Údarás Náisiúnta Iompair
National Transport Authority

Draft Transport Strategy for the Greater Dublin Area

West Corridor Study

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Contents

1 Introduction

1.1 Background

The National Transport Authority (NTA) is preparing a new transport strategy for the Greater Dublin Area (GDA) which will consider the future of the transport system in the GDA for the period up to year 2035. As a means towards informing the direction of the new strategy the NTA has defined eight Study Areas to be assessed for this review in order to understand more fully the 2035 travel demand coming from the Study Areas into Dublin City Centre, and the public transport services that will be required to effectively meet that demand.

Jacobs Engineering Ireland (Jacobs) and SYSTRA provide consultancy services to the NTA through a Modelling Services Framework. By this means Jacobs and SYSTRA were commissioned by the NTA to undertake a desktop transport assessment of six of the eight identified corridors within the GDA.

This report focuses on the **West Study Area**. There are also Study Areas being examined by Jacobs / SYSTRA in the North West, Navan, South East, South West and Inner Orbital.

1.2 Study Objectives and Principles

This study examines the future transport needs of the West Study Area. Consideration is given to the role and function of the strategic road network as well as the performance of existing public transport provision.

A particular aim of the study is to explore and identify public transport options that could effectively meet the growth in travel demand to the year 2035, between the West Study Area and Dublin City Centre (within the Canal boundary). Additional demand for internal travel within the corridor has also been considered when reviewing both travel demand and potential public transport schemes. The review also takes cognisance of through trips that can increase demand on current and future public transport services.

The focus is placed on meeting the demand of those trips that are greater than 3km in distance, as it has been assumed that the majority of trips less than 3km may be taken by walking or cycling.

Based on the level of demand that is identified, and considering functionality and cost, a set of appropriate public transport solutions are presented. Packages may include bus, bus rapid transit (BRT), light rail, metro and heavy rail. Interchange between public transport modes has been considered. The public transport options identified are considered to offer the most effective, efficient and sustainable solution to serve growth in transport demand and provide the best means of contributing to an integrated public transport strategy for the GDA.

This study has considered the existing road network in the Study Area and has included the various significant road proposals that are under consideration. Discussions have been held by the NTA with the National Roads Authority and local authorities to establish the likely road network changes that will be required during the period of the transport strategy. While many of these road proposals have not yet been developed in detail, and designs are not available, the impacts of these proposals have accounted for in the analysis of the public transport requirements. Accordingly, while the analysis of the public transport necessary for the future is the focus of this study, it has involved a composite consideration of the road network.

1.3 Study Methodology

The study has been undertaken in four stages:

- Stage 1 established travel demand within the 2011 base year and 2035 forecast year using the demand from the Greater Dublin Area Regional Model (GDARM);
- Stage 2 identified public transport options that have the potential to meet the demand identified in Stage 1 based solely on capacity thresholds by public transport mode (e.g. rail, light rail, BRT and bus);
- Within Stage 3 the most appropriate public transport options that meet the demand requirements were scored and sifted based on functionality (journey time and ability to meet demand) and cost (capital cost as related to service level); and
- Stage 4 tested the preferred option in the GDARM to confirm its viability.

These stages are discussed in the following sections.

1.3.1 Stage 1 - Establish Demand

To forecast the strategic public transport needs for each of the Study Areas in 2035, demand was established using the GDARM, which has a base year of 2011. To produce the 2035 forecast, planning data was provided by the NTA based on the 2035 population and employment projections.

The 2011 demand outputs were generated for the GDA for the AM peak hour (08:00–09:00) for all trips greater than 3km within these time periods. The same process was applied for the 2035 demand. The AM peak hour was chosen for the demand analysis because this is when the travel demand is at its highest over the day. The PM peak was not used for this stage of review, as demand tends to be spread over a longer time and it also does not typically cater for both work and school trips.

Screenlines were used to develop a broader understanding of travel demand passing through the Study Area. This analysis is primarily used to help inform the capacity requirements for future public transport options for the study area.

1.3.2 Stage 2 - Public Transport Option Development

The second stage of the study focuses on developing public transport options to meet the travel demand growth from 2011 to 2035, from the study area into the Dublin City Centre during the AM peak hour (08:00-09:00).

Catchment bands for existing public transport services were defined and applied to identify growth within the catchment of existing service areas and to identify areas where the level of service provided by public transport is low or where no service is provided.

Service capacities for possible public transport modes were then defined. This includes the definition of the seating capacity and crush capacity for Dart Underground, Commuter Rail, Light Rail, Bus Rapid Transit, Urban Bus, Intercity Bus and Shuttle Bus. For the purpose of option development for the 2035 transport strategy, public transport options are considered based on design capacity which is equivalent to an operating level of service that is at or below 85 per cent of crush capacity. This ensures that at no time will the entirety of the target demand be accommodated by a service that is underutilised, or is so busy as to make the service less desirable. Crush capacity is an industry standard expression relating to the loading upper limit of

public transport services that allow standing as a means of careering for higher level patronage. Design capacity is assumed at 85 per cent of this to allow for a more comfortable and attractive level of service to be provided.

Development of public transport options for Stage 2 of the study focused on utilising the capacity and frequency definitions to determine the appropriate public transport mode to meet AM peak hour demand.

1.3.3 Stage 3 - Public Transport Option Scoring

Stage 3 takes the output of the high level public transport options developed in Stage 2 and scores them based on categories relating to demand, functionality and cost.

The functionality scoring category analysed the capacity of the public transport option to meet the 2035 travel demand from the Study Area into Dublin City Centre during the AM peak hour. It also considered the maximum duration of the journey. This was based on the maximum length of the journey from the start to the City Centre and the average speed of the public transport mode.

The cost scoring category is based on the capital costs per option. It also considers the extent to which existing infrastructure is utilised and maximised for efficiency. Typical capital costs have been assumed, generally based on a cost per km. Typical costs include a level of risk. A more detailed review would be required to confirm the likely cost, for example to account for land acquisition and all major risks. Operational costs are not considered. Despite this, the outline costs are considered to provide a reasonable estimation of costs at a suitable level for comparative purposes for this stage of review.

The public transport options with the best score were recommended to be considered further as part of the larger 2035 Greater Dublin Area Transport Strategy.

This Do Minimum scenario, described in Section 2.3 is used as a basis for the development of the public transport options to serve the growth in demand to 2035 originating within the West Corridor.

1.3.4 Stage 4 – Transport Modelling Assessment

This stage tested the preferred option in the Greater Dublin Area Regional Model (GDARM). The modelling exercise was undertaken to determine the likely viability, usage and operation of the proposed services for implementation by 2035.

In addition to the Do Minimum scenario, the GDARM includes additional schemes assumed (described in Section 2.3) as part of the wider GDA Strategy.

1.4 Report Structure

The report is structured as follows:

- Section 2 describes the West Study Area and outlines the Do Minimum scenario;
- Section 3 details the results of the demand analysis for the Study Area and identifies the 2035 public transport target demand;
- Section 4 develops the public transport options to meet the demand established in Section 3;

- Section 5 scores the public transport options developed in Section 4 outlining an emerging preferred option to be brought forward to the modelling assessment;
- Section 6 outlines the modelling assessment of the proposed public transport services;
- Section 7 describes the Preferred Emerging Scheme; and
- Annexes 1-3 provide supplementary information on capacity analysis; assumptions used in relation to capacity, cost and speed; and the scoring process.

2 Study Area

2.1 Corridor Description

The West Study Area begins immediately west of Dublin City Centre and runs from the South Circular Road at Islandbridge/Kilmainham as far west as the settlements of Leixlip and Celbridge in Co. Kildare. The study area is bounded to the north by the River Liffey and to the south by the Grand Canal. The area includes neighbourhoods such as Ballyfermot, Chapelizod and Palmerstown to the east of the M50. To the west of the M50 the study area follows the Liffey and the Grand Canal as far as the boundary between Co. Dublin and Co. Kildare and includes the Liffey Valley and Lucan areas to the north and the strategic development zones of Adamstown and Clonburris to the south.

The Dublin Metropolitan West Study Area boundary, which is shown below in Figure 2-1, was developed by NTA using the electoral division boundaries from the Central Statistics Office.

The study area covers an area of 91.9km^2 and has a population of 139,100 people. It consists primarily of suburban residential areas and areas of employment, with an east-west green belt consisting of Phoenix Park and Liffey Valley running through it. The existing road network and public transport services are close to or are at capacity at a number of locations.

2.1 Existing and Planned Strategic Road Network

The corridor is defined by the N/M4 national primary route, which connects the city centre to Sligo via Mullingar and Longford and to Galway via the M6. The corridor also contains the M50 motorway which caters for significant volumes of orbital traffic.

The capacity of the N/M4 and M50 must be protected for strategic traffic movements, including the distribution of goods. Congestion along the M50 is an increasingly serious issue, particularly at peak times. This peak congestion on the M50 also impacts on the N4 between Maynooth and the M50.

There is limited opportunity for significant road capacity enhancements in the West Study Area from the perspective of both physical constraints and environmental considerations. Therefore, providing for increasing transport demand through alternative modes, such as public transport, will be necessary to protect the function and operation of the N/M4 and M50 strategic corridors.

2.2 Existing and Planned Public Transport Provision

The West Study Area is currently served by the Luas Red line, Irish Rail Commuter Trains, Intercity and a wide range of bus services, including regional and express services, to the City Centre, as follows:

- Heavy Rail – Maynooth and Kildare Commuter lines;
- Light Rail – Luas Red Line; and
- Dublin Bus – 9 Dublin Bus Services.

The existing Public Transport provision in the West Study Area consists predominantly of radial services that cater for demand between the West Study Area and Dublin City Centre and beyond, as well as through trips. Dublin Bus and Irish Rail Commuter Trains are the dominant public transit services in the area.

2.2.1 Luas Red Line

Figure 2-2 illustrates the existing Heavy Rail and Light Rail provision within the West Study Area. It can be seen that the existing provision caters predominantly for radial demand to/from the City Centre. There are 7 operational Luas Red Line stops within the study area, between Red Cow and Suir Road.

2.2.2 DART/Irish Rail

On the Kildare line, there are 4 operational commuter rail stations in the Study Area between Hazelhatch and Park West, and on the Maynooth line there are two at Leixlip. Additionally there is a further station at Kishoge on the Kildare line which is not currently in use.

The proposed opening of the Phoenix Park Tunnel and link to Connolly station and onto Grand Canal Dock will improve access into the city centre for passengers on Kildare line commuter services.

Patronage information from the 2013 Rail Census along with data on seated, crush and design capacity at the current service frequency show:

- The Maynooth Line is at capacity. There is a 7 trains per hour (tph) limitation caused by signalling and level crossing constraints;
- The Kildare line is not being used to its capacity. This is perhaps because of the low levels of development around stations; the Heuston destination; and the 3tph non clockface service.

2.2.3 Bus

The study area is served by Dublin Bus routes mainly along the N4 corridor including the 66, 67, 25, 26, 51d and 76a. Orbital routes include the 239 and 76a operating between Liffey Valley Shopping Centre and Blanchardstown Shopping Centre and The Square Town Centre in Tallaght respectively. The 40 also operates from Finglas to the City Centre and on to Liffey Valley.

Bus Éireann regional services to Clane and Edenderry also pass through the study area, serving Celbridge and Liffey Valley en route to Dublin City Centre.

Figure 2-3 illustrates the coverage of the Dublin Bus services within the West Study Area. In general the bus services cover 55 per cent of the Study Area, and capture 92 per cent of demand.

Figure 2-4 shows the West Study Area in the context of the Dublin Bus Core Network Map. It is apparent that all of the Dublin Bus routes that traverse the West Study Area, while delivering a high degree of coverage, cater predominantly for radial demand to/from the City Centre.

