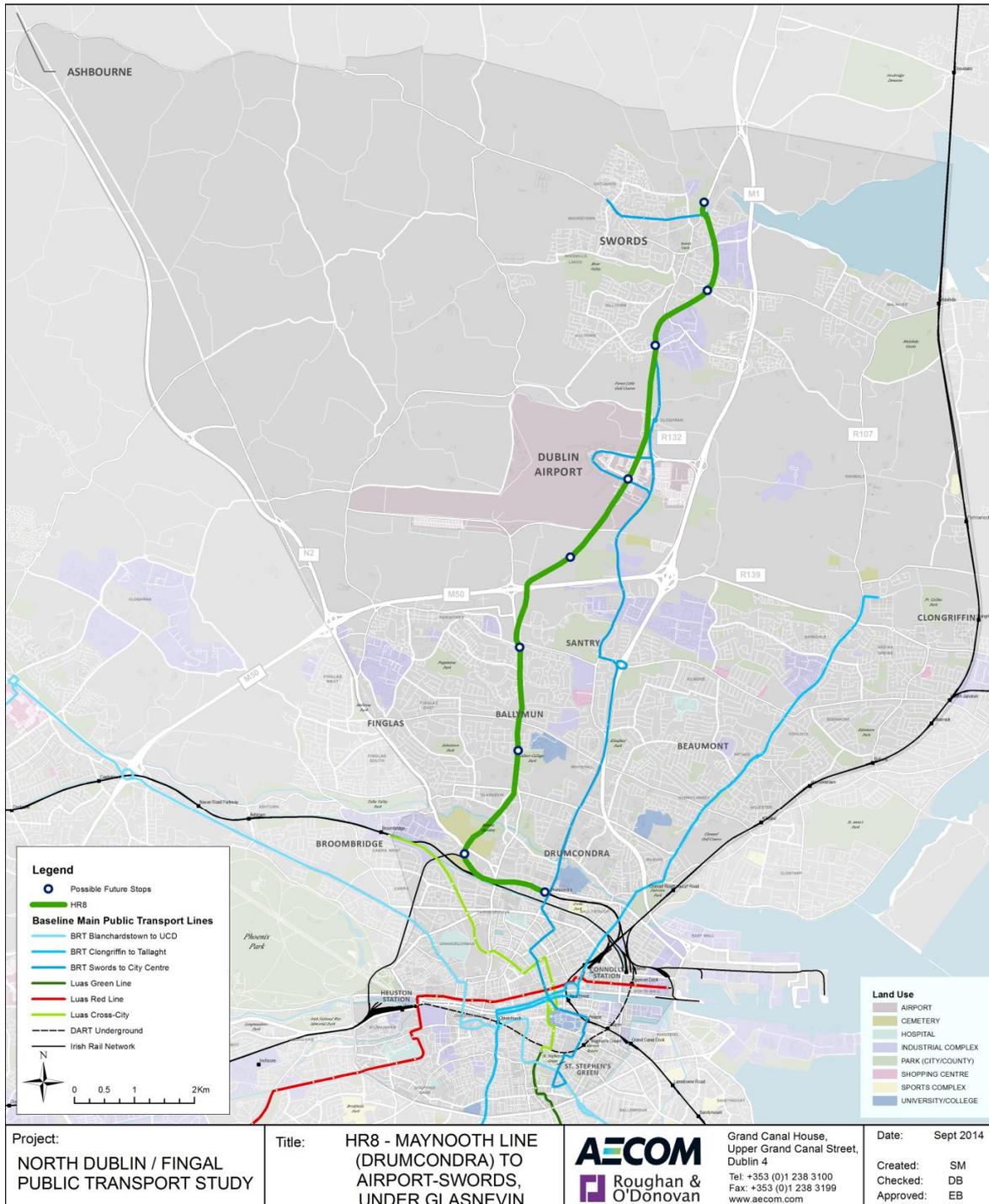
There are fewer concerns on the historical and cultural environment for this project than for other heavy rail options. Environmental considerations will be similar to the same as option HR7 north of the Airport.

2.8.6 Considerations for the appraisal process

The following considerations should be taken into account during the appraisal process:

- The cost of this option would be high in comparison with others due to the amount of tunnelling required;
- Disruption on Ballymun Road would be significant as the tunnel is constructed;
- This scheme is heavily dependent on capacities available on the Western Line;
- The route serves a very dense catchment area.

Figure 2.10: HR8 Maynooth Line (Drumcondra) to Airport and Swords



2.9 HR9: Heuston to Swords via Phoenix Park Tunnel

2.9.1 *Scheme promoter or developer*

This scheme was proposed as means of connecting Heuston Station, and potentially the DART Underground/Expansion service to the Airport and Swords. The scheme would operate as an integrated component of the DART Network.

2.9.2 *General description of the scheme*

Similar to HR8, this heavy rail option would require 12.6km of new rail line. It would commence at Heuston Station and continue to Swords via Dublin Airport. This option would run from Platform 10 at Heuston Station which would allow the service to connect easily to the Phoenix Park Tunnel. A new tunnel would be constructed under Glasnevin Cemetery and from this point the route to Swords would be the same as that proposed in HR8.

2.9.3 *Infrastructure considerations*

A railway connection already exists from Heuston Station to Cabra heading north which is intended to be brought into scheduled passenger service as part of the opening of Phoenix Park Tunnel Link in 2016. From a point just south of Glasnevin Cemetery, the alignment is similar to HR8.

2.9.4 *Impact during construction*

Based on conceptual proposals for this alignment, the railway line along the Ballymun Road would require cut and cover tunnelling which would cause long term disruption to the highway. Twin bored tunnels along the other sections would limit disruption to the area at the tunnel portals. The new bridge deck to cross the M50 motorway could be constructed adjacent to the motorway and either launched or lifted into position during an overnight closure of the motorway. Similarly, short term disruption would be caused for construction of bridge crossings of local and regional roads north and south of the airport.

2.9.5 *Environmental issues*

At the southern end of the proposed railway, between Heuston and Cabra, there are few environmental concerns as an existing railway alignment will be used.

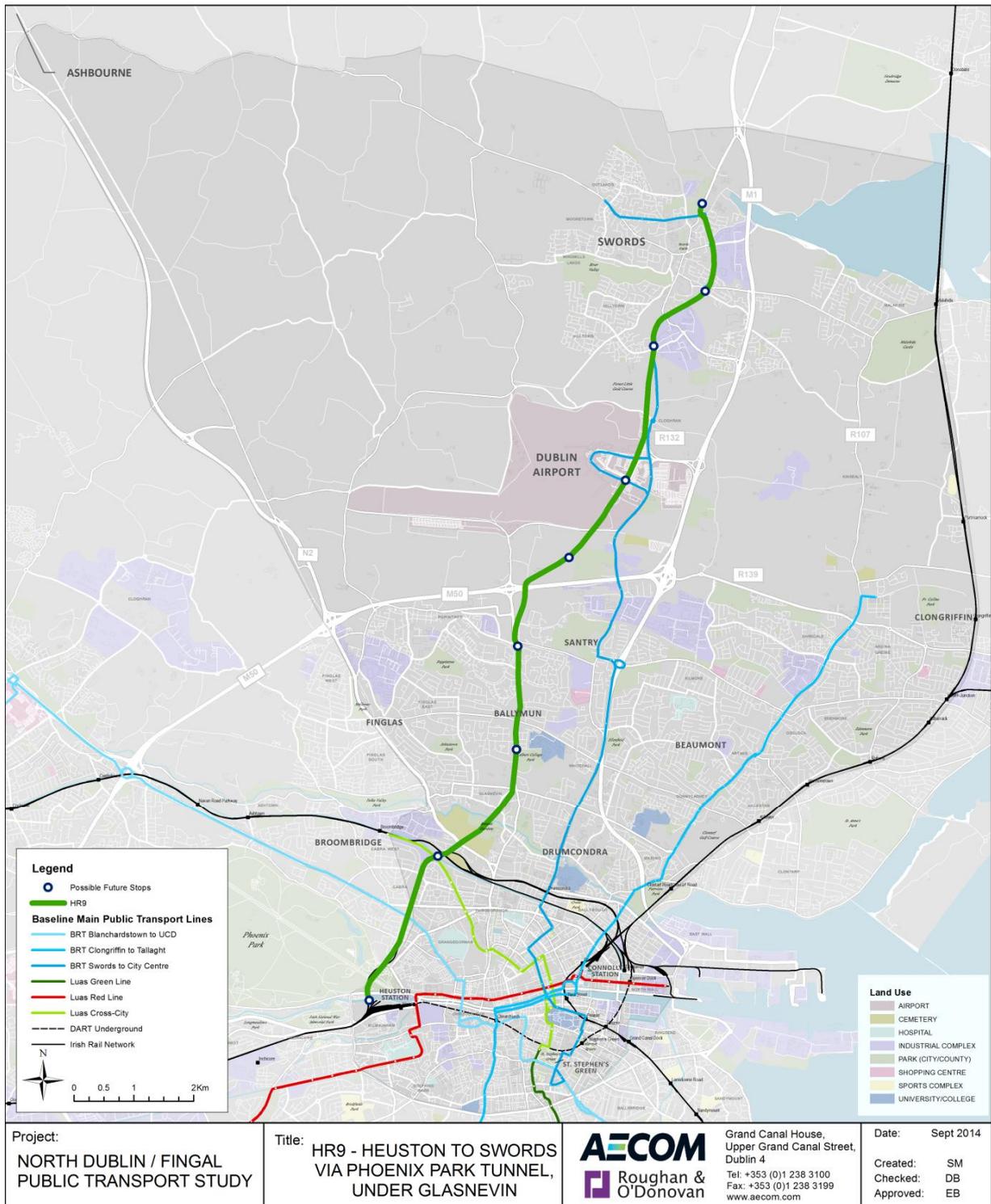
For the remainder of the route, the same environmental issues raised for HR8 will arise. Glasnevin Cemetery will be a sensitive issue and the route also passes through a highly populated residential area which may cause concerns for noise.

2.9.6 *Considerations for the appraisal process*

The following considerations should be taken into account during the appraisal process:

- There will be high costs compared to some of the heavy rail options due to the amount of tunnelling;
- Disruption at the Ballymun Road area will be significant as the cut and cover tunnel is constructed;
- This route could possibly be connected to Heuston Station in the future;
- Platform 10 is quite segregated from the main body of Heuston Station and would require relatively long walking distances to get to the Luas and taxi ranks;
- Successful operation of this scheme is largely contingent on delivery of DART Underground and DART Expansion;
- Interchange opportunities with Luas Cross City at Broombridge would need to be considered in more detail; and
- The underground station at the airport would need to be further considered in discussions with Dublin Airport Authority.

Figure 2.11: HR9 - Heuston to Swords via Phoenix Park Tunnel



2.10 HR10: Metro Dublin (St James's Hospital to Malahide)

2.10.1 Scheme promoter or developer

This scheme is being proposed by the Metro Dublin consortium.

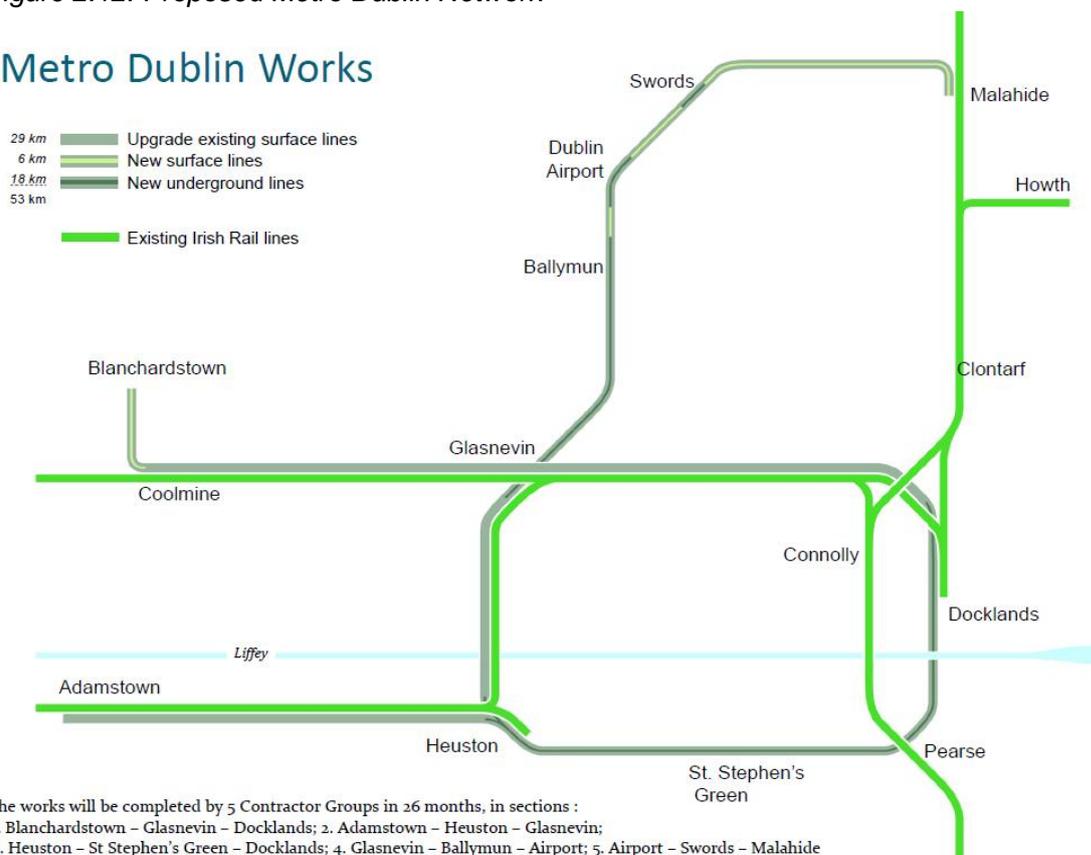
2.10.2 General description of the scheme

Metro Dublin includes a proposal for a new metro system that includes and extends the proposed DART Underground/Expansion. The system is 53 kilometres in length with 3 lines as follows:

- Blanchardstown – Glasnevin – Docklands – St Stephens Green (SSG);
- Adamstown – Heuston – SSG – Pearse – Docklands; and
- Malahide – Swords – Airport – Ballymun – Heuston – SSG.

Figure 2.12: Proposed Metro Dublin Network

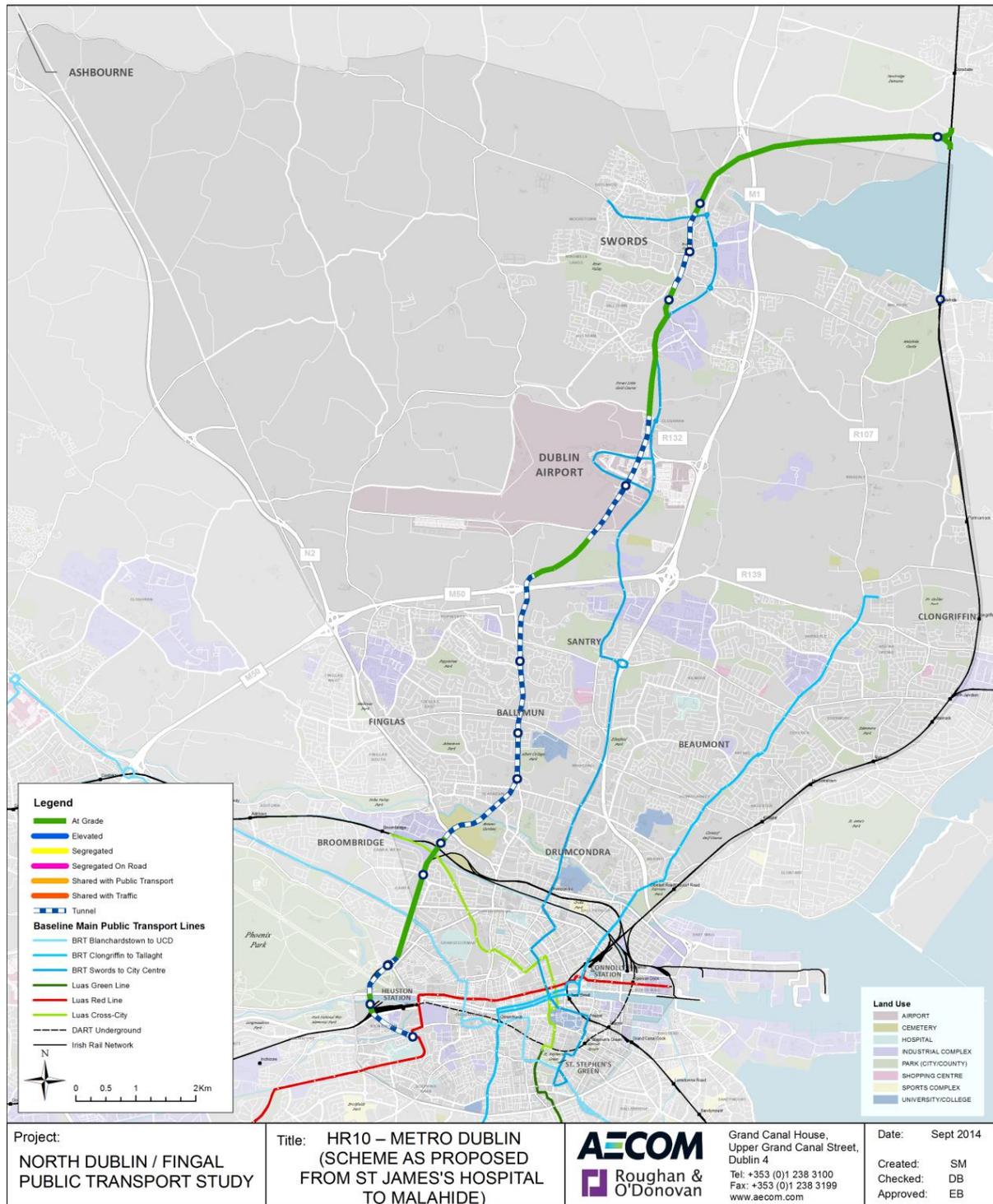
Metro Dublin Works



It should be noted that for the purpose of this study, it was agreed with Metro Dublin that only the alignment from Malahide to St James's Hospital would be taken into account. On this section, Metro Dublin is approximately 22km in length, of which 10.8km is in a single bore tunnel and 11km at grade.

Figure 2.13 shows the alignment within the study boundary, the areas of at grade running and tunnelled sections.

Figure 2.13: HR10 - Metro Dublin



The system is proposed to run on Irish Rail gauge with EMU Serie 7000 trains in six and three car units with a capacity of 1,274 passengers. The service will run at frequencies of 6, 9 12 and 15 minutes (peaks, off-peaks, evenings & rest).

Although travel demand assessments for the route have not been undertaken, Metro Dublin estimates a total patronage of 130m per year for the overall network.

Capital costs for Metro Dublin are stated by the Promoter as being €1.9bn for delivery of the three lines on the network. These costs include all capital works, land acquisition, rolling stock, procurement, control centres and depots.

Metro Dublin has proposed a programme of 42 months to deliver the full rail network. Within this 42 month period, the first 14 months is to include the planning process. Five separate Contractor Groups would be selected to deliver the project. It is proposed that the contractors would be in place by month 14 with full delivery of the network in 28 months.

2.10.3 Infrastructure considerations

Preliminary/detailed design drawings of Metro Dublin have not been provided for review by AECOM. However, the following information on Metro Dublin infrastructure proposals has been made available:

- Some sections of the alignment already exist; therefore the actual length to be built would be 10km tunnelled and 9km at grade;
- Seven new stations would be underground and a further five stations at grade;
- Tunnel depths will generally be at least 20m below surface between stations and about 10m at stations;
- The proposed infrastructure is largely based on recent works on the Madrid Metro;
- The alignment will serve a new underground station at St James's before reaching Heuston, emerging from the tunnel and crossing the River Liffey via the existing bridge;
- The existing Phoenix Park Tunnel will be used by Metro Dublin and therefore a double junction with the existing railway would be required between Heuston station and the River Liffey;
- A significantly larger interchange at Malahide is likely to be required;
- The network will run separate to the Irish Rail network and is not expected to be interoperable;
- Single bore tunnels have been proposed which for safety reasons is likely to raise significant concerns.

Some key concerns in relation to the proposed network include:

- There appears to be insufficient space to accommodate the proposed Metro Dublin alignment at Heuston. The distance between the existing at-grade railway lines outside Heuston and the River Liffey is insufficient to accommodate a tunnel portal, an achievable track gradient and a double junction;
- As with other heavy rail options, connecting the new railway line into the existing Malahide station may be difficult and could require a relocation of the station from its existing position. The current station is already constrained by existing buildings and roads;
- It is unclear whether geotechnical surveys of the full tunnelled section have been completed;
- Safety risks and a mitigation strategy for use of a single bore tunnel in favour of twin bored tunnels has not been presented;
- It is unclear whether the Phoenix Park tunnel can be satisfactorily adapted for use by Metro Dublin and how this might affect the wider network;
- There is concern that the proposed methodology is based on techniques applied in Spain as opposed to Ireland or even the UK where there are similar planning, design and delivery standards and procedures. Focus on the methodology used in Madrid has recently raised



significant issues and costs on projects in the UK where the proposed techniques were not transferable.

2.10.4 Impact during construction

There may be long term disruption to localised areas within the city centre during construction of the new underground stations. Further long term disruptions could be caused by construction compounds at tunnel portals, for the removal of spoil, manufacture or storage of tunnel segments and tunnel boring machine assembly. Disruption for crossings of the motorway, local and regional roads will be the same as for other heavy rail options.

2.10.5 Environmental issues

An assessment of the environmental impacts of Metro Dublin has not yet been undertaken. While many of the same environmental issues previously raised for the heavy rail options will also affect this option, the impacts on the Malahide Estuary Special Protection Area and Special Area of Conservation are likely to be significant.

2.10.6 Considerations for the appraisal process

The following considerations should be taken into account during the appraisal process:

- Detailed drawings of the proposed scheme have not been provided and as such it is difficult to validate technical feasibility;
- The proposed alignment from Heuston to Swords, although it doesn't connect with the 'city centre' could present significant benefit based on a dense catchment area;
- Travel demand assessment for the route has not been provided, although the full scheme is stated to carry 130m passengers per year;
- The proposed programme for delivery appears extremely ambitious in the context of similar schemes recently delivered in Ireland;
- The patronage and level of city centre access provided by the scheme is highly contingent on the delivery of the DART Underground scheme;
- The lack of fleet interoperability with existing Irish Rail infrastructure will result in the availability of Phoenix Park Tunnel train paths being heavily restricted for Kildare line services; and
- There are some concerns regarding technical feasibility of the scheme, particularly in relation to the use of Phoenix Park Tunnel and route alignment at Heuston Station.



