

Draft Transport Strategy for the Greater Dublin Area

Transport Modelling Report

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1 Introduction

1.1 Background

Under section 12 of the Dublin Transport Authority Act 2008, the NTA has prepared a Draft Transport Strategy for the Greater Dublin Area (GDA), the boundary of which is shown in Figure 1-1. A key element of assessment carried out for the strategy was the transport modelling which was undertaken using the NTA Eastern Regional Model (ERM).

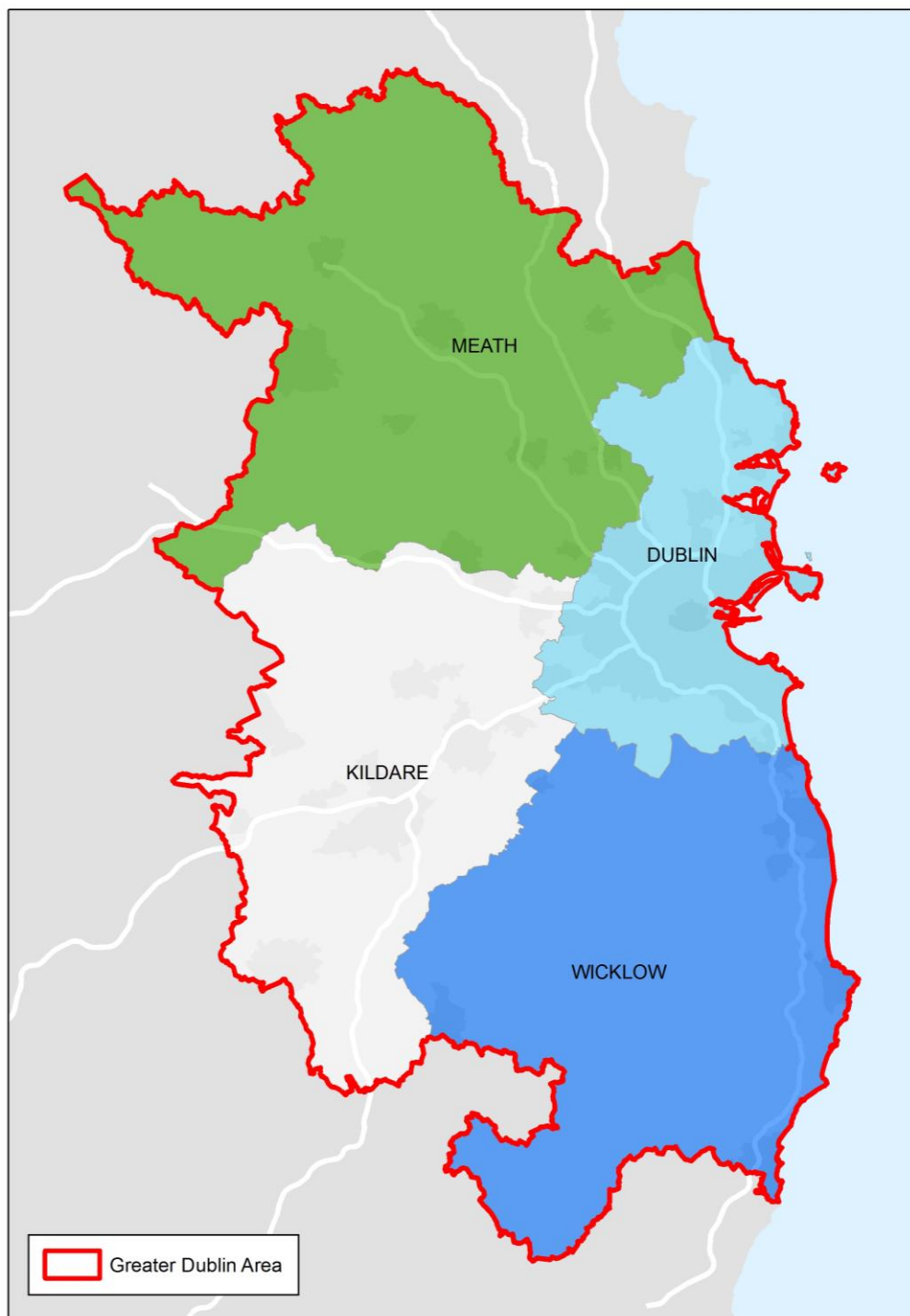


Figure 1-1: Greater Dublin Area Boundary

1.2 Purpose of Report and Report Structure

1.2.1 Purpose of Report

The purpose of this report is to detail the transport modelling process undertaken to support the development of the proposed GDA Transport Strategy 2015 – 2035 and to undertake the assessment of the GDA Strategy transport proposals, highlighting their impacts on travel patterns and mode share throughout the GDA.

1.2.2 Report Structure

This report is structured as follows:

- Chapter 2 describes the NTA Regional Modelling System, outlining its scope, extent, components, functionality and its suitability for use in developing the GDA Transport Strategy 2015 – 2035.
- Chapter 3 outlines the methodology applied in developing the demographic and economic forecasts and how they were applied in the NTA Regional Modelling System.
- Chapter 4 describes the different transport proposals that are included for assessment in the GDA Strategy.
- Chapter 5 assesses the proposed GDA Strategy against a 'Do Minimum' baseline, to determine the impacts associated with the GDA Strategy.
- Chapter 6 concludes the report.

2 NTA Regional Modelling System

2.1 Introduction

This section describes the NTA Regional Modelling System, outlining its scope, extent, components, functionality and its suitability for use in developing the GDA Transport Strategy. The national remit of the NTA requires a system of regional models to help it deliver on its planning and appraisal needs. The NTA Regional Modelling System comprises five regional transport models covering the Republic of Ireland and centred on the five main cities of Dublin, Cork, Galway, Limerick, and Waterford and are summarised in Table 2-1 below.

