Clifton Scannell Emerson Associates

Dublin Orbital Movement Study

Options Report

Údarás Náisiúnta Iompair
National Transport Authority

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EXECUTIVE SUMMARY

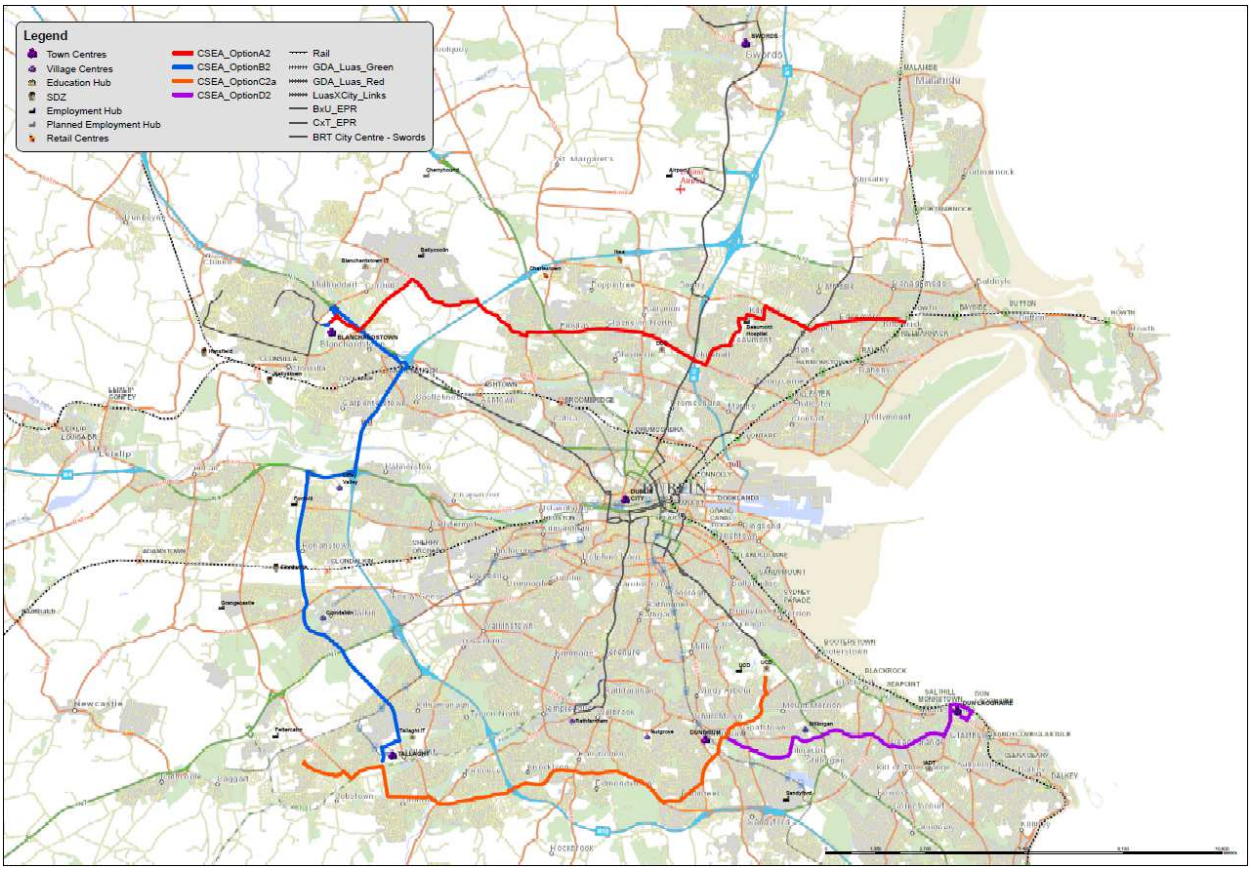
The overall objective of this Study is to identify the optimum medium – long term public transport solution connecting five "Key Centres" - Swords, Blanchardstown, Tallaght, Dundrum, and Dun Laoghaire, in an orbital movement, adequately meeting the demands of horizon year 2035.

In order to make a high level of assessment of the potential demand for orbital public transport services in Dublin, various datasets provided by the NTA were analysed, including model trip matrices, base and future Year Model trip ends, 2011 census population and employment data; and 2011 POWSCAR census journey to work data. The demand analysis indicates that bus-based services would be sufficient to meet the demand between Key Centres; and that high-quality bus-based services (BHLS) would be necessary between Blanchardstown – Tallaght – Dundrum.

Preliminary route options were developed, screened, and evaluated based on potential demand, key destinations served, journey time/ quality of service, significant engineering and environmental impacts, and high-level costings. Three most feasible options were shortlisted between Key Centres.

Shortlisted options were further analysed in terms of potential bus priority along the routes, and modelled on the NTA's 4-stage CUBE transport model and highway SATURN assignment models for the Greater Dublin Area network.

Preferred options were then selected based on potential demand indicated by network modelling, as well as assessments of engineering & environmental impacts, capital cost, and quality of service.



Preferred Orbital BHLS Routes

Section	Estimated Annual Patronage	AM Peak-period Service Frequency	Estimated Cost
Section A: Swords to Blanchardstown	2.35 million	6 minutes	€46,662,373
Section B: Blanchardstown to Tallaght	4.21 million	2 minutes	€63,462,081
Section C: Tallaght to Dundrum	3.68 million	2 minutes	€54,448,706
Section D: Dundrum to Dun Laoghaire	0.79 million	10 minutes	€8,841,012
			€173,414,173

This combination of emerging preferred routes should be modelled in the NTA's latest network model for the Greater Dublin Area, in order to fully assess its impact when implemented alongside other transport schemes planned for the GDA.

Analysis of demand between Blanchardstown and Swords has indicated low levels of demand between these two key centres - hence a high-quality direct PT service may not be viable. PT connection between Blanchardstown and Swords could instead be made by interchange with a high-quality high-capacity radial PT service to/from Swords.

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1. INTRODUCTION

1.1 Study Objectives

The overall objective of this Study is to identify the optimum medium – long term public transport solution connecting five "Key Centres" - Swords, Blanchardstown, Tallaght, Dundrum, and Dun Laoghaire, in an orbital movement, adequately meeting the demands of horizon year 2035.

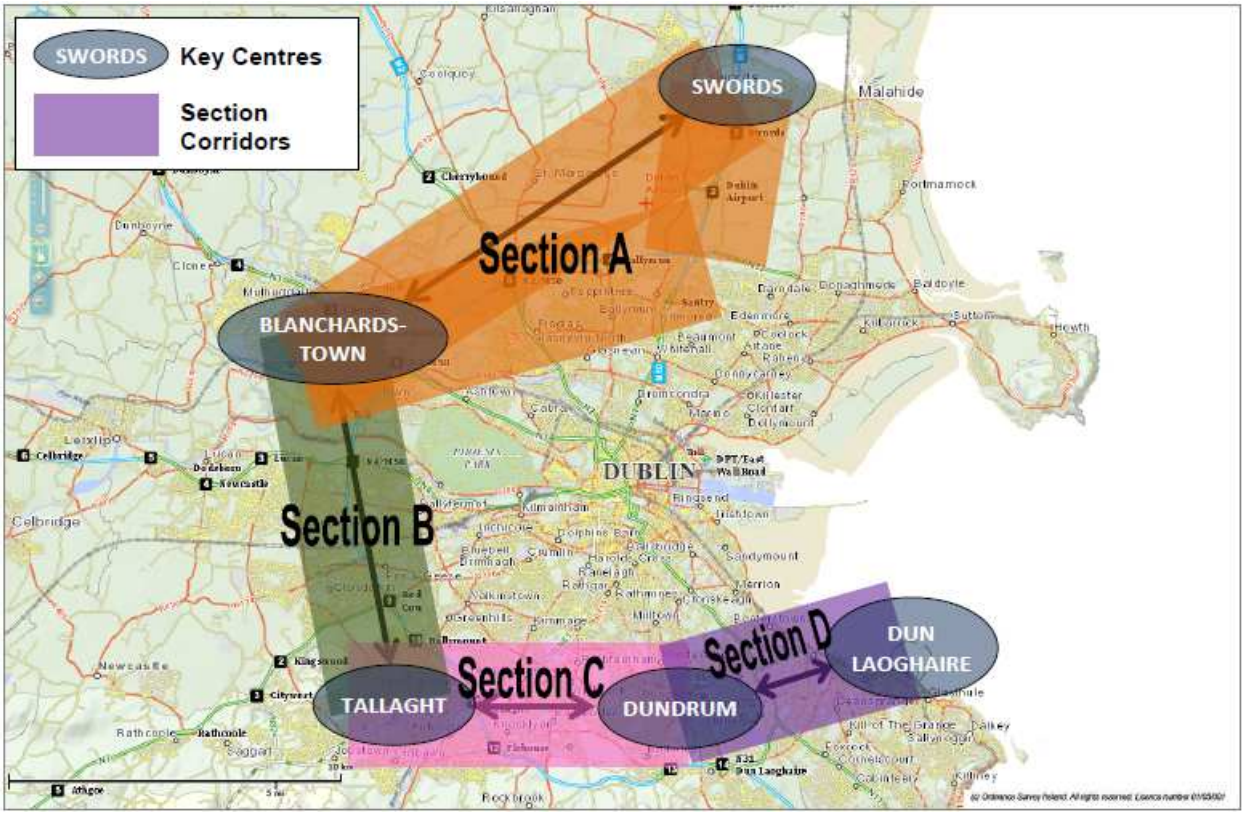


Figure 1 Key Centres and Route Sections

- Section A: Swords to Blanchardstown
- Section B: Blanchardstown to Tallaght
- Section C: Tallaght to Dundrum
- Section D: Dundrum to Dun Laoghaire

1.2 Strategic Context

This Study takes into consideration all major transport and land-use planning in the Study Area that are known at this time. The outcomes of this Study will feed into the NTA's 2015-2035 transport strategy for the Greater Dublin Area.

1.3 Principles of Orbital Public Transport Service

In this Study, the following principles form the basis upon which options have been developed, evaluated, compared, and assessed for feasibility.

i. Orbital public transport routes should service orbital trip demands between key centres/ main settlements along the corridors - for various travel purposes including work, education, retail, and leisure.

ii. Journey times on orbital routes need to be able to compete with car modes and radial public transport alternatives. Orbital trips are likely to have maximum journey times before alternatives become more attractive, e.g. radial public transport routes.

iii. Balance between serving the largest catchment and achieving optimal journey times.

iv. Horizon Year 2035 congestion levels (or counter congestion charging) on the M50 could influence PT demand capture rates.

v. Ability to serve shorter distance trips.

vi. Ability to capture secondary demand:

- Public transport interchanges with radial corridors
- Wider catchments served via Bike & Ride, Park & Ride, local public transport shuttles.

vii. Orbital routes should be considered in conjunction with the wider transport network.

viii. Connections to key trip generators (current and proposed) should be considered:

- Education hubs - UCD, DCU, ITT, ITB
- Employment hubs - Cherryhound, Grangecastle, City West, Cherrywood, Sandyford.
- Planned dense residential zones/ Strategic Development Zones - Hansfield, Porterstown, Tyrellstown, Clonburris, Cherrywood.

ix. Strategic orbital service should be fast, frequent and regular.

x. Routes should be easy-to-understand, coherent, and legible.

1.4 Methodology

The following outlines the work-flow and the tasks undertaken to progress this Study from inception up to selection of preferred route options.

1. Review existing data

- 2011 POWSCAR data
  - Review analysis previously completed by NTA.
  - Boundaries used: settlements, radial corridors, high-order.
  - General review of population in orbital towns, orbital commuting patterns (between orbital towns), and radial commuting patterns (between major orbital towns and the city centre).
- NTA household travel survey
  - All-day travel demand for various trip purposes.

2. Review previous studies

- Orbital Bus Route Study (internal NTA study completed in 2014)
  - Existing demands.
  - Existing constraints.
  - Short – medium term recommendations.
- Metro West
  - Business case based on all-day travel demand.

3. Demand analysis

a. Orbital Demand Analysis

- Analysis of density and location of demand in the study area, with future year trip end growth to understand how this is likely to change in the future.
- Orbital Demand is estimated based on:
  - Current journey to work trips by mode, as indicated by 2011 POWSCAR data;
  - NTA household travel survey data;
  - Land-use data;
  - Base year model trip matrices;
  - Do-minimums assumptions (e.g. Interconnector; BRT/ LRT between city centre and Ballymun and Swords; enhanced QBC / BRT between city centre and Blanchardstown); and
  - Growth, which is based on:
    - Future year trip ends
    - Induced effect (new trips generated by improved connection)

b. Demand Capture

- Assessment of the potential capture for an orbital PT service, split by:
  - Orbital journeys (origins and destinations within the corridor); and
  - Interchange (using the orbital route to interchange with radial routes into city centre).

- Demand Capture Rates are estimated based on:
  - Existing capture on current orbital public transport (PT) routes in Dublin; and
  - Mode splits into Dublin Centre for areas with good and poor PT access (used to assess possible transfer impacts when a good PT service is offered).

4. Option Development

- Identify if high-capacity solution or conventional bus mode is appropriate to meet future demand.
- Identify route options between key centres.
- Identify significant additional infrastructure that may be necessary.

5. Multi-criteria Analysis and Shortlist

- Analyse viability of remaining options based on six criteria:

a. Demand/ ridership

- Primary demand, based on 800m buffer zones on each side of each route option:
  - Current and future population directly served;
  - Current and future employment directly served; and
  - Current potential for commuter PT use along route, based on number of workers and students who are presently travelling along each route using either bus mode, or car mode for more than 7 minutes (2011 POWSCAR). It is noted here that this eliminates commuters who could be walking, or cycling, or driving such short distances that PT would not be regarded as an economically viable alternative.
- Secondary demand:
  - Potential for interchange to radial PT services;
  - Potential for interchange with local PT services; and
  - Potential for bike-and-ride and park-and-ride.

b. Key destinations served

- Town centres;
- Education hubs;
- Employment hubs;
- Retail centres; and
- SDZs and strategic land banks.

c. Journey time/ quality of service

- Estimated PT journey times under existing conditions, and if bus priority measures were implemented.
- Reliability of PT services under existing conditions, and if bus priority measures could be implemented.

d. Significant engineering impacts

- Major structures, e.g. bridges.
- Substantial land take requirements

e. Significant environmental impacts

- Natural heritage designations

- Severance impact
- Major built-environment impact

f. <u>High level costings</u>
- Capital investment

- Screening of options to eliminate those that are obviously not feasible:
  - Too expensive;
  - Low ridership/ low demand captured;
  - Does not serve key locations;
  - Severe physical constraints (eg. pinch points with no possible solution)
  - Environmentally devastating.

- Based on multi-criteria analysis of remaining options, 3no. most feasible options were selected between key centres.

6. Consultation with NTA on shortlisted options

- Preliminary findings presented for discussion.

- Confirmed shortlisted options brought forward to next stage for further assessment.

7. Modelling of shortlisted options

- Each shortlisted option is modelled on the NTA's 4-stage CUBE transport model which, includes separate public transport TRIPS and highway SATURN assignment models for the Greater Dublin Area.

- <u>Network modelling process:</u>
  - Validate the Do-Minimum model;
  - Confirm modelling assumptions;
  - Code each shortlisted options;
  - Run model with individual or combination of shortlisted options.

- A final run of the full model would then be carried out on set of options that have achieved the best results, in order to evaluate the overall impact of this combination.

8. Engineering Impacts of shortlisted options

- Each shortlisted option is assessed in terms of the complexity of identified infrastructure works; and the impacts these may have on its surrounding natural and built environment.

- Major engineering aspects that were assessed:
  - Route alignment and geometry, e.g. reallocation of road space;
  - Significant land acquisitions that may be required;
  - Significant and detrimental traffic impacts anticipated;

- Bridges required; and
- Environmental impacts resulting from infrastructure works and implementation of routes.

9. Potential Quality of Service for Passengers

Quality criteria of public passenger transport, as advised by EN13816:2002, can be divided into the following categories:

- Availability, e.g. potential to serve key locations and catchments;
- Accessibility;
- Information;
- Time, i.e. potential journey times and speeds from network model;
- Customer Care;
- Comfort; and
- Security
- Environmental Impact

10. Capital Cost Estimates of shortlisted options

- Construction costs, including stops, ticketing machines, and road infrastructure
- Rolling stock costs

11. Identify Preferred Option

- Compare shortlisted options based on potential demand (from network model), engineering and environmental impacts, potential quality of service, and capital costs.
- Select preferred routes between Key Centres.

2. DEMAND ANALYSIS

In order to make a high level of assessment of the potential demand for Orbital Public Transport services in Dublin, various data sources were analysed. This analysis was focused on understanding:

- The type of journeys that an Orbital route would serve; and
- The potential demand that could use an orbital service

To carry out this analysis, a number of datasets provided by the NTA were used. These include:

- Model trip matrices;
- Base and Future Year Model trip ends;
- Census population and employment data;
- POWSCAR Census journey to work data; and
- Household survey data

The following sub-sections describe the work undertaken to assess demand at a preliminary stage (without network modelling):

- **Orbital Demand** – Understanding of current orbital movements and their characteristics in Dublin;
- **Capture Analysis** – Assessment of the potential capture for an orbital PT service based on existing model data and current mode shares; and
- **Initial Ranking Analysis** – Ranking of the routes based on corridor accessibility of the different routes.

2.1 Orbital Demand

To gain understanding the levels of current orbital movements in Dublin, the NTA's 2011 base year model's trip matrices were analysed. This gives a full picture of movements across the Dublin area, built from:

- census data;
- land use data;
- other origin/destination surveys; and
- counts of people and vehicles across the transport network.

2.1.1 Orbital Movements

The NTA matrices give the movements at a fine level of zonal detail; so to get a high level understanding of orbital movements, model zones were combined into larger areas (as shown on Figure 2 and Figure 3):

- at the settlement level in the study area; and
- the city of Dublin split into 3no. areas (i) Centre (ii) North and (ii) South.

Figure 2 shows the four largest orbital and arterial flows in Dublin. Unsurprisingly the largest movements are arterial ones between the settlements and the centre of Dublin, with its high concentrations of employment and retail activity. However, the largest orbital flows are of a similar magnitude, showing that there are significant numbers of orbital trips being made in Dublin.

Having noted that orbital flows are sizeable, it is also notable that the largest orbital movements are between adjacent settlements. These trips are therefore shorter in distance compared to the movements into the City Centre. Figure 3 shows the flows between some non-adjacent settlements of a more comparable journey distance to the flows to the City Centre. The numbers of trips being made are considerably lower - around a third of the comparator City Centre movements.

The analysis at the settlement level shows that:

- There is substantial orbital demand indicating the potential for orbital PT services; and
- An orbital service will need to be attractive to short distance trips.

Figure 2 All Day Movements Between Settlements – 4 largest Orbital and Arterial Movements

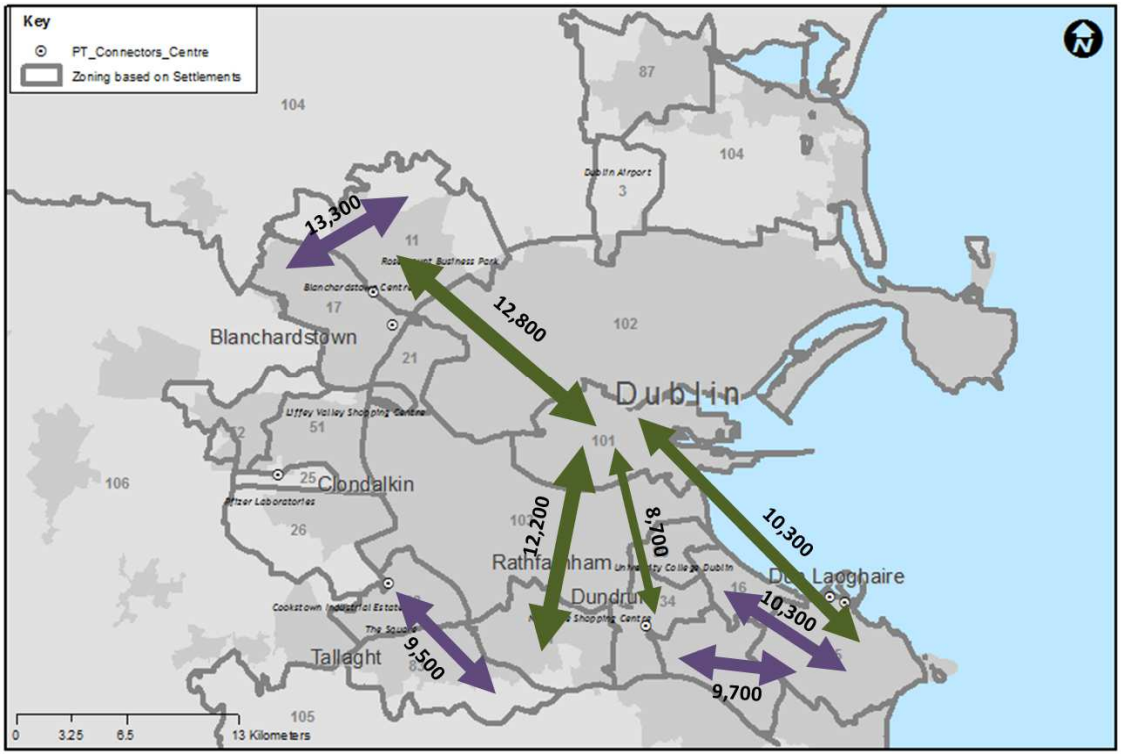
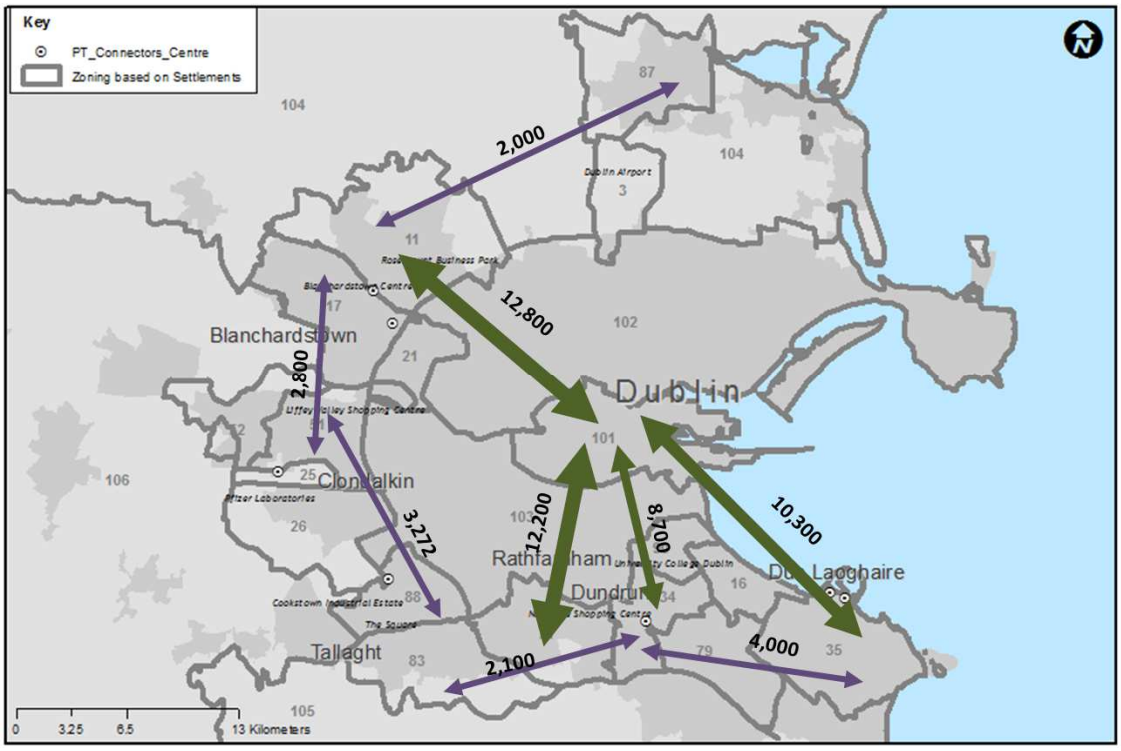


Figure 3 All Day Movements Between Settlements – Between non-adjacent Settlements



2.1.2 Orbital Trip Characteristics

To help define the potential for orbital PT services it is important to understand the characteristics of orbital demand. Analysis was undertaken to look at the current and future demand in the study area and the types of journey that make orbital movements.

2.1.2.1 Demand Analysis

The 2011 census data was analysed to understand the density and location of demand in the study area. Analysis was also undertaken of projected future year trip end growth to understand how this is likely to change in the future.

Figure 4 below shows the density of population in the study corridor with the darker green indicating denser levels of population. This shows a number of locations across the orbital corridors with relatively high density of population.

Figure 5 shows how trips are forecast to grow at an origin level in the future, indicating where there will be a growth in households in Dublin.

Figure 6 and Figure 7 show similar information, but for employment and trip generation growth, showing the destination end of the trip.

From analysing these figures, the key points in planning an orbital PT service are:

- There are areas of relatively high density population and employment along the orbital study corridors.
- Population is distributed more evenly across the corridor than employment. Many centres of the employment are in distinct locations often with relatively good existing transport links (either PT or highway).
- The main areas of growth in Dublin are focused in the study area, highlighting the importance of planning for this growth with future transport interventions.
- The southern sections of the study area (Sections C and D) are projected to have lower growth than Sections A and B. These are areas that are already well developed with less potential for growth compared to the West and North of Dublin.

Figure 4 2011 Census Population Density on Orbital Corridor

Figure 5 Trip End Generation Growth (2011-2035) – Currently Available NTA Data

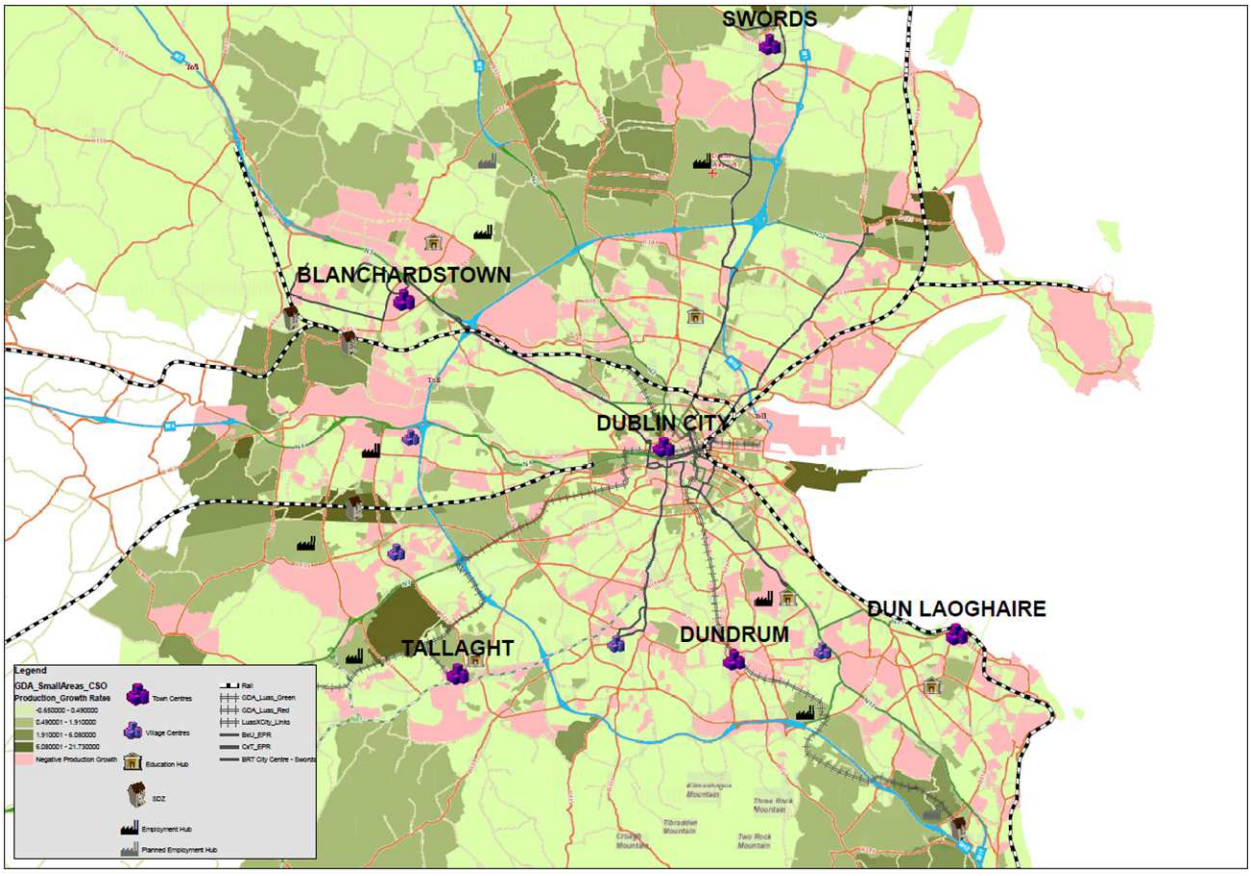
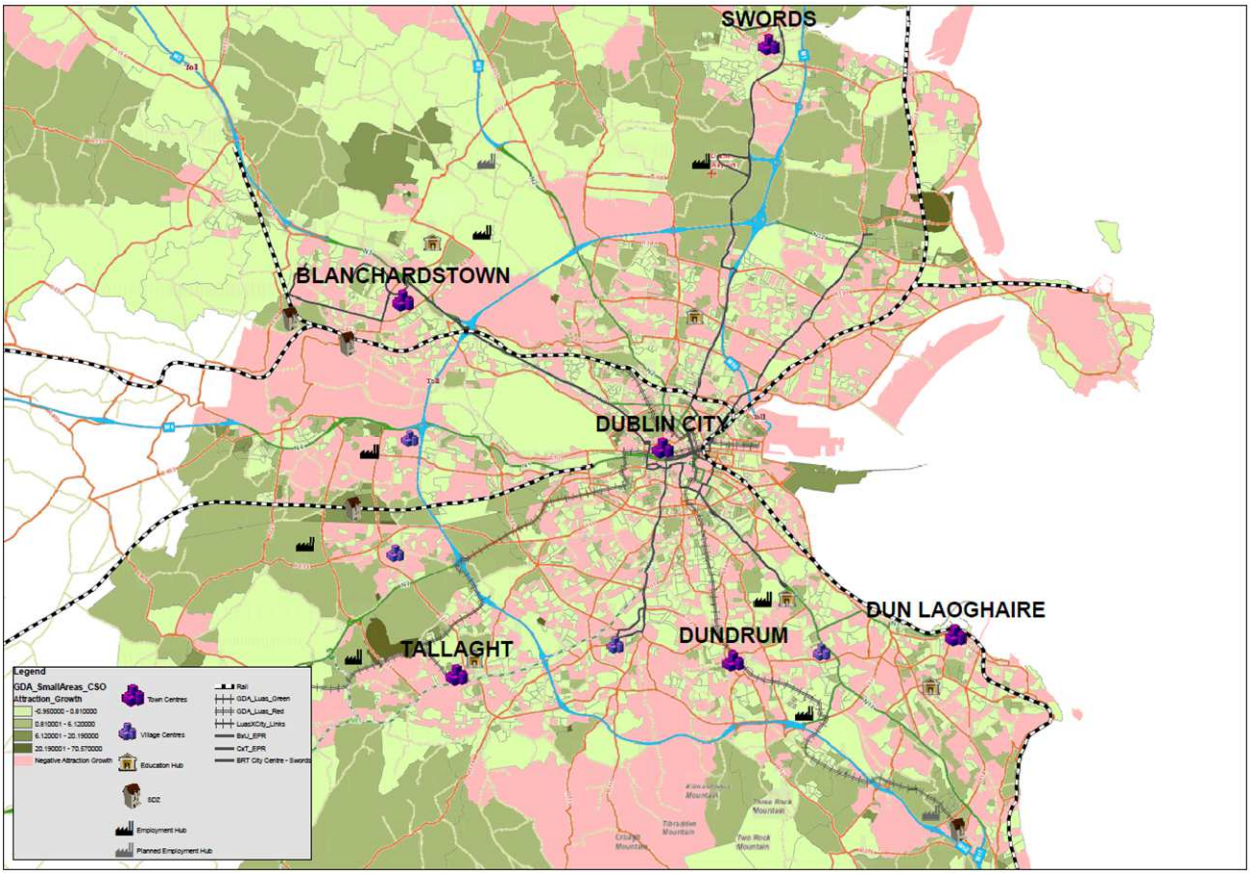


Figure 6 2011 Census Employment Density on Orbital Corridor

Figure 7 Trip End Attraction Growth (2011-2035) – Currently Available NTA Data



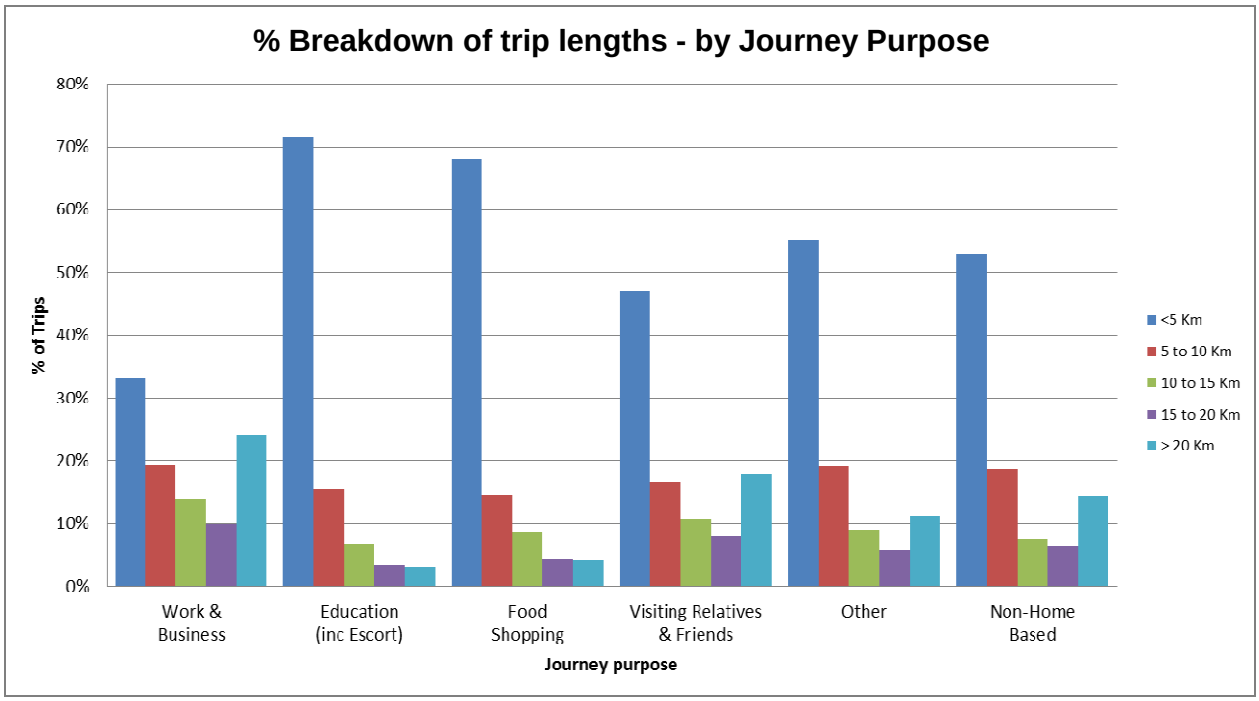
2.1.2.2 Orbital Journey Characteristics

Our experience on orbital transport studies is that these services typically attract a higher proportion of leisure/retail and education trips, compared to arterial movements into the city centre (which typically have more journey to work trips). It is therefore important to understand how these journey types differ from journey to work trips when planning an orbital service.