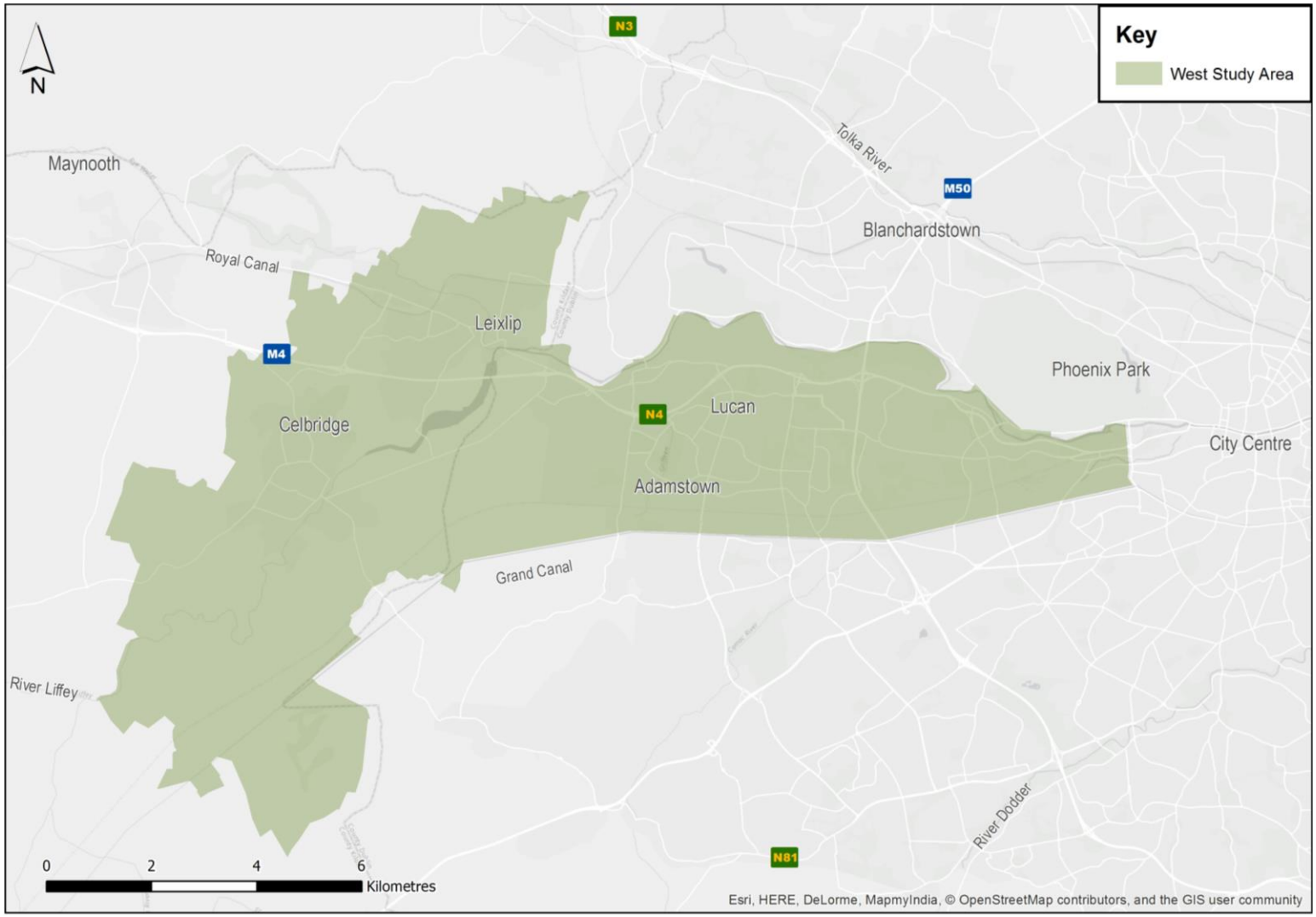


Figure 2-1: West Study Area & Surrounding Areas

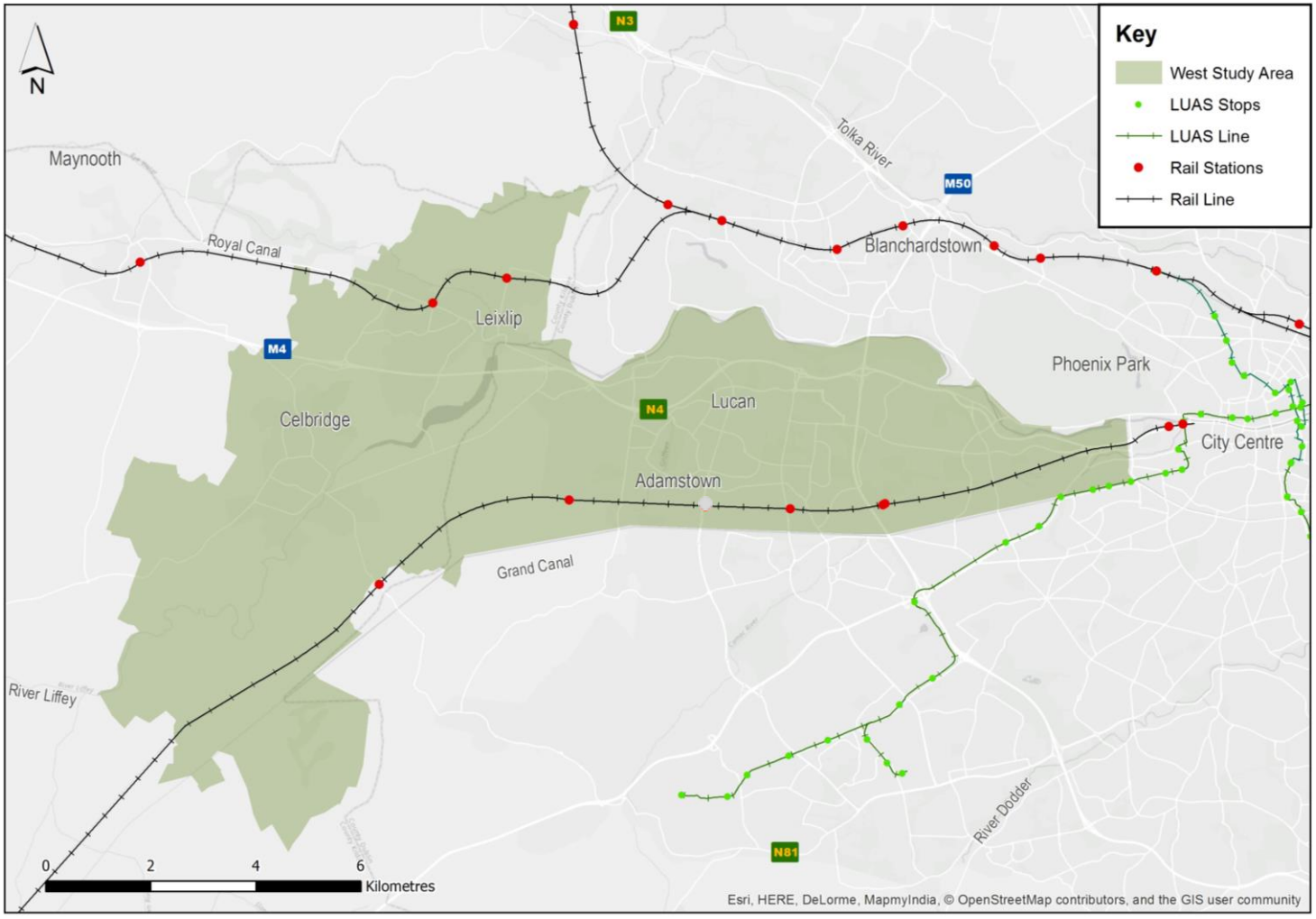


Figure 2-2: Existing Rail Services

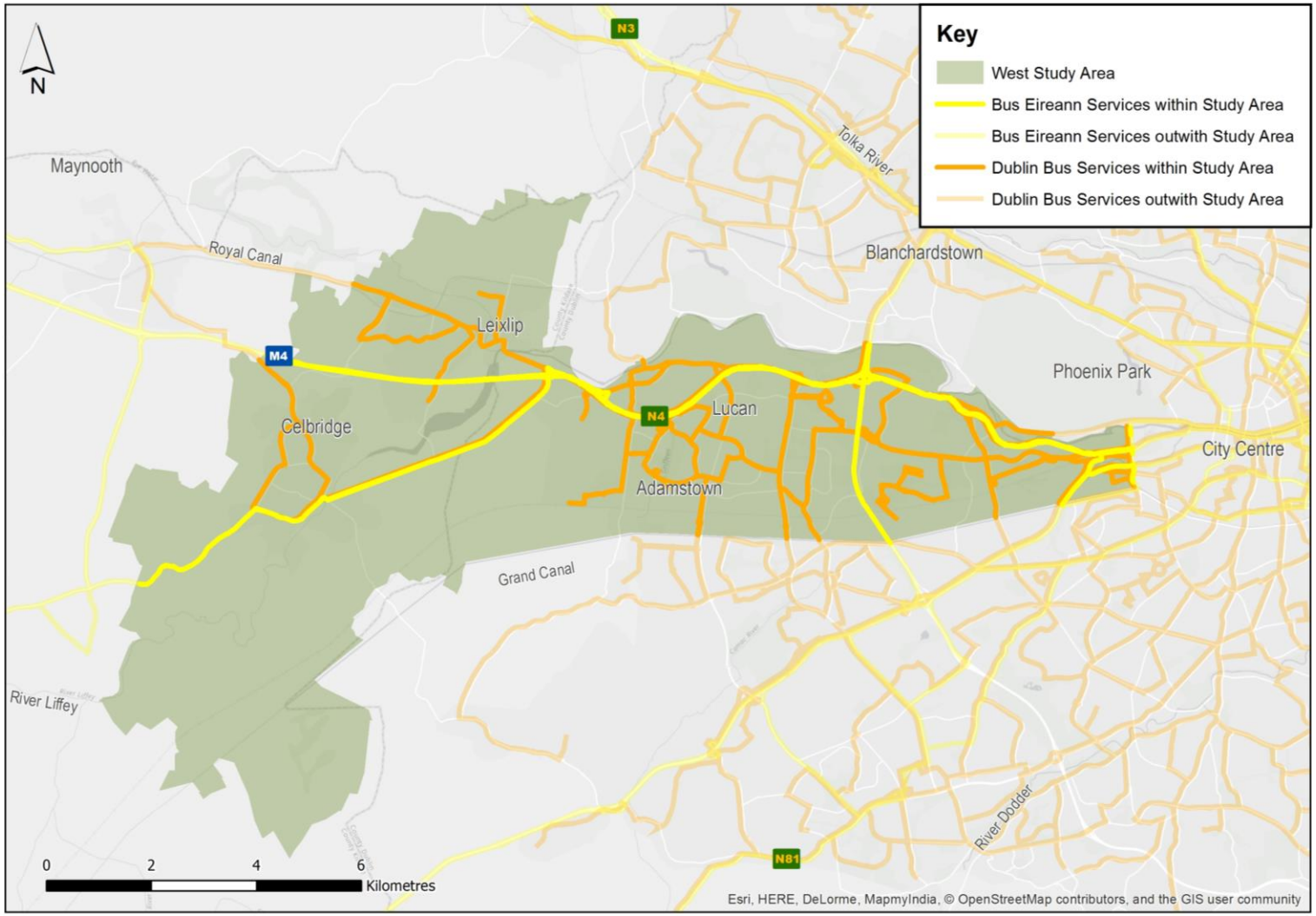


Figure 2-3: Existing Bus Services

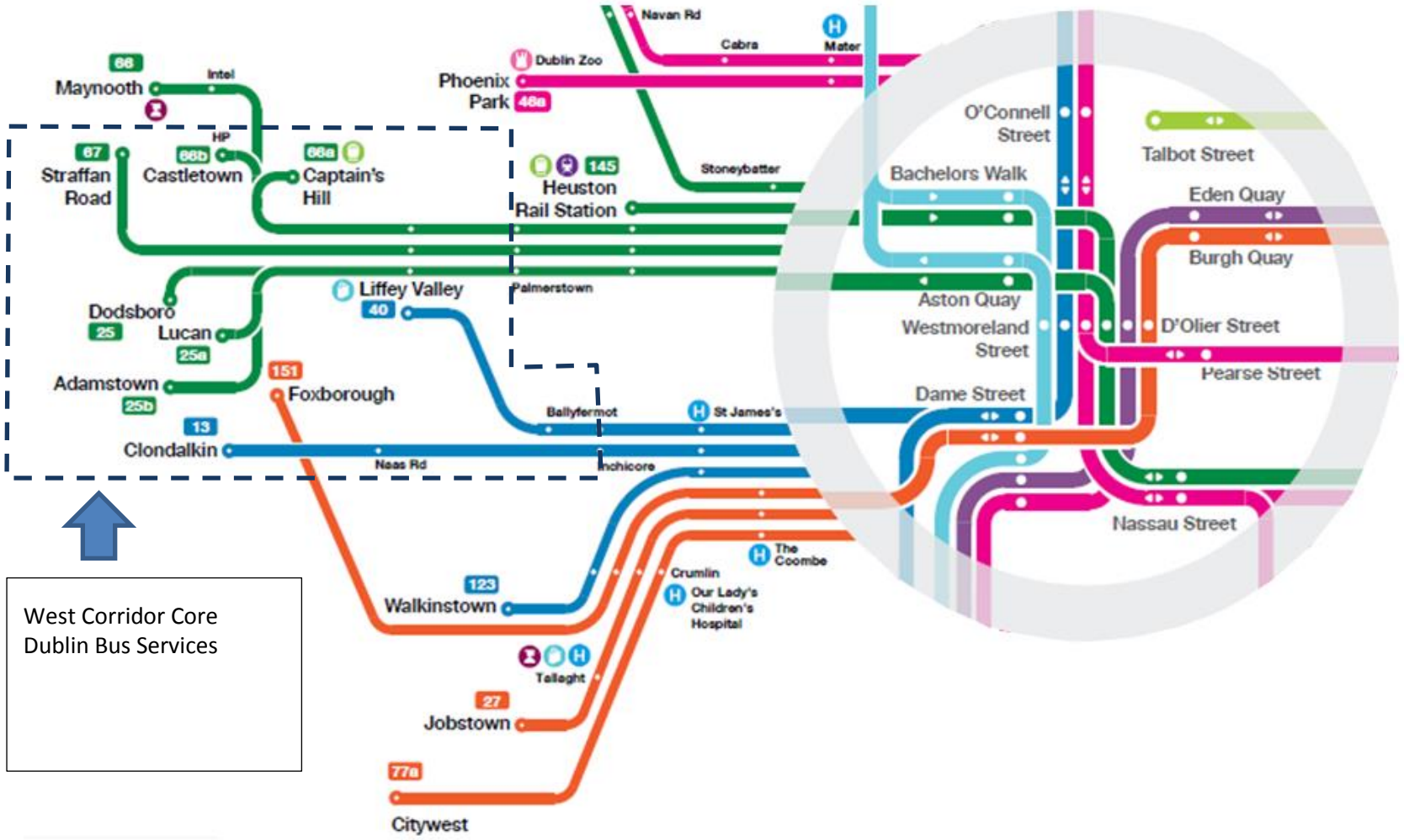


Figure 2-4: Dublin West Study Area – Dublin Bus Core Services

2.3 Do Minimum – Proposed Transport Provision

The Do Minimum Scenario includes public transport improvements within Dublin City Centre that have a high degree of certainty for completion before the forecast year. The Do Minimum public transport improvements include the following:

- Phoenix Park Tunnel;
- Dublin City Centre Rail Re-Signalling Project; and
- Luas Cross City.

In addition, the following road schemes, located in the West corridor, are included in the Do Minimum scenario:

- Holywell Village improvement and associated Distributor Road completion; and
- N3 Mulhuddart Interchange Upgrade.

While not all of these improvements directly impact this study area, they have been provided for context. Further details of the major public transport improvements assumed as part of the Do Minimum network are outlined below.

2.3.1 Phoenix Park Tunnel

The re-opening of the Phoenix Park Tunnel will allow for rail connectivity from the South West Line to the South East Line serving Drumcondra, Connolly, Tara Street, Pearse and Grand Canal Dock Stations. The trains using the Phoenix Park Tunnel will not stop at Heuston Station.

The proposed improvements can accommodate 4tph in one direction and 3tph in the other direction. It is likely that the 4tph would travel eastbound from the South West line using the tunnel in the AM peak and westbound in the PM peak to cater for the peak tidal demand into and out of the city centre.

2.3.2 Dublin City Centre Rail Re-Signalling Project

The Dublin City Centre Rail Re-Signalling project will enable increased train path capacity across the City on the Loop Line Bridge over the Liffey. The current capacity constraint of 12tph will be raised to 17tph with a peak hour capacity of 20tph for services to be identified. A new turn-back platform at Grand Canal Dock is planned for 9tph, leaving up to 11tph to carry on southbound to Dun Laoghaire and Bray.

2.3.3 Luas Cross City

The Luas Cross City is an extension of the existing Luas Green Line beginning at the current Green Line Terminus at St. Stephen's Green, interchanging with the Luas Red Line at O'Connell Street / Abbey Street and continuing northbound to the DIT Grangegorman Campus, Phibsborough and terminating at the Broombridge Rail Station on the Maynooth line. A loop is included at O'Connell Street and Marlborough Street to enable northbound services to return south.

Luas Cross City is currently under construction and the planned operation is for 10 trams per hour extended from the increased 20 trams per hour Green Line service using lengthened 53m long trains. This will provide a design capacity of approximately 3,000 in the peak hour. As demand increases, frequency of service can be increased to 20 trams per hour, with a maximum design capacity of approximately 6,000.

The Do Minimum Scenario is illustrated in Figure 2-5.

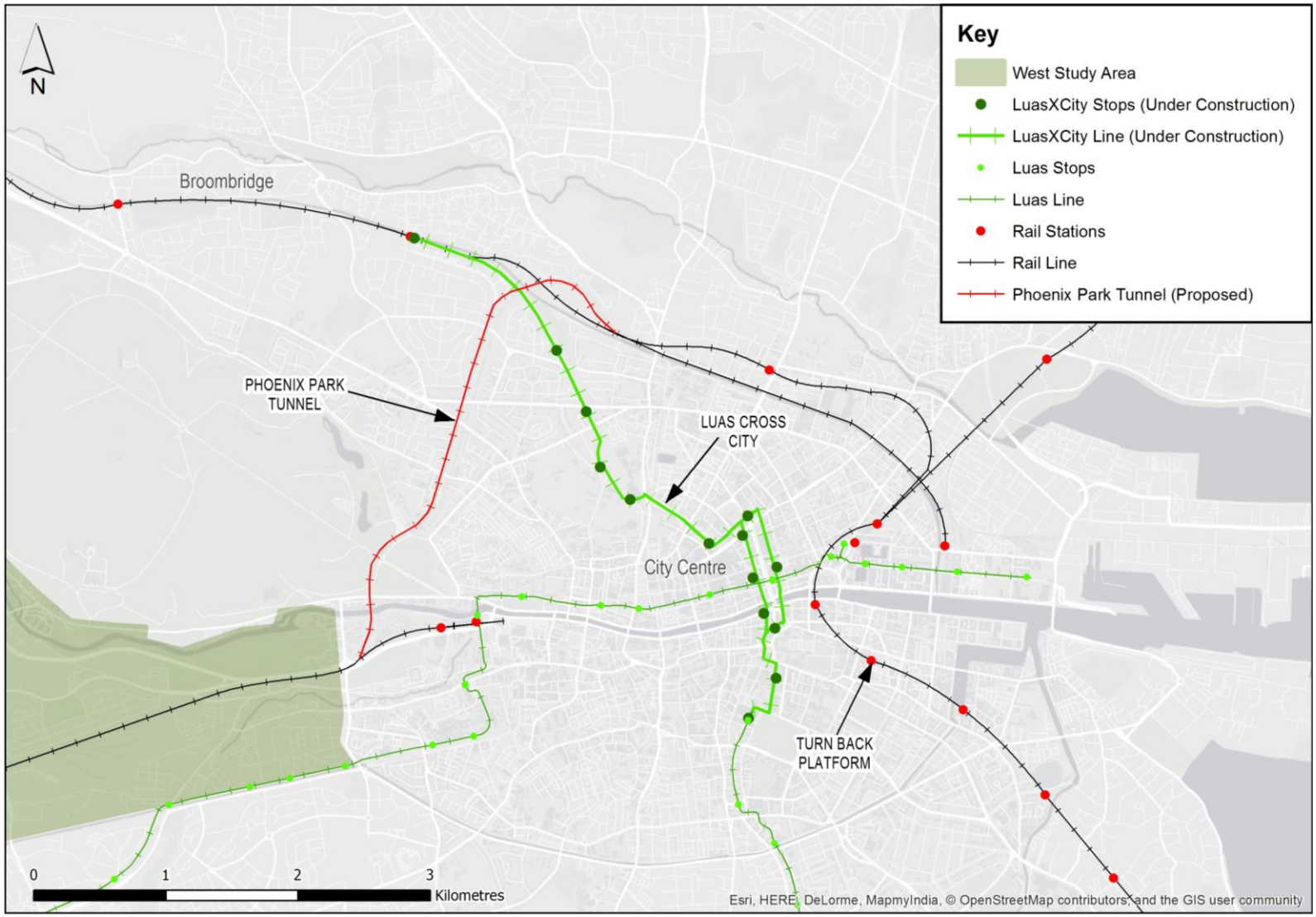


Figure 2-5: Do Minimum Proposed Public Transport

This Do Minimum scenario, above, is used as a basis for the development of the public transport options to serve the growth in demand to 2035 originating within the West Corridor. The preferred public transport options are then further assessed within the GDARM with other additional schemes assumed (described below) as part of the wider GDA Strategy to test and fine tune the West Corridor public transport recommendations.

2.3.4 Additional Schemes

The Do Minimum represents the future network supply based on current commitments. However, for the purpose of this study the additional schemes of the DART Underground, Metro North and the M50 multi-point tolling are also considered to be part of the future network for the Greater Dublin Area. Although these schemes are not fully committed, they have been considered as these could influence the choice of schemes that could evolve from the study. All of these schemes will increase the attractiveness of public transport within the GDA and are, therefore, tested with the preferred public transport option for the West Corridor through the GDARM (please refer to Chapter 6: Transport Modelling Assessment).

The specifics of these additional schemes are still yet to be finalised but for the purposes of this study it is assumed that Metro North would connect the City Centre to the Airport and Swords and would connect with the Luas Green Line. DART Underground is assumed to be a tunnel linking Heuston Station to St. Stephen's Green and Pearse Stations. The M50 multi-point tolling scheme is assumed to be as per the proposals contained with the M50 Demand Management Report, published by the NRA (now Transport Infrastructure Ireland, TII) in April 2014.

In the scenario without DART Underground and without Metro North we would consider the electrification of the Maynooth Line followed by the electrification of the Kildare line out to Hazelhatch and through the Phoenix Park tunnel to Connolly and also Docklands on the remodelled Church Junction and Spencer Dock. The benefits of electrification in terms of operating efficiency are well known and by using DART rolling stock the crush capacities are more than doubled. The connectivity across the city is much improved and the timetable could be recast to remove to equalise current Commuter and DART services.

The upgrade of the Green Line would proceed as in the Do Minimum and the increased services on the South East DART line would be as before to make full use of the increased City Centre capacity of 20tph. The use of EMU DART trains on the newly electrified lines would enable much improved connectivity between south east and north-west corridors and also between the south west and north east corridors.

The introduction of the DART Underground is a step change in capacity for the heavy rail network in Greater Dublin. Increased electrified services are made possible in a more efficient manner across the city with more connectivity and a much increased capacity. With a reasonable 12tph through the tunnel in each direction a design capacity of 14,400 is available on 8 car DART trains.

With the introduction of Metro North it should be possible to operate northwards of Sandyford with 30tph, reducing to 20tph in tunnel just south of St Stephens Green, leaving 10tph for the Luas Cross City route. The metro trains would be designed for in-tunnel operation.

3 Demand Analysis

3.1 Establishing Demand

3.1.1 Establishing Base Year and 2035 Forecast Year Demands

The demand data utilised for this study considers assessment of a typical AM (08:00 – 09:00) peak hour. Demands for a 3 hour AM period and an average midday Inter Peak hour were also derived, however these were not utilised as part of the assessment. The assessment considers the 2011 base year and a 2035 forecast year.

The trip end data for the GDA was derived from planning data for both the Base Year and 2035 forecast scenarios. The base year data is based on Small Area Population Statistics available from the Central Statistics Office as well as a combination of NACE building data, and POWSCAR variables and has been used in the calibration of the base year trip end model and demand model. The forecast data has been prepared by the NTA based on their most up to date forecasted land use assumptions which cover the entire country, although particular focus is given to the GDA region.

Having derived trip ends the GDA demand model applies destination choice algorithms to derive travel matrices which have been calibrated in the base year to replicate observed mode shares and trip length distributions. For this analysis, only trips with a distance of longer than 3km were considered as it is assumed that trips with a distance of less than 3km will be provided for through walking and cycling and local public transport. As such these trips were not considered in the assessment of the strategic public transport requirements for the study area.

3.1.2 Establishing Radial Movements

The focus of the demand analysis was to identify radial trips headed eastbound in the AM peak hour towards the City Centre. This accounts for the following movements:

- Trips generated internally destined for the City Centre;
- Trips generated internally and destined internally;
- Trips generated internally and destined beyond the City Centre. It is assumed that these public transport trips will pass through the city centre due to the current public transport service provision; and
- Trips originating west of the corridor travelling to and through the Study Area.

Identifying demand for these movements provides a suitable estimate of demand within and through the Study Area. However to establish the critical levels of demand at key points in the Study Area, a screenline analysis was conducted, which provides an estimate of demand across screenlines at key settlements. The results of this process will be discussed in section 3.2.

3.1.3 Target Demand Level

As part of the demand analysis, a target demand level has been identified, which represents the catering for 100 per cent of growth between year 2011 and 2035. It is therefore assumed that there will be no growth in car use to the City Centre. The current public transport provision may cater for an element of growth, however for the purpose of this review it is assumed that current public transport services are effectively at capacity. To determine the growth in public transport demand and capacity within the corridor in 2011 and 2035, an assessment was undertaken of the total demand to the City Centre and other destinations. As the operational and catchment area of the public transport services is much greater than the Study Area (for example, the catchment from the Luas Red line, regional and express bus services and the Maynooth and Kildare rail lines)

the catchment area of the study was extended to take into consideration the wider catchment and future growth in demand for the public transport services travelling through the Study Area.

In 2011 50 per cent of trips to the City Centre travelled by public transport and the present road network in the city centre is close to capacity. In future, new trips and all forecast growth in demand to the city centre is assumed to travel by public transport. For movements passing through the corridor to other destinations, a choice of mode will continue to exist. The mode choice for trips between origins and destinations outside the city centre are assumed to be unchanged between 2011 and 2035 as shown in Table 3-1 below.

Table 3-1: Mode Choice by origin and destination

Origin-Destination PT-Car Modal Split Assumptions	2035
City Centre	100% of new trips
Study Area	100% of new trips
Orbital	30% of new trips
Rest of Ireland	20% of new trips

The target public transport demand identified represents the existing public transport demand plus the growth in demand between year 2011 and 2035 (it is assumed that all new trips to the City Centre will be by public transport due to the road network capacity constraints). Although the current public transport provision may cater for an element of growth, for the purpose of this review it is assumed that current public transport services are effectively at capacity.