LIGHT RAIL

3.0 Light Rail

Ireland’s recent experience of Light Rail is restricted to the Dublin area at present where the Luas has been in place since 2004 when the Green and Red Lines opened. Both lines have been extended since they opened, with the overall network now comprising 38km and 54 stations. The main extensions to the system since 2004 are:

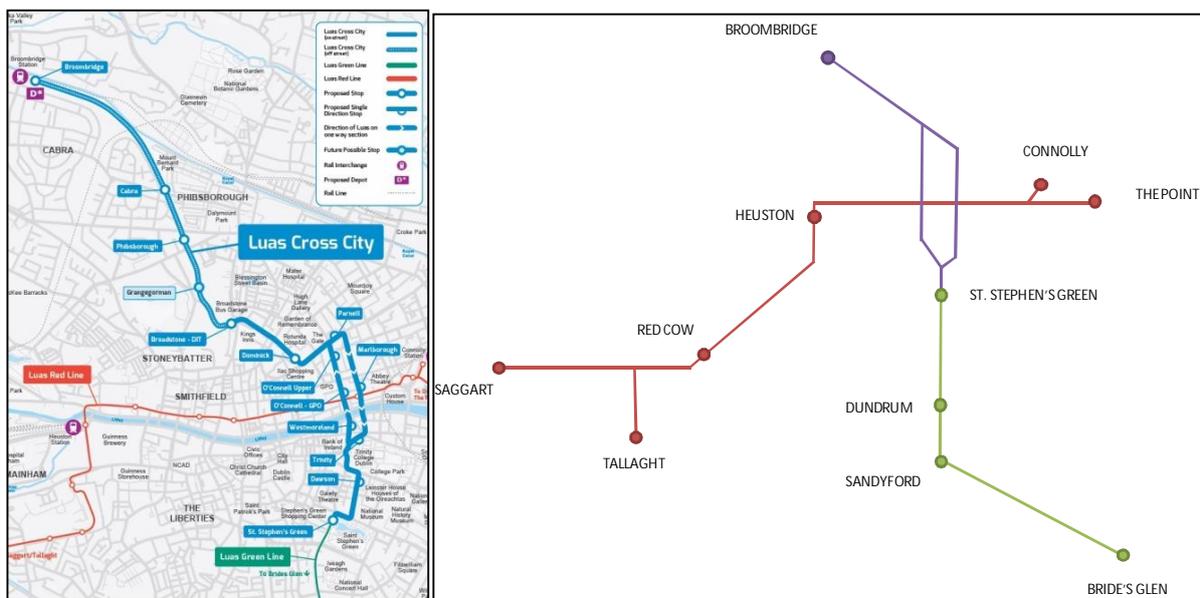
- Red Line C1 – December 2009 – Connolly Station to the Docklands opened;
- Green Line B1 – October 2010 – Sandyford to Cherrywood opened; and
- Red Line A1 – July 2011 – Saggart to Belgard opened.

Introduction of the Luas to Dublin has been a remarkable success and has significantly changed nature of travel as well as spatial development in the city. By 2006, 50 million trips were made on both lines combined and today the system carries 90,000 passengers per day or 30.5m per year (2013). Demand for the service is high, especially in the morning and evening peaks when crowding on the network is evident.

The Luas system operates on a 750 VDC overhead power supply and uses the international standard rail gauge of 1,435 mm, rather than the Irish standard of 1,600 mm. In terms of capacity, the system initially operated on the basis of 30m carriages with an overall capacity of 235 passengers per unit. These carriages were upgraded such that 43m carriages are now more common on the system, increasing the tram capacity to 280 passengers per unit.

Construction work is underway at present on the third Luas extension which will connect the Red and Green lines. The line, called Luas Cross City, will connect the Green Line at St Stephens Green with the Red Line on Abbey Street before running further north to Parnell Street, DIT at Grangegorman, Cabra and Broombridge where it will connect with main line commuter heavy rail services. Luas Cross City is to be completed and operational in 2017 and therefore forms part of the baseline network proposed for this study in 2035.

Figure 3.1: Luas Cross-City (LCC) project and integration in the future Luas network



Expansion of the current light rail system to serve the Study Area could present significant benefits as follows:

- Light rail is a high quality product with high capacity that has already been well received within the City;
- Expansion of the network would present significant integration benefits and maximise the overall offer presented by the network;
- Light rail integrates well into the urban environment which will be important for areas like the north inner city and Swords;
- Light rail has a proven ability to drive urban renewal and economic growth which is an important objective within the current Study Area;
- Light rail, unlike heavy rail, can have shared use sections where space is limited, although ideally it should be segregated as much as possible;
- Light rail presents a suitable option where the level of demand is between bus and heavy rail capacities;
- The current light rail network includes a number of Park and Ride facilities that will further encourage a shift from car mode for commuting trips;
- Light rail is highly legible with a high commuter awareness of routes, catchment areas as well as facilities to enable ease of utilisation; and
- Emissions from light rail are low and remote from the vehicle.

Despite these advantages, the provision of light rail services presents significantly higher capital costs than traditional bus or BRT solutions and requires a minimum threshold of demand to support a business case for development.

The following sections present a series of light rail options which have been proposed either by the RPA or AECOM for the study area and in general build on the planned LRT network for the City. The list includes the proposed Metro North as well as a more cost-optimised approach to delivery of a similar scheme.

3.1 LR1: Broombridge to Finglas

3.2 *Scheme promoter or developer*

This scheme has been promoted by the RPA as Line D1. The scheme has been promoted to extend the Luas Cross City line further north to increase the catchment area being served by the Luas network.

3.3 *General description of the scheme*

The total length of this light rail option is 4.8km, all of which is at-grade. Six new stations proposed on the route, all of which are at-grade.

This alignment starts with an extension off the Luas Cross City line at Broombridge Station. It crosses the canal and the railway line and continues at-grade along Broombridge Road. The line then crosses Ballyboggan Road and enters Tolka Valley Park. The route crosses the Tolka Valley Road and enters green space between Barnmore Grove and Carrigallen. The route remains segregated until it reaches Wellmount Road. After Wellmount Road, it continues along Patrickswell Place, bears left onto Cappagh Road then right into Finglaswood Road. The route then crosses Mellowes Road and continues to run within Mellowes Park on the eastern side of Casement Road. The route then joins St Margaret's Road on the east side of the N2.

The route runs through a dense residential area presenting potential for a high catchment. However, the route does not respond to the objective of this project in serving the Airport and Swords.

RPA estimated cost in the order of €250m to deliver this Luas extension.

3.4 *Infrastructure considerations*

Land acquisition will be required to accommodate the corridor in the southern part of the route. A new bridge would be required to cross the Tolka River and valley. Parts of the route are totally segregated and other parts shared with general traffic. Crossing the N2 at the top of Casement Road would require upgrading the junction to full signalisation. The southern section of St Margaret's Road may need to become one way to accommodate segregated on road provisions for the Luas service.

3.5 *Impact during construction*

As parts of the route are off road, this would minimise any lengthy disruption during construction. The on road shared route, will inevitably cause significant disruption and delays to traffic.

3.6 *Environmental issues*

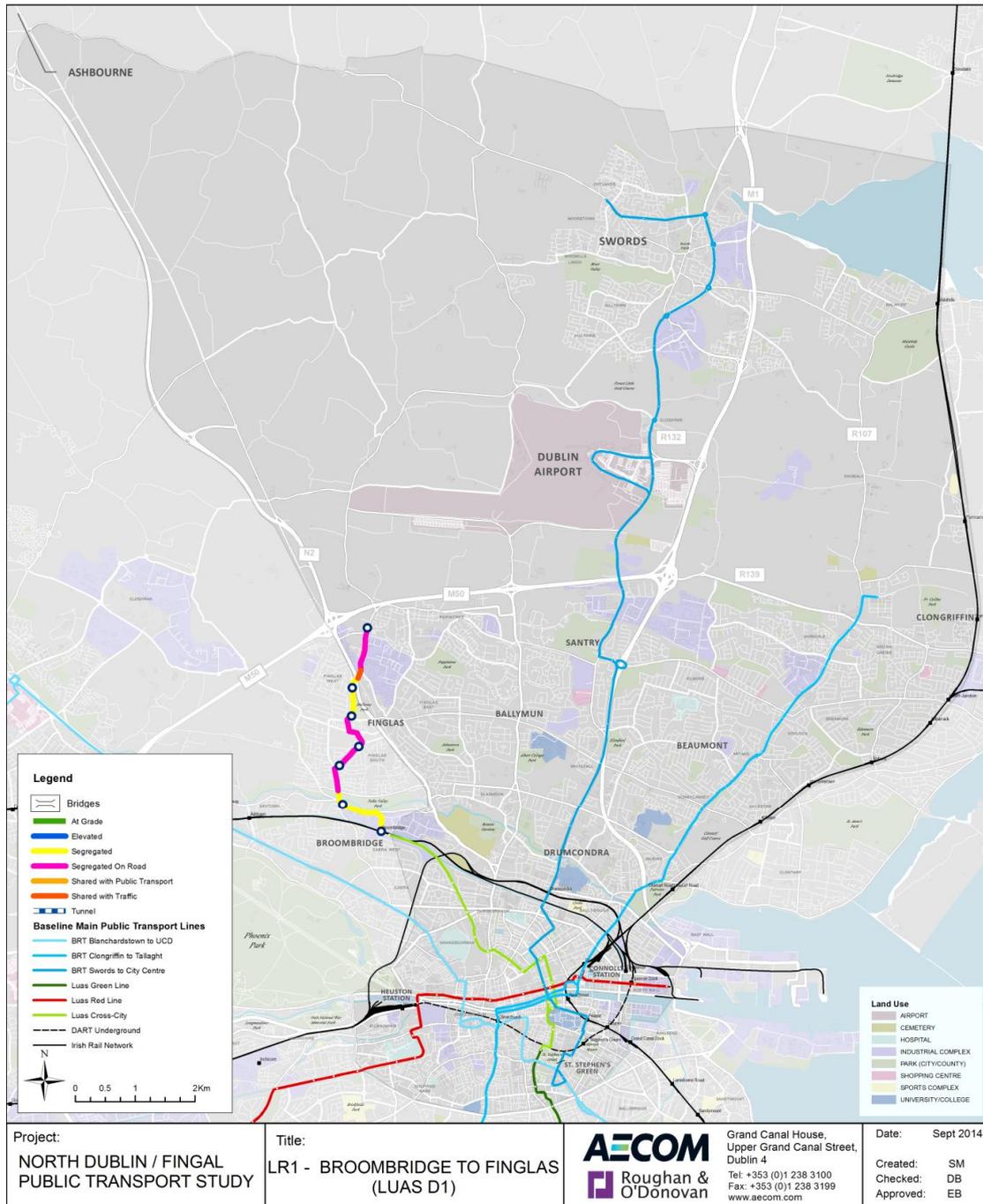
The proposed line uses the existing bridge to cross the Royal Canal, designated a Natural Heritage Area (NHA). If works are required to the bridge to accommodate the new services, this will need further investigation. Finglas House is listed on the Sites and Monuments records and is located in the Tolka Park. The detailed design of the route would need to take this into consideration. There may be protected species in the riparian zone along the river in Tolka Park, which will need to be further considered if this option were to progress. Noise would need to be considered on those parts of the route passing through residential areas. Parts of the route are also within a zone of Archaeological interest listed under the Dublin City Development Plan 2011-2017. Mellowes Park provides an ecological corridor for wildlife in the area, the park would need to be examined for protected flora and fauna.

3.7 Considerations for the appraisal process

The following characteristics of Light Rail option LR1 should be taken into account during scheme appraisal:

- The scheme is deliverable from a technical perspective and serves a wide catchment area; and
- The route does not meet the overall objective of the study in that it is an extension of the Luas Cross City route, which was never intended to serve Dublin Airport or Swords.

Figure 3.2: LR1 Broombridge to Finglas



3.8 LR2: Broombridge to Swords via Dublin Airport and Finglas

3.8.1 Scheme promoter or developer

This scheme has been proposed with the intention of extending the route LR1 to the Airport and Swords to meet the objectives of this study.

3.8.2 General description of the scheme

The total length of this light rail option is 15km, all of which is at-grade. Seventeen new stations are also proposed along the route, all at-grade.

The first 4.8km of the southern part of this route is identical to option LR1, the extension runs north from this point towards the airport and Swords. At the northern end of St Margaret's Road, the line crosses the M50 motorway. The line then turns eastwards just to the north of the M50, where it is segregated from traffic. The route continues east until the R132 and turns north following the R132. The proposed station at the airport is located west of the R132 just south of the airport roundabout where a people mover would be used to connect passengers to the Airport terminals. Alternatively, a one-way loop around the airport could be considered although this would require some redistribution of road space.

The route continues north off road on the west side of the R132, crossing the Naul Road at-grade. The route crosses the west side of Pinnockhill Roundabout. From this point, the route becomes a medium to low speed penetration light rail to serve Swords, for the last 2.1km of the route. Three stops are proposed in Swords; namely Pavillions, Castle and Estuary.

While the route would serve both the Airport and Swords, journey times from the City Centre would be high given the circuitous route via Finglas.

3.8.3 Infrastructure considerations

The infrastructure considerations for the southern part of the route are identical to LR1. In addition, a new bridge would be required to cross the M50 motorway at the northern end of St Margaret's Road. The stop at the Airport would require construction of a people mover to connect passengers to the terminal buildings with the alternative being a restriction on road capacity to allow the introduction of a one-way loop. A new bridge would be required to cross the Cloughran Valley at the northern end of the route. For two tracks to be segregated in Swords town, a one way system would be required on Dublin Road and Main Street.

3.8.4 Impact during construction

Some short term disruption would be expected at Broombridge when the new flyover junction is constructed. As parts of the route are off road, this will minimise any lengthy disruption during construction. A short to medium term disruption may occur with the bridge installation over the M50 motorway. Long term disruption would be expected on the roads where the route would be constructed, around Broombridge and Swords.

3.8.5 Environmental issues

The southern section of this route is the same as LR1 and the environmental issues are identical. North of the M50, the route passes through an area of green belt which may provide a habitat for certain species, requiring further detailed investigation if the route progresses further. This section also passes through an area of G3 zoning in the Development Plan which seeks to protect and enhance high amenity area and protect and provide for a green belt. Sillogue Park Golf Course is also located on the proposed route. North of the airport, the route passes through further G3 zoning.

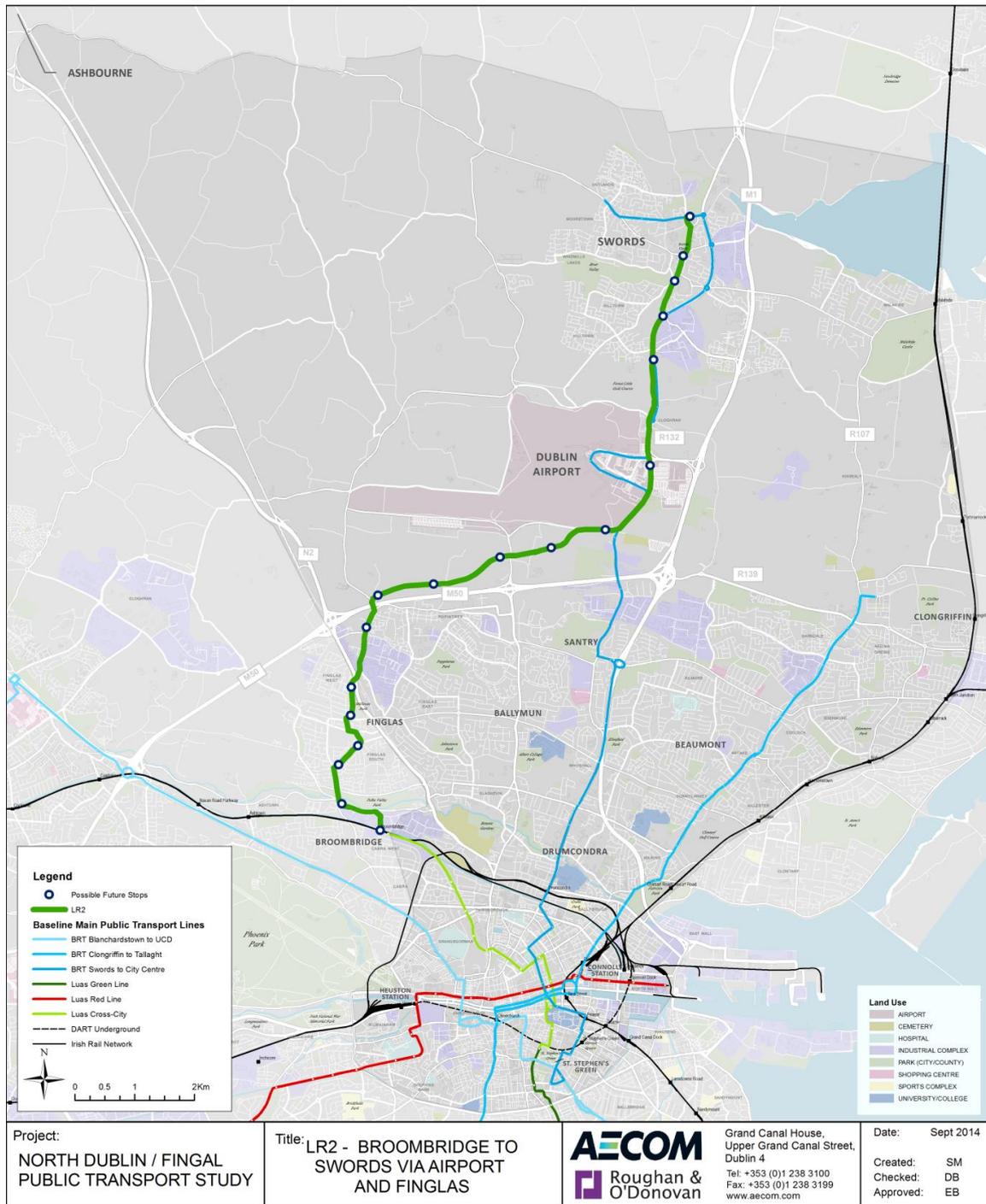
In Swords, any impacts on protected structures or listings on the SMR along Swords Main Street will need to be taken into account if this route goes ahead.

3.8.6 Considerations for the appraisal process

The following characteristics of Light Rail option LR2 should be taken into account during scheme appraisal:

- The route is technically feasible;
- This scheme has very good integration with the existing and proposed public transport options and good integration with land-use policies;
- This scheme is a cost effective solution as it does not include tunnelling or other major infrastructure;
- The catchment population is relatively low in comparison to other LRT options mainly due to the longer section of route which runs through currently undeveloped land north of the M50 through Dardistown; and
- As the route follows a westerly, indirect, path the journey time to the City Centre is particularly long in comparison to other LRT options.

Figure 3.3: Option LR2 Broombridge to Swords via Dublin Airport and Finglas



3.9 LR3/4/5 – Route Options for Luas Line D2

3.9.1 Scheme promoter or developer

These schemes are variations on a route proposed by the RPA (D2). Three different options are proposed as follows:

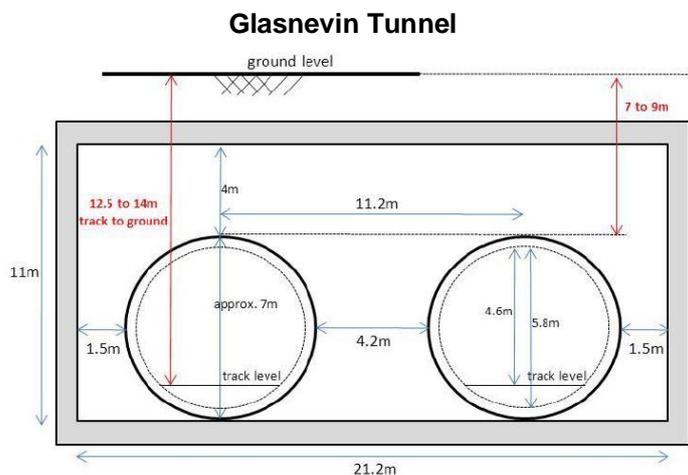
- LR3 - Cabra to Swords via Dublin Airport under Glasnevin Cemetery;
- LR4 - Cabra to Swords via Phibsborough and Dublin Airport; and
- LR5 - Cabra to Swords via Drumcondra and Dublin Airport.

While the RPA preferred option is a route under Glasnevin Cemetery, each of these options is brought forward for the current appraisal.

3.9.2 General description of the scheme

This scheme proposes an extension of the Luas Cross City from Cabra to Swords. While much of the route follows a relatively similar alignment apart from the Airport to Swords, different alignment are proposed for the southern section as follows:

- **LR3 (see Figure 3.4):** The total length of this light rail option is 13.5km, of which, 11.4km is at-grade and the remaining 2.1km is tunnelled. Twelve new stations are proposed for the route with one underground. The route follows a similar alignment to the proposed Metro North (LR6/7) route using a 2.2km tunnel to pass under Glasnevin Cemetery, and then following Ballymun Road and the R132 to Swords via at-grade infrastructure;



- **LR4 (See Figure 3.5):** LR4 is effectively an at-grade variation of LR3, following existing roads through Phibsborough and Glasnevin. As it is using existing roadways the traffic impact is much more significant than LR3 and the implementation of the infrastructure on some sections may be challenging, with significant detrimental impacts on Luas journey times and traffic;
- **LR5 (See Figure 3.6):** This route follows an alternative alignment via Drumcondra and Santry to reach the airport. This route would make use of the Quality Bus Corridors (QBC) along the route to provide dedicated LRT infrastructure. As with LR4 traffic impact in this congested inner suburban location will be significant as a result of the at-grade running. Average Luas speeds on the route would also reduce due to traffic impacts.

The main difference between these route alignments and the original Metro North alignment is that the route follows existing roads around the airport rather than linking directly to the Terminals. Along the airport frontage (R132) the LRT would share the existing bus lanes and will not enter the airport grounds. Therefore a “people-mover” will be required to link to the airport terminal buildings unless road capacity could be redistributed within the Airport to introduce a one way loop for the LRT. While the system links well into the existing the public transport system, the requirement for a people-mover link to the airport reduces the ease of integration somewhat.

RPA suggest that journey times on line D2 (via Glasnevin) from St Stephens Green to the Airport would be 35 minutes. Estimated capital costs for delivery of the project are stated by the RPA to be in the region of €640m.

3.9.3 Infrastructure considerations

The main features of this route are outlined below for each option:

- **LR3:** A new double junction would be constructed for the connection with Luas Cross City at Cabra. A tunnel would be required below the Botanic Gardens, approximately 2km in length. The tunnel would be a combination of bored tunnel and cut and cover sections;
- **LR4:** Limited road space throughout the Phibsborough and Glasnevin area which will result in either shared running or significantly reduced traffic capacity approaching the city from the N2 and Finglas; and
- **LR5:** The existing QBC/ proposed BRT would have to be removed to make space for the LRT infrastructure. The limited space particularly through Drumcondra and Santry will result in either shared running or a significant reduction in traffic capacity approaching from Santry/Swords and N1.

Each of the above options share road space along large sections and crosses roads at-grade with traffic signal control. A major bridge structure will be required to cross the M50 motorway for all options. As the Airport station is not within the terminal facilities, a people mover will be required to access the terminals from the stop west of the R132. The potential to introduce a one way loop around the Airport could be looked at although this will result in a reduction in road capacity. After the Airport, the routing would be the same as LR2 towards Swords with a bridge structure required to cross the Cloghran Valley.

3.9.4 Impact during construction

Medium term disruption would be expected around the tunnel portal construction compounds near Cabra and Glasnevin Cemetery. Short term disruption would be expected whilst the bridge structure was placed across the M50 motorway. However, longer term disruptions would be expected between Glasnevin and Swords while the light rail line is constructed on the shared roads.