The NTA provided a summary of their 2012 National Household Travel Survey, which was analysed to gain insight into the characteristics of journeys making orbital type movements. This household travel survey was completed by a number of households across Ireland to get a picture of all types of journeys that people make.

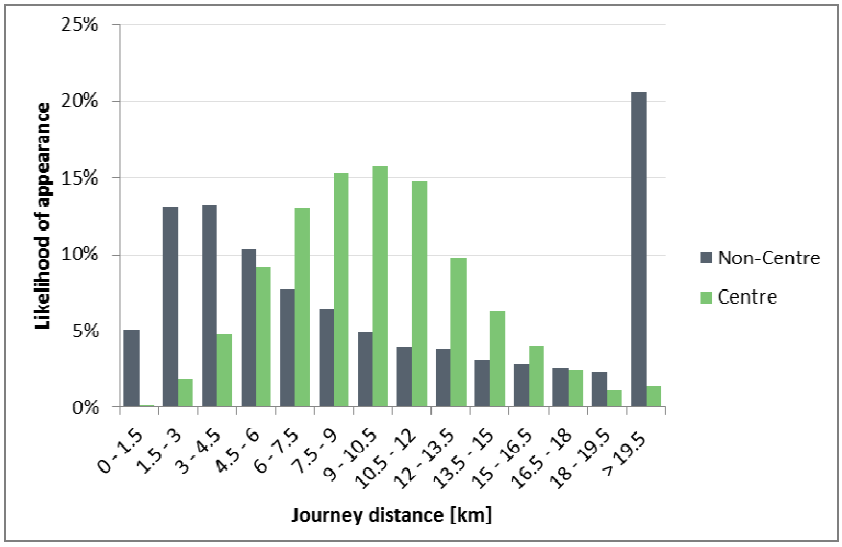
Figure 8 shows the journey distances travelled for different types of journey. This shows that journeys to work tend to be longer distance compared to other journey types. Shopping trips and education are the shortest in distance, with shopping trips also having by far the largest proportion of walk trips (which will not be considered as being in-scope for transfer to an orbital PT service).

Figure 8 Journey Purpose – NTA 2012 National Household Travel Survey



Trip lengths for trips into the centre of Dublin have been compared with orbital trips as shown in Figure 9**Error! Reference source not found.**. As expected, this highlighted that orbital trips have a higher proportion of shorter distance trips (under 6kms) compared to trips to the city centre. Non-centre trips also have a higher proportion of longer distance trips over 19km, however these are not planned to be catered for an orbital PT service.

Figure 9 Journey Length Distribution – Trips to/from Centre of Dublin and Non-Centre Trips



Mode shares by journey length for orbital and City Centre movements are shown in Figure 10.

The graphs show higher PT mode shares for trips into the city centre, which is a result of (a) the purposes of the trips being made, e.g. a high proportion of regular journey to work trips; (b) better PT network for radial movements; and (c) other factors such as limited supply of car-parking spaces and competitive PT journey times.

It also shows that it is the medium distance trips which have the highest PT shares, which again poses a challenge for orbital services where shorter and longer distance trips are more prevalent compared to the city centre movements.

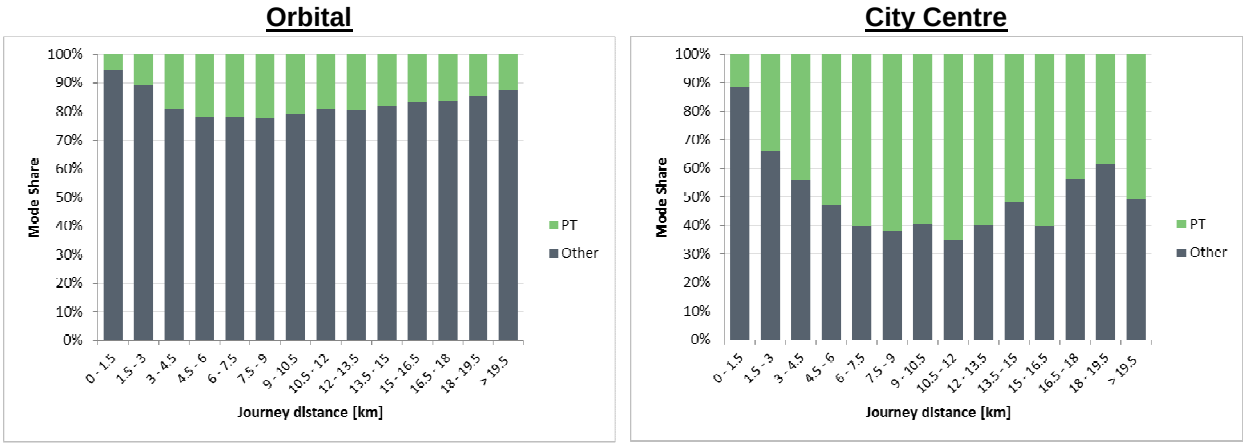


Figure 10 Journey Distance Mode Shares for Orbital and City Centre Trips

2.1.3 Existing Mode Shares

Existing modal shares in Dublin for the settlements in the orbital corridors were analysed using 2011 POWSCAR data. Figure 11 below shows the public transport mode shares for radial movements of settlements in the study area, showing mode shares into the City Centre and to outer Dublin (adjacent to the settlement). This can be compared to Figure 12 below which shows the mode shares for orbital movements between settlements within each study section.

These figures demonstrate high public transport mode shares for journeys into Dublin city centre. The mode shares reduce for movements not to the city centre, and in particular the orbital PT shares are fairly low with between 10% and 20% PT mode shares for the four sections (this excludes journey within settlements which have a lower mode share).

Figure 11 POWSCAR Public Transport Mode Shares – Between Settlements and Dublin

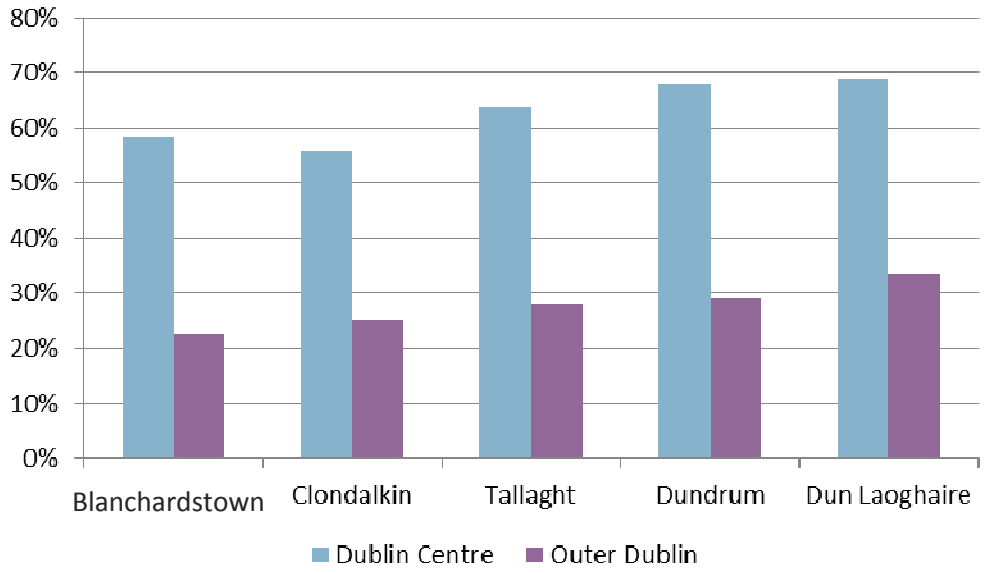
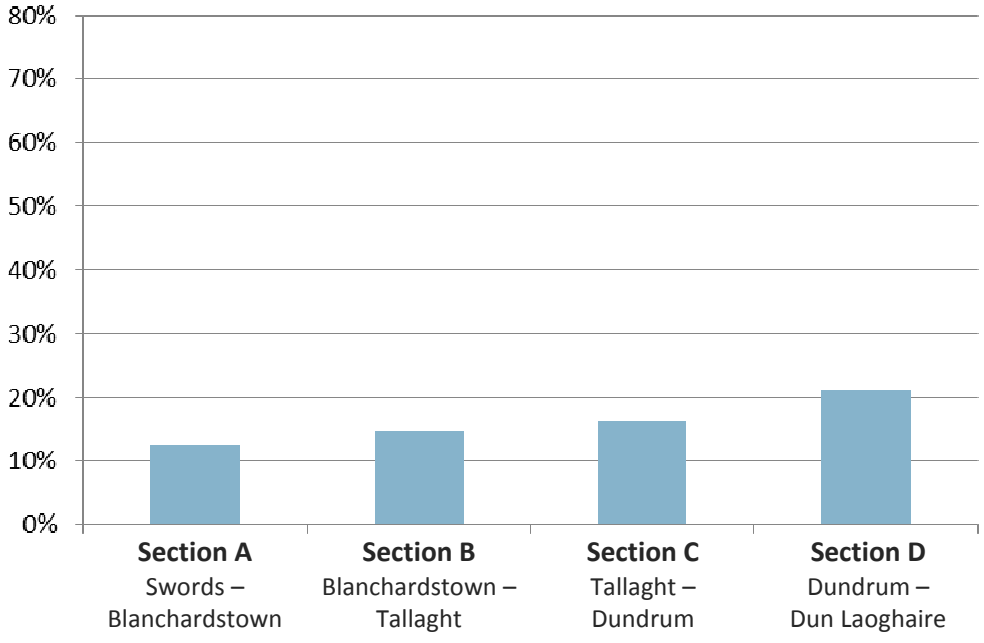


Figure 12 POWSCAR Public Transport Mode Shares – Between Settlements for Orbital Movements



2.1.4 Summary of Orbital Demand

The analyses above leads to the following key points for planning an orbital PT service in Dublin:

- There is significant orbital demand in Dublin, but many of the movements are relatively short distance.
- There are significant employment and population centres on the corridors.
- Current PT mode shares are low for orbital movements.
- Current patterns (trip length, journey purpose) of orbital movement are less conducive for use of public transport than arterial trips
- There is significant growth planned on the orbital corridors and it is necessary that PT services are designed to meet demand in these areas.

2.2 Capture Analysis

The analyses above provided an assessment of the broad nature of orbital demand in Dublin and how this compares with radial trip making. The success of the orbital service in attracting PT patronage will be dependent on journeys in the corridor that have reasonable access to the service. This means that passengers will need to have both their origin and destination within reasonable walking distance of the service. As well as orbital point-to-point trips, an orbital public transport service should also be anticipated to attract some extra demand from passengers who:

- Use orbital services and then transfer to other PT services; or
- Access orbital services using park and ride (P&R) or cycle and ride (this will allow people to travel further to access the service)

To assist with the specification of the orbital public transport routes that would be subject to more detailed assessment, an initial assessment was made of the potential numbers of passengers that a PT service could achieve. For this, the NTA model all mode demand matrices were used to define the levels of demand that have potential for transferring to an orbital PT service. This was combined with analysis of observed POWSCAR journey to work data which gives current mode shares of trips in Dublin to define capture rates for the PT service. (Noting that PT tends to be more attractive for JTW trips than for trips made for other purposes.)

2.2.1 Methodology for Capture Analysis

When producing the capture analysis the relevant demand was split into three types of orbital journey:

- **Orbital Demand by Corridor (No Interchange)** -
  These are point-to-point journeys that would be made on the orbital corridor without the need to change service. Journeys that both start and end within 800m each side of the route alignment for each individual corridor were considered in scope.

- **Orbital Demand Between Corridors (With Interchange)** -
  These are journeys that would be made on the orbital corridors, but there would be a need to change between orbital services. For the analyses journeys were considered that both start and end within 800m each side of the route alignment, but would have to change between orbital services.

- **City Centre Transfer** -
  Public transport journeys to/from the city centre that use the orbital service to access the radial transport network into the centre. Journeys that start or end within 800m each side of the route alignment, and start or end in Dublin City Centre were in scope for the analyses.

Short distance trips that are within walking distance have not been included, i.e. work trips less than 1.5km were excluded.

Detailed analysis has been carried out for one option per corridor (Preliminary route Options A1, B2, C1 and D1 were used at this stage). It is not necessary to test each route at this stage of the project, as the analysis is done to define the potential scale of demand that should be planned for, when shortlisting the options for detailed testing. Two sets of demand capture have been derived- a central case and an upside case, to give an assessment of the potential range of passenger numbers using the orbital services. The central case assumptions are discussed in detail below, with the upside results following later.

The capture rates are based on analysis of POWSCAR mode shares. They were derived by analysing existing high-quality PT corridors and using these observed capture rates to define what could be achieved if the orbital services were similarly attractive. The applied capture rates following this analysis are:

- For orbital movements that would not need to interchange, the capture rate is based on the current mode share of journeys between Tallaght and South Inner Dublin (i.e not Dublin centre). This is a corridor served by the LUAS, representing a high quality PT alternative without a need for any interchange and trips are more likely to be of a similar journey distance to the orbital demand. In addition parking availability will be less constrained than in the centre of Dublin and, therefore, more similar to the orbital routes.

- For orbital movements requiring interchange, the capture rate for Tallaght to North Inner Dublin was applied. This is a movement served by public transport, but requires an interchange.
  Note: Orbital movements requiring more than one interchange are not considered.

- The following assumptions are made when deriving the city centre capture rates:
  - Demand from zones that currently have a “high quality” PT options for travelling into the city centre (i.e. close to LUAS, DART or heavy rail lines) are not considered for the orbital services.
  - There would be no extra capture from current PT movements into the city.
  - That PT mode shares to the city centre will not exceed the “high quality” corridors.
  - Of the remaining demand we have assumed that half of this would transfer to the orbital services. The PT shares into the city centre will therefore be closer to the “high quality” zones, but given the need to interchange PT is still not considered as attractive an option.

The capture rates applied are as follows:

- Orbital Demand by Corridor (No Interchange): **28%**
- Orbital Demand Between Corridors (With Interchange): **24%**
- City Centre Transfer: **4%**

The matrices were provided for the AM Peak period and inter-peak average hour. In order to provide all weekday and annual flows the following factors were applied:

- For daily demand:
  - **2x AM period** (i.e. PM considered to be inverse of AM)
  - **6x Inter-Peak period**
- Annualisation factor – **300** (days)

Table 1 and Table 2 below show the potential demand in the corridor for the three different demand segments. Also shown is the settlement-level orbital demand, which when compared to the relevant demand (total demand), demonstrates the extent to which demand is geographically dispersed in these suburban areas. The demand analysis demonstrates that:

- There is significant orbital demand;
- Section C has the highest potential for an orbital service, and Section A the lowest; and
- Orbital demand is fairly dispersed, with a relatively small proportion of the demand being close enough to the corridor to use the PT services (without P&R), with the following observations:
  - Routes A and B have around 10% of orbital trips in-scope;
  - Route C has around 55% in-scope; and
  - Route D around 20% in-scope

Table 1: Base Year 2011 - Demand (without Swords Extension)

Route	Settlement Level Orbital Demand (No Interchange)	Orbital (No Interchange)	Orbital (Interchange)	City Centre	Total (Corridor)
A1	56,000	6,300	2,300	1,800	10,400
B2	92,000	11,200	8,500	7,400	27,000
C1	63,000	34,300	14,900	14,700	63,900
D1	66,000	13,600	9,400	3,500	26,500
Total	**277,000**	**65,400**	**35,000**	**27,400**	**127,800**

Table 2: Future Year 2035 Capture - Demand (without Swords Extension)

Route	Settlement Level Orbital Demand (No Interchange)	Orbital (No Interchange)	Orbital (Interchange)	City Centre	Total (Corridor)
A1	63,000	8,400	2,900	2,300	13,600
B2	113,000	16,400	10,700	9,400	36,500
C1	70,000	34,800	17,100	17,100	69,000
D1	69,000	13,500	10,100	4,000	27,600
Total	315,000	73,200	40,800	32,800	146,800

Following the 'Demand Analysis' stage, routes OptionA2 and OptionB1 were considered to be preferable (rather than OptionA1 and OptionB2). To assess the impact on capture rates the numbers have been factored up based on the extra trips generated in the routes catchment area. This assumes that the trip distribution and capture rates between the original and new preferred route options are the same. It should be noted that the full capture analysis has not been undertaken on these options and that there is likely to be some differences in the trip distribution, particularly between OptionA1 and OptionA2 whose route alignments are very different.

The demand on the orbital routes, after applying the capture rates, is shown in Table 3 and Table 4 below. It shows the following:

- Routes A and D have the lowest demand - around 6,500 passengers per day by 2035 on Route A (another 1,000 trips would be added if the route is extended to Swords), and 6,400 on Route D.
- Route C has the highest potential demand, with around 14,500 passengers per day by 2035
- Route B has potential demand of around 9,000 passengers per day by 2035

Table 3: Base Year 2011 - Capture (without Swords Extension)

Route	Orbital (No Interchange)	Orbital (With Interchange)	City Centre	Total (Daily)	Total, Mil. (Annual)
A1	1,800	500	100	2,400	0.72
B2	3,100	2,000	300	5,400	1.64
C1	9,600	3,600	600	13,800	4.14
D1	3,800	2,300	100	6,200	1.87
Total	**18,300**	**8,400**	**1,100**	**27,800**	**8.37**

Table 4: Future Year 2035 - Capture (without Swords Extension)

Route	Orbital (No Interchange)	Orbital (With Interchange)	City Centre	Total (Daily)	Total, Mil. (Annual)
~~A1~~	~~2,400~~	~~700~~	~~100~~	~~3,200~~	~~0.95~~
A2	4,900	1,400	200	6,500	1.94
B1	5,400	3,100	500	9,000	2.67
~~B2~~	~~4,600~~	~~2,600~~	~~400~~	~~7,600~~	~~2.27~~
C1	9,700	4,100	700	14,500	4.37
D1	3,800	2,400	200	6,400	1.92
Total	**20,500**	**9,800**	**1,400**	**31,700**	**9.50**

2.2.2 Peak Hour Analysis

The same methodology was applied to the AM peak hour matrices. This is useful for benchmarking against other PT schemes where the passenger numbers are often reported in peak flows.

Table 5 shows these hourly figures (these are combined figures for both directions).

Table 5: AM Peak Hour 2035 Flows (Both Directions)

Route	Orbital (No Interchange)	Orbital (With Interchange)	City Centre	Total (Hourly)
~~A1~~	~~400~~	~~100~~	~~20~~	~~500~~
A2	818	205	41	1,023
B1	825	471	71	1,414
~~B2~~	~~700~~	~~400~~	~~60~~	~~1,200~~
C1	1,500	700	110	2,300
D1	500	400	20	900
Total	**3,100**	**1,600**	**210**	**4,900**

When assessing the numbers above the following factors should be taken into account that would increase the numbers of passengers expected to use an orbital PT service:

- The matrix used to assess the future demand, if amended or revised;
- No induced trips are assumed, where new journeys are made following the improvement in connectivity on the orbital corridor;
- There is no explicit consideration of Park& Ride or Bike & Ride trips; or
- Any increased congestion or demand management on the M50 is not assessed which could increase the PT capture rates.

2.2.3 Upside Capture

An alternative demand analysis has also been produced, with a more optimistic set of assumptions. While these assumptions are optimistic, they are reasonable, albeit at the higher end of what could be anticipated. In this analysis, the following have been assumed:

- For Orbital Demand by Corridor (No Interchange):
  - Same capture rate as between Dun Laoghaire and South Inner Dublin (DART corridor): **34%**
  - An “induced” factor to account for the generation of new trips and the impact of demand management on the M50: an additional **10%** of new trips added to the captured demand.
  - Park and Ride: an additional **5%** of new trips added to the captured demand from outside of the route corridor.
- Orbital Demand Between Corridors (With Interchange):
  - No change from the central case: **24%**
- City Centre Transfer:
  - All areas in the orbital corridor to have the same PT capture rates into the city centres - **8%**

Table 6: Future Year 2035 - Capture (without Swords Extension) – Upside Case

Route	Orbital (No Interchange)	Orbital (With Interchange)	City Centre	Total (Daily)	Total, Mil. (Annual)
~~A1~~	~~3,300~~	~~700~~	~~200~~	~~4,200~~	~~1.26~~
A2	6,800	1,400	400	8,600	2.58
B1	7,700	3,100	900	11700	3.48
~~B2~~	~~6,500~~	~~2,600~~	~~800~~	~~9,900~~	~~2.95~~
C1	13,700	4,100	1,500	19,300	5.78
D1	5,300	2,400	300	8,000	2.43
Total	**28,800**	**9,800**	**2,800**	**41,400**	**12.41**

2.2.4 Summary of Capture Analysis

There are factors which mean passenger numbers could be higher than those shown in the capture analysis above, for example:

- Larger development growth in the corridor than forecast by the existing NTA model;
- A significant change in trip distribution following the introduction of a high quality orbital service; or
- The full impact of demand management on the M50

However it should be noted that the 800m buffer and the nearly 30% capture rates are at the higher end of what we would expect to be achieved. The numbers presented are, therefore, a reasonable starting point for understanding the scale of the demand to be planned for in shortlisting the options selected for the detailed testing.

2.3 Choice of Mode

The demand analysis indicates that bus-based services would be sufficient to meet the demand on each route section; and high-quality bus-based services would be necessary on Section B and Section C.

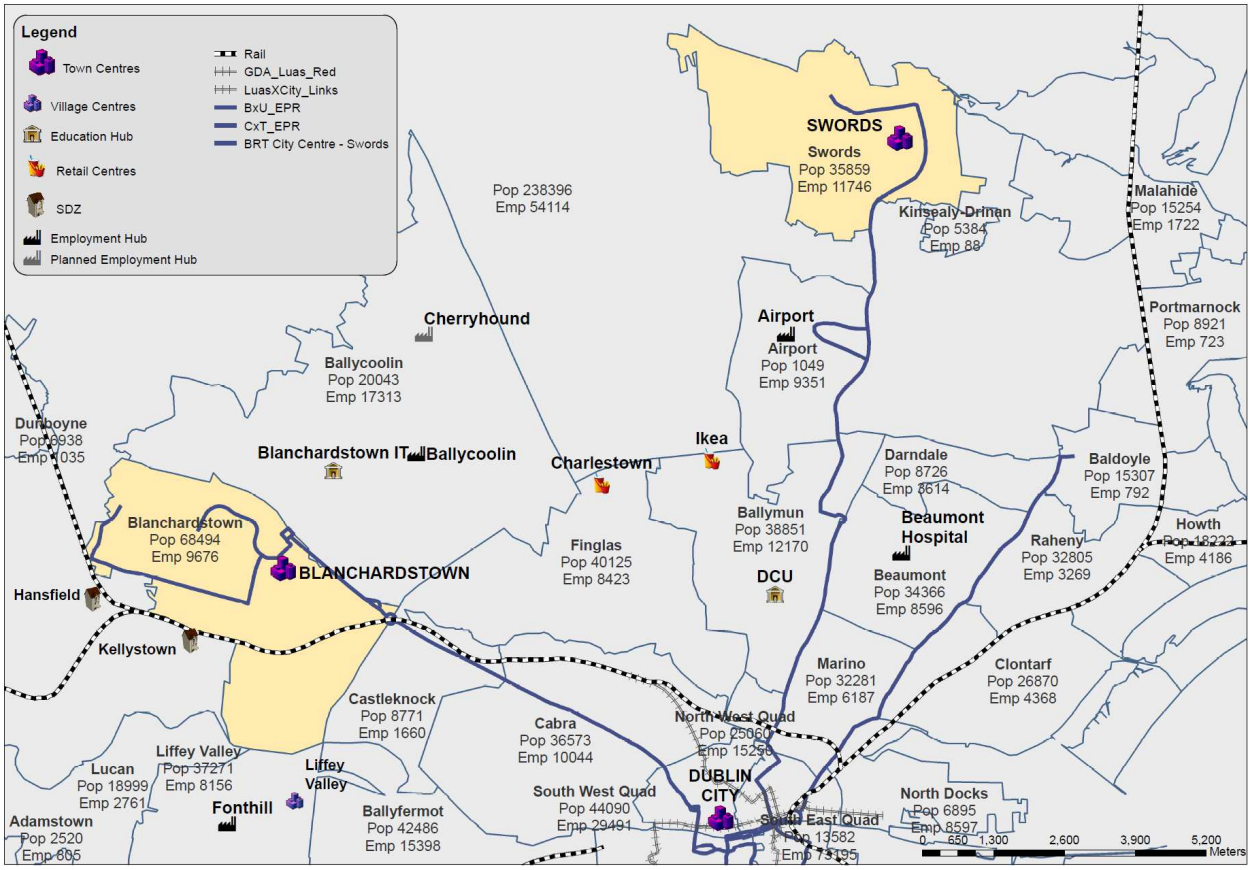
While BRT-type dedicated running ways may not be possible for most routes in most sections, due to space constraints in urban built-up locations, it is still possible to provide bus services that meet higher-than-conventional quality standards in terms of availability, accessibility, information, time, customer care, comfort, and security.

The recommended quality criteria for bus with high level of service (BHLS) are further discussed in the next chapters.

3. SECTION A: SWORDS TO BLANCHARDSTOWN

Swords and Blanchardstown were identified as two northern "Key Centres" to be served by orbital public transport service. The population and employment levels in Swords and Blanchardstown settlement areas are shown on Figure 13 below (and in following page).

Figure 13 Swords and Blanchardstown Key Centres



At present there is no direct public transport service between Swords and Blanchardstown. The quickest method of travel between these two places is by car mode, using the M50 motorway; and the quickest way by public transport mode is radially via city centre. A comparison of current travel times is attached in *Appendix A* of this document.

Long-term high-capacity public transport services to north / northwest Dublin, which are expected to be delivered by future year 2035, include:

- Blanchardstown/ UCD BRT (shown on Figure 13 and Figure 14);
- Swords/ Airport to City Centre BRT (shown on Figure 13, Figure 14s, and Figure 15)

Existing orbital Dublin Bus routes serving Blanchardstown and/or Swords include:

- 17a Blanchardstown Centre – Kilbarrack
- 76a Blanchardstown Centre – Tallaght
- 102 Sutton Station – Dublin Airport
- 220 Mulhuddart – Ballymun, via Blanchardstown Centre
- 239 Blanchardstown Centre – Liffey Valley

Current Dublin Bus routes and planned long-term public transport routes for Blanchardstown and Swords are shown on Figure 14; and for east of Blanchardstown on Figure 15. Transport for Ireland schematic maps of current bus services from Swords and Blanchardstown are also shown in *Appendix B* of this document.

Figure 13 Swords and Blanchardstown Key Centres

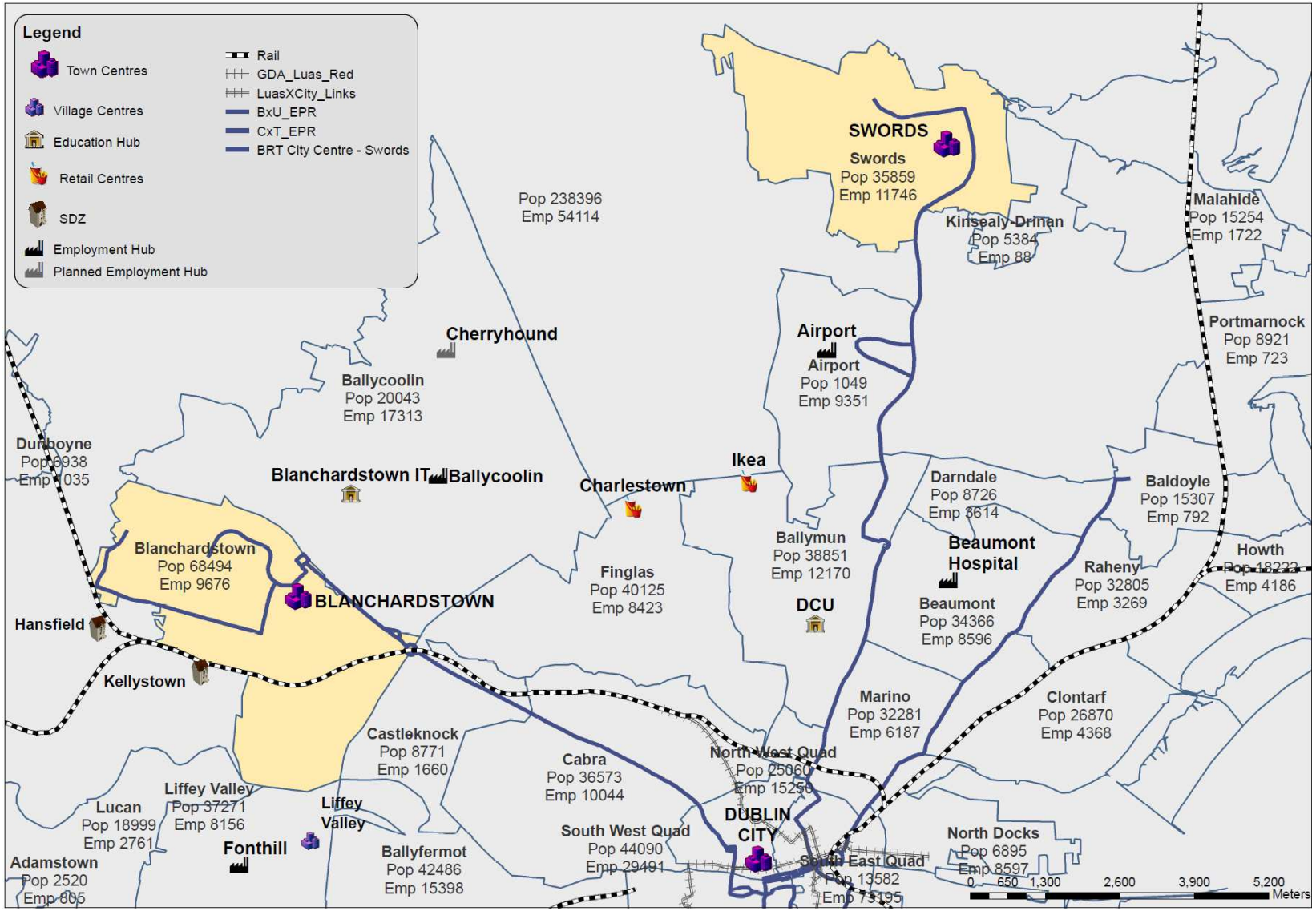


Figure 14 Swords and Blanchardstown Existing and Planned Public Transport Services

