Metro UCD to Sandyford Feasibility Study

Metro UCD to Sandyford Feasibility Report

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Contents

Executive Summary

This study was undertaken to consider the feasibility and suitability of a Metro system for serving the transport demand along the corridor from the city centre to University College Dublin (UCD) and further south to Sandyford.

As outlined in this report, this study has identified and tested a pair of potential Metro alignments which are considered broadly representative of the range of potential Metro options for serving the transport corridor from Central Dublin to Sandyford via UCD.

Both alignments share an origin point at Sandyford in the south, run north to a station on the eastern side of the UCD campus and north towards Ballsbridge, a higher employment area. The first (Charlemont alignment) then continues to back west to integrate with the proposed MetroLink at Charlemont. The second (Pearse alignment) continues north from Ballsbridge to terminate at Pearse Station, where DART services provide a wide range of connection opportunities.

Although selected with the goal of serving the areas within this corridor with the greatest trip generating potential, the forecast usage of the proposed alignments is seen to be relatively low, both in relation to loadings on the core proposed MetroLink alignment and the available capacity offered. A significant proportion of usage (approximately 60%) is also identified as arising from transfers from existing public transport options, with overall levels of trip making by public transport increasing by a maximum of 1.2% for the best performing option.

Analysis of the benefits and costs of the proposals show that, depending on the option, the expected benefit to cost ratio (BCR) is between 0.13-0.6, with a corresponding Net Present Value of €2.5Bn to -€1.1Bn. Whilst the options are considered broadly feasible from a technical and environmental perspective, this provides an initial indication that a Metro option is unlikely to be a cost effective approach to enhancing public transport in this area of Dublin.

More detailed review of the demand forecasts supporting the appraisal highlights some of the challenges in developing a successful Metro option to serve this area but also some potential opportunities which may be worth further exploration.

Firstly, although University College Dublin was identified at the start of the study as a key destination, with high demand potential, the modelling analysis shows how the relatively wide geographical distribution of demand and existing intercity bus connections make it hard for a Metro option to compete effectively in connecting UCD to the South, particularly given the high stop frequency of both the Metro and Luas lines and the current requirement for interchange with the Luas Green Line for connections further south.

Secondly, the relative performance of the options appraised makes a very strong case for options of this type being fully integrated with the existing Metro as a through running service, which appears to offer a more attractive service, for similar or lower cost.

More generally it is also apparent that the study corridor is already relatively well served in terms of its existing Rail, Luas and bus provision, which restricts opportunities for achieving major mode shift.

More positively however is the relative success of the Charlemont alignment in enabling access to UCD from the north. Although still modest relative to station usage levels for the existing MetroLink proposals, demand levels may be sufficient to support Metro style proposals of a more modest character, such as a Luas spur connecting UCD to the Green Line (either standalone or as a variation on the Metro South proposals).

1. Introduction

1.1 Study background

The National Transport Authority, (NTA has commenced the review of the Transport Strategy for the Greater Dublin Area 2016-2035, and the preparation of a new strategy, which will consider the future development of the transport system in the GDA for the period up to 2042.

As part of this review, the NTA wishes to conduct a number of transport planning studies based on specific areas, corridors and / or potential transport schemes. In some cases, these studies relate to matters which have arisen as a result of the implementation of the 2016 transport strategy, through the public consultation exercises on large projects such as BusConnects and Metrolink and the need to review the Strategy Measures in the context of continued growth and changes in travel patterns. One such matter related to the potential for a Metro to serve transport demand along the corridor from the city centre to UCD and further south.

1.2 Study purpose

The purpose of this study is therefore to investigate the technical, environmental, demand and economic feasibility for a Metro along this corridor.

As an exploratory study, the objective is only to establish the feasibility, or otherwise, of such a scheme in order to assess whether it could be incorporated into the assembly stage of the draft transport strategy. Should a scheme of this nature be selected for further development, a more detailed route selection process would be necessary to identify an emerging preferred route from a set of feasible route options.

1.3 Study approach

Any successful scheme will need to perform well on all four feasibility dimensions (technical, environmental, demand and economic) the level of effort required to assess each is however variable.

At the strategic level, Metro style[1] schemes in the Greater Dublin Area can be considered as broadly feasible from a technical and environmental perspective, this is however subject to confirmation of a wide range of key scheme specific factors., which can be resource intensive to fully explore. The demand and economic context is however more varied, and it is recognised that there may be locations in Greater Dublin where the level or nature of the local travel demand may not support or justify provision of transport infrastructure on a scale or cost implied by a Metro style solution.

The Eastern Regional Model (ERM), part of the National Transport Authority's (NTA) Regional Modelling System, represents the travel-to-work areas of the population centre of Dublin and nearby regions, and provides an accessible tool for reviewing the demand and economic performance of transport enhancement proposals.

This study has prioritised the development of a clear understanding of the demand impacts and transport user benefits of the schemes reviewed and analysis of how this compares to the likely delivery and operation costs. This is supported by a higher level technical review sufficient to confirm feasibility of key factors (including tunnel portal location, track alignment, avoidance of scheduled national monuments) and support development of cost estimates for each option.

Together this allows for a clear understanding of the demand and economic feasibility for the options assessed, and the identification of any specific concerns regarding the technical and environmental feasibility. This provides an initial filter of schemes likely to be feasible and, where schemes are identified which offer a higher degree of demand and economic feasibility, a focus for more detailed technical development.

[1] For the purposes of this study, Metro style schemes have been interpreted as infrastructure comparable in capability to that of the proposed MetroLink scheme. I.e. high frequency (up to 40 tph), fully segregated rapid transit, with stations up to 1 km apart and vehicles approximately 60m length, with alignments at grade or underground depending on location.

2. Study area

The wider study area is defined by the extents of the NTA's ERM, which allows the transport impacts of the proposals to be analysed across the full extent of the Greater Dublin Area, including further afield locations such as Bray and other areas outside the M50, which, while some distance from the proposed infrastructure might be impacted by resulting changes in travel patterns.

2.1 Route study area

As agreed with the NTA, the physical extent of the Metro options to be considered are bounded to the north and south by potential connection points with existing Rail and Luas lines and the proposed MetroLink.

To the north, options for routes starting at Charlemont (the proposed MetroLink southern terminus) and Pearse or Connolly stations were considered. To the south an interchange to the Luas at/around Sandyford was proposed for all options.

The alignment of the Green Line Luas bounds the route study area to the west, while the DART line bounds the study area to the east. This is shown below in Figure 2-1.

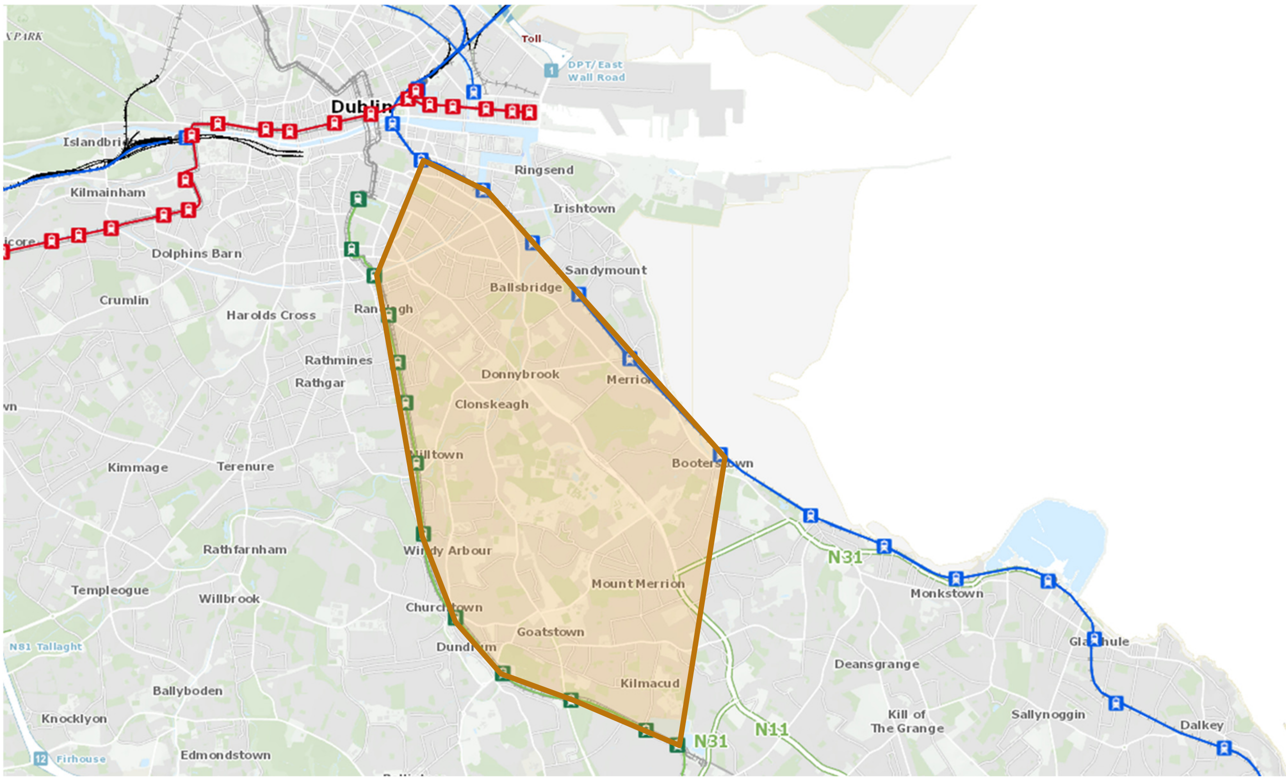

Figure 2-1: Route study area

2.2 South East Dublin

Within the above area and South of the Grand Canal/R111, South East Dublin is broadly comprised of low and medium rise residential and mixed use neighbourhoods.

In addition to the UCD campus, identified as a key potential trip attractor for a Metro proposal, potentially significant demand attractors include multiple medical facilities and the local employment centres.

North of UCD the most significant clusters of employment are noted at Ballsbridge and Donnybrook, while to the south, Sandyford and Central Park business park areas are noted as areas of high employment.

All route options considered connect to Sandyford/Central Park, while the benefits of various routings through the neighbourhoods north of UCD were reviewed based on the demand catchments for potential station locations.

A small number of higher demand areas also sit just beyond the study area. These include the Aviva stadium, potentially a major trip destination for sporting or cultural events, and areas around Lansdowne Road and Sandymount stations at the extreme east of the study area and the Leopardstown/Carrickmines corridor to the south. It was not considered realistic to include connections in the Lansdowne Road area, due to the proximity of the the existing DART line, while connection to Carrickmines is provided through interchange at Sandyford.

2.3 University College Dublin

University College Dublin (UCD) was identified as a key target for this study, as with over 3,500 staff and almost 30,000 students[2] it was considered a potentially significant and high volume trip attractor for a Metro style service. Since 2009 the University has been actively pursuing opportunities to improve access to the campus by sustainable modes. These efforts have also provided valuable insights into the characteristics of the existing travel patterns to and from the campus.

As outlined in the 2015-16 Commuting Survey Results, bus, cycling, car, and walk are the dominant access modes for the student population, and a large majority of bus (84%) and car (66%) users travel over 30 minutes to access the site. A key factor influencing these travel patterns may be the high proportion of the student body who live at their family home while attending the university.

Analysis of trip patterns from the Eastern Regional Model indicates that many study trips originate along the N11/M11 corridor towards Bray, which is well connected to the University by the longer distance regional bus network, where services generally operate on an ‘intercity’ or regional model, with limited stops, which provides competitive longer distance journey times.

2.4 Sandyford

Sandyford, including Sandyford Business park, Central Park and Leopardstown, is one of the largest concentrations of employment in South Dublin, with a number of business park developments in close proximity to each other. As a location it is well connected by road (M50 and R113) and also the LUAS Green Line.

Connecting to Sandyford is expected to be a significant positive contribution to the passenger demand for any Metro style proposal.

2.5 Stillorgan

Immediately to the North of Sandyford, Stillorgan, incorporating a local town centre and retail centre, is a potentially attractive intermediate location between UCD and Sandyford.

2.6 Bray

Bray, approximately 20 km to the South of Dublin, is physically well beyond the immediate footprint of the Metro UCD to Sandyford proposals. It is however of interest as an origin for a significant number of education trips to UCD. Looking ahead, the extension of the LUAS Green Line from Brides Glen to Bray is assumed to be in place by 2045, connecting Bray to Sandyford, and from there to the Metro options under review.

The attractiveness of the LUAS option for accessing UCD or the wider UCD to Sandyford Metro corridor will however be very dependent on the journey times achievable relative to the existing long distance bus connections.

[2] https://ucdestates.ie/commuting/survey/2015-16-results/

2.7 Central Dublin, Northern Dublin and Dublin Airport

Beyond the corridor of the new Metro alignments themselves, these proposals will also provide new access opportunities from the corridor served to Central and Northern Dublin, including Dublin Airport.

Central Dublin is likely to be a key commuter destination for trips from the study, while Dublin Airport is recognised as an important origin and destination for the existing MetroLink proposals, which is likely to attract trips throughout the day.

While both options serve these locations, either directly via through-running for the Charlemont option, or through access to the DART network via interchange at Pearse station. The absence of an interchange cost, alongside the relatively close spacing of the City centre stations relative to the heavy rail network, and direct airport access may make the Charlemont option more successful than the Pearse option in connecting new users to these locations.

3. Future Transport Context

The performance of the proposed options has the potential to be highly influenced by the wider transport context including public transport enhancements in the adjacent local area. The potential interfaces and interactions with other schemes are discussed further in the context of the modelling scenario assumptions.

To provide a balanced assessment of the proposals, their impact on the transport network has been assessed for two future years, a 2030 modelled year, when it is assumed that the schemes from the National Development Plan (NDP) will be fully in place, and a 2045 modelled year, which includes a number of additional items, as specified in the Greater Dublin Area strategy.

3.1 2030 National Development Plan (NDP)

The following schemes are assumed in the 2030 Do-NDP based scenario.

3.1.1 MetroLink

The MetroLink scheme is included in full in the 2030 Do-NDP scenario, with the assumption of a 2 minute (30 tph) headway[3].

3.1.2 Luas

- No changes from current

3.1.3 BusConnects

- Radial Core Bus Corridors
- BusConnects Fares / Ticketing
- BusConnects Routes and Services

3.1.4 Park and Ride

- Rail and Bus based P&R provision (partial implementation by 2028)

3.1.5 Rail

- Revised Irish Rail Timetables and supporting rolling stock
- DART+ Programme, including additional stations at Kishogue, Cabra, Pelletstown, Woodbrook, Kylemore and Glasnevin

3.1.6 Other

2030 assumptions regarding Cycling, National Roads, Regional and Local Roads and Demand Management remain as per the 2030 Do-NDP scenario.

3.1.7 Potential interactions

It is noted that there are potential interactions between the proposed new Metro alignments and both the Luas Green Line and BusConnects corridor via UCD. Should Metro UCD to Sandyford proposals be progressed for further development, there may be opportunities to rationalise overall public transport provision along this corridor.

[3] This is below the technical capacity of the system which can operate at up to 40 trains per hour.

3.2 2045 Greater Dublin Area strategy

The following additional public transport elements are included in the 2045 Do GDA based scenario.

3.2.1 MetroLink

The MetroLink scheme is included in full in the 2045 Do-GDA scenario, with the assumption of a 2 minute (30 tph) headway

3.2.2 Luas

- Luas Green Line Capacity Enhancement - Phase 2 (30 tph, 55m vehicles)
- Finglas Luas (Green Line extension Broombridge to Finglas)
- Extension of Luas Green Line to Bray
- Lucan Luas

3.2.3 BusConnects

- No additional measures

3.2.4 Rail

- DART+ Tunnel Element (Kildare Line to Northern Line)

3.2.5 Other

2045 assumptions regarding Cycling, National Roads, Regional and Local Roads and Demand Management remain as per the 2030 Do-NDP scenario.

3.2.6 Potential interactions

In addition to the previously identified interactions with the Luas Green Line and BusConnects corridors, two further schemes of interest are highlighted.

Firstly, the extension of the Green Line to Bray is noted as having potential synergies with the Metro: UCD to Sandyford proposals, allowing light-rail trips all the way from UCD to Bray. The scale of Luas usage for this route will however depend on the relative competitive balance between the Luas and existing regional bus services.

Secondly, the inclusion of the full implementation of the DART Underground tunnel component between Kylemore and Docklands stations, connecting the Kildare Line with the Northern Line., using an alignment with an intermediate station at Pearse in the 2045 Do GDA based scenario, was highlighted as having the potential to make Pearse station a potentially highly attractive interchange point, with additional connections to the north and south west. This was considered potentially supportive for a standalone line terminating beneath Pearse station. Usage of this interchange option will however be subject to the normal influence of interchange time requirements, interchange penalties and service frequencies on the relevant DART services.

4. Modelled routes

As highlighted in the NTA brief, the nature of the study is exploratory in nature, and is not scoped to either define a preferred Metro alignment or whether a Metro connection should be the preferred option for improving transport connections within the study area. Rather, it is aimed at determining whether a Metro option could be considered as a viable/feasible option for enhancing public transport in this area, and worth retaining as a potential option for further consideration as part of the next iteration of the Transport Strategy for the Greater Dublin Area.

Identification of representative route options for modelling was undertaken through a multi-disciplinary review , allowing contributions from a broad range of key disciplines to inform the selection process.

4.1 Strategic assumptions

Reflecting this context, identification of routes for modelling has focussed on defining viable route options, which serve a realistic set of destinations within the study area, and are considered to avoid any critical constraints which would prevent delivery of a Metro solution.

Analysis of the demand potential for a range of station locations was used to inform the route development workshop, and the proposed routes are considered broadly representative of an achievable set of routes. They have not however been optimised either from a demand or capital cost perspective.

Detailed consideration of stabling and fleet requirements has not be undertaken at this stage, but supporting assumptions on the additional vehicle requirements have been developed based on the additional route lengths as part of the cost estimating exercise.

Station to station seamless interchange has been allowed for at both Sandyford Luas and (where applicable) at Pearse stations based on a preliminary estimate of the interchange distance. These have been estimated on an indicative basis and would require more detailed study to develop into specific proposals.

4.2 Station demand potential

Prior to the route selection workshop, the demand potential (number of local jobs, residents and education places) for a wide range of indicative station locations were reviewed using demographic projections for 2050 which also inform the Eastern Regional Model (ERM).

Thirty four locations were selected for analysis based on the study area indicated in the task brief, with each location reviewed on the basis of demand potential within a 500 metre radius. The selected station locations are shown in Figure 4-5.

At this stage in the process, locations were selected to provide a high degree of coverage to the study area and develop an understanding of how demand levels might vary around key sites (UCD, Sandyford) and along the existing main transport corridors (R138, R133, N11) and along the full northern width of the study area. Apart from at Ranelagh and at Sandyford, locations were not selected immediately adjacent to Green Line or the DART line.

A summary of the local jobs, resident population and education spaces are shown in Figure 4-2, Figure 4-3 and Figure 4-4 respectively.

Although the station locations could be broadly characterised as options for serving various local town centres within the study area, they should not be taken as evidence for the feasibility or otherwise of specific station proposals, which had not been considered at this stage in the process.