For the at-grade options via Phibsborough and Drumcondra significant traffic disruption can be envisaged, with medium to long term road closures required to facilitate construction in this constrained suburban environment.

3.9.5 Environmental issues

The cut structure that this route proposes at Cabra will minimise much of the potential conflict with natural heritage and environmental topics. Several Sites and Monument Record locations are listed around Glasnevin, and the cemetery site itself is very sensitive for historical and cultural heritage. Construction noise and the effects on the local population should be considered when the line emerges along Ballymun Road. An old estate house exists to the east of Charter School Hill. If this

area is impacted by the scheme, it would result in significant impact on the landscape. North of the airport and through to Swords, the environmental issues are consistent with option LR2.

Through Phibsborough and Drumcondra this option follows existing roads, which would limit environmental impact, however there are listed structures along both of these alignments some of which may be impacted by the necessary infrastructure.

3.9.6 Considerations for the appraisal process

The following characteristics of these options should be taken into account during scheme appraisal:

- The schemes are technically feasible and would extend the existing Luas network through high density residential areas;
- These options offer good integration with the existing and proposed public transport options as well as land use policies;
- Opportunities to integrate with Dublin Airport need to be looked at in further detail;
- LR3 through Glasnevin is the most expensive of the three proposed options as it requires tunnelling however the impact of traffic is likely to be significantly less than the other two options; and
- As the route requires shared running on some sections, particularly to the front of the airport, the capacity of the route may be reduced as a result.

Figure 3.4: Option LR3 Cabra to Swords via Dublin Airport under Glasnevin Cemetery

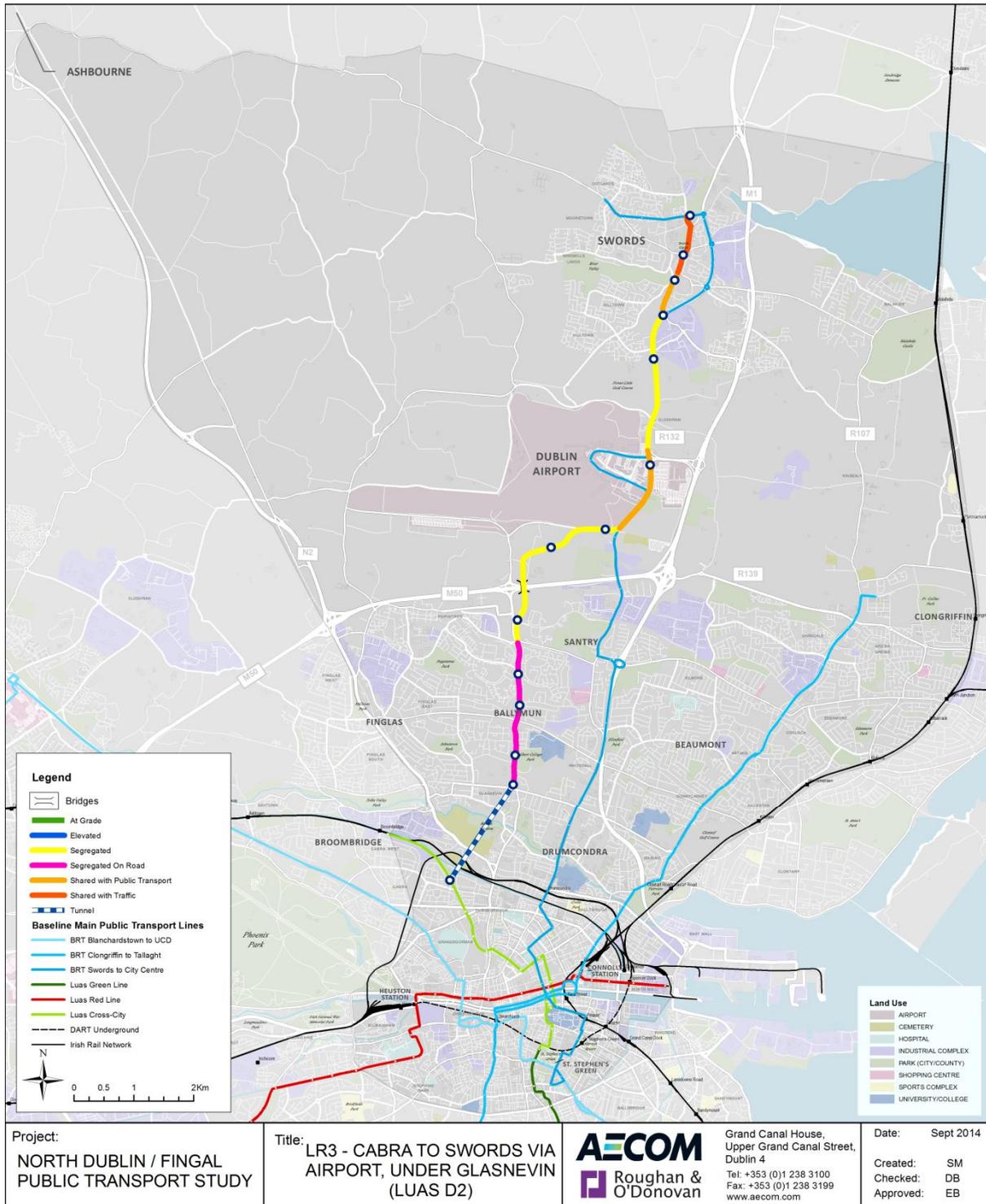


Figure 3.5: Option LR4 Cabra to Swords via Phibsborough and Dublin Airport

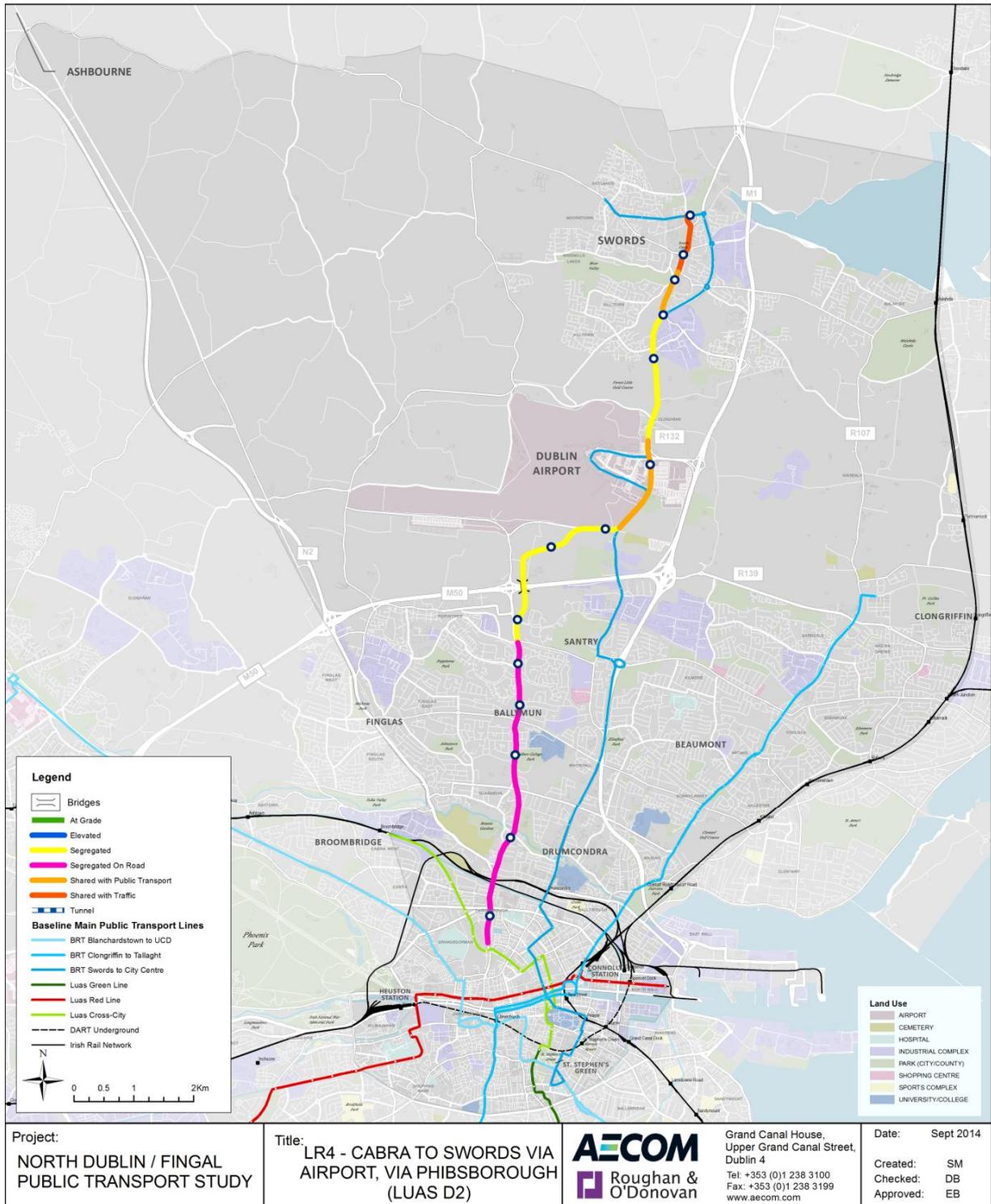
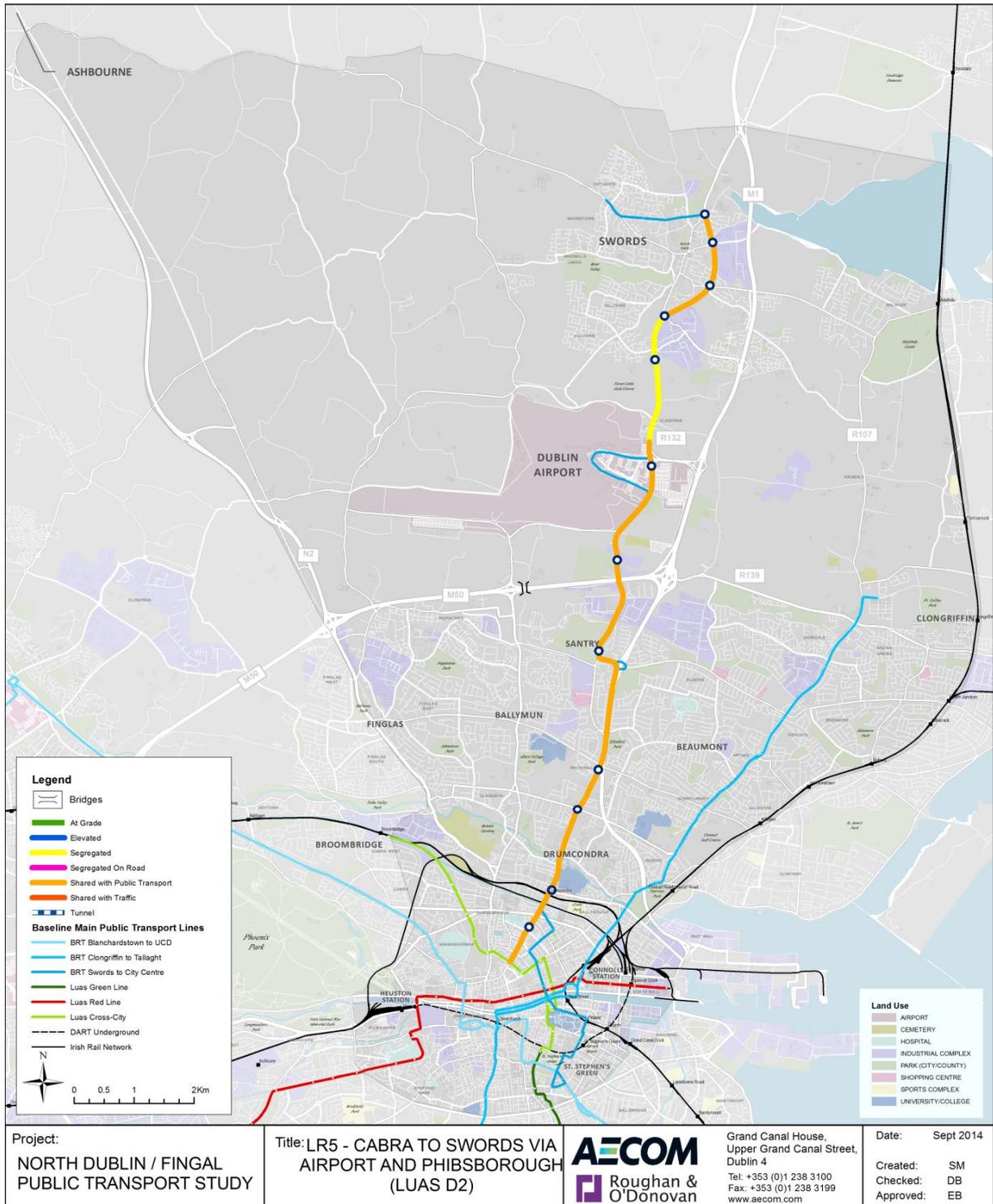


Figure 3.6: Option LR5 Cabra to Swords via Drumcondra and Dublin Airport



3.10 LR6. Metro North

3.10.1 *Scheme promoter or developer*

This is the original Metro North Scheme as proposed by the RPA and approved by An Bord Pleanála in 2010.

3.10.2 *General description of the scheme*

Metro North was proposed for development as part of the Transport 21 investment programme in 2005 as part of Dublin's integrated light rail network. However, despite granting of a Railway Order for the scheme in 2010 as well as advanced procurement, the scheme was deferred in 2011 due to financial constraints. The scheme, estimated to cost in region of €2.5bn (excluding inflation), will provide a light rail connection from St. Stephen's Green to Swords in 30 minutes via Dublin Airport.

The approved route is 16.5km long and runs between Estuary, to the north of Swords, and St. Stephen's Green in the city centre as shown in Figure 3.7. The proposed route runs largely at ground level and on elevated viaducts from Estuary to north of the Airport, in tunnel through the airport, and back to ground level through the lands south of the airport, crossing over the M50 and then going underground again from north of Ballymun to its terminus at St. Stephen's Green.

There are 14 stops along the route, nine underground and five at ground level. Underground stops will be provided at the Airport, Ballymun, Dublin City University, Griffith Avenue, Drumcondra, Mater, Parnell Square, O'Connell Bridge and St Stephen's Green. At ground level stops will be provided at Estuary, Seatown, Swords, Fosterstown, Dardistown, and Northwood. Park & Ride facilities are provided at Dardistown and Fosterstown.

Metro North is an important component of the Draft Greater Dublin Area Transport Strategy as well as development plans for Fingal County Council and Dublin City Council. The scheme forms the basis for a revised spatial development pattern based on high density development close to the corridor. The scheme was also the basis for an Economic Corridor connecting the City Centre with Dublin Airport and Swords. As such, the current transport and land use planning policy context for the Study Area has been developed on the basis of Metro North progressing.

Metro North was proposed with a capacity of 8,000 passengers per direction per hour (ppdph) based on 5 minute headways in the AM peak. Capacity was proposed to increase incrementally through the procurement of additional vehicles with the ultimate capacity, based on a 2 minute headway, in the order of 20,000 ppdph. This capacity reflected an expected forecast demand at the time of approximately 17,000 ppdph.

The scheme was proposed to be inter-operable with Luas with a track gauge of 1435 mm and a nominal operating voltage of 750V DC.

The Metro North Business Case, developed by the RPA, indicated a strong economic case for Metro North. The benefit to cost ratio of the project was estimated in excess of 1.5:1 using traditional economic appraisal methods, and at 2:1 when taking account of wider economic benefits.

3.10.3 Infrastructure considerations

The following infrastructure aspects of the Metro North are proposed:

- **Tunnelling:** Nearly 70% of the Metro North alignment is proposed to run underground. This adds significant complexity and cost to the project. The bored tunnel diameter is approximately 6m with an average depth to track level approximately 20m deep. The proposed tunnelling configuration is as follows:
 - o Twin-bore running tunnels between St. Stephen's Green and Albert College Park portal;
 - o A ventilation and intervention shaft will be provided between the Stops at Drumcondra and Griffith Avenue;
 - o Twin-cell cut and cover running tunnels between Albert College Park up to immediately south of Northwood Stop;
 - o Twin-bore running tunnels beneath Dublin Airport;
- **Structures:** A total of seven bridges, two viaducts, three footbridges and three underpasses are proposed as part of the alignment. Most significant of these are the M50 crossing at Northwood and the R132 viaducts and underpasses;
- **Stops:** Nine sub-surface stops and five at-grade Stops. Platforms on all stops are proposed at 94 metres in length. Platform surfaces are 280 mm above rail level and the face of the platform 1242 mm from the centreline of the track. For at-grade Stops the minimum platform widths are 3.5m on side platforms and 6 metres on island platforms. These stop will be very similar to the Luas stops;
- **For sub-surface stops,** the minimum platform widths are 3.5m on side platforms and typically 9 to 12 metres on island platforms. These have been increased to 14 metres at the Airport and 20 metres at St. Stephen's Green terminus to accommodate the estimated increased passenger flows. Sub-surface stops will have platforms 10 to 20m below the surface with permanent surface features such as entrance canopies, lift and ventilation shafts;
- **Depot:** Metro North is to have its own dedicated depot located south of the Airport at Dardistown. This will provide accommodation for a headquarters and administration building, vehicle maintenance and stabling facilities and an infrastructure maintenance facility;
- **Track:** Three different types of track bed are proposed along the length of the line. The width of track is typically 8m wide. The engineering requirement of a particular location will dictate the type of track bed required at that location, and can be summarised as follows:
 - o Ballast track - In long sections with no pedestrian access (typically at grade);
 - o Slab track - On structures (in tunnels, on viaducts and bridges) and in sections adjacent to public roads;
 - o Embedded track - In stop areas and wherever vehicles or the public have access to the track;
 - o Grass track - Where required for aesthetic reasons;
- **System:** The 750V DC overhead catenary system will be similar to the Luas system with overhead wiring and pole structures. There will also be the need for a number of sub-stations to provide power to the system;

- **Vehicles:** Bi-directional light metro vehicles (LMVs) with a width of 2.4 metres, a nominal length of 45 metres were proposed. The vehicles have a minimum of 70% low floor area and will be able to operate continuously at 70 kph. A fleet of 84 LMVs was the estimated requirement to accommodate the ultimate peak service of two minute headways. An initial fleet of 36 LMVs required initially to accommodate the peak opening service running at five minute headways; and
- **Fare Collection System:** An automated fare collection system, compatible with the Integrated Ticketing System, is proposed.

3.10.4 *Environmental Issues*

Metro North was granted a Railway Order on 27th October 2010.

The environmental issues for Metro North were fully assessed within the Environmental Impact Assessment (EIA) undertaken as part of the RPA Railway Order Application, prepared in accordance with the legal provisions set out in the Transport (Railway Infrastructure) Act of 2001, Section 39.

The EIA describes the main environmental issues and potential impacts due to the introduction of Metro North. These related to the effects of temporary construction operations and their associated nuisances such as noise, dust, visual impacts as well as impacts to traffic and protected structures and risks related to settlement and spoils disposal. On completion of Metro North there will be potential operational issues such as noise, vibration, air and visual impacts. Impacts can be positive or negative.

RPA consulted widely with the public during the development of the proposed scheme. Some of the issues raised during those consultations are outlined below and have been dealt with within the EIS:

- Impact of the proposed scheme on local businesses;
- Potential for negative health effects during construction;
- Potential for negative effects on existing utilities and the navigation system at Dublin Airport;
- Nuisance and disturbance associated with noise and vibration and air quality;
- Visual intrusion;
- Impact of the proposed scheme on ecology - flora and fauna;
- Potential to pollute surface water and groundwater;
- Traffic disruption;
- Impacts on buses, pedestrians and cyclists;
- Potential negative effects on property;
- Potential for negative effects on St. Stephen's Green.

3.10.5 *Impacts During Construction*

Construction works would be expected to start at the same time at various locations along the route, including all stop locations. Due to the linear nature of the construction site it is possible for certain activities to overlap with others or to run concurrently. Total construction duration is expected to take up to 60 months.

RPA has identified a number of packages of enabling works that will commence in advance of the main construction works including contracts for utility diversions; heritage works, including

relocating a number of monuments either to the National Museum of Ireland or into storage for safekeeping; junction reconfigurations to facilitate traffic management; a temporary bridge over the River Liffey to accommodate traffic during construction of some of the stops in the city centre; the construction of a part of the stop box at the Mater campus; and other ancillary works such as archaeological and building surveys, to assist in ensuring the site is available for the contractor to carry out the main works. The majority of these works are now complete.

In general the construction of the Metro North main works will involve the following phases:

- Site preparation;
- Establishing site offices, compounds and security;
- Utilities diversion;
- Excavation and construction of underground stops;
- Construction of tunnels and structures;
- Installation of the trackbed and rails;
- Installation of mechanical, electrical and operating equipment;
- The fitting out of stops and associated equipment; and
- Finishing to surfaces and soft landscaping.

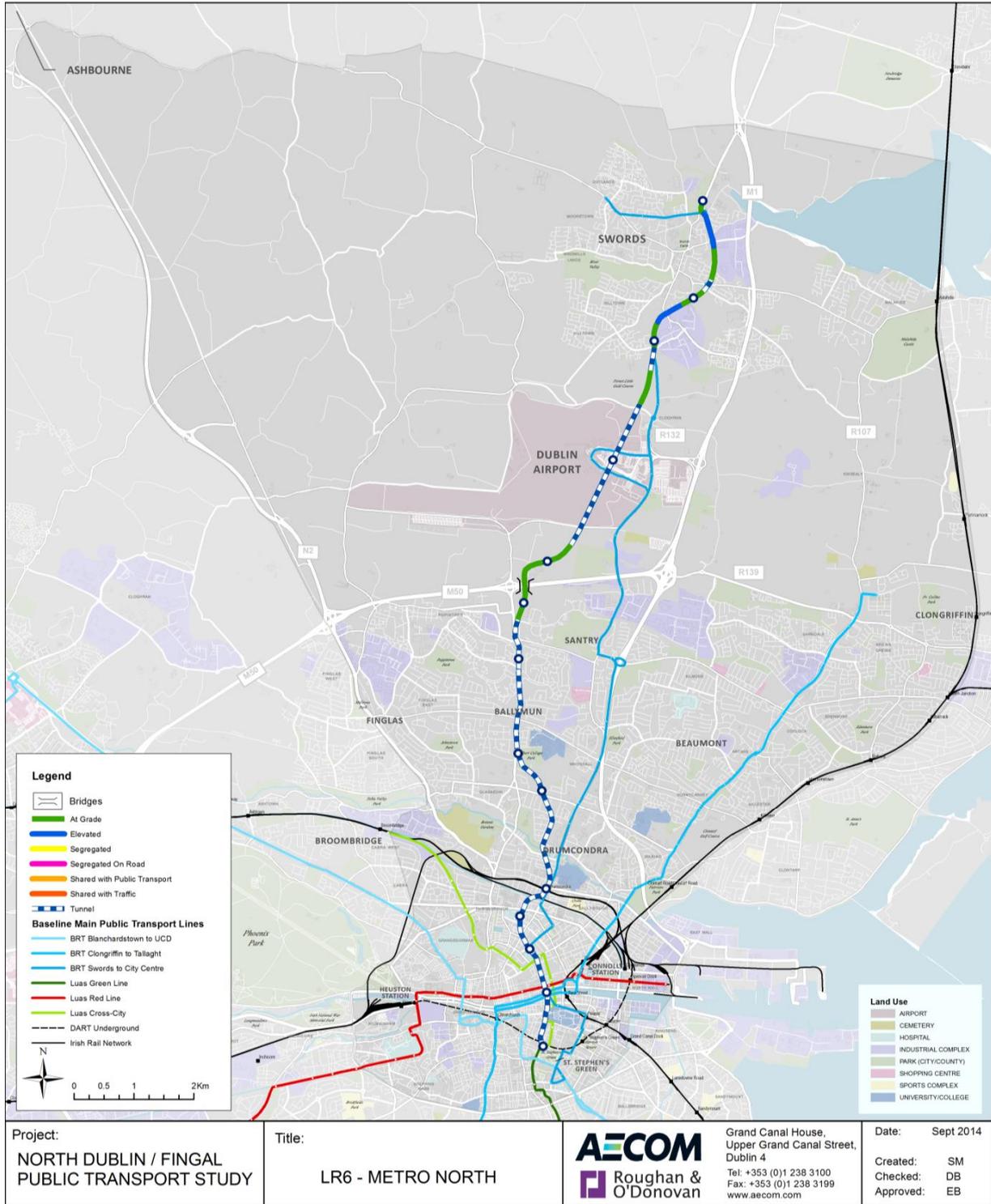
Throughout the construction phase, monitoring would be carried out e.g. for noise, vibration and air quality. Areas of temporary land take would be required to support the 25 construction compounds for site accommodation and offices to manage the works, for the storage of materials, plant and equipment, fabrication and vehicle parking.