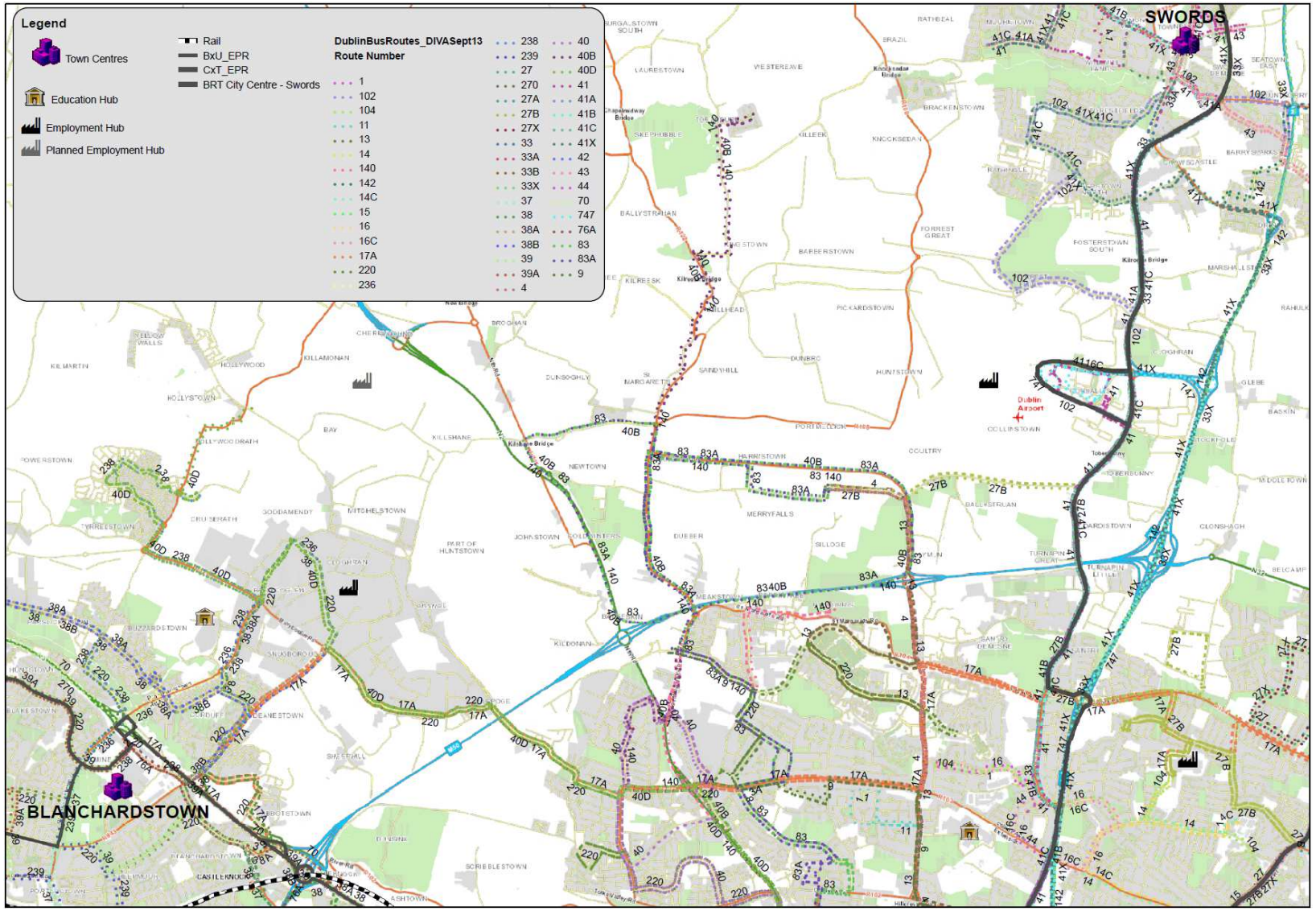
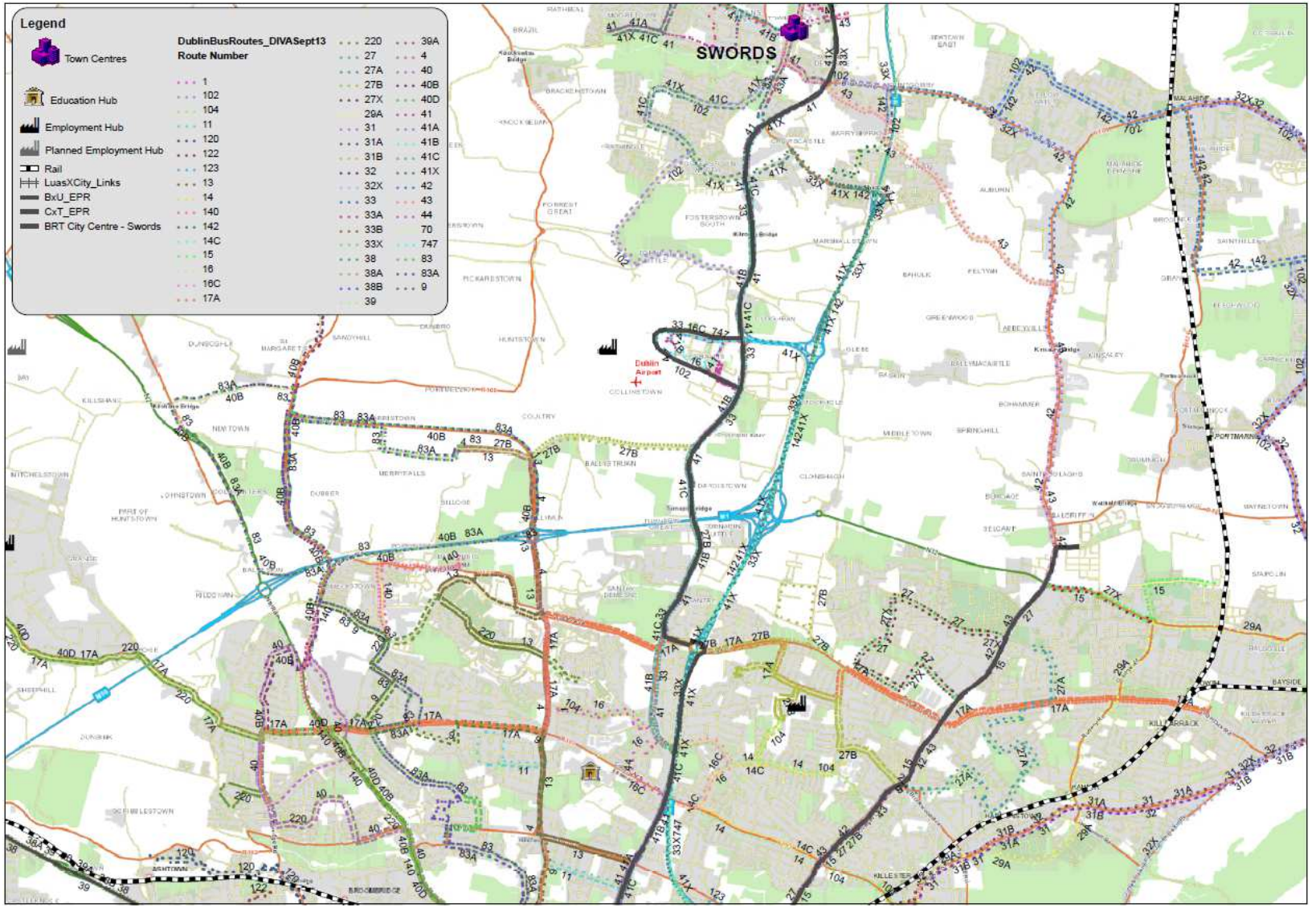


Figure 15 East of Blanchardstown Existing and Planned Public Transport Services



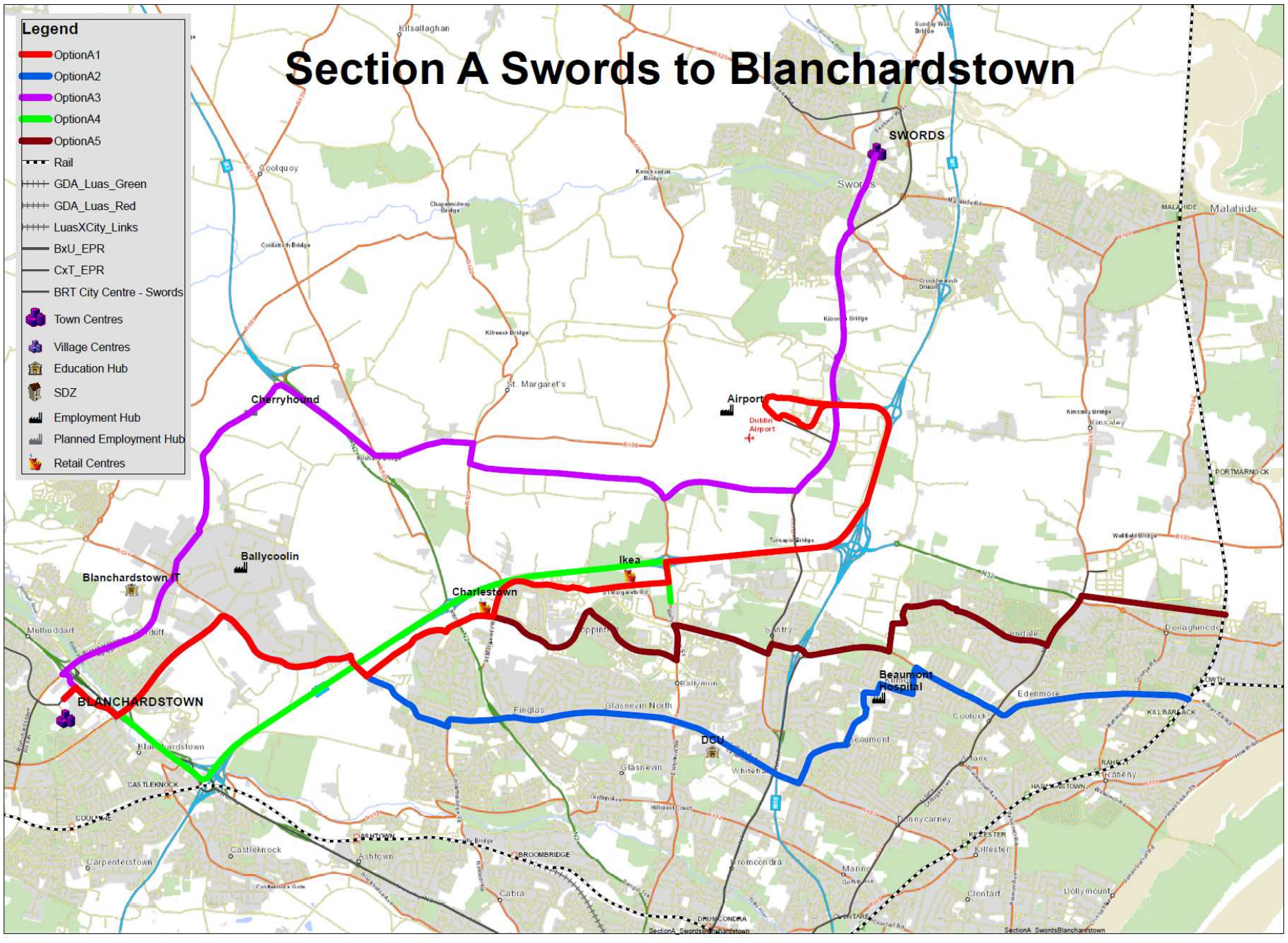
3.1 Preliminary Route Options

Five preliminary orbital route options were identified northwards and westwards of Blanchardstown. Of these, one would connect directly with Swords (OptionA3); and four would connect via interchange with the Swords/ Airport to city Centre BRT or with proposed high-capacity radial PT service between Swords – Airport – City Centre.

- OptionA1 Blanchardstown – Airport (via Charlestown)
- OptionA2 Blanchardstown – Finglas – Whitehall (via DCU) to Howth Junction (via Beaumont)
- OptionA3 Blanchardstown – Swords (via Cherryhound)
- OptionA4 Blanchardstown – Ballymun (via M50)
- OptionA5 Blanchardstown – Ballymun (via Charlestown) to Clongriffin (via Clonshaugh)

These are shown in following Figure 16 and in *Appendix C* of this document.

Figure 16 Preliminary Route Options For Section A: Swords to Blanchardstown



3.2 Appraisal of Preliminary Options

3.2.1 Criteria

In order to shortlist options that could be brought forward for further assessment, all identified preliminary options have been screened based on the following headline criteria:

i. Demand;
ii. Key destinations served;
iii. Journey times;
iv. Significant engineering impacts;
v. Significant environmental impacts;
vi. High level costing

Under each of these headline criteria is a list of elements which are deemed crucial to evaluating the feasibility of each route option. These elements are listed in the appraisal table.

3.2.2 Comparative Evaluation

All identified preliminary options were evaluated comparatively, i.e. how each option fares in comparison with other options.

- Where an option fares obviously better than most other options, it is given a green status:
- Where an option fares obviously poorer than most other options, it is given a red status:
- Where an option fares nearly the same as most other options, i.e. does not fare obviously better or poorer than most other options, it is given an amber status:

Appraisal of the identified preliminary options for Section A is shown in *Table 7*.

Table 7: Appraisal of Preliminary Options for Section A: Swords to Blanchardstown

Route Options	A1	A2	A3	A4	A5
1. DEMAND					
1.1. Primary Demand *(within 800m)*					
1.1.1.Population *(2011 Census)*	34,131	113,618	30,468	22,304	97,677
1.1.2.Employment *(2011 Census)*	30,686	37,594	37,907	10,320	29,541
Population + Employment Total	*64,817*	*151,212*	*68,375*	*32,624*	*127,218*
1.1.3.Potential Commuter Trip Demand *(based on 2011 POWSCAR[1])*	1,554	7,207	2,169	726	4,813
% Potential Commuters with multiple car ownership	*59%*	*65%*	*65%*	*64%*	*62%*
1.1.4.Future year 2035 Population	42,047		37,963	26,747	
1.1.5.Future year 2035 Employment	39,331		41,852	8,578	
Future year 2035 Population + Employment Total	*81,378*		*79,815*	*35,325*	
1.2. Secondary Demand					
1.2.1.Radial PT interchange modes	Future LRT/ BRT	Future LRT/ BRT/ DART	Future LRT/ BRT	Future LRT/ BRT	Future LRT/ BRT/ DART
1.2.2.Local PT interchange locations	Dardistown/ Airport; Blanchardstown	Whitehall; Blanchardstown; Howth Junction	Dardistown/ Airport; Blanchardstown	Blanchardstown	Blanchardstown; Clongriffin
1.2.3.Potential bike and ride locations	Blanchardstown	Blanchardstown, Howth Junction	Blanchardstown	Blanchardstown	Blanchardstown, Clongriffin
1.2.4.Dublin Airport	•				
2. KEY DESTINATIONS SERVED					
2.1. Town Centres					
2.1.1.Swords	*Interchange with LRT/ BRT*	*Interchange with LRT/ BRT*	•	*Interchange with LRT/ BRT*	*Interchange with LRT/ BRT*
2.1.2.Blanchardstown	•	•	•	•	•
2.2. Education Hubs					
2.2.1.Blanchardstown IT			•		
2.2.2.DCU		•			
2.3. Employment hubs					
2.3.1.Swords	*Interchange with LRT/ BRT*	*Interchange with LRT/ BRT*	•	*Interchange with LRT/ BRT*	*Interchange with LRT/ BRT*
2.3.2.Dublin Airport	•		•		
2.3.3.Ballycoolin	•	•	•		•
2.3.4.Blanchardstown	•	•	•	•	•
2.3.5.Beaumont Hospital		•			

[1] Based on number of commuters with place of residence and place of work or school along route AND are currently commuting by bus, or are currently commuting by car (driving or as passenger) with current commuting journey times of more than 7 minutes.

Route Options	A1	A2	A3	A4	A5
2.4. Retail centres					
2.4.1.Swords	*Interchange with LRT/ BRT*	*Interchange with LRT/ BRT*	•	*Interchange with LRT/ BRT*	*Interchange with LRT/ BRT*
2.4.2.Blanchardstown	•	•	•	•	•
2.4.3.Charlesland	•				•
3. JOURNEY TIMES					
3.1. Length (km)	14km	19.0km	19.1km	11.3km	20.2km
3.1.1.Journey Time[2] with Existing Infrastructure	53 mins	53 mins	69 mins	27 mins	56 mins
3.1.2.Potential Journey Time[2] and Speed with Proposed Infrastructure	36 mins / 23kph	58 mins / 20kph	62 mins / 18kph	22 mins / 31kph	58 mins / 21kph
3.2. Reliability (e.g. bus priority and sensitivity to congestion)					
3.2.1.% Bus Priority at Junctions					
3.2.2.% Existing Bus Lanes	15%	9%	18%	3.5%	19%
3.2.3.% Potential Bus Lanes	33%	24%	39%	19%	24%
3.2.4.% Motorway (uncongested)	28.5%	-	-	89%	-
4. SIGNIFICANT ENGINEERING IMPACTS					
4.1. Major Structures	• Bridge over N3	• Bridge over N3	None anticipated	None anticipated	• Bridge over N3
4.2. Substantial Landtake	Cappoge	None anticipated	None anticipated	None anticipated	None anticipated
5. SIGNIFICANT ENVIRONMENTAL IMPACTS					
5.1. Protected Natural Heritage Sites	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated
5.2. Land Severance	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated
5.3. Impact on Built Environment	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated
6. HIGH LEVEL COSTINGS					
6.1. Capital investment (excluding transit vehicles)	€25M	€35	€20M	€5M	€20

[2] Bus speeds have been based on the NTA's analysis of AVL data for Dublin Bus route 75. Motorway speed is assumed to be 60km/h at all times. Full bus priority is assumed to be 27km/h at all times. Otherwise speed is assumed to be 19km/h.

3.3 Options Screening

At this stage, a screening process was carried out to eliminate options that are obviously unfeasible.

OptionA4 was eliminated because the demand it can potentially serve is very low.

OptionA3 was eliminated because the expected journey time (69 mins) would be too long in comparison with car-mode journey time (18 mins).

3.4 Shortlisted Options

Based on the comparative evaluation shown in *Table 7*, the following three options have fared better than the rest, and will be progressed to the next stage for further assessment.

- **OptionA1** Blanchardstown – Airport (via Charlestown)
- **OptionA2** Blanchardstown – Whitehall (via DCU) – Howth Junction (via Beaumont)
- **OptionA5** Blanchardstown – Ballymun (via Charlestown) – Clongriffin (via Clonshaugh)

Analysis of demand between Blanchardstown and Swords has indicated low levels of demand between these two key centres - hence a high-quality direct PT service may not be viable.

PT connection between Blanchardstown and Swords could instead be made by interchange between an orbital service to/ from Blanchardstown and proposed high-capacity radial PT service between Swords – Airport – City Centre.

3.4.1 OptionA1: Blanchardstown – Airport (via Charlestown)

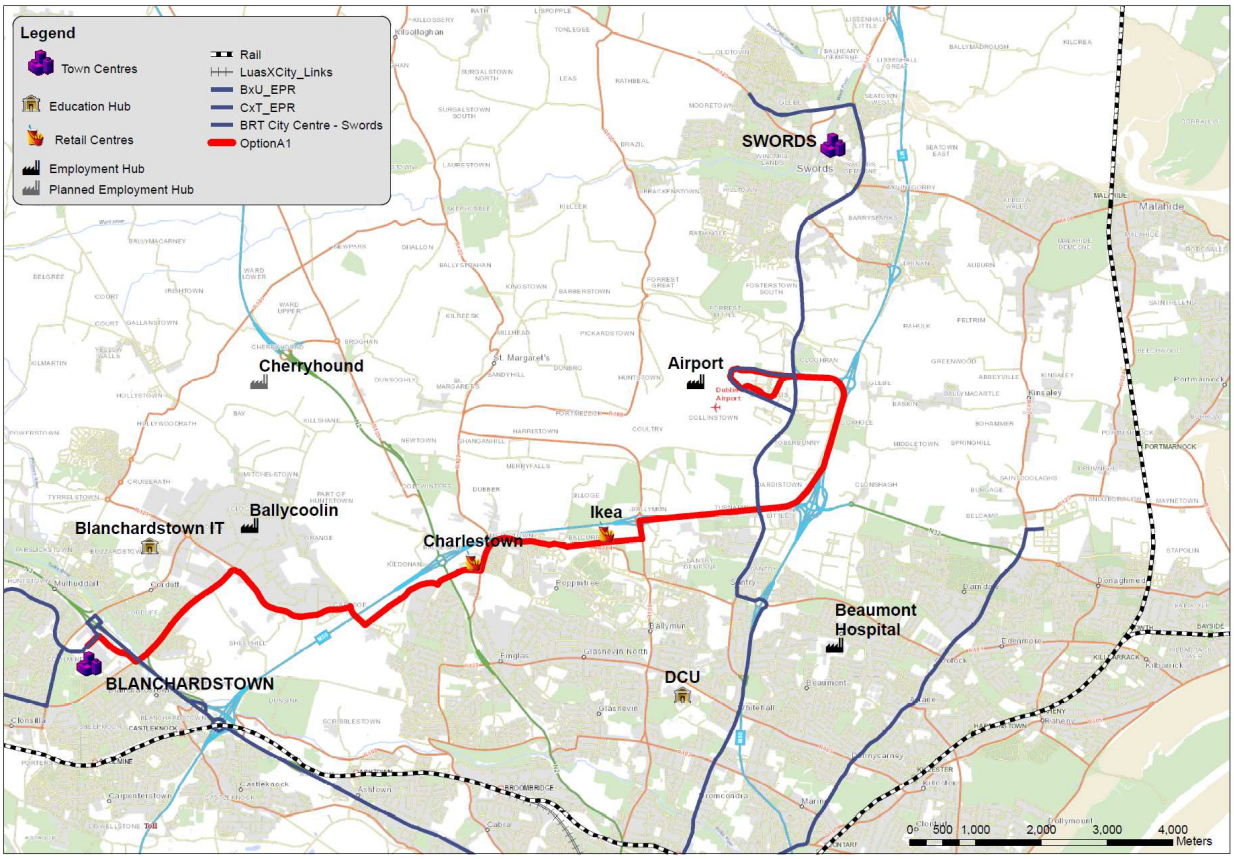


Figure 17 OptionA1 Blanchardstown – Airport (via Charlestown)

OptionA1 has been shortlisted because of its following advantages:

- Potential to provide PT connection between Blanchardstown, Charlestown, Ikea, and Dublin Airport, which is currently not available;
- Potential for interchange with radial PT service to/from Swords, i.e. Swords – City Centre BRT or high-capacity PT service between Swords – Airport – City Centre; and
- Potentially high speed service (22kph) due to existing bus lanes, routing on motorways (M50/ M1), and good potential to provide additional bus priority infrastructure.

Analysis of demand between Blanchardstown and Swords has indicated low levels of demand between the two key centres. However there would be demand for orbital public transport (PT) service between Blanchardstown and Dublin Airport, as Blanchardstown has a large population catchment with no PT service to the airport available at present.

This option would allow for PT connections to/ from Swords via interchange with radial PT services at Dublin Airport or the R132 / N1.

3.4.2 OptionA2: Blanchardstown – Finglas – Whitehall (via DCU) – Howth Junction

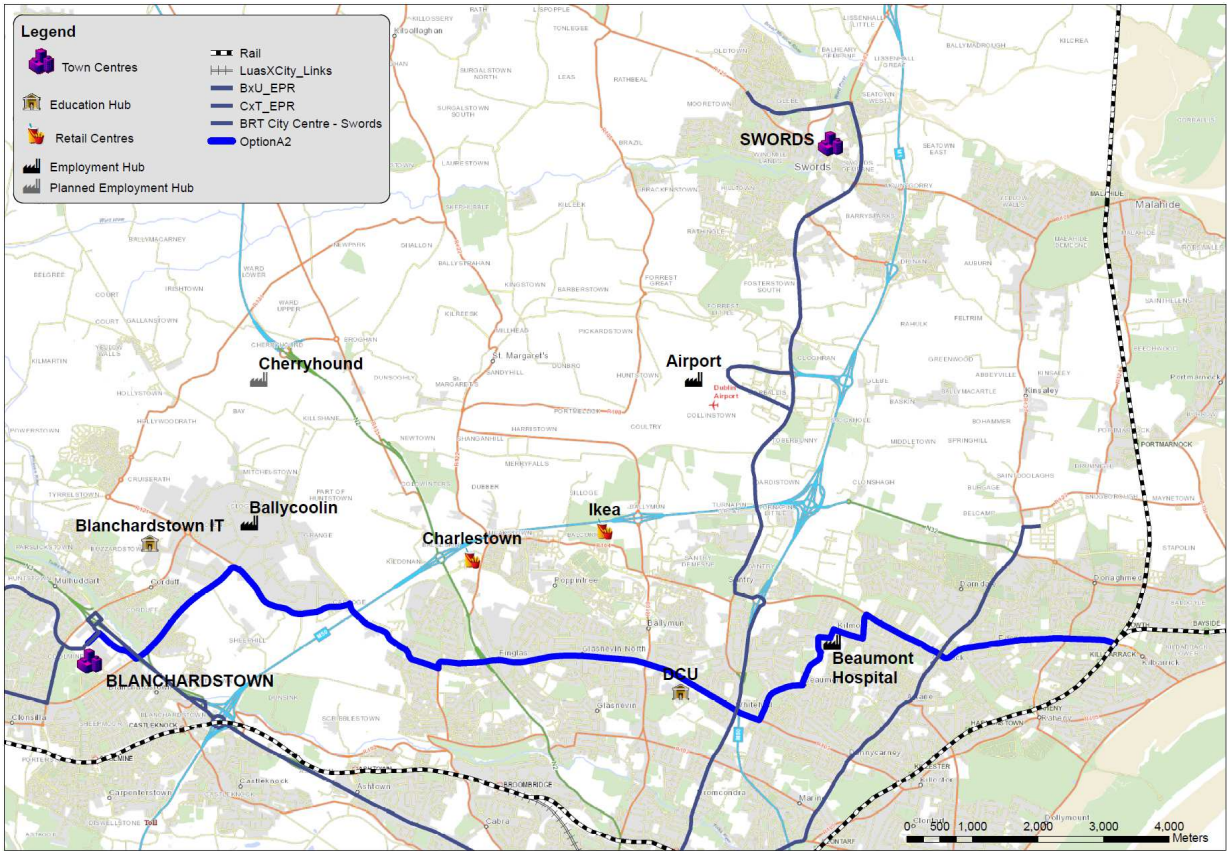


Figure 18 OptionA2 Blanchardstown – Finglas – Whitehall (via DCU) to Howth Junction (via Beaumont) Error! Reference source not found.

OptionA2 has been shortlisted because of its following advantages:

- Potential to link large population catchments with employment hubs, DCU, and Beaumont Hospital;
- Potential for interchange with radial PT services to/from Swords, and with the DART.

This option would allow for PT connections to/ from Swords via interchange with radial PT services at Whitehall.

3.4.3 OptionA5: Blanchardstown – Ballymun (via Charlestown) – Clongriffin (via Clonshaugh)

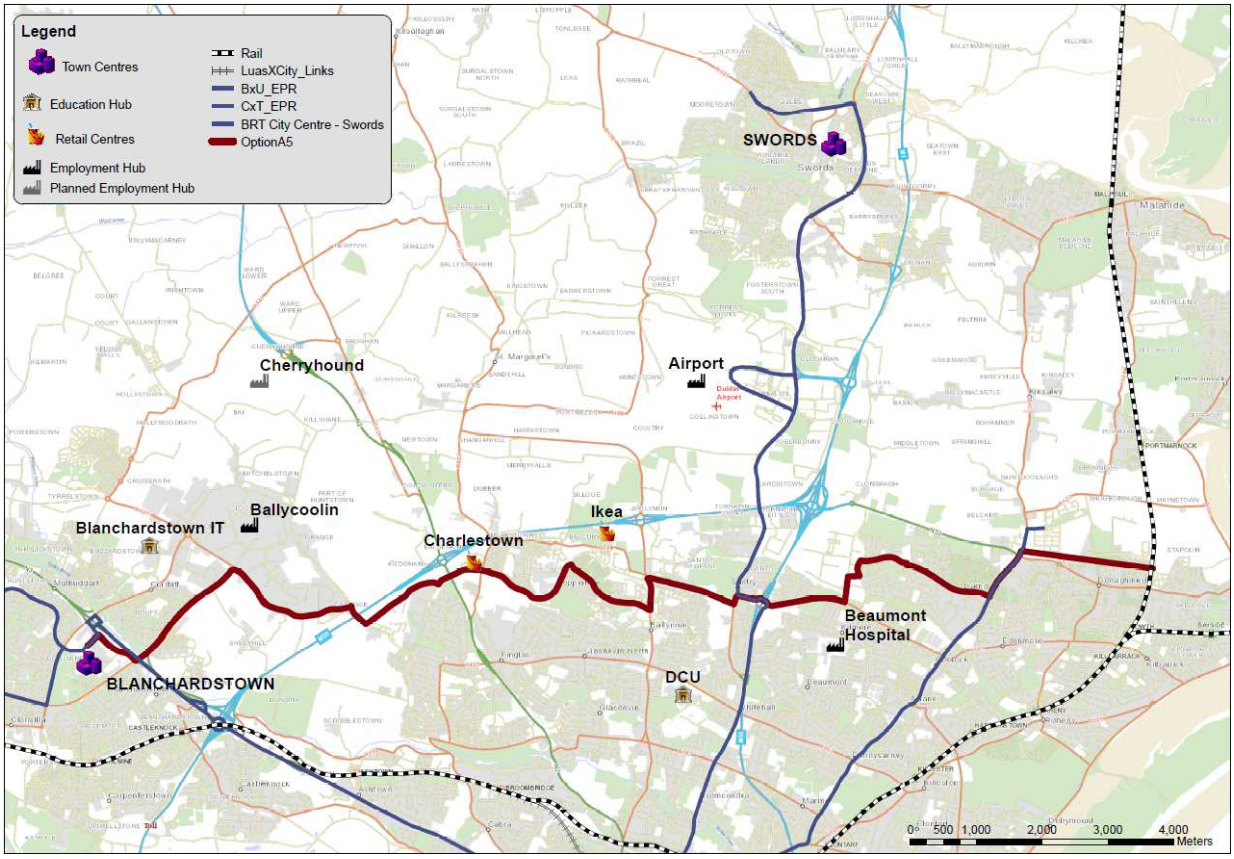


Figure 19 OptionA5 Blanchardstown – Ballymun (via Charlestown) to Clongriffin (via Clonshaugh)

OptionA5 has been shorlisted because of its following advantages:

- Potential to provide PT connection between Blanchardstown, Charlestown, Ballymun, Coolock, Belmayne, and Clongriffin, which is currently not available;
- Potential for interchange with radial PT services to/from Swords, and with the DART.

This option would allow for PT connections to/ from Swords via interchange with radial PT services at Whitehall.

3.5 Assessment of Shortlisted Options

3.5.1 Network Modelling

Each shortlisted option was modelled on the NTA's 4-stage CUBE transport model which includes separate public transport TRIPS and highway SATURN assignment models for the Greater Dublin Area.[3]

Appendix G describes the methodology undertaken in modelling the schemes, and includes some caveats on the results. The results from this stage of the study will be used in selecting preferred options; but further work is required to provide enough confidence in the numbers to use in a cost benefit analysis.

For each option the model has been run twice for the 2033 future year AM peak period scenario, with two different assumptions on the quality of the services:

a. 'As Bus and no QBC' – where the routes are coded as a conventional bus and with no additional bus priority than in the Do Minimum; and

b. 'New Mode with QBC' – coded as a high quality bus mode, with journey speeds calculated based on those described in Table 7 above.

Results below show the potential usage and journey times estimated from the modelling process. The best-performing option for each category above has been highlighted

Options — **Total Boarding's for AM Peak Period 2033** — **Total Passenger KMs** — **Passengers per Kilometre**

Route	As Bus	New Mode with QBC	As Bus	New Mode with QBC	As Bus	New Mode with QBC
A1	1,260	2,978	10,725	29,682	93	258
A2	2,956	7,768	19,233	53,212	168	465
A5	3,796	7,273	26,426	51,455	205	399

		Maximum Peak Hour Loadings As Bus			Maximum Peak Hour Loadings As New Mode with QBC		
	Time Period	A5	A1	A2	A5	A1	A2
Westbound (Airport-Blanchardstown)	AM1	485	140	386	630	268	648
	AM2	415	247	308	716	453	943
	AM3	288	113	253	484	248	575
Eastbound (Blanchardstown-Airport)	AM1	312	192	257	531	469	544
	AM2	345	268	269	725	652	828
	AM3	209	103	191	494	386	559

	Total Daily Boarding's		Total Annual Patronage (Mil.)	
Route	As Bus	New Mode with QBC	As Bus	New Mode with QBC
A1	3,000	8,000	0.38	0.90
A2	8,000	21,000	0.89	2.35
A5	10,000	19,000	1.14	2.19

Peak Direction Journey Times (in minutes) — **Peak Direction Speeds (kph)**

Route	As Bus	New Mode with QBC	As Bus	New Mode with QBC
A1	139	37	8.24	30.59
A2	63	44	18.41	26.17
A5	77	51	16.79	25.43

[3] The NTA's 2006 network model with 2033 future year was used. The NTA's efforts to update this network model were still underway at this stage.

3.5.2 Engineering and Environmental Issues

The main engineering and environmental issues that could arise from provision of new infrastructure along each shortlisted route have been listed below.

It should be noted that for the purpose of this study, engineering and environmental issues are identified at strategy level - for the purpose of comparing the levels of complexity in delivering new infrastructure along shortlisted routes, and to inform the selection of a preferred route. Localised issues along the emerging preferred route can be further identified and dealt with at design stage.