3.2 Demand Assessment

In order to determine the level of demand to be accommodated by the potential public transport options, five screenlines were applied to the Study Area. The screenlines were developed to address the radial demand moving eastbound towards the City Centre and through the City Centre to the wider GDA. This analysis supplements the settlement demand analysis and is useful because it includes movements from trips generated externally that pass through the Study Area. These trips may have destinations within the Study Area, within the City Centre, or to external sectors. The screenline demand takes into account all trips moving eastbound across the screenline during the AM peak hour.

3.2.1 Screenline Demand

The figures below illustrate the level of demand crossing the five screenlines for the 2011 base year, 2035 forecast year, and the demand growth from 2011 to 2035.

The base year demand within Figure 3-1 indicates that at the western end of the corridor, there are approximately 24,400 trips entering the corridor within a single hour of the AM peak period. This level continues to rise through the corridor to a level of 47,400 trips at the screenline on the boundary with the City Centre.

As per the study assumptions, these figures include only journeys that are greater than 3km in length, and include journey through the corridor, internal to the Study Area and also those that originate or terminate within the area.

Figures 3-2 and 3-3 show that the potential growth in travel is significant within the corridor. Growth across the eastbound screenlines is between 12 to 21 percent through to year 2035. The largest percentage growth is forecast to be at the eastern screenline, the screenline closest to the City Centre. Overall, the forecast change in total demand equates to an additional 2,850 to 9,850 journeys per single hour during the peak. The level of growth leaving the Study Area eastbound across the City Centre screenline is the highest level of growth at 9,850 trips.

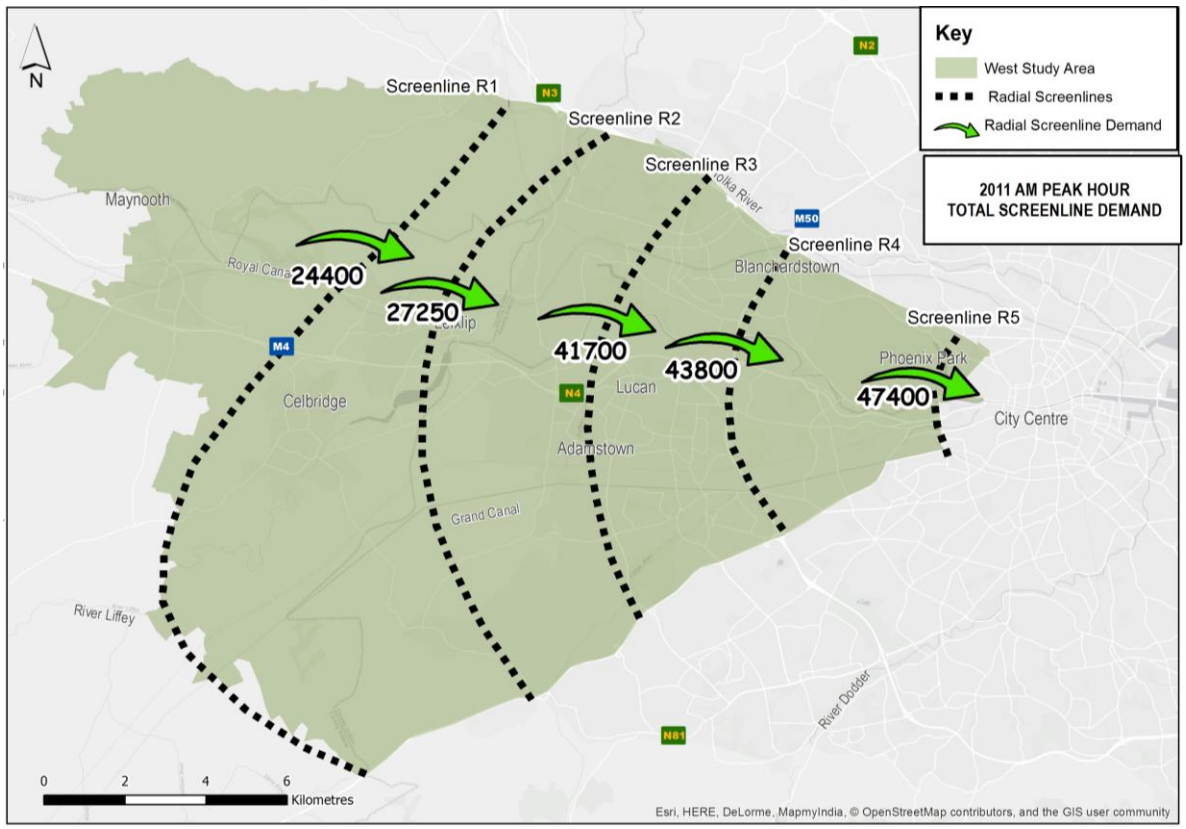


Figure 3-1: 2011 AM Peak Hour Screenline Demand

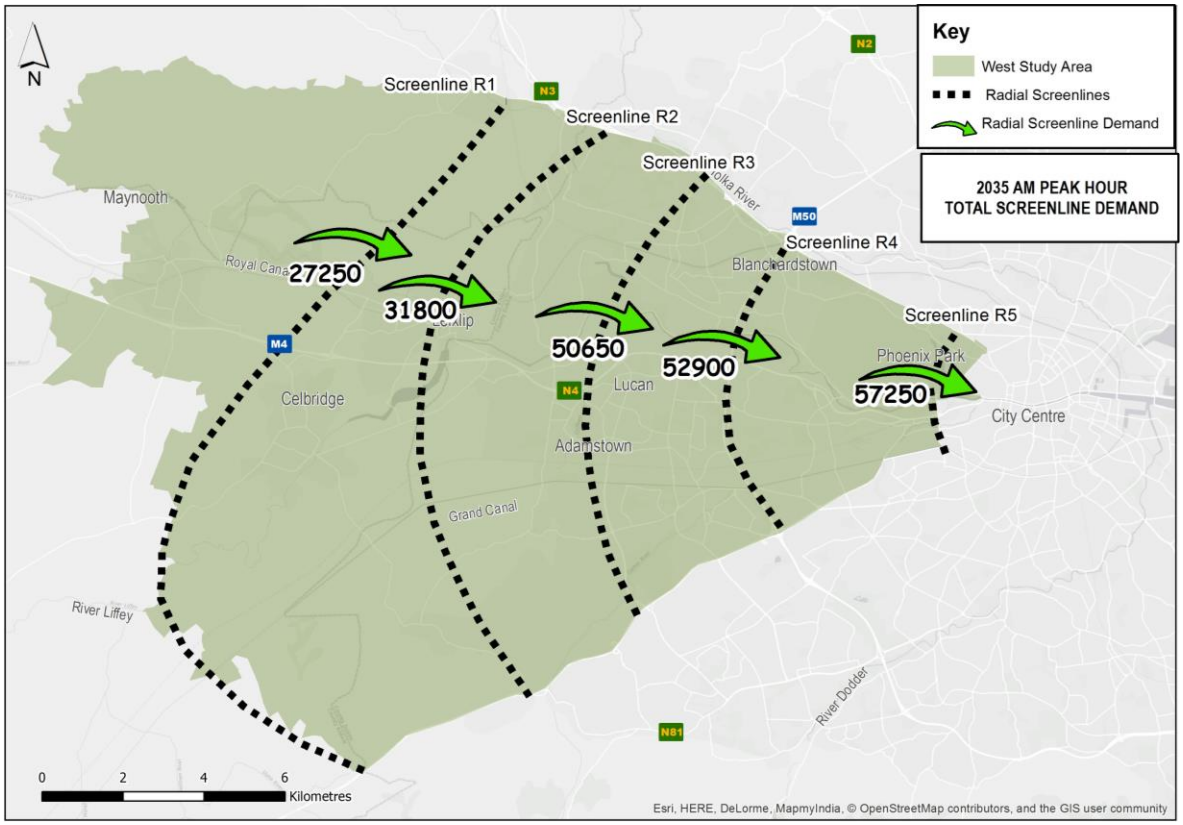


Figure 3-2: 2035 West Study Area Screenline Demand

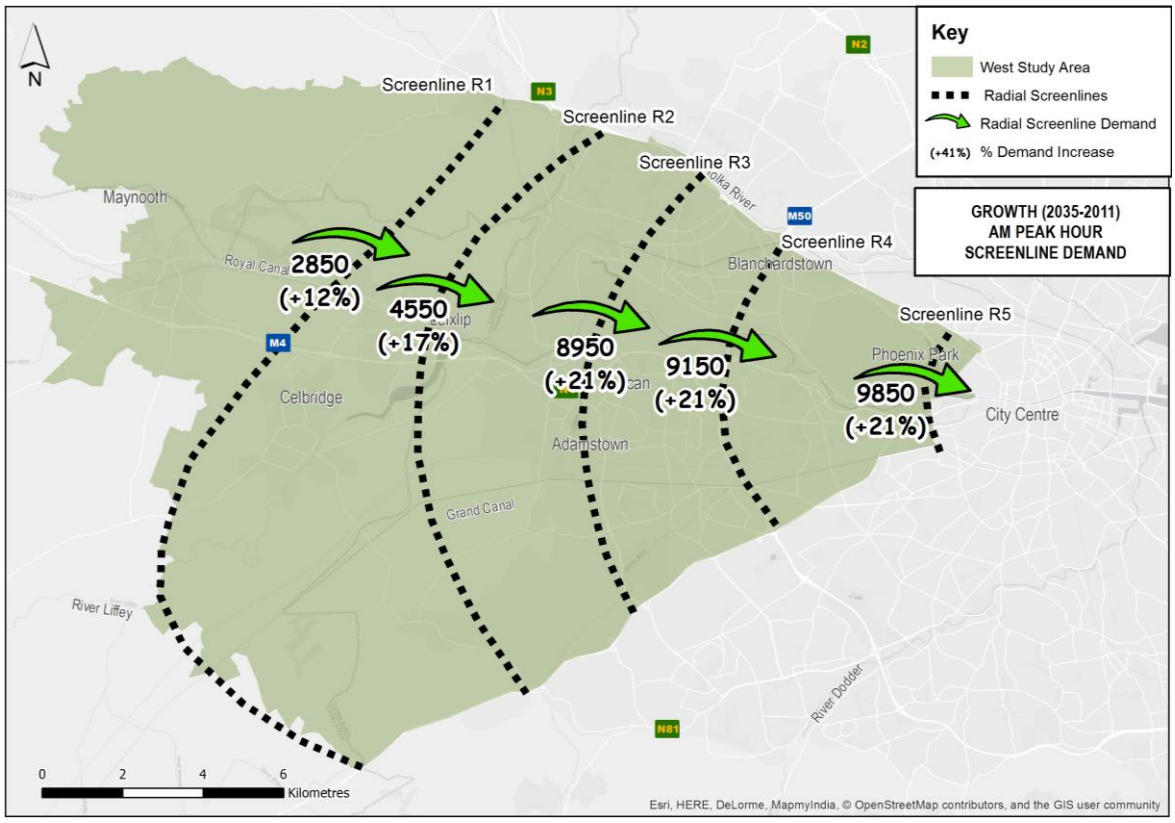


Figure 3-3: Growth in West Screenline Demand

Figure 3-4 further details the trip destinations for each screenline. Destinations are sectored by trips to the City Centre, Study Area and through trips passing through the Study Area destined to the wider GDA. Predictably, demand for the City Centre increases as you move east through the Study Area.

There is relatively small growth in demand from the area outside the study area to the west, towards the City Centre and more than half the growth in travel demand entering the Study Area, from the west, have destinations within the Study Area or City Centre. Growth in travel demand continues to increase with proximity to reach a peak growth of 9,850 occurring at screenline R5, the closest screenline to the City Centre. As can be seen in Figure 3.4 below, 4,625 trips (~47% of demand) at screenline R5 is destined to the City Centre, the remaining 5,319 trips (~53% of demand) is destined to other areas ("through trips").

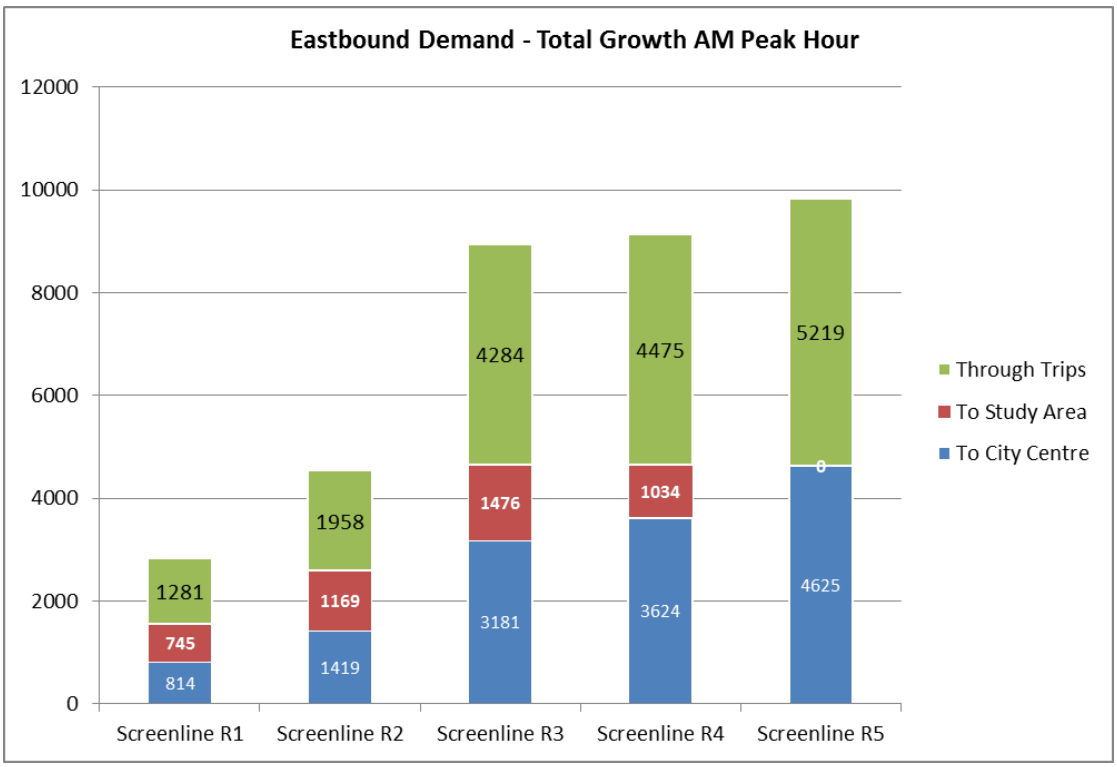


Figure 3-4: Screenline Demand Growth by Destination

Figure 3-5 illustrates the target demand level that was used for the development of public transport options. This target was developed to identify the level of demand that will need to be catered for by new or upgraded public transport services in the forecast year 2035. The target is derived by applying mode share assumptions to the demand growth as described in Section 3.1.3.

The target demand entering the Study Area at screenline R1 is 1,800 trips. This demand continues to increase through to screenline R5 where it reaches 5,700 trips. The target demand at each screenline represents an upper bound of demand growth that could be attracted to public transport.

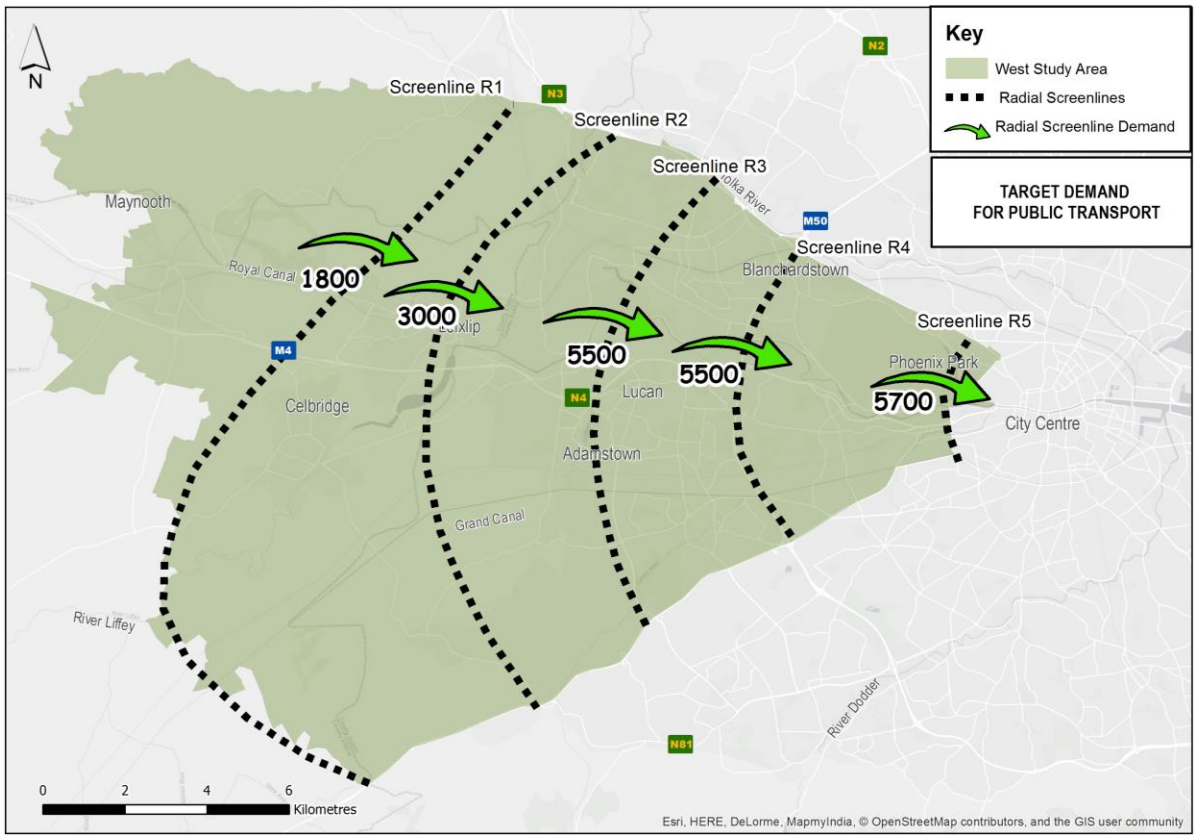


Figure 3-5: Target Demand for Public Transport

4 Public Transport Option Development

4.1 Introduction

This section outlines the development of various public transport options at a high level in order to meet the target demand crossing the screenlines. From Chapter 3, the level of demand to be accommodated by public transport is 5,700 trips entering the City Centre. For the purposes of the assessment it is assumed that during the AM Peak hour the current public transport services are generally close to or at capacity and therefore can accommodate little or no increase in demand. It is therefore assumed for the purpose of this study, that the additional demand to be served by Public transport for the West area is approximately 5,700.

It is necessary, therefore, to generate likely public transport options that can provide a level of service to accommodate this target demand level. The options, in the first instance, were generated by focussing solely on the proposed public transport services/modes ability to accommodate the screenline demand. This method was adopted so that the option generation process was not restricted by current network constraints that could be removed in the future.

As mentioned previously in Chapter 2, the Do Minimum Network is used as a basis for the development of the public transport options to serve the West Corridor. The recommended public transport option is then assessed further within the GDARM with other additional schemes such as DART Underground and Metro North which will have a positive impact on the demand for public transport within the West Corridor.

4.2 Design Capacity of Public Transport Modes

The following lists the potential Public Transport modes that were considered to meet the target demand within the corridor:

- Heavy Rail (DART and Commuter);
- Light Rail (Luas and Metro);
- Bus Rapid Transit (BRT);
- Urban Bus Services (including feeder and express bus services);
- Intercity Bus Service; and
- Shuttle Bus

Each mode has a pre-defined seated capacity and crush capacity, which is the maximum capacity that can be achieved with people standing. In order to ensure that a quality level of service is provided by the proposed options, design capacities for each of the above service type were developed. Design capacity is assumed to be 85 per cent of crush capacity or 100 per cent of seated capacity, whichever figure is greater. This ensures that at no time will the entirety of the target demand be accommodated by a service that is underutilised or is so busy as to make the service less desirable.