Table 2-1: Regional Modelling System

Regional Modelling System	Abbreviation
Eastern Regional Model	ERM
South East Regional Model	SERM
South West Regional Model	SWRM
Mid-West Regional Model	MWRM
Western Regional Model	WRM

Each regional model has the following key attributes:

- Full geographic coverage of the relevant region;
- A detailed representation of the road network, particularly the impact of congestion on on-street public transport services and include modelling of residents' car trips by time period from origin to destination;
- A detailed representation of the public transport network & services, and can predict demand on the different public transport services within the regions;
- A representation of all major transport modes including active modes (walking and cycling) and includes accurate mode-choice modelling of residents;
- A detailed representation of travel demand, e.g. by journey purpose, car ownership/availability, mode of travel, person types, user classes & socio-economic classes, and representation of four time periods (AM, Inter-Peak, PM and Off-Peak); and
- A prediction of changes in trip destination in response to changing traffic conditions, transport provision and/or policy.

Figure 2-1 illustrates the geographical extents of the Regional Model Areas.

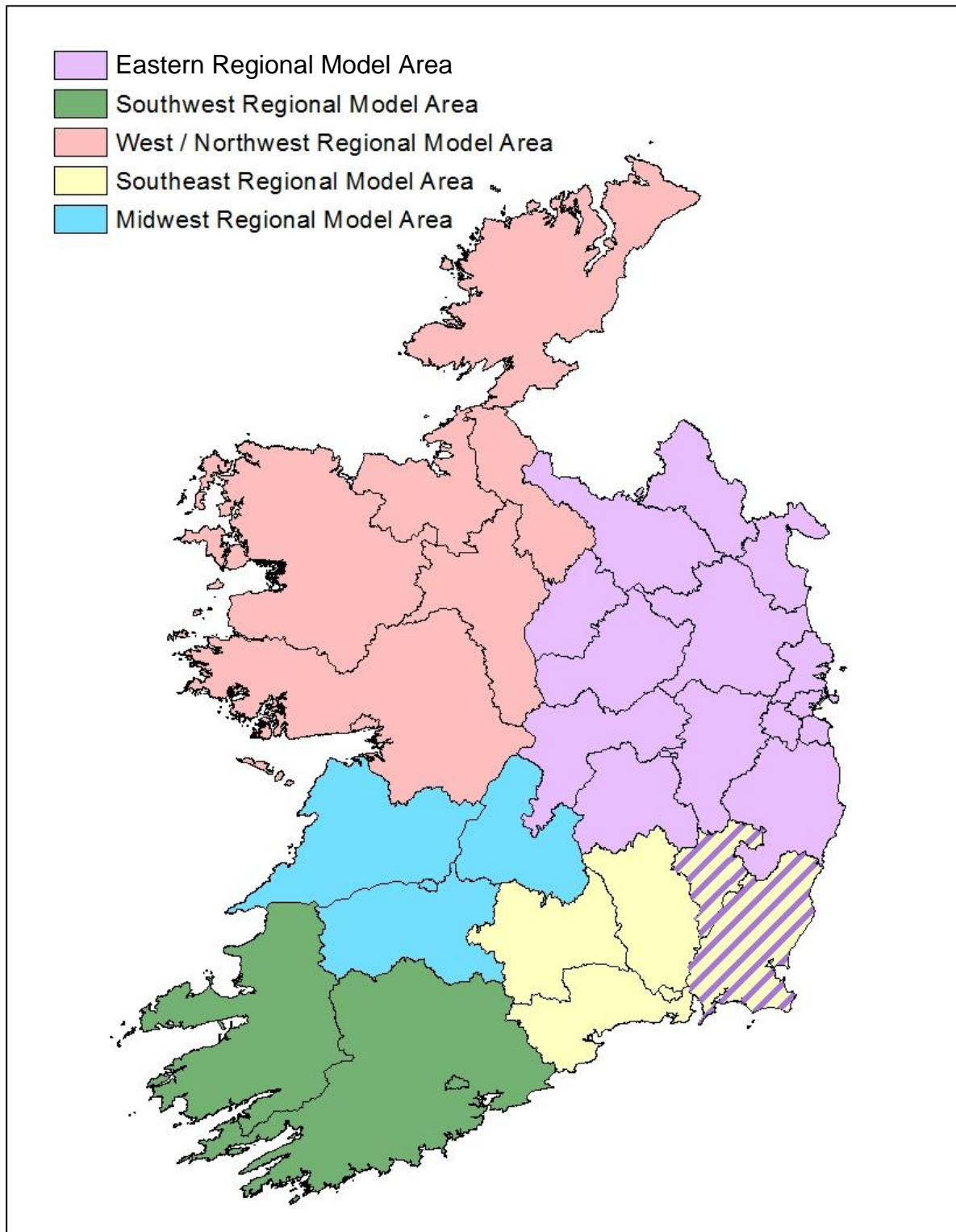


Figure 2-1: Modelling System Regional Model Areas

The Eastern Regional Model (ERM) has been used to support the development of the GDA Transport Strategy.

2.2 Regional Modelling System Dimensions

The regional modelling system features or dimensions are defined in terms of:

- Zone system.
- Modes of travel represented;
- Base year;
- Time-periods; and
- Demand segmentation;

2.2.1 Zone System

The zone system definitions for each of the regional models were based on Census Small Area (CSA) boundaries and Electoral Districts (EDs). The 2011 CSAs are the core base layer for each zoning system. CSAs are the smallest geographic unit of data available with which to define the model zone system. Each CSA is a defined geographic area associated with demographic data (e.g. population, age distribution, employment status), and the work / school travel characteristics of the population (via *Place of Work, School or College - Census of Anonymised Records* (POWSCAR)).

CSAs are subsets of EDs. ED boundaries are commonly used as the unit of geographic information in Ireland and as such it was desirable to maintain a transparent relationship between EDs and the model zone system. Regional Model zones can be smaller or larger than either of these units where required.

The criteria used for developing zone boundaries for the ERM and other regional models included:

- Population, Employment and Education – maximum values were specified for zone population, number of jobs and persons in education;
- Activity Levels – limits were applied to zone activity levels ensuring that zones with either very low, or very high, levels of trips were not created;
- Intra-zonal Trips – threshold values were applied to the proportion of intra-zonal trips, within each zone, to avoid an underestimation of flow, congestion and delay on the network;
- Land Use – zones were created with homogeneous land use and socio-economic characteristics where possible;
- Zone Size/Shape – thresholds were applied to zone size, and irregularity of shape, to avoid issues with inaccurate representation of route choice;
- Political Geography – as mentioned above, it is possible to aggregate all zones to ED level i.e. zone boundaries do not intersect ED boundaries;
- Special Generators/Attractors – large generators/attractors of traffic such as Airports, Hospitals, shopping centres etc. were allocated to separate zones.