3.10.6 Considerations for the appraisal process

The following characteristics of Metro North should be taken into account during scheme appraisal:

- The scheme satisfies the project objectives and, having already been developed to detailed design, is technically feasible;
- The proposed route serves a very dense catchment area and many of the major trip generators within the study area;
- The service has a very high capacity potential which would need to be examined against estimated demand through detailed modelling;
- The service offers excellent journey times owing to the level of frequency and segregation proposed;
- The proposed Metro North alignment has formed the basis for spatial plans within the study area for some time, therefore it integrates excellently with future planning proposals;
- The scheme has already been through the required statutory planning processes and was granted planning approval to be developed; and
- The cost of the scheme is high relative to all other schemes being assessed.

Figure 3.7: LR6 – Metro North



3.11 LR7. Optimised Metro North

3.11.1 Scheme promoter or developer

This scheme has been proposed by the RPA as a revised version of Metro North with a number of amendments made to the scope of the project to reduce capital costs.

3.11.2 General description of the scheme

The scheme would follow the same alignment as Metro North but incorporates a number of different infrastructure proposals. The revised scope is on the basis of revised patronage forecasts for Metro North. Forecasts for the route have been reduced as a result of:

- Reduced economic growth and impacts of the recession;
- Changes in plans for traffic demand management; and
- Changes in delivery plans for schemes outlined in A Platform for Change.

Based on these circumstances, the RPA has revised long term patronage forecasts for Metro North to no more than 12,000 ppdp, although this is subject to more detailed modelling.

3.11.3 Infrastructure considerations

Arising from the revised demand forecasts for Metro North, the scope of the scheme has been revised as follows:

- **Smaller Stations:** It is assumed that a 60m long tram will provide sufficient capacity to meet the long term demand on the Airport-Swords corridor. This would allow the station platforms to be reduced from their current 94m to 60m. Reducing the length of platforms in stations to 60m would result in savings of approximately €79 million;
- **Rolling stock:** In addition to the construction savings outlined above, the revised capacity requirement of 12,000 ppdp reduces the quantity of rolling stock required by one third. This results in an additional saving of €46m;
- **Fewer Stations:** The opening of Luas Cross City will provide greater accessibility around the city centre for public transport users. This offers an opportunity to review and rationalise the Metro North city centre stations. At present, Metro North includes stations at O'Connell Bridge and Parnell Square. The O'Connell Bridge station involves major construction sites in both Westmoreland Street and O'Connell Street Lower, with consequent significant disruption to Luas Cross City services. The Parnell Square station was complex and involved difficult interfaces with both the Rotunda Hospital and the Abbey Presbyterian Church. Parnell Square station is also relatively close to the next station to its north at the Mater Hospital. Greater accessibility provided by Luas Cross City offers an opportunity to combine these two stations into a single station at O'Connell Street Upper. The street at this point is wide and would allow for phased delivery of the station in a manner which would minimise disruption to Luas Cross City services. Omitting O'Connell Bridge and Parnell Square stations in favour of a station at O'Connell Street Upper is estimated to save approximately €131 million; and
- **Vertical Alignment Changes:** Running the service at grade where possible could offer significant savings. An at-grade alignment for Metro North through Ballymun was previously considered. It is recommended that Metro North revert to an at-grade alignment in this area and any grade separation required in the future be included in the scope of the Metro West project. Metro North ran on an elevated viaduct along the R132 at Swords. It is recommended that this also reverts to an at-grade alignment. Adopting an at-grade

alignment through Ballymun, Dardistown and on the R132 at Swords would save approximately €196 million.

3.11.4 Impact during construction

The impacts during construction will be similar to those outlined for Metro North, although some sections will be less significant, for example on Ballymun Road where the route will no longer be in a tunnel.

3.11.5 Environmental issues

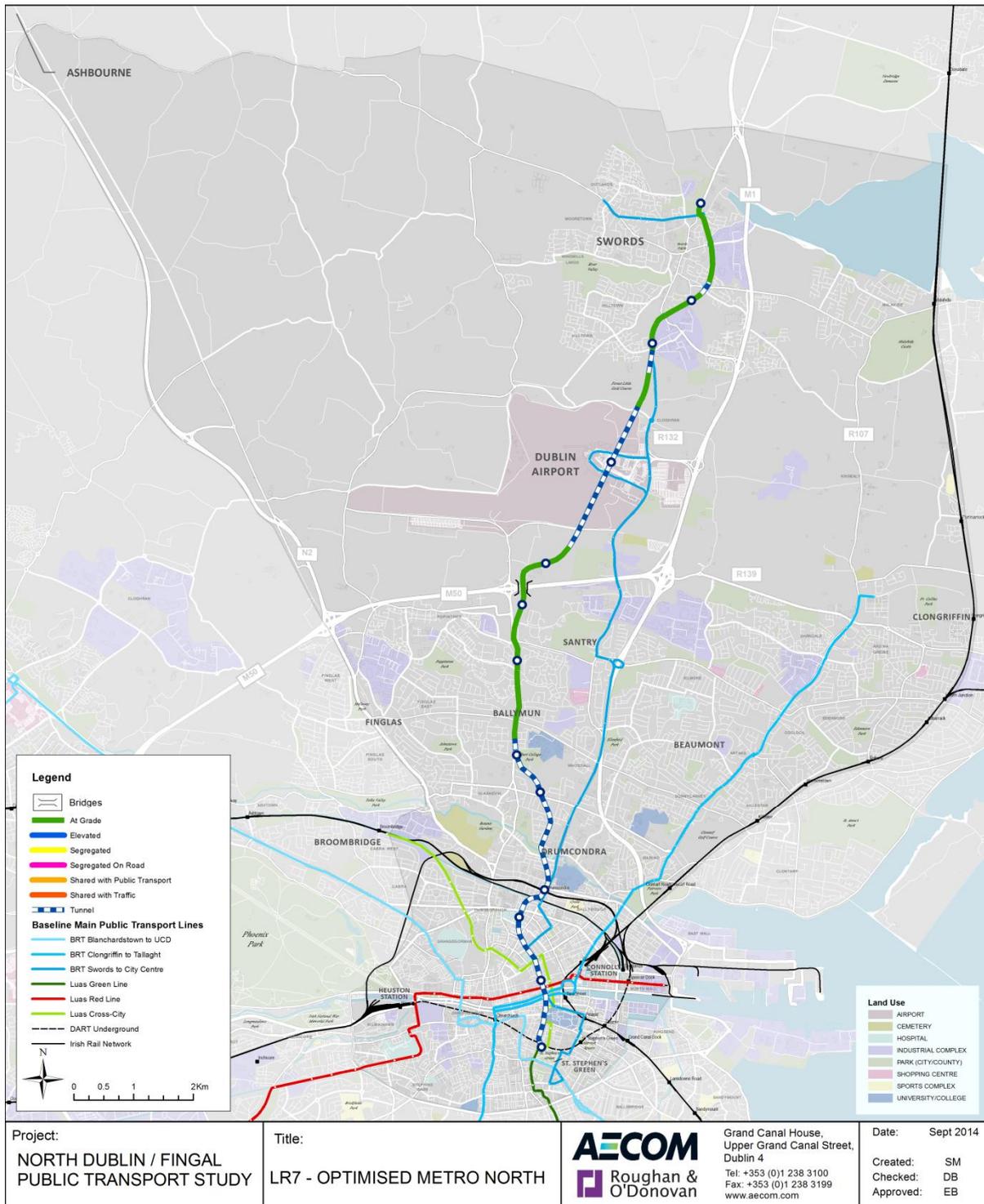
The impacts will be similar to those identified for Metro North but will need more detailed investigation due to revised at-grade alignments.

3.11.6 Considerations for the appraisal process

The following characteristics of Optimised Metro North should be taken into account during scheme appraisal:

- The scheme satisfies the project objectives and is technically feasible;
- The proposed route serves a very dense catchment area and many of the major trip generators within the study area;
- The service has a very high capacity potential which would need to be examined against estimated demand through detailed modelling;
- The proposed alignment has formed the basis for spatial plans within the study area for some time, therefore it integrates excellently with future planning proposals;
- The scheme has already been through preliminary planning processes; and
- The cost of the scheme is high, but is 20% lower than the original Metro North Scheme with a saving of €461m in comparison with the original Metro North proposal.

Figure 3.8: LR7 – Optimised Metro North



3.12 LR8. City Access Transit (CAT)

3.12.1 Scheme promoter or developer

This scheme was proposed by Drumcondra 2005, an amalgamation of Residents Associations from the Drumcondra, Dublin 9 area. It was proposed as an alternative to the Metro North Scheme which was to run further west of Drumcondra which, in the Residents Association's view, was too expensive and was missing a significant catchment area. The route would serve both the Airport and Swords and is therefore in line with the brief for the project.

3.12.2 General description of the scheme

The primary corridor is approximately 17km in length and is an extension of the Luas Cross-City route which is currently under construction. This route follows a similar route as the existing Swords Quality Bus Corridor, along Dorset Street and Drumcondra Road (R132), as far as Santry where it would be routed to the east to pick up employment zones in the Clonshaugh Industrial Area. The route would continue north from Clonshaugh and cross over the M1 to the Airport, and subsequently terminate to the north of Swords.

The CAT proposal also has a secondary routing in order to link the Finglas and Ballymun areas to the wider public transport network, through a further extension of the Luas Cross-City at Broombridge (Liffey Junction). This LRT route would run into Finglas on a similar routing to that of LRT1, proposed by the RPA. At Ballymun the routing would continue along Santry Avenue, Coolock Lane and Oscar Traynor Road until it reaches the DART Line at Howth Junction; although the routing of the last section following Oscar Traynor Road is complex. This extension would provide interchange options with the Airport/Swords LRT at Santry and also interchange possibilities with the DART. This scheme runs to a distance of approximately 12km.

The primary corridor, via Drumcondra, meets the brief in that it links the City Centre with the Airport and Swords. Therefore only the primary route would be considered as part of this assessment.

3.12.3 Infrastructure considerations

Dorset Street and Drumcondra Road are heavily trafficked routes leading to and from Dublin City Centre, currently carrying in the region of 35,000 AADT, with congestion evident for much of the day. The route also accommodates the existing Swords QBC and proposed Swords BRT. The implementation of a light rail scheme along this route would require the full removal of the QBC/BRT lanes along Dorset Street and Drumcondra Road, and would also require the removal of (mainly) right turning facilities at many junctions. While physically possible to provide the LRT route along this corridor the traffic impact would be significant, particularly for local movements due to the reduction in the number of turning facilities. In addition, the trees along this section of the route would be negatively impacted by the overhead cables and the possible widening of the carriageway.

After the Collins Avenue junction, space is available to provide LRT infrastructure to one side of the existing carriageway, to the east of the Tunnel Portals. Space is also available along Coolock Lane (R139) to provide LRT facilities, although existing bus priority facilities may need to be removed.

Along Clonshaugh Road the cross-section is much narrower with one lane in each direction and many houses fronting onto the street. As a result significant land expropriation would be required and some residential units may need to be removed. An alternative route via the IDA Park could be considered in order to avoid these constraints, although impact on businesses could be significant.

After Clonsaugh Road the routing primarily follows agricultural land to the East of the M1, and would have to cross over the M1 on a bridge before entering the Dublin Airport Long Term Car Parking Area. The route would then travel at-grade into the proposed Public Transport Hub between Terminal 1 and 2, although there are significant challenges with the construction of this route as space is significantly constrained due to the presence of utilities above and below the ground. As a result some impact on the traffic capacity of the routes within the Airport is envisaged with this route option.

On leaving the airport the route would turn north towards Swords and would follow the R132 alignment which has sufficient space to accommodate the proposed LRT, although some land expropriation is envisaged, and traffic impact, particularly around the Airside Park, is likely as a result of a reduction in capacity of the already congested junction.

3.12.4 Impact during construction

Construction impacts on Dorset Street and Drumcondra Road would be very significant as space to facility diverted traffic is not available over much of its length. From this initial assessment it is likely that these roads would have to be closed for a prolonged period to facilitate the construction of a central running LRT system.

North of Collins Avenue, the constructability of this option improves, although significant localised impacts can be expected around Clonsaugh Industrial Estate and the Airport.

3.12.5 Environmental issues

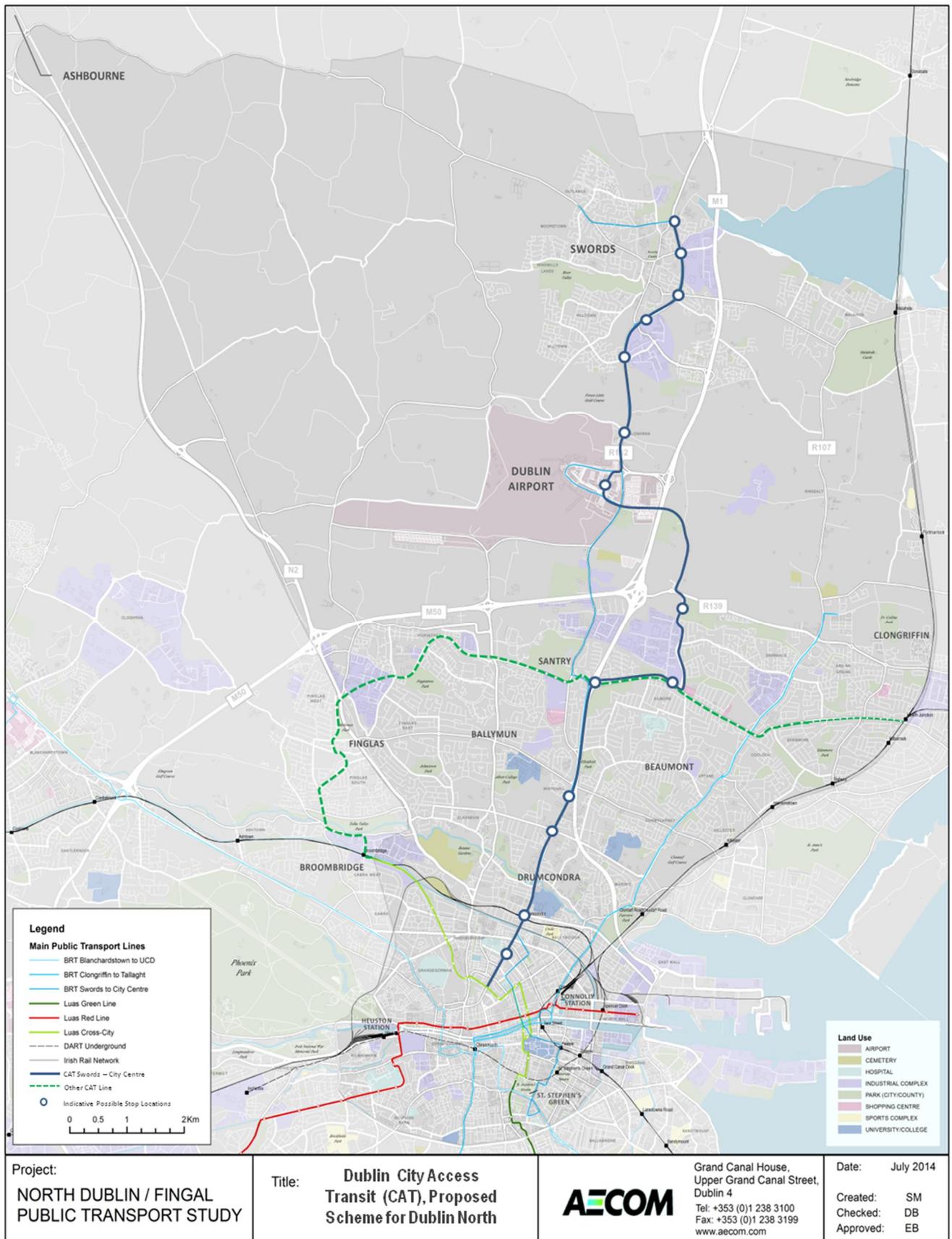
Through Drumcondra the route follows existing roads, which would limit environmental impact. However, there are listed structures along the routes some of which may be impacted by the proposed infrastructure. To the north, the route passes through agricultural land which may also generate some negative impacts. Overall, the environmental impact of this option is considered to be relatively low, although it would need to be reviewed in detail if this project was to proceed to the next stage.

3.12.6 Considerations for the appraisal process

The following characteristics of the CAT Alignment should be taken into account during scheme appraisal:

- The routing via Dorset Street and Drumcondra Road would be challenging to deliver, and would result in a significant loss of capacity for other modes on this important route into the City Centre;
- The route is relatively circuitous, and would probably need to share some sections with other services due to aforementioned alignment constraints, leading to journey times in the area of 1 hour from the City Centre to the Airport. This would not provide a competitive service as journey times are expected to be in the region of 40 minutes by bus and 20 minutes by taxi;
- The scheme does not respond well to the current transport and land use objectives set out in the Fingal and Dublin City Development plans, particularly in relation to the need for a north/south economic development corridor as it is located further to the east where development potential is limited; and
- Based on similar schemes being delivered in Ireland, the estimated cost of the scheme would be comparable with LR4 and LR5.

Figure 3.9: LR8 – City Access Transit (CAT)



BUS RAPID TRANSIT



4.0 Bus Rapid Transit

Bus Rapid Transit (BRT) can be described as a bus mass transit system which uses a segregated and integrated network with highly accessible, high capacity vehicles. BRT was pioneered in South America but since the 1980s it has increasingly been deployed in Europe, Africa, the US and China as a flexible, cost effective solution for medium scale travel demand.

BRT seeks to emulate the service, performance quality, and amenity characteristics of modern light rail-based transit systems at a lower cost whilst offering a certain degree of flexibility. As such, some of the typical design features of BRT include:

- Segregated routes with priority at junctions giving buses significant advantage over general traffic;
- Frequent and high-capacity services;
- High quality waiting and interchange facilities with platforms, shelter and information very similar to standard light rail stations;
- High-quality vehicles that are easy to board, quiet, clean and comfortable;
- Integrated fare systems with pre-paid fare collection to minimise boarding delays;
- Attractive and convenient user information and marketing campaigns;
- Modal integration, with BRT service coordinated with walking and cycling facilities, taxi services, intercity bus, rail transit, and other transportation services; and
- High level of security for transit users and pedestrians.

The potential capacity of BRT varies significantly with some systems capable of carrying up to 36,000ppdph (Bogota, Columbia) where double lanes are introduced with potential for express services. The average carrying capacity of systems currently being developed in China and the US is 6,000ppdph. In Istanbul, a large BRT network is in place with a maximum peak throughput of approximately 19,000ppdph. In France, a number of more modestly sized BRT schemes are in place across the country in Paris, Lyon and Nantes with an average peak throughout of approximately 2,000ppdph.

The success of BRT is largely focused on its ability to carry high passenger numbers with similar benefits to conventional light rail but with significantly lower costs. Studies have found that capital costs per km of light rail schemes are on average three times greater than those for BRT schemes.

Closer to home, BRT has been developed in 14 towns/cities in the UK with a further 8 under construction/planned. In Ireland, although significant experience has evolved in the past 20 years through the roll-out of Quality Bus Corridors (QBCs), BRT has not been developed until recent plans for the Swiftway BRT system were proposed in Dublin.

Swiftway is proposed to be a high quality network which uses buses on roadways or dedicated lanes to transport passengers quickly and efficiently. Swiftway offers many benefits compared to other transport solutions – including the important advantages of being relatively quick to commission, cost-effective to install and less intrusive during the construction phase compared to light rail or underground alternatives.

The proposed Swiftway network would include three BRT lines as follows:

- **Swords to City Centre:** This scheme is intended to serve the busy corridor between Swords and the City Centre, with 24 stops at key locations along the route and a potential three additional future stops identified;



- **Blanchardstown to UCD:** This scheme is intended to serve the busy corridor between Blanchardstown and UCD including the City Centre, with 34 stops identified at key locations along the route.



- **Clongriffin to Tallaght:** This scheme is intended to serve the busy corridor linking Clongriffin, the City Centre and Tallaght. While an Emerging Preferred Route has been identified between Clongriffin and Rathfarnham, work is ongoing to determine the route from Rathfarnham to Tallaght.



Planning and design of each of the three routes is currently ongoing. Public consultation on preliminary designs for the Swords/Airport route recently concluded and the design is currently being prepared for a statutory approval application in 2015. Some of the key features of the proposed Swiftway BRT network are summarised below.

Vehicle

- High quality, modern, attractive and comfortable vehicles
- Fully accessible for wheelchairs, prams and mobility impaired persons
- 18m single articulated vehicle with multiple doors to facilitate fast boarding and alighting and increase reliability
- Capacity for 120 persons per vehicle

Stops

- High quality design, with amenities similar to Luas as standard
- Level boarding from stop platforms on and off the vehicles
- Stops conveniently located to optimise catchment accessibility and service reliability
- Off-board ticketing through vending machines at stops and Leap Card ticket validation

Cost

- Construction is generally about 1/3 of the cost of a light rail system
- The construction period for BRT is often shorter than for light rail meaning that the benefits can be delivered sooner
- Typically reduced costs in relation to land and property costs as the BRT system will predominantly operate on the existing road network
- Avoids major relocation of utilities and track construction



Segregation & Priority

- High quality, smooth and level running surface
- High level of separation from normal traffic
- Uses shared Bus/BRT lane or own BRT lane
- Priority at traffic signals and junctions



Integration

- Development of a network of routes and services
- Interchanges and links with other transport nodes at key points
- Safe access to and from stops for both walking and cycling
- Cycling facilities provided at stops
- Integrated ticketing

Branding / Attractiveness

- Own distinctive brand identity to set it apart from conventional bus services
- Vehicles to have attractive livery matching the brand identity
- Coordinated use of the BRT brand at stops and on information material
- Purpose of branding is to promote a strong public and visual presence for the BRT service

The following sections set out proposals for a number of additional BRT services within the Fingal/North Dublin study area that may have the capacity to meet future demand. Each route is presented at a conceptual level and appraised in Sections 6 and 7.