Table 4-1 details the Design Capacity for each of the services and outlines the peak hour design capacity for each service based on the frequency of the service. The highlighted capacities show the frequency at which the service type meets the targeted demand entering the City Centre from the Study Area.

Table 4-1: Design Capacity and Peak Hour Service Frequency

Frequency	Design Capacity (per service vehicle/train)						
	DART	Commuter	Light Rail	Bus Rapid Transit	Dublin Bus	Intercity Bus	Shuttle Bus
60 min	1,190	410	260	100	70	50	30
40 min	1,780	610	390	150	110	70	40
30 min	2,380	820	520	200	150	100	60
20 min	3,570	1,230	780	310	220	150	90
15 min	4,760	1,630	1,040	410	300	200	120
12 min	5,950	2,040	1,300	510	370	250	150
10 min	7,140	2,450	1,560	610	450	300	180
8 min	8,920	3,070	1,940	760	560	370	225
6 min	11,900	4,090	2,590	1,020	740	500	300
5 min	14,280	4,910	3,110	1,220	900	600	360
4 min	17,850	6,130	3,890	1,530	1,120	750	450
3 min	23,800	8,180	5,180	2,040	1,500	1,000	600
2 min	35,700	12,270	7,780	3,060	2,240	1,500	900

Note: The highlighted text above indicates where the target demand of 5,700 trips could be provided by a single public transport mode operating at the specified service frequency

4.3 High Level Public Transport Options

This section outlines those different public transport options developed at a high-level to cater for screenline target demand based on the service frequencies and capacities in Table 4-1.

The high-level options developed do not consider network constraints, existing public transport services. The sole focus at this high-level options development stage is to outline public transport services than can accommodate the maximum screenline demand within the West Study Area.

Based on a comparison of the various capacity levels and the target demand of around 5,700 trips the highlighted areas within Table 4-1 shows the frequencies for each individual mode that would be necessary to meet this demand. For example DART service frequency of 1 every 12 minutes would provide 5,950 capacity which would provide for the demand of 5,700 trips, or an LRT frequency of 2 to 3 minutes. For Bus as an option, multiple services would be required to meet the demand.

The following lists the 5 public transport options considered (see Annex A, Figures A-7 to A-8), and includes a package of measures in addition to single mode options.

The forecast increase in peak hour demand to Dublin is 5,700 trips and the five proposed options that were considered are now presented below.

- ***Option 1: Luas, Enhanced Rail, QBC and Express Bus Services***
  - New Luas line between Newcastle Road and City Centre, interchanging with existing Red Line at Blackhorse to provide capacity for 4,500;
  - Phased increase in capacity through either second line starting from Blackhorse to the City Centre or full segregation of Luas Red Line;

- Two new Quality Bus Corridor routes between Newcastle Road and City Centre to improve penetration of the northern and southern edges of the corridor and provide capacity of 1,200;
- One additional Commuter service along Kildare line will provide capacity of 400 peak hour trips;
- Express bus services to provide capacity of 300 peak hour trips for development west of Celbridge to City Centre; and
- Feeder bus services at lateral intervals of 800 metres will provide capacity of 2,500 peak hour trips connecting with radial services.

- ***Option 2: New Rail Line***
  - New rail line along alignment between Newcastle Road, Lucan and City Centre midway between the Maynooth and Kildare lines will provide capacity of 6,200 peak hour trips; and
  - Feeder bus services with stops every 800 metres will provide connecting capacity of 5,500 peak hour trips.
- ***Option 3: Enhanced Rail, Bus Rapid Transit and Enhanced Bus Services***
  - Kildare Line enhancement at 12 min frequency will provide capacity of 2,000 peak hour trips (additional services along the Maynooth line were considered but excluded due to the high cost to increase line capacity);
  - Express bus services to provide capacity of 300 peak hour trips for development west of Celbridge to City Centre;
  - Feeder bus services at lateral intervals of 800 metres will provide capacity of 2500 peak hour trips connecting with radial services; and
  - BRT corridor between Newcastle Road and City Centre will provide capacity of 3000 peak hour trips.
- ***Option 4:*** **Luas and Enhanced Rail**
  - New Luas line between Newcastle Road and City Centre, interchanging with existing Red Line at Blackhorse to provide capacity for 4,500;
  - Phased increase in capacity through either second line starting from Blackhorse to the City Centre or full segregation of LUAS Red Line; and
  - Kildare Line enhancement at 12 min frequency will provide capacity of 2,000 peak hour trips.
- ***Option 5:*** **Enhanced Bus**
  - Same as for option 1 for QBC and Express Bus Services will provide capacity of 1,500 peak hour trips;
  - Enhanced existing bus services will provide capacity of 5,000 peak hour trips; and
  - Feeder bus services at lateral intervals of 800 metres will provide capacity of 2,500 peak hour trips connecting with radial services.

Table 4-2 illustrates the high-level coverage of the proposed service for each option, and identifies the service frequency required to meet the screenline demand.

Table 4-2: Public Transport Options to Meet Target Demand

West Study Area

Target: 5,700 trips in AM Peak Hour

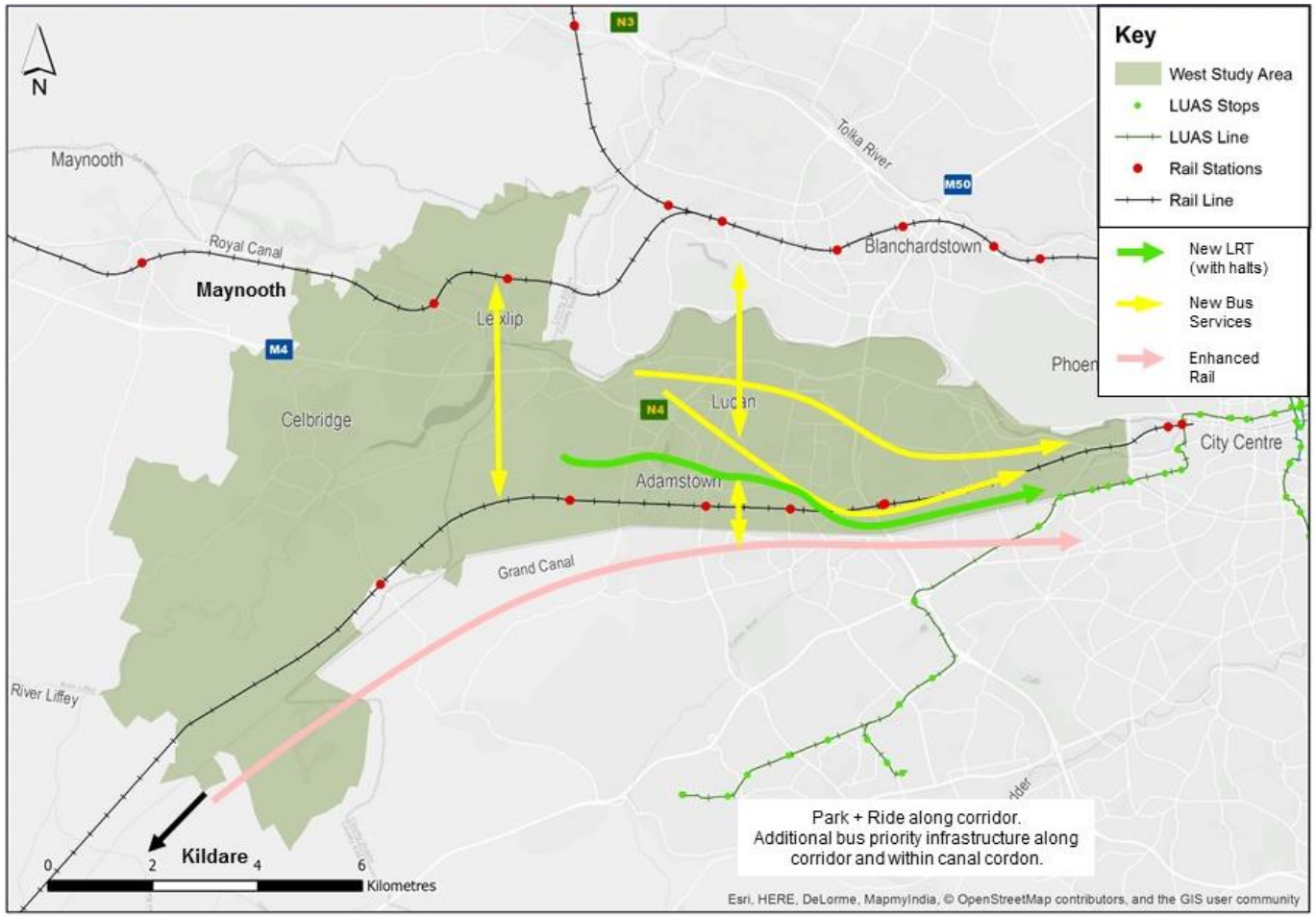
			Option 1	Option 2	Option 3	Option 4	Option 5
Public Transport Option	Approx Capacity	Services to Meet Capacity	Enhanced Rail, Luas + Supporting QBCs	Heavy Rail	Enhanced Rail + BRT + Bus	Enhanced Rail + Luas	Bus only
New Rail Line	10,000	1 Rail Line		X			
Rail Enhancement	400 - 2,000	1 - 2 Rail Enhancements	X		X	X	
LRT	3,750 - 4,500	1 - 2 LRT Lines	X			X	
LRT Enhancement							
BRT	3,000	BRT Routes			X		
QBC	1,200 - 1,500	1 - 2 QBC Routes	X		X		X
Express Bus Service	300	1 - 2 Routes	X		X		X
Metro	7,800	1 Metro Line					
Feeder Bus Services	2,500	local bus services	X	X	X	X	
Bus Services	500	Up to 15 Bus Routes					X
Total New Capacity			6,400	10k+	6,500	6,500	6,500

4.4 Capacity Assessment and Sifting of Proposed Public Transport Options

Table 4-2 details the capacity assessment undertaken for 100 per cent of demand growth for the Study Area (2035 demand minus 2011 demand for the AM peak hour).

For this exercise a number of assumptions were made in recognition of the high level nature of this study. Firstly, demand for the base year public transport was assumed to be catered for by existing public transport services. Secondly, it was assumed that there is no excess capacity for existing services during the AM peak hour. The table outlines the following for each of the five options considered:

- Proposed service type and frequency at each screenline; and
- Comparison of proposed service Design Capacity and maximum screenline demand.

Option 1: Luas, Enhanced Rail, QBC and Express Bus Services	Decision: Taken Forward for Detailed Review
Decision Rationale: This option was chosen to be taken forward for further scoring. The growth in demand in the Study Area is distributed throughout the Study Area. This option meets the demand target across all screenlines. The public transport capacity increase is focused around the core high capacity LUAS line running centrally along the Study Area, midway between the Kildare and Maynooth line, combined with additional multimodal public transport capacity enhancement along the corridor. QBC corridors run along the north and south parts of the Study Area linking to radial QBCs. An Express Bus Service and provision of 1 additional train per hour along the Kildare line would provide fast transport for demand from the west. To provide access to the main radial services, there would be feeder bus services. The public transport capacity enhancements could be phased to match the growth in demand.	**Option Schematic:** 

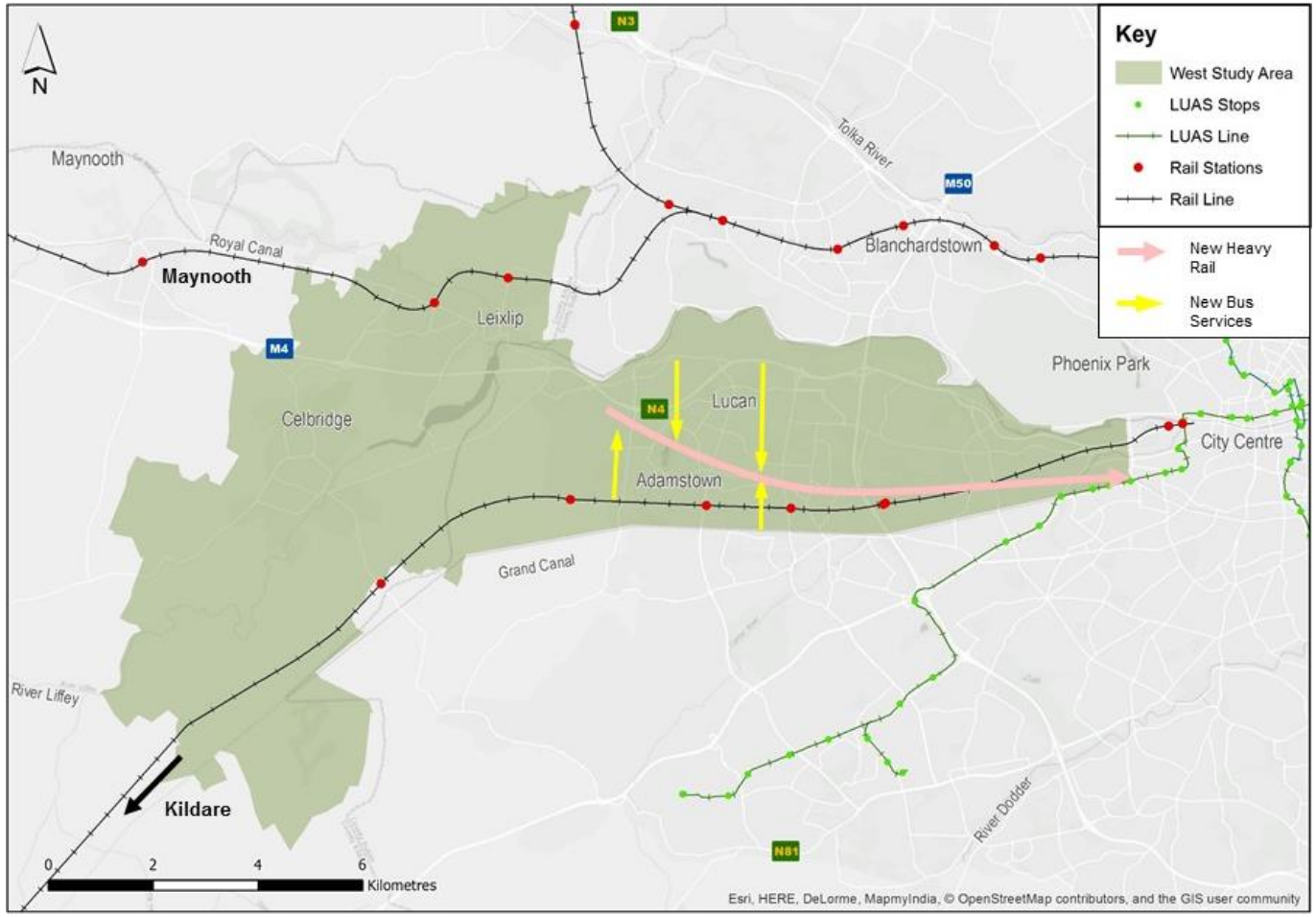
Demand Assessment and Service Frequency:

Design Capacity

Screenline	Maximum Demand Increase	New Rail Line	Rail Enhancement	LRT	Express Bus Service	QBC	Enhanced Bus Service	Bus / Feeder Bus Services	Metro	Existing PT Capacity	Total	Surplus
R1	1815									1815	1815	0
R2	2979									2979	2979	0
R3	5514		400	4400	300	1200					6300	786
R4	5553		400	4400	300	1200					6300	747
R5	5668		400	4400	300	1200					6300	632
Total	21530	0	1200	13200	900	3600	0	0	0		23694	2164

Service Frequency

Screenline		New Rail Line	Rail Enhancement	LRT	Express Bus Service	QBC	Enhanced Bus Service	Bus / Feeder Bus Services	Metro	Existing PT Capacity		
R1										5 - 15 min		
R2										5 - 15 min		
R3			60 min	4 min	12 min	12 min						
R4			60 min	4 min	12 min	12 min						
R5			60 min	4 min	12 min	12 min						

Option 2: New Rail Line	Decision: Not Taken Forward
Decision Rationale: Option 2 proposed a new high capacity rail line to provide a fast high capacity limited stop line through the core of the West Study Area, with local connectivity and access via bus feeder services similar to Option 1 above, connecting areas of growth with the rail line and onwards to Dublin City Centre and beyond. However, there is no clear existing geographical alignment for a new line or onward its onward connection to the west. To provide attractive journey times there would need to be a limited number of stations. Travel for local trips within the Study Area are likely to require two or more interchanges. The bus feeder service would need to be extensive to transport the target demand of 6,200 to a small number of stations	**Option Schematic:** 

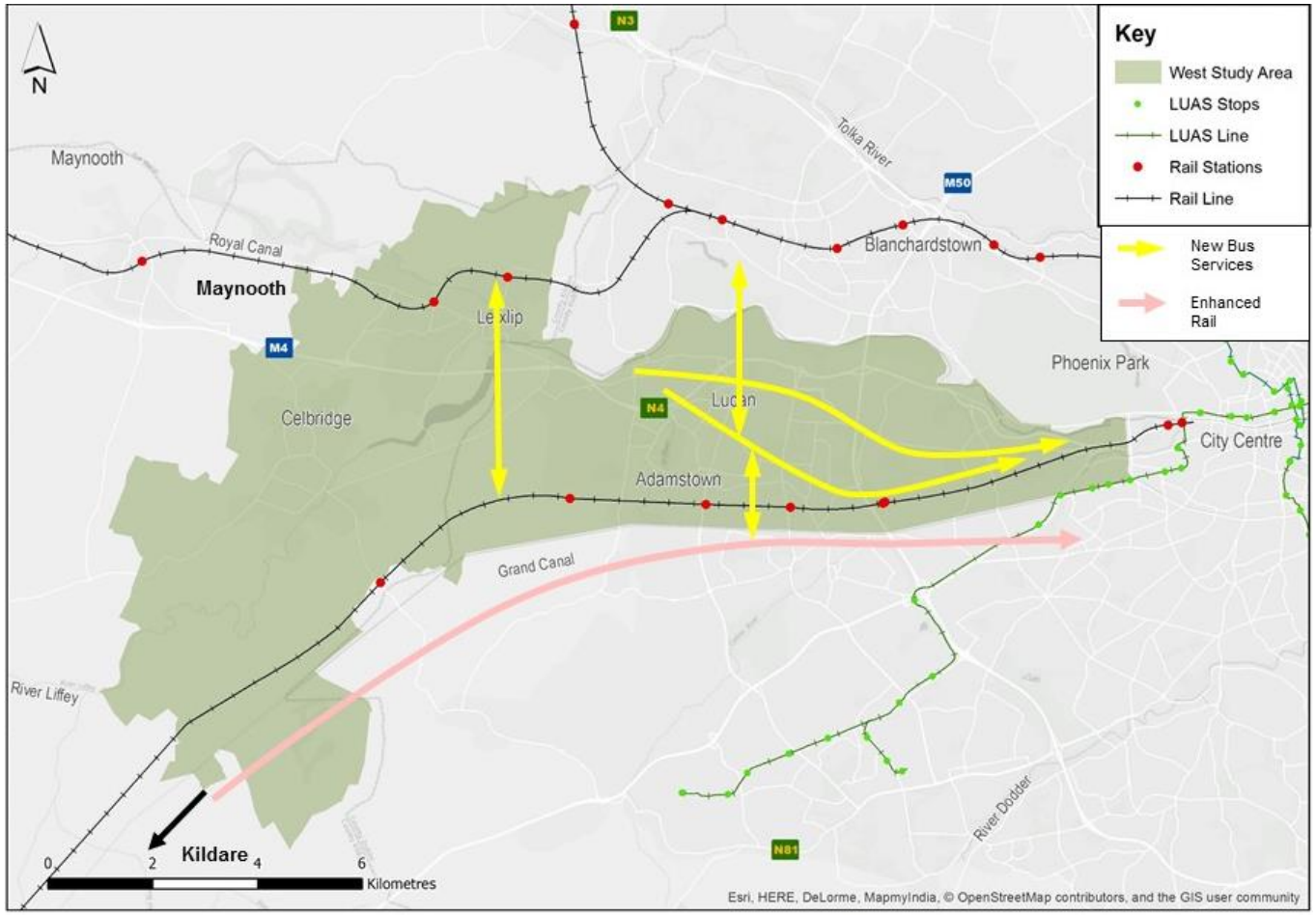
Demand Assessment and Service Frequency:

Design Capacity

Screenline	Maximum Demand Increase	New Rail Line	Rail Enhancement	LRT	Express Bus Service	QBC	Enhanced Bus Service	Bus / Feeder Bus Services	Metro	Existing PT Capacity	Total	Surplus
R1	1815									1815	1815	0
R2	2979									2979	2979	0
R3	5514	10000									10000	4486
R4	5553	10000									10000	4447
R5	5668	10000									10000	4332
Total	21530	30000	0	0	0	0	0	0	0		34794	13264

Service Frequency

Screenline		New Rail Line	Rail Enhancement	LRT	Express Bus Service	QBC	Enhanced Bus Service	Bus / Feeder Bus Services	Metro	Existing PT Capacity		
R1										5 - 15 min		
R2										5 - 15 min		
R3		10 min										
R4		10 min										
R5		10 min										

Option 3: Enhanced Rail, Bus Rapid Transit and Enhanced Bus Services	**Decision: Taken Forward for Detailed Review**
Decision Rationale: Option 3 proposed an enhanced rail service for up to 2,000 trips per hour, providing increased capacity to Dublin City Centre along the Kildare line, with local access provided in a manner similar to Option 1 by a dense connecting feeder bus service network. In addition, as for Option 1, enhanced Quality Bus Corridors improve penetration of the northern and southern edges of the corridor (up to 12 buses per hour) and an Express Bus Services provide for the increased development west of Celbridge (up to 6 buses per hour). Existing bus services would be enhanced to provide capacity of up to 3,000 for the additional demand from the Study Area.	**Option Schematic:** 

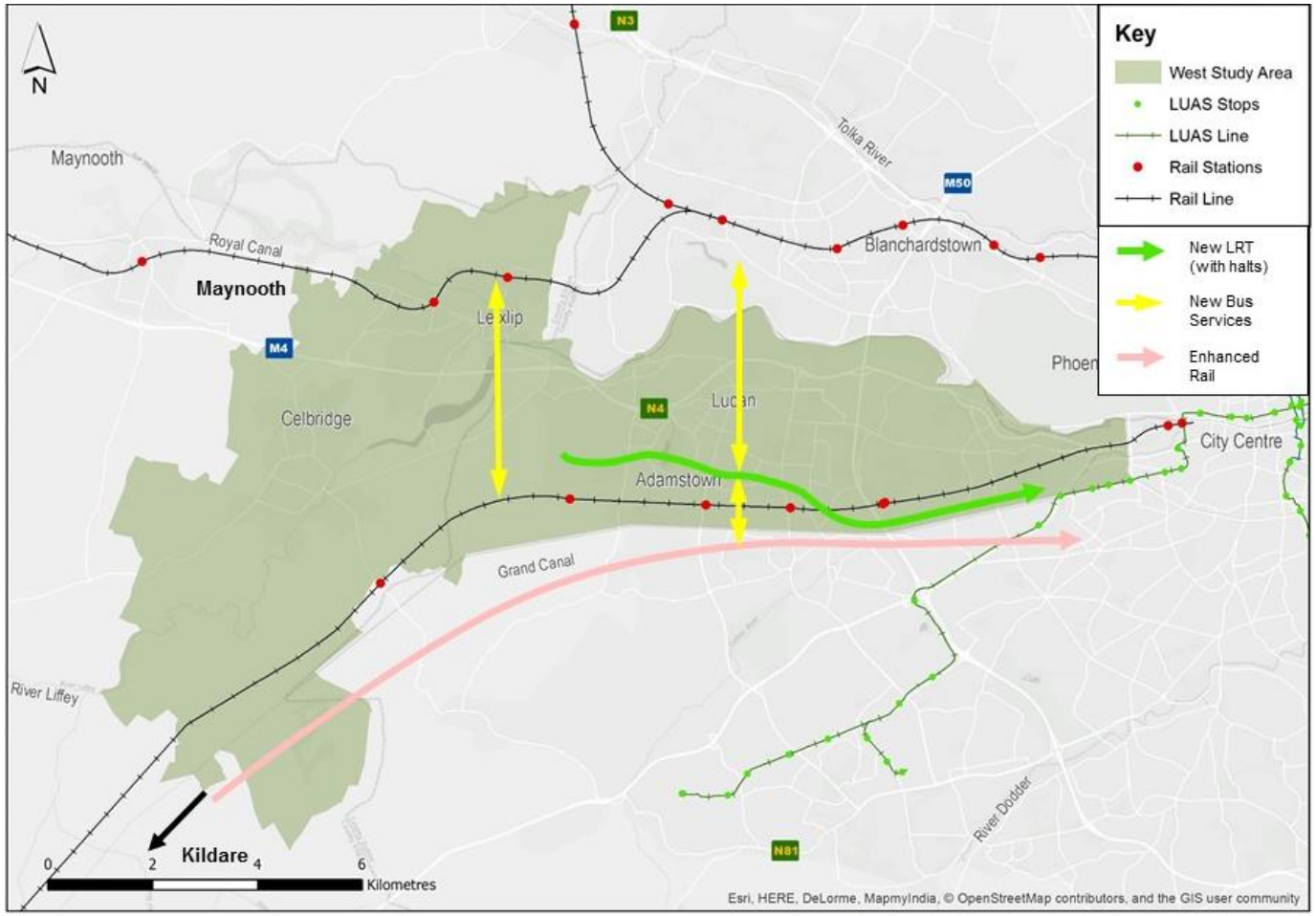
Demand Assessment and Service Frequency:

Design Capacity

Screenline	Maximum Demand Increase	New Rail Line	Rail Enhancement	LRT	Express Bus Service	QBC	Enhanced Bus Service	Bus / Feeder Bus Services	Metro	Existing PT Capacity	Total	Surplus
R1	1815									1815	1815	0
R2	2979									2979	2979	0
R3	5514		2000		300	1200	3000		500		7000	1486
R4	5553		2000		300	1200	3000		500		7000	1447
R5	5668		2000		300	1200	3000		500		7000	1332
Total	21530	0	6000	0	900	3600	9000	0	1500		25794	4264

Service Frequency

Screenlines	Demand Increase	New Rail Line	Rail Enhancement	LRT	Express Bus Service	QBC	Enhanced Bus Service	Bus / Feeder Bus Services	Metro	Existing PT Capacity	Total	Surplus
R1										5 - 15 min		
R2										5 - 15 min		
R3			12 min		12 min	12 min	5 - 15 min					
R4			12 min		12 min	12 min	5 - 15 min					
R5			12 min		12 min	12 min	5 - 15 min					

Option 4: Luas and Enhanced Rail	Decision: Taken Forward for Detailed Review
Decision Rationale: Option 4 proposed to provide a new LUAS line with up to 15 trams per hour, interchanging with the existing Red Line between Blackhorse and Fatima. A second line from Blackhorse to the City Centre would provide a further increase in capacity, via Inchicore, for example. The existing line capacity along the Kildare line will be enhanced by the provision of 5 trains per hour with 4 tph using the Phoenix Park Tunnel to access Connolly Station and GCD. Growth in other movements in the western part of the Study Area will continue to use existing public transport services, with enhanced bus services and feeder bus links to the Kildare line, as described for option 1. Connections between the areas of growth and the high capacity radial PT services will be provided by feeder bus services.	**Option Schematic:** 

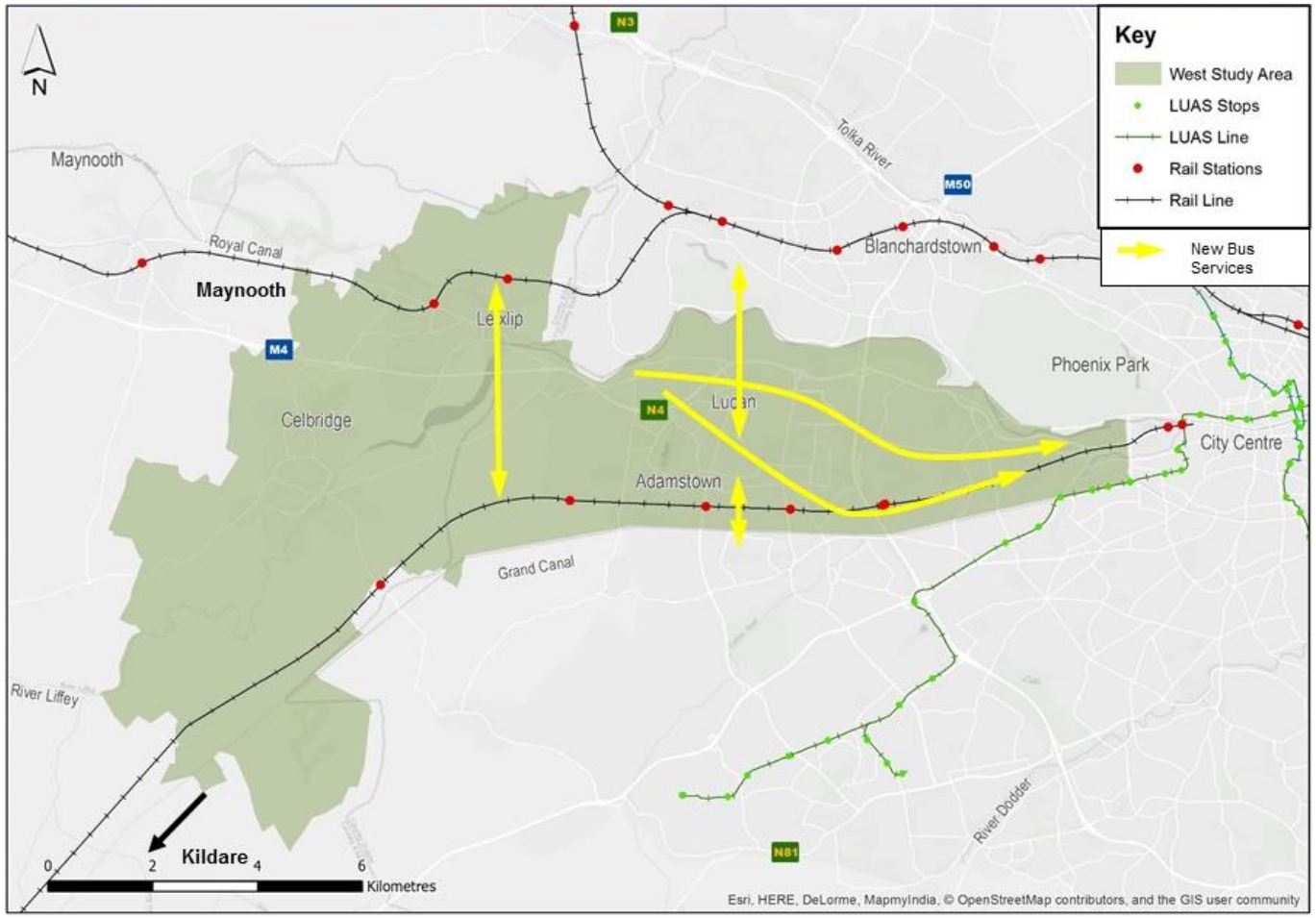
Demand Assessment and Service Frequency:

Design Capacity

Screenline	Maximum Demand Increase	New Rail Line	Rail Enhancement	LRT	Express Bus Service	QBC	Enhanced Bus Service	Bus / Feeder Bus Services	Metro	Existing PT Capacity	Total	Surplus
R1	1815									1815	1815	0
R2	2979									2979	2979	0
R3	5514		2000	4400							6400	886
R4	5553		2000	4400							6400	847
R5	5668		2000	4400							6400	732
Total	21530	0	6000	13200	0	0	0	0	0		23994	2464

Service Frequency

Screenlines	Demand Increase	New Rail Line	Rail Enhancement	LRT	Express Bus Service	QBC	Enhanced Bus Service	Bus / Feeder Bus Services	Metro	Existing PT Capacity	Total	Surplus
R1										5 - 15 min		
R2										5 - 15 min		
R3			60 mn	4 min				500				
R4			60 min	4 min				500				
R5			60 min	4 min				500				

Option 5: Enhanced Bus	Decision: Not Taken Forward
Decision Rationale: Option 5 proposed Quality Bus Corridors to improve penetration of the northern and southern edges of the corridor (up to 12 buses per hour) and an Express Bus Service cater for the increased development west of Celbridge (up to 6 buses per hour). Existing bus service frequencies to the City Centre would be substantially increased to provide capacity to meet the target demand and this would require extensive traffic management and prioritisation, which could give rise to high levels of delays to other traffic and reduction in air quality. As for Option 1, feeder bus services will provide access to the Kildare rail links via station interchanges and the QBC bus services. Providing bus services at the frequencies required to meet the demand will not be possible on a roadway network that is already significantly constrained	**Option Schematic:** 

Demand Assessment and Service Frequency:

Design Capacity

Screenline	Maximum Demand Increase	New Rail Line	Rail Enhancement	LRT	Express Bus Service	QBC	Enhanced Bus Service	Bus / Feeder Bus Services	Metro	Existing PT Capacity	Total	Surplus
R1	1815									1815	1815	0
R2	2979									2979	2979	0
R3	5514				300	1200	4700				6200	686
R4	5553				300	1200	4700				6200	647
R5	5668				300	1200	4700				6200	532
Total	21530	0	0	0	900	3600	14100	0	0		23394	1864

Service Frequency

Screenlines	Demand Increase	New Rail Line	Rail Enhancement	LRT	Express Bus Service	QBC	Enhanced Bus Service	Bus / Feeder Bus Services	Metro	Existing PT Capacity	Total	Surplus
R1										5 - 15 mins		
R2										5 - 15 mins		
R3					12 min	12 min	5 - 15 mins					
R4					12 min	12 min	5 - 15 mins					
R5					12 min	12 min	5 - 15 mins					

5 Public Transport Option Scoring

5.1 Detailed Scheme Appraisal Methodology

The comparison is based on the ranking of the options against three criteria as follows:

- Demand Accommodated within Catchment;
- Journey Time; and
- Cost.

The higher the ranking score, the better the option achieved the criteria. The overall ranked scores for each criterion are then summed for each option. The highest scoring option is considered as the preferred option.

This section outlines the comparison of the three options identified in the Option Development stage as follows:

- Option 1: Luas, Enhanced Rail, QBC and Express Bus Services;
- Option 3: Enhanced Rail, Bus Rapid Transit and Enhanced Bus Services; and
- Option 4: Enhanced Rail and LUAS.

5.2 Appraisal of Proposed Public Transport Options

As part of the Option Scoring assessment a more detailed approach to the public transport options was taken. The routing of the proposed public transport services was undertaken in greater detail, taking into account: proposed demand growth locations; network constraints; and interchange with existing public transport. Figures 5-1 to 5-3 illustrate the identified routes of the Proposed Public Transport Options.

5.2.1 Option 1: Luas, Enhanced Rail, QBC and Express Bus Services

Option 1 proposes the following:

- Investment in new Luas Lucan Line enhancements that will lead to 15 train services in the AM Peak hour and capacity of up to 4,500 trips. The rolling stock would be 53 metres long trams and provide a direct interchange with the Red line at Blackhorse and joint running. Full segregated running or a second line from Blackhorse into the City Centre via Inchicore could be constructed to increase the line capacity as demand requires it;
- Two new Quality Bus Corridor routes (up to 12 buses per hour) to improve penetration of the northern and southern edges of the corridor will provide capacity of 1,200 peak hour trips;
- Express bus services (up to 6 buses per hour) will provide capacity of 300 peak hour trips for development west of Ballyoulster;
- One additional Commuter service along Kildare line will provide capacity if 400 peak hour trips;
- Increased connectivity to the Kildare and Maynooth rail services provided through the provision of cycle facilities; and
- Feeder bus services at lateral intervals of 800 metres will provide capacity of 2,500 peak hour trips connecting with radial services.

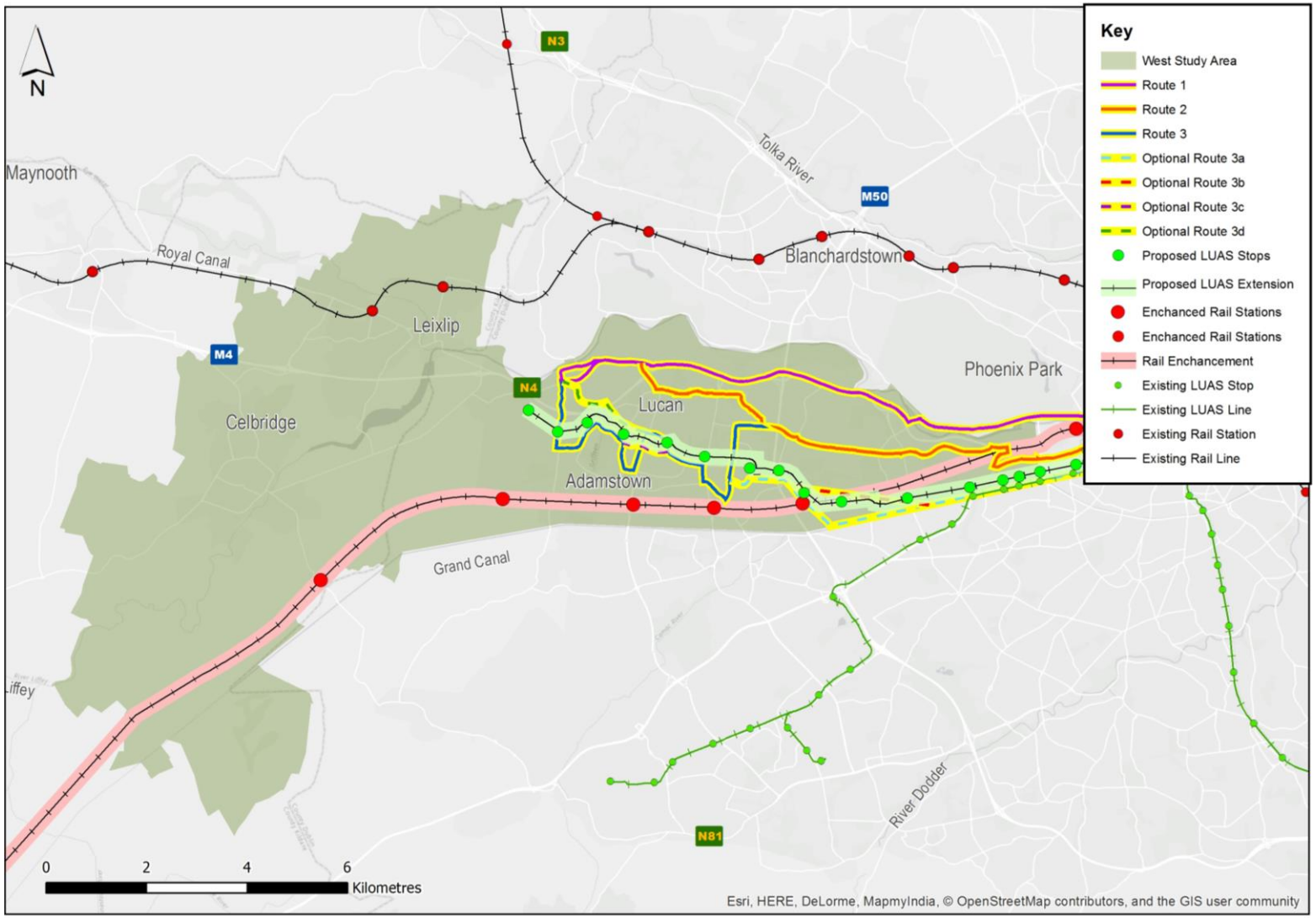


Figure 5-1: Option 1

5.2.2 Option 3: Enhanced Rail, Bus Rapid Transit and Enhanced Bus Services

Option 3 proposes the following:

- Investment will enhance Kildare Line service to 12 min frequency and provide capacity of 2,000 peak hour trips;
- Two new Quality Bus Corridor routes (up to 12 buses per hour) to improve penetration of the northern and southern edges of the corridor will provide capacity of 1,200 peak hour trips;
- Express bus services (up to 6 buses per hour) will provide capacity of 300 peak hour trips for developments west of Ballyoulster;
- Feeder bus services at lateral intervals of 800 metres will provide capacity of 2,500 peak hour trips connecting with radial services; and
- Existing bus service enhancements will provide capacity of 3,000 peak hour trips.