Figure 2-2 below shows the ERM Zone System covering the whole of Ireland.

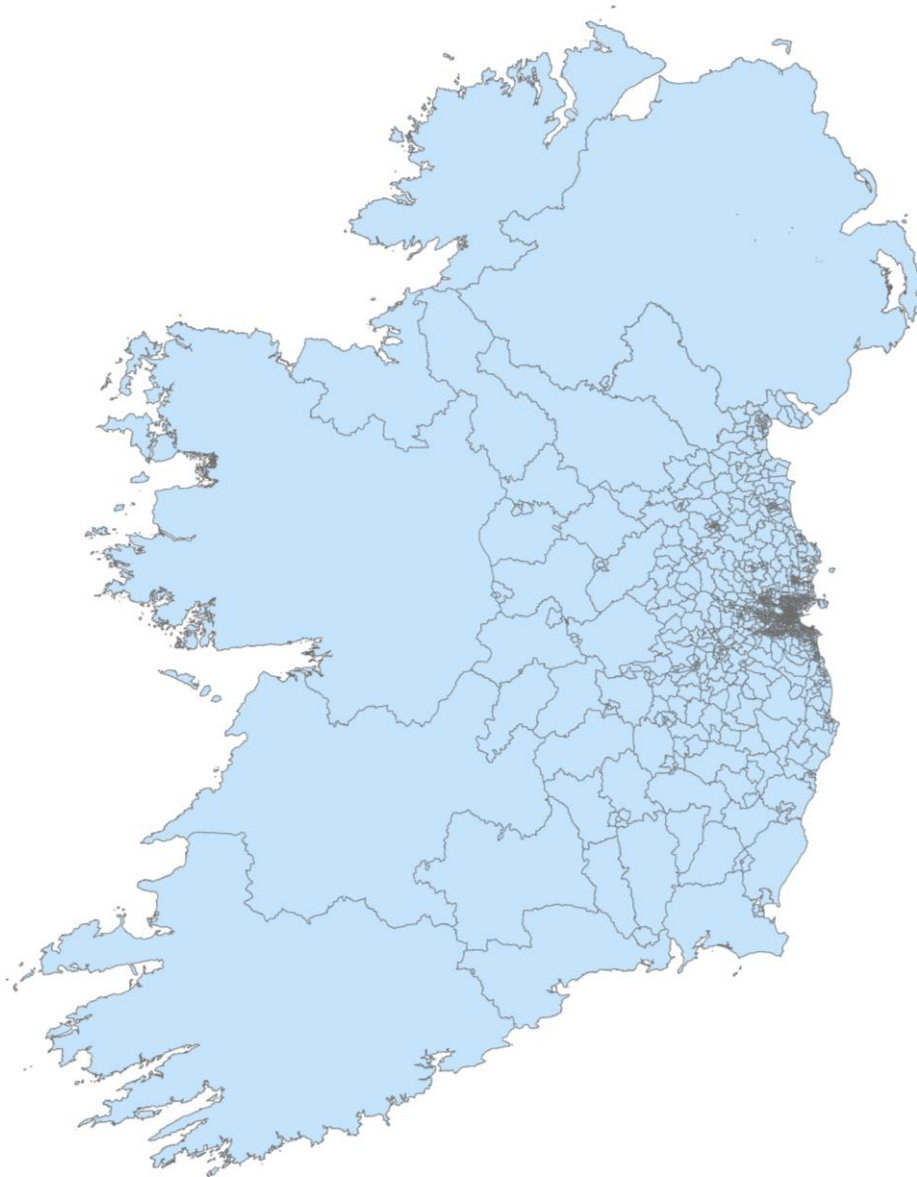


Figure 2-2: ERM Zone System

The key zone system statistics include:

- **Total zones: 1680;**
- Dublin City Council zones: 491;
- Fingal County Council zones: 253;
- South Dublin County Council zones: 221;
- Dún Laoghaire-Rathdown County Council zones: 175;
- Kildare County zones: 142;
- Meath County zones: 138;
- Wicklow County zones: 103;
- Zones external to GDA: 154.
- Special Zones (Dublin Airport, Dublin Port Terminal & Dún Laoghaire Ferry Terminal): 3.

2.2.2 Modes of Travel

The regional model system covers all surface access modes for personal travel and goods vehicles:

- Private vehicles – taxis and cars;
- Public transport – bus, rail, Luas, BRT, Metro;
- Active modes – walking and cycling; and
- Goods vehicles – light goods vehicles and heavy goods vehicles.

2.2.3 Base Year

The base year of each model is 2012 with a nominal month of April. This is largely driven by the date of the Census (POWSCAR) and the National Household Travel Survey (NHTS). It should be noted that the POWSCAR dates to 2011 but the travel patterns are assumed to be broadly the same in 2012.

2.2.4 Time Periods

The model represents an average weekday. The day is split into five time periods considered within each of the regional models, detailed in Table 2-2 below. The periods allow the relative difference in travel cost between time periods to be represented. Representative peak hours are used in the assignment models, which are based on period to peak hour factors derived from survey data for each time period and mode.

Table 2-2: Time Periods

Period	DEMAND MODEL FULL PERIOD	ASSIGNMENT PERIOD
AM Peak	07:00-10:00	Peak hour – based on a Peak Hour factor of 0.393 for cars, 0.393 for active modes and 0.47 for public transport
Morning Inter Peak (IP1)	10:00-13:00	Average hour from full period - based on a Peak Hour factor of 0.33 for cars, 0.33 for active modes and 0.33 for public transport
Afternoon Inter Peak (IP2)	13:00-16:00	Average hour from full period (not assigned)
PM Peak	16:00-19:00	Peak hour - based on a Peak Hour factor of 0.358 for cars, 0.358 for active modes and 0.4 for public transport
Off Peak	19:00-07:00	Free flow assignment

2.3 ERM Structure

2.3.1 Overarching Structure

As mentioned above, the ERM is the model used to support the development of the GDA Transport Strategy. All of the regional models, including the ERM, include 3 core modelling processes (i.e. Demand Model, Road Assignment Model and Public Transport Assignment Model) which receive inputs from the National Demand Forecast Model (NDFM) and provide outputs for transport appraisal and secondary analysis. This process is shown in Figure 2-3 below.