4.1 BRT1. Clongriffin to Airport via Malahide

4.1.1 Scheme promoter or developer

This scheme was proposed to respond to the requirements of the study by connecting the City Centre with the Airport and Swords via the Malahide Road corridor. The scheme would act as an extension to the proposed Swiftway from Tallaght to Clongriffin and could therefore be developed in addition to, or in tandem with, this scheme.

4.1.2 General description of the scheme

This scheme is a 10.8km extension of the Tallaght/Clongriffin BRT line through Malahide, Swords and Dublin Airport. The route is proposed to provide connectivity to the large residential catchment in Malahide and Dublin Airport. Ultimately, the route would provide a connection from Tallaght and the city centre to Clongriffin, Malahide and Dublin Airport.

It is proposed that the scheme would run along the R107 to Malahide, turning west on the Swords Road/R106 and then down the R132 where bus lanes are already provided as part of the Swords BRT scheme. A possible addition to this route would be for the BRT to operate along a spur to Malahide railway station to offer connections between the heavy rail network and the Airport. This route would link Malahide to the BRT network in addition to providing a link between Connolly Station and Dublin Airport.

4.1.3 Infrastructure considerations

The R107 is a moderately busy route (estimated 10,000-17,000 AADT). It is a single carriageway route with no bus lanes between Clongriffin and Malahide at present. As such, to introduce a segregated BRT at present would be virtually impossible without acquiring significant land for development of the scheme. This may be possible as the extent of active frontage on the route is relatively limited in parts. The introduction of segregated facilities along various sections of the route could be combined with improved priority at junctions and bus stops to minimise journey times. It is noted that the Fingal Development Plan 2011-2017 includes a road upgrade/realignment of the R107 Malahide Road as well as an East-West Distributor Road. This proposed BRT scheme could therefore be incorporated into that upgrade.

At Malahide, it is proposed that the route would turn west on the R106. A spur to connect with Malahide Train Station is also recommended although this would add significant journey time, especially for travellers to the Airport from locations south of Malahide.

As there is no junction between the R106 and the M1, the proposed service would connect with the R132 in Swords and utilise the existing BRT lanes to connect to the Airport. This route would provide access to the Airside Business Park where the service would interchange with the Swords BRT service.

4.1.4 Impact during construction

Construction impacts will be limited to movement along the R107 and R106. Should land be acquired along this corridor, it may be possible to limit construction impact. Additional impact would be expected at junctions were additional lanes may be required and signals upgraded.

4.1.5 Environmental issues

A review of environmental concerns along the proposed alignment suggests that protected structures along the R107 may present an obstacle to acquisition of land for segregated bus lanes. In addition, lands on either side of the R107 are protected by the following policies from Fingal CDP 2011-2017:

- OS - Preserve and provide for open space and recreational amenities;

- GB - Protect and provide for a Greenbelt area; and
- HA - Protect and enhance areas of high amenity.

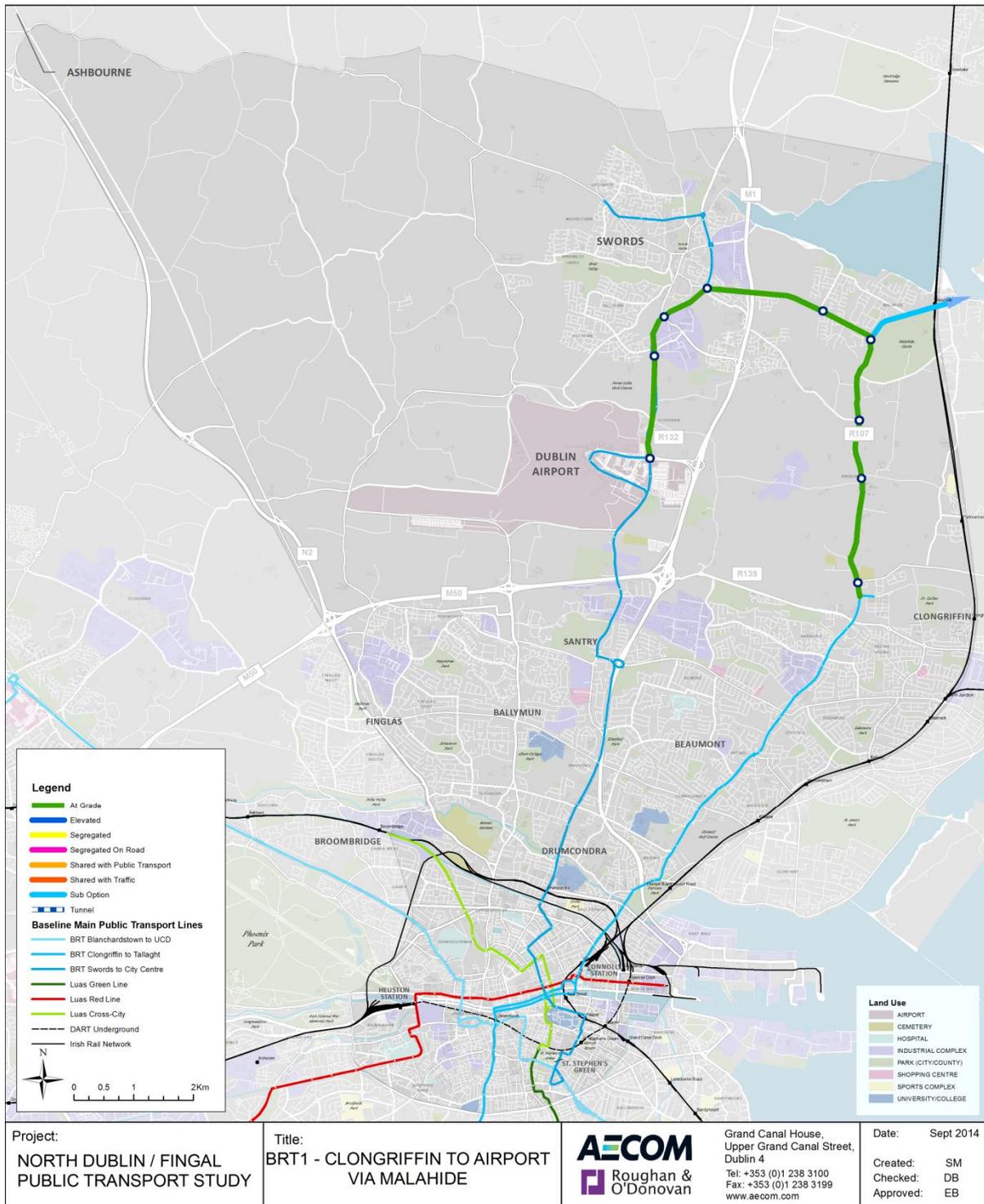
It is concluded that the proposed scheme could have a significant environmental impact. Further development of the scheme would be subject to more detailed environmental appraisal.

4.1.6 Considerations for the appraisal process

The following characteristics of BRT 1 should be taken into account during scheme appraisal:

- The scheme is deliverable from a technical perspective and would utilise approximately 3km of existing bus lane within its overall 10.8km length;
- The route is relatively circuitous leading to journey times in excess of 50 minutes from the City Centre to the Airport. This would not provide a competitive service as current bus journey times are 40 minutes by bus and 20 minutes by taxi;
- The route does not serve the centre of Swords but would connect with proposed development areas to the east of Swords and provide interchange with the proposed Swords BRT at the Swords Central, Swords South, Airside and the Airport stops;
- Capacity along the route would be limited to 7,000 ppdp/h assuming high frequency services.
- The scheme does not respond well to the current transport and land use objectives set out in the Fingal and Dublin City Development plans, particularly in relation to the need for a north/south economic development corridor; and
- Based on similar schemes being delivered in Ireland, the estimated cost of the scheme would be €80m-€100m.

Figure 4.1: BRT 1 Clongriffin Airport via Malahide



4.2 BRT 2 Clongriffin to Airport

4.2.1 *Scheme promoter or developer*

This scheme was proposed as a means of accessing the Airport directly from the proposed Tallaght/Clongriffin BRT and Clongriffin DART Station. The scheme would act as an extension to the proposed Swiftway from Tallaght to Clongriffin and could therefore be developed as part of this package by the NTA.

4.2.2 *General description of the scheme*

This scheme would involve an 8.9km extension of the proposed Tallaght/Clongriffin BRT line that would run from Clongriffin Train Station to Dublin Airport. The BRT service would initially run along Main Street in Clongriffin where an existing bus lane is in place for approximately 1 km. The service would then run along the 'Hole in the Wall Road' where a bus lane is in place before turning right onto the R139 which has a bus lane in place for the majority of its length to the M1.

The route would connect to the proposed Swords BRT route at the airport and could be delivered relatively inexpensively. It would improve connections from across the Dublin Area to the Airport by connecting rail and BRT routes. If a high level of segregation is not provided, journey times could be quite dissuasive.

4.2.3 *Infrastructure considerations*

As outlined above, the proposed route would predominantly use existing bus lanes for its entire length. The main infrastructure works required would be minor and involve upgrades at junctions along the R139 and at the M1. In order to provide a greater level of priority for the BRT, the potential to designate a bus only lane during peak hours on the M1 could be investigated.

4.2.4 *Impact during construction*

The impact during construction of the proposed route would be minimal and would be limited to junctions, bus stop upgrade and potential works along the M1.

4.2.5 *Environmental issues*

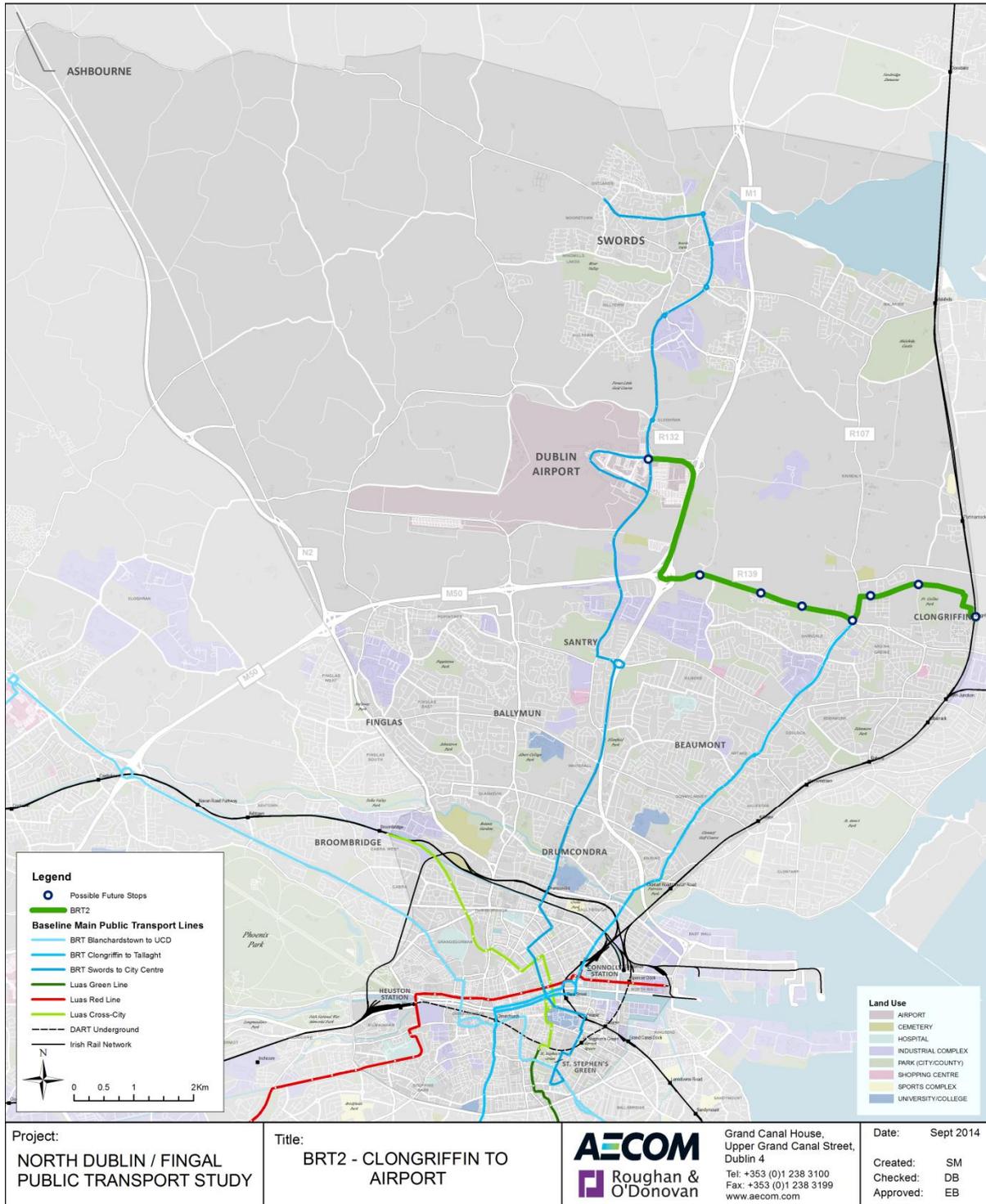
An assessment of the environmental constraints along the proposed option has concluded that there are no likely significant impacts of the proposed scheme. This is largely due to the fact that proposed work will be restricted to the existing carriageway.

4.2.6 *Considerations for the appraisal process*

The following characteristics of BRT 2 should be taken into account during scheme appraisal:

- The proposed route does not connect with Swords directly and therefore does not align with the overall objective of the feasibility study.
- The scheme is technically feasible and would be relatively inexpensive to deliver due to its short length.
- The scheme would provide an excellent level of integration with existing services by extending the proposed BRT to Clongriffin Station and the Airport.
- Capacity along the route would be limited to 4,500 ppdp assuming high frequency services.
- The scheme does not respond well to the current transport and land use objectives set out in the Fingal and Dublin City Development plans, particularly in relation to the need for a north/south economic development corridor.

Figure 4.2: BRT 2 Clongriffin to Airport



4.3 BRT 3. City Centre to Airport via Ballymun

4.3.1 *Scheme promoter or developer*

This scheme was proposed as a means of accessing the Airport directly from along an alternative corridor to that already proposed. This proposed route would follow a similar alignment to the proposed Metro North.

4.3.2 *General description of the scheme*

BRT 3 is a 11.2km route from the City Centre to the Airport via Ballymun. It would extend the BRT network serving the Dublin Area, offering direct connections from the city centre to Grangegorman, Phibsborough, Glasnevin, Ballymun, Santry and an additional BRT link to the Airport.

This route would start on King Street North where it would provide interchange with the proposed Blanchardstown/UCD BRT route. It would then run northwards along the R108 to Ballymun and the M50. The route would then link to the Airport through the Old Airport Road from the R108/M50 interchange. An alternative option would be to follow the M50 and M1 to Dublin Airport.

4.3.3 *Infrastructure considerations*

Providing a high standard of BRT within the north inner city will be difficult to achieve because the current road network is heavily trafficked, quite narrow and serves a large residential area. Restricting traffic movements in the area would therefore be very difficult to achieve without significantly impacting upon access.

North of Glasnevin, the R108 is much wider with existing bus lanes which could be used for BRT. In these areas, junctions would require upgrade to prioritise BRT.

From the M50 to the airport the BRT could either follow the existing M50/M1 motorway network or the R139 where the potential to introduce segregated facilities could be investigated.

4.3.4 *Impact during construction*

Depending on the delivery approach taken, delivery of a BRT along the R108 could present significant delays both during and after construction. Unless the route is given priority, especially in the North Inner City area, it is unlikely to deliver the level of journey time benefits required to justify the cost.

4.3.5 *Environmental issues*

An assessment of the environmental constraints along the R108 suggests that the greatest constraints would be the adverse environmental and safety impact generated by traffic diverting through residential areas following reduced capacity on the main arterial routes.

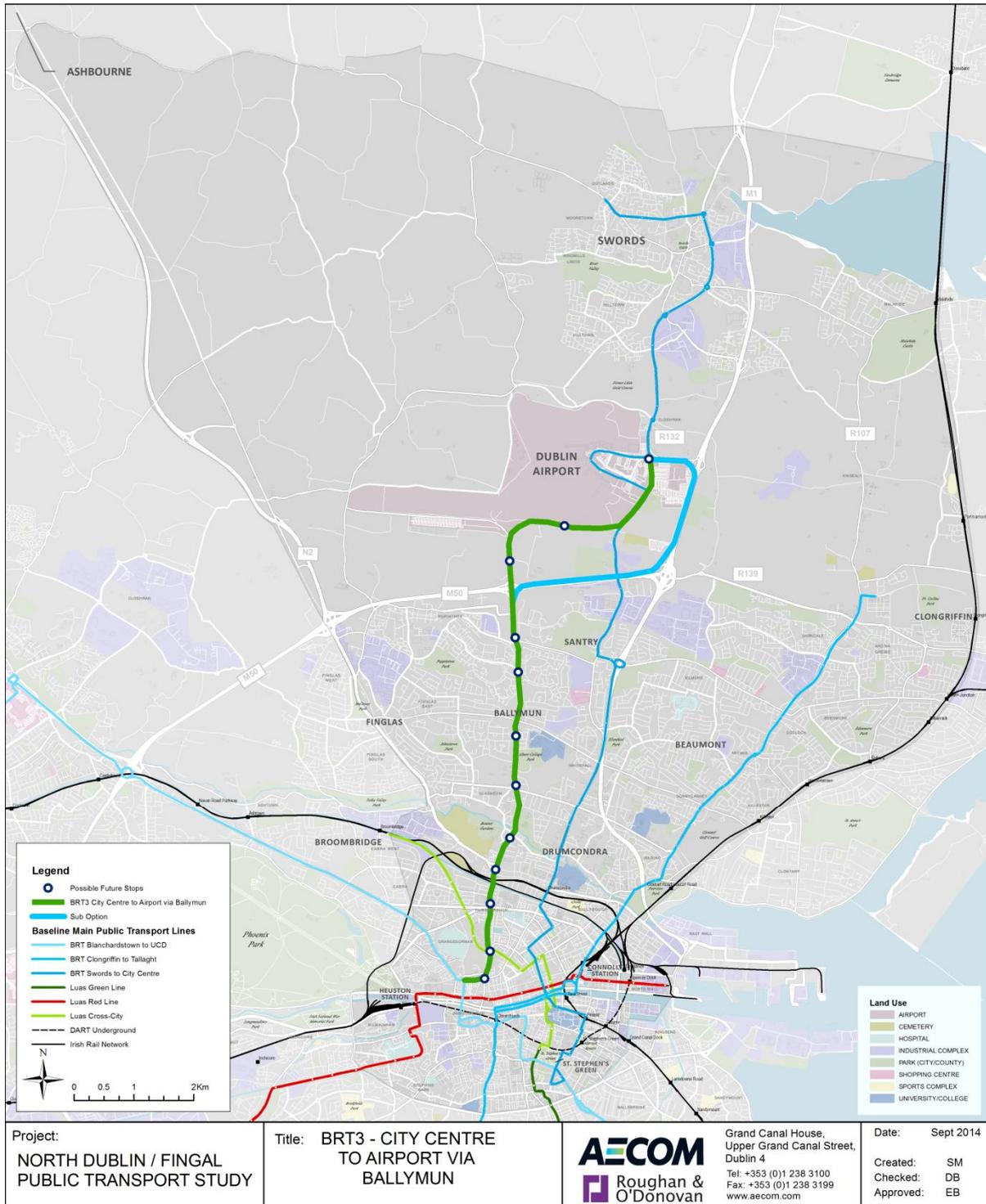
4.3.6 *Considerations for the appraisal process*

The following characteristics of Route BRT 3 should be taken into account during scheme appraisal:

- This scheme would not connect directly with Swords but provide an interchange at the Airport to connect with the Swords Swiftway.
- Although delivery of a BRT route on the R108 is technically feasible, it is likely to generate significant disruption to existing traffic, especially in the North Inner City and Phibsborough. Restricting use of the R108 to traffic in these areas is likely to have a significant negative impact on traffic congestion in area and on residential areas along the corridor.
- The scheme would provide a good fit against transport and land use policies for the area. However, unless a high quality, high priority BRT could be delivered these benefits are unlikely to materialise.
- Capacity along the route would be limited to 4,500 ppdph assuming high frequency services.

- The scheme does not provide direct integration with existing rail services due to its proximity to stations.

Figure 4.3: BRT 3 City Centre to Airport via Ballymun



4.4 BRT 4. Docklands to Swords via Tunnel

4.4.1 Scheme promoter or developer

This scheme was proposed as a means of providing a direct, fast route to the Airport and Swords. This route is quite similar to current express service to the Airport and Swords (747, Swords Express).

4.4.2 General description of the scheme

This route would run from Dublin's Docklands to the Airport through the Port Tunnel. On exiting the tunnel, the BRT service would run along the M1 and connect to the Airport via the R132. At the Airport, this service would connect to the Swords BRT route providing the possibility of interchange for some services. Overall, 12.6km of new BRT lanes would be provided or upgraded, excluding the Port Tunnel.

To provide shorter journey times, the central reservation of the M1 could be used by the BRT on exiting the Tunnel. This would then ramp up to an elevated section which would connect into the Airport junction and provide access to the Airport via the R132.

This option would provide the additional benefit of fast journey times between the City Centre and the Airport/Swords but with fewer stops and catchments served.

4.4.3 Infrastructure considerations

One of the main infrastructure considerations for this study is the feasibility of using the Tunnel for the BRT service. This would need to be developed in partnership with the NRA in addition to proposals for the elevated ramp to the Airport junction.

4.4.4 Impact during construction

If the M1 and R132 are used to access the Airport then the proposed infrastructure work would be limited. However should the M1 median be utilised this would require significant traffic management on the M1 during construction.

Should an elevated ramp be developed to provide access to the airport from the M1 this would have significant impacts on operations along the M1. Impacts during construction on the Tunnel would be limited due to the high quality carriageway and safety precautions already in place.