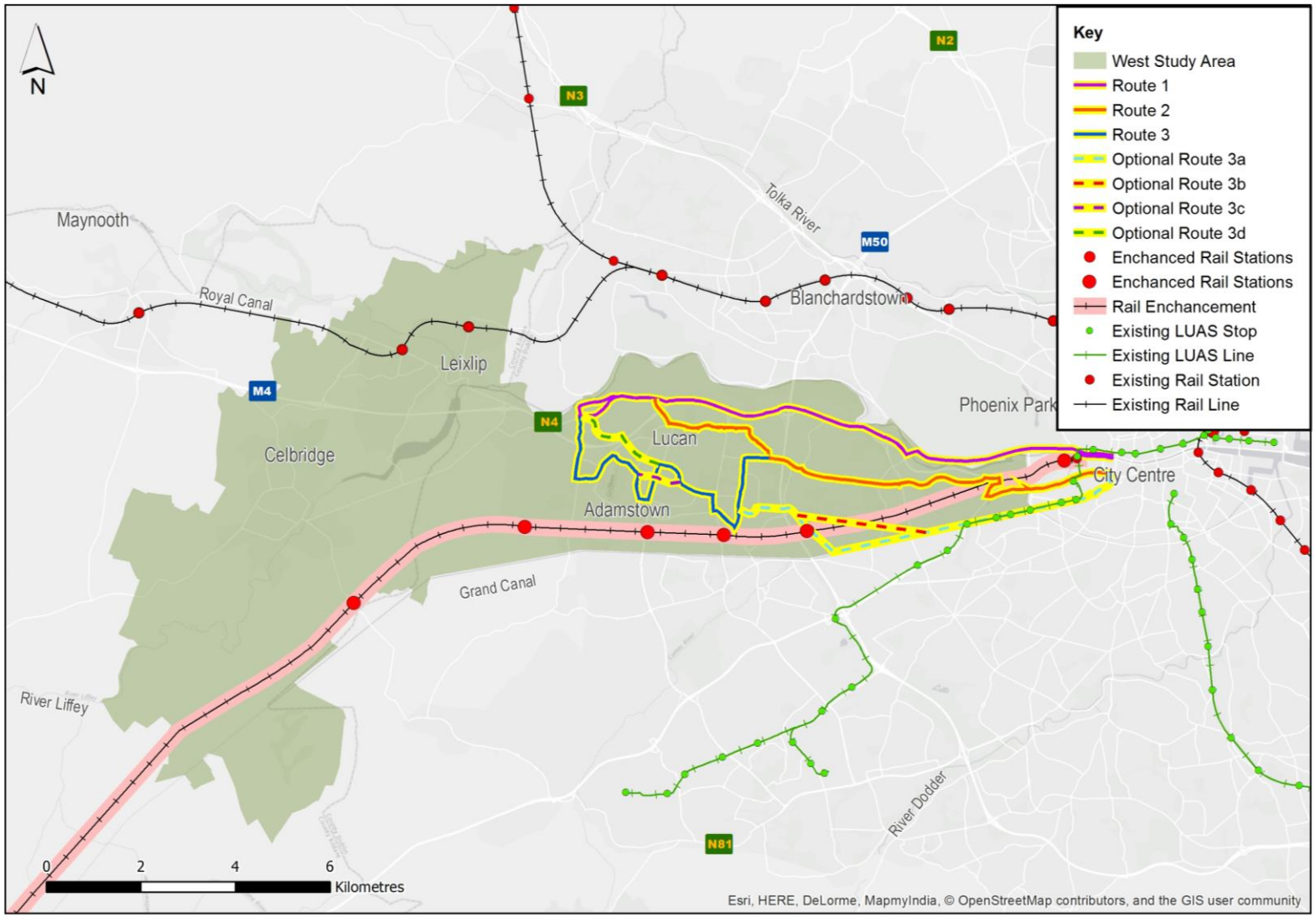


Figure 5-2: Option 3

5.2.3 Option 4: Enhanced Rail and Luas

Option 4 proposes the following:

- Investment in new Luas Lucan Line enhancements that will lead to 15 train services in the AM Peak hour and capacity of up to 4,500 trips. The rolling stock would be 53 metres long trams and provide a direct interchange with the Red line at Blackhorse and joint running. Full segregated running or a second line from Blackhorse into the City Centre could be constructed phased to increase the line capacity;
- Two new Quality Bus Corridor routes (up to 12 buses per hour) to improve penetration of the northern and southern edges of the corridor will provide capacity of 1,200 peak hour trips;
- Express bus services (up to 6 buses per hour) will provide capacity of 300 peak hour trips for development west of Ballyoulster;
- Investment will enhance Kildare Line service to 12 min frequency and provide capacity of 2,000 peak hour trips; and
- Feeder bus services at lateral intervals of 800 metres will provide capacity of 2,500 peak hour trips connecting with radial services.

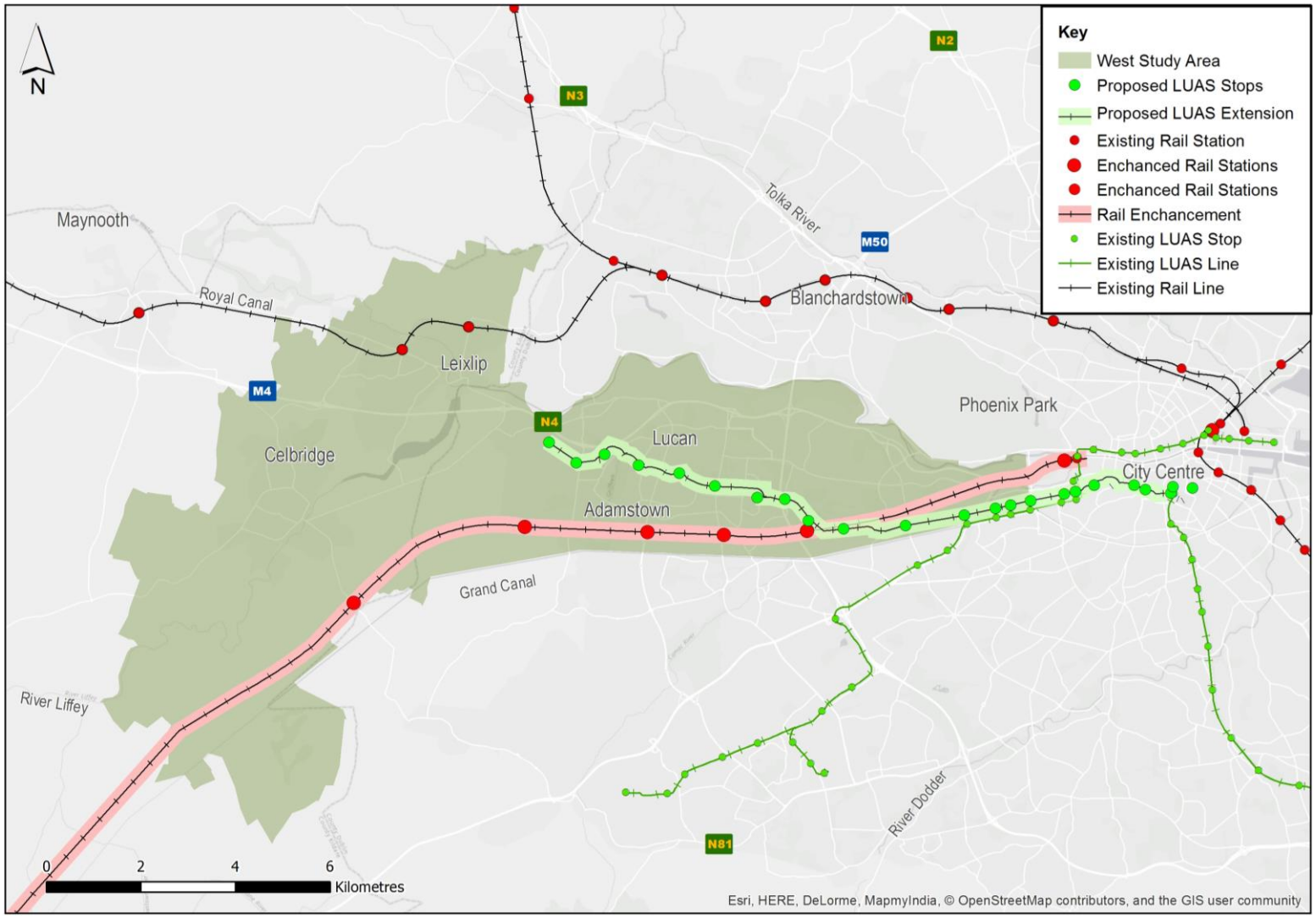


Figure 5-3: Option 4

5.3 Comparison of Target Demand Accommodated

As already outlined earlier in the report, each of the remaining proposed three options provides adequate service capacity that can cater for 100 per cent of the target demand. In order to score how well each option accommodates the target demand level a catchment analysis has been undertaken.

5.3.1 Service Catchment

The catchment analysis is based on agreed catchment areas associated with the different types of public transport service as shown in Table 5-1.

Table 5-1: Service Catchment Distance

Service Type	Catchment Distance	Catchment Band Type
DART	1,000m	Radius from stop
Commuter	1,000m	Radius from stop
Light Rail	800m	Radius from stop
Bus Rapid Transit	800m	Radius from stop
Dublin Bus	400m	Band out from route
Intercity Bus	400m	Band out from route
Shuttle Bus	400m	Band out from route

5.3.2 Catchment Analysis of Proposed Options

The catchment analysis indicated that the public transport accessibility catchment within the Study Area at presently is very high at 92 per cent. Any further increase in catchment is largely constrained by geographic factors including the dispersed and largely rural nature of the remaining inaccessible areas. Nevertheless the proposed public transport options marginally increase the catchment to 93 per cent.

5.4 Journey Time Comparison

Table 5-2 shows the journey time assessment scores for the options. The factors affecting journey times within the western part of the Study Area are similar for all of the proposed options and have not been considered further within the assessment. For example, for journeys to the City Centre, feeder bus connections to high speed routes such as the Kildare and Maynooth lines are desirable, as the faster travel time are likely to outweigh the interchange penalty associated with the use of local feeder bus services.

If funding was available, the extension of the Luas line further westwards beyond Newcastle Road would increase the public transport capacity and catchment within the corridor. Feeder bus services would be required once again.

A third alternative using Express Bus Services, would be dependent on the preferred options adopted further to the east and the capacity on the road network to enter the City Centre cordon.

Table 5-2: Journey Time Analysis of Proposed Options and Rank

Option	Description	Direct Journey Time (min)	Score	Adjusted Score
Option 1	Luas LRT spine + QBC + Rail	46	5	3
Option 2	New Rail Line	45	2	
Option 3	BRT/Rail	58	3	1
Option 4	Luas/Rail	46	4	2
Option 5	Bus	58	1	

Note: Journey time includes assumptions on interchange and connection times

5.5 Cost Comparison

The estimated cost of each option proposed was considered as one of the scoring criteria. Table 5-3 outlines the service and infrastructure unit cost for the proposed services and required infrastructure. These are capital costs only and do not include operation costs. The scheme costs for the five options were compared on the basis of unit cost rates.

Table 5-4 details the comparison of the cost estimates for each proposed option. Due to the significant costs associated with the foundation and track infrastructure associated with new rail line, Option 2 has the highest cost estimates. The cost of building a new Luas is also significant.

For the assessment it has been assumed that the DART Underground will be approved and train capacity will be increased along both the Maynooth and Kildare lines without cost to the West Study Area proposals.

Table 5-3: Unit cost rates applied in scheme evaluation

Service / Infrastructure	Units	Unit Cost	Source
Luas LRT	€M/km	**40-50**	Luas B1 RPA Proof of Evidence 2006
BRT	€M/km	**10.95**	NTA / RPA Presentation on BRT
QBC	€M/km	**1.9**	West Study Area assumed 1/6 of BRT Cost
Express Busway	€M/km	**1.9**	West Study Area assumed 1/6 of BRT Cost
Rail Line - new	€M/km	**60-100**	
Rail Line - Train	€M/train	**0-15**	Upgraded for DART Underground study

Table 5-4: Proposed Scheme Costs

Option	Description	Cost €M	Score	Adjusted Score
1	Luas LRT spine + QBC + Rail	700	2	1
2	New Rail Line	1,050	1	
3	BRT/Rail	150	5	3
4	Luas/Rail	650	3	2
5	Bus	150	4	

5.6 Summary of Option Scoring

Table 5-5 outlines the summary of the option scoring process. For each scoring criteria the options are ranked from 1 to 3, 1 representing the lowest performance in that criterion and 3 representing the highest performance. Each criteria rank is summed to provide a total value for each option. The option with the highest score is considered to best meet the criteria.

The ranking and overall scoring is based on an open and transparent addition of scores for three criteria, catchment, journey times and costs, without the application of additional weighting factors. It is appropriate to evaluate the initial options For the West Corridor strategic study against these criteria. Note that as a consequence the relative differences between the rankings may be much greater than implied within these scores.

Based on this scoring approach, Option 1 is seen to score the highest in overall terms with good demand coverage and journey times, the weakness of this option being the high cost. Option 3 scored second highest. The strength of this option is the lower cost of BRT construction, however journey times are slower. Option 4 scored the lowest. This has the high cost of new Luas rail construction.

An assessment was undertaken to examine the catchment of the Luas line to the City Centre and the catchment for Line F route 2 was marginally better than route 1. However, the design for route 2 includes a short length of joint running with the Red Line limits which constrains future capacity. A second line between Blackhorse and the City Centre may be required to provide capacity for the forecast level of demand in 2035.

The costs associated with enhancing the capacity along the Kildare line is low as the line is currently operating at below capacity, however the Maynooth line is operating at capacity and it would be too costly to upgrade the line on the basis of travel demand within the West corridor.

The bus based options have been assessed on the basis that priority and journey time would be maintained in future.

Table 5-5: Scheme Comparison

Option	Description	Rank Score			
		Catchment/ Accessibility	Journey Time	Cost	Overall Scoring
1	Luas LRT spine + QBC + Rail	3	3	1	**7**
3	BRT/Rail	2	1	3	**6**
4	Luas/Rail	1	2	2	**5**
2	New Rail Line				
5	Bus				

6 Transport Modelling Assessment

6.1 Background

Following identification of the preferred public transport option for the West Corridor, a modelling exercise has been undertaken to determine the likely usage and operation of the proposed new services that may be in place by year 2035.

The modelling testing exercise is reported within this chapter. The emerging measures were tested Greater Dublin Area Regional Model (GDARM).

This testing stage also includes the majority of initiatives that form the GDA Strategy and therefore takes cognisance of the impacts of both the corridor initiatives and interaction with those services being proposed within the overall strategy.

It should be noted that within this modelling exercise, the model testing does not include the full impact of Demand Management measures that may be utilised to further enhance the level of journeys made by public transport. In addition, Park and Ride facilities and shuttle bus services to rail and light rail stations have not been modelled and therefore the model output is likely to under represent the actual level of use on public transport. The outcome of the current model testing, therefore, provides a conservative view of demand levels that may use the measures included within the Strategy.

Further information on the transport modelling and strategy measures tested is provided within an overarching Transport Modelling Report.

Figure 6-1 illustrates the proposed GDA public transport proposals in the context of the West Study Area corridor.

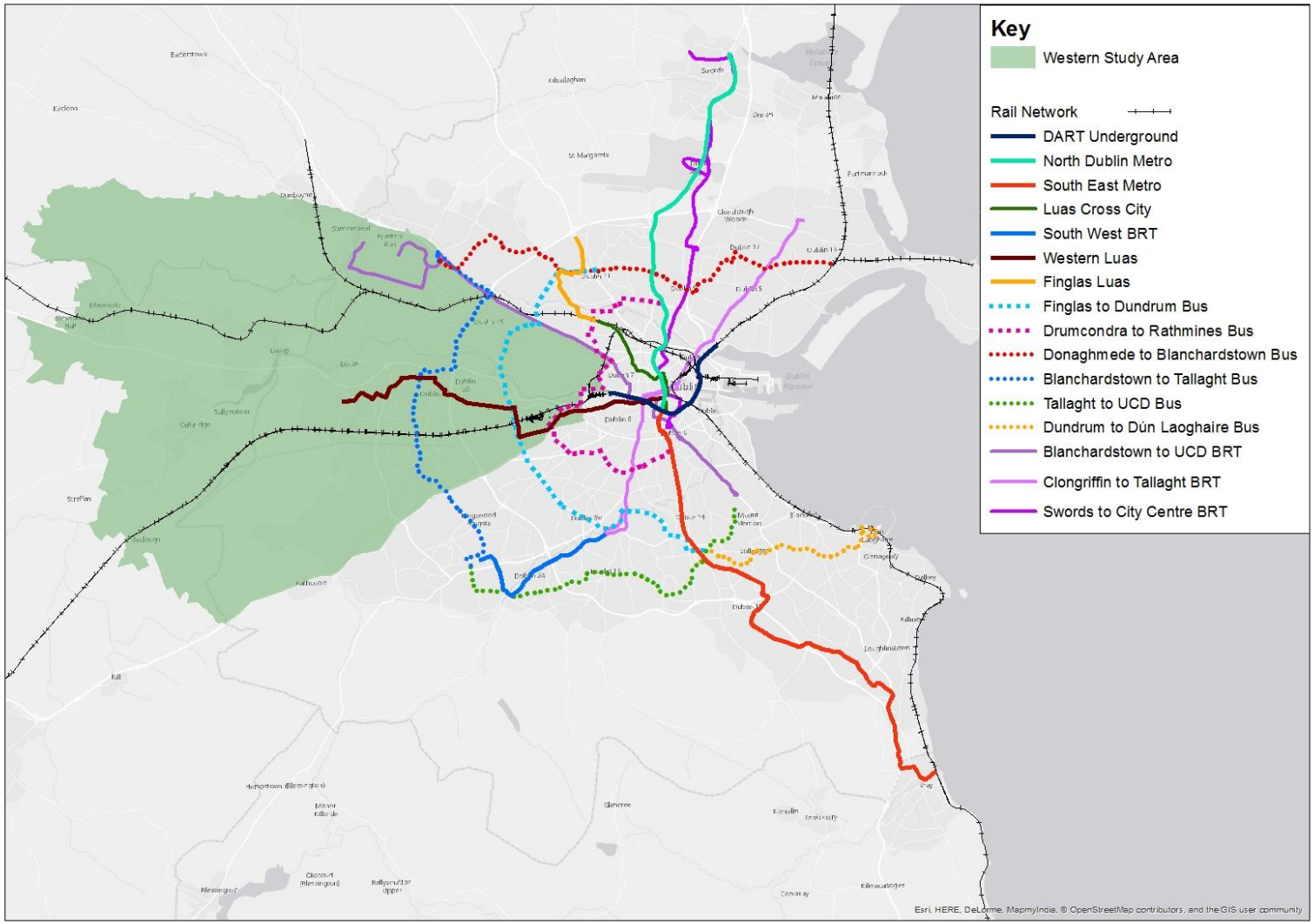


Figure 6-1: Proposed GDA Strategy Public Transport Proposals

6.2 Modelled Public Transport Proposal

The proposed transport provision for the West Corridor tested within the GDARM includes two Quality Bus Corridors on the northern and southern edges of the Study Area, a Luas line running centrally through the Study Area from the Luas Red Line at Blackhorse to Lucan and an additional rail service along the Kildare line. All these proposed services (i.e. Luas, Quality Bus Corridors and the rail network) are assumed to be served by feeder buses crossing the Study Area. These proposals are tested with the wider Strategy measures presented in Figure 6-1.