Figure 4-1: Catchment analysis locations

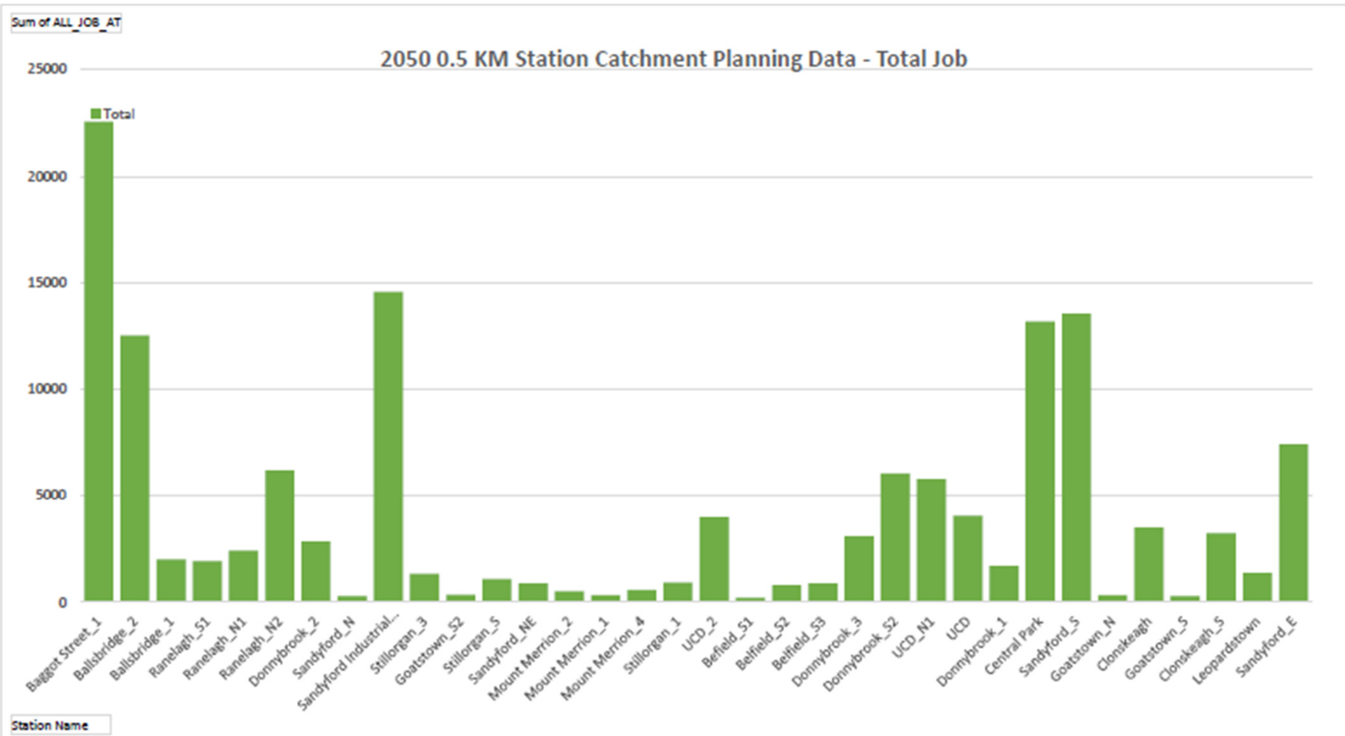

Figure 4-2: Station Catchment Data, Local Jobs

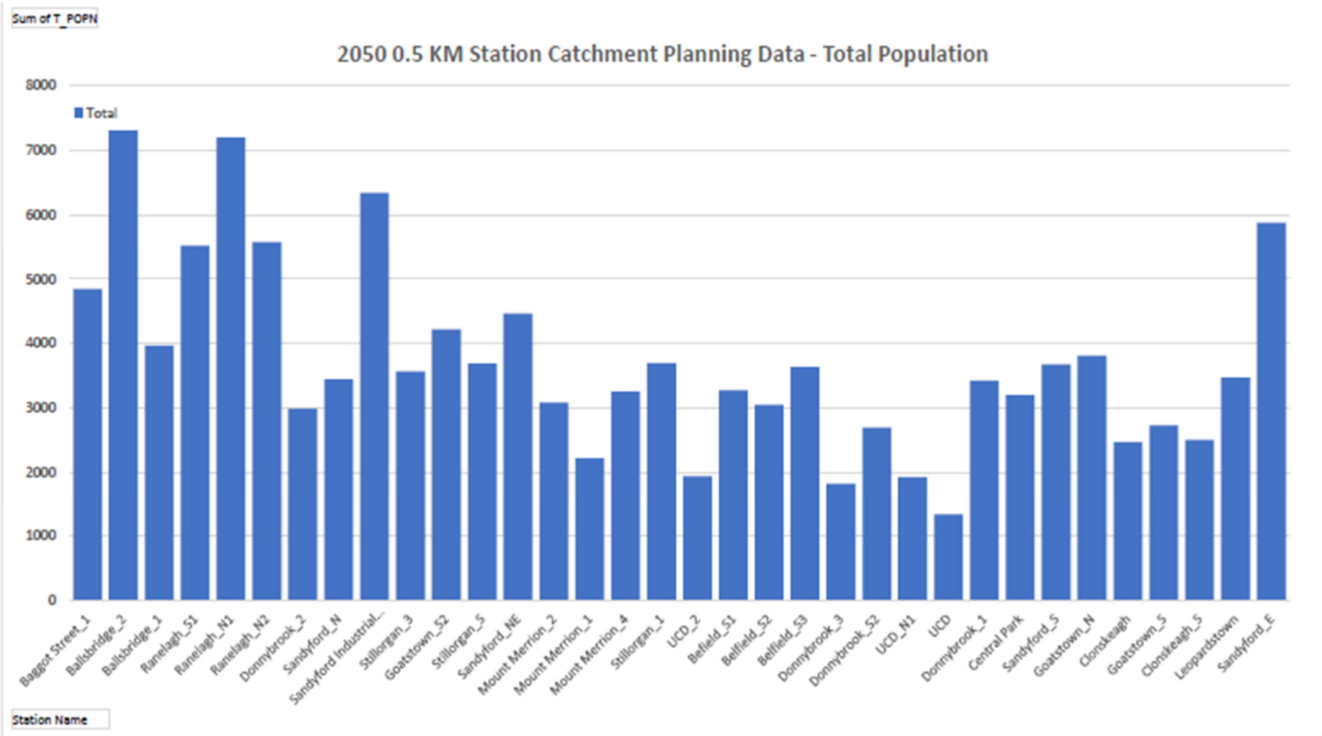

Figure 4-3: Station Catchment Data, Local Population

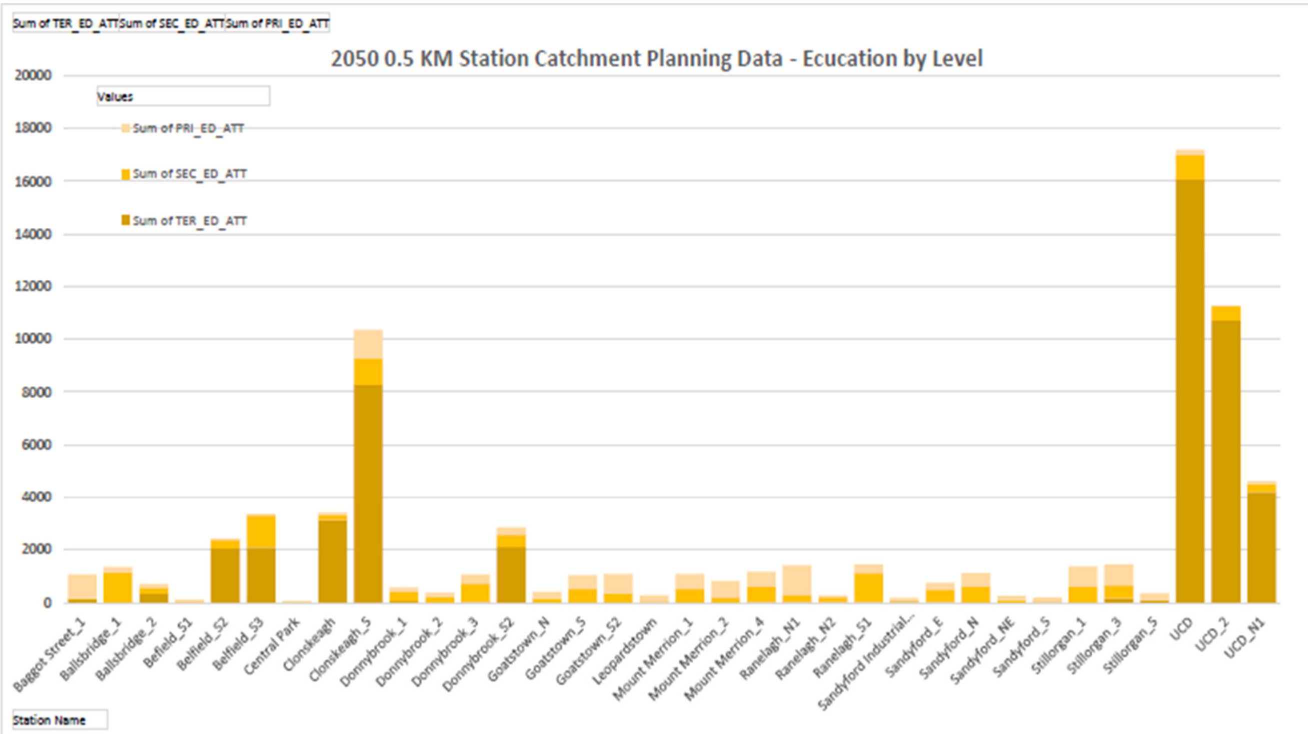

Figure 4-4: Station Catchment Data, Local Education spaces

4.3 Methodology

Route identification was undertaken, with input from the NTA and Jacobs Subject Matter Experts, covering Travel Demand Modelling, Tunnelling, Railway Engineering and Environmental disciplines.

Following a collaborative review process, the following decisions were reached regarding the proposed routes:

1) a Northern origin point (Pearse station) for the 2^{nd} route alignment,

2) a potential southern portal location & southern terminus,

3) a station location at the UCD campus

Alignment options from the Northern origin points to the UCD station location and then south to the proposed southern terminus were identified, with discussion of the potential benefits and issues these presented.

Further analysis of the demand potential for the alignments was used to refine the alignment options which both adopted the alignment north of UCD which had the greatest number of jobs within the station catchments.

4.4 Northern origin points

Following initial discussions of the three potential northern origin points (Charlemont, Pearse and Connolly), Charlemont (with services through-running onto MetroLink) was confirmed as one of the preferred options. Pearse was selected in preference to Connolly station as the second northern origin point for review on the basis of the reduced tunnelling requirements required and the long term strength of Pearse (following completion of the DART+ Tunnel) as a potential interchange location.

4.5 Southern terminus and portal location

Identification of a southern portal location to support the necessary tunnelling and a suitable location for the southern terminus of the proposed alignments was a second major focus of the multidisciplinary review..

Priorities and constraints impacting evaluation of options for this include:

- Enabling interchange with the Green Line at or near Sandyford
- Sufficient space to coordinate launch of a Tunnel Boring Machine (TBM)
- Minimising overall tunnel length
- Site accessibility
- Planning constraints
- Community impacts

The following, five potential portal locations were identified in discussion and reviewed at a high level in terms of their potential feasibility.

1) Green space occupied by Naomh Olaf GAA Club

2) SE of Sandyford LUAS depot - Silverpark GAA grounds

3) Land parcel NW of Glencairn house – adjacent to M50 & Luas

4) Overflow car parking/Grosvenor school site in Central Park (at intersection of M50 and Green line)

5) Stillorgan reservoir site

The locations of these are shown in Figure 4-5. Site five, the Stillorgan reservoir site, was considered most realistic option. It was identified as likely to be of adequate size, with road access for construction traffic. It's location also facilitates provision of a terminus station in close proximity to the existing Sandyford Luas station, whilst the lack of community use and land ownership by a public utility were considered to potentially facilitate planning approvals.

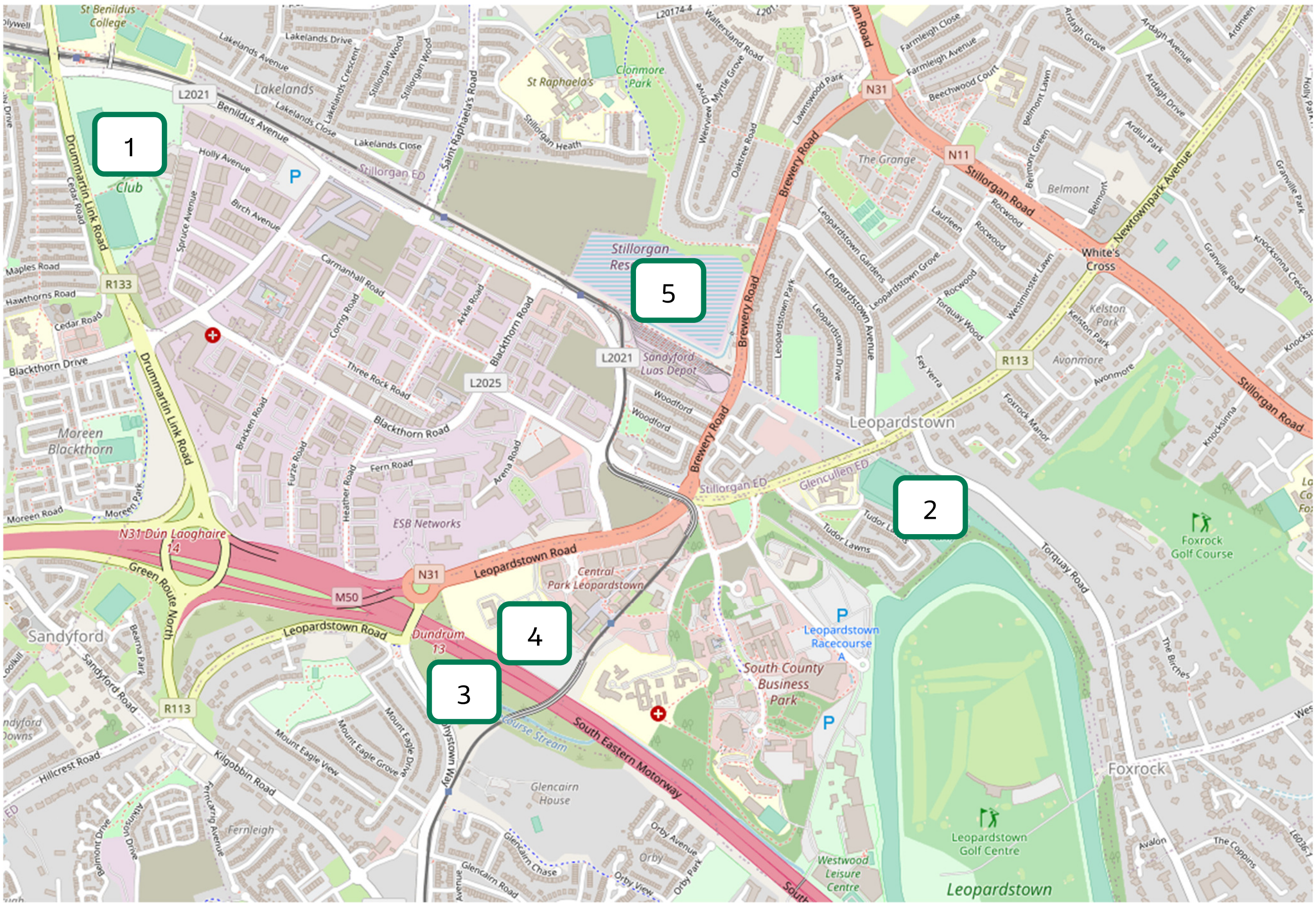

Figure 4-5: Southern Portal Options

4.6 Alignment development

Consideration of alignment options was undertaken in a staged fashion, firstly to select a station location at the UCD campus, and then develop route options to the north and south.

4.6.1 UCD station location

The station catchment data for stations in the UCD area highlighted the central and eastern portions of the campus as having the highest demand potential, with much of the western portion of the campus being occupied by sporting facilities.

Although a central location would have the highest demand, this was also identified as presenting the greatest challenges in terms of site availability, settlement and even potentially seismic impacts on sensitive facilities. A central campus location was also highlighted as potentially less attractive/visible for the general public.

The eastern station location was considered highly feasible whilst still likely to capture a high level of the potential demand in the area and was selected as the most representative option for what could be provided.

4.6.2 Alignments north of UCD

As outlined above, three alignments north to Charlemont from UCD were developed. These vary from a more direct western alignment, running from UCD to Charlemont, to a central and eastern alignment which aim to capture some of the demand seen around Donnybrook and Ballsbridge, whilst still respecting the MetroLink turning radius.

A similar logic was followed for the alignments with a Pearse Station origin, although this is less constrained by the turning radius issues.

Supplementary analysis of the station catchments on each route was undertaken, this is shown in Table 4-1, and shows a substantially higher levels of jobs in the catchment areas of the eastern alignment. On this basis, the eastern alignment was selected for both the Charlemont and Pearse origins.

Table 4-1: Alignment catchment analysis, UCD North

Alignment	Jobs	Population
West - Charlemont (exclude Ranelagh N1 due to proximity of Green line & Charlemont Metro)	3,600	9,000
Central - Charlemont or Pearse	8,500	9,800
East - Charlemont (exclude Baggot St due to alignment)	15,600	9,100

4.6.3 Alignment south of UCD

South from UCD to the identified portal and terminus location, the demand potential of the potential station locations, as seen in the catchment analysis, are relatively uniform. Given this, greater weight was placed on other factors, including maintaining a direct route and the reduced settlement impacts from aligning the tunnel with existing highway alignments.

A route aligned with the R138 / N11 was therefore proposed for the southern portion of both route options. The feasibility of station locations along this alignment was discussed and intermediate stations are proposed at Belfield, Mount Merrion and Stillorgan Village (near the junction of N11 and R825). These are envisaged as located either beneath the roadway or adjacent open space (Belfield and Mount Merrion) or parking space (Stillorgan Village). Box style construction has been assumed, however there may be benefits from adopting a mined approach, particularly at Belfield where there is a national monument site nearby.

The feasibility, acceptability and positive contribution to the schemes of stations at these sites would need to be explored further.

4.7 Final alignments

As described above two Metro alignments have been developed, one originating at Charlemont Metrolink station, as a through running extension of MetroLink and one originating at Pearse station as a standalone line.

Both alignments run via Ballsbridge to a station on the eastern side of University College Dublin, before continuing along a shared alignment to Sandyford, the location of the southern tunnel portal and where the alignments terminate in close proximity to the existing Sandyford Luas station.

The indicative tunnel alignments, station and vent/escape shaft locations, as developed to support the cost estimating process for these two routes are shown in Figure 4-6.

The underground stations are expected to be a mix of urban (with more constrained construction) and suburban (less constrained construction) types. Stations north of UCD and at Mount Merrion are assumed to be of the urban type, with the remainder assumed to be suburban.