	Engineering Issues	Environmental Issues
OptionA1	▪ New public transport road link of approximately 420m between Cappagh Road and North Road (see Figure 20). ▪ Upgrading of existing signalised junctions to provide bus priority. ▪ Most bus priority improvements can be accommodated within existing roadway. Only some minor land acquisition may be required at pinch-point locations. ▪ Relocation of some boundary walls along road edges. ***Impact: Medium***	▪ Environmental impact of potential new road links. ▪ Possible minor land acquisition. ▪ Loss of vegetation and trees along road edges. ***Impact: Medium***
OptionA2	▪ Widening of some road sections to accommodate new bus lanes. ▪ Upgrading of existing signalised junctions to provide bus priority. ▪ Most bus priority improvements can be accommodated within existing roadway. Only some minor land acquisition may be required at pinch-point locations. ▪ Relocation of some boundary walls along road edges. ***Impact: Low***	▪ Possible minor land acquisition. ▪ Loss of vegetation and trees along road edges. ***Impact: Low***
OptionA5	▪ New public transport road link of approximately 420m between Cappagh Road and North Road (see Figure 20). ▪ New public transport road link of approximately 350m through Belmayne estate (see Figure 21). ▪ Widening of some road sections to accommodate new bus lanes. ▪ Most bus priority improvements can be accommodated within existing roadway. Only some minor land acquisition may be required at pinch-point locations. ▪ Relocation of some boundary walls along road edges. ▪ Upgrading of existing signalised junctions to provide bus priority. ***Impact: Medium***	▪ Environmental impact of potential new road links. ▪ Possible minor land acquisition. ▪ Loss of vegetation and trees along road edges. ***Impact: Medium***

Table 8 Section A Shortlisted Options - Engineering and Environmental Issues

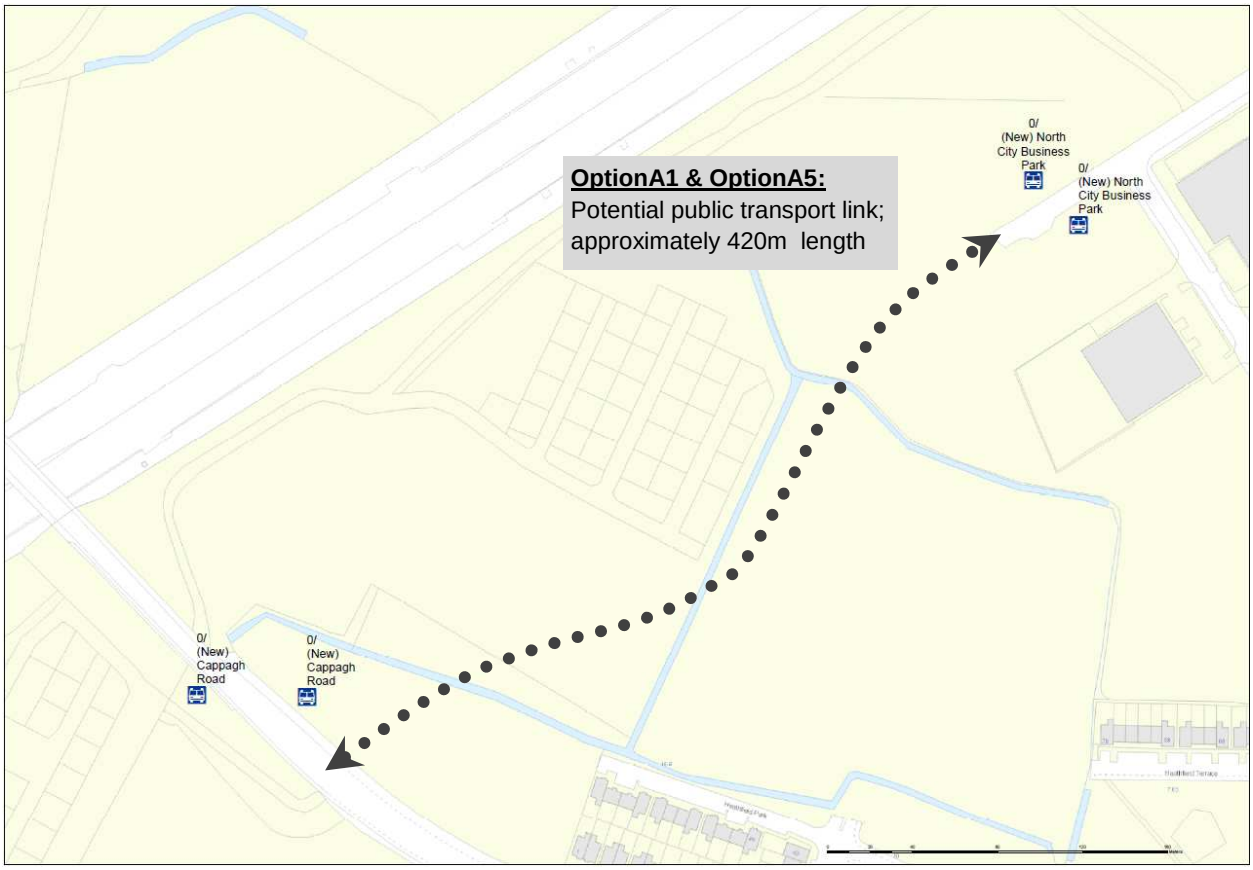


Figure 20 Location of Potential New Public Transport Link between Cappagh Road and North Road

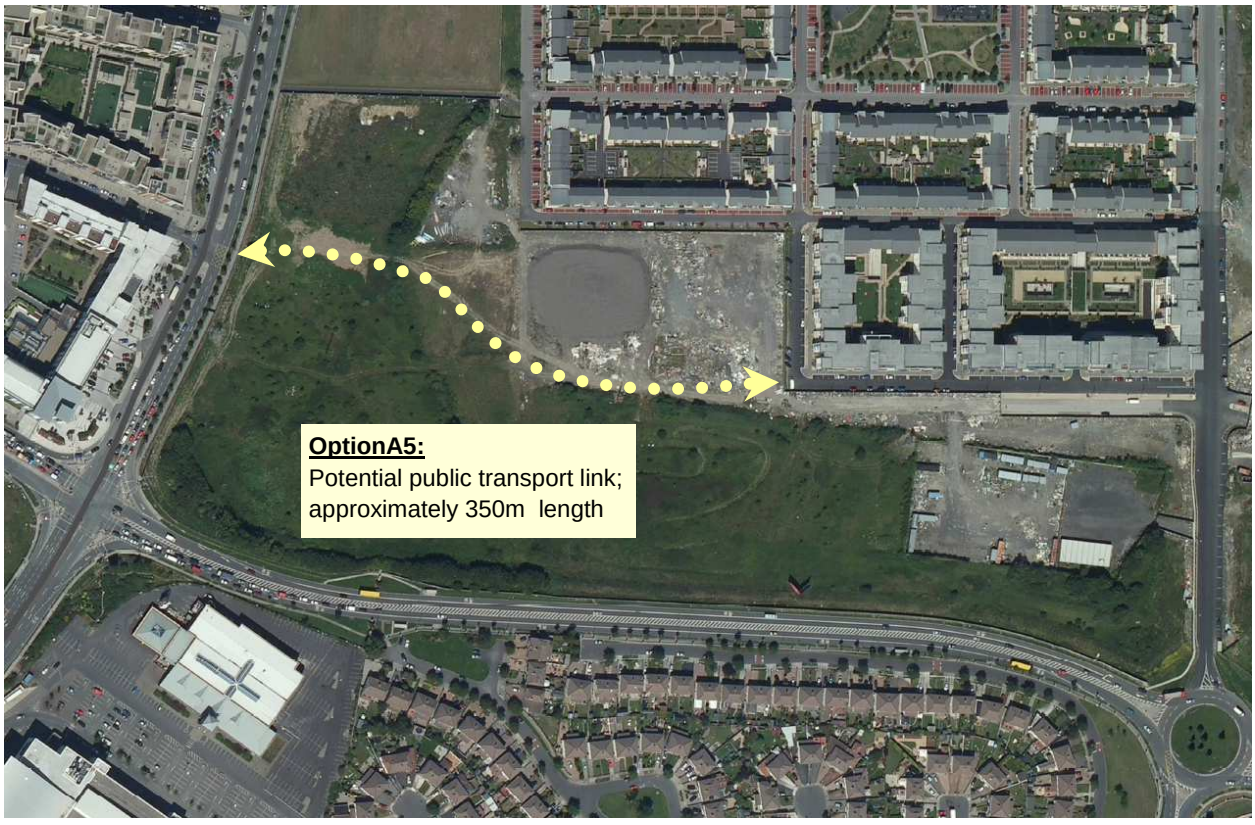


Figure 21 Potential New Public Transport Link through Belmayne

3.5.3 Potential Quality of Service

Quality criteria of a public transport service, as viewed by the customer, typically covers aspects of service availability, accessibility, information, time, customer care, comfort, and security.

Table 9 Section A Shortlisted Options – Standards of Bus Service Provision

Availability	✓ Bus service operating 18 hours a day. ✓ Bus service frequencies of no less than 15mins. *(see Table 10 for service frequencies)*
Accessibility	✓ Good access to bus service, with bus stops located at 400m distances along route. ✓ Direct bus service connections to key trip attractors. ✓ Good integration with other PT services at interchange locations; at least one bus scheduled to arrive before 6am or before first departing train/ tram/ bus, whichever earlier; and at least one bus to depart at 12 midnight or after last arriving train/ tram/ bus, whichever later.
Information	✓ Availability of up-to-date Real Time Passenger Information on RTPI boards, website, and mobile app. ✓ Bus schedules displayed at bus stops.
Time	✓ Short journey times. ✓ Good reliability, i.e. adherence to schedule. *(see Table 10 for service frequencies)*
Customer Care	✓ Customer-oriented operator and staff. ✓ Assistance for customers needing help at stops. ✓ Flexible ticketing options; including ticketing machines at bus stops that are capable of dispensing change and allowing LEAP card top-ups.
Comfort	✓ Vehicles with sufficient seating/ personal space, and facilities to accommodate wheelchairs, buggies, and even bicycles (on vehicle-mounted racks). ✓ Good ride quality on roads. ✓ Sheltered bus stops. ✓ Availability of complementary facilities at bus terminals, e.g. toilets and convenience stores.
Security	✓ Safe drivers, vehicles, and roads. ✓ Availability of public lighting and natural surveillance at bus stops. ✓ Availability of visible monitoring on vehicles.

At this stage, in terms of potential quality of service, the key difference between **each** shortlisted route would be the service frequency and journey times.

Table 10 shows the service frequencies and journey times for each shortlisted route in Section A. Journey times have been estimated from network modelling; and headways (service frequencies) have been estimated based on demand and cycle times (round-trip journey times + 10mins for terminus activity).

Short headways (i.e. high frequency service) and short journey times indicate that a service is likely to operate more reliably - and thereby, ceteris paribus, provide a better quality of service.

	Maximum Line Loading	Headway (Service Frequency)		Journey Time (Max. in Single Direction)	Estimated Speed
		Peak	Off-Peak		
OptionA1	652 eastbound	8 mins	15 mins	37 mins	31 kph
OptionA2	943 westbound	6 mins	11 mins	44 mins	26 kph
OptionA5	725 eastbound	7 mins	15 mins	51 mins	25 kph

Table 10 Section A Shortlisted Options – Potential Quality of Service

3.5.4 Capital Costs

For the purpose of this study, capital costs for each of the shortlisted schemes have been estimated as construction costs (including preliminaries, design & supervision, and contingencies) + rolling stock costs. Summary of estimated capital costs for shortlisted options in Section A are shown below.

	Construction Costs	Rolling Stock Costs	Total Capital Costs
OptionA1	€13,337,710	€4,398,000	€17,735,710
OptionA2	€37,499,873	€9,162,500	€46,662,373
OptionA5	€23,652,985	€6,963,500	€30,616,485

Table 11 Section A Shortlisted Options – Capital Cost Estimates

3.6 Preferred Option for Section A

Option A2 is the emerging preferred route because:

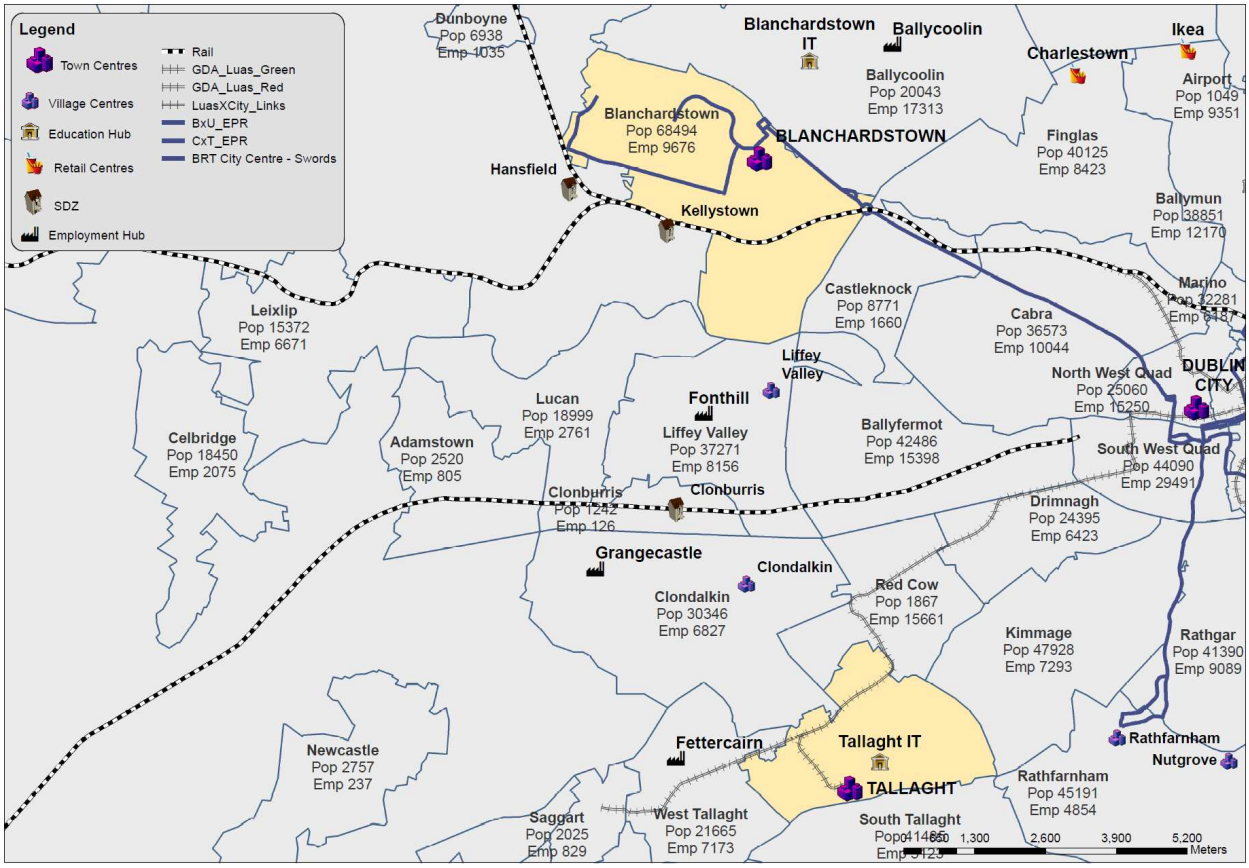
- It has the highest levels of estimated AM peak-period boardings, passengers-kilometres, and passengers-per-kilometre;
- It has the highest levels of estimated peak hour loading, and daily and annual boardings;
- It has potentially good quality of service due to high service frequencies and speeds; and
- It has low levels of complexity and impact in terms of anticipated engineering and environmental issues.

The capital cost of OptionA2 is estimated at €46,662,373.

4. SECTION B: BLANCHARDSTOWN TO TALLAGHT

Blanchardstown and Tallaght were identified as two western "Key Centres" to be served by orbital public transport service. The population and employment levels in Blanchardstown and Tallaght settlement areas are shown on Figure 22 below (and in following page).

Figure 22 Blanchardstown and Tallaght Key Centres



At present Dublin Bus route 76a serves Blanchardstown and Tallaght via the M50. There are 3no. scheduled services per day, in each direction, during weekdays; with end-to-end scheduled journey times of 1hr 02min. By comparison, journey time by car mode via the M50 motorway is 19mins; and by radial public transport mode is 1hr 40mins. A comparison of current travel times is attached in *Appendix A* of this document.

Long-term high-capacity public transport services to west Dublin, which are expected to be delivered by future year 2035, i.e. the Blanchardstown/ UCD BRT (shown on Figure 23).

Existing orbital Dublin Bus routes serving Blanchardstown and/or Tallaght include:

- 56a Tallaght – Ringsend Road
- 75 Tallaght – Dun Laoghaire
- 76 Tallaght – Chapelizod, via Liffey Valley
- 76a Blanchardstown Centre – Tallaght
- 220 Mulhuddart – Ballymun, via Blanchardstown Centre
- 239 Blanchardstown Centre – Liffey Valley
- 777 Tallaght – Dublin Airport (express coach)

Current Dublin Bus routes and planned long-term public transport routes for Blanchardstown and Tallaght are shown on Figure 23. Transport for Ireland schematic maps of current bus services from Blanchardstown and Tallaght are also shown in *Appendix B* of this document.

Figure 22 Blanchardstown and Tallaght Key Centres

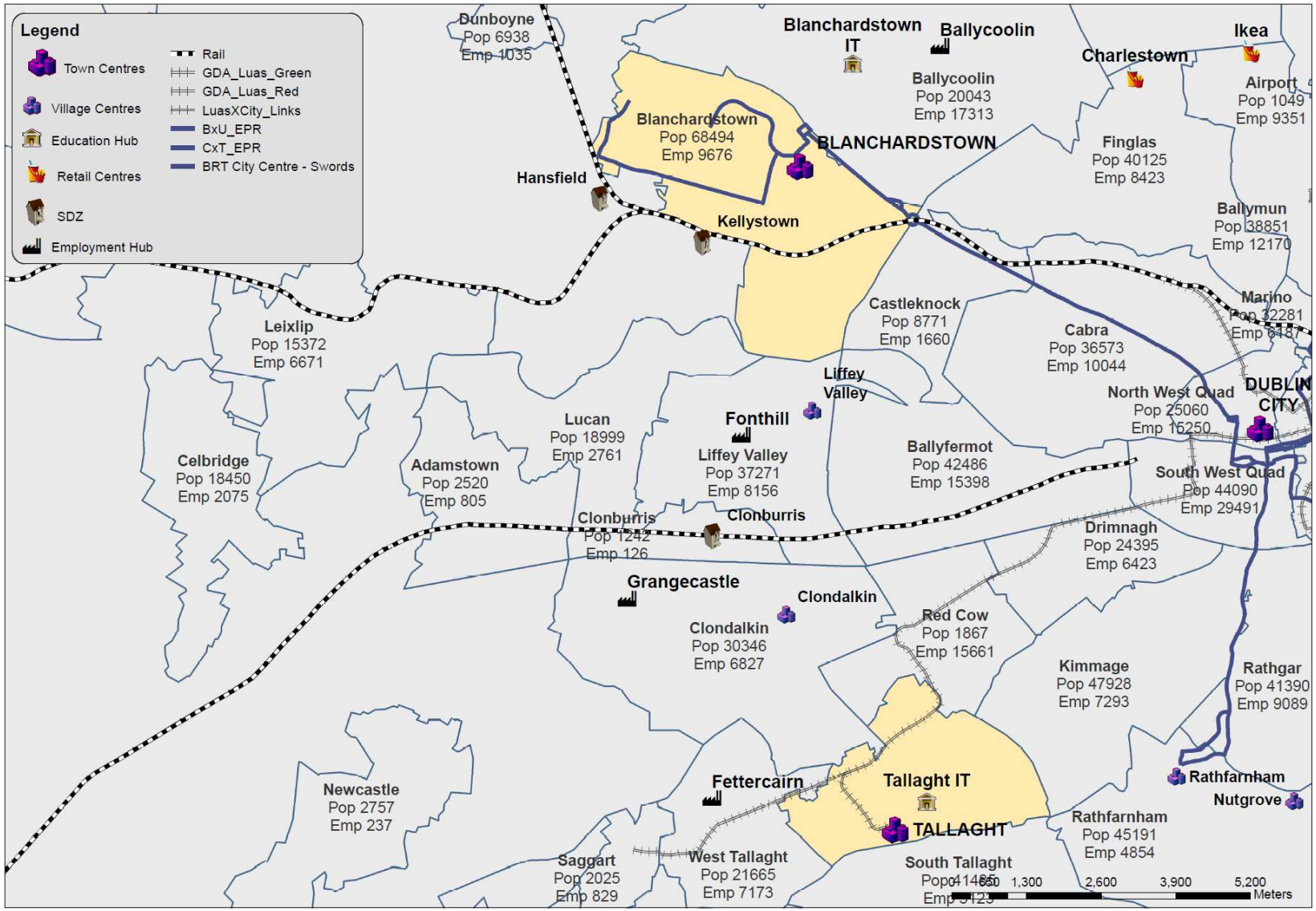
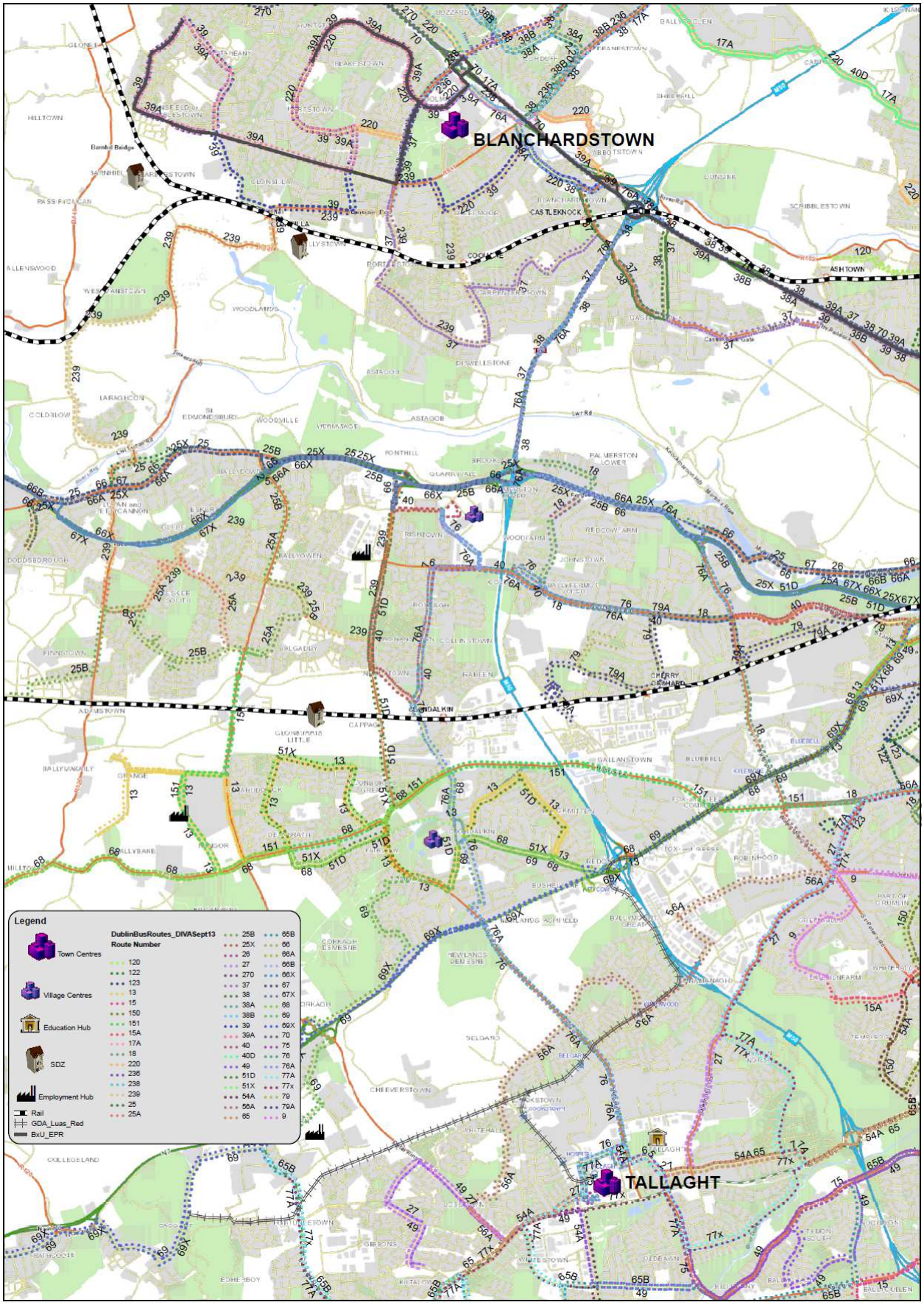


Figure 23 Blanchardstown and Tallaght Existing and Planned Public Transport Services



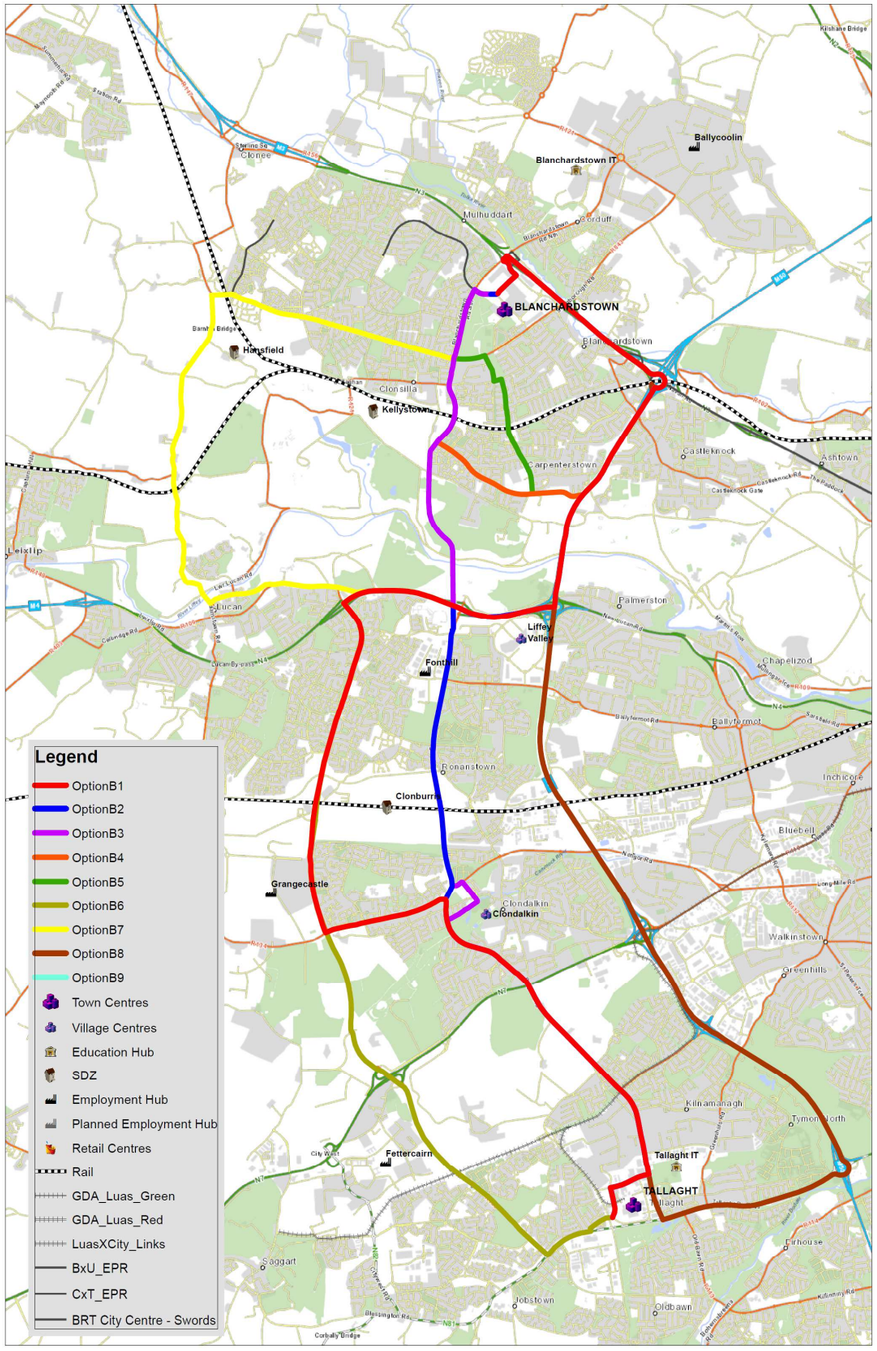
4.1 Preliminary Route Options

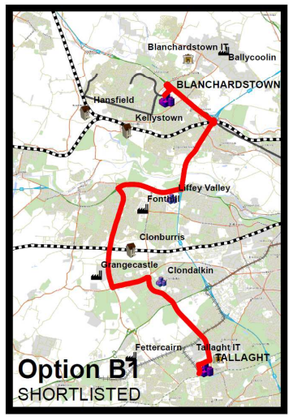
Nine preliminary orbital route options were identified between Blanchardstown and Tallaght. Most of these would also connect with other village centres and major employment hubs along the way, including Clondalkin, Liffey Valley, Lucan, Grangecastle, and Fettercairn.

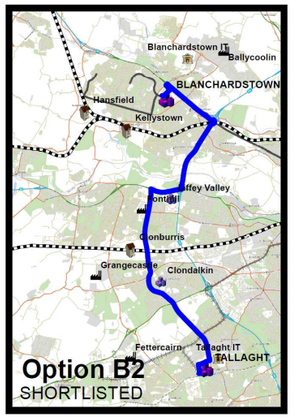
- OptionB1 Blanchardstown – Liffey Valley (via M50) – Lucan – Clondalkin– Tallaght
- OptionB2 Blanchardstown – Liffey Valley (via M50) – Clondalkin (via Fonthill) – Tallaght
- OptionB3 Blanchardstown – Clondalkin (via new bridge over Liffey at Castleknock) – Tallaght
- OptionB4 Blanchardstown – Liffey Valley (via Porterstown, M50) – Clondalkin (via Outer Ring Road) – Tallaght
- OptionB5 Blanchardstown – Liffey Valley (via Coolmine, M50) – Clondalkin (via Outer Ring Road) – Tallaght
- OptionB6 Blanchardstown – Liffey Valley (via M50) – Lucan – Tallaght
- OptionB7 Blanchardstown – Lucan – Clondalkin (via Outer Ring Road) – Tallaght
- OptionB8 Blanchardstown – Tallaght (via M50)
- OptionB9 Blanchardstown – Tallaght (via Grangecastle and new bridge over Liffey at Castleknock)

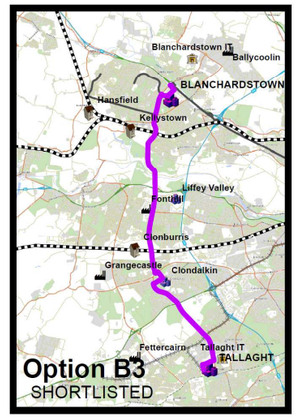
These are shown in following Figure 24 and in *Appendix D* of this document.

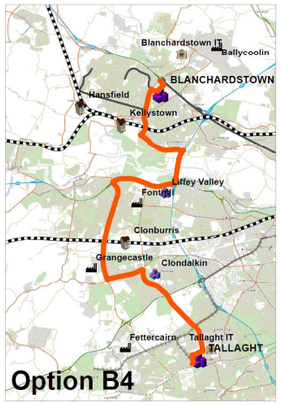
Section B Blanchardstown to Tallaght

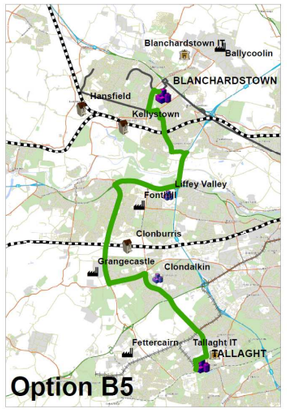


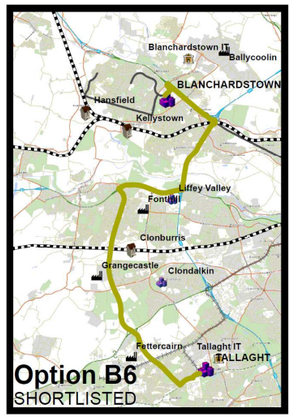


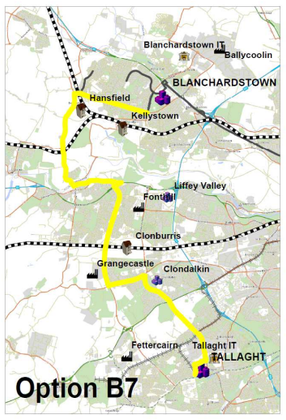


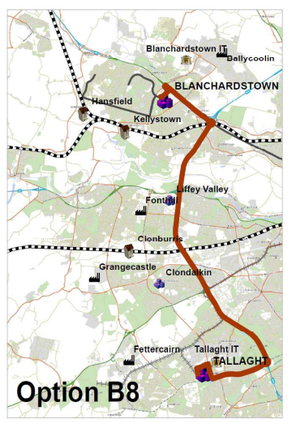












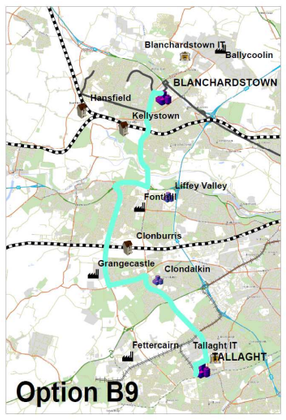


Figure 24 Preliminary Route Options for Section B: Blanchardstown to Tallaght

4.2 Appraisal of Preliminary Options

4.2.1 Criteria

In order to shortlist options that could be brought forward for further assessment, all identified preliminary options have been screened based on the following headline criteria:

i. Demand;
ii. Key destinations served;
iii. Journey times;
iv. Significant engineering impacts;
v. Significant environmental impacts;
vi. High level costing

Under each of these headline criteria is a list of elements which are deemed crucial to evaluating the feasibility of each route option. These elements are listed in the appraisal table.

4.2.2 Comparative Evaluation

All identified preliminary options were evaluated comparatively, i.e. how each option fares in comparison with other options.

- Where an option fares obviously better than most other options, it is given a green status:
- Where an option fares obviously poorer than most other options, it is given a red status:
- Where an option fares nearly the same as most other options, i.e. does not fare obviously better or poorer than most other options, it is given an amber status:

Appraisal of the identified preliminary options for Section B is shown in *Table 12*.

Table 12 Appraisal of Preliminary Options for Section B: Blanchardstown to Tallaght

Route Options	B1	B2	B3	B4	B5	B6	B7	B8	B9
1. DEMAND									
1.1. Primary Demand *(within 800m)*									
1.1.1.Population *(2011 Census)*	79,210	63,340	77,021	97,709	94,561	79,667	90,776	38,255	86,203
1.1.2.Employment *(2011 Census)*	31,686	30,949	31,444	32,421	32,600	35,107	28,964	23,802	32,355
Population + Employment Total	*110,896*	*94,289*	*108,465*	*130,130*	*127,161*	*114,774*	*119,740*	*62,057*	*118,558*
1.1.3.Potential Commuter Trip Demand *(based on 2011 POWSCAR[4])*	4,554	3.628	4,161	5,812	5,800	4,212	5,924	1,559	5,777
% Potential Commuters with multiple car ownership	*67%*	*63%*	*66%*	*71%*	*72%*	*63%*	*71%*	*65%*	*70%*
1.1.4.Future year 2035 Population	94,968	77,849	93,360	115,523	112,343	98,587	106,416	44,164	
1.1.5.Future year 2035 Employment	33,857	31,483	32,564	35,118	35,683	40,174	33,346	25,615	
Future year 2035 Population + Employment Total	*128,825*	*109,332*	*125,924*	*150,641*	*148,026*	*138,761*	*139,762*	*69,779*	
1.2. Secondary Demand									
1.2.1.Radial PT interchange modes	Luas, Rail, BRT	Luas, BRT	Luas, Rail, BRT, Kildare Rail	Luas, Rail, BRT, Kildare Rail	Luas, Rail, Kildare Rail, BRT	Luas, Rail, BRT	Luas, Rail, BRT, Kildare Rail	LUAS, BRT	Luas, Rail, BRT, Kildare Rail
1.2.2.Local PT interchange locations	Blanchardstown; Tallaght; Kishogue	Blanchardstown; Tallaght; Fonthill	Blanchardstown; Tallaght; Porterstown; Fonthill	Blanchardstown; Tallaght; Porterstown; Kishogue	Blanchardstown; Tallaght; Coolmine; Kishogue	Blanchardstown; Tallaght; Kishogue	Blanchardstown; Tallaght; Hansfield; Kishogue		Blanchardstown; Tallaght; Porterstown; Kishogue
1.2.3.Potential bike and ride locations	Blanchardstown; Tallaght; Grangecastle	Blanchardstown; Tallaght; Grangecastle	Blanchardstown; Tallaght; Grangecastle	Blanchardstown; Tallaght; Grangecastle	Blanchardstown; Tallaght; Grangecastle	Blanchardstown; Tallaght; Grangecastle	Blanchardstown; Lucan; Tallaght		Blanchardstown; Tallaght; Grangecastle
2. KEY DESTINATIONS SERVED									
2.1. Town Centres									
2.1.1.Blanchardstown	•	•	•	•	•	•	•	•	•
2.1.2.Liffey Valley	•	•		•	•	•			
2.1.3.Clondalkin	•	•		•	•				
2.1.4.Tallaght	•	•	•	•	•	•	•	•	•
2.1.5.Lucan							•		
2.2. Education Hubs									
2.2.1.Tallaght I.T.	•	•	•	•	•	•	•	•	•
2.3. Employment hubs									

[4] Based on number of commuters with place of residence and place of work or school along route AND are currently commuting by bus, or are currently commuting by car (driving or as passenger) with current commuting journey times of more than 7 minutes.