It should be noted that the addition of the wider Strategy measures, particularly that of DART Underground, will have the effect of significantly increasing the capacity of the Kildare Rail line above that which was assumed as part of the West Corridor public transport rail improvement recommendation.

6.3 Modelling Assessment

6.3.1 Screenline Assessment

As described earlier in the report, the demand level was defined across screenlines within the corridor Study Area to determine the appropriate service to accommodate the forecast total demand growth. This assessment made the assumption that all growth would use public transport. The public transport service proposals were then modelled to determine a more conservative projection of 2035 public transport usage. Figure 6-2 illustrates the forecasted 2035 AM peak hour public transport patronage crossing each of the screenlines. This includes bus, metro south, and rail (dart and commuter trains).

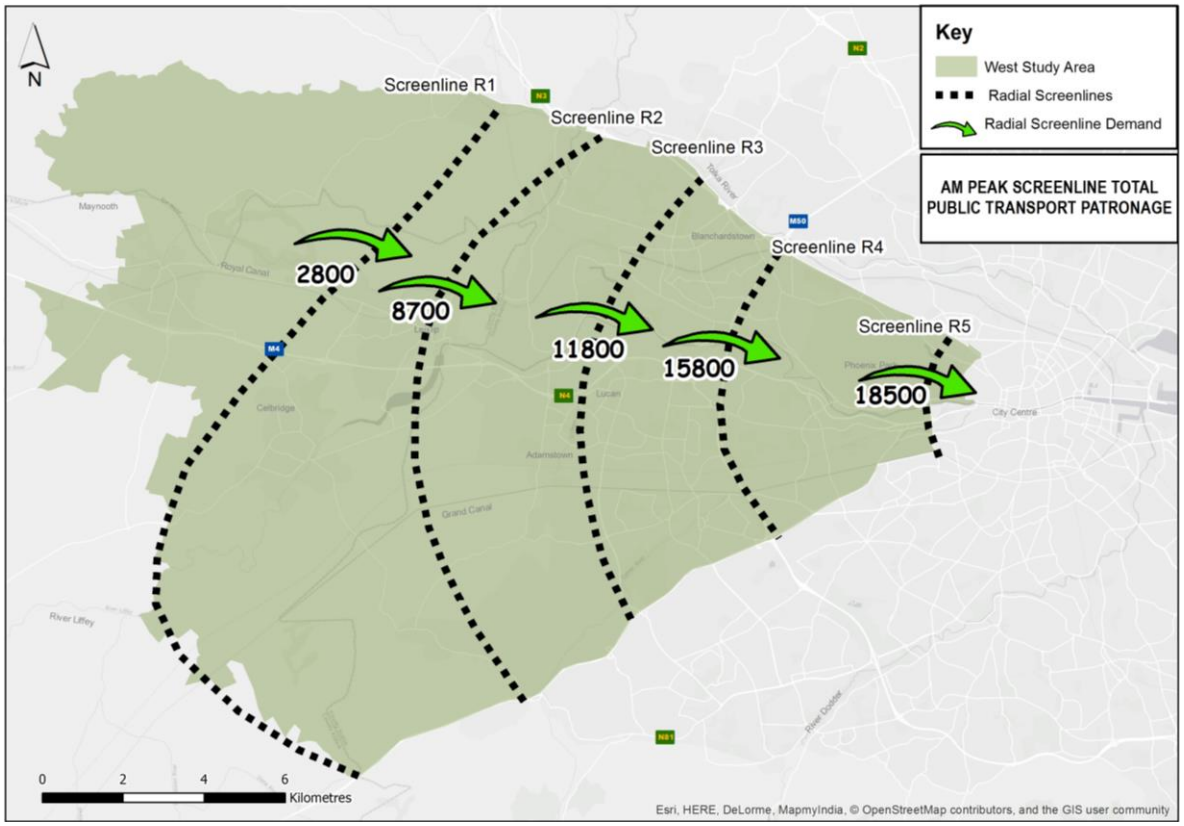


Figure 6-2: AM Peak Screenline Total Public Transport Patronage

The following figure compares the 2035 public transport target demand (defined as the growth in public transport usage plus existing 2011 public transport demand) against the modelling results.

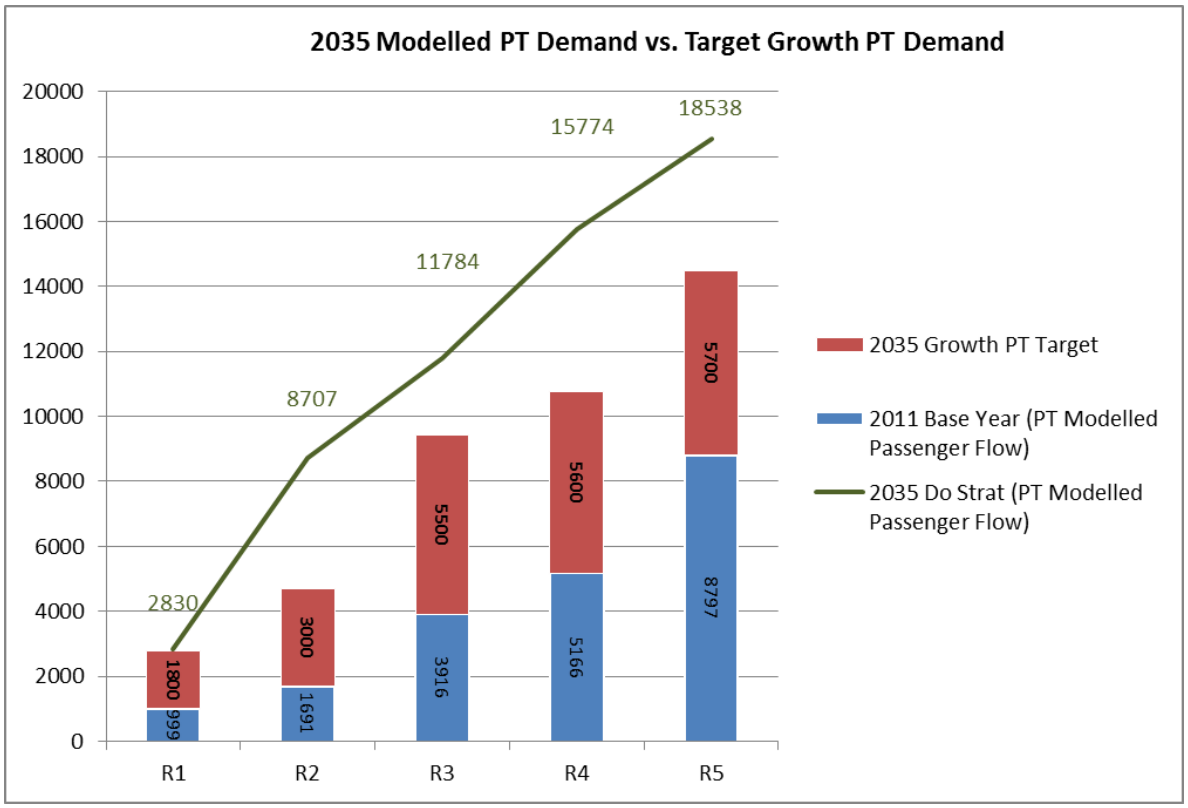


Figure 6-3: Modelled PT Demand for 2035 Compared to Target PT Growth

Comparing the preliminary demand assessment against the modelling results reveals notable differences for the West Study Area. The divergence begins at screenline and continues to the city centre screenline at R5, with the modelling assessment forecasting higher public transport usage that the demand assessment. This indicates that in addition to accommodating the growth in demand due to development, the public transport strategy contributes to significant mode shift to public transport for existing trips.

As mentioned previously, the introduction of DART Underground to the Western Rail line, together with improvements to frequency on the Maynooth corridor provide a step change in public transport provision along the corridor, particularly for longer distance commuters.

6.3.2 Corridor Study Area Mode Share

The introduction of the proposed public transport measures within the corridor Study Area, in conjunction with the introduction of wider GDA Strategy public transport proposals can accommodate increased public transport patronage.

Figure 6-4 outlines the overall mode share of the West Study Area to Dublin City Centre; showing a public transport mode share of 68 per cent, which is greater than the mode share for private car travel of 32 per cent.

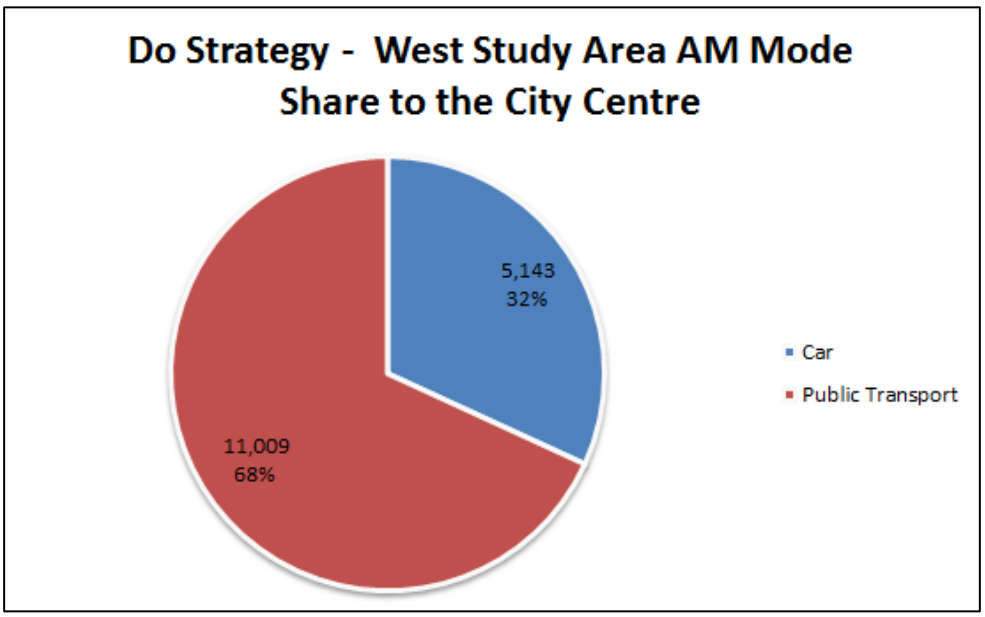


Figure 6-4: AM Peak Corridor Study Area Mode Share

6.3.3 Public Transport Boarding and Alighting Profile

Figures 6-5, 6-6 and 6-7 detail the boarding and alighting profiles for the Luas line and the commuter rail services (for Maynooth and Kildare rail lines respectively) through the Study Area to Dublin City Centre in the AM Peak. Each graph shows the cumulative passenger numbers for each service, as well as the overall Design and Crush Capacity modelled for these services.

The Luas service has been modelled to have a maximum number of 2,650 passengers at Kilmainham stop. Seated capacity is reached after Griffeen Valley Park eastbound and passengers are required to stand until the terminus at Trinity. It can be seen that at no point during the AM peak hour is the Luas operating above the design capacity.

The passenger numbers increase at a steady rate from the western terminus at Newcastle Road through to Blackditch stop, with boarding and alighting being similar through to Tyrconnell stop with 11 out of 19 stops having more than 100 boarders forecast.

The improved rail service along the Maynooth line is seen to deliver maximum passenger numbers of around 5,000 passengers between Clonsilla station and Broombridge stations. Seated capacity is reached at Maynooth eastbound, and therefore there are services that may have standing over this section. It can be seen that at rail services are also operating above design capacity between Clonsilla and Broombridge. Further analysis has indicated that up to 250 longer distance trips interchange at Maynooth to travel via DART line to Broombridge and Drumcondra to access the Luas line and Metro North services respectively. Thus although the current design for the Maynooth DART service exceeds the design capacity there is the potential for additional stops on longer distance rail services at Drumcondra for Metro North to provide relief if required, with minimal impact on overall journey times along the corridor.

The Kildare Line, in the modelled scenario, utilises the DART Underground which provides enhanced penetration for public transport into core employment areas of the south east quadrant of the City Centre. The DART Underground allows for a greatly improved rail service along the Kildare line and is seen to deliver maximum passenger numbers of between 5,500-6,000 passengers between Parkwest and St. Stephen's Green (new station proposed as part of DART

Underground where there is an assumed interchange with Metro North). The Kildare Line also caters for Inter-City / Regional services which carries an additional 2,000 passengers travelling towards the City Centre in the AM Peak.

The above analysis indicates that, while the proposed improvements to the public transport services operate efficiently and effectively, there is still adequate scope for further patronage increases beyond 2035 particularly on the Kildare Line and Western Luas.

Figure 6-5: Western LUAS Boarding and Alighting Profile

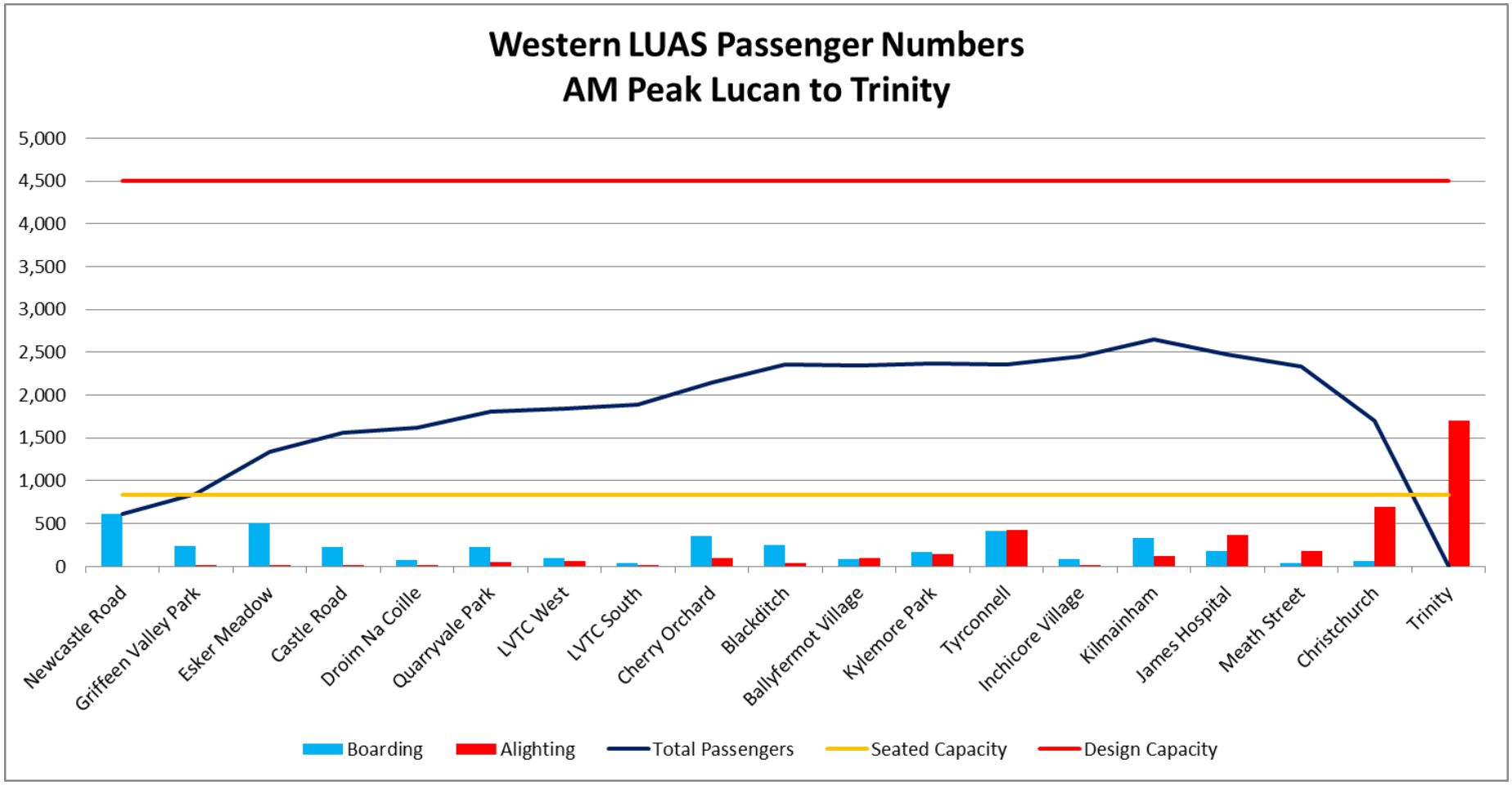


Figure 6-6: Maynooth to Greystones Rail Boarding and Alighting Profile (Maynooth Line)