Figure 4-6: Charlemont (Left) and Pearse (Right) alignments

4.8 Charlemont alignment

As shown in Figure 4-6, the Charlemont alignment would include:

- Seven new underground stations
- One new surface level station (Sandyford)
- Tunnel portal and surface level turnback (Sandyford)
- Three vent/escape shafts
- Over 8km of twin track tunnel
- Almost 10km of track

4.9 Pearse alignment

As shown in Figure 4-6, the Pearse alignment would include:

- Eight new underground stations
- One new surface level station (Sandyford)
- Tunnel portal and surface level turnback (Sandyford)
- Subsurface turnback and temporary stabling (Pearse)
- Four vent/escape shafts
- Over 8km of twin track tunnel
- Over 10km of track

5. Demand analysis

5.1 Charlemont alignment

5.1.1 Line loading

Metro line loadings for the AM peak in 2045 with Metro UCD to Sandyford in place using the Charlemont alignment are shown in Figure 5-1 and Figure 5-2. These include comparison with the selected Do-minimum scenario for this modelled year (2045, Do GDA+MetroLink), highlighting the additional level of Metro trips achieved in the AM peak hour. Figure 5-3 and Figure 5-4 show the scheme line loadings for the four weekday modelled hours, highlighting the varying usage.

As shown in Figure 5-1, the new section of the Charlemont alignment attracts northbound flows of around 4,000 passengers in the AM peak, and also increases loadings on the central section of the existing MetroLink route, particularly between Charlemont and Glasnevin. Although not insubstantial, the peak loadings towards central Dublin however remain substantially below the equivalent Southbound values of almost 12,000, indicating the same intensity of use is not expected.

In the Southbound direction additional demand is noted, boosting peak ridership to over 12,000 and increasing more visibly from Ballymun Southwards. Southbound ridership on the Metro UCD to Sandyford extension however is relatively low, dropping from 4,000 at Charlemont to 2,000 at UCD.

Looking at the All Time Period data we can see that peak line loading for the new infrastructure is approximately 4,000 passengers (AM peak northbound, AM peak southbound, PM peak northbound), with loadings in the Lunch time and School run hours are generally a third to a half of peak values.

Although not insubstantial, when compared to the loadings achieved by MetroLink in the Do-minimum scenario, the forecast loadings along the new infrastructure is notably lower in both the northbound and southbound directions which may make it challenging to justify a scheme of this scale.

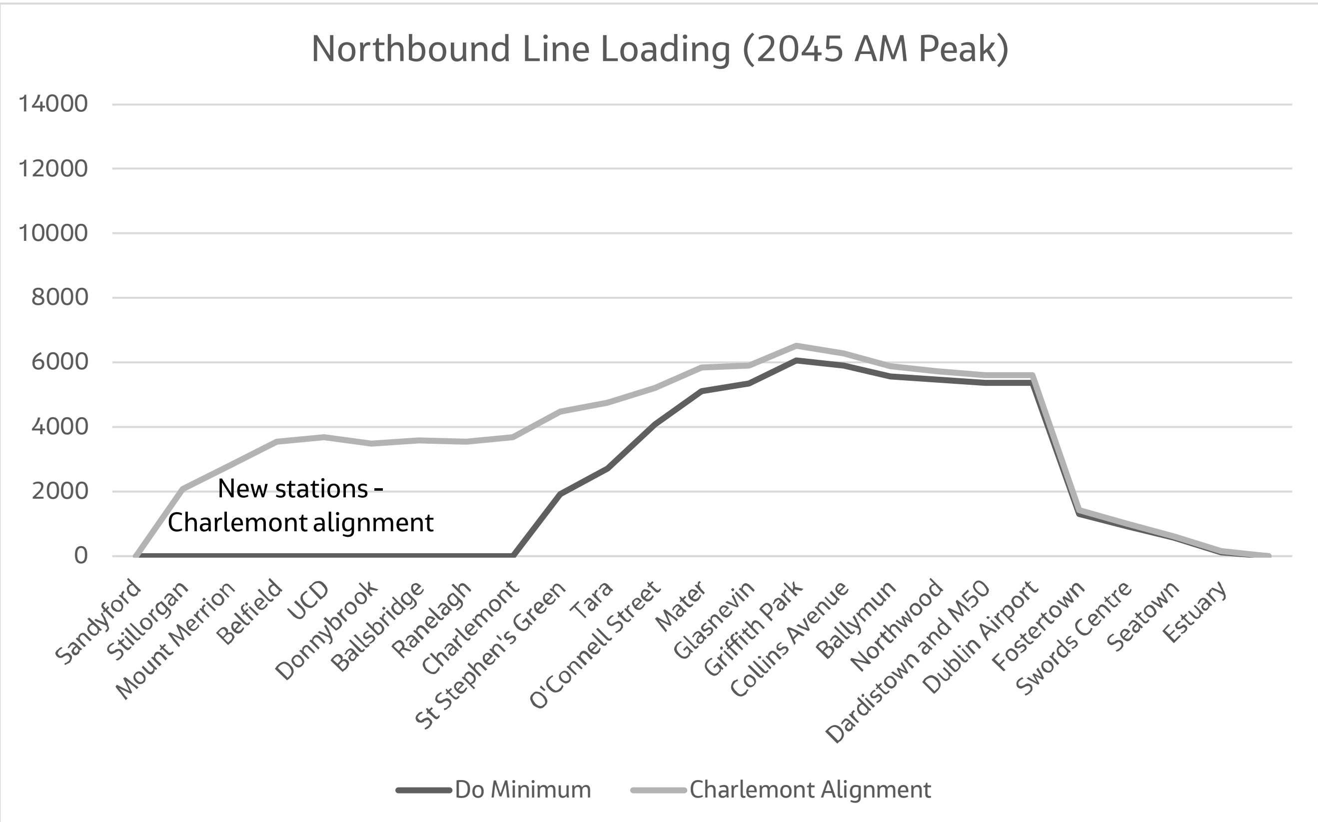

Figure 5-1: Charlemont Alignment, Northbound Line Loadings, 2045 AM peak

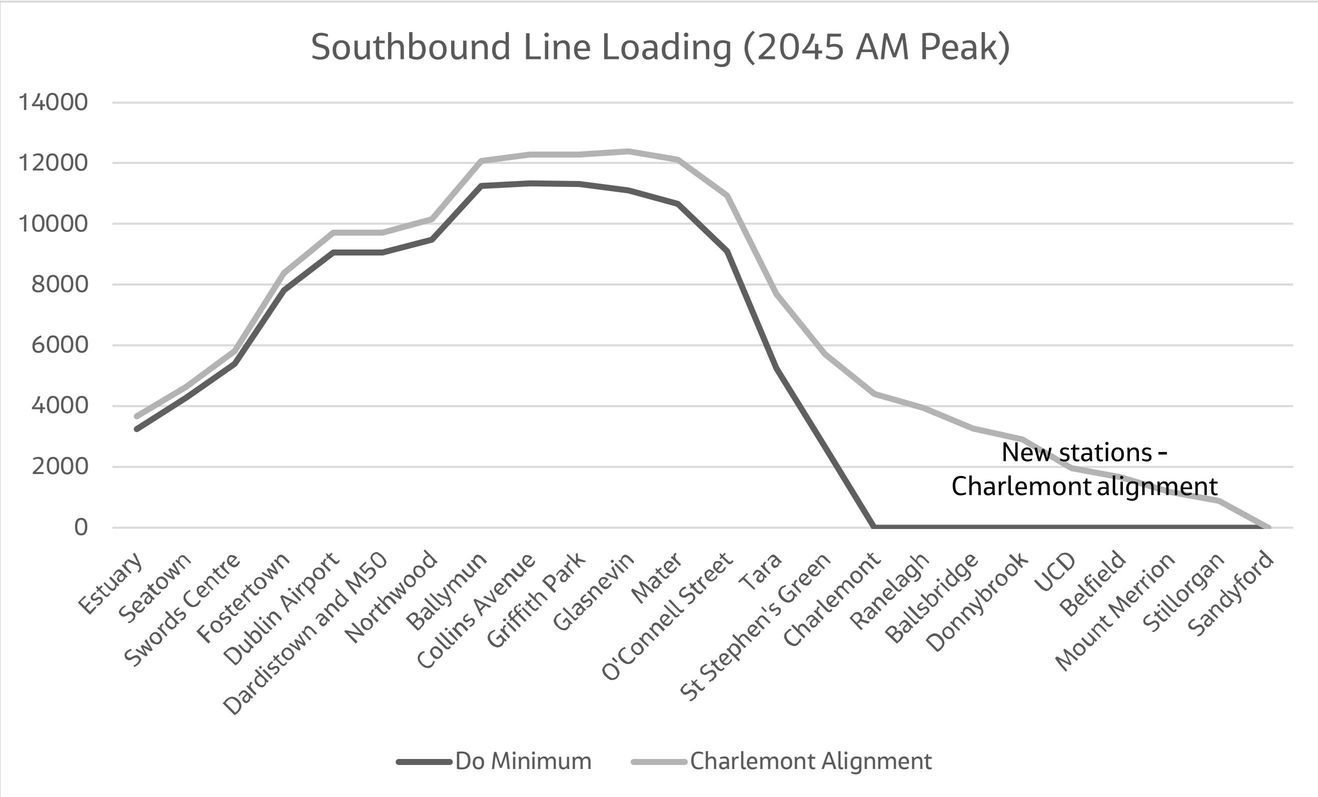

Figure 5-2: Charlemont Alignment, Southbound Line Loadings, 2045 AM peak

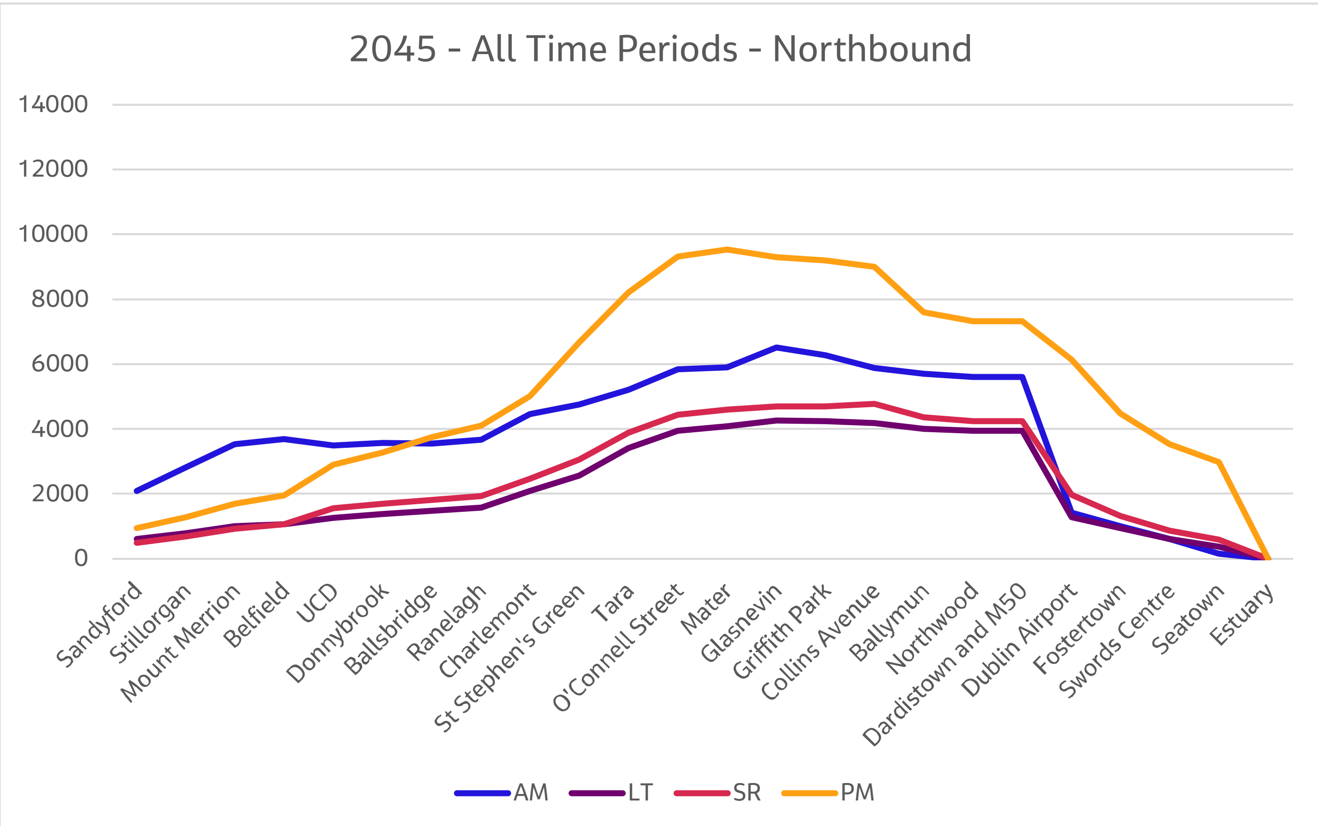

Figure 5-3: Charlemont Alignment, Northbound Line Loadings, 2045 All time periods

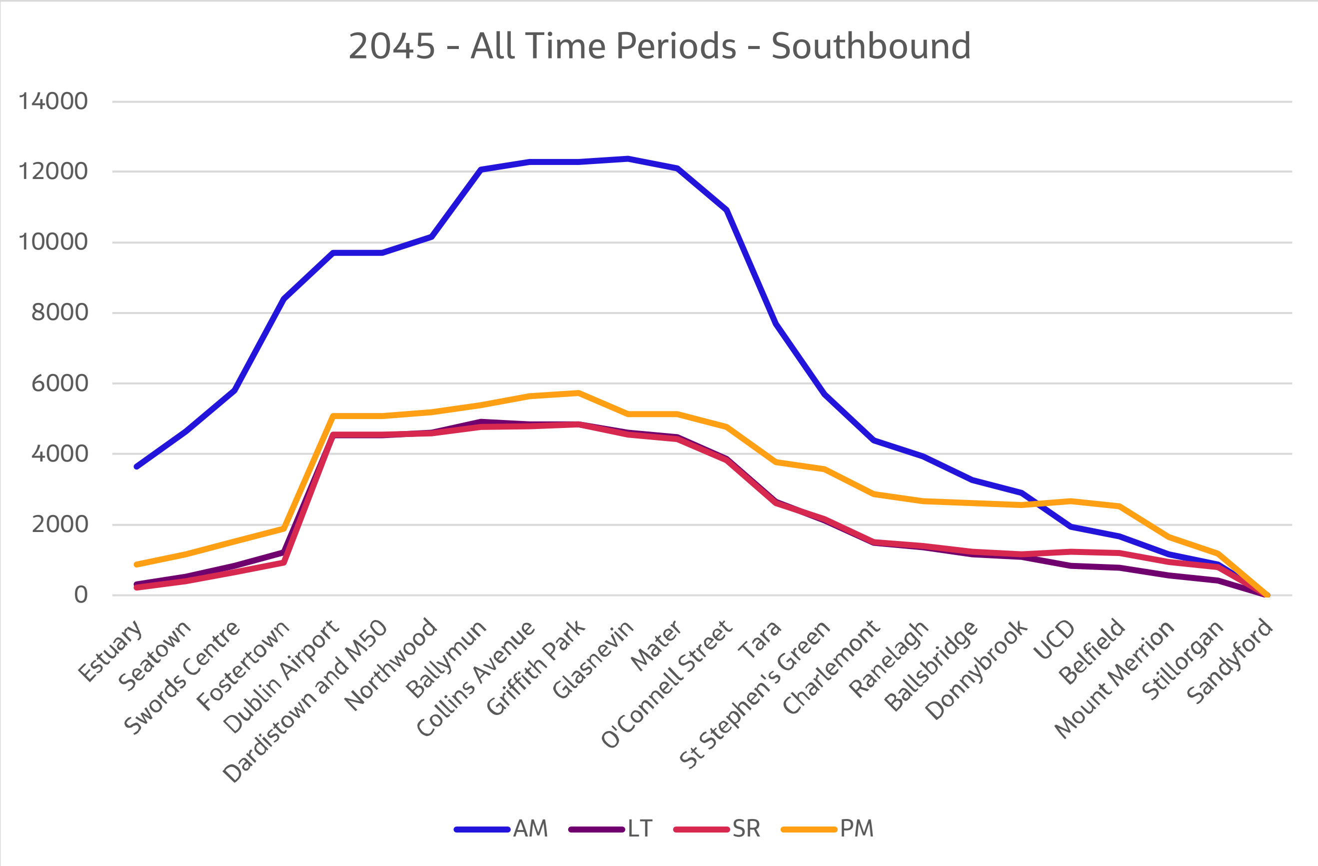

Figure 5-4: Charlemont Alignment, Southbound Line Loadings, 2045 All time periods

5.1.2 Changes in public transport mode share

Analysis of the aggregate public transport mode share shows the Charlemont option results in an increase in public transport mode share in both 2030 and 2045, increasing the expected annual number of public transport trips by 4.2 and 4.6 million in each year respectively. This is an increase of approximately 1.1-1.2% against Do-minimum levels. Impacts on highway use are more modest, with only very modest reductions in car use observed. This results in a net decrease in annual expected car trips by just over 0.3 million in 2045.

Overall, the option can be seen as supporting a minor increase in use of public transport, and a very minor reduction in car trips.

5.1.3 Changes in public transport demand patterns

The impacts of the Metro UCD to Sandyford Charlemont option, in terms of changes in public transport ridership are shown in Figure 5-5 and Figure 5-6. These provide further details on how the proposal would impact on the Luas Green Line, DART and local bus services.

These highlight one of the potential limitations of these proposals, which is that a large portion of the forecast ridership is made up of passengers transferring from existing public transport options, including both the Green Line and bus services, and also a smaller level of demand transfer from DART services. This reduces the potential for significant mode share impacts.