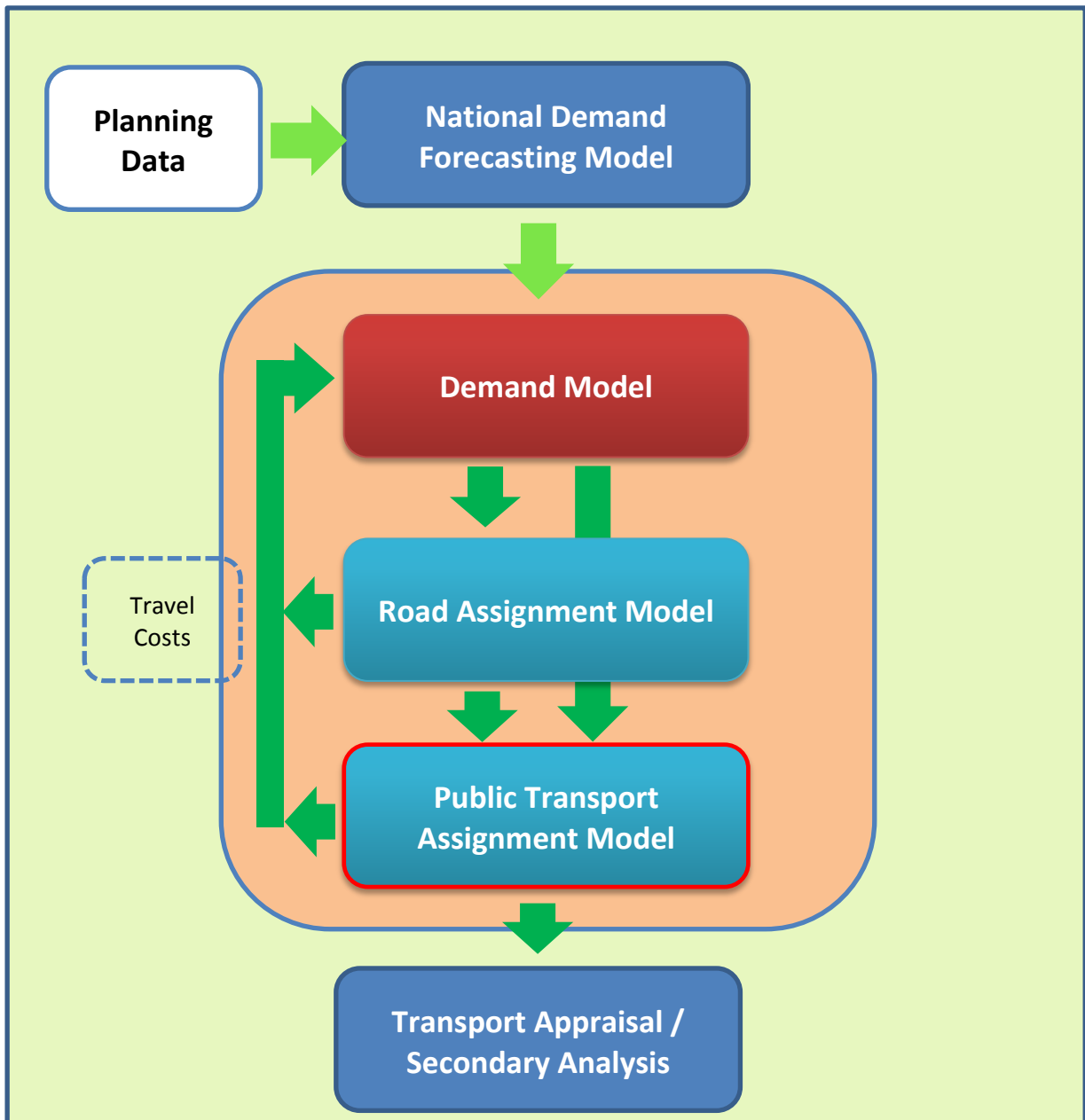


Figure 2-3: Model Structure

2.3.2 Planning Data

The Planning Data referred to above is a national database of 99 demographic and spatial variables for each of the 18,488 CSAs in the state. The main categories of planning data are:

- References and spatial definitions;
- Origin-based person types; e.g. age bands, gender, principal economic status (PES), employment type, and various combinations of categories;
- Destination-based person types; e.g. employment type or education type; and
- Households.

2.3.3 National Demand and Forecasting Model (NDFM)

The **NDFM** is a separate modelling system that estimates the total quantity of travel demand generated by and attracted to every Census Small Area (CSA) on a daily basis. The level of demand from, and to, each zone (referred to as trip ends) is related to characteristics such as population, number of employees and land-use data. The trip ends form a consistent basis for modelling travel demand across Ireland and therefore allow consistent forecasts to be produced across all of the regional models. The NDFM provides forecasts for input to the regional models and into the demand model.

The NDFM comprises the set of models and tools that are used to derive national levels of trip making, for input to each of the regional models. The NDFM outputs levels of trip making at the smallest available spatial aggregation (CSA).

The key components of the NDFM are as follows:

- The **Planning Data Adjustment Tool (PDAT)** controls the planning data inputs to the core NDFM system. It is used to amend planning data to represent the combination of general changes over time and the relevant land-use planning scenarios;
- The **Car Ownership/Car Competition Models** estimate the level of car ownership in a CSA, (sub-dividing the number of households in each CSA between 'No Car', 'Cars < Adults' and 'Cars >= Adults' households) i.e. the car competition bands;
- The **Car Availability Model** classifies the set of individual person trips as either 'Car Available' or 'Car-not-available' using calibrated relationships between the three car competition bands and the trip purpose;
- The **National Trip-End Model (NTEM)** converts the planning data into person trips, using calibrated trip rates; andThe **Regional Modelling System Integration Tool (RMSIT)** estimates the level of trip-making by main mode (car, bus, rail and goods vehicles) between 38 of the main urban settlements in Ireland.