Route Options	B1	B2	B3	B4	B5	B6	B7	B8	B9
2.3.1.Blanchardstown	•	•	•	•	•	•	•	•	•
2.3.2.Liffey Valley	•	•		•	•	•			
2.3.3.Fonthill		•	•						
2.3.4.Clondalkin	•	•	•	•	•		•		•
2.3.5.Tallaght	•	•	•	•	•	•	•	•	•
2.3.6.Grangecastle (partial)	•			•	•	•	•		•
2.3.7.Fettercairn						•			
2.4. Retail centres									
2.4.1.Blanchardstown	•	•	•	•	•	•	•	•	•
2.4.2.Liffey Valley	•	•		•	•	•			
2.4.3.Tallaght (The Square)	•	•	•	•	•	•	•	•	•
2.5. SDZ and Strategic Land Banks									
2.5.1.Clonburris	•	•	•	•	•	•	•		•
2.5.2.Kellystown			•	•	•				•
2.5.3.Hansfield							•		
3. JOURNEY TIMES									
3.1. Length (km)	21.1km	17.5km	15.0km	19.3km	19.7km	20.2km	22.7km	15.5km	17.8km
3.1.1.Journey Time[5] with Existing Infrastructure	40 mins	34 mins	40 mins	46 mins	47 mins	37 mins	59 mins	32 mins	47 mins
3.1.2.Journey Time[5] and Speed with Proposed Infrastructure	38 mins / 33kph	30 mins / 35kph	34 mins / 27kph	45 mins / 26kph	46 mins / 26kph	37 mins / 33kph	58 mins / 23kph	16 mins / 58kph	41 mins / 26kph
3.2. Reliability (e.g. bus priority and sensitivity to congestion)									
3.2.1.% Bus Priority at Junctions									
3.2.2.% Existing Bus Lanes	44%	24%	36%	52%	50%	63%	39%	0%	43%
3.2.3.% Potential Bus Lanes	49%	32%	45%	58%	56%	67%	44%	89%	72%
3.2.4.% Motorway (uncongested)	33%	40%	-	3%	5%	40%	-	100%	-
4. SIGNIFICANT ENGINEERING IMPACTS									
4.1. Major Structures	None Expected	None Expected	• Liffey Valley high-level bridge	None Expected	None Expected	None Expected	None Expected	None Expected	• Liffey Valley high-level bridge

[5] Bus speeds have been based on the NTA's analysis of AVL data for Dublin Bus route 75. Motorway speed is assumed to be 60km/h at all times. Full bus priority is assumed to be 27km/h at all times. Otherwise speed is assumed to be 19km/h.

Route Options	B1	B2	B3	B4	B5	B6	B7	B8	B9
4.2. Substantial Landtake	None Expected	None Expected	•	• New Slip from M50	• New Slip from M50	None Expected	None Expected	None Expected	•
5. SIGNIFICANT ENVIRONMENTAL IMPACTS									
5.1. Protected Natural Heritage Sites	None Expected	None Expected	• Liffey Valley pNHA	None Expected	None Expected	None Expected	None Expected	None Expected	• Liffey Valley pNHA
5.2. Land Severance	None Expected	None Expected	•	None Expected	None Expected	None Expected	None Expected	None Expected	•
5.3. Impact on Built Environment	None Expected	None Expected	• Castleknock Golf Club	• Carpenterstown (minor)	• Carpenterstown (minor)	None Expected	None Expected	None Expected	• Castleknock Golf Club
6. HIGH LEVEL COSTINGS									
6.1. Capital investment (Assuming BHLS, excluding transit vehicles)	€26M	€20M	€150M	€30M	€30M	€24M	€28M	€5M	€154M

4.3 Options Screening

At this stage, a screening process was carried out to eliminate options that are obviously unfeasible.

OptionB8 was eliminated because the demand it can potentially serve is much lower in comparison to other options.

OptionB7 was eliminated because the expected journey time (59 mins) would be too long in comparison with car-mode journey time (19 mins).

OptionB9 was eliminated because the cost of constructing a bridge over the Liffey would be very high, and the Liffey Valley pNHA would be impacted by such a bridge. OptionB3 also requires a bridge over the Liffey; however it will still be brought forward to the next stage for modelling purposes, as its alignment is very similar to Metro West - which has already been progressed to advanced pre-planning stage by the RPA.

4.4 Shortlisted Options

Based on the comparative evaluation shown in *Table 12*, the following three options have fared better than the rest, and will be progressed to the next stage for further assessment.

- **OptionB1** Blanchardstown – Liffey Valley (via M50) – Lucan – Clondalkin – Tallaght
- **OptionB2** Blanchardstown – Liffey Valley (via M50) – Clondalkin (via Fonthill) – Tallaght
- **OptionB6** Blanchardstown – Liffey Valley (via M50) – Lucan – Tallaght

Additionally, **OptionB3** (Blanchardstown – Clondalkin, via new bridge over Liffey at Castleknock – Tallaght) has also been shortlisted for further assessment as its alignment is very similar to Metro West, which has already been progressed to advanced pre-planning stage by the RPA.

OptionB4 and OptionB5 have not be shortlisted because these will require the construction of a new slip lane onto the M50, which cannot be safely provided to meet current DMRB standards due to limited length available for merging on the southbound.

4.4.1 OptionB1 Blanchardstown – Liffey Valley (via M50) – Lucan – Clondalkin – Tallaght

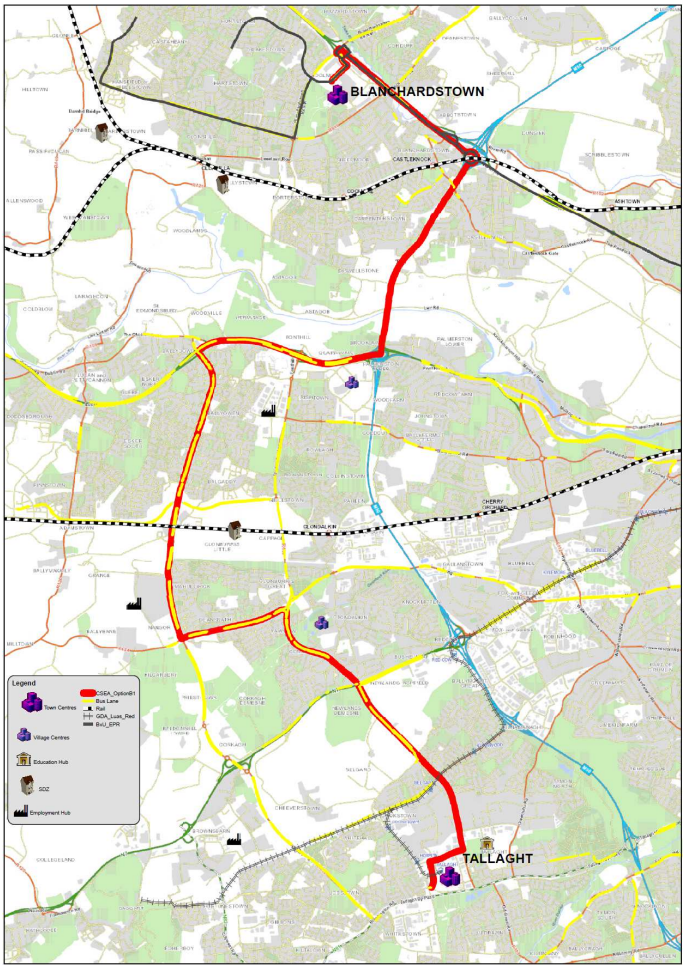


Figure 25 OptionB1: Blanchardstown – Liffey Valley (via M50) – Lucan – Clondalkin – Tallaght

OptionB1 has been shortlisted because of its following advantages:

- Potential to provide PT connection between Blanchardstown, Liffey Valley, Lucan, Grangecastle, Clondalkin, and Tallaght, which is currently not available;
- Potential to serve a numerous town centres along the route, including Liffey Valley and Clondalkin;
- Potentially good reliability and speeds (32kph) due to existing bus lanes, routing on motorways (M50, M3, M4), and good potential to provide additional bus priority infrastructure.

4.4.2 OptionB2 Blanchardstown – Liffey Valley (via M50) – Clondalkin (via Fonthill) – Tallaght

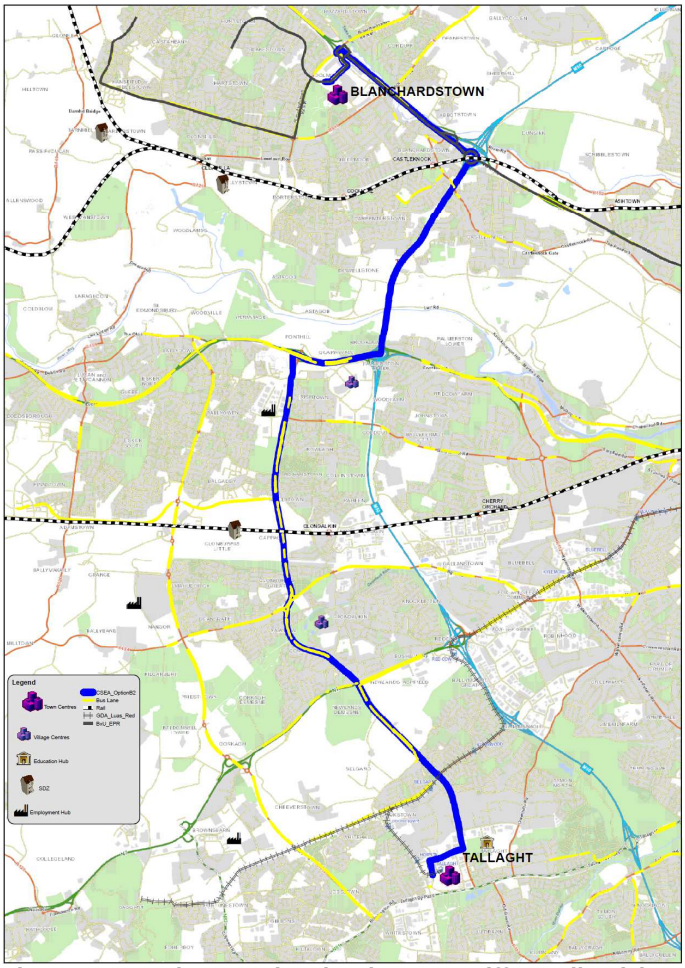


Figure 26 OptionB2: Blanchardstown – Liffey Valley (via M50) – Clondalkin (via Fonthill) – Tallaght

OptionB2 has been shortlisted because of its following advantages:

- Potential to serve a numerous key destinations along the route, including Liffey Valley, Fonthill, and Clondalkin;
- Potentially high speed service (32kph) due to existing bus lanes, routing on motorways (M50, M3, M4), and good potential to provide additional bus priority infrastructure.

4.4.3 OptionB6 Blanchardstown – Liffey Valley (via M50) – Lucan – Tallaght

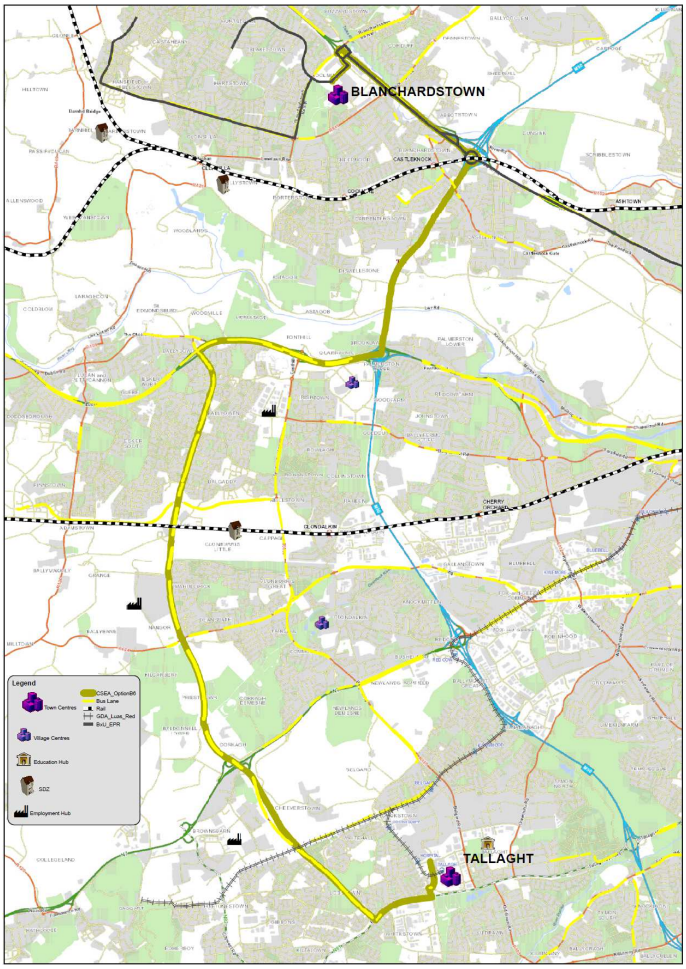


Figure 27 OptionB6: Blanchardstown – Liffey Valley (via M50) – Lucan – Tallaght

OptionB6 has been shortlisted because of its following advantages:

- Potential to provide PT connection between Blanchardstown, Liffey Valley, Lucan, Grangecastle, Fettercairn, and Tallaght, which is currently not available;
- Potential to serve Liffey Valley town centre along the route;
- Potentially good reliability and speeds (36kph) due to lengths of existing bus lanes (63% of route) and routing via motorways (M50, M3, M4).

4.4.4 OptionB3 Blanchardstown –Clondalkin (via bridge over Liffey at Castleknock) – Tallaght

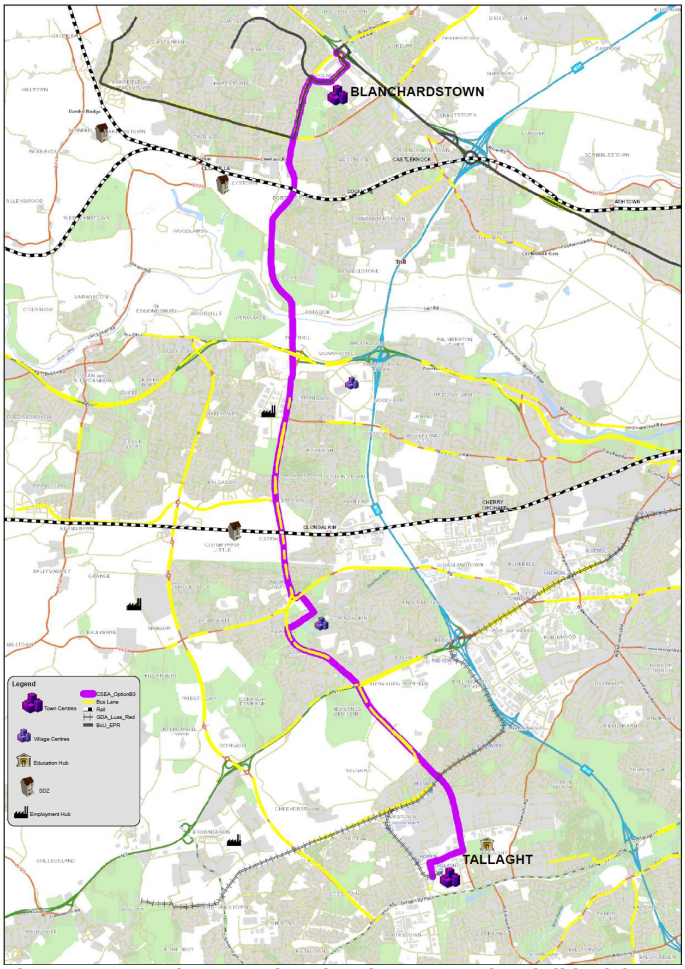


Figure 28 OptionB3: Blanchardstown – Clondalkin (via bridge over Liffey at Castleknock) - Tallaght

OptionB3 has been shortlisted for assessment in the next stage because its alignment is similar to Metro West, which has already been developed up to advanced pre-planning stage by the RPA in 2010.

This option also has the potential to interchange with radial rail services, i.e. Luas red line, Maynooth and Kildare railway lines; and the potential to serve Kellystown and Clonburris SDZs.

4.5 Assessment of Shortlisted Options

4.5.1 Network Modelling

Each shortlisted option was modelled on the NTA's 4-stage CUBE transport model which includes separate public transport TRIPS and highway SATURN assignment models for the Greater Dublin Area.

Appendix G describes the methodology undertaken in modelling the schemes, and includes some caveats on the results. The results from this stage of the study will be used in selecting preferred options; but further work is required to provide enough confidence in the numbers to use in a cost benefit analysis.

For each option the model has been run twice for the 2033 future year AM peak period scenario, with two different assumptions on the quality of the services:

a. 'As Bus and no QBC' – where the routes are coded as a conventional bus and with no additional bus priority than in the Do Minimum; and

b. 'New Mode with QBC' – coded as a high quality bus mode, with journey speeds based on those described in Table 12 above.

Results below show the potential usage and journey times estimated from the modelling process. The best-performing option for each category above has been highlighted

Options — **Total Boarding's for AM Peak Period 2033**

Route	As Bus	New Mode with QBC
B1	6,509	11,882
B2	7,493	13,917
B3	7,902	12,510
B6	6,376	10,783

Total Passenger KMs

As Bus	New Mode with QBC
43,862	89,380
44,795	87,754
47,969	72,086
46,671	85,656

Passengers per Kilometre

As Bus	New Mode with QBC
364	742
437	856
516	775
400	734

		Maximum Peak Hour Loadings As Bus				Maximum Peak Hour Loadings As New Mode with QBC			
	Time Period	B6	B3	B1	B2	B6	B3	B1	B2
Southbound (Blanchardstown-Tallaght)	AM1	926	982	797	857	1,331	1,466	1,218	1,508
	AM2	1,565	1,286	1,092	1,090	2,046	2,286	1,801	2,372
	AM3	632	728	647	658	992	1,252	1,070	1,252
Northbound (Tallaght-Blanchardstown)	AM1	367	619	412	672	774	793	842	948
	AM2	600	894	663	951	1,079	1,127	1,146	1,295
	AM3	287	453	316	548	640	644	717	893

	Total Daily Boarding's		Total Annual Patrongage (Mil.)	
Route	As Bus	New Mode with QBC	As Bus	New Mode with QBC
B1	17,000	32,000	1.97	3.60
B2	20,000	37,000	2.27	4.21
B3	21,000	33,000	2.39	3.79
B6	17,000	29,000	1.93	3.26

Peak Direction Journey Times (in minutes)

Route	As Bus	New Mode with QBC
B1	94	41
B2	99	29
B3	46	33
B6	66	32

Peak Direction Speeds (kph)

As Bus	New Mode with QBC
13.12	30.00
10.55	36.00
20.25	28.14
18.10	37.45

4.5.2 Engineering and Environmental Issues

The main engineering and environmental issues that could arise from provision of new infrastructure along each shortlisted route have been listed below.

It should be noted that for the purpose of this study, engineering and environmental issues are identified at strategy level - for the purpose of comparing the levels of complexity in delivering new infrastructure along shortlisted routes, and to inform the selection of a preferred route. Localised issues along the emerging preferred route can be further identified and dealt with at design stage.

Table 13 Section B Shortlisted Options - Engineering and Environmental Issues

	Engineering Issues	Environmental Issues
OptionB1	▪ Widening of some road sections to accommodate new bus lanes. ▪ Upgrading of existing signalised junctions to provide bus priority. ▪ Most bus priority improvements can be accommodated within existing roadway. Only some minor land acquisition may be required at pinch-point locations. ▪ Relocation of some boundary walls along road edges. ***Impact: Low***	▪ Possible minor land acquisition. ▪ Loss of vegetation and trees along road edges. ***Impact: Low***
OptionB2	▪ Widening of some road sections to accommodate new bus lanes. ▪ Upgrading of existing signalised junctions to provide bus priority. ▪ Most bus priority improvements can be accommodated within existing roadway. Only some minor land acquisition may be required at pinch-point locations. ▪ Relocation of some boundary walls along road edges. ***Impact: Low***	▪ Possible minor land acquisition. ▪ Loss of vegetation and trees along road edges. ***Impact: Low***
OptionB3	▪ New road link between Porterstown Road and N4 at Liffey Valley, with a new high-level bridge across the Liffey (see Figure 29). ▪ Widening of some road sections to accommodate new bus lanes. ▪ Upgrading of existing signalised junctions to provide bus priority. ▪ Most bus priority improvements can be accommodated within existing roadway. Only some minor land acquisition may be required at	▪ Environmental impact of potential new road link and bridge over the Liffey. ▪ Possible minor land acquisition. ▪ Loss of vegetation and trees along road edges.

	Engineering Issues	Environmental Issues
	pinch-point locations. ▪ Relocation of some boundary walls along road edges. ***Impact: High***	***Impact: High***
OptionB6	▪ Widening of some road sections to accommodate new bus lanes. ▪ Upgrading of existing signalised junctions to provide bus priority. ▪ Most bus priority improvements can be accommodated within existing roadway. Only some minor land acquisition may be required at pinch-point locations. ▪ Relocation of some boundary walls along road edges. ***Impact: Low***	▪ Possible minor land acquisition. ▪ Loss of vegetation and trees along road edges. ***Impact: Low***

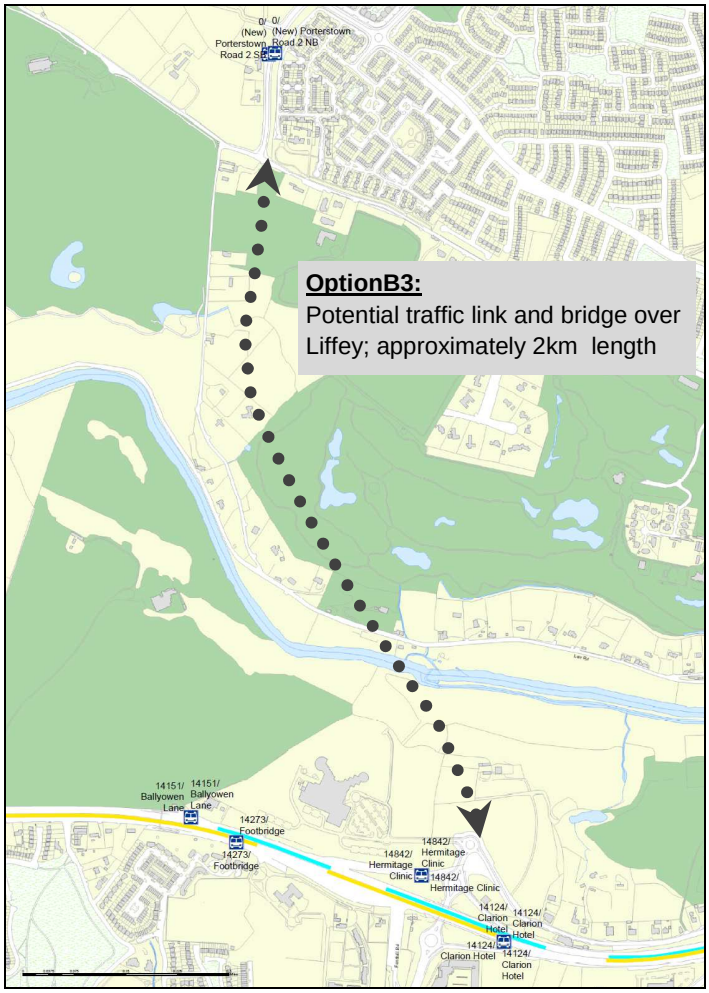


Figure 29 Location of Potential New Road Link between Porterstown Road and N4

4.5.3 Potential Quality of Service

Quality criteria of a public transport service, as viewed by the customer, typically covers aspects of service availability, accessibility, information, time, customer care, comfort, and security.

Table 14 Section B Shortlisted Options – Standards of Bus Service Provision

Availability	✓ Bus service operating 18 hours a day. ✓ Bus service frequencies of no less than 15mins. *(see Table 15 for service frequencies)*
Accessibility	✓ Good access to bus service, with bus stops located at 400m distances along route. ✓ Direct bus service connections to key trip attractors. ✓ Good integration with other PT services at interchange locations; at least one bus scheduled to arrive before 6am or before first departing train/ tram/ bus, whichever earlier; and at least one bus to depart at 12 midnight or after last arriving train/ tram/ bus, whichever later.
Information	✓ Availability of up-to-date Real Time Passenger Information on RTPI boards, website, and mobile app. ✓ Bus schedules displayed at bus stops.
Time	✓ Short journey times. ✓ Good reliability, i.e. adherence to schedule. *(see Table 15 for service frequencies)*
Customer Care	✓ Customer-oriented operator and staff. ✓ Assistance for customers needing help at stops. ✓ Flexible ticketing options; including ticketing machines at bus stops that are capable of dispensing change and allowing LEAP card top-ups.
Comfort	✓ Vehicles with sufficient seating/ personal space, and facilities to accommodate wheelchairs, buggies, and even bicycles (on vehicle-mounted racks). ✓ Good ride quality on roads. ✓ Sheltered bus stops. ✓ Availability of complementary facilities at bus terminals, e.g. toilets and convenience stores.
Security	✓ Safe drivers, vehicles, and roads. ✓ Availability of public lighting and natural surveillance at bus stops. ✓ Availability of visible monitoring on vehicles.

At this stage, in terms of potential quality of service, the key difference between **each** shortlisted route would be the service frequency and journey times.

Table 15 shows the service frequencies and journey times for each shortlisted route in Section B. Journey times have been estimated from network modelling; and headways (service frequencies) have been estimated based on demand and cycle times (round-trip journey times + 10mins for terminus activity).

Short headways (i.e. high frequency service) and short journey times indicate that a service is likely to operate more reliably - and thereby, ceteris paribus, provide a better quality of service.

	Maximum Line Loading	Headway (Service Frequency)		Journey Time (Max in Single Direction)	Estimated Speed
		Peak	Off-Peak		
OptionB1	1,801 southbound	3 mins	6 mins	41 mins	30 kph
OptionB2	2,372 southbound	2 mins	4 mins	29 mins	36 kph
OptionB3	2,286 southbound	2 mins	5 mins	33 mins	28 kph
OptionB6	2,046 southbound	3 mins	5 mins	32 mins	37 kph

Table 15 Section B Shortlisted Options – Standards of Bus Service Operations

4.5.4 Capital Costs

For the purpose of this study, capital costs for each of the shortlisted schemes have been estimated as construction costs (including preliminaries, design & supervision, and contingencies) + rolling stock costs. Summary of estimated capital costs for shortlisted options in Section B are shown below.

	Construction Costs	Rolling Stock Costs	Total Capital Costs
OptionB1	€37,972,618	€12,094,500	€50,067,118
OptionB2	€49,901,581	€13,560,500	€63,462,081
OptionB3	€362,876,801	€14,293,500	€377,170,301
OptionB6	€15,333,774	€13,560,500	€28,894,274

Table 16 Section B Shortlisted Options – Capital Cost Estimates

4.6 Preferred Option for Section B

Option B2 is the emerging preferred route because:

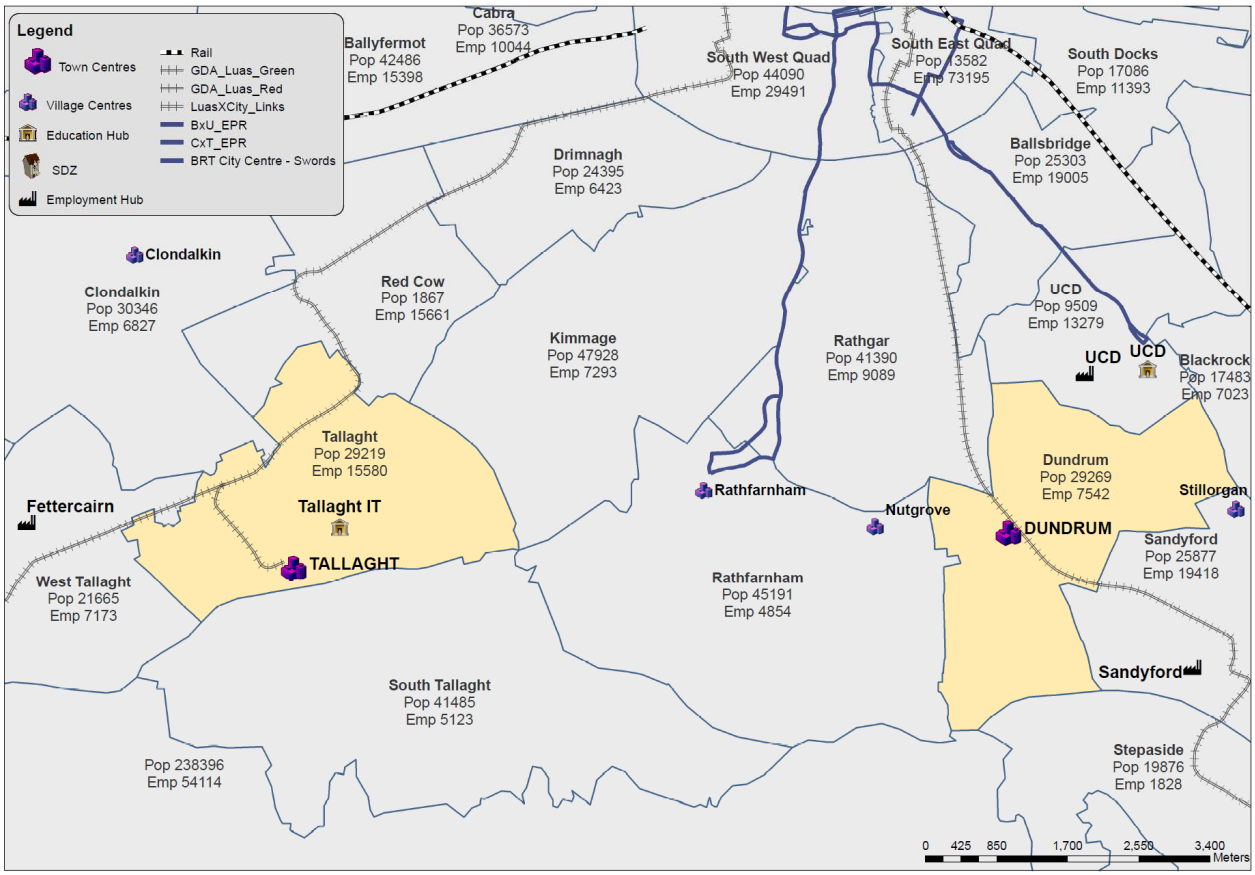
- It has the highest levels of estimated AM peak-period boardings and passengers-per-kilometre, and fairly high level of passengers.kilometres;
- It has the highest levels of estimated peak hour loading, and daily and annual boardings;
- It has potentially good quality of service due to high service frequencies and speeds; and
- It has low levels of complexity and impact in terms of anticipated engineering and environmental issues.

The capital cost of OptionB2 is estimated at €63,462,081.

5. SECTION C: TALLAGHT TO DUNDRUM

Tallaght and Dundrum were identified as two southern "Key Centres" to be served by orbital public transport service. The population and employment levels in Tallaght and Dundrum settlement areas are shown on Figure 30 below (and in following page).

Figure 30 Tallaght and Dundrum Key Centres



At present Dublin Bus route 75 serves Tallaght and Dundrum (and Dun Laoghaire). The scheduled frequency is 20mins, and scheduled journey time is 50min between Tallaght and Dundrum (+35mins to 40mins to/from Dun Laoghaire).

By comparison, journey time by car mode is 19mins; and journey time by radial public transport mode is approximately 1hr. A comparison of current travel times is attached in *Appendix A* of this document.

Existing orbital Dublin Bus routes serving Tallaght and/or Dundrum include:

- 56a Tallaght – Ringsend Road
- 75 Tallaght – Dun Laoghaire
- 76 Tallaght – Chapelizod, via Liffey Valley
- 76a Blanchardstown Centre – Tallaght
- 777 Tallaght – Dublin Airport (express coach)

Current Dublin Bus routes for Tallaght and Dundrum are shown on Figure 31. Transport for Ireland schematic maps of current bus services from Tallaght is also shown in *Appendix B* of this document.