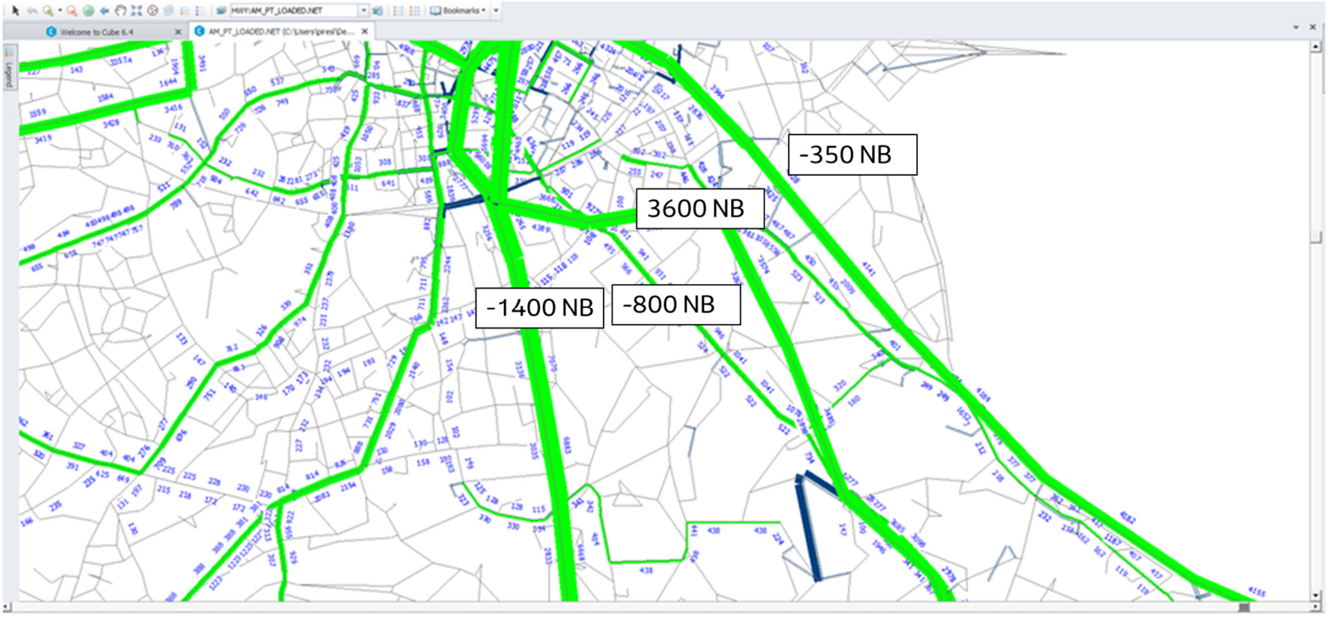

Figure 5-5: Charlemont Alignment, Changes in public transport flows, North of UCD, 2045 AM peak

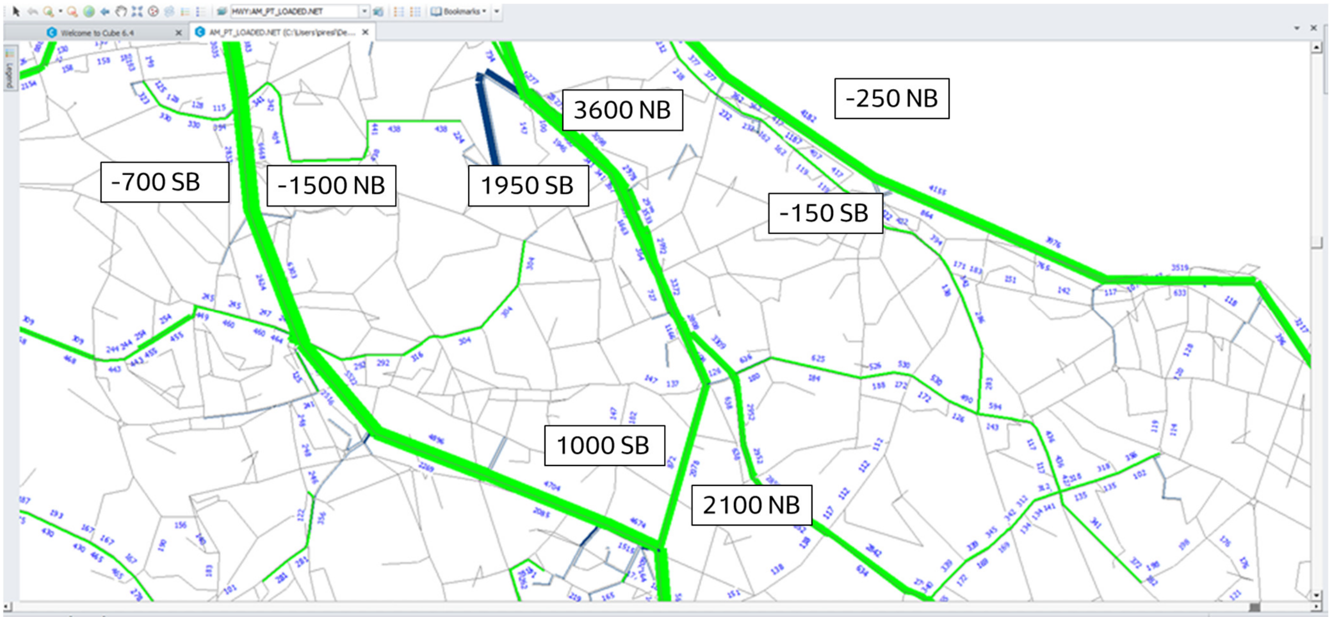

Figure 5-6: Charlemont Alignment, Changes in public transport flows, South of UCD, 2045 AM peak

As seen in Figure 5-5, northbound flows towards Charlemont on the new Metro option (3,600) can to a significant degree be accounted for by reduced use of DART (-350), Bus (-800) and Luas (-1,400). In aggregate, transfers from existing public transport routes appear to be approximately 60% for the total line ridership approaching Charlemont station.

A similar pattern is also apparent at the southern end of the route, where, as seen in Figure 5-6, new northbound flows (2,100) are offset by reduced volumes on the Green line (-1,500) and DART (-250).

5.1.4 Alignment with UCD student catchment

Analysis of scheme performance highlights a number of elements which suggest that the proposed Charlemont option is not fully realising the pre-study expectations in terms of trips to and from the UCD campus.

In particular, the level of trips accessing UCD from the south is lower than initial expectations. Whilst usage of UCD station is not negligible, it would be the 2nd busiest station on the new alignment after Sandyford, it is noted that in the 2045 AM peak the majority of the station demand at UCD is associated with trips to or from north of the station.

Despite a Metro and Luas connection from UCD to Bray, review of the user costs, indicates that for locations south of Sandyford, the existing express bus services continue to offer better journey times to UCD from many locations, with the relatively slow nature of the Luas connection and need to interchange at Sandyford limiting the attractiveness of longer distance trips by Metro and Luas.

At the strategic level, it seems that a Metro option via Charlemont is relatively successful at capturing demand from the North of UCD while a lower capture rate is achieved for trips from the South, where spatially the trip origins are distributed relatively widely, including in areas to the south and east of the proposed alignment which would not be captured by this proposal. Many of these trips, from both directions, are however already public transport users.

5.1.5 Alignment with other catchment areas

Sandyford and the corridor from UCD towards Ballsbridge were identified as areas of higher employment intensity during the option development process, and are directly served by this proposal. Specific population concentrations are less well defined, but also include Sandyford and the area to the South of UCD.

Usage of the stations located within these catchment areas is however broadly seen to be relatively low. Whilst usage of Sandyford station is relatively high, Ballsbridge and Donnybrook stations are lightly used with demand lower than all but two of the stations from the existing MetroLink proposals. Stations south of UCD have similarly low levels of demand.

The relatively low density of population and employment along portions of the proposed alignment and the existing presence of Rail, Luas and Bus corridors in the study area are likely to be associated with the relatively low station by station trip volumes observed.

5.2 Pearse alignment

5.2.1 Line loading

Metro line loadings for the AM peak in 2045 with Metro UCD to Sandyford in place using the Pearse alignment are shown in Figure 5-7 and Figure 5-8. These include comparison with the selected Do-minimum scenario for this modelled year (2045, Do GDA+MetroLink), highlighting the additional level of Metro trips achieved in the AM peak hour. Figure 5-9 and Figure 5-10 show the scheme line loadings for the four weekday modelled hours, highlighting the varying usage.

As shown in Figure 5-7, the new Pearse to Sandyford alignment attracts northbound flows of approximately 2,400 passengers in the AM peak, impacts on the existing MetroLink route are however minimal. Although not insubstantial, the peak loadings towards central Dublin however remain substantially below existing peak flows on MetroLink. In the Southbound direction ridership on the Pearse to Sandyford alignment is lower, peaking at just over 1,000 passengers in the AM peak. Impacts on MetroLink flows are again minimal.

Looking at the All Time Period data we can see that peak line loading for the new infrastructure is approximately 2,400 passengers (AM peak northbound). Loadings in the Lunch time and School run hours are generally a third to a half of peak values.

These remain substantially below the forecast loadings for the proposed MetroLink route and are likely to be indicative of relatively low levels of user benefits, making a Metro style scheme potentially challenging to justify.

These lower line loadings for a very similar corridor indicate that accessing Central Dublin via interchange at Pearse station is substantially less attractive that via a through running connection to the existing MetroLink route. Factors contributing to this could include the lack of direct airport connection, user costs from interchange and the differing station locations and service frequencies of the DART network.

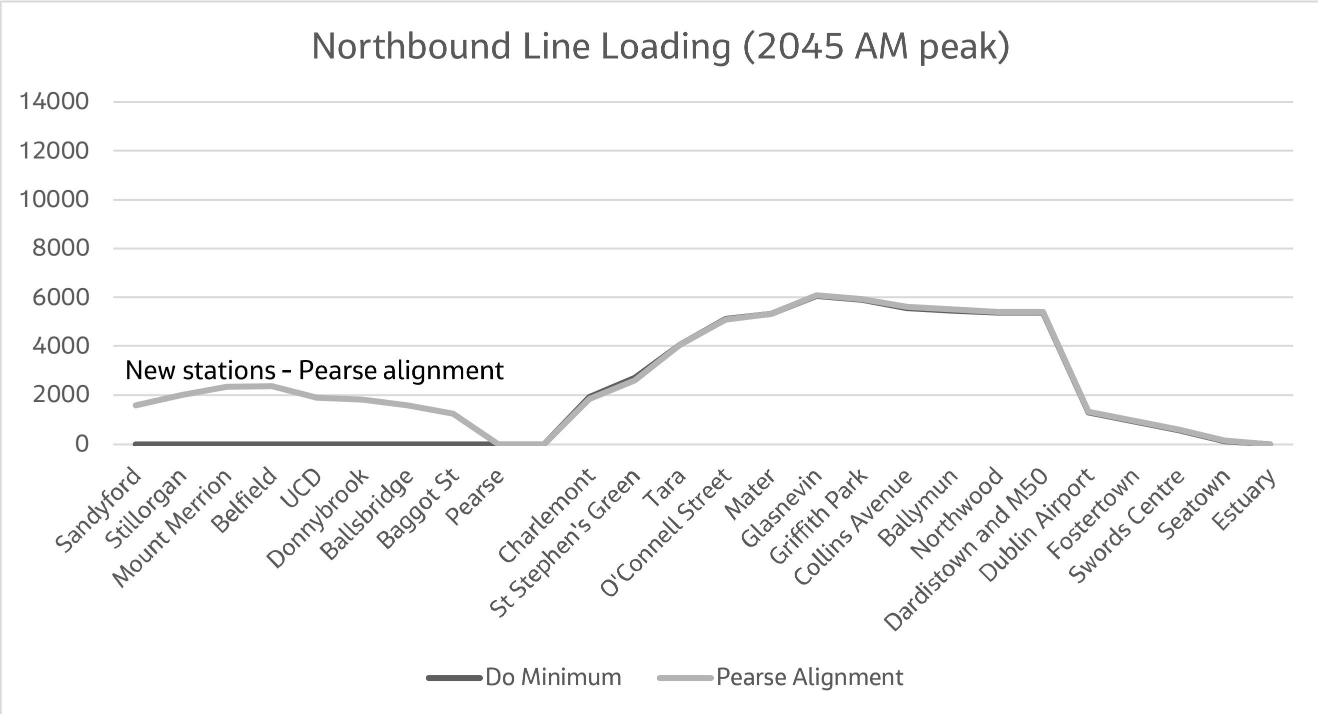

Figure 5-7: Pearse Alignment, Northbound Line Loadings, 2045 AM peak

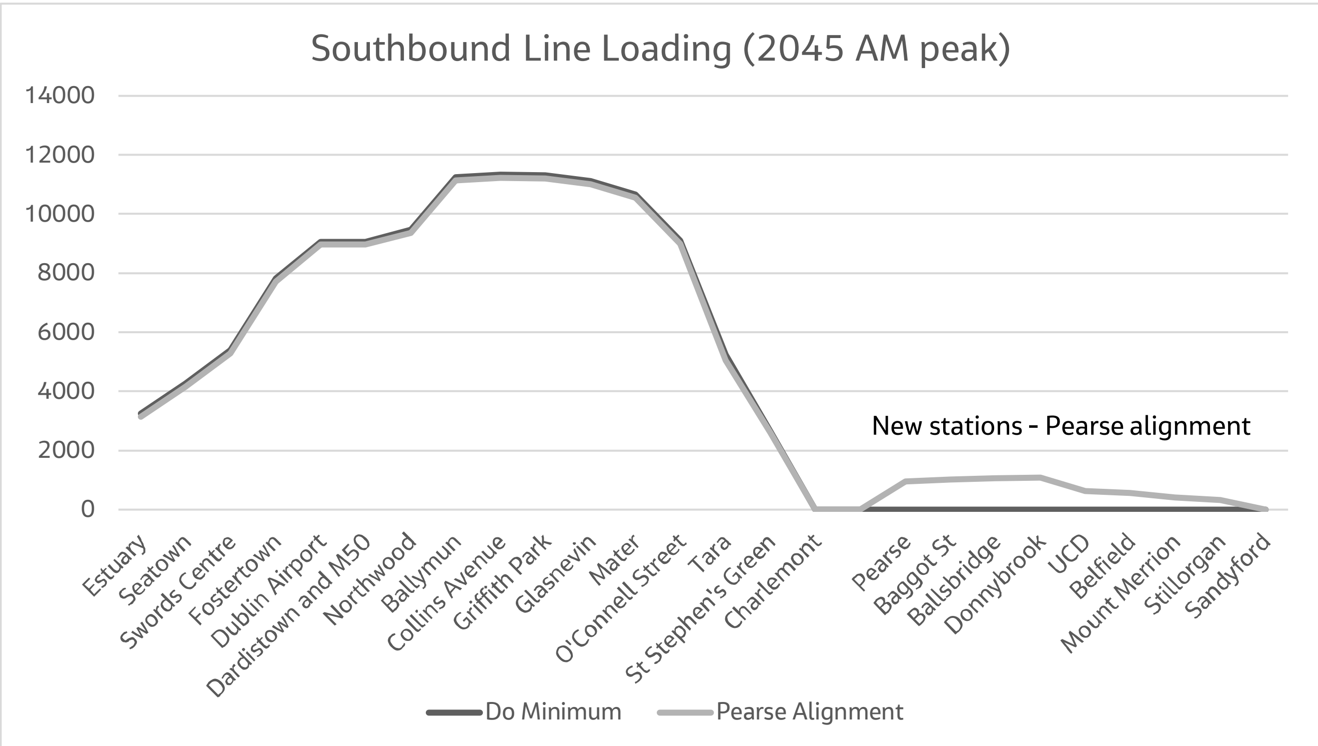

Figure 5-8: Pearse Alignment, Southbound Line Loadings, 2045 AM peak

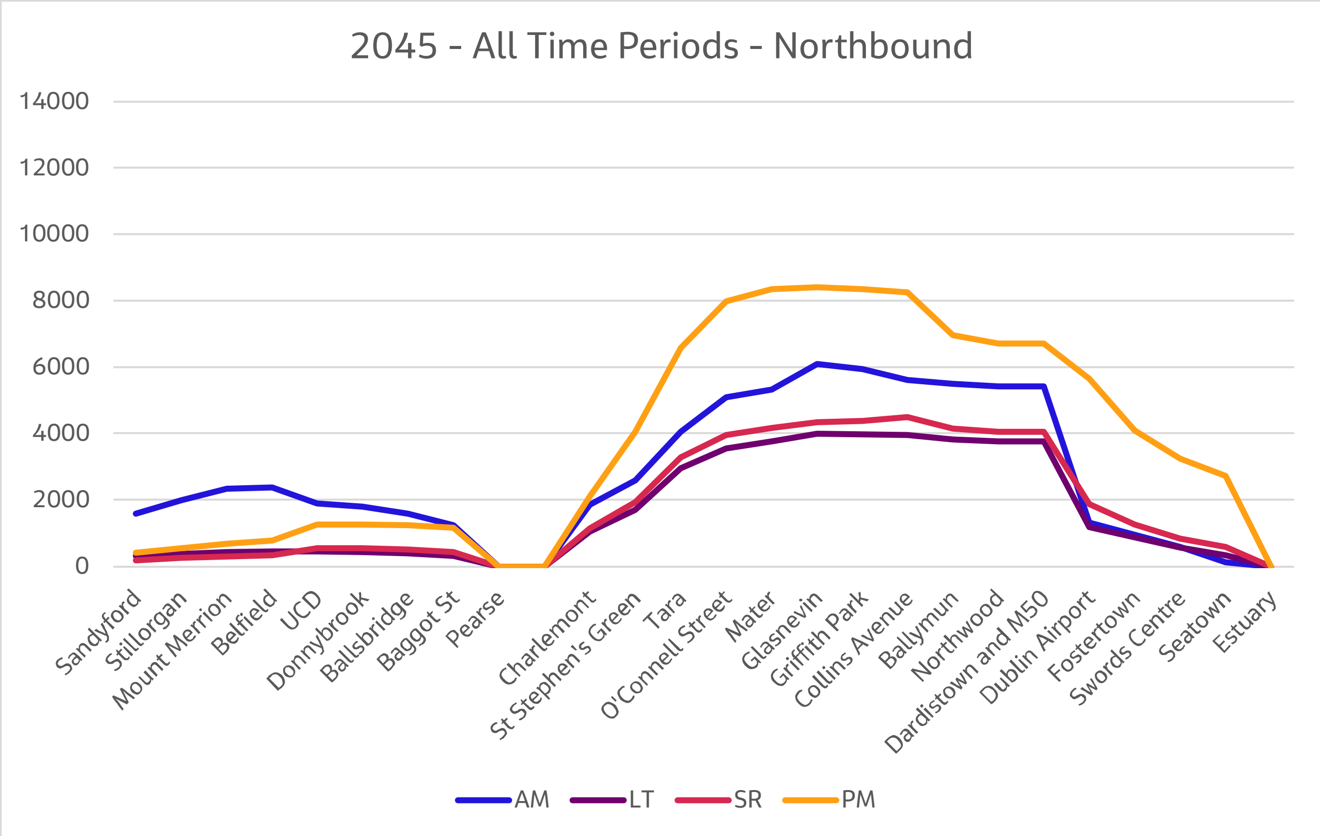

Figure 5-9: Pearse Alignment, Northbound Line Loadings, 2045 All time periods

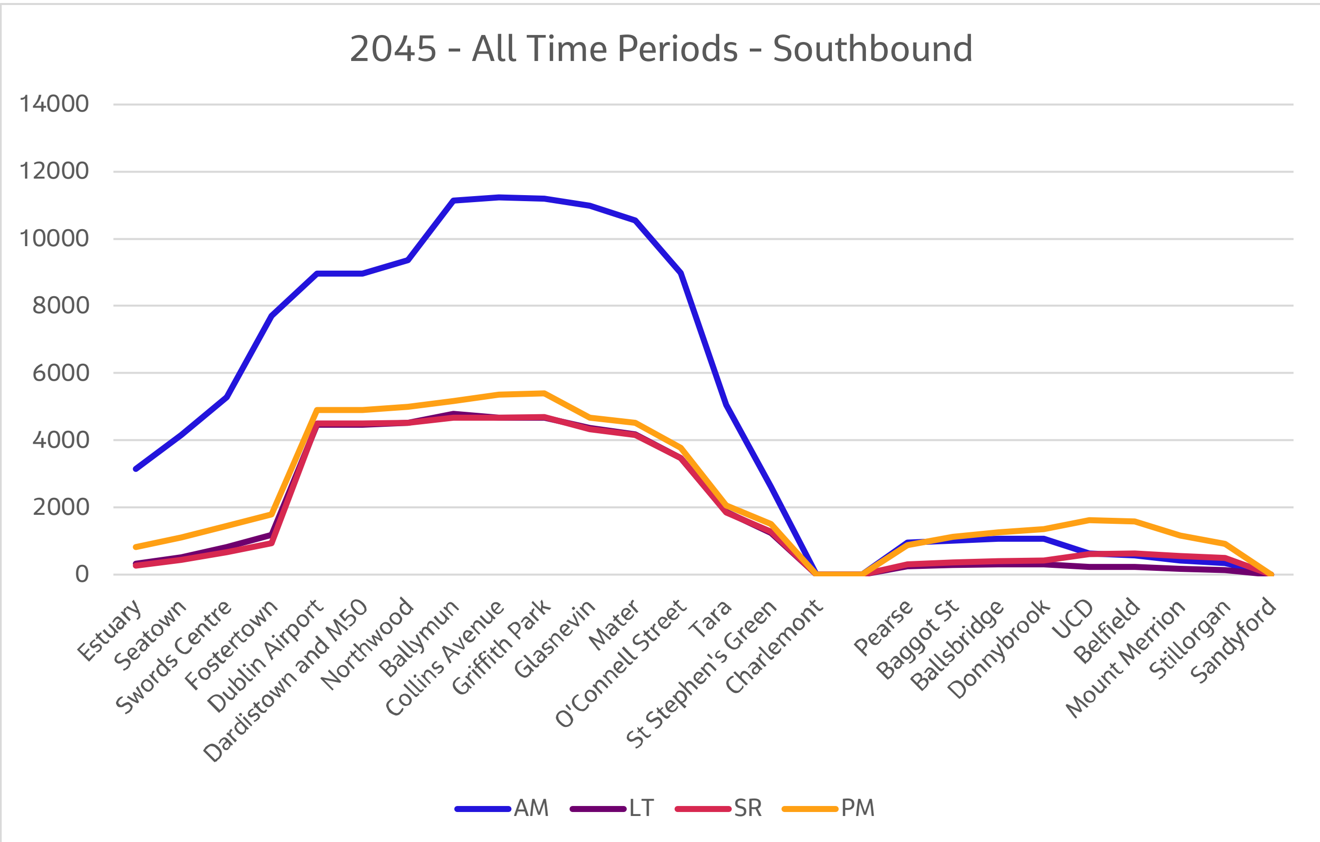

Figure 5-10: Pearse Alignment, Southbound Line Loadings, 2045 All time periods

5.2.2 Changes in public transport mode share

Analysis of the aggregate public transport mode share shows that the Charlemont option results in an increase in public transport mode share in both 2030 and 2045, increasing the expected annual number of public transport trips by 1.6 and 2.1 million in each year respectively, an increase of approximately 0.5% against Do-minimum levels.