Figure 2-4 shows the system of NDFM models and the key regional model components that the NDFM interacts with.

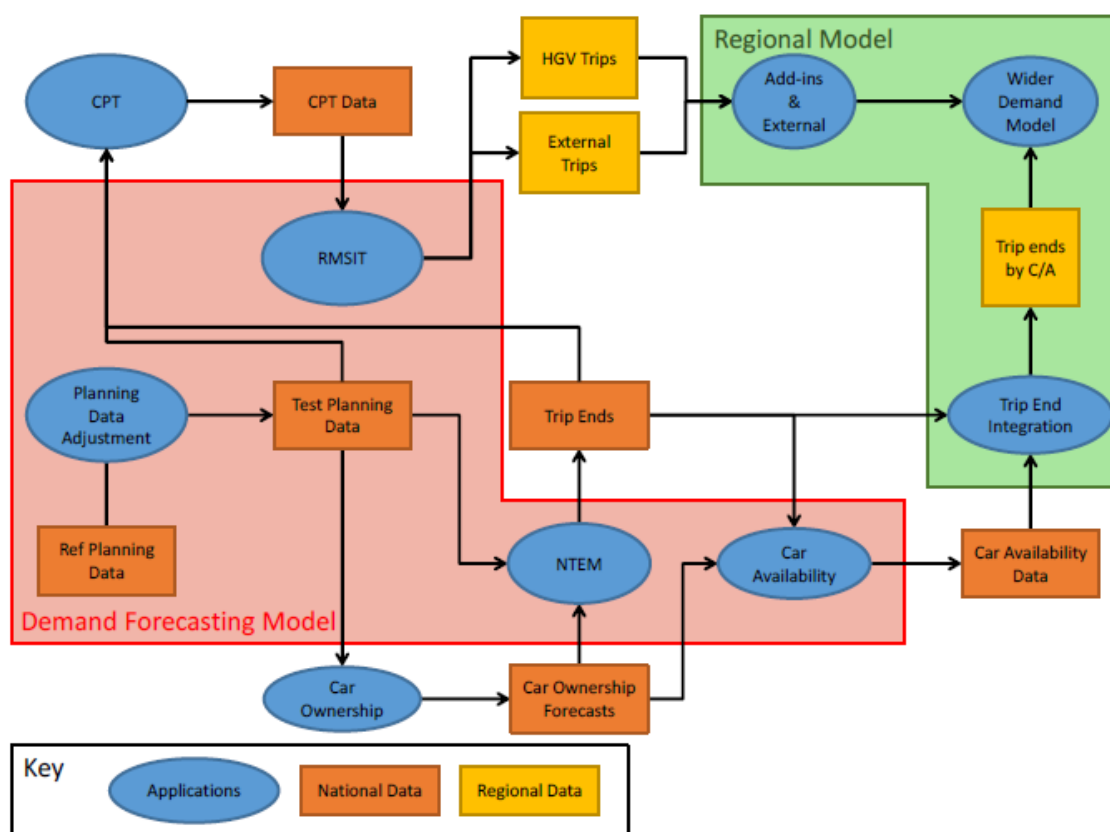


Figure 2-4: NDFM Structure

2.3.4 Demand Segments

Groups of people with similar travel behaviours (for example, commuters who own a car) are represented by distinct demand segments in the regional modelling system. This allows those groups to be treated differently in the regional demand model according to their behaviour.

The NDFM demand segments were derived from the National Household Travel Survey (NHTS) data and *Place of Work, School or College - Census of Anonymised Records* (POWSCAR) data sets. They have been segmenting into 33 distinct classifications as noted below in Table 2-3.

Table 2-3: Demand Segments

No.	Purpose	Car Availability	Third Level of Segmentation
1	Commute	Available	Blue collar
2	Commute	Available	White collar
3	Commute	Not available	Blue collar
4	Commute	Not available	White collar
5	Education	Available	Primary
6	Education	Available	Secondary
7	Education	Available	Tertiary

No.	Purpose	Car Availability	Third Level of Segmentation
8	Education	Not available	Primary
9	Education	Not available	Secondary
10	Education	Not available	Tertiary
11	Escort to education	Available	Primary
12	Escort to education	Available	Secondary
13	Escort to education	Available	Tertiary
14	Escort to education	Not available	Primary
15	Escort to education	Not available	Secondary
16	Escort to education	Not available	Tertiary
17	Other	Available	Employed
18	Other	Available	Non-working
19	Other	Not available	Employed
20	Other	Not available	Non-working
21	Shopping - food	Available	Employed
22	Shopping - food	Available	Non-working
23	Shopping - food	Not available	All
24	Visit friends / relatives	Available	Employed
25	Visit friends / relatives	Available	Non-working
26	Visit friends / relatives	Not available	All
27	Employers Business	All	All
28	All	Available	Retired
29	All	Not Available	Retired
30	One-way business	Available	All
31	One-way business	Not available	All
32	One-way other	Available	All
33	One-way other	Not available	All

2.3.5 Tours

Tours are an important aspect of how Trip Ends are modelled. The main concept is that every person is expected to make a distinct series of trips beginning from their house and ultimately returning home (signalling the end of a tour). The five distinct trip types which may comprise a tour are shown graphically below in Figure 2-5 and include:

- Simple From Home;
- Simple To Home;
- One-way From Home;
- One-way To Home; and

- Non-Home-Based (NHB) trips.

All tours are defined relative to a home or a destination. This corresponds to the concept of productions and attractions where productions are associated with homes and attractions are associated with destinations. The terms productions and attractions are not used when discussing one-way or NHB trips. These are dependent on direction, are not defined to return to a home or a particular attraction, and therefore in these cases the labels origin and destination are used referring to the start and finish location of such trips.

It is worth noting that trip chains (a tour comprising more than two trips) are modelled as multiple single trips. These consist of an outbound (one way From Home) and an inbound (one-way To Home) as well as any number of intermediate NHB trips. An example of this is shown in Figure 2-5.