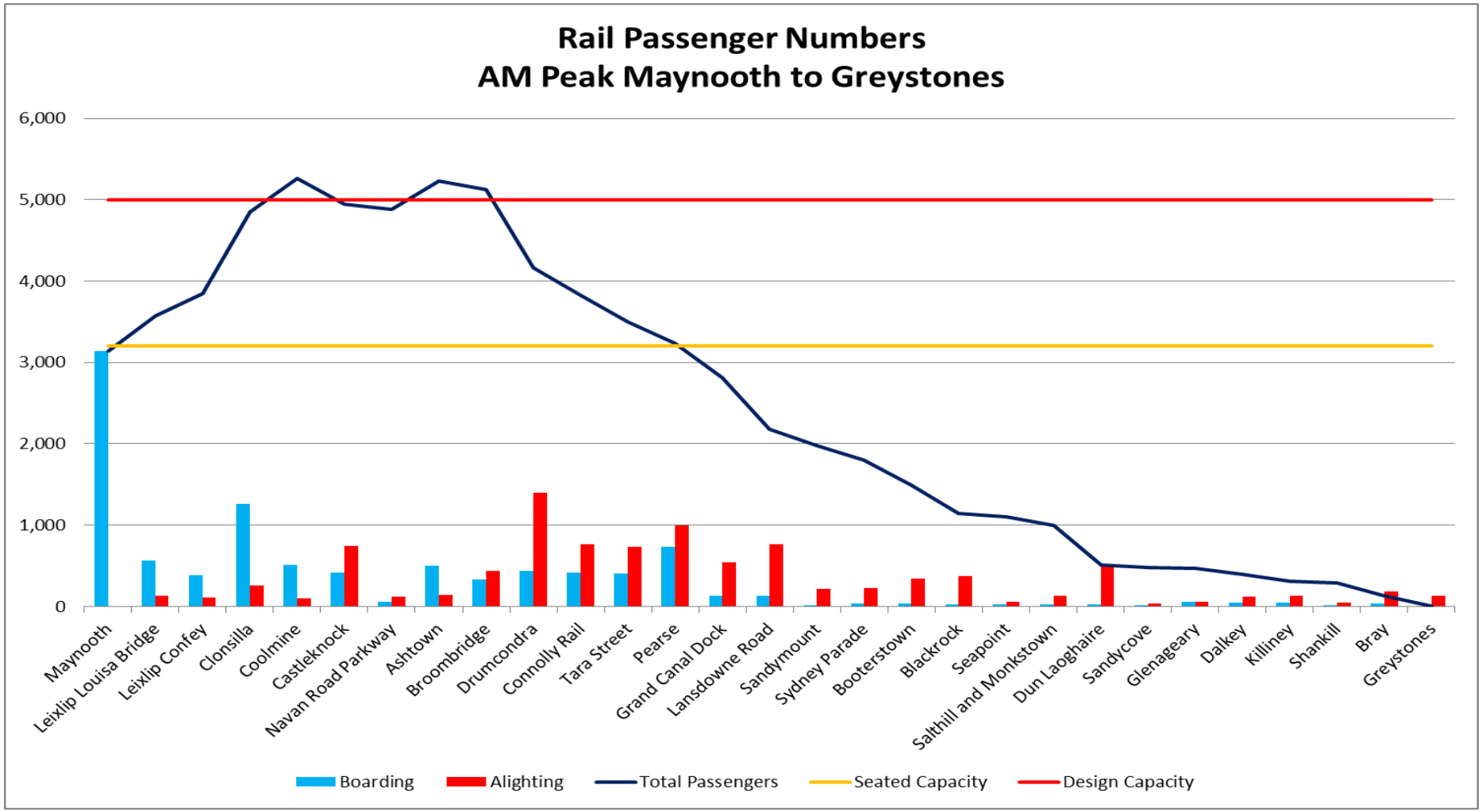
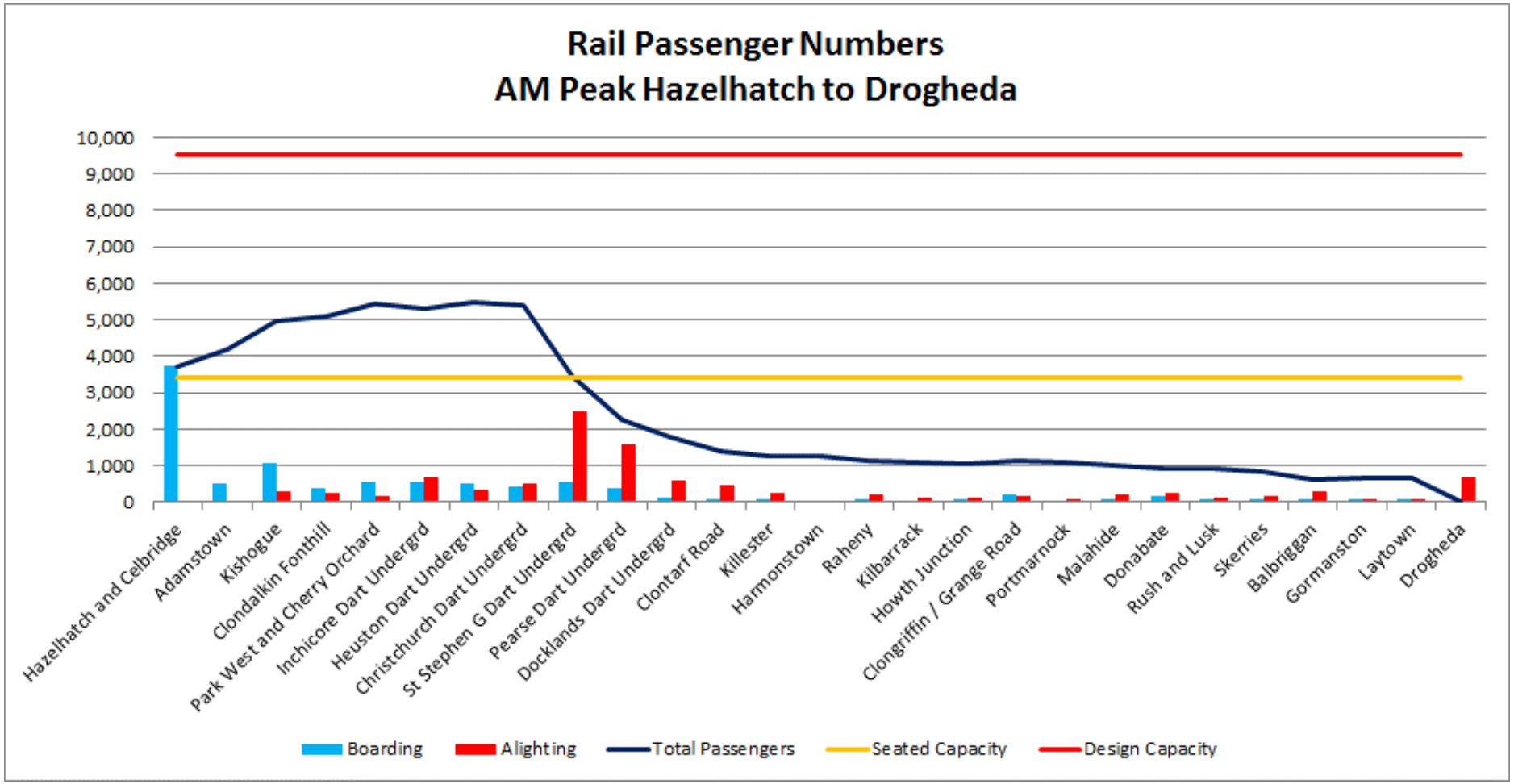


Figure 6-7: Hazelhatch to Drogheda Rail Boarding and Alighting Profile (Kildare Line)



6.3.4 Journey Times and Service Speeds

Table 6-1 outlines the high level journey times and average service speeds for the proposed public transport provision from the West Study Area to Dublin City Centre in the AM peak hour. Table 6-1 shows that passengers from Lucan can access Dublin City Centre in around 40 minutes by Luas at an average speed of 23kph. Passengers from Maynooth can access Dublin City Centre in just over 50 minutes at a higher average speed of 33kph.

Table 6-1: Proposed Public Transport Journey Times and Service Speeds

	Distance Km	Journey Time Min	Speed kph	Travel Distance pas.km
Western LUAS	15.7	41	23	30,826
Maynooth to Greystones	n/a	1hr 41	33	22,834
Maynooth to Grand Canal Dock	28.6	52	33	n/a

6.4 Modelling Summary and Conclusions

The modelling assessment has shown that the patronage and passenger numbers using the proposed services mostly align with the anticipated demand, indicating that the proposed public transport provision is of the appropriate scale to accommodate the forecast demand growth. The overall public transport mode share for trips from the West Study Area to Dublin City Centre is seen to increase to 68 per cent. The comparison of the service passenger numbers against the design capacity indicates that at no point are the services over-crowded and that by 2035 there is still scope to accommodate further growth. The assessment also showed that journey times to Dublin City Centre from Lucan are modelled at 41 minutes, providing an efficient, reliable service in combination with the DART services from Maynooth.

The modelling has shown that even with the inclusion of DART Underground which provides a significant step up in capacity on the Kildare Rail line, the Western LUAS Line is still required to serve demand in the West Study Area.

7 Emerging West Study Area Public Transport Option

7.1 Recommendation

The following outlines the recommended West Study Area Public Transport proposal to be brought forward to be included in the 2035 GDA Public Transport Strategy. This has been developed from the Do Minimum scenario and further assessed with the wider GDA Strategy measures using the GDARM.

The public transport recommendations for the West Study Area are as follows:

- New Luas line (Western Luas) with the following specification:
  - 15 trams per hour.
  - 53 m in length.
  - Extended platforms for joint running with Red line.
  - Peak hour design capacity of 4,500.
  - Services running between Newcastle Road and City Centre.
  - Interchange and joint running with Red Line between Blackhorse and Fatima stops is assumed, however second line may be required via Inchicore.
  - City Centre alignment along Redline/Davitt Road.
- Kildare Line service enhancement (prior to DART Underground being delivered)
  - +1 tph commuter peak.
  - Peak hour design capacity of 400.
  - Use Phoenix Park Tunnel to access Connolly and/or Docklands
- Enhanced bus service - Express Bus
  - Up to 6 buses/hour.
  - Peak hour capacity of 500.
  - Serving development in Celbridge.
- Enhanced bus service - QBC
  - Route 1 – Northern alignment entering the Study Area at Island Bridge and following Chapelizod Road and N4 Lucan Road until the Lucan Retail Park. The proposed northern service leaves the N4 via Lucan Road to its terminus at Adamstown Road.
  - Route 2 – Southern alignment enters the Study Area on the R810 at St James's Hospital and follows Emmet Road and Sarsfield Road to reach Ballyfermot Road. Beyond the M50 the route serves the Liffey Valley Shopping Centre before traversing St Lomans Road and Lucan Road to reach Adamstown Road.
  - Up to 6 buses/hour/route.
  - Peak hour capacity of 500 per route.
- Additional bus priority infrastructure
  - Along corridor.
  - Within canal cordon.
- Bus feeder services connecting to Luas, Kildare and Maynooth lines:
  - Located within eastern part of Study Area.
  - Services separation about 800m.
  - Peak hour capacity of 1,500.
  - Integrated with Orbital services.
  - Fleet of approximately 55 additional buses.
- Park and Ride parking
  - Where the National Road network meets the rail network.

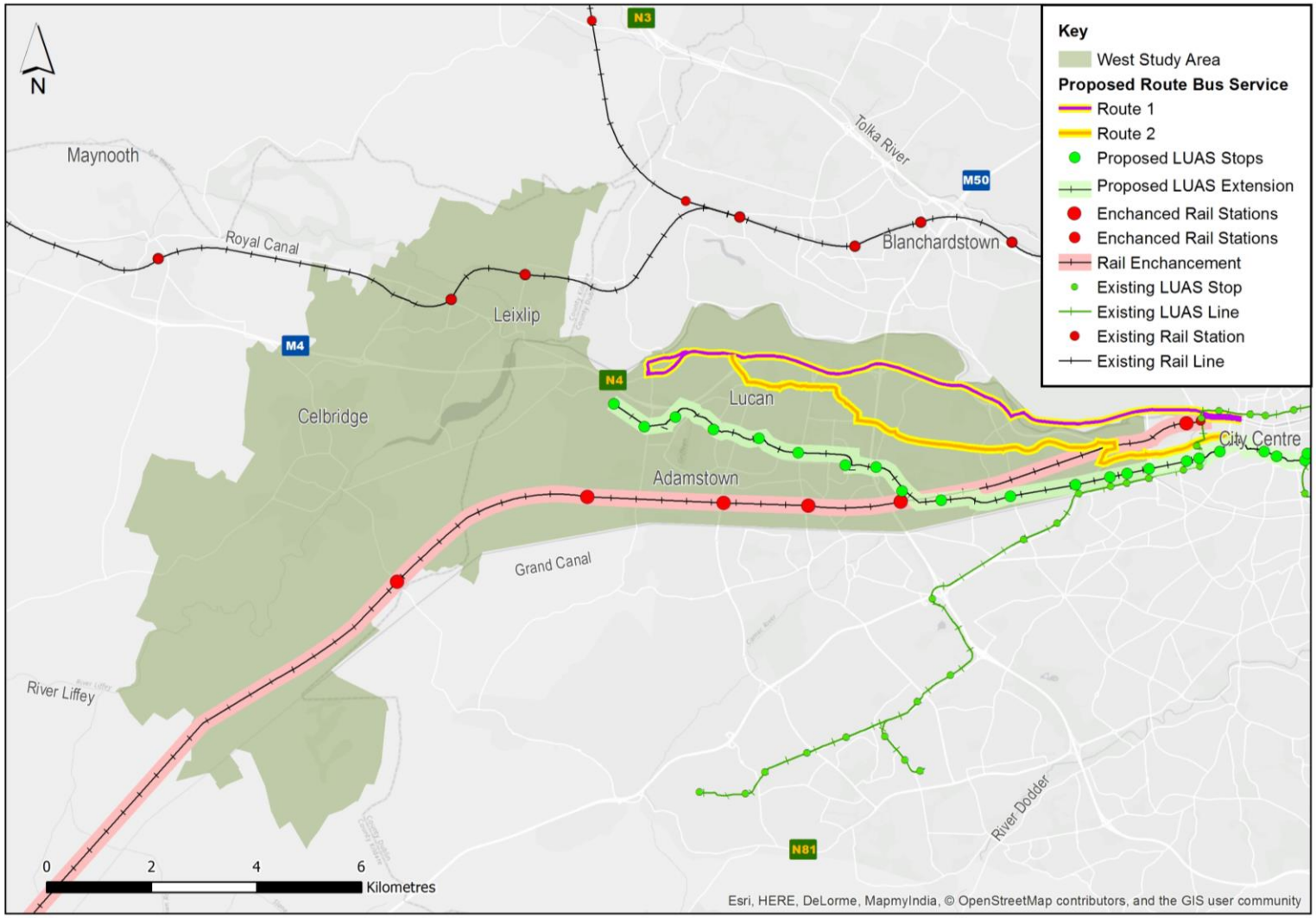


Figure 7-1: Option 1

7.2 Benefits

The benefits of the Western Corridor Public Transport Recommendations are as follows:

- Meets projected demand growth to 2035 (i.e. all future growth can be accommodated on public transport from and through the area);
- Mode share for public transport to the City Centre is currently approximately 50 per cent. This option has the ability to capture 100 per cent of the future growth targets, providing at least 68 per cent public transport mode share, with the capacity to deliver higher depending on future demand management policies;
- Increase accessibility to public transport from high existing level of 92 per cent to 93 per cent;
- Is complementary to the delivery of DART Underground and the benefits to the Kildare Rail Line that DART Underground provides;
- Provides public transport connections with Metro North allowing trips to the airport from the West Area;
- Can support significantly more demand above 2035 levels;
- Can support further concentration of development along the Western Luas Line and the Kildare Rail line (particularly post DART Underground);
- Opens up public transport access to/from West to North East and South-East of City; and
- Provides interchange with inner and outer orbital movements extending the effective catchment of all public transport in the study area.

7.3 Risks & Considerations

The section describes risks associated with the recommended West Corridor Study public transport improvements.

- Design Risk
  - Design subject to detailed design and appraisal of emerging schemes.
  - Design capacity based on current public transport modes (crush load, design load and peak spreading).
  - Interaction with Inner and Outer Orbital travel demand and demand associated with wider area economic growth subject to detailed wide area modelling.
  - Interchange with high capacity core services based on detailed design, planning and level of service of feeder bus services.
  - Detailed design of priority QBC and BRT priority may conflict with other modes and movements.
  - Forecast infrastructure costs based on extrapolation of current costs.
  - Disruption caused to existing Luas line during the general construction and operational impacts associated with the development of the new Luas line and on-line running.
  - Remodelling of track layouts and stops might be necessary with resulting disruption.
  - Any potential timetable recast may be disruptive.
- General Uncertainty and Economic Risk
  - On-going availability of funding and securing funding allocation.
  - Right of way acquisition for Luas line construction.
    - Interaction possible with other major public transport systems.

7.4 Cost

Table 7-1: Scheme Costs

New LUAS line	€600 million
QBC/Expressway	€25 million
Bus Feeders	€25 million
Total Cost	**€650 million**

Annex 1 Capacity Assumptions

Capacity Assumptions	Seating Capacity	Crush Capacity	Design Capacity	Source
DART (EMU 8500 series, 2x4 car@160 seats)	320	1400	1190	www.irishrail.ie/about-us/dart
Commuter (DMU Class 2900, 2x4car@185 seats)	370	481	409	www.irishrail.ie/about-us/dart
Light Rail (401 & 402 Citadis - 40m tram)	70	305	259	RPA Report - Luas Patronage Gorwth - Average of Green and Red Luas
Light Rail (402 Citadis - 53m tram)			303	
Bus Rapid Transit	60	120	102	From CCIP Model
Dublin Bus	74	88	75	From GDA Model
Intercity Bus	50	53	50	From GDA Model
Shuttle Bus	30	30	30	Notional
Assumed Design Capacity reduction factor of	**85%**	**or 100% of seated capacity, whichever is larger**		

Table 7-1 Capacity Assumptions

Annex 2 Cost Assumptions

This section details the cost assumptions and sources that were used for the estimation of capital costs for the option development.

Service Type	Name	Cost over 30 year operational period				Length	Capital Cost per km	Source	Notes
		Capital	Operation	Renewals	Revenue				
		€m	€m	€m	€m	km	€m		
Heavy Rail New Line - Rural	**Double Track**						**5.50**	Irish Rail 2030 Rail Network Strategy Review	include construction and land acquisition
	Single Track						**3.50**	Irish Rail 2030 Rail Network Strategy Review	include construction and land acquisition
Heavy Rail New Line - Urban / Sub-Urban	**Metro North**	3800				18	**211.11**	RPA Metro North Updated Business Case 2010	include construction and land acquisition
	Metro Tunnel	2546				7	**363.71**	assuming that tunnel cost twice as much as non tunnel	
	Metro Non-Tunnel	1254				11	**114.00**	assuming that tunnel cost twice as much as non tunnel	
Heavy Rail Upgrade - Sub-Urban / Rural	**Kildare Route Project**	420				13	**32.31**	Irish Rail Kildare Route Project SDCS 2007	include construction and land acquisition
Heavy Rail - New Station	**Adamstown Station**						**6.20**	http://www.punchconsulting.com/our-projects/civil-infrastructure/adamstown-railway-station-dublin/	
New Train									
Light Rail General	**UK Costs**						**18.30**	UK Trams - Cost of Light Rail 2012	x 1.5 currency conversion to euro
	Europe Costs						**23.85**	UK Trams - Cost of Light Rail 2012	x 1.5 currency conversion to euro
	Luas Red & Green	775				25	**31.00**	wikipedia	
Light Rail in Urban Area	**Luas Docklands**	90				1.5	**60.00**	boards.ie	
	Luas Cross City	368				6.72	**54.76**	https://www.luascrosscity.ie/	
Light Rail in Sub-Urban / Rural Area	**Luas B1**	302	131	91	281	7.6	**39.74**	RPA Proof of Evidence Luas Line B1 2006	includes some large bridge infrastructure
New Luas Tram									
BRT in Sub-Urban / Urban Area	**BRT Lucan**	121	9.8	32		12	**10.08**	RPA Lucan Luas Demand Appraisal 2012	
	Blanch - UCD	188				16.5	**11.39**	NTA / RPA Presentation 2012	
	Clong - Tallaght	264				23.2	**11.38**	NTA / RPA Presentation 2012	
New BRT Vehicle									
Quality Bus Corridor							**3.65**	Assumed 1/3 BRT cost	
New Bus									
Bridge Crossing	**Taney bridge (21.5, 108m)**	11					**84.94**	http://www.irishtimes.com/news/bridge-due-to-be-completed-in-october-1.1089164	
	Suir Bridge (90m, 225m)	29.8					**94.60**	Waterford Bypass presentation to engineers ireland Feb 2010	

Table 7-2 Capital Cost Assumptions and Sources

Annex 3 Speed Assumptions

This section details the speed assumptions and sources that were used for the estimation of average speed in kilometres per hour for the public transport option development.

Service Type	Speed kph	Source	Comment
DART	32	GDA PT Lines	Overall average of all DART lines
Commuter South East	35.1	GDA PT Lines	Bray line
Commuter West	33.5	GDA PT Lines	Maynooth line
Metro	70	RPA Metro North Updated Business Case 2010	Likely an upper limit speed, not operational speed
Luas Red	22.2	GDA PT Lines	Not segregated for most of route
Luas Green	24.8	GDA PT Lines	Segregated for most of route
BRT	20	NTA / RPA Presentation 2012	Minimum requirement set. Can be up to 25kph
QBC	17.19	NTA / RPA Presentation 2012	Stillorgan QBC. Probably an efficient QBC?
Bus	15	Notional speed	

Table 7-3: PT Speed Assumptions