Overall, the option can be seen as supporting a minor increase in use of public transport, but only results in a marginal reduction in car trips.

5.2.3 Changes in public transport demand

Impacts on local public transport flows are shown in Figure 5-11 for the 2045 AM peak. As with the Charlemont alignment it can be seen that transfers from other public transport options, primarily the Luas Green Line, are a major component of this. This again reduces the transformational potential of the scheme.

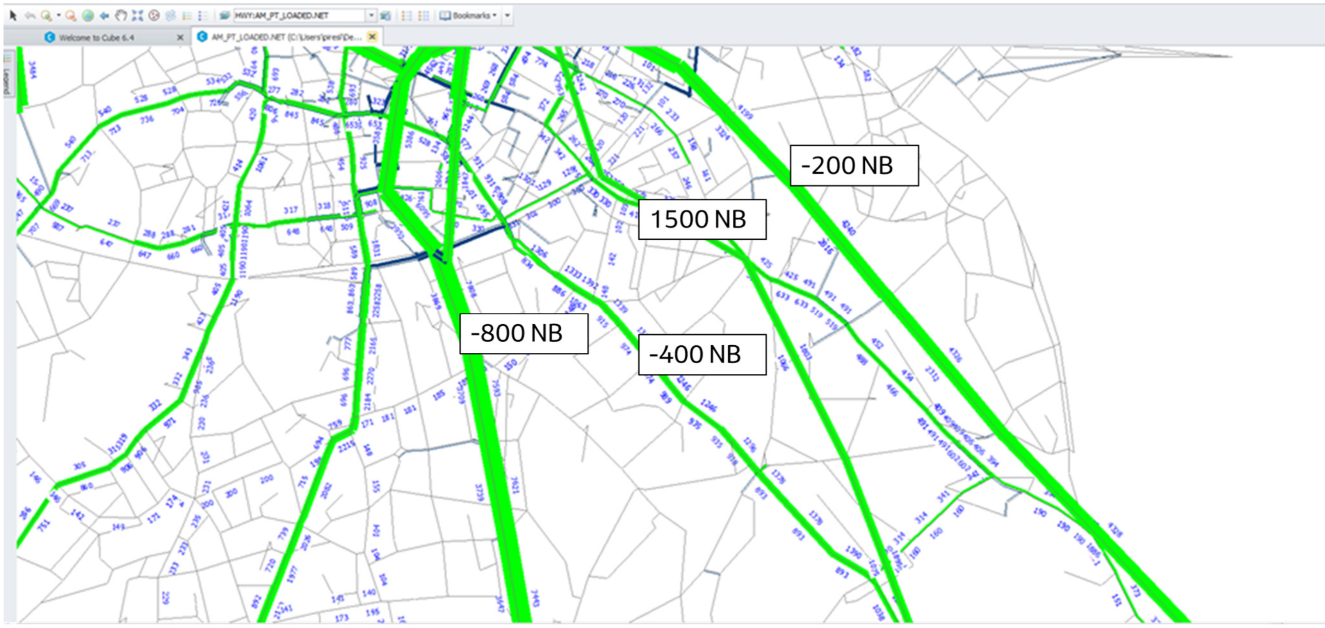

Figure 5-11: Pearse Alignment, Changes in public transport flows, North of UCD, 2045 AM peak

5.2.4 Alignment with UCD student catchment

Discussion of performance of the Pearse alignment option in regard to connection to UCD highlights similar challenges to those observed with the Charlemont option and the level of trips accessing UCD from the south is lower than pre-study expectations.

As highlighted in the line loading analysis, use of this option is lower overall relative to the Charlemont option, and at UCD, there is a significant decline in trips to and from the north, while trips to and from UCD from the south are at effectively equivalent levels.

At the strategic level, the Pearse alignment option appears poorer at capturing demand for UCD from the but matches the Charlemont option in terms of capture for trips from the South.

5.2.5 Alignment with other catchment areas

Sandyford and the corridor from UCD towards Ballsbridge were identified as areas of higher employment intensity during the option development process, and are directly served by this proposal. Specific population concentrations are less well defined, but also include Sandyford and the area to the South of UCD.

As would be expected in light of the low line loadings shown in Figure 5-9 and Figure 5-10 usage of the stations located within these catchment areas is very low relative to usage of the stations of the existing MetroLink proposal. Whilst usage of Sandyford and Pearse stations are relatively high, Baggot Street, Ballsbridge and Donnybrook stations are lightly used with demand lower than all the stations from the existing MetroLink proposals. Stations south of UCD have similarly low levels of demand.

Combined with the previously discussed challenges of connecting to central Dublin via Pearse station which is specific to this alignment option, other factors contributing to this low level of forecast use are likely to include the relatively low intensity of population and employment along portions of the proposed alignment and the existing presence of Rail, Luas and Bus corridors in the study area.

6. Cost estimation

A costing exercise was undertaken to support a consistent value for money appraisal for the various Metro options being considered as part of the development of studies for the review of the transport strategy.. As outlined below, these estimates capture the full range of key factors to allow for a comprehensive estimation of the Net Present Value of the costs, reflecting a specific understanding of the separate impacts of:

- Capital costs
  - Direct and indirect costs
  - Contractor overhead profit and insurance
  - Client costs
  - Land and property
  - Risk allowances
- Operations and maintenance costs
- Assumed expenditure profiles
- Interface with MetroLink construction

6.1 Capital costs

Following review of the route options with the estimation team, initial capital costs were estimated for each option on the basis of the quantities of basic units. These included:

- Station underground (open cut or mined)
- Station surface
- Vents/Escape shafts
- Metres of single bore twin track tunnel etc…
- Metres of track
- Numbers of trains
- Location of and access to the maintenance depot
- Location of operation control centre and alternative spare
- Park-and-ride facility
- Systemwide installations (track, fencing, power supply, comms, signalling, etc…)

Where appropriate item costs were adjusted to control for factors such as:

- Urban or suburban settings (stations)
- Station depth
- Adjacency to railway lines
- Likely utilities
- Etc.

An initial cost was then built up for each option through application of previously developed library rates. This was then uplifted on an item by item by item basis to account for preliminary costs and then using global factors for contractor overheads, profits and bonds and sureties. Further allowances for client costs (indirect costs and land and property) were estimated for each option through comparison with the MetroLink scheme.

6.2 Application of risk and optimism bias

Reflective of the very early stage of project development and the correspondingly low level of engineering detail available at this stage a Quantified Risk Assessment (QRA) has not been undertaken at this point. Reference Case Forecasting has instead been used to adjust for risk and optimism bias. As reported in the UK Government's Transport Appraisal Guidance, analysis by Oxford Global Projects recommends different optimism bias uplifts for different projects at different stages of the project lifecycle. These are summarised in Table 6-1 for the earliest stage of project development.

As a complex project blending elements of Rail, Fixed link, land and property and rolling stock a blended allowance of 65% was applied to the total cost estimate. Although cautious, this is considered reasonable at this stage in the process, given the proportion of costs attributed to station construction, signalling and Rolling stock.

Table 6-1: Recommended optimism bias uplifts for different projects at different stages of the life of a transport project

Category	Item	Stage 1 (Project Definition)
Roads	Motorway, trunk roads, local roads	46%
Rail	Metro, Light rail, Guided buses on tracks, line upgrades, high speed rail	56%
Fixed links	Bridges and Tunnels	55%
Building projects	Stations and Terminal buildings	70%
IT projects	IT system development	69%
Land and property	Property purchases	33%
Rolling stock (new procurement)	Powered and unpowered vehicles	61%

The adjusted capital cost build-up for the two route options is summarised in Table 6-2 and Table 6-3. These costs are presented in Quarter four 2019 Euros, and are exclusive of VAT, which is addressed as part of the conversion to Net Present Costs.

Table 6-2: Metro UCD – Sandyford, Charlemont Route option, capital costs (factor costs, Q4 2019 prices, nearest €100,000).

Category	Item	Total (EUR) (Q4 2019)
Capital costs	Tunnels & Intervention shafts	506,100,000
	Subsurface stations	1,089,700,000
	Rolling stock	197,100,000
	Other	415,400,000
	Total	2,207,300,000
Client costs	Indirects	316,700,000
	Land and property	211,400,000
Sub-total		2,735,400,000
Risk & Optimism Bias	65%	1,778,000,000
Total		4,513,400,000

Table 6-3: Metro UCD – Sandyford, Pearse Route option, capital costs (factor costs, Q4 2019 prices, nearest €100,000).

Category	Item	Total (EUR) (Q4 2019)
Capital costs	Tunnels & Intervention shafts	534,900,000
	Subsurface stations	1,254,400,000
	Rolling stock	225,500,000
	Other	507,900,000
	Total	2,522,800,000
Client costs	Indirects	316,700,000
	Land and property	362,000,000
Sub-total		3,127,100,000
Risk & Optimism Bias	65%	2,032,600,000
Total		5,159,700,000

6.3 Operations and maintenance

Independently to the capital cost estimation process, an allowance for operations and maintenance (O&M) costs of the proposed Metro UCD – Sandyford route options was developed to capture the potential O&M costs over a 60 year operational time horizon. For both the Metro Knocklyon and Metro UCD to Sandyford route options a total allowance of €600m (in 2011 Euros) across the 60 year period is proposed as approximately representative with reference to the equivalent MetroLink projections.

6.4 Expenditure profile

To allow estimation of the present value of the capital and O&M costs, expenditure profiles were developed support this.

6.4.1 Capital expenditure profile

For both proposed routes a four year construction programme ending in 2030 was assumed with equal expenditure assumed in each year. At this stage, this assessment should be considered highly preliminary, and is proposed solely for the purpose of evaluating the present value of the costs.

6.4.2 O&M expenditure profile

Rather than following a pro-rata estimate of €10m per annum, O&M expenditure was assumed to increase over the 60 year operation period, as the age of the assets increases, from €6.6m in the 1st year to €13.8m in year 60.

6.5 Construction price inflation

The potential impacts of Covid-19 and construction of MetroLink on construction prices are considered an area of significant uncertainty and remain to be confirmed.

Whilst a project of a scale of the MetroLink construction might be expected to drive increases in construction costs, this has not been quantified, and any impact would also be influenced by the timing of these proposals. Conversely, the schemes proposed may be in a position to benefit from efficiencies and lessons learned during the delivery of MetroLink.

No specific allowance has been made for the separate impacts of these issues, which are considered to fall under the overall allowance for Risk and Optimism bias.

6.6 Present value of costs

For use in the value for money appraisal, the costs have been adjusted for presentation in a 2011 market price basis and value, this has been undertaken in line with Transport Infrastructure Ireland's Project Appraisal Guidelines (PE-PAG-02030).

The capital and O&M costs are provided on a factor cost basis. As set out in PE-PAG-02030, an uplift of 1.183 has been applied for conversion to a market cost basis for comparison with the potential user benefits,

As per TII guidance the present value year has been taken as 2011, the capital costs have been deflated to 2011 values based on the observed Consumer Price Index for the period 2011- 2019. O&M costs were originally estimated on a 2011 basis. Future year capital and O&M costs are similarly discounted to 2011 values with discount rates as per TII guidance of 4% for years 1-30 and 3.5% for years 31-60.

Table 6-4: in Costs in (2011 Prices and Values, nearest €100,000).

Category	Metro UCD to Sandyford (Charlemont alignment)	Metro UCD to Sandyford (Pearse alignment)
Construction Cost	2,505,900,000	2,864,600,000
Operating Cost	105,500,000	105,500,000
Total Cost	2,611,300,000	2,970,100,000

7. Economic appraisal

7.1 Introduction

A Public Transport User Benefits Appraisal (TUBA) of the Dublin MetroLink (University College Dublin (UCD) to Sandyford), schemes has been completed as part of the feasibility study. This appraisal has been conducted to identify the user benefits expected from scheme implementation. The Public Transport appraisal has been split into two distinct sections, corresponding to the two potential alignments described in of the report: Charlemont Alignment and Pearse Alignment. While the appraisal will foremostly provide an indicative value of user benefits expected from scheme implementation, comparisons between the Charlemont Alignment and Pearce Alignment outputs will aid option selection. The appraisal of each alignment option has followed the same defined process.

The transport modelling outputs which underpin the economic appraisal have been produced using the National Transport Authority's (NTA) Regional Modelling System, developed as part of the Modelling Services Framework in collaboration with SYSTRA and Jacobs Engineering Ireland. The National Transport Authority's Regional Modelling System comprises the National Demand Forecasting Model, five large-scale, technically complex, detailed and multi-modal regional transport models and a suite of Appraisal Modules covering the entire national transport network of Ireland. The five regional models are focussed on the travel-to-work areas of the major population centres in Ireland. The Eastern Regional Model (ERM) has been used for this appraisal as it focuses on the travel-to-work areas of the population centre of Dublin and nearby regions. The ERM captures all day travel demand, thus enabling more accurate modelling of mode choice behaviour and increasingly complex travel patterns.

The appraisal has been conducted using the TUBA v1.9.13. The economics parameter file used is the same as for the assessment of the core MetroLink scheme which was updated in line with the most recent common appraisal framework and guidance. This has ensured that the economic appraisal has been completed in accordance with the Transport Infrastructure Ireland (TII) cost benefit analysis guidance - implementing a 'willingness to pay' approach to economic appraisal of multi-modal schemes.

As specified in the economics file, the ERM, and Irish guidance, impacts will be modelled in four distinct time periods: AM, LT, SR and PM. The annualization factors used for each of these time periods are presented in Table 7-1 and are those provided by the NTA for scheme appraisal.

Table 7-1: Annualization factors used for appraisal

Time Period	Annualization factor
AM (07:00-10:00)	616
LT (10:00-13:00)	3,044
SR (13:00-16:00)	688
PM (16:00-19:00)	688

A sectoring file was used to aid analysis of the scheme impacts. Within the core area model zones were used and at the edge of the model area (away from area of impact) zones were aggregated. In total 380 discrete ERM zones were used, alongside 33 larger sectors for rest of ERM.

To align with the construction plan, the Public Transport User benefits appraisal has assumed a first year of 2030, with modelled years of 2030 and 2045. In line with the Public Spending Code and Common Appraisal Framework, Public Appraisal Guidelines indicate that where schemes offer long term benefits the approach of using a 30-year appraisal period, and incorporating the residual value of assets after this period, may not accurately the capture the true impact of public spending. If this is the case, then a 60-year appraisal period should be used (30 years + 30 years in lieu of residual asset value).

Due to the lifespan of this project (and aligned with the approach to appraisal used for the core MetroLink scheme) a 30 year period is not considered sufficient to accurately capture the long term impact of the scheme. Therefore a 60 year appraisal period has been used for this assessment. This means that 2089 (60 years after scheme opening) is used as the horizon year for appraisal.

In line with the appraisal of the core MetroLink scheme, weighted generalised cost outputs, from the CUBE Public Transport Model within the ERM, were used for the appraisal of the public transport element of the scheme and standard outputs for the highways element. The highways element is not affected by discrepancies in cost calculations in the CUBE / appraisal interface and so use of standard outputs is appropriate.

7.2 UCD to Sandyford – Charlemont Alignment

7.2.1 Introduction

Section 7.2 discusses the user and provider impacts expected to occur as a result of the UCD to Sandyford MetroLink development, Charlemont Alignment. An overview of the Charlemont Alignment route option is provided in Section 4.8 of this report.

The Charlemont Alignment is expected to provide connectivity from Sandyford to the city centre, via Charlemont. It is expected to provide a total of €1.45bn (2011 prices and values) benefits over the appraisal period. This includes benefits through improved accessibility to and from the city centre via public transport, and benefits for highways users from decreased congestion as a result of modal shift away from private road vehicles.

Figure 7-1 illustrates the total combined Public Transport and Highways impact of the proposed scheme for trip origins. Positive benefits can be seen for the majority of areas situated directly along the route corridor extension, as residents in these areas will now have access to MetroLink, improving city centre access. Benefits are especially noticeable around the University College Dublin (UCD) campus. This is because the MetroLink extension will allow students and staff direct light rail access to the city centre, whereas previously this was not available. Benefits are also experienced by residents in areas to the north of the city centre. This is because the proposal extends the MetroLink, providing users to the north with improved access to locations south of the city. Residents in areas to the south and east of the scheme, including Mount Merrion and Stillorgan, also experience benefits.

Regions to the west of the main route corridor generally experience the lowest origin benefits as a result of the proposed scheme, with very few regions experiencing benefits of greater than €50,000 (2011 prices and values) in 2045. Further, some regions to the west, including Clondalkin, are expected to experience disbenefits as a result of the scheme. Some disbenefits are also seen towards the south west of Dublin city centre, across Crumlin, Walkinstown and Kimmage. Overall the scheme provides a benefit to Dublin transport users.