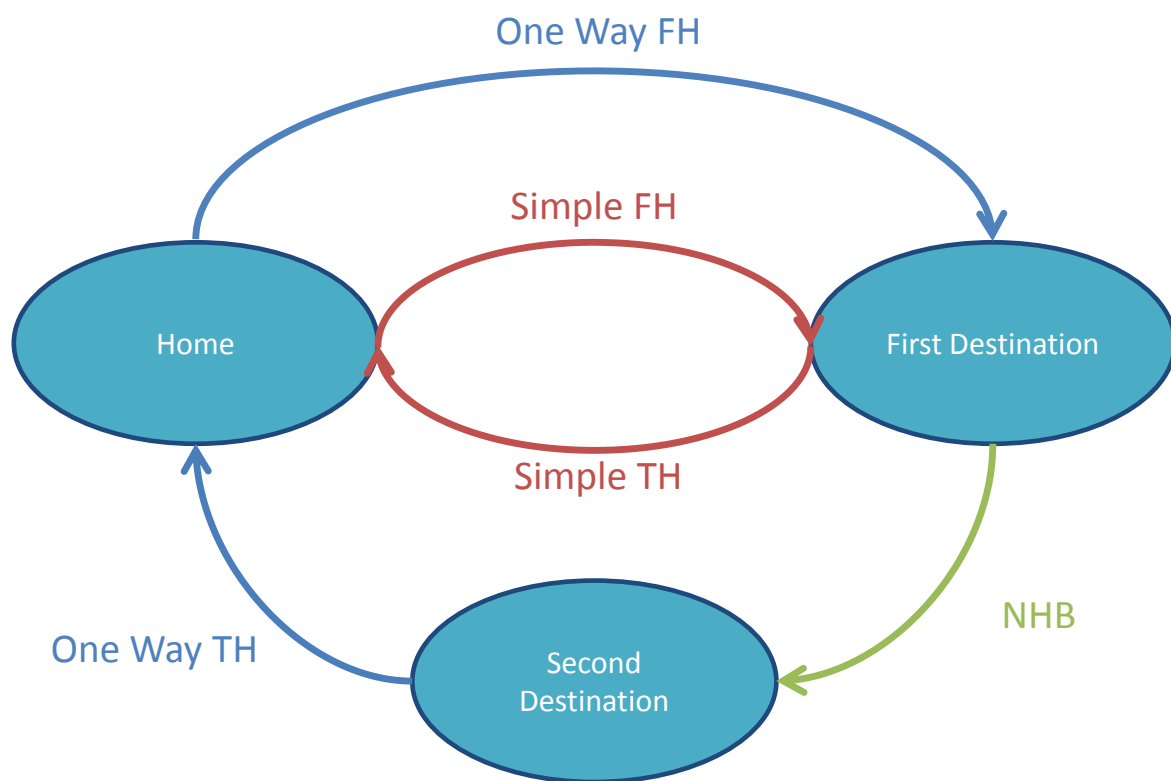


Figure 2-5 Trip Chains

Figure 2-6 shows the most basic relation of origins and destinations with respect to directional trips, comparable to simple tours.

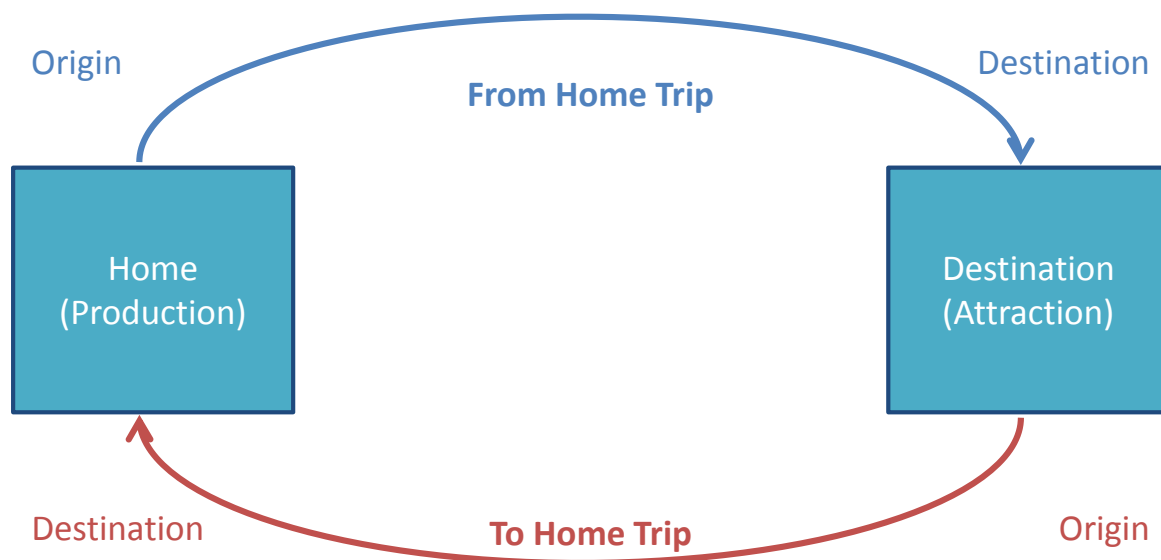


Figure 2-6 PA V OD for Simple Tours

Figure 2-7 below shows the same relationship for trip chains, where it is particularly noted that both ends of a non-home-based tour correspond to attractions.