Figure 30 Tallaght and Dundrum Key Centres

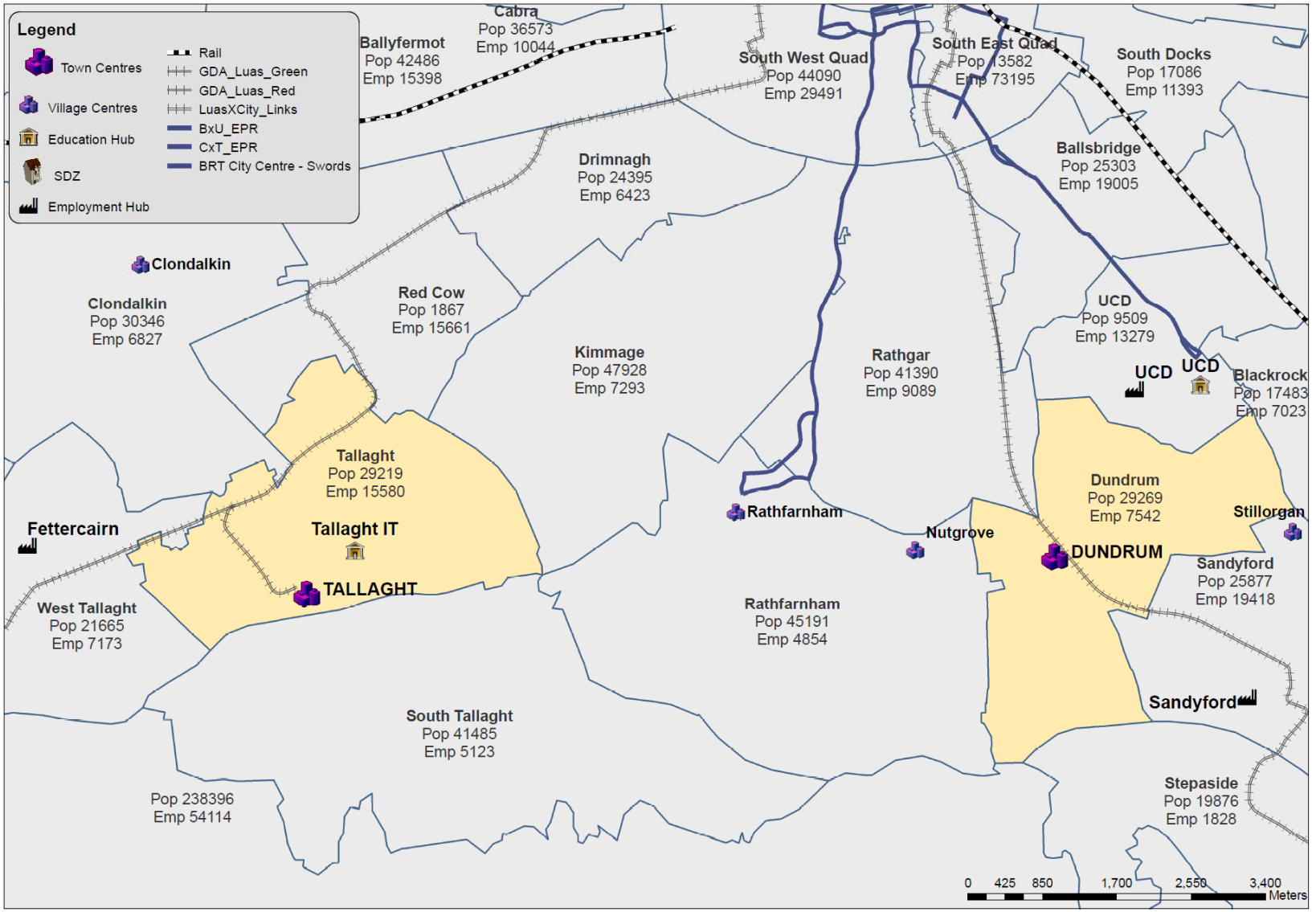
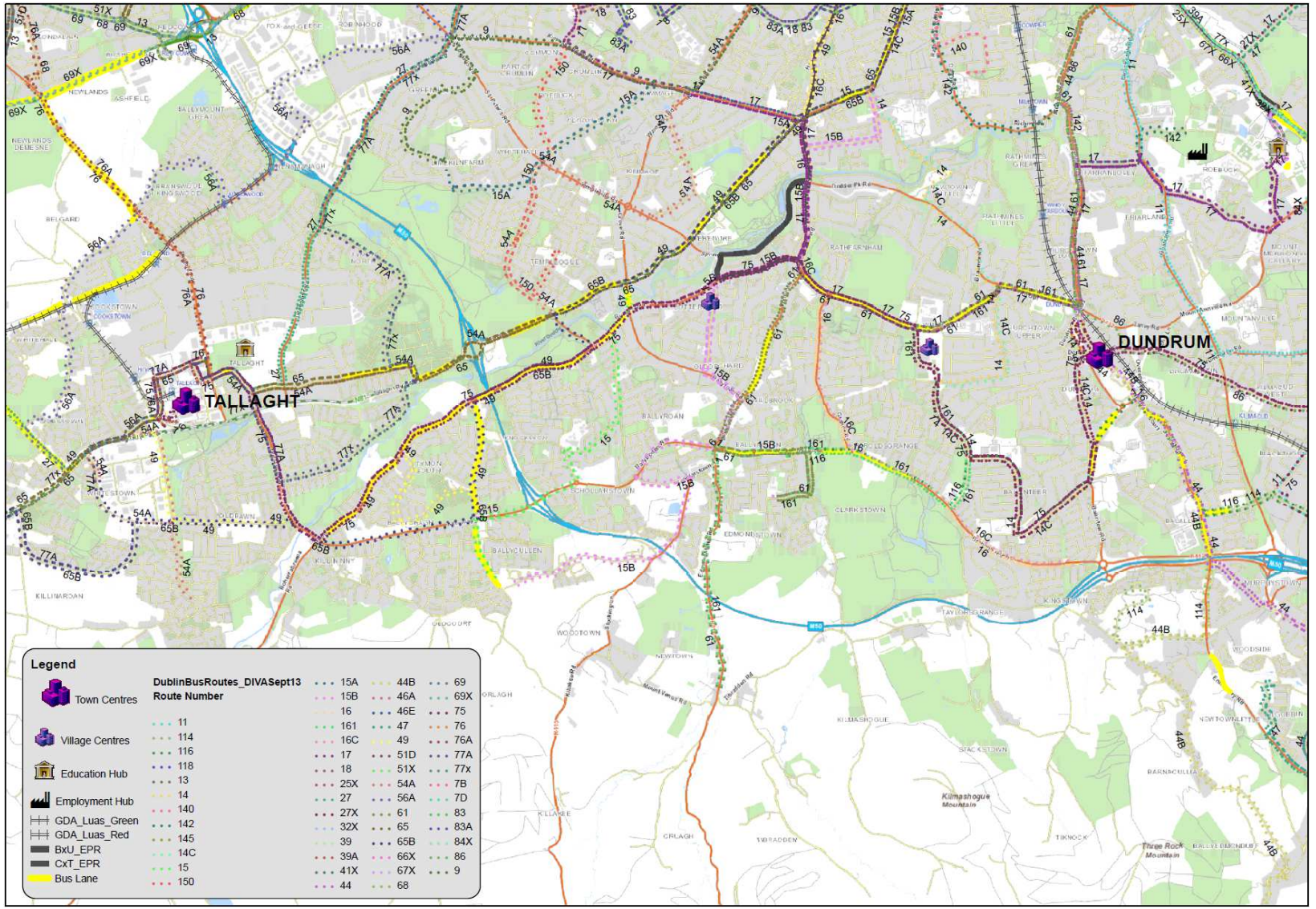


Figure 31 Tallaght and Dundrum Existing and Planned Public Transport Services



5.1 Preliminary Route Options

Eight preliminary orbital route options were identified between Tallaght and Dundrum.

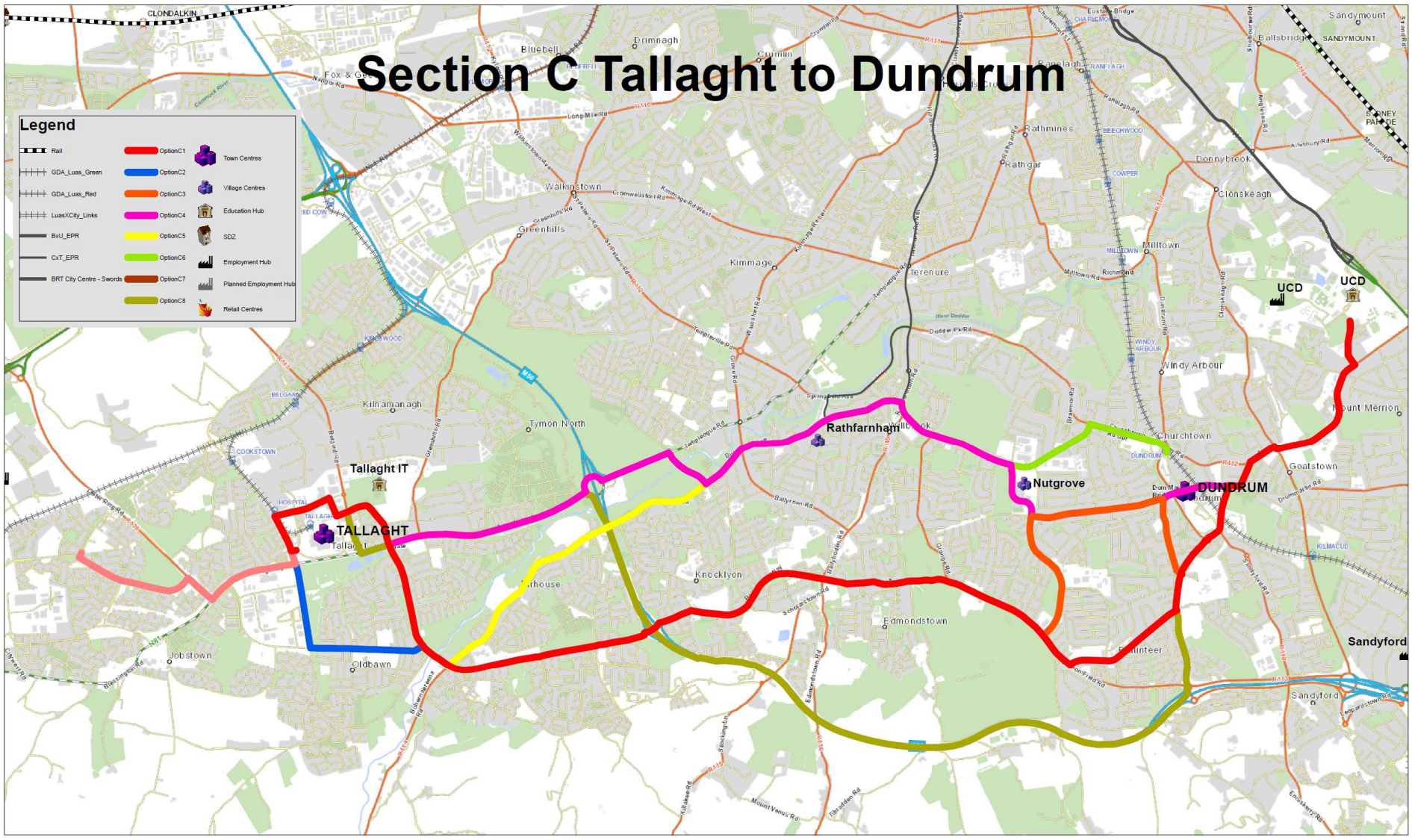
- OptionC1 Tallaght – Dundrum (via Old Bawn Road) – UCD
  [OptionC1a] Extension considered: Fettercairn – Tallaght
- OptionC2 Tallaght – Dundrum (via Whitestown Way) – UCD
- OptionC3 Tallaght – Dundrum (via Barton Road East) – UCD
- OptionC4 Tallaght – Rathfarnham (via N81) – Dundrum – UCD
- OptionC5 Tallaght – Rathfarnham (via Firhouse Road) – Dundrum – UCD
- OptionC6 Tallaght – Rathfarnham (via Firhouse Road) – Dundrum (via Churchtown Road Upper)
- OptionC7 Tallaght – Rathfarnham (via Firhouse Road) – Dundrum
- OptionC8 Tallaght – Dundrum (via M50)

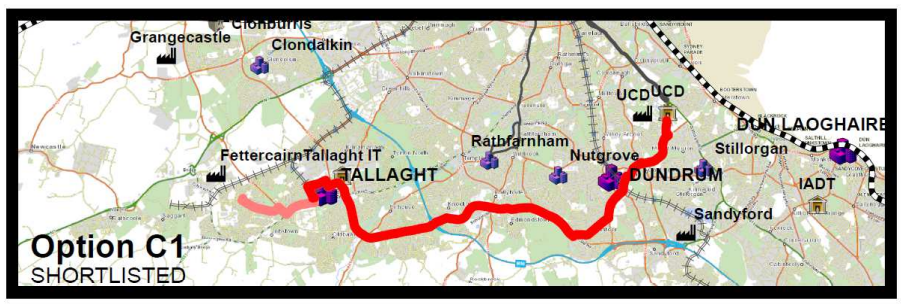
Extension to UCD has been considered. This is aimed at assessing the feasibility of a direct PT service between Tallaght and UCD, which is not available at present. It is noted here that OptionC5 and OptionC7 have similar alignments; the difference between them is that OptionC5 extends eastwards from Dundrum to UCD, whereas OptionC7 terminates at Dundrum.

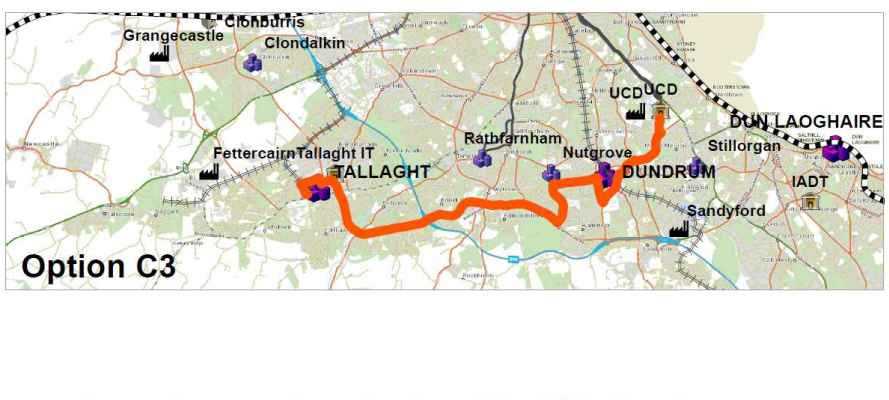
Extension to Fettercairn has also been considered. This is aimed at assessing the feasibility of extending the Tallaght – Dundrum route to residential/ employment catchments west of Tallaght town centre, and the potential to increase patronage on the route by serving the population and workplaces here. OptionC1a has been assessed to identify the level of additional demand that could be captured if routes are extended westwards from Tallaght to Fettercairn.

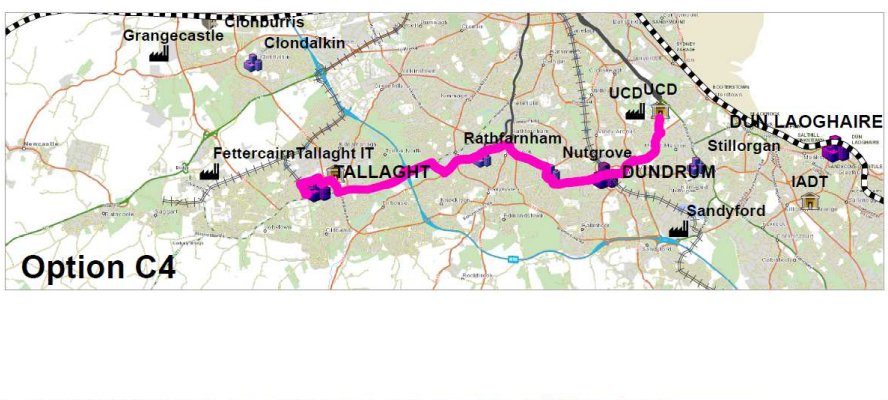
These are shown in following Figure 32 and in *Appendix E* of this document.

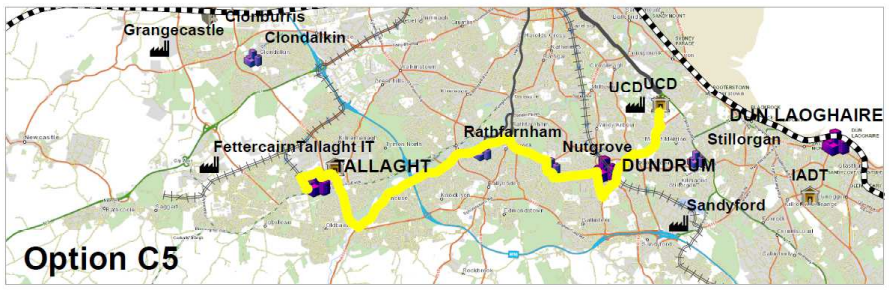
Figure 32 Preliminary Route Options for Section C: Tallaght to Dundrum

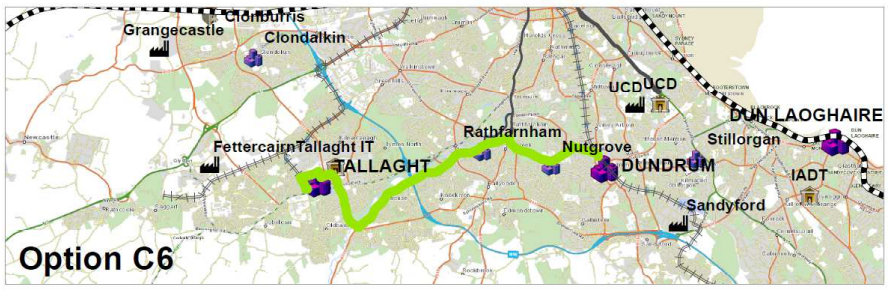


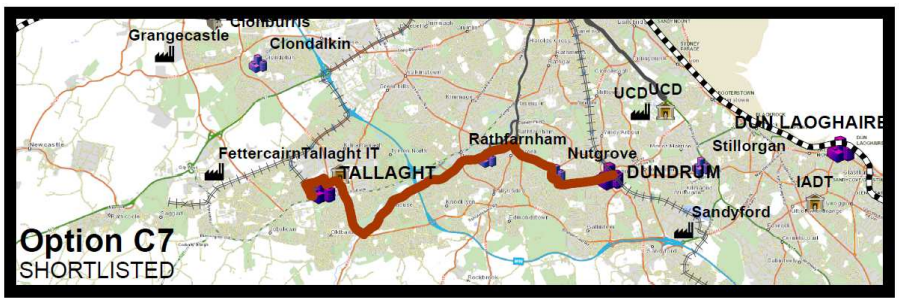


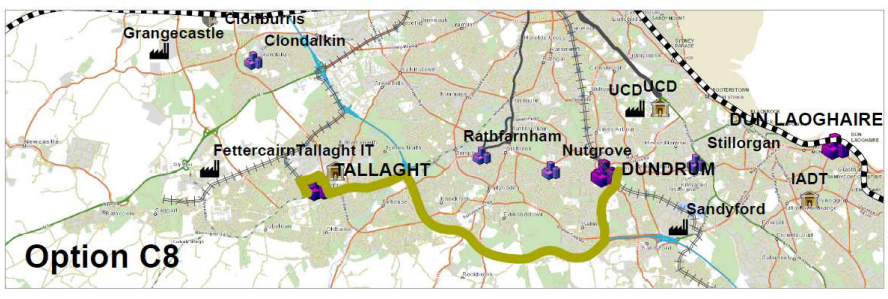












5.2 Appraisal of Preliminary Options

5.2.1 Criteria

In order to shortlist options that could be brought forward for further assessment, all identified preliminary options have been screened based on the following headline criteria:

vii. Demand;
viii. Key destinations served;
ix. Journey times;
x. Significant engineering impacts;
xi. Significant environmental impacts;
xii. High level costing

Under each of these headline criteria is a list of elements which are deemed crucial to evaluating the feasibility of each route option. These elements are listed in the appraisal table.

5.2.2 Comparative Evaluation

All identified preliminary options were evaluated comparatively, i.e. how each option fares in comparison with other options.

- Where an option fares obviously better than most other options, it is given a green status:
- Where an option fares obviously poorer than most other options, it is given a red status:
- Where an option fares nearly the same as most other options, i.e. does not fare obviously better or poorer than most other options, it is given an amber status:

Appraisal of the identified preliminary options for Section C is shown in *Table 17*.

Table 17 Appraisal of Preliminary Options for Section C: Tallaght to Dundrum

Route Options	C1	C1a	C2	C3	C4	C5	C6	C7	C8
1. DEMAND									
1.1. **Primary Demand** *(within 800m)*									
6.1.1. Population *(2011 Census)*	93,655	C1 + 18,516 = 112,168	96,115	95,376	79,483	90,892	70,657	74,827	62,119
6.1.2. Employment *(2011 Census)*	29,061	C1 + 2,688 = 31,749	20,493	30,371	31,380	31,997	24,321	27,126	22,007
Population + Employment Total	*122,726*	*143,917*	*116,608*	*125,747*	*110,863*	*122,889*	*94,978*	*101,953*	*84,126*
6.1.3. Potential Commuter Trip Demand *(based on 2011 POWSCAR[6])*	6,867	C1 + 2,109 = 8,976	5,962	7,086	5,197	6,459	4,186	4,716 *(+1,743 if extend to UCD; i.e. 6,459)*	3,081
% Potential Commuters with multiple car ownership	*84%*	*77%*	*84%*	*83%*	*84%*	*83%*	*81%*	*81%*	*79%*
6.1.4. Future year 2035 Population	102,287		102,076	104,423	86,453	98,544	79,462	83,026	67,801
6.1.5. Future year 2035 Employment	31,864		19,976	32,787	32,620	32,513	29,374	28,745	21,350
Future year 2035 Population + Employment Total	*134,151*		*122,052*	*137,210*	*119,073*	*131,057*	*108,836*	*111,771*	*89,151*
1.2. **Secondary Demand**									
1.2.1. Radial PT interchange modes	Luas, Bus	Luas, Bus	Luas, Bus	Luas, Bus	Luas, Bus, BRT	Luas, Bus, BRT	Luas, Bus, BRT	Luas, Bus, BRT	Luas, Bus
1.2.2. Local PT interchange locations	Tallaght; Dundrum	Tallaght; Dundrum	Tallaght; Dundrum	Tallaght; Dundrum	Tallaght; Dundrum; Rathfarnham	Tallaght; Dundrum; Rathfarnham	Tallaght; Dundrum; Rathfarnham	Tallaght; Dundrum (not LUAS); Rathfarnham	Tallaght; Dundrum
1.2.3. Potential bike and ride locations	Tallaght	Tallaght	Tallaght	Tallaght	Tallaght; Rathfarnham	Tallaght; Rathfarnham	Tallaght; Rathfarnham	Tallaght; Rathfarnham	Tallaght
2. KEY DESTINATIONS SERVED									
2.1. **Town Centres**									
2.1.1. Tallaght	•	•	•	•	•	•	•	•	•
2.1.2. Rathfarnham					•	•	•	•	
2.1.3. Dundrum	•	•	•	•	•	•		•	•
2.2. **Education Hubs**									
2.2.1. Tallaght I.T.	•	•		•	•	•	•	•	•

[6] Based on number of commuters with place of residence and place of work or school along route AND are currently commuting by bus, or are currently commuting by car (driving or as passenger) with current commuting journey times of more than 7 minutes.

Route Options	C1	C1a	C2	C3	C4	C5	C6	C7	C8
2.2.2.UCD	•	•	•	•	•	•			
2.3. **Employment hubs**									
2.3.1.Tallaght	•	•	•	•	•	•	•	•	•
2.3.2.Dundrum	•	•	•	•	•	•		•	•
2.3.3.UCD	•	•	•	•	•	•			
2.4. **Retail centres**									
2.4.1.Tallaght (The Square)	•	•	•	•	•	•	•	•	•
2.4.2.Dundrum	•	•	•	•	•	•		•	•
2.4.3.Nutgrove					•	•	•	•	
3. JOURNEY TIMES									
3.1. **Length (km)**	15.3km	17.9km	14.4km	16.7km	14.1km	16.4km	11.9km *(+4km if extend to UCD)*	12.4km *(+4km if extend to UCD)*	13.8km
3.1.1.Journey Time[7] with Existing Infrastructure	47 mins	55 mins	45 mins	52 mins	43 mins	50 mins	35 mins *(+ 13 mins if extend to UCD, i.e. 48 mins)*	37 mins *(+13 mins if extend to UCD, i.e. 50 mins)*	32 mins
3.1.2.% Journey Time[7] / Speed with Proposed Infrastructure	42 mins / 22kph	48 mins / 22kph	38 mins / 23kph	44 mins / 20kph	42 mins / 20kph	50 mins / 20kph	35 mins / 20kph *(+ 13 mins if extend to UCD, i.e. 48 mins / 20kph)*	38 mins / 20kph *(+13 mins if extend to UCD, i.e. 51 mins / 20kph)*	30 mins / 28kph
3.2. **Reliability** (e.g. bus priority and sensitivity to congestion)									
3.2.1.% Bus Priority at Junctions									
3.2.2.% Existing Bus Lanes	9%	9%	5%	8%	10%	14%	22%	18%	7%
3.2.3.% Potential Bus Lanes	31%	37%	30%	27%	22%	14%	22%	18%	10%
3.2.4.% Motorway (uncongested)	-	-	-	-		-	-	-	53%
4. SIGNIFICANT ENGINEERING IMPACTS									
4.1. **Major Structures**	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated
4.2. **Substantial Landtake**	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated

[7] Bus speeds have been based on the NTA's analysis of AVL data for Dublin Bus route 75. Motorway speed is assumed to be 60km/h at all times. Full bus priority is assumed to be 27km/h at all times. Otherwise speed is assumed to be 19km/h.

Route Options	C1	C1a	C2	C3	C4	C5	C6	C7	C8
5. SIGNIFICANT ENVIRONMENTAL IMPACTS									
5.1. **Protected Natural Heritage Sites**	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated
5.2. **Land Severance**	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated
5.3. **Impact on Built Environment**	Road widening; some loss of trees	Road widening; some loss of trees	Road widening; some loss of trees	Road widening; some loss of trees	Road widening; some loss of trees	Road widening; some loss of trees	Road widening; some loss of trees	Road widening; some loss of trees	Road widening; some loss of trees
6. HIGH LEVEL COSTINGS									
6.1. **Capital investment** (BHLS, excluding transit vehicles)	€35M	€38M	€42M	€36M	€18M	€16M	€12M *(+ €4M if extend to UCD, i.e. €16M)*	€13M *(+ €4M if extend to UCD, i.e. €17M)*	€5M

5.3 Options Screening

At this stage, a screening process was carried out to eliminate options that are obviously unfeasible.

OptionC6 was eliminated because it does not connect directly to Dundrum town centre, and

OptionC8 was eliminated because the demand it can potentially serve is much lower in comparison to other options.

5.4 Shortlisted Options

Based on the comparative evaluation shown in *Table 17*, the following three options have fared better than the rest, and will be progressed to the next stage for further assessment.

- **OptionC1** Tallaght – Dundrum (via Old Bawn Road) – UCD
- **OptionC2** Tallaght – Dundrum (via Whitestown Way) – UCD
- **OptionC7** Tallaght – Rathfarnham (via Firhouse Road) – Dundrum

OptionC3 and OptionC5 were not shortlisted because their journey times were circa 15% longer than OptionC1 and OptionC2 even though they're serving similar levels of demand.

OptionC4 was not shortlisted because the demand served is circa 20% lower than OptionC7 (compared by assuming extension on OptionC7 to also serve UCD similarly).

5.4.1 OptionC1 Tallaght – Dundrum (via Old Bawn Road) – UCD

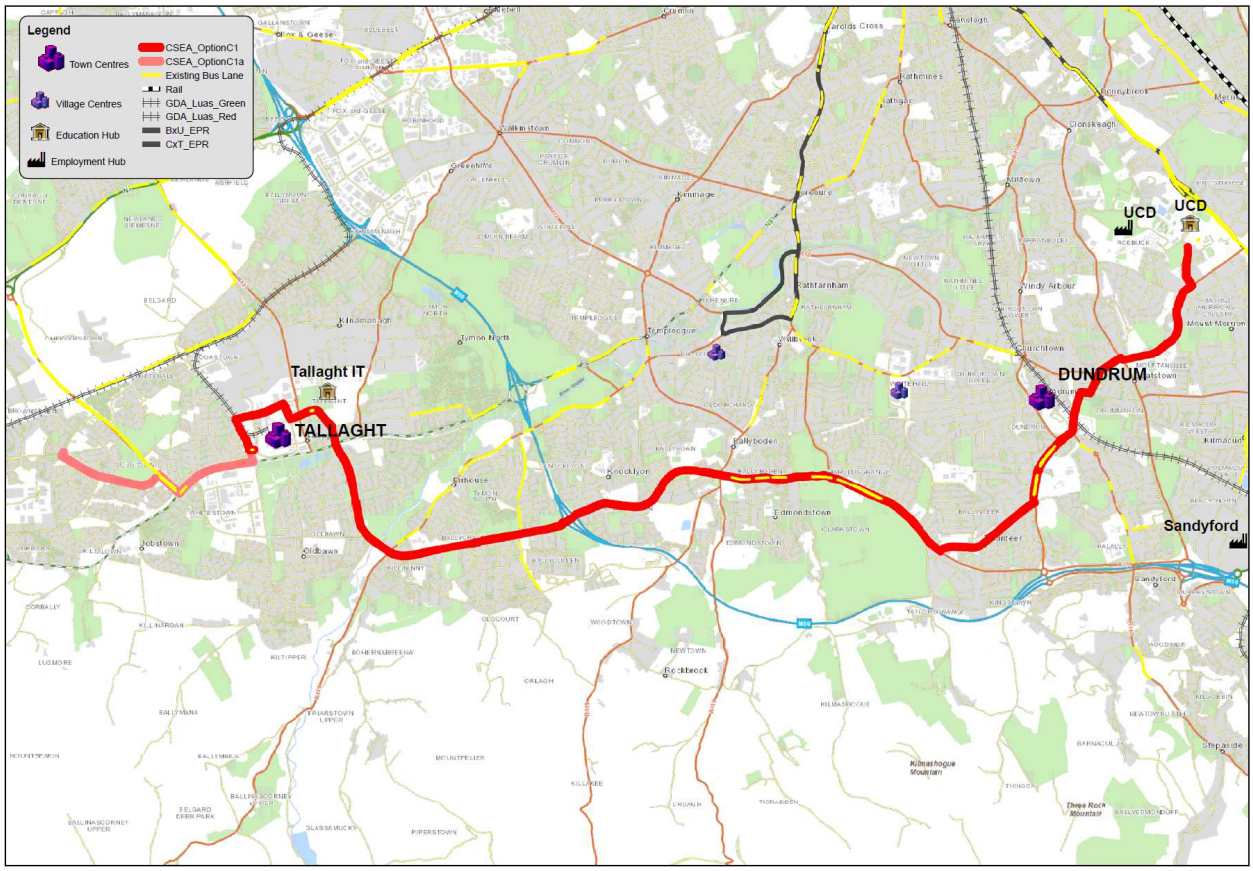


Figure 33 OptionC1: Tallaght – Dundrum (via Old Bawn Road) – UCD; and OptionC1a with extension from Tallaght to Fettercairn.

OptionC1 has been shortlisted because of its following advantages:

- Potential to provide PT connection between Tallaght and UCD, which is not available at present;
- Potential for interchange with high-quality radial PT services, i.e. Luas red line at Tallaght and Luas green line at Balally/ Dundrum.

This option would also allow for PT connections to/ from Sandyford via interchange with Luas green line at Balally / Dundrum.

Extension of the route westwards from Tallaght to Fettercairn (OptionC1a) would incur an additional journey time of 7 minutes. However this could potentially be viable because circa 2,100 additional commuters could be served.

5.4.2 OptionC2 Tallaght – Dundrum (via Whitestown Way) – UCD

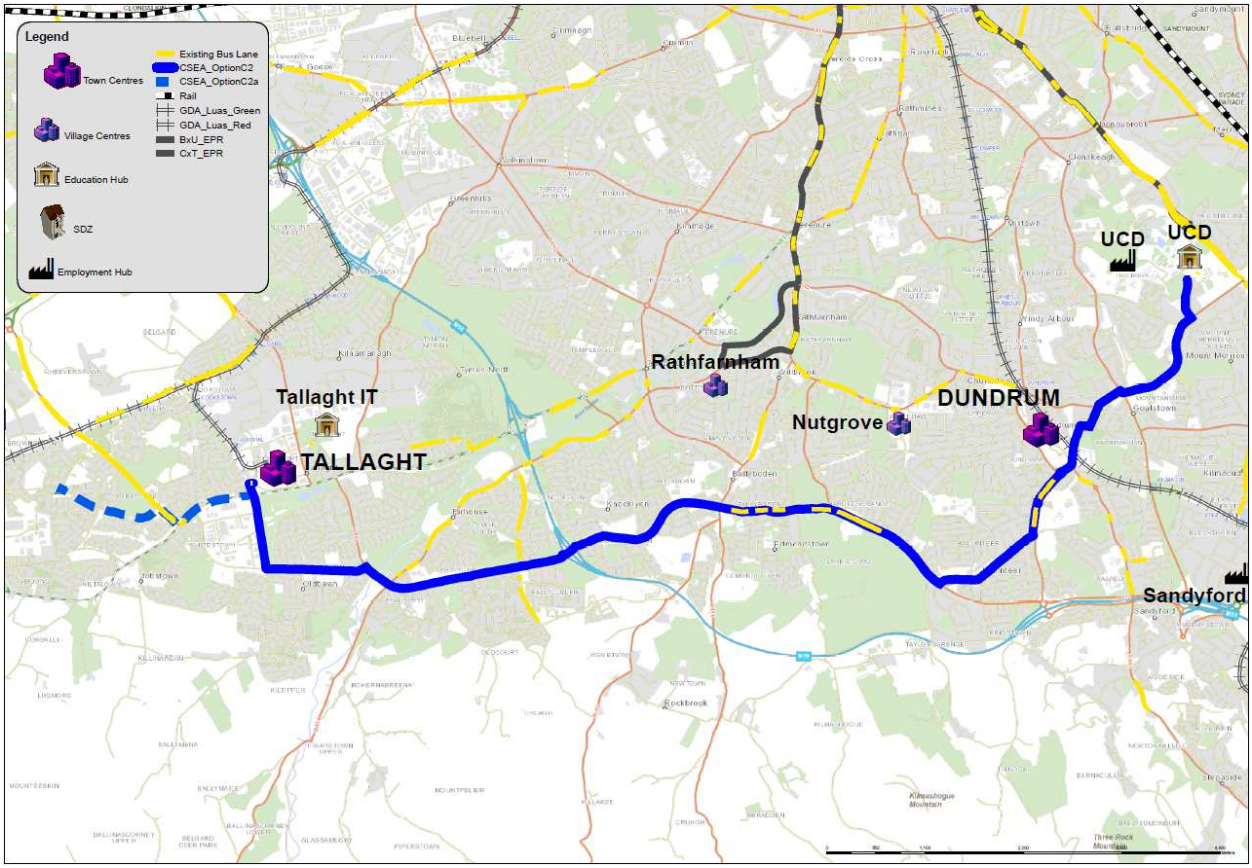


Figure 34 OptionC2: Tallaght – Dundrum (via Whitestown Way) – UCD; and OptionC2a with extension from Tallaght to Fettercairn.

OptionC2 has been shortlisted because of its following advantages:

- Best travel time among screened options (40 mins);
- Potential to provide PT connection between Tallaght and UCD, which is not available at present; and
- Potential for interchange with high-quality radial PT services, i.e. Luas red line at Tallaght and Luas green line at Balally/ Dundrum.

This option would also allow for PT connections to/ from Sandyford via interchange with Luas green line at Balally / Dundrum.