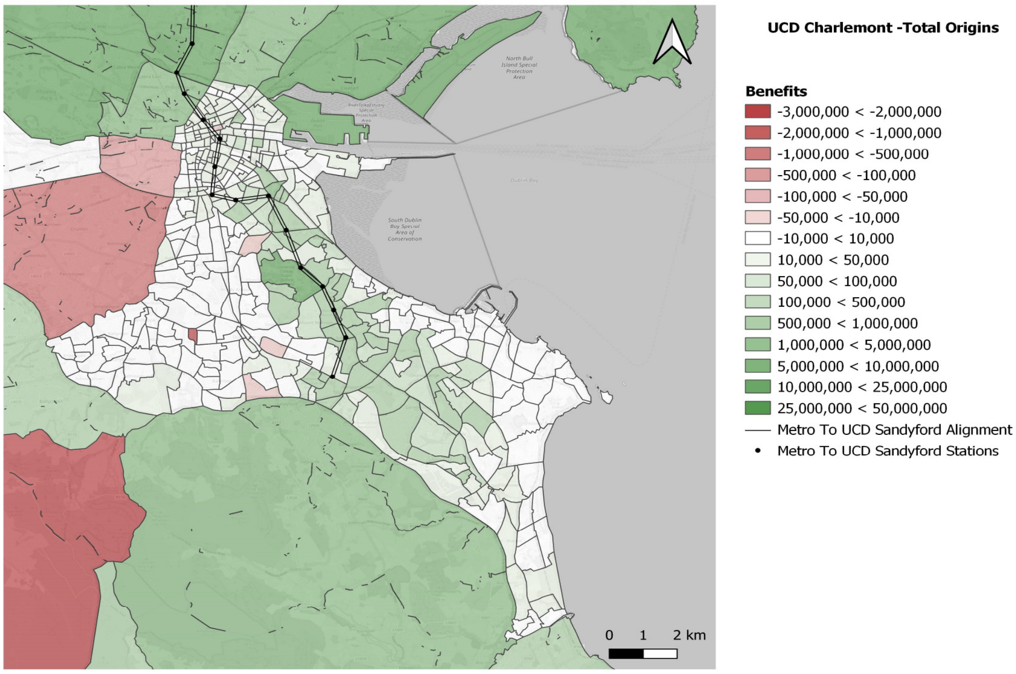

Figure 7-1: Total monetised user impact (€), all times periods, 2045, origin, 2011 prices and values.

Figure 7-2 illustrates the total combined Public Transport and Highways impact of the proposed scheme for trip destinations. It shows a similar distribution of impacts to Figure 7-1, with areas of high benefits directly along the route corridor extension and to the north of the city centre. Particularly large benefits are expected to accrue for residents in Finglas, Glasnevin and Donaghmede. The majority of Dublin experiences net benefits as a result of the proposed scheme, with a high concentration of benefits seen around UCD campus, Mount Merrion and Stillorgan. This is likely to be due to users benefitting from improved city centre access following the extension of the southern section of the MetroLink.

There are very few regions expected to experience disbenefits as a result of the proposed scheme. Small disbenefits of €10,000-€50,000 (2011 prices and values) are expected in a small section of Bray and the North Wall section of the city centre. The only disbenefits greater than €50,000 (2011 prices and values) are seen to the west of Dublin, in the outlying regions of Tallaght and Clondalkin.

As outlined below these impacts are primarily driven by impacts on highway users. Congestion at a number of the junctions on the M50 is a known future issue with the modelling of these being potentially sensitive to relatively small demand changes – further exploration of the impacts here would be recommended as part of any further work on this option.

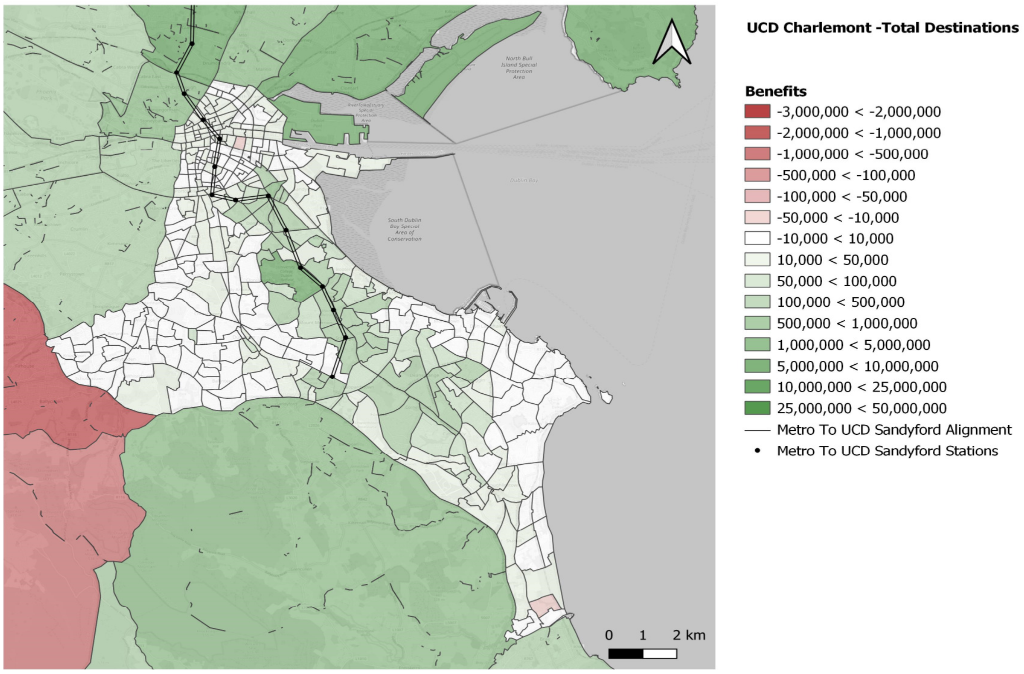

Figure 7-2: Total monetised user impact (€), all time periods, 2045, destination, 2011 prices and values.

Further detail, disaggregated by journey type, is provided in subsections 7.2.2 and 7.3.3 of this report.

Public Transport

Figure 7-3 illustrates the Public Transport impact of the proposed scheme for AM trip origins. This primarily considers the benefits arising for commuters travelling to work, mapped by their origin.

Generally, there are widespread low-level benefits across Dublin. The majority of the city centre, areas along the east coast, and local communities to the west of the MetroLink including Rathgar and Dundrum, all experience negligible impacts. The highest benefits are received by areas directly along the MetroLink corridor or to the north of the city centre. Areas of particularly high benefit along the route corridor include UCD campus, Mount Merrion, and Stillorgan, where a group of regions experiencing monetised time benefits of between €10,000-€5,000,000 (2011 prices and values) can be seen at the southern end of the route corridor. Areas of particularly high benefit to the north of the city centre include Donaghmede, Ballymun and Glasnevin.

Generally, regions to the west of the scheme corridor and along the east coast experience the lowest benefit. Residents of these areas have to travel the furthest to reach the scheme. Only two regions, North Wall (in the city centre) and an outlying region near Wicklow Mountains National Park, experience disbenefits of greater than €10,000 (2011 prices and values) as a result of the proposed scheme in the AM period.

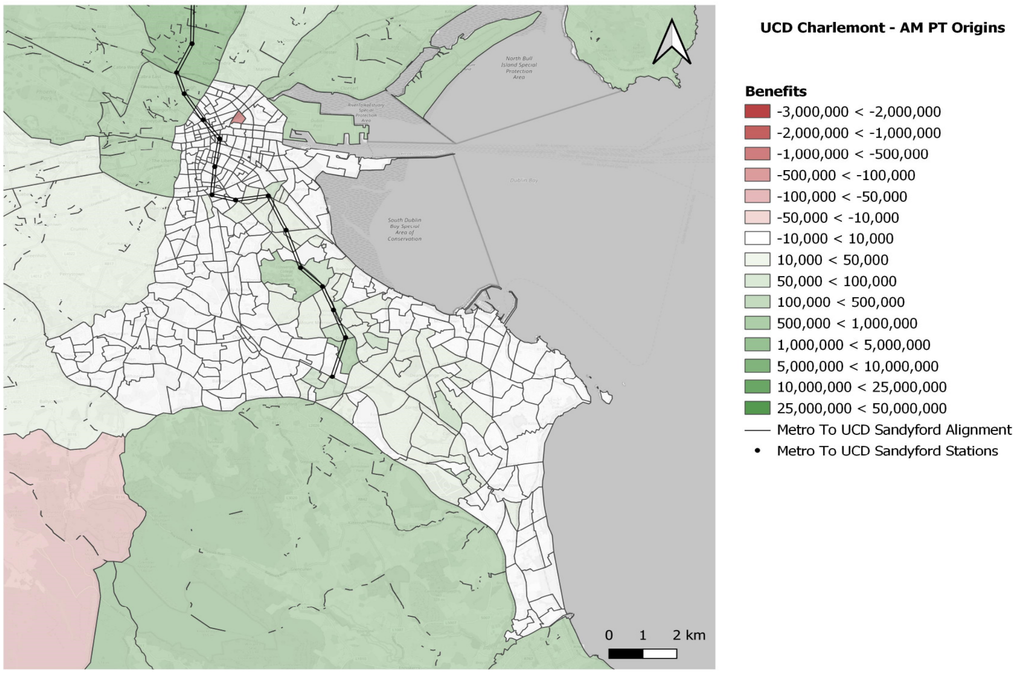

Figure 7-3: Total monetised user impact (€), AM, 2045, origins, 2011 prices and values.

Figure 7-4 illustrates the Public Transport impact of the proposed scheme for PM trip destinations. The general distribution of impacts is widespread, with benefits experienced in the majority of regions. The highest benefits are received by areas directly along the MetroLink corridor or to the north of the city centre. Areas of particularly high benefit along the route corridor include UCD campus, Mount Merrion, and Stillorgan, where a group of regions experiencing monetised time benefits of between €10,000 - €1,000,000 (2011 prices and values) can be seen at the southern end of the route corridor. Areas of particularly high benefit to the north of the city centre include Clongriffen, Ballymun and Malahide.

Generally, regions to the west of the scheme corridor and along the east coast experience the lowest benefit. Residents of these areas have to travel the furthest to reach the scheme. Only one region, an outlying region near Wicklow Mountains National Park, experiences disbenefits of greater than €10,000 (2011 prices and values) as a result of the proposed scheme in the PM period.

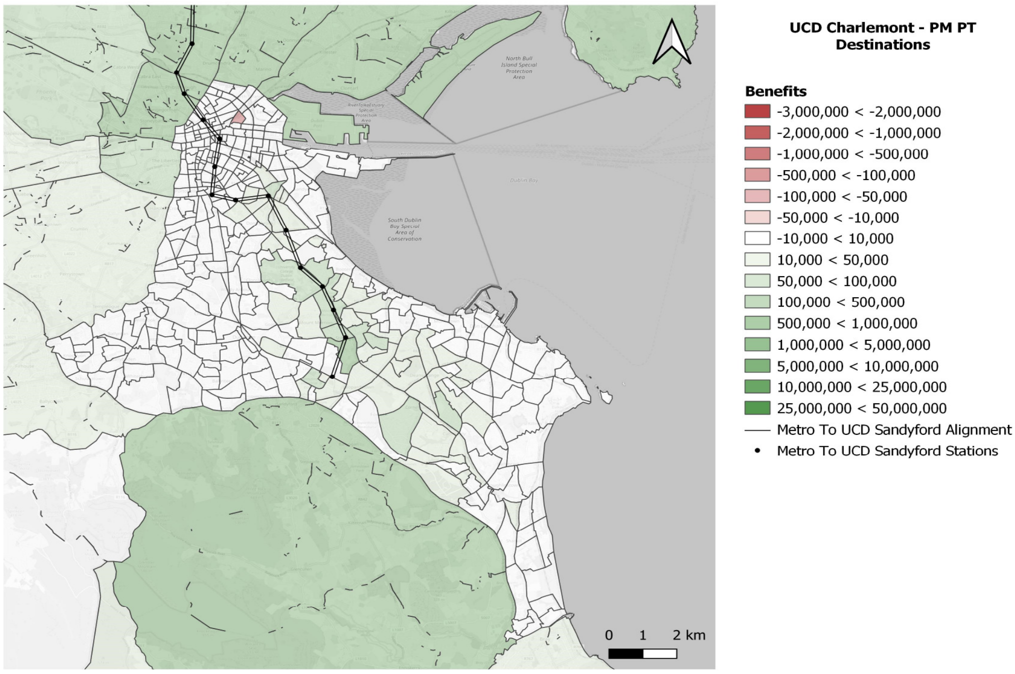

Figure 7-4: Total monetised user impact (€), PM, 2045, destinations, 2011 prices and values.

Table 7-2 shows the distribution of monetised public transport user time impacts by trip purpose. All five trip purposes receive a net monetised user time benefit as a result of the Charlemont Alignment. Leisure trips receive the greatest benefit with aggregate user benefits of €423,000,000 (2011 prices and values) across the 60-year appraisal period. Large benefits are also received by business and commuting users, while slightly smaller benefits are received by the educational and retired user groups.

The ‘User Charges’ column in Table 7-2 indicates the welfare change for Public Transport users from the change in fare payments. A positive user charge value is expected for all trip purposes as a result of the Charlemont Alignment. The greatest benefit is expected for commuting and educational trips, which both see benefits of over €6,000,000 (2011 prices and values).

As this is a public transport scheme there are no vehicle operating costs considered within this part of the appraisal because public transport users do not perceive them. Any costs associated with the additional Metro vehicles required to operate the scheme and their operations are captured within the costs estimates.

Table 7-2: Total monetised user impacts by trip purpose over a 60-year Appraisal Period (2011 Prices and Values, nearest €100,000).

Trip Purpose	User Time impacts (€)	User Charges (€)
Business	330,500,000	3,600,000
Commuting	204,200,000	6,600,000
Leisure	423,000,000	5,900,000
Education	130,600,000	5,900,000
Retired	11,000,000	0

Table 7-3 shows the total monetised public transport user impacts accrued across the 60-year appraisal period disaggregated by time period. All four time periods are expected to receive net benefits over the 2030-2089 appraisal period. The LT time period is expected to receive approximately €495,000,000 (2011 prices and values) of benefits – the most of any time period. This is partly due to the high number annualization factor associated with this period, which is used to approximate off peak and weekend trips. Benefits in the AM and PM time periods are of a similar magnitude (approximately €240,000,000) (2011 prices and values), while the SR time period receives the lowest value of benefits.

The 'User Charges' column in Table 7-3 indicates the welfare change for Public Transport users from the change in fare payments. A positive user charge value is expected for all time periods as a result of the Charlemont Alignment. The greatest benefit is expected for PM trips, with benefits of over €8,000,000 (2011 prices and values).

Table 7-3: Total monetised user impacts by time period over a 60-year Appraisal Period (2011 Prices and Values, nearest €100,000).

Time Period	User Time impacts (€)	User Charges (€)
AM	251,700,000	6,500,000
LT	494,600,000	3,700,000
SR	121,200,000	3,200,000
PM	233,200,000	8,600,000

Table 7-4 shows the change in operator revenue and indirect tax revenue as a result of the proposed scheme, disaggregated by time period. All four time periods are expected to see an increase in operator revenue as a result of the proposed scheme. This is because of an increase in MetroLink patronage for all time periods, with more people willing to use the scheme as a result of the proposed improvements. The greatest increase in operator revenue is experienced in the LT time period, with over €55,000,000 (2011 prices and values) increase in revenue. The increase in operator revenue in the AM and PM time periods is broadly similar.

A reduction in indirect tax revenue can be seen for all time periods, with the greatest reduction in the LT time period (over €7,000,000) (2011 prices and values). Over the 60-year appraisal period, a total reduction of approximately €17,000,000 (2011 prices and values) is expected. Indirect tax revenues are expected to fall as a result of the proposed scheme due to the increase in public transport patronage. Increased public transport usage is causes a re-allocation of expenditure towards public transport. As consumers spend a greater proportion of their income on public transport (which is not taxable) and less on alternative, taxable, consumption, indirect tax revenue falls.

Table 7-4: Total monetised provider impacts and changes in indirect tax revenues by time period over a 60-year Appraisal Period (2011 Prices and Values, nearest €100,000).

Time Period	Operator Revenue (PT fares) (€)	Indirect Taxes (€)
AM	27,600,000	-3,900,000
LT	55,300,000	-7,400,000
SR	11,000,000	-1,400,000
PM	26,000,000	-3,700,000

7.2.2 Highways

Figure 7-5 illustrates the Highways impact of the proposed scheme for AM trip origins. This primarily considers the benefits arising for commuters travelling to work, mapped by their origin. Figure 7-5 does not show a clear distribution of impacts.

Some areas directly to the north and west of the city centre, including Ballymun, Clondalkin and Phibsborough, are expected to experience disbenefits as a result of the Charlemont Alignment, while other, nearby, areas such as Killester, Donaghmede and Ballyfermot are expected to experience benefits.

Negligible impacts are expected in the immediate vicinity of the MetroLink corridor south of the city centre, with very few impacts of greater than €10,000 (2011 prices and values) in 2045.

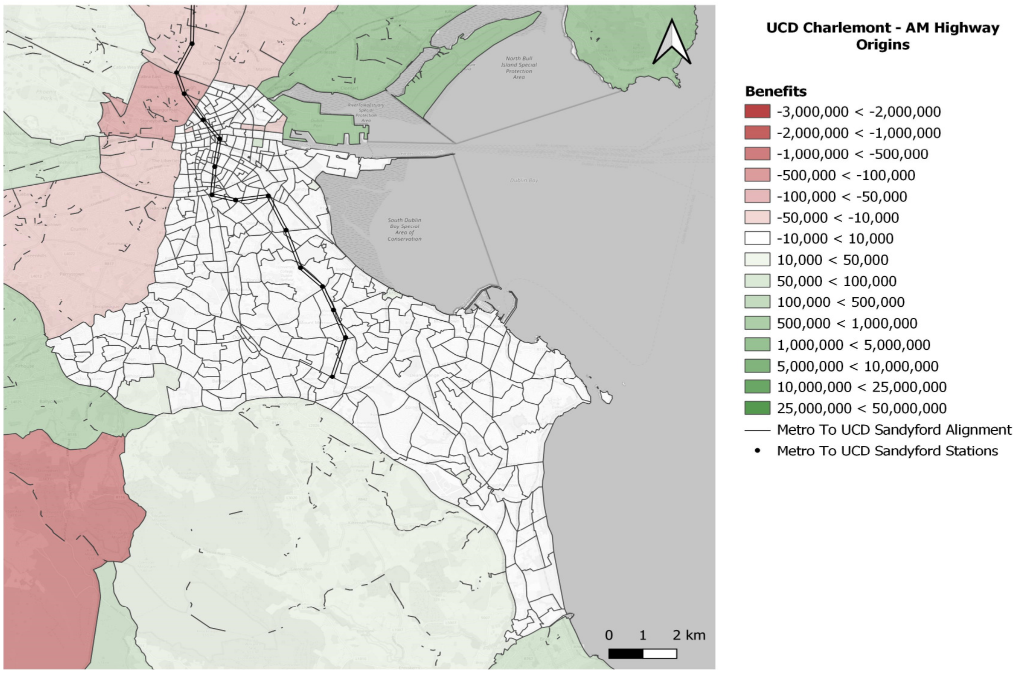

Figure 7-5: Total monetised user impact (€), AM, 2045, origins, 2011 prices and values.