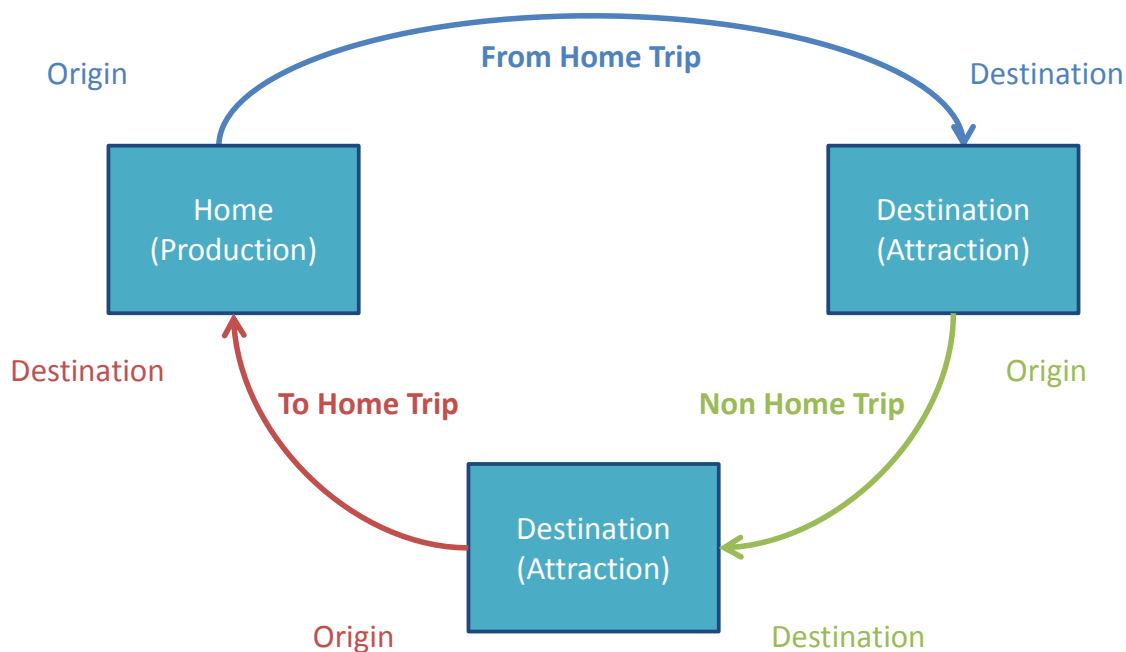


Figure 2-7 PA V OD for Extended Tours

Tours are considered as movements within or from time period to time period as shown in the Tour Grid below in Table 2-4. The tours under the diagonal for the IP1, IP2 and PM time periods (marked in green) are those which are not considered in any calculations while the off-peak tours (marked in red) are considered only in commute demand segments. Time period demand is derived either by summing the rows (From Home) or the columns (To Home).

Table 2-4: Tour Grid

TP Out\ TP In	AM	IP1	IP2	PM	OP
AM	1	2	3	4	5
IP1	6	7	8	9	10
IP2	11	12	13	14	15
PM	16	17	18	19	20
OP	21	22	23	24	25

2.3.6 ERM Demand Model

The **Demand Model** models travel behaviour and is implemented in Cube Voyager. The demand model processes all-day travel demand from the NDFM through a series of choice models to represent combined mode, time of day, destination and parking decision making. The outputs of the demand model are a set of trip matrices which are assigned to the Road and Public Transport models to determine the route-choice and generalised costs.

The demand model consists of a number of components that interact in a sequential manner between the trip end model and the assignment models. It includes the following distinct components:

- Macro Time of Day;
- Mode Choice;
- Destination Choice;
- Parking; and
- Tours and One-Way.

A simple representation of the model structure is shown in Figure 2-8.

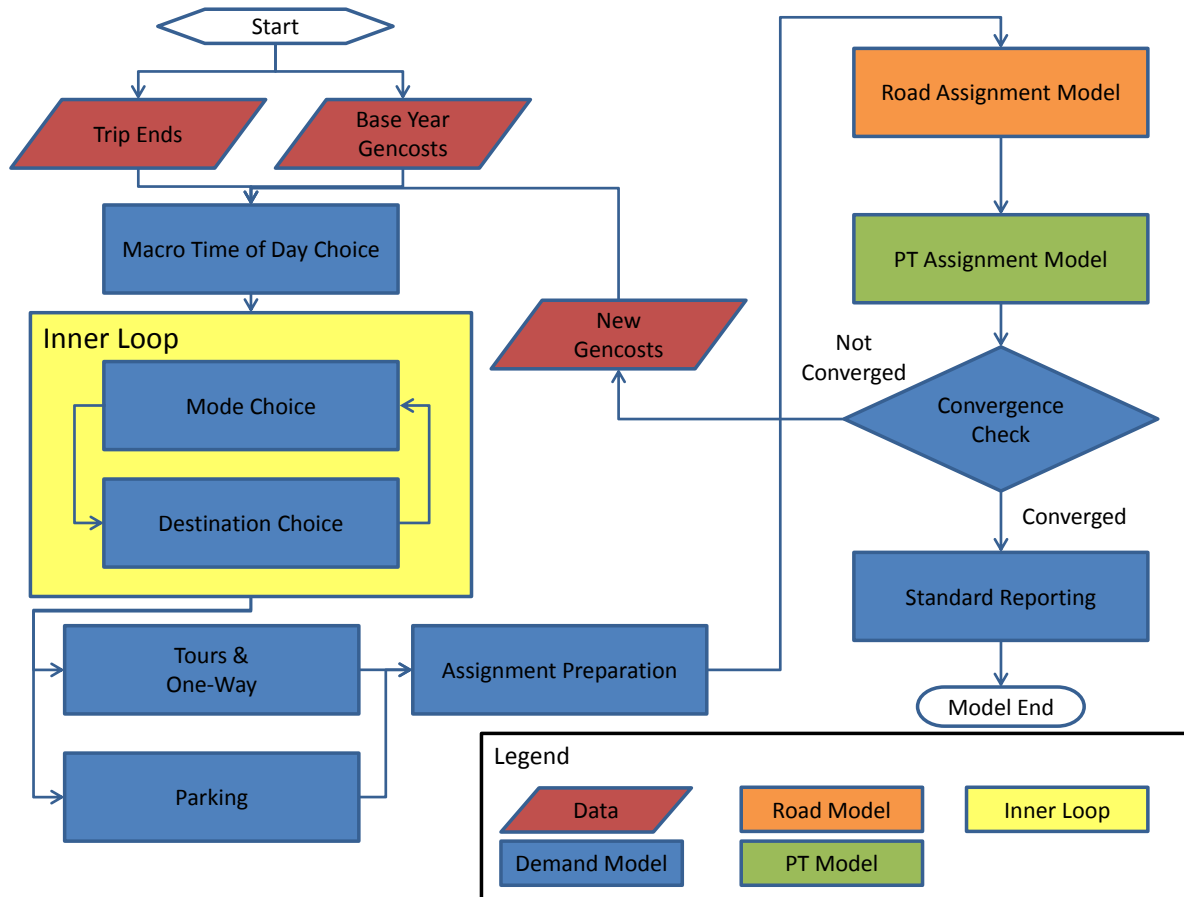


Figure 2-8: Demand Model Structure

2.3.7 ERM Road Assignment Model

The **Road Assignment Model** (RDAM) is implemented in SATURN and includes capacity restraint whereby travel times are recalculated in response to changes in assigned flows. The main purpose of the RDAM is to assign road users to routes between their origin and destination zones. The cost of travel is then calculated by the RDAM for input to the demand model and economic appraisal.