Extension of the route westwards from Tallaght to Fettercairn (OptionC2a) would incur an additional journey time of 7 minutes. However this could potentially be viable because circa 2,100 additional commuters could be served.

5.4.3 OptionC7 Tallaght – Rathfarnham (via Firhouse Road) – Dundrum

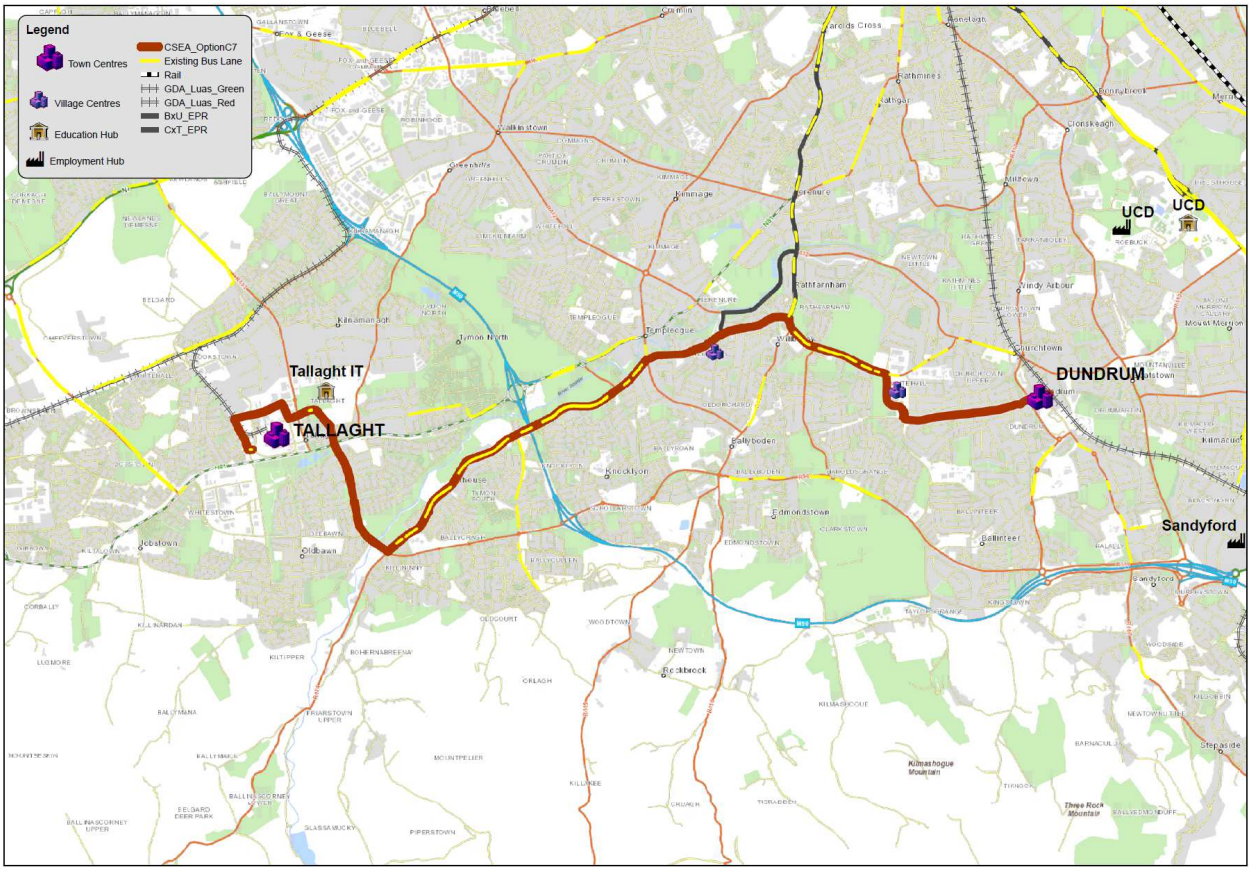


Figure 35 OptionC7: Tallaght – Rathfarnham (via Firhouse Road) – Dundrum

OptionC7 has been shortlisted for further assessment in the next stage because its alignment is a shorter variation of existing Dublin Bus route 75 (by bypassing Ballinteer).

5.5 Assessment of Shortlisted Options

5.5.1 Network Modelling

Each shortlisted option was modelled on the NTA's 4-stage CUBE transport model which includes separate public transport TRIPS and highway SATURN assignment models for the Greater Dublin Area.

Appendix G describes the methodology undertaken in modelling the schemes, and includes some caveats on the results. The results from this stage of the study will be used in selecting preferred options; but further work is required to provide enough confidence in the numbers to use in a cost benefit analysis.

For each option the model has been run twice for the 2033 future year AM peak period scenario, with two different assumptions on the quality of the services:

a. 'As Bus and no QBC' – where the routes are coded as a conventional bus and with no additional bus priority than in the Do Minimum; and
b. 'New Mode with QBC' – coded as a high quality bus mode, with journey speeds based on those described in Table 17 above.

OptionC1 and OptionC2 both could include an extension between Tallaght and Fettercairn. Modelling of these two options indicated similar levels of demand, but journey times on OptionC1 could be longer than OptionC2. This may be due to higher levels of congestion on the N81 - Old Bawn Road route (OptionC1) compared with the Whitestown Way – Firhouse Road West route (OptionC2). As such, modelling of the Tallaght – Fettercairn extension was carried out on OptionC2 only, i.e. OptionC2a.

Results below show the potential usage and journey times estimated from the modelling process. The best-performing option for each category above has been highlighted

Options	Total Boarding's for AM Peak Period 2033		Total Passenger KMs		Passengers per Kilometre	
Route	As Bus	New Mode with QBC	As Bus	New Mode with QBC	As Bus	New Mode with QBC
C1	5,879	10,914	32,859	68,665	369	771
C2	5,816	10,955	31,969	67,427	377	796
C2a	7,055	12,173	39,736	75,459	400	759
C7	3,054	6,857	15,634	37,222	215	511

		Maximum Peak Hour Loadings As Bus			Maximum Peak Hour Loadings As New Mode with QBC		
	Time Period	C1	C7	C2	C1	C7	C2
Eastbound (Tallaght to Dundrum)	AM1	706	341	731	1,462	769	1,517
	AM2	908	515	950	2,214	1,169	2,331
	AM3	527	238	530	1,120	537	1,141
Westbound (Dundrum to Tallaght)	AM1	585	341	534	917	626	794
	AM2	747	424	660	1,289	1,005	1,123
	AM3	382	222	351	614	445	525

	Total Daily Boarding's		Total Annual Patrongage (Mil.)	
	As Bus	New Mode with QBC	As Bus	New Mode with QBC
C1	16,000	29,000	1.78	3.30
C2	16,000	29,000	1.76	3.32
C2a	19,000	32,000	2.14	3.68
C7	8,000	18,000	0.92	2.08

	Peak Direction Journey Times (in minutes)		Peak Direction Speeds (kph)	
Route	As Bus	New Mode with QBC	As Bus	New Mode with QBC
C1	104	39	8.38	22.47
C2	98	32	8.51	25.75
C2a	106	40	9.23	24.38
C7	75	34	9.68	21.28

5.5.2 Engineering and Environmental Issues

The main engineering and environmental issues that could arise from provision of new infrastructure along each shortlisted route have been listed below.

It should be noted that for the purpose of this study, engineering and environmental issues are identified at strategy level - for the purpose of comparing the levels of complexity in delivering new infrastructure along shortlisted routes, and to inform the selection of a preferred route. Localised issues along the emerging preferred route can be further identified and dealt with at design stage.

	Engineering Issues	Environmental Issues
OptionC1	▪ Widening of some road sections to accommodate new bus lanes. ▪ Upgrading of existing signalised junctions to provide bus priority. ▪ Most bus priority improvements can be accommodated within existing roadway. Only some minor land acquisition may be required at pinch-point locations. ▪ Relocation of some boundary walls along road edges. *Impact: Low*	▪ Possible minor land acquisition. ▪ Loss of vegetation and trees along road edges. *Impact: Low*
OptionC2	▪ Widening of some road sections to accommodate new bus lanes. ▪ Upgrading of existing signalised junctions to provide bus priority. ▪ Most bus priority improvements can be accommodated within existing roadway. Only some minor land acquisition may be required at pinch-point locations. ▪ Relocation of some boundary walls along road edges. *Impact: Low*	▪ Possible minor land acquisition. ▪ Loss of vegetation and trees along road edges. *Impact: Low*
OptionC2a	▪ Widening of some road sections to accommodate new bus lanes. ▪ Upgrading of existing signalised junctions to provide bus priority. ▪ Most bus priority improvements can be accommodated within existing roadway. Only some minor land acquisition may be required at pinch-point locations. ▪ Relocation of some boundary walls along road edges. *Impact: Low*	▪ Possible minor land acquisition. ▪ Loss of vegetation and trees along road edges. *Impact: Low*
OptionC7	▪ Upgrading of existing signalised junctions to provide bus priority. *Impact: Low*	▪ No significant issues anticipated. *Impact: Low*

Table 18 Section C Shortlisted Options - Engineering and Environmental Issues

5.5.3 Potential Quality of Service

Quality criteria of a public transport service, as viewed by the customer, typically covers aspects of service availability, accessibility, information, time, customer care, comfort, and security.

Table 19 Section C Shortlisted Options – Standards of Bus Service Provision

Availability	✓ Bus service operating 18 hours a day. ✓ Bus service frequencies of no less than 15mins. *(see Table 20 for service frequencies)*
Accessibility	✓ Good access to bus service, with bus stops located at 400m distances along route. ✓ Direct bus service connections to key trip attractors. ✓ Good integration with other PT services at interchange locations; at least one bus scheduled to arrive before 6am or before first departing train/ tram/ bus, whichever earlier; and at least one bus to depart at 12 midnight or after last arriving train/ tram/ bus, whichever later.
Information	✓ Availability of up-to-date Real Time Passenger Information on RTPI boards, website, and mobile app. ✓ Bus schedules displayed at bus stops.
Time	✓ Short journey times. ✓ Good reliability, i.e. adherence to schedule. *(see Table 20 for service frequencies)*
Customer Care	✓ Customer-oriented operator and staff. ✓ Assistance for customers needing help at stops. ✓ Flexible ticketing options; including ticketing machines at bus stops that are capable of dispensing change and allowing LEAP card top-ups.
Comfort	✓ Vehicles with sufficient seating/ personal space, and facilities to accommodate wheelchairs, buggies, and even bicycles (on vehicle-mounted racks). ✓ Good ride quality on roads. ✓ Sheltered bus stops. ✓ Availability of complementary facilities at bus terminals, e.g. toilets and convenience stores.
Security	✓ Safe drivers, vehicles, and roads. ✓ Availability of public lighting and natural surveillance at bus stops. ✓ Availability of visible monitoring on vehicles.

At this stage, in terms of potential quality of service, the key difference between **each** shortlisted route would be the service frequency and journey times.

Table 20 shows the service frequencies and journey times for each shortlisted route in Section C. Journey times have been estimated from network modelling; and headways (service frequencies) have been estimated based on demand and cycle times (round-trip journey times + 10mins for terminus activity).

Short headways (i.e. high frequency service) and short journey times indicate that a service is likely to operate more reliably - and thereby, ceteris paribus, provide a better quality of service.

	Maximum Line Loading	Headway (Service Frequency)		Journey Time (Average in Single Direction)	Estimated Speed
		Peak	Off-Peak		
OptionC1	2,214 eastbound	2 mins	5 mins	39 mins	22 kph
OptionC2	2,331 eastbound	2 mins	5 mins	32 mins	26 kph
OptionC2a	2,246 eastbound	2 mins	5 mins	40 mins	23 kph
OptionC7	1,169 eastbound	5 mins	9 mins	34 mins	21 kph

Table 20 Section C Shortlisted Options – Standards of Bus Service Operations

5.5.4 Capital Costs

For the purpose of this study, capital costs for each of the shortlisted schemes have been estimated as construction costs (including preliminaries, design & supervision, and contingencies) + rolling stock costs. Summary of estimated capital costs for shortlisted options in Section C are shown below.

	Construction Costs	Rolling Stock Costs	Total Capital Costs
OptionC1	€31,438,917	€16,126,000	€47,564,917
OptionC2	€35,947,154	€15,759,500	€51,706,654
OptionC2a	€37,589,706	€16,859,000	€54,448,706
OptionC7	€4,673,075	€8,063,000	€12,736,075

Table 21 Section C Shortlisted Options – Capital Cost Estimates

It is noted here that the rolling stock cost for OptionC7 is lower due to lower demand, i.e. lower level of maximum line-loading in the AM peak-period.

5.6 Preferred Option for Section C

Option C2a is the emerging preferred route because:

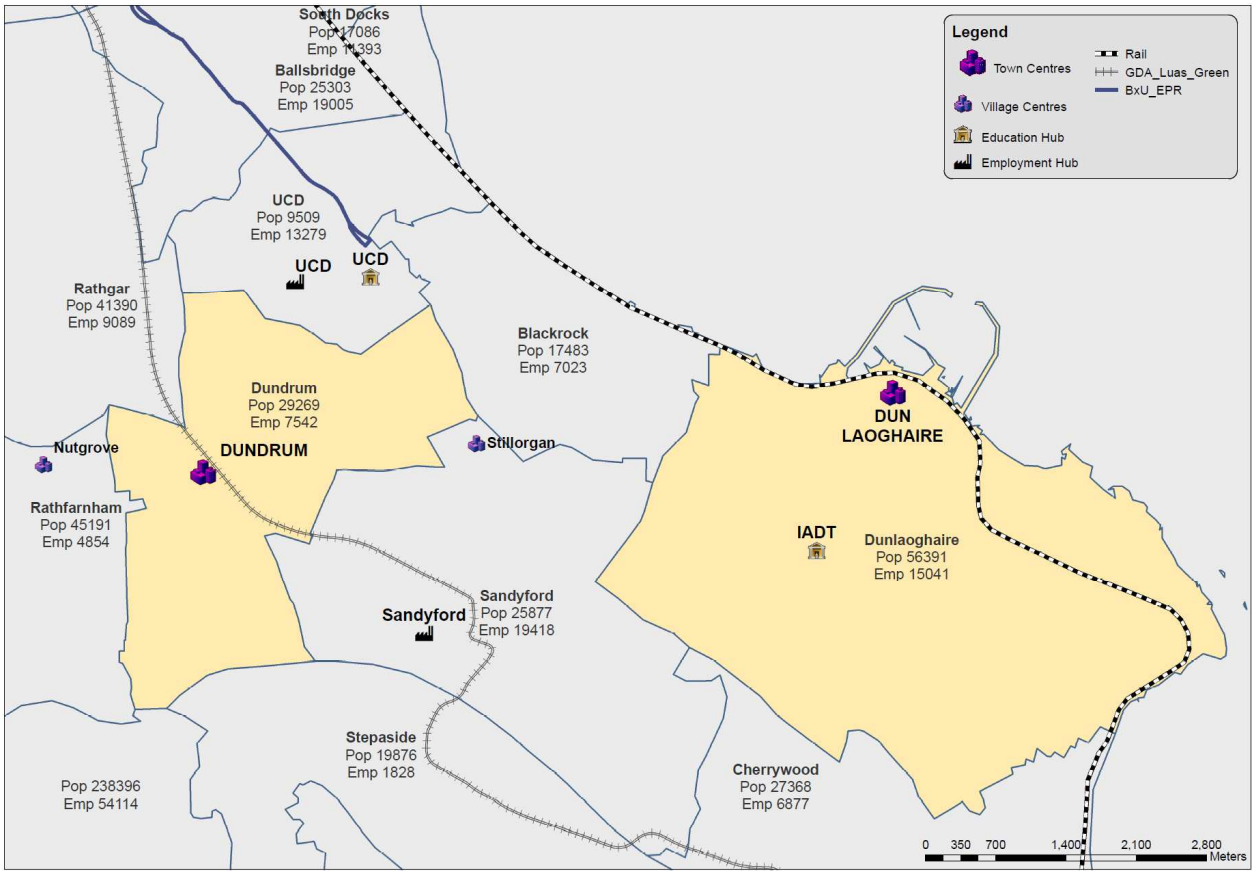
- It has the highest level of estimated AM peak-period boardings and passengers.kilometres, and fairly high passengers-per-kilometre;
- It has the highest levels of estimated peak hour loading, and daily and annual boardings;
- It has potentially good quality of service due to high service frequencies and speeds; and
- It has low levels of complexity and impact in terms of anticipated engineering and environmental issues.

The capital cost of OptionC2a is estimated at €54,448,706.

6. SECTION D: DUNDRUM TO DUN LAOGHAIRE

Dundrum and Dun Laoghaire were identified as two southern "Key Centres" to be served by orbital public transport service. The population and employment levels in Dundrum and Dun Laoghaire settlement areas are shown in Figure 36 below (and in following page).

Figure 36 Dundrum and Dun Laoghaire Key Centres



At present Dublin Bus route 75 serves Dundrum and Dun Laoghaire (and Tallaght). The scheduled frequency is 20mins, and scheduled journey time is 35min between Dundrum and Dun Laoghaire (+50mins to/from Tallaght). This journey time increases by approximately 10mins when the bus makes scheduled detours through Sandyford Industrial Estate during 4 – 5 times every weekday during AM/ PM peak travel times.

By comparison, journey time by car mode is 19mins; and journey time by radial public transport mode is approximately 1hr. A comparison of current travel times is attached in *Appendix A* of this document.

Existing orbital Dublin Bus routes serving Dundrum and/or Dun Laoghaire include:

- 59 Dun Laoghaire - Cabinteely
- 63 Dun Laoghaire - Kilternan
- 75 Dun Laoghaire – Tallaght (via Dundrum)

Current Dublin Bus routes for Dundrum and Dun Laoghaire are shown on Figure 37. Transport for Ireland schematic maps of current bus services from Dun Laoghaire is also shown in *Appendix B* of this document.

Figure 36 Dundrum and Dun Laoghaire Key Centres

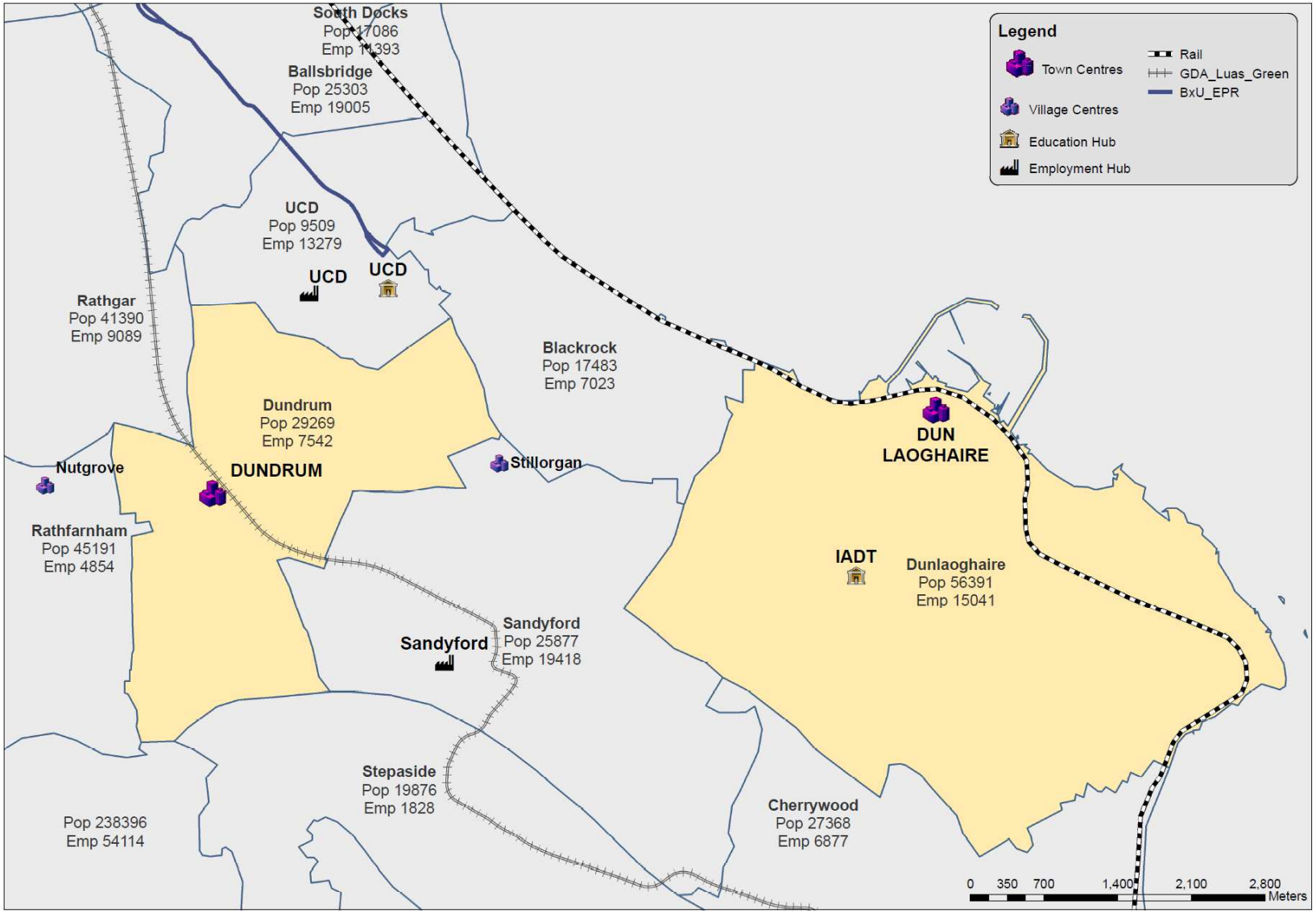
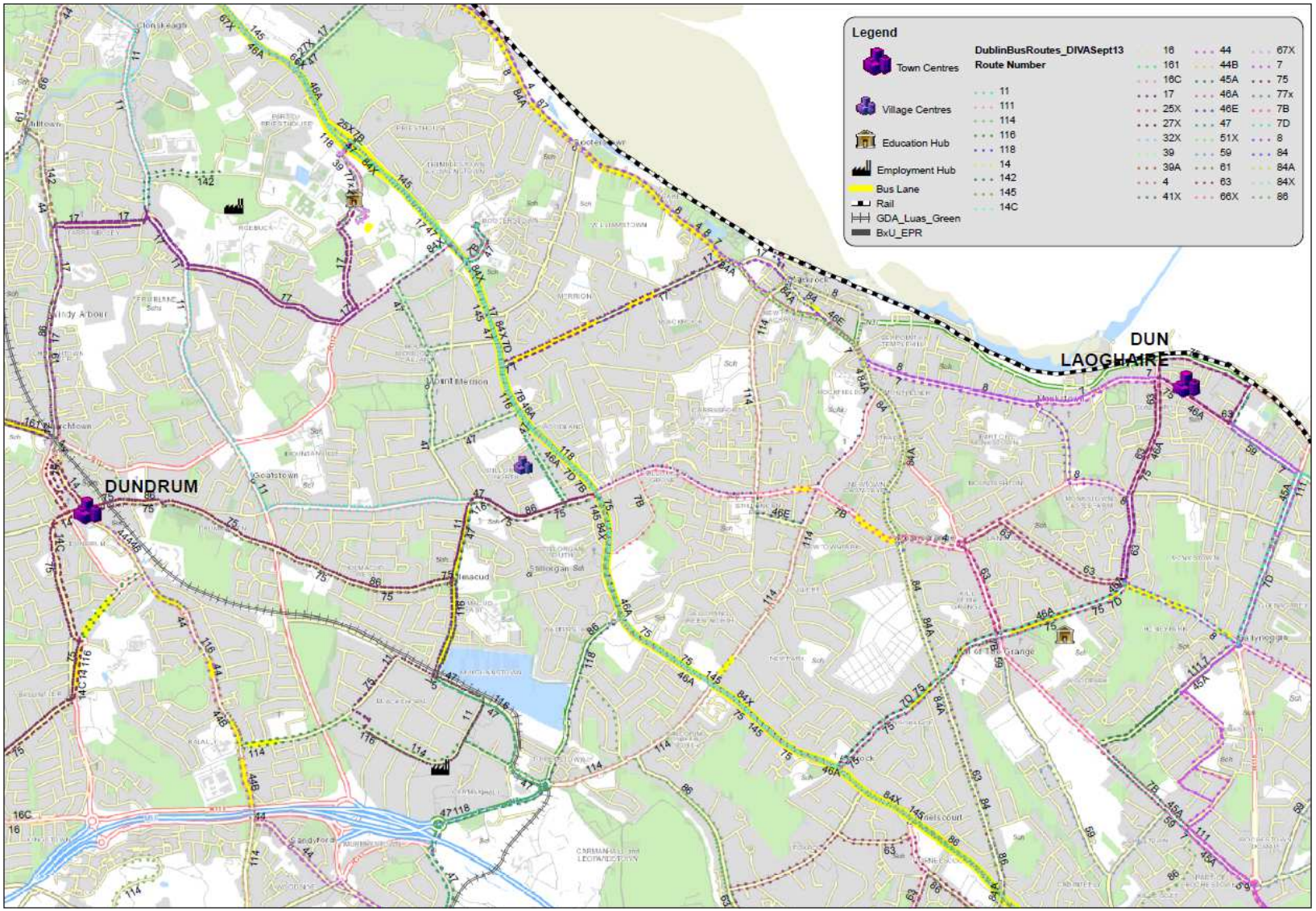


Figure 37 Tallaght and Dundrum Existing and Planned Public Transport Services



6.1 Preliminary Route Options

Six preliminary orbital route options were identified between Dundrum and Dun Laoghaire.

- OptionD1 Dundrum – Stillorgan (via Lower Kilmacud Road) – Dun Laoghaire (via Stillorgan Park)

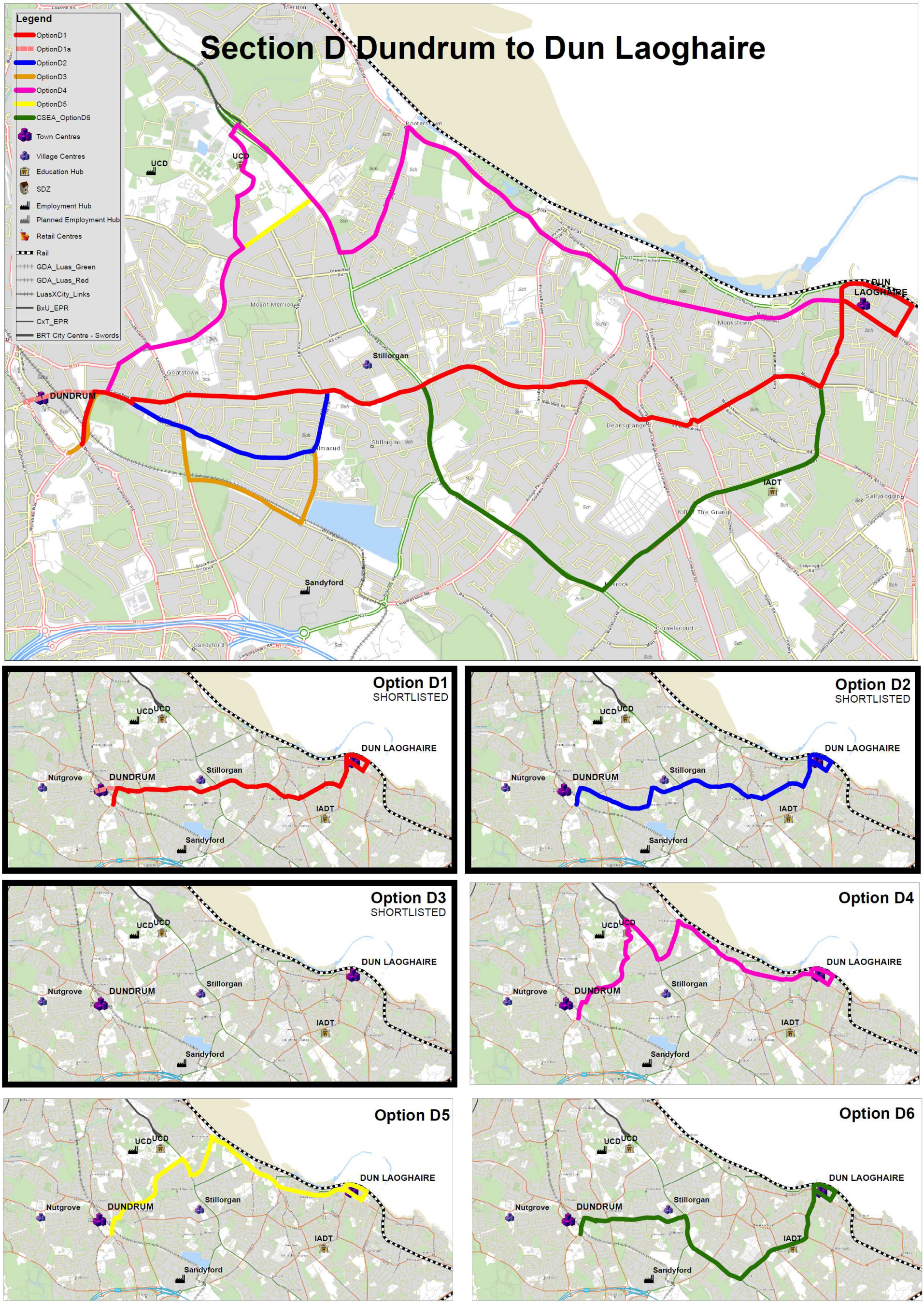
  [OptionD1a] Alternative of commencing at Dundrum village

- OptionD2 Dundrum – Stillorgan (via Upper Kilmacud Road) – Dun Laoghaire (via Stillorgan Park)
- OptionD3 Dundrum – Sandyford (via Benildus Avenue) – Stillorgan – Dun Laoghaire (via Stillorgan Park)
- OptionD4 Dundrum – UCD – Dun Laoghaire (via Rock Road)
- OptionD5 Dundrum – UCD (via Fosters Avenue) – Dun Laoghaire (via Rock Road)
- OptionD6 Dundrum – Stillorgan (via Upper Kilmacud Road) – Dun Laoghaire (via Deansgrange)

At the Dundrum end of each option, routes are commencing at Ballaly Luas Station. The alternative of commencing at Dundrum village instead has also been considered.

These are shown in Figure 38 and in *Appendix F* of this document.

Figure 38 Preliminary Route Options for Section D: Dundrum to Dun Laoghaire



6.2 Appraisal of Preliminary Options

6.2.1 Criteria

In order to shortlist options that could be brought forward for further assessment, all identified preliminary options have been screened based on the following headline criteria:

xiii. Demand;
xiv. Key destinations served;
xv. Journey times;
xvi. Significant engineering impacts;
xvii. Significant environmental impacts;
xviii. High level costing

Under each of these headline criteria is a list of elements which are deemed crucial to evaluating the feasibility of each route option. These elements are listed in the appraisal table.

6.2.2 Comparative Evaluation

All identified preliminary options were evaluated comparatively, i.e. how each option fares in comparison with other options.

- Where an option fares obviously better than most other options, it is given a green status:
- Where an option fares obviously poorer than most other options, it is given a red status:
- Where an option fares nearly the same as most other options, i.e. does not fare obviously better or poorer than most other options, it is given an amber status:

Appraisal of the identified preliminary options for Section D is shown in *Table 22*.

Table 22 Appraisal of Preliminary Options for Section C: Tallaght to Dundrum

Route Options	D1	D1a	D2	D3	D4	D5	D6
1. DEMAND							
1.1. **Primary Demand** *(within 800m)*							
1.1.1.Population *(2011 Census)*	50,704	51,744	52,437	54,845	49,522	47,420	55,865
1.1.2.Employment *(2011 Census)*	16,757	16,821	18,174	28,386	27,342	20,180	18,748
Population + Employment Total	*67,461*	*68,565*	*70,611*	*83,231*	*76,864*	*67,600*	*74,613*
1.1.3.Potential Commuter Trip Demand *(based on 2011 POWSCAR[8])*	2,186	2,200	2,205	3,043	3,383	2,282	3,247
% Potential Commuters with multiple car ownership	*84%*	*84%*	*82%*	*81%*	*82%*	*87%*	*83%*
1.1.4.Future year 2035 Population	53,912		57,473	62,281	53,038	51,147	59,976
1.1.5.Future year 2035 Employment	14,577		16,428	28,378	25,438	17,796	17,067
Future year 2035 Population + Employment Total	*68,489*		*73,901*	*90,659*	*78,476*	*68,943*	*77,043*
1.2. **Secondary Demand**							
1.2.1.Radial PT interchange modes	Bus, Luas, DART	Bus, DART	Bus, Luas, DART	Bus, Luas, DART	Bus, Luas, DART	Bus, Luas, DART	Bus, Luas, DART
1.2.2.Local PT interchange locations	Dundrum, N11 Dun Laoghaire	N11 Dun Laoghaire	Dundrum, N11 Dun Laoghaire	Dundrum (not Luas), N11, Dun Laoghaire, Stillorgan (Luas), Sandyford (Luas)	Dundrum, N11, Booterstown, Blackrock, Monkstown, Dun Laoghaire	Dundrum, N11, Booterstown, Blackrock, Monkstown, Dun Laoghaire	Dundrum, N11, Booterstown, Blackrock, Monkstown, Dun Laoghaire
1.2.3.Potential bike and ride locations	Dun Laoghaire	Dun Laoghaire	Dun Laoghaire	Dun Laoghaire	Dun Laoghaire	Dun Laoghaire	Dun Laoghaire
2. KEY DESTINATIONS SERVED							
2.1. **Town Centres**							
2.1.1.Dundrum	•	•	•	•	•	•	•
2.1.2.Stillorgan	•	•	•	•			
2.1.3.Sandyford				•			
2.1.4.Blackrock					•	•	
2.1.5.Dun Laoghaire	•	•	•	•	•	•	•
2.2. **Education Hubs**							
2.2.1.UCD					•	•	
2.2.2.Dun Laoghaire IADT							•
2.3. **Employment hubs**							
2.3.1.Dundrum	•	•	•	•	•	•	•
2.3.2.Stillorgan	•	•	•	•			

[8] Based on number of commuters with place of residence and place of work or school along route AND are currently commuting by bus, or are currently commuting by car (driving or as passenger) with current commuting journey times of more than 7 minutes.