4.4.5 Environmental issues

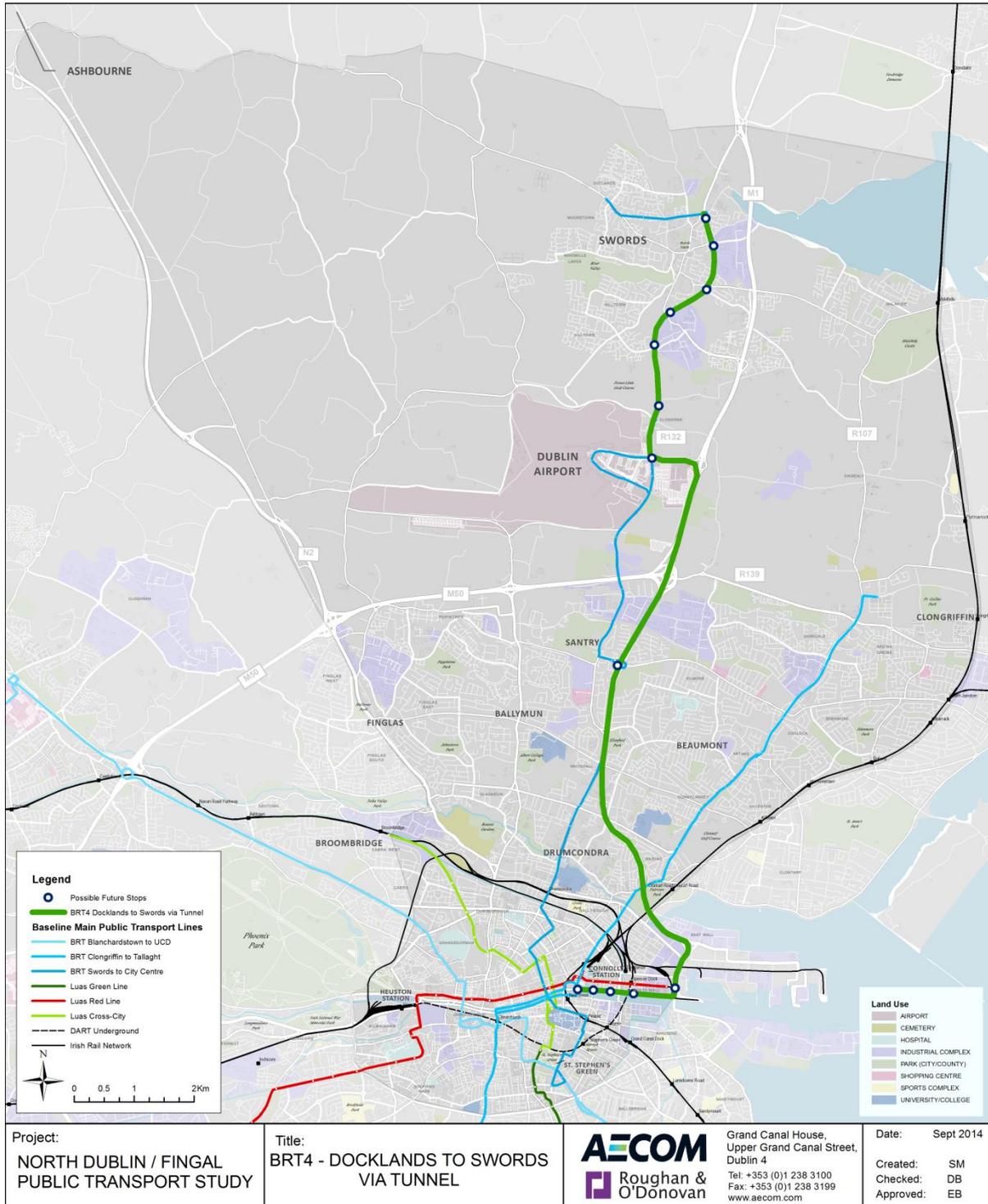
An assessment of the environmental constraints along the proposed route has concluded that there are no likely significant impacts of the proposed scheme.

4.4.6 Considerations for the appraisal process

The following characteristics of Route BRT 4 should be taken into account during scheme appraisal:

- The scheme is technically feasible but will need significant NRA involvement to ensure the impact upon tunnel traffic during construction is minimised;
- The route will act purely as a direct route from the City to the Airport and Swords with limited catchment served in-between these three nodes;
- The route would have a cost estimate of €100 - 130m;
- BRT vehicles, similar to buses with standing passengers, are subject to a speed limit of 60kph. The impact of such a service on tunnel capacity and safety would require detailed consideration;
- Capacity along the route would be limited to 4,500 ppdph assuming high frequency services;
- The scheme would provide a good level of public transport integration, connecting with the existing rail network and the proposed DART Underground in the Docklands as well as the proposed Swords BRT at numerous stops at the airport and further north.

Figure 4.4: Option BRT4 Docklands to Swords via Tunnel



4.5 BRT Option 5 : Combination of BRT 2,3 and 4

4.5.1 Scheme promoter or developer

This package of BRT schemes was proposed as a means of providing greater access to the Airport and Swords from the City Centre across a wider catchment area. The package combines each of the proposed BRT lines outlined above (2, 3 and 4).

4.5.2 General description of the scheme

This scheme combines BRT2, BRT3 and BRT4 to provide an additional 32.7km of BRT lane provision. This option would strengthen the Swords to City Centre corridor whilst significantly increasing the destinations served by the proposed Swiftway BRT system to include Ballymun, Phibsborough, Clongriffin (with DART connection), Dublin Docklands and Connolly Station.

4.5.3 Infrastructure considerations

A summary of the main infrastructure considerations as outlined above for these options includes:

- **BRT 2:** Limited new infrastructure required;
- **BRT 3:** Securing prioritisation for BRT through the North Inner City; and
- **BRT 4:** Use of the tunnel for BRT and the feasibility of any prioritisation.

4.5.4 Impact during construction

A summary of the construction impacts of the three proposed options is as follows:

- **BRT 2:** The impact during construction of the proposed route would be minimal and would be limited to junctions, bus stop upgrade and potential works along the M1;
- **BRT 3:** Could present significant delays during and after construction; and
- **BRT 4:** If the M1 and R132 are used to access the Airport then the proposed infrastructure work would be limited however significant traffic management required if M1 median utilised.

4.5.5 Environmental issues

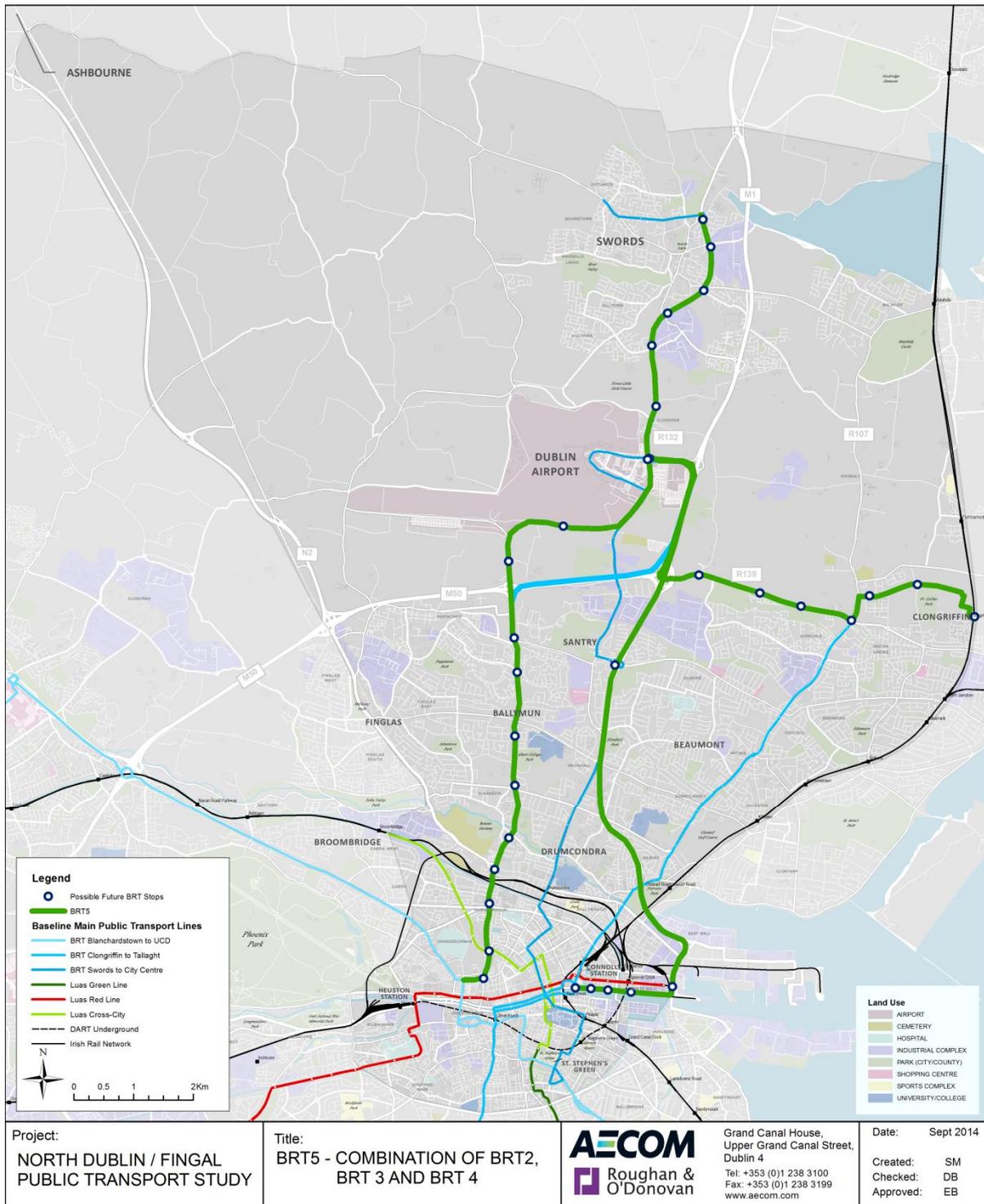
The only environmental constraints identified by the overall package of BRT options is the potentially adverse impact due to rat running and diverted traffic following construction of a BRT with priority on the R108.

4.5.6 Considerations for the appraisal process

The following characteristics of a package of BRT routes through the study area should be taken into account during scheme appraisal:

- The combined package of routes covers an extensive catchment area.
- Each of the routes is technically feasible, subject to further scheme development.
- Although each individual route is relatively cost effective, the combined package of routes is estimated to cost between €250 - 330m. As such, the network would be expected to present significant benefit to the commuter.
- The capacity of each individual route would be no greater than 4,500 ppdpd assuming high frequency service patterns.
- The capacity and safety aspects associated with routing the BRT service through the Dublin Port Tunnel.

Figure 4.5: Option BRT5 – Combination of BRT 2, 3 and 4





COMBINED OPTIONS

ENJOY
THE SHOW

Entering Service
An tUll moun carónise

 Dublin Bus

Transport
for Ireland

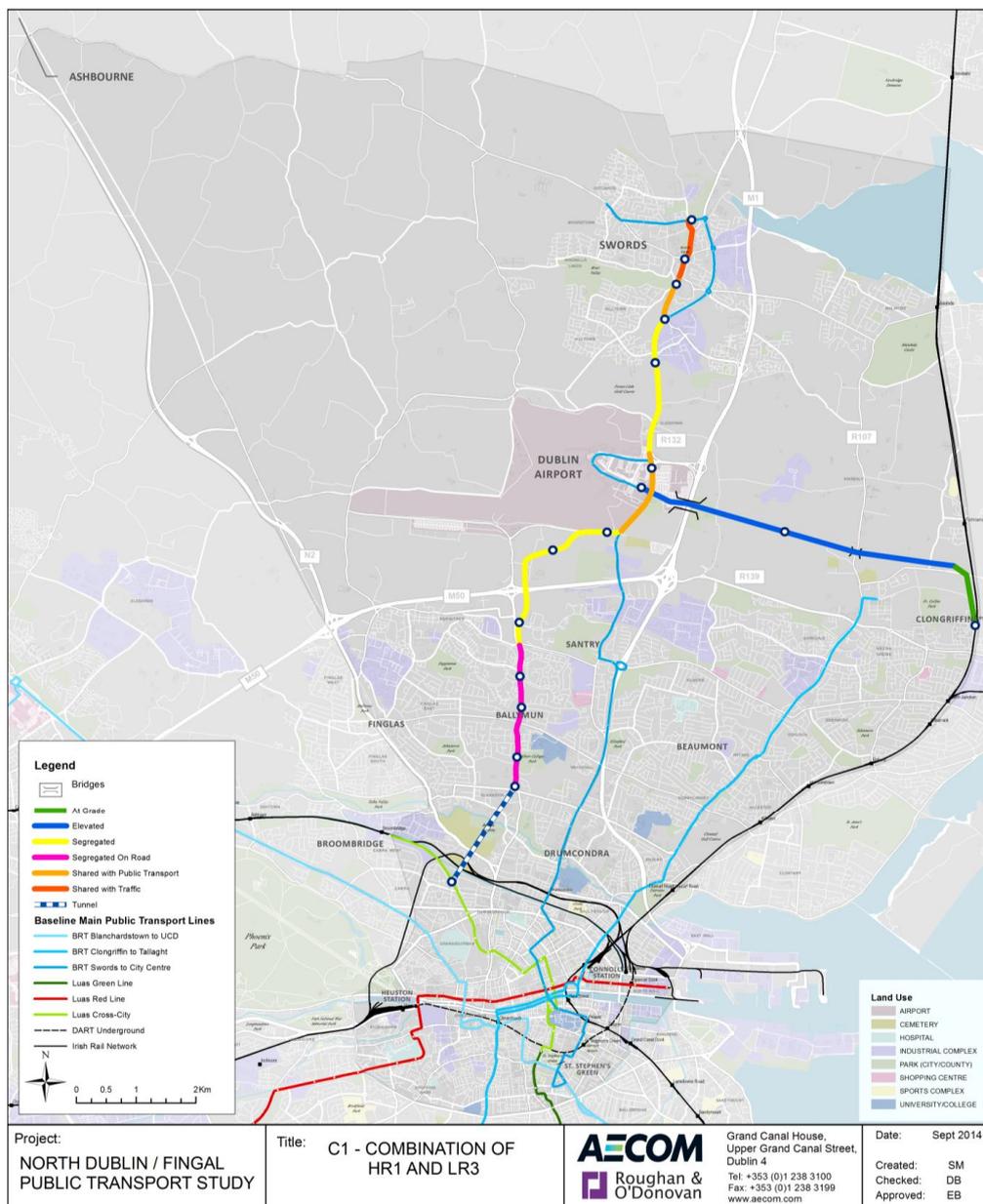
5.0 Combined Options

In addition to setting out separate scheme options for each mode, combinations of schemes are proposed where they could present advantage in responding to the project objectives. Each 'combination' is set out in the following sections.

5.1 C1. Combination of HR1 and LR3

This scheme would combine HR1 - a heavy rail scheme from the Northern Line to the airport – with LR3 - a Luas line from the Luas Cross City at Cabra to Swords. Passengers from Swords could therefore benefit from a direct access to the City Centre with Luas, while from the airport, passengers could benefit from both heavy rail and light rail services to reach the City Centre. This option was suggested during the stakeholder workshop and received the support of both Irish Rail and the RPA. This option overcomes the issue of HR1 not serving Swords, a requirement of the study.

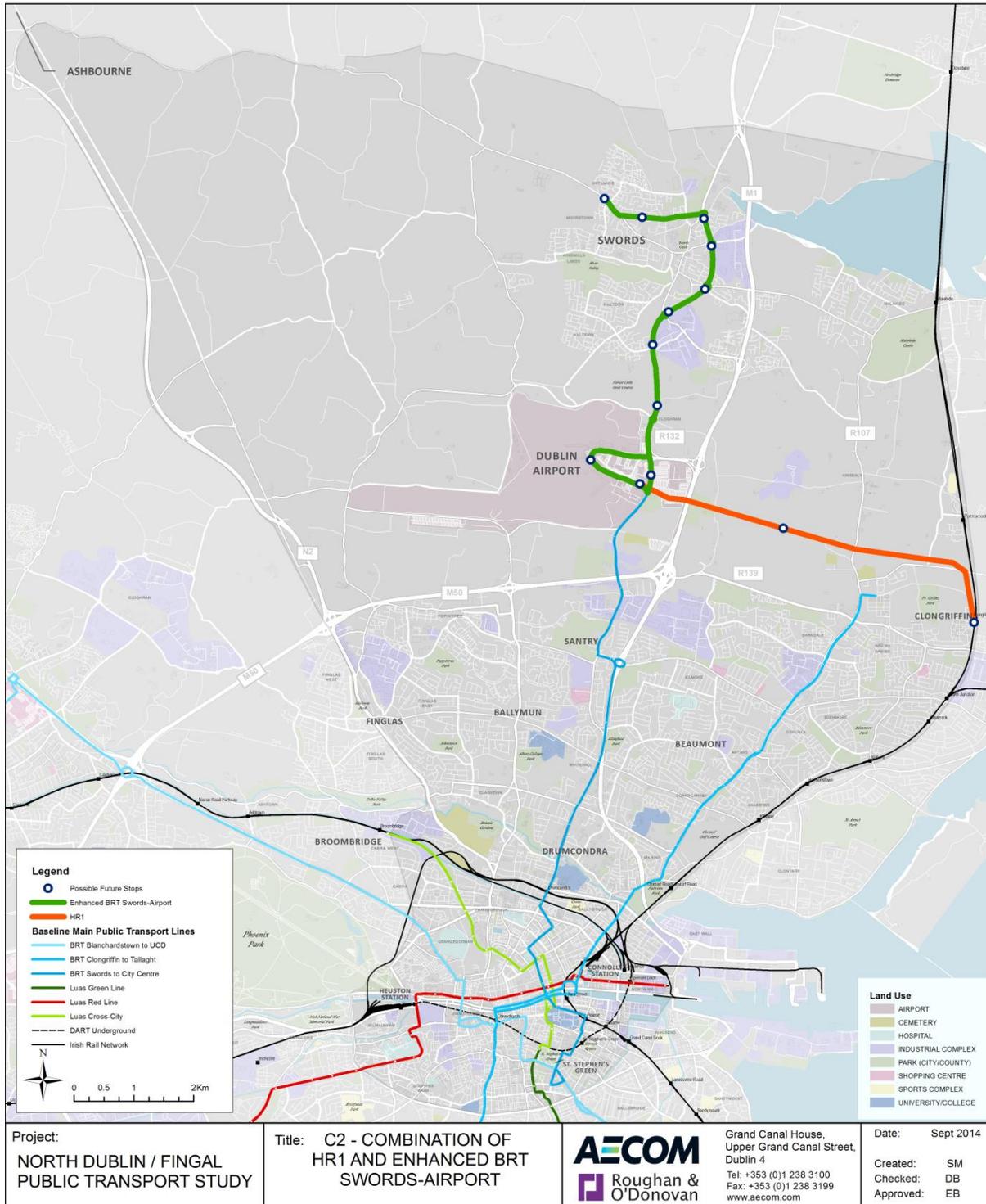
Figure 5.1: Option C1



5.2 C2. Combination of HR1 and high-capacity BRT Swords-Airport

This scheme was suggested as an enhancement of the proposed Irish Rail scheme from Clongriffin to the Airport. It would combine the rail spur with an enhanced high-capacity 5km BRT line to Swords. This BRT would have full segregation from traffic, a high level of priority at junctions and could operate with high-frequency. An interchange would be required at the airport for passengers from Swords to connect to the rail network.

Figure 5.2: Option C2



A nighttime photograph of a city street corner. The scene is dominated by long, horizontal light trails from moving vehicles, creating a sense of motion. The buildings are illuminated with a cool blue light, and a semi-transparent dark grey box is overlaid in the center, containing the text 'APPRAISAL PRINCIPLES & APPROACH'.

APPRAISAL PRINCIPLES & APPROACH

6.0 Appraisal Principles and Approach

6.1 Introduction

As outlined in Sections 2 to 5, a long list of 25 suggested options to meet the transport needs of the study area have been identified. The next step in this study is to carry out a preliminary or “sketch” appraisal of all of these options to identify a short list that should be taken forward for further investigations and a full appraisal. This section of the report describes the principles and process that were adopted for the preliminary appraisal. Results of the appraisal are outlined separately in Section 7.

6.2 Guidelines for Appraisal

The Public Spending Code and the Common Appraisal Framework for Transport Projects and Programmes govern the appraisal of public capital investments. The current official guidance on the application of the ‘Guidelines on a Common Appraisal Framework (CAF) for Transport Projects and Programmes’ published by the Department of Transport (DoT, now DTTAS), June 2009, requires schemes to undergo a ‘Multi-Criteria Analysis’ (MCA) under the following criteria;

- Economy;
- Safety;
- Environment;
- Accessibility and Social Inclusion; and
- Integration.

A full appraisal of a proposed transport scheme under the Economy criterion requires a full cost-benefit analysis is undertaken in respect of the principal options identified. The purpose of this preliminary appraisal is to identify these “principal options” to be taken forward for full appraisal in line with the CAF.

The approach devised is based on identifying readily available measures that will predict how an option would be rated under each of these five criteria when a full appraisal was carried out. In this way, we can ensure that the short list of options taken forward for full appraisal includes the optimum options that would be identified as the best approach if all 25 options in the long list were subjected to a full appraisal.

In order to make the analysis more tractable, the focus was on three of the criteria that are most relevant to strategy development viz:

- Economy;
- Integration; and
- Environment

The Economy criterion embraces the effectiveness of the options and the efficiencies to which they give rise.

Integration concerns the compatibility of the options with land use plans and policies, as well as physical integration issues such as interaction with other modes and the rest of the public transport network.

The Environment criterion includes an impact assessment of scheme options on a range of environmental aspects such as air quality, noise, landscape and visual quality, biodiversity, cultural, archaeological and architectural heritage.

Each of the remaining criteria, Safety and Accessibility and Social Inclusion will be assessed in more detail at the next stage of appraisal.

6.3 Screening

As a first step, two screening questions were posed in relation to each of the options. Options that did not receive a positive answer to both of these questions were rejected and not considered further in the appraisal process. The screening questions were:

- Is the scheme technically feasible?; and
- Does the scheme meet the fundamental project objectives by providing public transport for travellers between Dublin City Centre, Dublin Airport and Swords.

6.4 Coding

A three colour coding system was established to summarise the performance of each option under each of the three appraisal criteria as shown in Figure 6.1.

In general, an option has been rated green if it presented advantages over other options, amber if neutral relative to other options and red if it presented disadvantages compared to other options.

Figure 6.1: Colour coding used for the appraisal table

Colour	Description
	Some advantages over other options
	Neutral compared to other options
	Some disadvantages over other options

6.5 Preliminary Measurement of “Economy” Criterion

The full appraisal of the economic impact of a transport investment is based on measuring the full economic benefits of the proposal for travellers and others, and the full costs of the proposal. For this preliminary appraisal, a number of variables were identified which could act as an appropriate proxy for potential benefits of the option. The purpose of these proxy measures for economic benefits was to allow an assessment of the relative amount of benefits that each option could be expected to deliver.

In addition, parameters were devised to allow the calculation of preliminary estimates of the capital cost of each option. The purpose of these preliminary estimates of costs is to allow an assessment of the relative costs of each option.

Taken together, the proxies for benefits and the preliminary estimates of capital cost, allow an appraisal of the relative economic impacts of the options identified at this stage.

Catchment per kilometre of additional route

The effectiveness of any option is determined in large part, by the extent to which it can attract passengers and thus deliver economic benefits. Modelling of passenger demand was not feasible at this preliminary appraisal stage. However, indicators of potential demand per kilometre of additional public transport route provided were used in order to assess the relative economic efficiency of the options.

The first indicator of potential demand was the projected future population and employment in the catchment areas of the additional routes to be serviced by each option. This was assessed by considering the stations/stops associated with each network option and the catchment areas associated with them. The total catchment population per route kilometre served by each option was then calculated.