Figure 7-6 illustrates the Public Transport impact of the proposed scheme for PM trip destinations. The distribution of impacts is similar to the AM Highway Origins map in Figure 7-5. Areas in the immediate vicinity of the MetroLink corridor to the south of the city centre experience negligible impacts, while there are mixed impacts experienced by areas to the north of the city centre. Generally, highway users from areas to the north east of the city centre, including Donaghmede, Whitehall and Donnycarney, experience benefits from the proposed scheme. This may be due to a reduction in highways congestion, with travellers switching from private transport to public transport.

Disbenefits of €10,000 to €100,000 (2011 prices and values) are experienced by highways users to west of the city centre in 2045, in areas such as Castleknock, Ballyfermot and Crumlin.

Given the smaller scale of the scheme impact on Highway users, both in terms of demand, as outlined in 5.1.2, and overall user benefits relative to the Do-minimum user costs, the results from the highways appraisal are more likely to be impacted by issues of model noise, and convergence related cost differences between the Do-minimum and Do-something scenarios.

Both the AM and PM results however indicate some widespread highway user disbenefits to the west of the City Centre, although these are somewhat highlighted by the larger geographical aggregations used in this region. Notwithstanding that factor, congestion at a number of the junctions on the M50 is a known future issue, with modelling being potentially sensitive to relatively small demand changes – further exploration of factors driving the impacts to the west of Central Dublin would be recommended as part of any further work on this option.

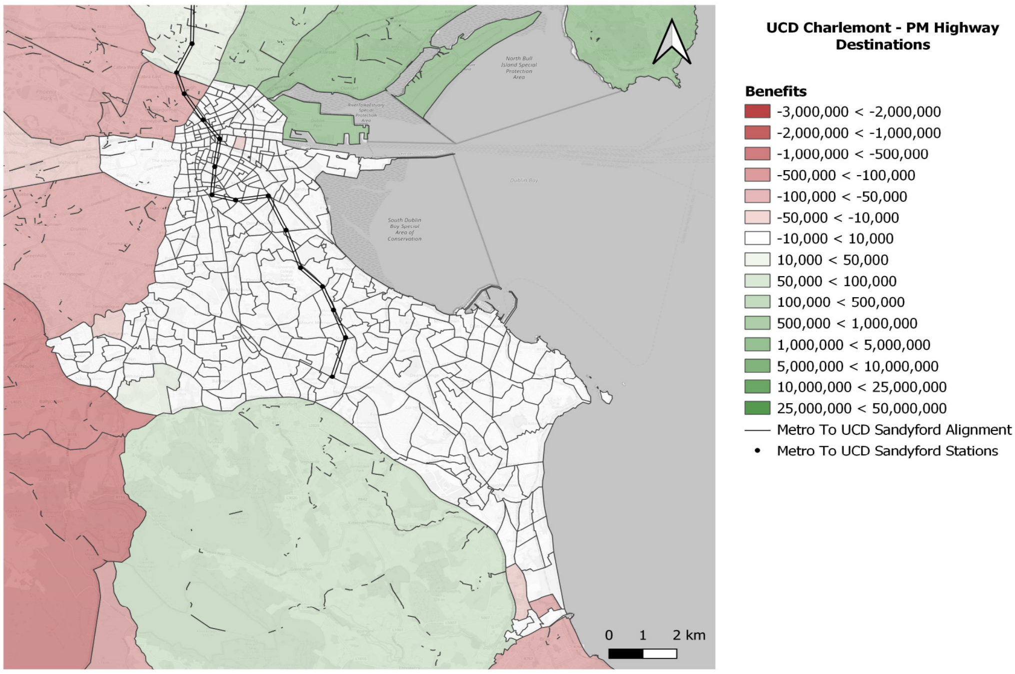

Figure 7-6: Total monetised user impact (€), PM, 2045, origins, 2011 prices and values.

Table 7-5 shows the distribution of monetised highways user time impacts by trip purpose. Four of the five trip purposes experience a monetised user time benefit as a result of the Charlemont Alignment, with the greatest benefit being the €138,000,000 (2011 prices and values) received by business trips across the 60-year appraisal period. An unanticipated monetised user time disbenefit can be seen for educational users over the appraisal period, indicating journeys take longer than they did previously as a result of the proposed public transport improvements. Given the scale of this impact, the drivers of this has not been explored further.

A disbenefit as a result of user charge changes (national toll) can be seen for three of the five trip purpose groups. The greatest disbenefit is for leisure trips, indicating this group sees the greatest increase in toll payments. The two trip purposes with the lowest user time benefits (business trips and educational trips) both see welfare benefits from user charge changes. For education, this suggests that journeys are now taking longer, but are also cheaper.

Table 7-5 also shows the change in welfare resulting from changes in vehicle operating costs for highways users as a result of the scheme. Positive welfare benefits can be seen for fuel and non-fuel vehicle operating costs across all five trip purposes, with the greatest benefit for leisure travel. Positive welfare benefits indicate highways users have to pay lower operating costs as a result of the MetroLink improvements. A large proportion of this benefit is likely to be due to a reduction in congestion.

Table 7-5: Total monetised user impacts and vehicle operating costs by trip purpose over a 60-year Appraisal Period (2011 Prices and Values, nearest €100,000).

Trip Purpose	User Time (€)	User Charges National Toll (€)	Vehicle Operating Cost (fuel) (€)	Vehicle Operating Cost (non-fuel) (€)
Business	138,000,000	-2,700,000	500,000	3,600,000
Commuting	800,000	2,900,000	300,000	2,700,000
Leisure	91,400,000	-3,400,000	800,000	4,000,000
Education	-600,000	100,000	0	100,000
Retired	4,700,000	-400,000	100,000	200,000

Table 7-6 shows the distribution of monetised highways user time impacts, user charges and vehicle operating costs (fuel and non-fuel), disaggregated by time period. The greatest user time benefit is experienced in the LT time period, where benefits of €224,000,000 (2011 prices and values) accrue over the 60-year appraisal period. Time benefits are also experienced in the AM and SR time periods. These benefits are likely to accrue due to the reduction in highways congestion from the implementation of the MetroLink improvements allowing quicker road journeys. A disbenefit of €81,000,000 (2011 prices and values) can be seen in the PM time period. This indicates that those travelling via highways in the PM time period are negatively impacted by the MetroLink development through journey delays or speed reductions. Further review of this would be recommended during any subsequent analysis of this proposal.

Table 7-6 shows the benefit impact of changes in user charge payments (tolls) as a result of the proposed scheme, disaggregated by time period. Both the AM and PM time periods see a benefit from changes in user charge payments over the 60-year appraisal period. This is likely to be the result of reduced travel on toll roads due to a decrease in congestion on non-toll roads. A disbenefit of €15,000,000 (2011 prices and values) is seen in the LT time period. This suggests highways users in the LT time period are paying more toll charges than they were previously.

Table 7-6 also shows the change in welfare from changes in vehicle operating costs for highway users as a result of the scheme. A benefit can be seen as a result of changes in both fuel and non-fuel vehicle operating costs for the AM, LT and SR time periods. This suggests highways users travelling in these time periods are spending less on vehicle operating costs. A disbenefit can be seen in both fuel and non-fuel vehicle operating cost in the PM time period.

Table 7-6: Total monetised user impacts by time period over a 60-year Appraisal Period (2011 Prices and Values, nearest €100,000).

Time Period	User Time (€)	User Charges National Toll (€)	Vehicle Operating Cost (fuel) (€)	Vehicle Operating Cost (non-fuel) (€)
AM	55,500,000	3,700,000	800,000	1,500,000
LT	224,000,000	-14,900,000	1,300,000	7,600,000
SR	35,500,000	0	300,000	1,900,000
PM	-80,700,000	7,800,000	-600,000	-400,000

Table 7-7 shows the expected change in operator and indirect tax revenue as a result of the proposed scheme, disaggregated by time slice.

Table 7-7 also shows the expected change in indirect tax revenue as a result of the proposed scheme. The AM, LT and SR time periods all experience a reduction in indirect tax revenue over the 60-year appraisal period. This indicates a reduction in taxable expenditure on road travel by highways users travelling in these time periods. Conversely, an increase in indirect tax revenue is expected in the PM time slice. As indicated in Table 7-6, this is likely to be due to an increase in vehicle operating costs, many of which are taxable.

Table 7-7: Total provider impacts and changes in indirect tax revenues by time period over a 60-year Appraisal Period (2011 Prices and Values, nearest €100,000).

Time Period	Operator Revenue National Toll (€)	Indirect Taxes (€)
AM	-5,700,000	-400,000
LT	2,700,000	-1,400,000
SR	-2,900,000	0
PM	-12,100,000	1,200,000

Table 7-8 shows the distribution of monetised highways user time impacts, user charges and vehicle operating costs (fuel and non-fuel), disaggregated by vehicle type. The greatest user time benefits are experienced by car users, who received over 80% of all highways benefits generated by the proposed scheme. Positive benefits are experienced by all vehicle types. Car users also experience a benefit from the change in user charge payments, of approximately €370,000 (2011 prices and values). All other vehicle types receive a disbenefit as a result of changes in user charge payments. This is greatest for the OGV1 vehicle type.

A decrease in welfare as a result of user charges implies that OGV1, OGV2 and LGV users are increasing their expenditure on toll roads as a result of the scheme. However, as the welfare benefit from user time improvements is greater than the disbenefit from an increase in user charge payments, there is a net benefit for all vehicle types. One likely explanation of this is that, following the implementation of the proposed scheme, OGV1, OGV2 and LGV users are willing to increase expenditure on user charges in order to reduce journey times.

Table 7-8 also shows the change in welfare from changes in vehicle operating costs for highway users as a result of the scheme. Benefits are seen for almost all vehicle types for both fuel and non-fuel operating costs, implying reductions in operating costs for all vehicle types. The greatest benefits are experienced by car users.

Table 7-8: User benefits and changes in revenues by submode/vehicle type over a 60-year Appraisal Period (2011 Prices and Values, nearest €100,000).

Vehicle Type	User Time (€)	User Charges National Toll (€)	Vehicle Operating Cost (fuel) (€)	Vehicle Operating Cost (non-fuel) (€)
Car	195,200,000	400,000	1,300,000	7,000,000
LGV	850,000	-400,000	300,000	1,700,000
OGV1	35,000,000	-2,400,000	100,000	1,600,000
OGV2	3,000,000	-1,000,000	0	300,000
All	234,200,000	-3,500,000	1,700,000	10,600,000

Table 7-9 shows the expected change in operator and indirect tax revenue as a result of the proposed scheme, disaggregated by vehicle type. A reduction in toll revenue of nearly €22,000,000 (2011 prices and values) is expected from car users. This is likely to be caused by car users switching to non-toll roads due to reductions in congestion as a result of the scheme. An increase in toll revenue is expected from all other vehicle types. A decrease in indirect tax revenue is expected from car, LGV and OGV1 users as a result of the Charlemont Alignment over the 60-year appraisal period. This indicates a reduction in taxable expenditure on road travel by highways users travelling by these vehicle types.

Table 7-9: Total provider impacts and changes in indirect tax revenues by submode/vehicle type over a 60-year Appraisal Period (2011 Prices and Values, nearest €100,000).

Vehicle Type	Operator Revenue National Toll (€)	Indirect Taxes (€)
Car	-21,900,000	-400,000
LGV	500,000	-200,000
OGV1	2,400,000	0
OGV2	1,000,000	0
All	-18,000,000	-600,000

7.2.3 Summary

Figure 7-7 presents the combined Highways and Public Transport Economic Efficiency of the Transport System (TEE) Tables over a 60-year Appraisal Period (2011 Prices and Values).

Non-business: Commuting	ALL MODES		Highways		Public Transport
User benefits	TOTAL				Passengers
Travel time	€ 205,018		€ 810		€ 204,208
Vehicle operating costs	€ 3,045		€ 3,045		€ -
User charges	€ 9,496		€ 2,888		€ 6,608
During Construction & Maintenance	€ -		€ -		€ -
NET NON-BUSINESS BENEFITS: COMMUTING	€ 217,559	*(1a)*	€ 6,743		€ 210,816

Non-business: Other	ALL MODES		Highways		Public Transport
User benefits	TOTAL				Passengers
Travel time	€ 660,032		€ 95,470		€ 564,562
Vehicle operating costs	€ 5,157		€ 5,157		€ -
User charges	€ 8,124		-€ 3,665		€ 11,789
During Construction & Maintenance	€ -		€ -		€ -
NET NON-BUSINESS BENEFITS: OTHER	€ 673,313	*(1b)*	€ 96,962		€ 576,351

Business			Highways		Public Transport
User benefits			Road Personal	Road Freight	Passengers
Travel time	€ 468,319		€ 99,782	€ 38,084	€ 330,453
Vehicle operating costs	€ 4,106		€ 2,127	€ 1,979	€ -
User charges	€ 858		€ 718	-€ 3,421	€ 3,561
During Construction & Maintenance	€ -		€ -	€ -	€ -
Subtotal	€ 473,283	*(2)*	€ 102,627	€ 36,642	€ 334,014
Private sector provider impacts					
Revenue	€ 107,960				€ 107,960
Operating costs	€ -				
Investment costs	€ -				
Grant/subsidy	€ -				
Subtotal	€ 107,960	*(3)*	€ -		€ 107,960
Other business impacts					
Developer contributions		*(4)*			
NET BUSINESS IMPACT	€ 581,243	*(5) = (2) + (3) + (4)*	€ 102,627	€ 36,642	€ 441,974

TOTAL		
Present Value of Transport Economic Efficiency Benefits (TEE)	€ 1,472,115	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2011 prices and values

Figure 7-7: Combined Highways and Public Transport TEE Tables (2011 Prices and Values, €000's)

Figure 7-8 shows the combined Highways and Public Transport Public Accounts (PA) Table over a 60-year Appraisal Period (2011 Prices and Values).

	ALL MODES		Highways	Public Transport
Local Government Funding	**TOTAL**		**INFRASTRUCTURE**	
Revenue				
Operating Costs				
Investment Costs				
Developer and Other Contributions				
Grant/Subsidy Payments				
NET IMPACT	€ -	(7)		
Central Government Funding: Transport				
Revenue	€ 6,030		€ 18,025	-€ 11,996
Operating costs	€ 105,462			€ 105,462
Investment Costs	€ 2,505,861			€ 2,505,861
Developer and Other Contributions	€ -			
Grant/Subsidy Payments	€ -			
NET IMPACT	€ 2,617,353	(8)		
Central Government Funding: Non-Transport				
Indirect Tax Revenues	€ 16,409	(9)	€ -	€ 16,409
TOTALS				
Broad Transport Budget	€ 2,617,353	(10) = (7) + (8)		
Wider Public Finances	€ 16,409	(11) = (9)		

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2011 prices and values.

Figure 7-8: Combined Highways and Public Transport PA Table (2011 Prices and Values, €000's)

Figure 7-9 shows the combined Highways and Public Transport Analysis of Monetised Costs and Benefits (AMCB) Table over a 60-year Appraisal Period (2011 Prices and Values).

It should be noted that no accident valuation has been undertaken as part of this appraisal. However, the impact is expected to be small in comparison to overall scheme benefits and of similar value across schemes.

Analysis of Monetised Costs and Benefits

Accidents	€	-	(17)
Economic Efficiency: Consumer Users (Commuting)	€	217,559	(1a)
Economic Efficiency: Consumer Users (Other)	€	673,313	(1b)
Economic Efficiency: Business Users and Providers	€	581,243	(5)
Wider Public Finances (Indirect Taxation Revenues)	-€	16,409	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	€	1,455,706	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	€	2,617,353	(10)
Present Value of Costs (see notes) (PVC)	€	2,617,353	*(PVC) = (10)*
OVERALL IMPACTS			
Net Present Value (NPV)	-€	1,161,647	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)		0.6	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Figure 7-9: Combined Highways and Public Transport AMCB Table (2011 Prices and Values, €000's)

The BCR for the scheme is 0.6. This represents a return of €0.60 for every €1 spent for direct transport users. Without consideration of other wider benefits which may be associated with the scheme, the Charlemont alignment provides poor value for money.

7.3 UCD to Sandyford – Pearse Alignment

7.3.1 Introduction

Section 7.3 of this report discusses the user and provider impacts expected to occur as a result of the UCD to Sandyford MetroLink development, Pearse Alignment. An overview of the Pearse Alignment route option is provided in Section 4.9 of this report.

The Pearse Alignment is a standalone line which runs from Sandyford via UCD to a separate terminus at Pearse station to the south east of the city centre. It is designed to improve connectivity to and from the city centre for residents located to the south of Dublin. It is expected to provide a total of €380m (2011 Prices and Values) benefits to Public Transport users over the 60 year appraisal period. This includes benefits through improved accessibility to and from the city centre via public transport.

7.3.2 Public Transport

Figure 7-10 illustrates the Public Transport impact of the proposed scheme for AM trip origins. This primarily considers the benefits arising for commuters travelling to work, mapped by their origin.

Generally, there are widespread low-level benefits across Dublin. The highest benefits are received by areas directly along the southern extent of the Pearse alignment in Mount Merrion and near the UCD Belfield Campus, where there are a group of regions experiencing monetised time benefits of between €10,000 - €500,000 (2011 Prices and Values). Regions on the outskirts of the city centre which also receive notably high benefits include Cabra West, the Liberties, and Swords.

Generally, the regions which experience the lowest benefit from the proposed development are located at the southern end of the existing MetroLink route, to the west of the Pearse Alignment, and along the east coast. The only region to experience a disbenefit of greater than €10,000 (2011 Prices and values) as a result of the proposed scheme in the AM time period is the region in which Clondalkin is situated.