Route Options	D1	D1a	D2	D3	D4	D5	D6
2.3.3.Sandyford				•			
2.3.4.UCD					•	•	
2.3.5.Blackrock					•	•	
2.3.6.Dun Laoghaire	•	•	•	•	•	•	•
2.4. **Retail centres**							
2.4.1.Dundrum	•	•	•	•	•	•	•
2.4.2.Stillorgan	•	•	•	•			
2.4.3.Dun Laoghaire	•	•	•	•	•	•	•
3. JOURNEY TIMES							
3.1. **Length (km)**	9.3km	9.5km	9.8km	10.8km	12.13km	10.72km	10.88km
3.1.1.Journey Time[9] with Existing Infrastructure	28 mins	28 mins	29 mins	33 mins	36 mins	33 mins	33 mins
3.1.2.Potential Journey Time[9] / Speed with Proposed Infrastructure	23 mins / 24kph	27 mins / 21kph	25 mins / 24kph	28 mins / 23kph	36 mins / 20kph	33 mins / 19kph	32 mins / 20kph
3.2. **Reliability** (e.g. bus priority and sensitivity to congestion)							
3.2.1.% Bus Priority at Junctions							
3.2.2.% Existing Bus Lanes	3%	3%	5%	7%	19%	13%	24%
3.2.3.% Potential Bus Lanes	9%	9%	5%	11%	19%	13%	29%
3.2.4.% Motorway (uncongested)	-	-	-	-	-	-	-
4. SIGNIFICANT ENGINEERING IMPACTS							
4.1. **Major Structures**	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated
4.2. **Substantial Landtake**	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated
5. SIGNIFICANT ENVIRONMENTAL IMPACTS							
5.1. **Protected Natural Heritage Sites**	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated
5.2. **Land Severance**	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated
5.3. **Impact on Built Environment**	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated	None anticipated
6. HIGH LEVEL COSTINGS							
6.1. **Capital investment** (BHLS, excluding transit vehicles)	€14M	€14M	€11M	€16M	€13M	€12M	€16M

[9] Bus speeds have been based on the NTA's analysis of AVL data for Dublin Bus route 75. Motorway speed is assumed to be 60km/h at all times. Full bus priority is assumed to be 27km/h at all times. Otherwise speed is assumed to be 19km/h.

6.3 Options Screening

At this stage, a screening process was carried out to eliminate options that are obviously unfeasible.

OptionD4 and **OptionD5** were eliminated because the section between UCD and Dun Laoghaire is already served by radial bus service No.46A; and the section between Booterstown and Dun Laoghaire is also served by radial bus and DART services. The potential demand capture for these two orbital route options would be lower, as they are competing with a number of high-quality radial PT services.

OptionD6 was eliminated because the section between Stillorgan and Dun Laoghaire is already served by radial bus service No.46A. The potential demand capture for this orbital route option would be lower, as it is competing with a high-quality radial bus services.

6.4 Shortlisted Options

Based on the comparative evaluation shown in *Table 22*, the following three options have fared better than the rest, and will be progressed to the next stage for further assessment.

- OptionD1 Dundrum – Stillorgan (via Lower Kilmacud Road) – Dun Laoghaire (via Stillorgan Park)
- OptionD2 Dundrum – Stillorgan (via Upper Kilmacud Road) – Dun Laoghaire (via Stillorgan Park)
- OptionD3 Dundrum – Sandyford (via Benildus Avenue) – Stillorgan – Dun Laoghaire (via Stillorgan Park)

6.4.1 OptionD1 Dundrum – Stillorgan (via Lower Kilmacud Road) – Dun Laoghaire (via Stillorgan Park)

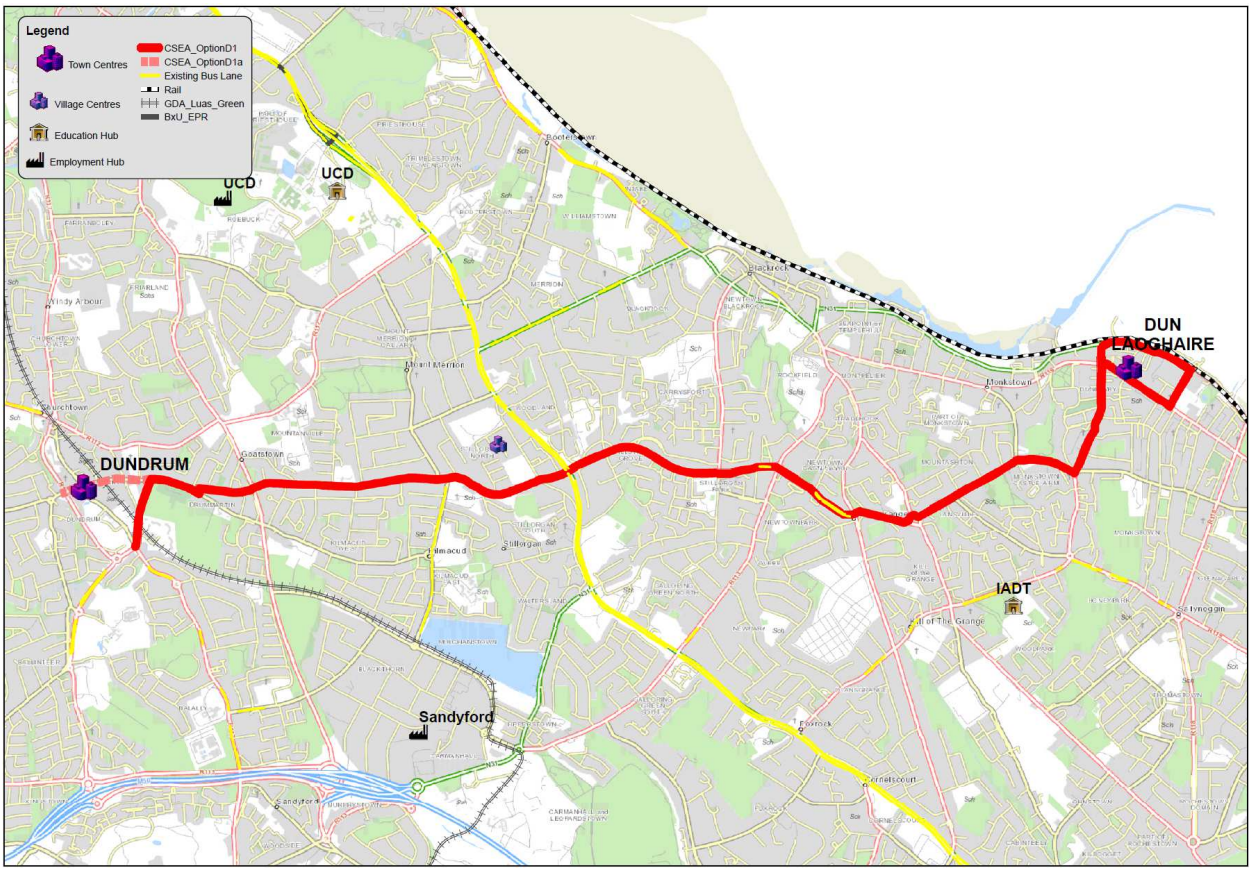


Figure 39 OptionD1: Dundrum – Stillorgan (via Upper Kilmacud Rd) – Dun Laoghaire (via Stillorgan Park); OptionD1a: Alternative of commencing route at Dundrum village

OptionD1 has been shortlisted because of its following advantages:

- Shortest route between Dundrum and Dun Laoghaire key centres.
- Potential to provide PT service connecting residential catchment along Stillorgan Park with Dundrum and Dun Laoghaire, and Upper Kilmacud Road with Dun Laoghaire, which are not available at present; and
- Potential for interchange with high-quality radial PT services, i.e. QBC along N11 and Luas green line at Balally.

This option would also allow for high-quality PT connection to/ from Sandyford via interchange with Luas green line at Balally / Dundrum.

Alternative of commencing the route at Dundrum village instead of Balally Luas station has also been considered. While this alternative may have marginally higher demand, it would not interchange as well with Luas service. According to 2011 POWSCAR information, the number of additional commuters served by this alternative is circa 14 people. As such, the option of commencing at Balally Luas station is preferred over the alternative of commencing at Dundrum village.

6.4.2 OptionD2 Dundrum – Stillorgan (via Upper Kilmacud Road) – Dun Laoghaire (via Stillorgan Park)

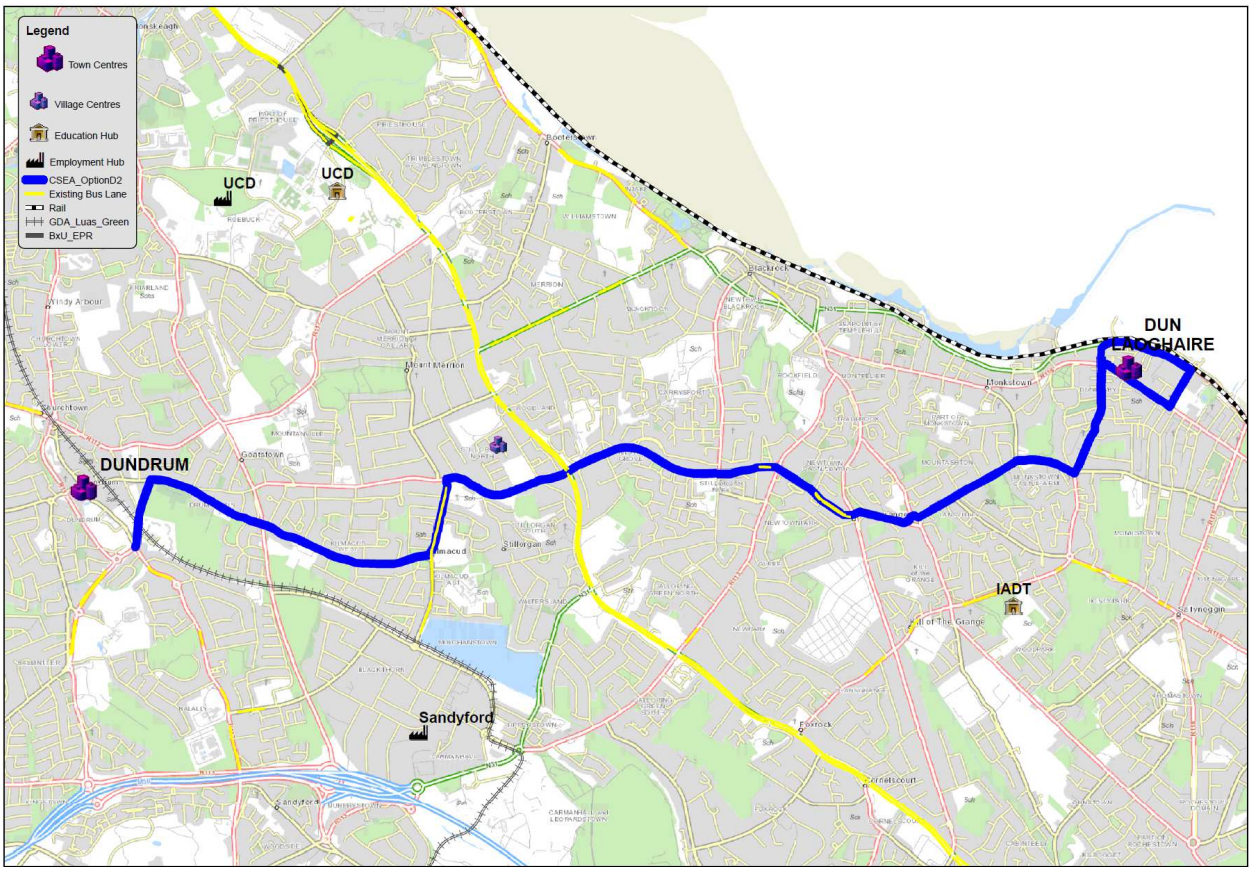


Figure 40 OptionD2: Dundrum – Stillorgan (via Lower Kilmacud Road) – Dun Laoghaire (via Stillorgan Park)

OptionD2 has been shortlisted because of its following advantages:

- Potential to provide PT service connecting residential catchment along Stillorgan Park with Dundrum and Dun Laoghaire, which is not available at present; and
- Potential for interchange with high-quality radial PT services, i.e. QBC along N11 and Luas green line at Balally.

This option would also allow for high-quality PT connection to/ from Sandyford via interchange with Luas green line at Balally / Dundrum.

6.4.3 OptionD3 Dundrum – Sandyford (via Benildus Avenue) – Stillorgan – Dun Laoghaire (via Stillorgan Park)

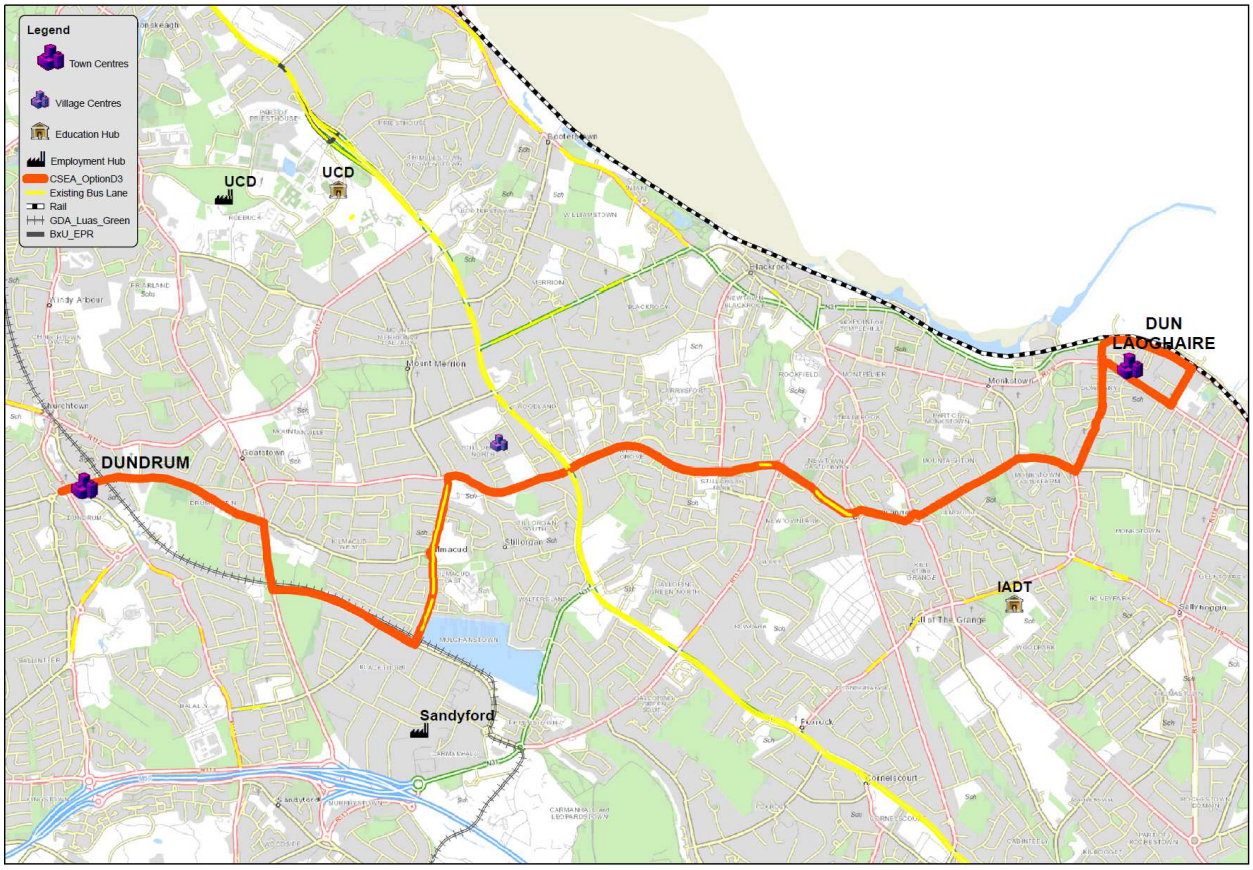


Figure 41 OptionD3: Dundrum – Sandyford (via Benildus Avenue) – Stillorgan – Dun Laoghaire (via Stillorgan Park)

OptionD2 has been shortlisted because of its following advantages:

- Potential to provide direct PT service between Dun Laoghaire and Sandyford, which is not available at present;
- Potential to provide PT service connecting residential catchment along Stillorgan Park with Dundrum and Dun Laoghaire, which is not available at present; and
- Potential for interchange with high-quality radial PT services, i.e. QBC along N11 and Luas green line at Balally and Sandyford.

6.5 Assessment of Shortlisted Options

6.5.1 Network Modelling

Each shortlisted option was modelled on the NTA's 4-stage CUBE transport model which includes separate public transport TRIPS and highway SATURN assignment models for the Greater Dublin Area.

Appendix G describes the methodology undertaken in modelling the schemes, and includes some caveats on the results. The results from this stage of the study will be used in selecting preferred options; but further work is required to provide enough confidence in the numbers to use in a cost benefit analysis.

For each option the model has been run twice for the 2033 future year AM peak period scenario, with two different assumptions on the quality of the services:

a. 'As Bus and no QBC' – where the routes are coded as a conventional bus and with no additional bus priority than in the Do Minimum; and

b. 'New Mode with QBC' – coded as a high quality bus mode, with journey speeds calculated based on those described in Table 22 above.

Results below show the potential usage and journey times estimated from the modelling process. The best-performing option for each category above has been highlighted.

Options **Total Boarding's for AM Peak Period 2033**

Route	As Bus	New Mode with QBC
D1	856	2,512
D2	891	2,607
D3	782	2,294

Total Passenger KMs

As Bus	New Mode with QBC
3,962	12,437
4,114	12,355
3,593	11,639

Passengers per Kilometre

As Bus	New Mode with QBC
76	238
75	224
60	194

		Maximum Peak Hour Loadings As Bus			Maximum Peak Hour Loadings As New Mode with QBC		
	Time Period	D1	D2	D3	D1	D2	D3
Eastbound (Dundrum to Dunlaoghaire)	AM1	102	84	116	242	264	277
	AM2	130	116	125	379	403	457
	AM3	76	58	75	175	165	195
Westbound (Dunlaoghaire to Dunrdum)	AM1	139	159	209	374	354	463
	AM2	106	155	209	549	544	649
	AM3	102	105	144	275	245	311

	Total Daily Boarding's		Total Annual Patrongage (Mil.)	
Route	As Bus	New Mode with QBC	As Bus	New Mode with QBC
D1	2,000	7,000	0.26	0.76
D2	2,000	7,000	0.27	0.79
D3	2,000	6,000	0.24	0.69

Peak Direction Journey Times (in minutes)

Route	As Bus	New Mode with QBC
D1	50	25
D2	49	26
D3	59	27

Peak Direction Speeds (kph)

As Bus	New Mode with QBC
10.37	20.85
11.19	21.42
10.02	21.74

6.5.2 Engineering and Environmental Issues

The main engineering and environmental issues that could arise from provision of new infrastructure along each shortlisted route have been listed below.

It should be noted that for the purpose of this study, engineering and environmental issues are identified at strategy level - for the purpose of comparing the levels of complexity in delivering new infrastructure along shortlisted routes, and to inform the selection of a preferred route. Localised issues along the emerging preferred route can be further identified and dealt with at design stage.

	Engineering Issues	Environmental Issues
OptionD1	▪ Widening of some road sections to accommodate new bus lanes. ▪ Upgrading of existing signalised junctions to provide bus priority. ▪ Most bus priority improvements can be accommodated within existing roadway. Only some minor land acquisition may be required at pinch-point locations. ▪ Relocation of some boundary walls along road edges. *Impact: Low*	▪ Possible minor land acquisition. ▪ Loss of vegetation and trees along road edges. *Impact: Low*
OptionD2	▪ Widening of some road sections to accommodate new bus lanes. ▪ Upgrading of existing signalised junctions to provide bus priority. ▪ Most bus priority improvements can be accommodated within existing roadway. Only some minor land acquisition may be required at pinch-point locations. ▪ Relocation of some boundary walls along road edges. *Impact: Low*	▪ Possible minor land acquisition. ▪ Loss of vegetation and trees along road edges. *Impact: Low*
OptionD3	▪ Widening of some road sections to accommodate new bus lanes. ▪ Upgrading of existing signalised junctions to provide bus priority. ▪ Most bus priority improvements can be accommodated within existing roadway. Only some minor land acquisition may be required at pinch-point locations. ▪ Relocation of some boundary walls along road edges. *Impact: Low*	▪ Possible minor land acquisition. ▪ Loss of vegetation and trees along road edges. *Impact: Low*

Table 23 Section D Shortlisted Options - Engineering and Environmental Issues

6.5.3 Potential Quality of Service

Quality criteria of a public transport service, as viewed by the customer, typically covers aspects of service availability, accessibility, information, time, customer care, comfort, and security.

Table 24 Section D Shortlisted Options – Standards of Bus Service Provision

Availability	✓ Bus service operating 18 hours a day. ✓ Bus service frequencies of no less than 15mins. *(see Table 25 for service frequencies)*
Accessibility	✓ Good access to bus service, with bus stops located at 400m distances along route. ✓ Direct bus service connections to key trip attractors. ✓ Good integration with other PT services at interchange locations; at least one bus scheduled to arrive before 6am or before first departing train/ tram/ bus, whichever earlier; and at least one bus to depart at 12 midnight or after last arriving train/ tram/ bus, whichever later.
Information	✓ Availability of up-to-date Real Time Passenger Information on RTPI boards, website, and mobile app. ✓ Bus schedules displayed at bus stops.
Time	✓ Short journey times. ✓ Good reliability, i.e. adherence to schedule. *(see Table 25 for service frequencies)*
Customer Care	✓ Customer-oriented operator and staff. ✓ Assistance for customers needing help at stops. ✓ Flexible ticketing options; including ticketing machines at bus stops that are capable of dispensing change and allowing LEAP card top-ups.
Comfort	✓ Vehicles with sufficient seating/ personal space, and facilities to accommodate wheelchairs, buggies, and even bicycles (on vehicle-mounted racks). ✓ Good ride quality on roads. ✓ Sheltered bus stops. ✓ Availability of complementary facilities at bus terminals, e.g. toilets and convenience stores.
Security	✓ Safe drivers, vehicles, and roads. ✓ Availability of public lighting and natural surveillance at bus stops. ✓ Availability of visible monitoring on vehicles.

At this stage, in terms of potential quality of service, the key difference between **each** shortlisted route would be the service frequency and journey times.

Table 25 shows the service frequencies and journey times for each shortlisted route in Section D. Journey times have been estimated from network modelling; and headways (service frequencies) have been estimated based on demand and cycle times (round-trip journey times + 10mins for terminus activity).

Short headways (i.e. high frequency service) and short journey times indicate that a service is likely to operate more reliably - and thereby, ceteris paribus, provide a better quality of service.

	Maximum Line Loading	Headway (Service Frequency)		Journey Time (Average in Single Direction)	Estimated Speed
		Peak	Off-Peak		
OptionD1	549 westbound	10 mins	15 mins	25 mins	21 kph
OptionD2	544 westbound	10 mins	15 mins	26 mins	21 kph
OptionD3	649 westbound	8 mins	15 mins	27 mins	22 kph

Table 25 Section D Shortlisted Options – Standards of Bus Service Operations

6.5.4 Capital Costs

For the purpose of this study, capital costs for each of the shortlisted schemes have been estimated as construction costs (including preliminaries, design & supervision, and contingencies) + rolling stock costs. Summary of estimated capital costs for shortlisted options in Section D are shown below.

	Construction Costs	Rolling Stock Costs	Total Capital Costs
OptionD1	€7,651,350	€2,565,500	€10,216,850
OptionD2	€6,275,512	€2,565,500	€8,841,012
OptionD3	€11,552,923	€2,932,000	€14,484,923

Table 26 Section D Shortlisted Options – Capital Cost Estimates

6.6 Preferred Option for Section D

Option D2 is the emerging preferred route because:

- It has the highest level of estimated AM peak-period boardings;
- It has the highest level of estimated annual patronage;
- It has potentially fairly good journey times and speeds;
- It has low levels of complexity and impact in terms of anticipated engineering & environmental issues.
- It requires the lowest level of capital cost.

OptionD3 has performed better than OptionD2 in terms of frequencies and speeds, but has less AM peak-hour boardings and annual patronage. This lower demand could be due to the duplication of PT services between Balally and Sandyford, i.e. the LUAS.

In this study, both OptionD2 and OptionD3 have been routed pass Balally LUAS station via Wyckham Way, where there may be local congestion caused by traffic going to/from Dundrum Shopping Centre. If the intended bus service were to be routed through the centre of Dundrum village instead of Wyckham Way – Ballaly LUAS station, i.e. no interchange with LUAS in Dundrum/ Balally, then OptionD3 could be reconsidered. This would interchange with the LUAS at Kilmacud LUAS stop instead.

The capital cost of OptionD2 is estimated at €8,841,012, and OptionD3 €14,484,923.

7. CONCLUSIONS AND RECOMMENDATIONS

The recommended mode is bus with high level of service (BHLS). The emerging preferred routes are shown below and in Appendix H of this document.

Figure 42 Preferred Orbital BHLS Routes

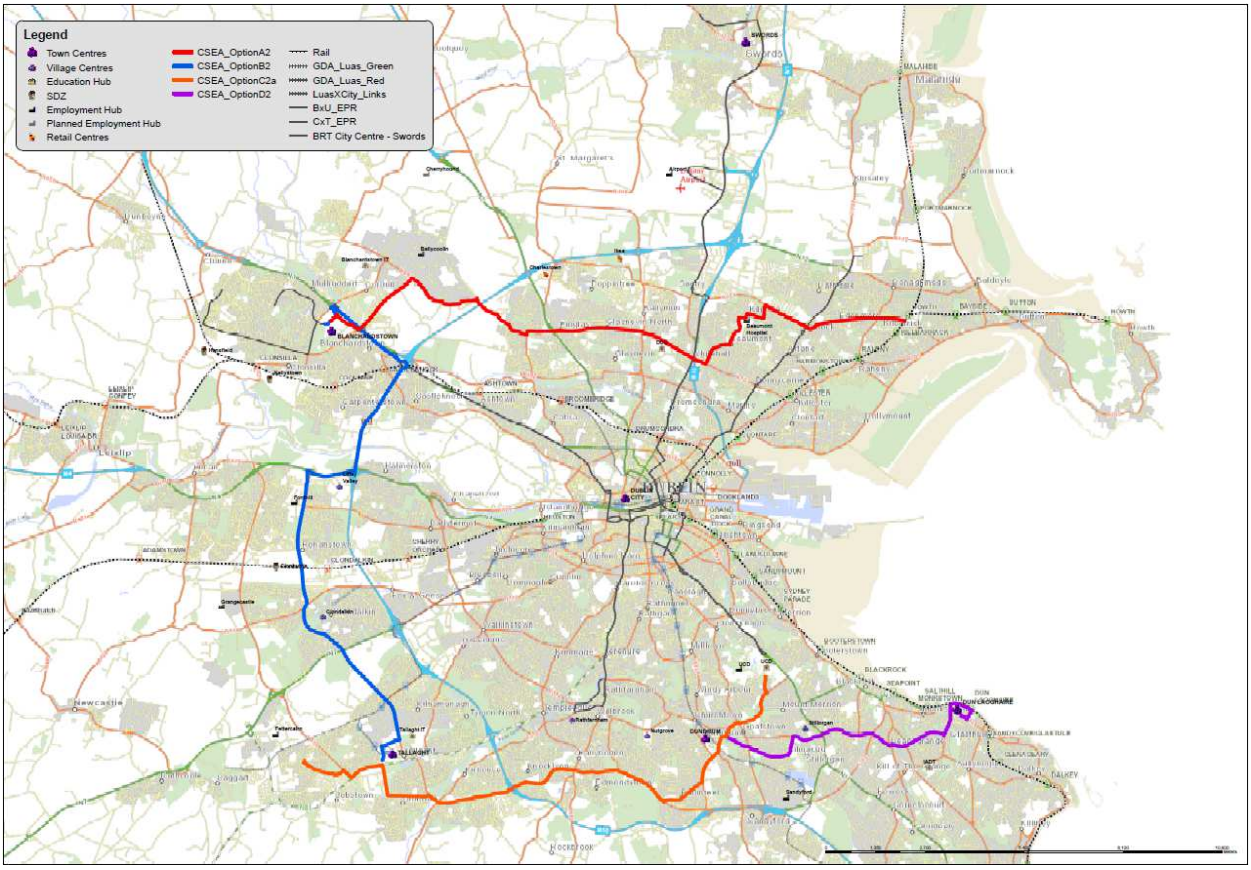


Table 27 Preferred Orbital Routes

Preferred Route	Estimated Annual Patronage	AM Peak-period Service Frequency	Max. Line Loading in AM Peak-period	Estimated Cost
OptionA2	2.35 million	6 minutes	943 westbound	€46,662,373
OptionB2	4.21 million	2 minutes	2,372 southbound	€63,462,081
OptionC2a	3.68 million	2 minutes	2,246 eastbound	€54,448,706
OptionD2	0.79 million	10 minutes	544 westbound	€8,841,012
				€173,414,173

This combination of preferred routes should be modelled in the NTA's latest network model for the Greater Dublin Area, in order to fully assess its impact when implemented alongside other transport schemes planned for the GDA.

Analysis of demand between Blanchardstown and Swords has indicated low levels of demand between these two key centres - hence a high-quality direct PT service may not be viable. PT connection between Blanchardstown and Swords could instead be made by interchange with a high-quality high-capacity radial PT service to/from Swords.

APPENDICES

Appendix A: Comparison of Existing Travel Times between Key Centres

From	To	Driving	PT Orbital		PT Radial		Notes	Quickest Route		
			Time	Service used	Time	Service used		Overall	Orbital?	Radial?
Dun Laoghaire	Dun Laoghaire	0	0	/	0	/	/	/	/	/
	Dundrum	20 min	33 min	Bus 75	1h 8 min	DART 7-Y/13/16, bus 44/61 and walk	Radial via Pearse Station	Driving	√	
	Tallaght	30 min	1h 20 min	Bus 75	1h 24 min	DART 13/16, bus 145 and Luas red line	(Routes already set out on Maps)	Driving	√	
	Blanchardstown	32 min	2h 47 min	Bus 75, 76/7a, 25 and 239	1:39min/1:15min bus/train-bus	Bus 7 and 39/39a, or DART 13/16 and bus 39/39a	Orbital via Tallaght and Lucan	Driving		√
	Swords	36 min	4h 2 min	Bus 75, 76/7a, 25, 239 71a and 41/41b	1:11min/1:09min bus/train-bus	Bus 703 and 41, or DART 13 and bus 43	Orbital via Tallaght, Lucan and Blanchardstown	Driving		√
Dundrum	Dun Laoghaire	20 min	35 min	Bus 75	58 min	Walking, Luas green line, bus 7	Radial via Pearse Station	Driving	√	
	Dundrum	0	0	/	0	/	/	/	/	/
	Tallaght	20 min	43 min	Bus 75	1h 25 min	Luas Green Line, walking and bus 27/77a	Radial via Stephen's Green	Driving	√	
	Blanchardstown	20 min	2h 17 min	Bus 75, 76/7a, 66/66a/66b/67 and 239	1h 31 min	Bus 44 and 39/39a	Orbital via Tallaght and Lucan	Driving		√
	Swords	30 min	3h 30min	Bus 75, 76/7a, 66/66a/66b/67, 17a and 41/41b	1h 35 min	Bus 14 and 500	Orbital via Tallaght, Lucan and Blanchardstown	Driving		√
Tallaght	Dun Laoghaire	31 min	1h 11min	Bus 75	1h 18 min	Bus 65 and DART 9-Y/13	(Routes already set out on Maps)	Driving	√	
	Dundrum	18 min	36 min	Bus 75	1h 19 min	Bus 27/49/54a/77a, walking and bus 44	Radial via Stephen's Green	Driving	√	
	Tallaght	0	0	/	0	/	/	/	/	/
	Blanchardstown	18 min	1h 50 min	Bus 76/76a, 25, 66 DART 14 and walking	1h 32 min	Bus 27/49/54a/77a and 39/39a	Orbital via Tallaght and Lucan	Driving		√
	Swords	29 min	1h 11 min	Luas red line, buses 726 and 41	1h 38 min	Luas red line and bus 500	(Routes already set out on Maps)	Driving	√	
Blanchardstown	Dun Laoghaire	34 min	2h 54 min	Bus 239, 66/66a/66b/67, 76/76a, and 75	1h 36 min	Bus 39/39a and 7	Orbital via Lucan and Tallaght	Driving		√
	Dundrum	19 min	2h 18 min	Bus 239, 66/66a/66b/67, 76/76a, and 75	1h 27 min	Bus 39a and 14	Orbital via Lucan and Tallaght	Driving		√
	Tallaght	19 min	1h 43 min	Bus 239, 66/66a/66b/67 and 76/76a	1h 40 min	Bus 39/39a and 27	Orbital via Lucan	Driving		√
	Blanchardstown	0	0	/	0	/	/	/	/	/
	Swords	17 min	1h 23 min	Bus 17a and 41/41b	1h 30 min	Bus 39a, 151 and 500	(Routes already set out on Maps)	Driving	√	
Swords	Dun Laoghaire	35 min	3h 56 min	Bus 33/41c, 17a, 239, 25, 76 and 75	1:33min/1:06 min bus/bus-train	Bus 500, DART 9-/13	Orbital via Blanchardstown, Lucan and Tallaght	Driving		√
	Dundrum	31 min	3h 21 min	Bus 33/41c, 17a, 239, 25, 76 and 75	1h 31 min	Bus 500 and 14	Orbital via Blanchardstown, Lucan and Tallaght	Driving		√
	Tallaght	31 min	2h 45 min	Bus 33/41c, 17a, 239, 25, 76 and 75	1h 42 min	Bus 500 and 27	Orbital via Blanchardstown and Lucan	Driving		√
	Blanchardstown	18 min	1h 17 min	Bus 33/41c and 17a	1h 40 min	Bus 33/41c and 17a and walking	(Routes already set out on Maps)	Driving	√	
	Swords	0	0	/	0	/	/	/	/	/

Appendix B: Transport for Ireland Bus Routes from Swords, Blanchardstown, Tallaght, and Dun Laoghaire

Appendix C: Preliminary Options for Section A Swords to Blanchardstown

Appendix D: Preliminary Options for Section B Blanchardstown to Tallaght

Appendix E: Preliminary Options for Section C Tallaght to Dundrum

Appendix F: Preliminary Options for Section D Dundrum to Dun Laoghaire

Appendix G: Network Modelling Methodology

Appendix H: Emerging Preferred Routes

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