The second indicator of potential demand was the projected job numbers in the route catchments. This indicator was included for two reasons:

- it would help reflect the capacity of each option to cater for commuter traffic, plus the transfer from the car usually provides significant benefits in the form of congestion alleviation; and
- it would provide an indicator of wider economic benefits associated with the options, which focus on the extent to which transport networks widen labour markets and increase the potential for inter-firm interactions.

The population and level of employment in the catchment area of each option was measured by:

- Using the zone structure for the Greater Dublin Area defined by the NTA for modelling purposes;
- Deriving forecasts of future population and employment in each zone based on the NTA's central growth scenario;
- Defining a physical catchment area of each option based on a 1km radius around light and heavy rail stops and a 600m radius around BRT stops (new stops only);
- Estimating the future population and employment level of each new catchment area served by summing the full population of any zones that fall completely within a catchment area and a proportion of the population and employment of any zones that fall partly within a catchment area. This proportion was equal to the proportion of the area of the zone that fell within the catchment area.

There was a wide variation in range for population and employment per route kilometer catchment across the study area. For example, the minimum population was approximately 1,300 while the maximum was 8,400. Similarly, the minimum employment catchment was 700 and the maximum was 11,700.

Based on these values, coding was assigned to threshold bands for population and employment as set out below:

Table 6.2: Coding for population and employment catchments

Code	Pop or Employment per Km	Total Population and Employment
	> 5,000	>10,000
	2,000 to 5,000	4,000 to 10,000
	<2,000	< 4,000

Journey Times

The efficiency of each option involves consideration of the level of service offered in terms of reduced journey times. Values for journey times for each of the options were derived from the following sources:

- Metro North journey times were based on information made public by the RPA in connection with the scheme;
- Heavy rail journey times were based on the average speed on the existing system between Connolly and Clongriffin, according to the Irish Rail 2014 timetable. While this is an acceptable approach for this 'high level' stage of project development, it is acknowledged that some heavy rail options could have shorter journey times owing to express services and longer distances between stations;

- Light rail journey times were based on the RPA projections prepared for each option⁷ or the average speed of these services where specifics were not available; and,
- Although average journey speeds for BRT range from 20-25kph, the BRT journey times for the purpose of appraisal were based on the current estimates from design work on the Swords Swiftway⁸.

It should be noted that only in-vehicle time has been taken into account. Additional time for access, egress and interchange are taken into account through the 'Integration' criterion.

The average speeds assumed are outlined in Table 6.3.

Table 6.3: Average Speeds (including dwell times)

	Speeds (kph)
Metro	34
DART	31
Luas	14-27 depending on precise route
BRT	26

Based on these values, codes were assigned to bands of values for journey times as follows:

Table 6.4: Colour codes, journey times

Code	Swords-City Centre
	< 30 min
	30 to 45 min
	> 45 min

⁷ RPA, Luas D1: Analysis of route options, Oct 2013, page 41, for LR2 journey times.

RPA, Luas Line D2 to Airport-Swords: Concept Design Report, June 2014, page 41, for LR3 journey times.

RPA, Luas D2 to Airport-Swords: Analysis of route options, page 41, for LR4 and LR5 journey times – used as well to derivate LR8 journey times based on LR5 average speed.

RPA, North Dublin Transport Study, Metro and Light Rail Options, Aug 2014, pages 4-5, for LR7 journey times

⁸ Based on consultation with the design team currently developing the Swiftway proposal, as authorised by the NTA, and the information released as part of the public consultation held in Oct/Nov 2014.

Capital Cost

The overall indicative cost of implementing each scheme is used as a measure of economic efficiency in the appraisal. Costs generally comprise the capital costs of infrastructure and vehicles/rolling stock as well as operational and maintenance costs. However, it was decided to assess capital costs only for practical reasons and because all the other costs are dependent on the level of service that vary over the lifetime of the transport system.

An “order of magnitude” level estimate of the cost of each option was calculated based on a common set of parameters of the cost per km and cost per station of each mode. This was developed based on an assessment of similar recent/planned schemes in the Irish context. The costs were then checked against current industry standards at present costs.

The parameters used are not intended to give an estimate of the cost of actually implementing any of the options, merely to indicate the likely relative cost of options. The parameters used are set out in Table 6.5.

Table 6.5: Parameters, Capital Costs

Mode	Type	Cost Min (€m)	Cost Max (€m)	Unit
BRT	Tunnelled	n/a	n/a	per km
	At grade	€6.4	€8.3	per km
LRT	Tunnelled	€70	€130	per km
	At-grade	€28	€40	per km
	At-grade Station	€1.3	€2.6	per station
	Underground Station	€44.6	€118.9	per station
Heavy Rail	Tunnelled	€145	€170	per km
	At-grade (greenfield site)	€17	€25	per km
	At-grade Station	€9	€14	per station
	Underground station	€120	€145	per station

These parameters were derived from a review of business cases and studies for specific current projects and proposals⁹. An additional factor was applied to each value to account for risk and contingencies at this early stage of project development. These were reviewed and verified by AECOMs cost estimation team.

The maximum values per kilometre, or per unit, from the above table were applied to each proposed option. Codes were then assigned to each scheme cost based on the overall threshold set out below:

⁹ The parameters for BRT costs were based on a feasibility study for the Swiftway BRT prepared for the NTA in June 2014. The parameters for LRT costs were based on an RPA study of Metro and Light Rail options for North Dublin Transport from August 2014. The heavy rail parameters were based on Cost estimates of the DART Underground project prepared for Irish Rail, and previous Irish Rail business cases.

Table 6.6: Coding used for Capital Costs

Code	Capital Cost
	< €1bn
	€1bn - €1.5bn
	>€1.5bn

6.6 Preliminary Measurement of “Integration”

The appraisal of each proposed option in relation to integration impact was based on a qualitative assessment of the following criteria on each proposed scheme:

- Compatibility with Land Use Planning Policies;
- Integration with Public Transport Networks; and
- Integration with Other Modes.

The coding applied to each option in relation to integration impact was as follows:

Table 6.7: Coding applied for Integration Criteria

Code	Impact
	Very Good
	Good
	Fair

Compatibility with Land Use Planning Policies

Further development of Swords and the Airport are key features of land use policy for the study area. While the initial screening process ensured each option connected with these areas, the appraisal also considered the extent to which the proposed options supported the development of Swords and the airport.

The general thrust of planning policy for the study area, as identified in the Strategic Context Report, focused on:

- The consolidation of land uses in the city centre, gateways and other focal points; and
- The use of transport infrastructure and particularly rail-based infrastructure to support the consolidation of activity.

The implications of these aspects of land use policy have been included in the land use scenario underpinning the Do-Minimum Strategy. As a result, they have been broadly assessed under the Economy criterion, when population and job numbers in the catchment were calculated.

A further consideration is the extent to which different options have the capacity to deliver the required land use distribution. Land use decisions are made by private decision-makers, whether property developers or consumers such as house buyers or companies setting up commercial premises. While there is a general consensus that rail systems have land use impacts that ordinary bus services do not, it is not clear that this conclusion holds for BRT services.

Integration with Public Transport Networks

Public transport integration incorporates two aspects, as follows:

- The extent to which each of the options offers services that avoid the need to interchange with other public transport services to complete journeys within the Dublin City-Airport-Swords corridor; and
- The ease with which each of the options offers services that facilitates public transport based journeys to destinations off the Dublin City-Airport-Swords corridor.

With regard to the former, it is appropriate to consider two journeys: Dublin City – Airport and Dublin City-Swords and assess the extent to which interchange is required to complete these journeys. Where interchanges are required, the quality of that interchange is also assessed.

The second criterion considers the extent to which the option has connectivity with other rail, light rail and proposed BRT services. As ordinary bus services are relatively ubiquitous, connectivity with these services is unlikely to prove a discriminating attribute. Access to stations was also looked at, as some options would offer a more local level of service with more frequent stops.

Integration with Other Modes

As all options serve the airport, this criterion relates to the ease of transfer to the air mode that is offered by each option. At this stage of project delivery, the precise level of connectivity to the airport is yet to be determined. For this reason, each option has been rated as ‘Good’ in this regard.

6.7 Preliminary Measurement of “Environment”

An environmental constraints assessment was undertaken for each of the proposed options using the following criteria:

- Historical Environment (Cultural Heritage);
- Natural Heritage/Environmental Topics;
- Plan Policies/Zoning; and
- Nature Development Areas within each local authority.

Based on the analysis provided, a conclusion was drawn as to whether each option had negligible, moderate or significant (negative) environmental impacts. This was recorded on the appraisal table using the coding outlined below.

Table 6.8: Coding used for Environmental Criterion

Code	Impact
N	Negligible
M	Moderate
S	Significant

Application and results of the preliminary appraisal are outlined in the next section.

SCHEME APPRAISAL



7.0 Scheme Appraisal

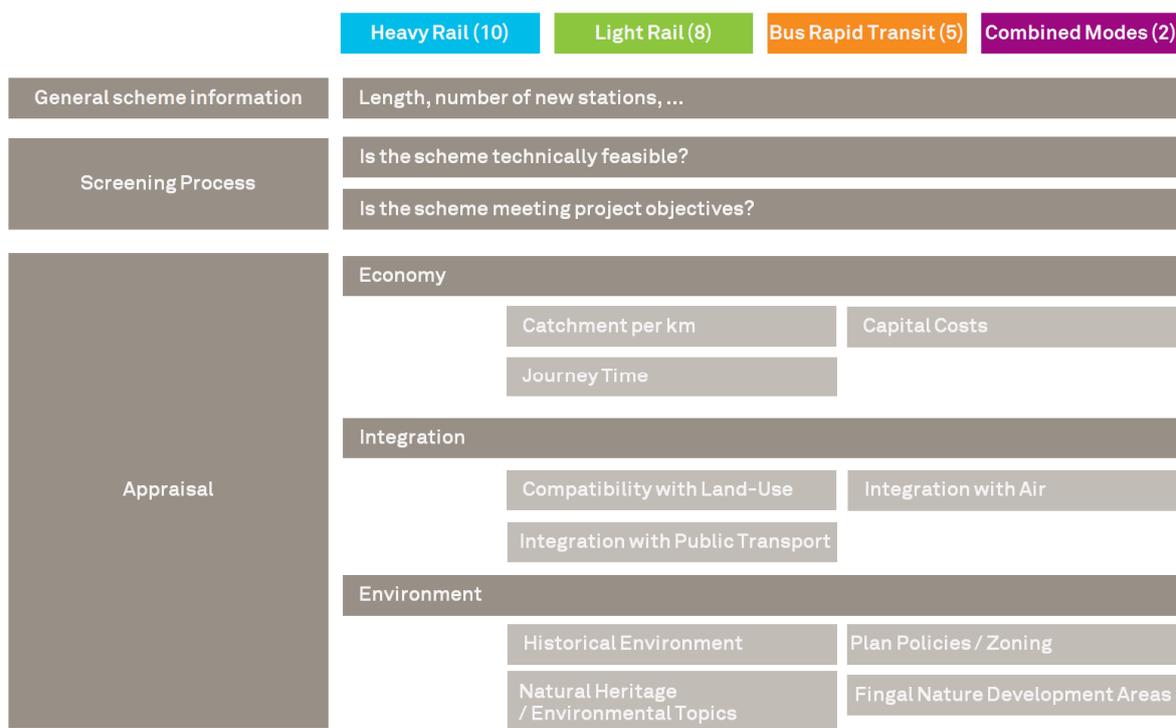
7.1 Introduction

The purpose of the preliminary appraisal is to select a representative set of options which cover all potential approaches to fulfilling the identified project need. This ensures that the detailed appraisal of shortlisted options will identify the optimum approach to meeting the public need.

On this basis, the approach taken by the appraisal is to identify the best option or options from each mode (as opposed to selecting the overall best five or six options). Following this approach ensures that the best option is included in the short list taken forward for further development and appraisal.

With this in mind, the appraisal process described in Section 6 was applied to each of the options and the results were brought together in a summary appraisal table as shown in Figure 7.1. Some general information on each option is provided followed by the screening process questions. Where options do not satisfy the screening process, no further information for that option has been developed. For those proceeding to appraisal, quantified and qualitative information on each option is presented for the three appraisal criteria.

Figure 7.1: Appraisal table structure



7.2 Screening

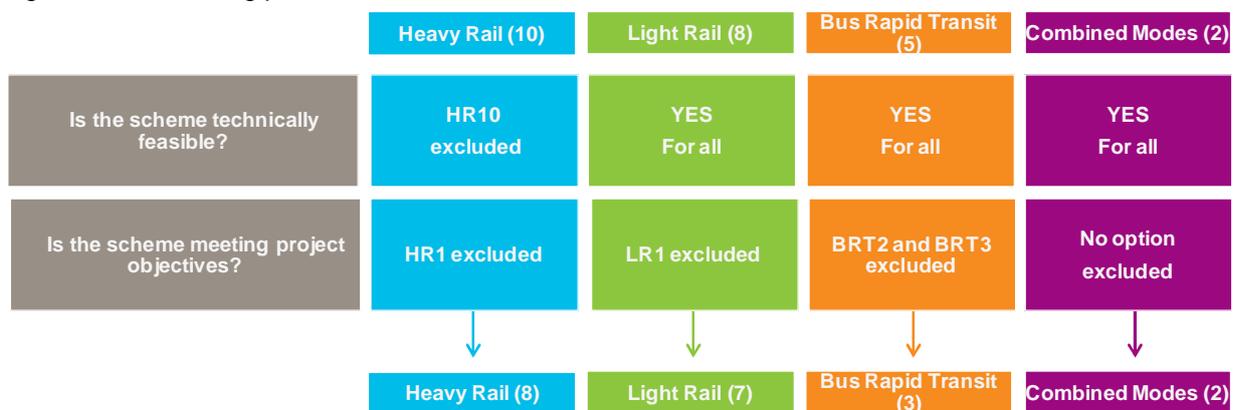
As previously outlined, each of the options was subject to an initial screening process regarding the project objectives and technical feasibility. Any option which did not satisfy each of these criteria was excluded from further appraisal. On this basis, the following options did not proceed to the appraisal process:

- HR1 does not meet the basic project objective of serving Swords. (However this proposed rail spur from Clongriffin to the Airport forms part of combined option C1 which will be brought forward for full appraisal);
- HR10, the “Metro Dublin”, has been rejected on the basis of technical feasibility particularly in relation to measures required to integrate the scheme between St James’ Hospital and

- Heuston Station. Concerns were also raised in relation to the use of Phoenix Park Tunnel. However, there are strengths to the proposed alignment and as such a similar alignment, HR8, is brought forward to the next stage of the study for further development and appraisal;
- LR1 can be eliminated on the basis that it does not meet the high level project objective of connecting to Dublin Airport and Swords (However an expanded version of this scheme, LR2, that runs from Cabra/Finglas to the airport and on to Swords has been proposed and included in this appraisal exercise); and
 - BRT Lines 2 and 3 can be eliminated on the basis that neither of them directly serve Swords.

Figure 7.2 below summarises the impact of the screening process which has resulted in the overall number of options for sketch appraisal reducing from 25 to 20. The appraisal of each of these options is presented in the following sections on a mode specific basis.

Figure 7.2: Screening process



7.3 Heavy Rail Options

Table 7.1 overleaf sets out the preliminary appraisal results for the heavy rail options. It should be noted that few of the heavy rail options perform well in relation to catchment. This is largely due to the fact that only ‘new’ catchments served are taken into account. These rail options involve the construction of new rail lines in areas of relatively low population and employment rather than in the city centre.

7.3.1 Summary Appraisal of Heavy Rail Schemes

As previously set out, HR1 and HR10 were eliminated during the screening process. A summary of the principal results with respect to each of the remaining eight options is outlined below.

HR2: Extension of HR1 Rail Spur to Swords

This scheme scores relatively well on the economic criteria. The proposed spur serves a reasonable level of population per extra kilometre of track, and at this stage it appears to be a relatively low cost option compared to other heavy rail options. However the cost estimate made at this stage assumes that only 2km of tunnel will be needed to build this rail spur from Clongriffin to Swords. Once further design work is undertaken it could emerge that significant additional tunnelling is actually needed to serve and traverse the airport. This would significantly increase the costs of this option.

This scheme integrates reasonably well with other policies, as it would serve the planned development of Swords, integrate with existing public transport infrastructure and provide a high quality link to Dublin Airport. The scheme does present some environmental risks which would have to be addressed further in the design phase.

HR3: Malahide to Airport via Swords

This scheme performs relatively poorly on the economic criterion. The route is shorter than HR2; however, the sparsely populated lands around this route and the costs of the tunnelling needed lead to a lower catchment per kilometre and a higher cost than HR2. The proposed routing also integrates less well with land use policy as it does not serve the development of Swords as well as HR2. Although the journey time from Swords to Dublin City Centre is acceptable, this option serves the airport via Swords so it must be noted that the journey time from the airport to Dublin City Centre is high.

HR4: North Malahide Estuary to Airport via Swords West

The appraisal results for this option are essentially the same as for HR3. The cost of this option is lower than HR3 as no tunnelling is required. However, the journey times between the City Centre and Dublin Airport would be higher.

HR5: Combination of HR1 and HR3

Similar to HR4, this option is longer than HR2 leading to a lower catchment per kilometre, and relatively poor economic performance compared to HR2 notably due to tunnelling requirements.

HR6: Combination of HR1 and a spur from Malahide to Swords

This option also performs poorly on the economic criterion as it involves constructing a relatively large length of track to serve a small catchment. In addition, it integrates poorly with land use policies as it does not enhance the planned Airport-Swords corridor. It also integrates poorly with public transport by placing extra demands on the existing rail network, and integrating poorly with existing services.

HR7: Maynooth Line (Broombridge) to Swords via Airport

This is one of four options to build a new heavy rail link from the city centre northwards to Dublin Airport and Swords. (The others are HR8 and HR9). These all score more highly than the rail spurs on the catchment criterion as they serve populated and developed areas. HR7 is the longest of these three options and has significantly greater journey times. HR7 also scores lower than the other two new rail lines on integration with public transport as it provides fewer connections to other public transport services.

HR8: Maynooth Line (Drumcondra) to Airport and Swords via Tunnel under Glasnevin

This proposal for a new rail line from the city to the airport and Swords delivers the same relatively high scoring for catchment as HR7 and HR9. It also provides excellent journey times by taking a fast direct route via a tunnel. This option is highly compatible with land use policies and integrates very well with the existing public transport network.

HR9: Heuston to Swords via Phoenix Park Tunnel, under Glasnevin

This option scores similarly to HR8 on a preliminary appraisal. However it must be considered the weakest of the three proposals for a new rail link to the airport and Swords as:

- There are likely to be operational constraints associated with use of the Phoenix Park Tunnel;
- There are likely to be issues in relation to interchange options at Heuston; and
- Its commencement at Heuston does not present a favourable city centre destination; however, it may be possible to interchange at Cabra with the LCC;

Table 7.1 Appraisal overview table, 10 Heavy Rail Options

Indicator	Unit	HEAVY RAIL									
		HR1	HR2	HR3	HR4	HR5	HR6	HR7	HR8	HR9	HR10
GENERAL SCHEME INFORMATION		GENERAL SCHEME INFORMATION									
Option Description		Clongriffin to Airport	Extension of HR1 to Swords	Malahide to Airport via Swords	North Malahide Estuary to Airport via Swords West	Combination HR1 + HR3	Combination HR1 + Spur Malahide to Swords	Maynooth Line (Broombridge) to Swords via Airport	Maynooth Line (Drumcondra) to Airport-Swords, under Glasnevin	Heuston to Swords via Phoenix Park Tunnel, under Glasnevin	Metro Dublin (scheme as proposed from St James's Hospital to Malahide)
Transport mode		HEAVY RAIL	HEAVY RAIL	HEAVY RAIL	HEAVY RAIL	HEAVY RAIL	HEAVY RAIL	HEAVY RAIL	HEAVY RAIL	HEAVY RAIL	HEAVY RAIL
New stations to be built at grade	number	2	4	1	3	4	3	5	5	5	5
New stations to be built underground	number	0	0	2	0	1	1	1	3	3	7
Length to be built	km	7.5	12.3	8.5	13.5	16.4	12.7	16.4	12.6	12.6	18.4
Tunnelled (twin)	km	0.0	2.0	5.0	0.0	2.8	2.8	2.6	6.6	6.6	0.0
Tunnelled (1)	km	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.8
At grade	km	7.5	10.3	3.5	13.5	13.6	9.9	13.8	6.0	6.0	8.6
SCREENING PROCESS		SCREENING PROCESS									
Is feasible?		Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Is meeting project objectives?		N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Going through appraisal?		No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
APPRAISAL		APPRAISAL									
1. Economy		1. Economy									
1.1 Catchment											
Population served in catchment, per km	n. per km		2,500	1,500	1,300	2,100	2,300	2,200	5,100	5,100	
Employment served in catchment, per km	n. per km		1,500	1,700	700	1,200	1,500	1,800	3,100	3,100	
TOT Population + Employment, per km	n. per km		4,000	3,200	2,000	3,300	3,800	4,000	8,300	8,300	
1.2 Estimated Journey Time											
Swords Centre (Pavilions) - Dublin City Centre (STG)	min		44	41	41	41	41	43*	28*	27**	
1.3 Capital Costs											
Estimated capital cost (range)	m€		600 - 790	1240 - 1490	310 - 460	960 - 1230	870 - 1100	940 - 1210	1760 - 2130	1760 - 2130	
2. Integration		2. Integration									
2.1 Compability with Land-use policies											
Development of Swords and Airport			Good	Fair	Fair	Good	Fair	Good	Very Good	Very Good	
2.2 Integration with PT											
Access to stations, interchange and destinations			Good	Good	Good	Good	Fair	Fair	Good	Good	
2.3 Service to the Airport											
Integration with Air Mode			Good	Good	Good	Good	Good	Good	Good	Good	
3. Environmental Constraints		3. Environmental Constraints									
3.1 Historical Environment			Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	
3.2 Natural Heritage / Environmental Topics			Significant	Significant	Significant	Significant	Significant	Moderate	Moderate	Moderate	
3.3 Plan Policies / Zoning			Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	
3.4 Fingal Nature Development Areas			Negligible	Moderate	Moderate	Moderate	Negligible	Moderate	Negligible	Negligible	
APPRAISAL CODING		APPRAISAL CODING									
1. Economy		1. Economy									
1.1 Catchment											
Population served in catchment, per km			Yellow	Red	Red	Yellow	Yellow	Yellow	Green	Green	
Employment served in catchment, per km			Red	Red	Red	Red	Red	Red	Yellow	Yellow	
TOT Population + Employment, per km			Yellow	Red	Red	Red	Red	Red	Yellow	Yellow	
1.2 Estimated Journey Time											
Swords Centre (Pavilions) - Dublin City Centre (STG)			Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Green	
1.3 Capital Costs											
Estimated capital cost (range)			Green	Yellow	Green	Yellow	Green	Yellow	Red	Red	
2. Integration		2. Integration									
2.1 Compability with Land-use policies											
Development of Swords and Airport			Yellow	Red	Red	Yellow	Red	Yellow	Green	Green	
2.2 Integration with PT											
Access to stations, interchange and destinations			Yellow	Yellow	Yellow	Yellow	Red	Red	Yellow	Yellow	
2.3 Service to the Airport											
Integration with Air Mode			Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	
3. Environmental Constraints		3. Environmental Constraints									
3.1 Historical Environment											
3.2 Natural Heritage / Environmental Topics			Red	Red	Red	Red	Red	Red	Yellow	Yellow	
3.3 Plan Policies / Zoning			Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	
3.4 Fingal Nature Development Areas			Green	Yellow	Yellow	Yellow	Green	Yellow	Green	Green	

* Journey Time to Connolly Station
** Journey Time to Heuston Station

7.3.2 Heavy Rail Options brought forward for further study

The results of this appraisal suggest that the following schemes do not perform well, relative to others, and can therefore be eliminated. These include:

- HR3 and HR4, which are both spurs from the northern line at Malahide, can be rejected on the basis of excessive journey times to the airport, capacity limitations, poor integration with land use policies and environmental concerns, and lower catchment per kilometre;
- HR5, a 'loop' from Clongriffin to Malahide via the airport and Swords, can be eliminated on the basis of similar reasons including: relatively low catchment area, journey times, capacity limitations and poor integration with land use policies; and,
- HR6, which is comprised of a spur at Clongriffin and a separate spur at Malahide, raises concerns regarding capacity on the northern line and poor land/public transport integration.