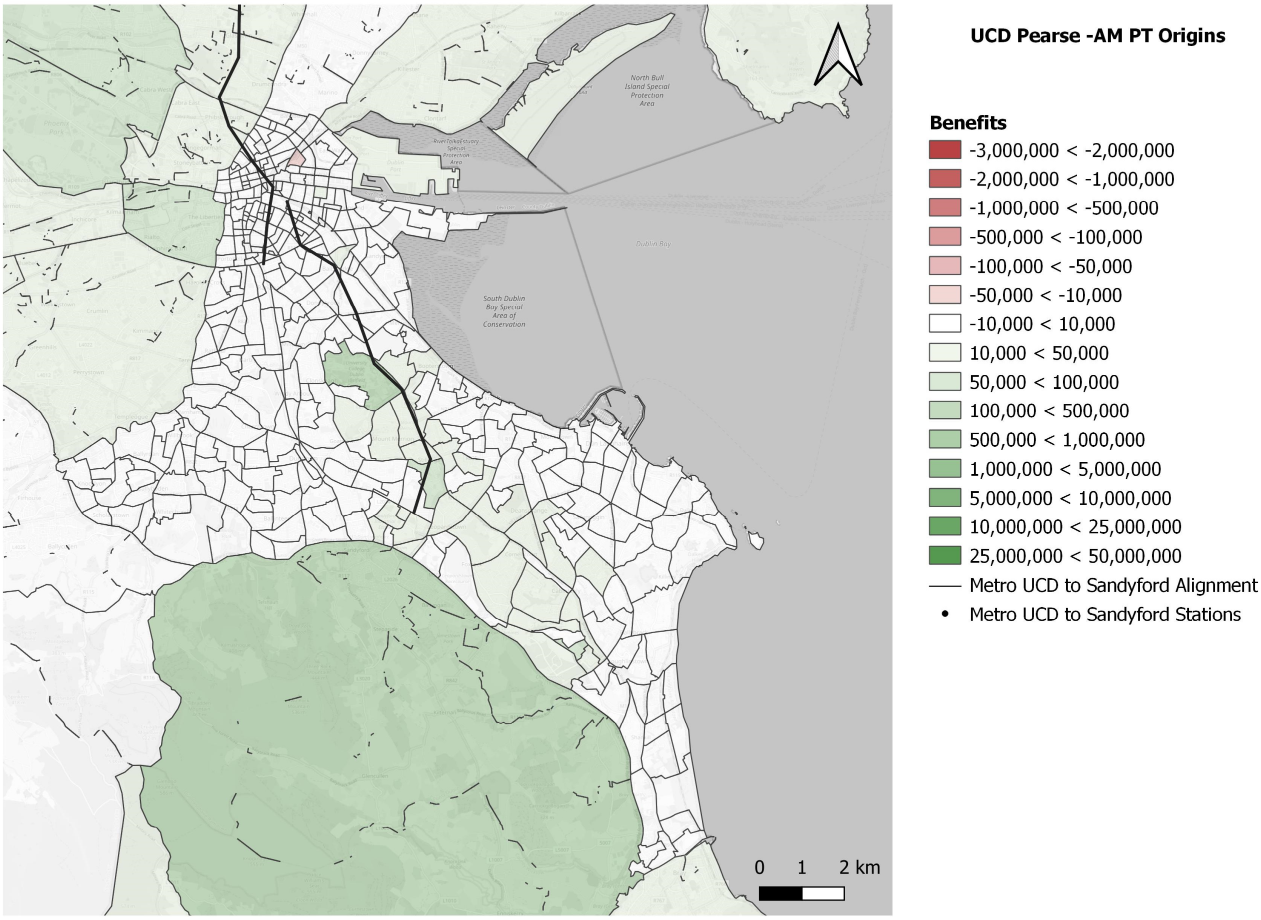

Figure 7-10: Total monetised user impact (€), AM, 2045, origins, 2011 prices and values.

Figure 7-11 illustrates the Public Transport impact of the proposed scheme for PM trip destinations. It shows that low level benefits are experienced across the majority of regions but some areas, located to the west of the Pearse Alignment, do experience low level disbenefits.

The highest benefits are received by areas directly along the Pearse route alignment, to the north of the city centre, or in the region containing the Wicklow mountains and Stepaside to the south. Areas of particularly high benefit along the route corridor include the regions surrounding the UCD Belfield campus, Mount Merrion, and Stillorgan, which experience monetised time benefits of between €10,000 - €100,000 (2011 prices and values). Areas located to the north of the city centre which experience notable benefits include Killester and Donaghmede.

Generally, regions to the west of the scheme corridor and along the east coast experience the lowest benefit. Residents of these areas have to travel the furthest to reach the scheme. Only two regions, located to the west of the Pearse alignment, experience disbenefits of greater than €10,000 (2011 prices and values) as a result of the proposed scheme in the PM time period. These regions include the community areas of Kimmage, Walkinstown, and Tallaght.

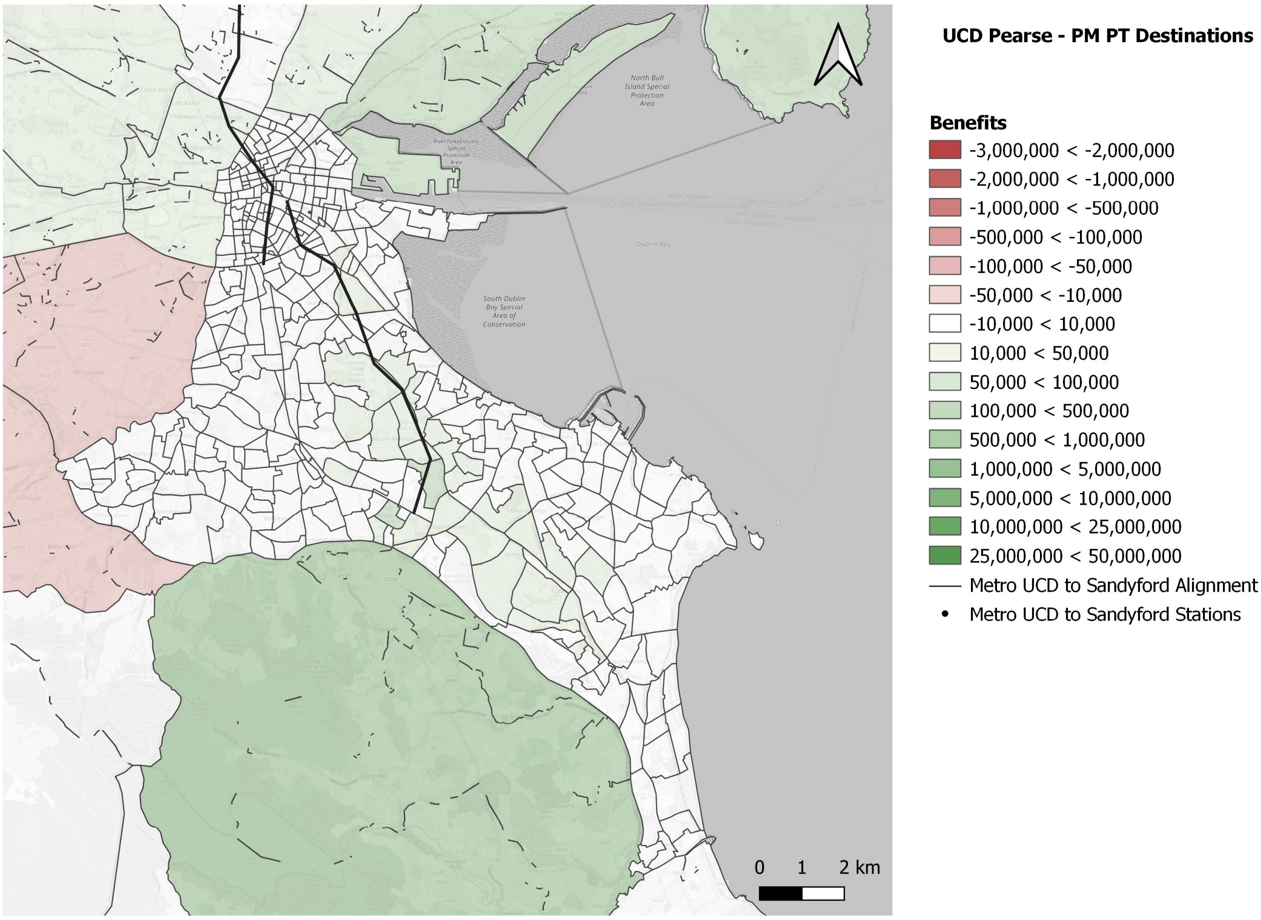

Figure 7-11: Total monetised user impact (€), AM, 2045, Destinations, 2011 prices and values.

Table 7-10 shows the distribution of monetised public transport user time impacts by trip purpose. All five trip purposes receive a net monetised user time benefit as a result of the Pearse Alignment. Commuting trips receive the greatest benefit, with aggregate user benefits of €93,500,000 (2011 prices and values) across the 60-year appraisal period. Benefits are distributed fairly consistently across the business, leisure, and education trip purposes.

The 'User Charges' column in Table 7-10 indicates the welfare change for Public Transport users from the change in fare payments. A positive user charge value is expected for all trip purposes as a result of the Pearse Alignment. The greatest benefit is expected for educational trips, which see benefits of approximately €3,600,000 (2011 prices and values).

Table 7-10: Total monetised user impacts by trip purpose over a 60-year Appraisal Period (2011 Prices and Values, nearest €100,000).

Trip Purpose	User Time impacts (€)	User Charges (€)
Business	75,000,000	1,200,000
Commuting	93,500,000	1,700,000
Leisure	81,000,000	1,900,000
Education	75,600,000	3,600,000
Retired	2,600,000	0

Table 7-11 shows the total monetised public transport user impacts accrued across the 60-year appraisal period disaggregated by time period. All four time periods are expected to receive net benefits over the 2030-2089 appraisal period. The AM time period is expected to receive approximately €111,000,000 (2011 prices and values) of benefits – the most of any time period. This is approximately €30,000,000 (2011 prices and values) higher than the PM time period, indicating the scheme provides more user time benefits in the morning than the evening.

The 'User Charges' column in Table 7-11 represents the welfare change for Public Transport users from the change in fare payments. A positive user charge value is expected for all time periods as a result of the Pearse Alignment, suggesting Public Transport users spend less on Public Transport fares than previous. The greatest benefit is expected for PM trips, with benefits of over €3,000,000 (2011 prices and values).

Table 7-11: Total monetised user impacts by time period over a 60-year Appraisal Period (2011 Prices and Values, nearest €100,000).

Time Period	User Time impacts (€)	User Charges (€)
AM	111,000,000	1,300,000
LT	102,200,000	2,500,000
SR	34,000,000	1,700,000
PM	81,000,000	3,100,000

Table 7-12 shows the change in operator revenue and indirect tax revenue as a result of the proposed scheme, disaggregated by time period. All four time periods are expected to see an increase in operator revenue as a result of the proposed scheme. This is because of an increase in MetroLink patronage for all time periods, with more people willing to use the scheme as a result of the proposed improvements. The greatest increase in operator revenue is experienced in the LT time period, with an increase of approximately €28,000,000 (2011 prices and values) in revenue.

A reduction in indirect tax revenue can be seen for all time periods, with the greatest reduction in the LT time period (over €3,000,000) (2011 prices and values). Over the 60-year appraisal period, a total reduction of approximately €6,500,000 (2011 prices and values) is expected. Indirect tax revenues are expected to fall as a result of the proposed scheme due to the increase in public transport patronage. Increased public transport usage is causes a re-allocation of personal expenditure towards public transport. As consumers spend a greater proportion of their income on public transport (which is not taxable) and less on alternative, taxable, consumption, indirect tax revenue falls.

Table 7-12: Total monetised provider impacts and changes in indirect tax revenues by time period over a 60-year Appraisal Period (2011 Prices and Values, nearest €100,000).

Time Period	Operator Revenue (PT fares) (€)	Indirect Taxes (€)
AM	10,100,000	-1,400,000
LT	28,000,000	-3,400,000
SR	4,900,000	-500,000
PM	6,700,000	-100,000

7.3.3 Highways

Economic appraisal of the Pearse alignment was undertaken in line with the standard approach. This indicated the potential for the scheme to have dis-benefits for road users from 2045 onwards. This does not align with the observed relationship between public transport and highway benefits, seen in the Charlemont alignment analysis, where highway benefits are approximately 18% of the public transport benefits) nor indeed in the 2030 results for the Pearse option.

As previously noted, given the smaller scale of the scheme impact on highway users, results from the highways appraisal are more likely to be impacted by issues of model noise, and convergence related differences between the Do-minimum and Do-something scenarios. On review, the highway appraisal results for the Pearse alignment were considered to have a high likelihood of overstating the negative impacts of highway users.

To allow a not unduly pessimistic appraisal of the Pearse alignment to be progressed, highway impacts have been assumed to be neutral.

If a relationship between highway and public transport benefits equivalent to that observed in the appraisal of the Charlemont option is assumed, then potential highway benefits could be in the order of €68m (2011 prices and values).

7.3.4 Summary

Figure 7-12 presents the Public Transport Economic Efficiency of the Transport System (TEE) Tables over a 60-year Appraisal Period (2011 Prices and Values).

For completeness the tables are presented in their standard layout (with the column for highways benefits included). As noted, these have not been included for the Pearse alignment, and so the cells are blank. A discussion about the potential value of highway benefits is included in the Tables below.

Non-business: Commuting	ALL MODES		Highways	Public Transport
User benefits	TOTAL			Passengers
Travel time	€ 93,461		€ -	€ 93,461
Vehicle operating costs	€ -		€ -	€ -
User charges	€ 1,745		€ -	€ 1,745
During Construction & Maintenance	€ -		€ -	€ -
NET NON-BUSINESS BENEFITS: COMMUTING	€ 95,206	*(1a)*	€ -	€ 95,206

Non-business: Other	ALL MODES		Highways	Public Transport
User benefits	TOTAL			Passengers
Travel time	€ 159,153		€ -	€ 159,153
Vehicle operating costs	€ -		€ -	€ -
User charges	€ 5,550		€ -	€ 5,550
During Construction & Maintenance	€ -		€ -	€ -
NET NON-BUSINESS BENEFITS: OTHER	€ 164,703	*(1b)*	€ -	€ 164,703

Business			Highways		Public Transport
User benefits			Road Personal	Road Freight	Passengers
Travel time	€ 75,010		€ -	€ -	€ 75,010
Vehicle operating costs	€ -		€ -	€ -	€ -
User charges	€ 1,226		€ -	€ -	€ 1,226
During Construction & Maintenance	€ -		€ -	€ -	€ -
Subtotal	€ 76,236	*(2)*	€ -	€ -	€ 76,236
Private sector provider impacts					
Revenue	€ 44,469				€ 44,469
Operating costs	€ -				
Investment costs	€ -				
Grant/subsidy	€ -				
Subtotal	€ 44,469	*(3)*	€ -		€ 44,469
Other business impacts					
Developer contributions		*(4)*			
NET BUSINESS IMPACT	€ 120,705	*(5) = (2) + (3) + (4)*	€ -	€ -	€ 120,705

TOTAL		
Present Value of Transport Economic Efficiency Benefits (TEE)	€ 380,614	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2011 prices and values

Figure 7-12: Public Transport TEE Tables (2011 Prices and Values €1000's).

Figure 7-13 shows the Public Transport Public Accounts (PA) Tables over a 60-year Appraisal Period (2011 Prices and Values).

	ALL MODES		Highways	Public Transport
Local Government Funding	**TOTAL**		**INFRASTRUCTURE**	
Revenue				
Operating Costs				
Investment Costs				
Developer and Other Contributions				
Grant/Subsidy Payments				
NET IMPACT	€ -	(7)		
Central Government Funding: Transport				
Revenue	-€ 4,941		€ -	-€ 4,941
Operating costs	€ 105,462			€ 105,462
Investment Costs	€ 2,864,641			€ 2,864,641
Developer and Other Contributions	€ -			
Grant/Subsidy Payments	€ -			
NET IMPACT	€ 2,965,162	(8)		
Central Government Funding: Non-Transport				
Indirect Tax Revenues	€ 6,311	(9)	€ -	€ 6,311
TOTALS				
Broad Transport Budget	€ 2,965,162	(10) = (7) + (8)		
Wider Public Finances	€ 6,311	(11) = (9)		

Notes: Costs appear as positive numbers, w hile revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2011 prices and values.

Figure 7-13: Public Transport PA Tables (2011 Prices and Values €1000's).

Figure 7-14 shows the Public Transport Analysis of Monetised Costs and Benefits (AMCB) Table over a 60-year Appraisal Period (2011 Prices and Values).

It should be noted that no accident valuation has been undertaken as part of this appraisal. However, the impact is expected to be small in comparison to overall scheme benefits and of similar value across schemes.

Analysis of Monetised Costs and Benefits

Accidents	€ -	*(17)*
Economic Efficiency: Consumer Users (Commuting)	€ 95,206	*(1a)*
Economic Efficiency: Consumer Users (Other)	€ 164,703	*(1b)*
Economic Efficiency: Business Users and Providers	€ 120,705	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	-€ 6,311	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	€ 374,303	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	€ 2,965,162	*(10)*
Present Value of Costs (see notes) (PVC)	€ 2,965,162	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	-€ 2,590,859	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	0.13	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Figure 7-14: Public Transport AMCB Table (2011 Prices and Values €1000's).

Without inclusion of the modelled highway impacts the BCR for the scheme is 0.13. This represents a return of €0.13 for every €1 spent for direct transport users. Without consideration of other wider benefits which may be associated with the scheme, or the benefits for Highways users, the Pearse alignment provides poor value for money.

Furthermore, we can consider the relative impacts of the highway element of the scheme using a benchmarking approach based on the outcome from the Charlemont Alignment. There is significant uncertainty with this, as the schemes have different functional forms, however even in a “high highway benefit” test, the Pearse scheme still provides low value for money.

In the Charlemont Alignment appraisal, highways benefits were 18% of public transport benefits. If a similar ratio of benefits was applied to the public transport appraisal of the Pearse Alignment, the highways benefits could be assumed at €68m (2011 prices and values). This would a equate to a potential BCR of 0.15

If the ratio of user benefits experienced by highways users in the Pearse alignment is assumed to be twice as large as those received in the Charlemont Alignment, the total highways benefits can be assumed as €137m (2011 prices and values). This would equate to a BCR of 0.17 Even in this high benefit scenario the BCR is below that achieved for the Charlemont.

This indicates that, even if the benefits for highways users generated by the Pearse Alignment were substantially higher than those generated by the Charlemont Alignment (which is not expected), then the additional highways user benefits are still small in magnitude relative to the public transport benefits and would not be expected to change any route option selection decision.

8. Summary

Following a demand-led approach, this study has reviewed the demand, economic, technical and environmental feasibility of two alternative Metro alignments which are considered broadly representative of the range of potential Metro options for serving the transport corridor from Central Dublin to Sandyford via (UCD).

Technical and environmental issues were reviewed at a high level, sufficient to provide initial confirmation of the expected feasibility around a number of key technical and environmental factors (including tunnel portal location, track alignment, feasibility of spoil removal from the portal site, avoidance of impacts on scheduled national monuments) and to support development of a scheme cost estimates.

Other more detailed aspects, for example disruption during construction, and potential land ownership constraints around the proposed station locations, have not been reviewed, but are considered resolvable during design development.

The demand subsequently assessed through use of the NTA's Regional Modelling System and, the results of which were taken forward to complete an assessment of the overall Transport User Benefits and calculate a benefit cost ratio (BCR) for each option. This was undertaken in line with the relevant guidance, and, as with the MetroLink scheme proposals was undertaken using a 60-year appraisal period.

The analysis of the benefits and costs of the proposals show that both have a benefit cost ratio (BCR) of below 1.0. This provides an initial indication that a Metro option is unlikely to be a cost effective approach to enhancing public transport in this area of Dublin.

Although both options can be seen to offer a poor value of money in appraisal terms, there are significant differences between them, with the Charlemont alignment offering better performance on multiple metrics, including higher user benefits, reduced cost, higher increase in public transport mode share and increased reductions in car trips.

With both options sharing a single alignment from UCD southwards, a key differentiator between the Charlemont and Pearse options is seen to be the quality of their connection to Dublin City Centre, rather than towards Sandyford and the south.

Review of the demand modelling results highlights a number of challenges around successfully serving travel demand to the UCD campus which may underpin the relatively low level of usage achieved by these options, these include the relatively wide distribution of the residential locations of the student population of UCD, the journey times for longer distance Metro/Luas trips and the presence of existing longer-distance, limited-stop, bus services.

Looking beyond these UCD specific challenges, it should also be noted that, population and employment densities within the corridor remain for the most part relatively low and the corridor is already served by a range of existing public transport services.

It is considered possible on this basis, that rather than the current longer distance proposals, focussing more specifically on connections between UCD and the City Centre may be a more appropriate approach for this corridor, and that the demand levels in this portion of the corridor may be sufficient to support Metro style proposals of a more modest character, such as a Luas spur connecting UCD to the Green Line (either standalone or as a variation on the Metro South proposals).