Of the remaining schemes, three present similar proposals for a new heavy rail line from the city to the airport and Swords (HR7, HR8 and HR9). The strongest of these is HR8, and this will be taken forward for further appraisal. This further appraisal will include preliminary design work which will optimise the actual route proposed for this new rail line.

It is also proposed to bring forward HR2, an expanded version of Irish Rail's proposal to build a rail spur from Clongriffin on the Northern Line to the airport. The appraisal results suggest that this could be an attractive option, if a heavy rail line can be brought through the airport at a reasonable cost.

The technical feasibility of this scheme as well as environmental constraints will be investigated during the next stage of scheme development.

In summary: of the original 10 heavy rail schemes proposed, 2 were eliminated at the screening stage of appraisal (HR1 and HR10). Following this, the sketch appraisal has been used to suggest two schemes for detailed appraisal, one as a spur from the Northern Line (HR2) and another from Maynooth Line (HR8).

HEAVY RAIL APPRAISAL SUMMARY		
HR1	Clongriffin to Airport	Eliminated at Screening Process
HR2	Extension of HR1 to Swords	Progress to Detailed Appraisal on the basis of effectiveness, efficiency and integration
HR3	Malahide to Airport via Swords	Eliminated due to excessive journey times, capacity limitations and poor integration with land use policies
HR4	North Malahide Estuary to Airport via Swords West	Eliminated due to excessive journey times, capacity limitations and poor integration with land use policy
HR5	Combination HR1 + HR3	Eliminated due to relatively low catchment area, journey times, capacity limitations and poor integration with land use policy
HR6	Combination HR1 + Spur Malahide to Swords	Eliminated due to capacity issues on the Northern Line and poor land/public transport integration
HR7	Maynooth Line (Broombridge) to Swords via Airport	Eliminated due to relatively higher cost per km
HR8	Maynooth Line (Drumcondra) to Airport-Swords, under Glasnevin	Progress to Detailed Appraisal on the basis of catchment, journey times and integration
HR9	Heuston to Swords via Phoenix Park Tunnel, under Glasnevin	Eliminated due to relatively higher cost per km
HR10	Metro Dublin (scheme as proposed from St James's Hospital to Malahide)	Eliminated at Screening Process

7.4 Light Rail Options

Table 7.2 overleaf highlights the appraisal results for the eight proposed light rail schemes. As previously highlighted, LR1 (Luas extension to Finglas) was rejected at the screening stage. As such, seven light rail options have been appraised. The principal results with respect to each option are outlined below.

LR2: Broombridge to Swords via Airport and Finglas

In common with most of the light rail options, LR2 scores highly on cost and integration with other public transport. It also scored neutrally on catchment per km of route, integration with land use policies and environmental considerations. However the journey time estimated (68 minutes from Dublin city centre to Swords) is very high relative to other options, and it scores very poorly on this criterion, i.e. this option's potential economic benefits are limited by its limited attractiveness to travellers and the limited benefits it would provide to any users.

LR 3, 4 and 5: LCC to Swords via Airport, under Glasnevin (Luas D2)

These three schemes were proposed by the RPA for an extension of the LUAS network to the Airport and Swords via Glasnevin, Phibsborough and Drumcondra respectively. LR4 and LR5 score better on catchment per kilometre than LR3 on the basis that they serve busy parts of the city. However LR4 and LR5 score poorly on journey times relative to LR3. All of these options score well on cost and integration. It is clear that this route should be considered further and so brought forward to the next stage of appraisal. The eventual choice between these three options is a matter of relatively detailed route choice and would have to be based on more detailed examination of these schemes and their technical feasibility.

LR6: Metro North

Metro North has already been subject to extensive development and appraisal. As one might expect, it scores highly in terms of potential benefits, but poorly for on cost. It also integrates very well with land use and transport policy.

Any decision to adopt a Metro type approach would have to be based on a forecast of high passenger demand which would mean that the Metro could deliver its full potential and be a cost effective approach to responding transport needs.

LR7: Optimised Metro North

LR7 is an optimised version of the original Metro North proposal that has been developed by the RPA. It proposes providing a similar service at significantly reduced costs. It produces the same preliminary appraisal results as Metro North but at a significantly reduced cost and therefore presents significant benefit.

LR8: Dublin City Access Transit

Very little information is available on this proposal. Its primary purpose is to improve public transport links in north Dublin City, rather than to provide a link to the Airport or Swords. As a result, journey times from the City Centre to Dublin Airport and Swords are relatively high.

Table 7.2 Appraisal overview table, 8 Light Rail Options

Indicator	Unit	LIGHT RAIL							
		LR1	LR2	LR3	LR4	LR5	LR6	LR7	LR8
GENERAL SCHEME INFORMATION		GENERAL SCHEME INFORMATION							
Option Description		Broombridge to Finglas (Luas D1)	Broombridge to Swords via Airport and Finglas	LCC to Swords via Airport, under Glasnevin (Luas D2)	LCC to Swords via Airport, via Phisborough (Luas D2)	LCC to Swords via Airport, via Drumcondra (Luas D2)	Metro North	Optimised Metro North	Dublin City Access Transit (CAT)
Transport mode		LIGHT RAIL	LIGHT RAIL	LIGHT RAIL	LIGHT RAIL	LIGHT RAIL	LIGHT RAIL	LIGHT RAIL	LIGHT RAIL
New stations to be built at grade	number	6	17	12	14	12	5	6	14
New stations to be built underground	number	0	0	1	0	0	9	7	0
Length to be built	km	4.6	15.0	13.5	14.3	14.4	16.5	16.5	16.9
	Tunnelled (twin)	0.0	0.0	2.1	0.0	0.0	11.2	9.7	0.0
	Tunnelled (1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	At grade	4.6	15.0	11.4	14.3	14.4	5.3	6.8	16.9
SCREENING PROCESS		SCREENING PROCESS							
Is feasible?		Y	Y	Y	Y	Y	Y	Y	Y
Is meeting project objectives?		N	Y	Y	Y	Y	Y	Y	Y
Going through appraisal?		No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
APPRAISAL		APPRAISAL							
1. Economy		1. Economy							
1.1 Catchment		1.1 Catchment							
Population served in catchment, per km	n. per km	5,100	5,800	6,600	7,000	8,400	8,200	6,100	
Employment served in catchment, per km	n. per km	2,700	3,400	4,300	5,000	11,700	11,200	4,400	
TOT Population + Employment, per km	n. per km	7,800	9,200	10,900	11,900	20,200	19,400	10,500	
1.2 Estimated Journey Time		1.2 Estimated Journey Time							
Swords Centre (Pavilions) - Dublin City Centre (STG)	min	68	45	51	58	25	27	71	
1.3 Capital Costs		1.3 Capital Costs							
Estimated capital cost (range)	m€	530 - 770	630 - 1050	500 - 730	500 - 730	1610 - 3300	1430 - 2860	590 - 850	
2. Integration		2. Integration							
2.1 Compability with Land-use policies		2.1 Compability with Land-use policies							
Development of Swords and Airport		Good	Very Good	Very Good	Good	Very Good	Very Good	Good	
2.2 Integration with PT		2.2 Integration with PT							
Access to stations, interchange and destinations		Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	
2.3 Service to the Airport		2.3 Service to the Airport							
Integration with Air Mode		Good	Good	Good	Good	Good	Good	Good	
3. Environmental Constraints		3. Environmental Constraints							
3.1 Historical Environment		3.1 Historical Environment							
		Moderate	Moderate	Negligible	Negligible	Moderate	Moderate	Negligible	
3.2 Natural Heritage / Environmental Topics		3.2 Natural Heritage / Environmental Topics							
		Significant	Significant	Significant	Significant	Significant	Significant	Significant	
3.3 Plan Policies / Zoning		3.3 Plan Policies / Zoning							
		Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	
3.4 Fingal Nature Development Areas		3.4 Fingal Nature Development Areas							
		Moderate	Moderate	Moderate	Moderate	Negligible	Negligible	Negligible	
APPRAISAL CODING		APPRAISAL CODING							
1. Economy		1. Economy							
1.1 Catchment		1.1 Catchment							
Population served in catchment, per km		Green	Green	Green	Green	Green	Green	Green	
Employment served in catchment, per km		Green	Green	Green	Green	Green	Green	Green	
TOT Population + Employment, per km		Green	Green	Green	Green	Green	Green	Green	
1.2 Estimated Journey Time		1.2 Estimated Journey Time							
Swords Centre (Pavilions) - Dublin City Centre (STG)		Red	Yellow	Red	Red	Green	Green	Red	
1.3 Capital Costs		1.3 Capital Costs							
Estimated capital cost (range)		Green	Green	Green	Green	Red	Red	Green	
2. Integration		2. Integration							
2.1 Compability with Land-use policies		2.1 Compability with Land-use policies							
Development of Swords and Airport		Yellow	Green	Green	Yellow	Green	Green	Yellow	
2.2 Integration with PT		2.2 Integration with PT							
Access to stations, interchange and destinations		Green	Green	Green	Green	Green	Green	Green	
2.3 Service to the Airport		2.3 Service to the Airport							
Integration with Air Mode		Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	
3. Environmental Constraints		3. Environmental Constraints							
3.1 Historical Environment		3.1 Historical Environment							
		Yellow	Yellow	Green	Green	Yellow	Yellow	Green	
3.2 Natural Heritage / Environmental Topics		3.2 Natural Heritage / Environmental Topics							
		Red	Red	Red	Red	Red	Red	Red	
3.3 Plan Policies / Zoning		3.3 Plan Policies / Zoning							
		Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	
3.4 Fingal Nature Development Areas		3.4 Fingal Nature Development Areas							
		Yellow	Yellow	Yellow	Yellow	Green	Green	Green	

* Journey Time to Connolly Station
** Journey Time to Heuston Station

7.4.1 Light Rail Options brought forward for further study

These appraisal results suggest that two schemes can be eliminated at this stage. LR2 can be eliminated on the basis that journey times to key focal points within the study area, such as Swords and the airport, are excessive. The employment catchment areas served are also significantly lower than other schemes. The original “Metro North” project and the optimised Metro North are essentially variants of the one proposal and the revised scheme (LR7) should be brought forward on the basis of its slightly revised scope and significantly lower costs. However, further validation of the technical and operational feasibility of LR7 is required, and will be undertaken at the next stage.

In the interim, an Optimised Metro North will be brought forward for further appraisal, including modelling work to predict patronage. Only a full modelling and cost benefit exercise will allow a judgement as to whether the capacity delivered by a Metro will be needed, and that the level of usage would justify the expected cost.

In addition to LR7, it is also proposed that a light rail scheme extending from Luas Cross City through to the Airport and Swords be investigated at the next stage of appraisal. This is proposed on the basis of good journey times, cost and integration impacts. At this stage the RPA’s preferred option, LR3 will be brought forward. However, the precise routing for the southern section of the route will become clearer at the next stage of project development.

A summary of the appraisal is provided as follows:

LIGHT RAIL APPRAISAL SUMMARY		
LR1	Broombridge to Finglas (Luas D1)	Eliminated at Screening Process
LR2	Broombridge to Swords via Airport and Fingal	Eliminated due to excessive journey times, and lower employment catchment served
LR3	LCC to Swords via Airport, under Glasnevin (Luas D2)	Progress to Detailed Appraisal, on the basis of good journey times, cost and integration impacts. At this stage LR3 will be brought forward, however, the precise routing for the southern section of the route is to be determined
LR4	LCC to Swords via Airport, via Phibsborough (Luas D2)	
LR5	LCC to Swords via Airport, via Drumcondra (Luas D2)	
LR6	Metro North	As this and LR7 are essentially variants of the one proposal, LR7 is being brought forward due to its reduced scope and lower costs.
LR7	Optimised Metro North	Progress to Detailed Appraisal on the basis of adjusted demand requirements and lower costs
LR8	Dublin City Access Transit (CAT)	Rejected due to excessive journey times for key areas in the corridor. However, a light rail alignment through Drumcondra (LR5) is a possible sub-option for next stage

7.5 Bus Rapid Transit Options

Table 7.3 highlights results of the appraisal process for the five proposed Bus Rapid Transit schemes. BRT 2 and 3 have already been rejected through the screening process, as such, three BRT schemes have been appraised as outlined below.

BRT1: Clongriffin to Airport via Malahide

This scheme should be rejected on the grounds of excessive journey times, limited capacity and catchment area as well as poor integration with land use policies and public transport.

BRT 4: Docklands to Swords via the Port Tunnel

As discussed in Section 4, this is a relatively low capacity option, but within those limits it scores well on preliminary appraisal. It has the potential to deliver benefits in a cost effective way and integrates well with other policies. It represents a small amount of additional capacity for a low cost. It is proposed that it be combined with other BRTs for further appraisal (see BRT5).

BRT5: Combination of BRT2, BRT3 and BRT 4

Because the cost of BRT Lines 2, 3 and 4 is relatively low, it is possible to combine them to arrive at a relatively low cost/low capacity option. This option is proposed as a further scheme, BRT 5. If future demand is relatively low, BRT5 may be the most cost effective approach to meeting the public transport needs of the airport and Swords. As a result, BRT5 should be taken on to the next stage of the study for modelling and cost benefit appraisal.

A summary of BRT appraisal is as follows:

BRT APPRAISAL SUMMARY		
BRT1	Clongriffin to Airport via Malahide	Eliminated due to excessive journey times, limited capacity and catchment area, as well as poor integration with land use policies and public transport
BRT2	Clongriffin to Airport via R139	Eliminated at Screening Process
BRT3	City Centre to Airport via Ballymun	Eliminated at Screening Process
BRT4	Docklands to Swords via Tunnel	Relatively low capacity option, scoring well on preliminary appraisal. Proposed that it be combined with other BRTs for further appraisal (see BRT5)
BRT5	Combination of BRT2, BRT3, BRT4.	Progress to Detailed Appraisal

7.6 Combined Options

Table 7.4 highlights results for the two proposed options which combine various options previously proposed. The appraisal results for these are as follows:

C1: Combination of HR1 and LR3

This scheme is a combination of the HR1 spur from Clongriffin to the airport with the LR3 light rail from Cabra to the airport and on to Swords. This combines two schemes to meet the study objectives, so providing high capacities and low journey times. The scoring on economy is limited by the extent of the extra route length needed.

C2: Combination of HR1 and enhanced Airport – Swords BRT

This scheme is a combination of HR1 with a high capacity BRT from Swords to the airport. The appraisal scores are relatively neutral, but this does not reflect the capacity of the scheme. In fact, this scheme provides only a limited additional service to Swords and can be rejected at this stage on grounds of capacity. This combined scheme also fails to provide a fixed rail commuting service to Swords residents.

On the basis of relatively better service and capacity, it is proposed that C1 is brought forward for further development and full appraisal.

A summary of appraisal of combined options is as follows:

COMBINED OPTIONS APPRAISAL SUMMARY		
C1	Combination of HR1 and LR3	Progress to Detailed Appraisal
C2	Combination of HR1 and enhanced BRT Swords-Airport	This would provide only limited additional service to Swords, is rejected at this stage on grounds of capacity and potential interchange constraints

Table 7.4 Appraisal overview table, 2 Combination Options

Indicator	Unit	MODES COMBINATION	
		C1	C2
GENERAL SCHEME INFORMATION			
Option Description			
Transport mode			
New stations to be built at grade	number	14	12
New stations to be built underground	number	1	0
Length to be built	km	21	12.4
	Tunnelled (twin)	2.1	0.0
	Tunnelled (1)	0	0
	At grade	18.9	12.4
SCREENING PROCESS			
	Is feasible?	Y	Y
	Is meeting project objectives?	Y	Y
	Going through appraisal?	Yes	Yes
APPRAISAL			
1. Economy			
1.1 Catchment			
Population served in catchment, per km	n. per km	4,500	3,100
Employment served in catchment, per km	n. per km	2,400	1,700
TOT Population + Employment, per km	n. per km	7,000	4,800
1.2 Estimated Journey Time			
Swords Centre (Pavilions) - Dublin City Centre (STG)	min	45	44
1.3 Capital Costs			
Estimated capital cost (range)	m€	810 to 1310	220 to 310
2. Integration			
2.1 Compability with Land-use policies			
Development of Swords and Airport		Very Good	Fair
2.2 Integration with PT			
Access to stations, interchange and destinations		Very Good	Very Good
2.3 Service to the Airport			
Integration with Air Mode		Good	Good
3. Environmental Constraints			
3.1 Historical Environment			
		Moderate	Moderate
3.2 Natural Heritage / Environmental Topics			
		Significant	Significant
3.3 Plan Policies / Zoning			
		Moderate	Moderate
3.4 Fingal Nature Development Areas			
		Moderate	Negligible
APPRAISAL CODING			
1. Economy			
1.1 Catchment			
Population served in catchment, per km			
Employment served in catchment, per km			
TOT Population + Employment, per km			
1.2 Estimated Journey Time			
Swords Centre (Pavilions) - Dublin City Centre (STG)			
1.3 Capital Costs			
Estimated capital cost (range)			
2. Integration			
2.1 Compability with Land-use policies			
Development of Swords and Airport			
2.2 Integration with PT			
Access to stations, interchange and destinations			
2.3 Service to the Airport			
Integration with Air Mode			
3. Environmental Constraints			
3.1 Historical Environment			
3.2 Natural Heritage / Environmental Topics			
3.3 Plan Policies / Zoning			
3.4 Fingal Nature Development Areas			

* Journey Time to Connolly Station

** Journey Time to Heuston Station



SUMMARY

8.0 Summary

This report has outlined and considered, by appraisal methods, 25 public transport infrastructure options for possible development to serve the future development of the Fingal/North Dublin study area. The amount of development, population and employment growth, was the subject of a previously submitted Strategic Context Report. The scheme options were developed on the basis of stakeholder consultation, in the first instance, together with a one to one conversation with various stakeholders to elicit their preferred scheme options for appraisal. Further options were developed by AECOM to meet the overall study objectives. All options were reported back to key stakeholders to ensure that there were no possible options or schemes missing from the appraisal process.

The scope and method of appraising the 25 schemes has been undertaken on the basis of:

- A preliminary 'screening' to ensure the schemes meet the project objectives and are technically feasible. Through this process, 5 schemes have been excluded from further appraisal;
- A sketch appraisal based on the guidelines and criteria incorporated within the CAF. On the basis of the sketch appraisal, just 6 of the 20 options are suggested for further investigation. These schemes are summarised below.

The appraisal has indicated that these schemes are certain to be preferable to the schemes that have been eliminated at this stage. The choice of the optimum approach from this reduced set of options requires further design work to confirm the feasibility and exact route of some of these shortlisted options. In addition, identifying the most cost effective option will require modelling work to forecast the passenger demand for each of these options. In essence, the remaining choice is between high capacity, fast options that may offer the most cost effective solution if they attract sufficient patronage and lower capacity cheaper options.

Table 8.1: Summary of shortlisted schemes

HR2	<p>A heavy rail spur from Clongriffin to the airport and Swords</p> <p>This scheme appears to provide a high quality, high capacity service to the airport and Swords. However, further work is needed to ensure that it is practical to bring a heavy rail service through Dublin Airport.</p>
HR8	<p>A new heavy rail line from the Maynooth Line to the airport and Swords via a tunnel under Glasnevin.</p> <p>This scheme is a new rail service from Dublin City Centre, through the northern suburbs to the airport and Swords. This also offers a high quality, high capacity service and increases public transport provision in the city. Further design work will be needed to determine the exact route, and demand forecasting will be needed to determine whether this approach is cost effective.</p>
LR3	<p>Light rail from Cabra to the airport and Swords via a tunnel under Glasnevin (Luas D2)</p> <p>This aims to extend Luas Cross City to the airport and Swords. Further design work will be needed to determine the exact route and demand forecasting will reveal whether this approach provides enough capacity and is cost effective.</p>
LR7	<p>Optimised Metro North</p> <p>The RPA have proposed this cost optimised approach to providing Metro North. If demand forecasting indicates sufficient passenger demand this may be the most cost</p>

	effective approach to providing enhanced links to the airport and Swords.
BRT5	This scheme is a combination of a number of proposed Bus Rapid Transit services. Demand modelling may indicate that this relatively low capacity, low cost option is the most cost effective approach to providing enhanced links to the airport and Swords.
C1	Combination of HR1 and LR3, i.e. a heavy rail spur from Clongriffin to the airport and light rail from Dublin to Swords via the airport. The HR1 scheme could be an effective way to provide a high capacity link to the airport. Combining this with a light rail service may meet the needs of both the Airport and Swords in a cost effective way.

A summary of the overall appraisal of these options is presented in Table 8.2, more detailed appraisal tables are presented earlier in this report. The schemes have been assessed on a quantitative and qualitative basis and are recommended for further development on the basis of their relatively strong performance against other schemes options.

Table 8.2: Summary of appraisal of shortlisted schemes

Indicator	HEAVY RAIL		LIGHT RAIL		BUS RAPID TRANSIT	MODES COMBINATION
	HR2	HR8	LR3	LR7	BRT5	C1
GENERAL SCHEME INFORMATION						
Option Description	Heavy rail line from Clongriffin serving the Airport and Swords	Maynooth Line (Drumcondra) to Airport-Swords, under Glasnevin	Cabra to Swords via Airport, under Glasnevin (Luas D2)	Optimised Metro North	Combination of BRT2, BRT3, BRT4.	Combination of HR1 and LR3
SUMMARY APPRAISAL COLOUR-CODED RANKS						
1. Economy						
1.1 Catchment per km						
1.2 Journey Times						
1.4 Capital Costs						
2. Integration						
2.1 Compatibility with Land-use policies						
2.2 Integration with Public Transport						
2.1 Service to the Airport / Integration with Air Mode						
3. Environmental Constraints						
3.1 Historical Environment						
3.2 Natural Heritage / Environmental Topics						
3.3 Plan Policies / Zoning						
3.4 Fingal Nature Development Areas						

Colour	Description
Green	Some advantages over other options
Yellow	Neutral compared to other options
Red	Some disadvantages over other options

The next stage of the study will take each of the shortlisted schemes forward for further scheme development including:

- Technical development, both engineering design and operational parameters;
- More detailed costing and environmental assessment; and
- Modelling and cost benefit analysis.



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