The inputs to the Road Assignment model from the demand model are the road assignment matrices from the assignment preparation stage.

The outputs from the Road Assignment model for the demand model processes consist of generalised costs skims by time period and assigned road networks in CUBE Voyager format which are passed on to the PT model.

In addition to these requirements for demand model processes, there are a series of standard SATURN outputs that are produced for use in the specific interrogation of the road networks for scheme and/or scenario assessment.

2.3.8 ERM Public Transport Assignment Model

In order to generate costs to update the choice model processes, a PT assignment must be undertaken to establish new generalised costs. The **Public Transport Assignment Model** (PTAM) is implemented in Voyager and is used to allocate PT users to services between their origin and

destination zones. The model includes a representation of the public transport network and services for existing and planned modes within the modelled area. The model includes:

- Rail;
- DART;
- Luas;
- Metro.
- Urban Bus;
- Inter-Urban Bus; and
- Bus Rapid Transit (BRT).

The outputs of the PT assignment model fall into two categories, those required by the demand model, and those produced for reporting and analysis purposes.

The outputs from the Public Transport Assignment model for the demand model processes consist of the assigned networks which are passed on to active mode assignment as the starting point for their network build procedure, and generalised cost skim matrices by user class for each of the assigned time periods that feed back into the main Mode and Destination choice demand model loop. An overview of the PT model process is shown below in Figure 2-9.

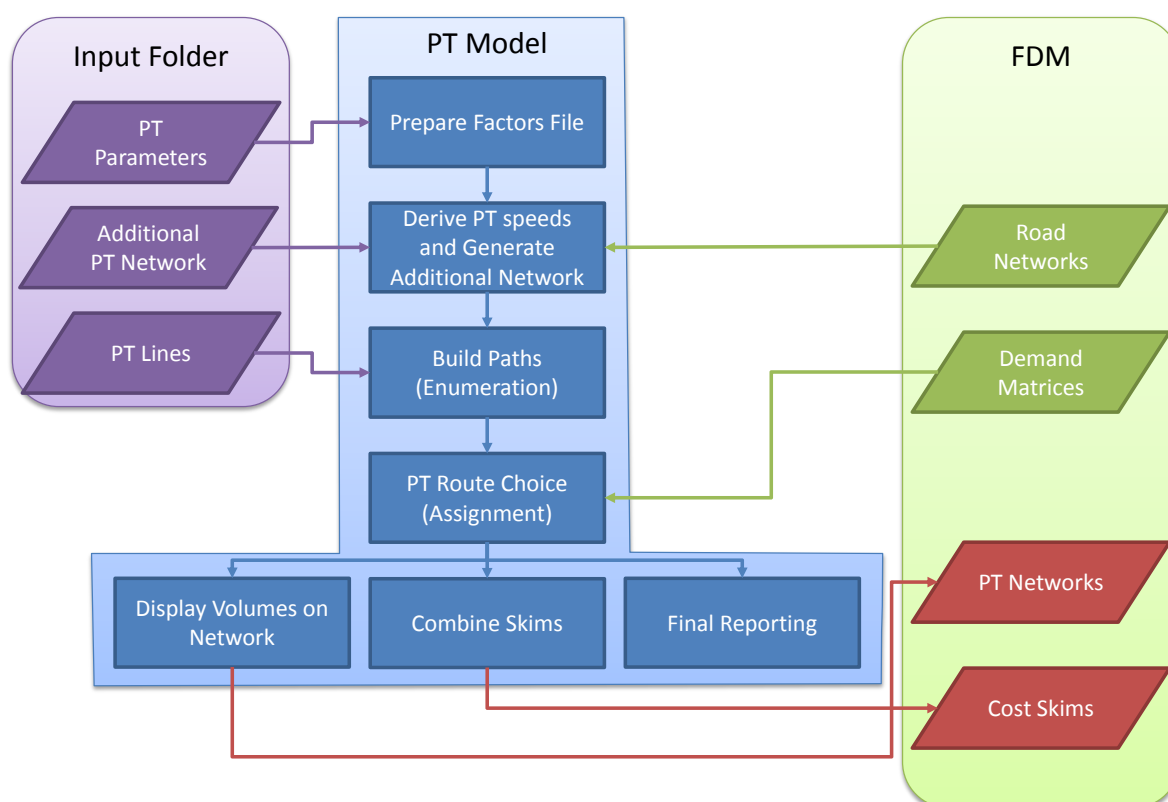


Figure 2-9: PT Model Process

2.3.9 ERM Active Modes Model

The Regional Modelling System represents active modes (i.e. walking and cycling) within the demand model to improve the realism of travel choices. In order to generate costs to update the choice model processes, an **active modes assignment** must take place to establish new generalised costs. This active modes assignment assumes no crowding or delays.

The inputs for the active assignment model are the output CUBE format PT networks, the demand model produced assignment matrices and separate input pedestrian only links and cycle lanes. The outputs of this process include an assigned network with walk and cycle flows by user class, and a set of generalised cost skims. The active assignment is a CUBE-based lowest cost path assignment model with no junction modelling based purely on distance and a constant speed by mode.

Walk speeds are taken as 4.8 kph for all user classes while cycle speeds are set to 12 kph as default except in specified cases as indicated by the cycle data network input. Improvements to cycling mode provision are included through associating improvements to cycling Quality of Service to increases in service user speeds.

2.4 Suitability of Eastern Regional Model in Developing the Strategy

2.4.1 Model Calibration and Validation

It is important that a strategic transport model is appropriately calibrated and validated. The ERM has been subject to a comprehensive calibration and validation process whereby a substantial amount of observed data has been incorporated into both the demand model and the assignment models as presented in Table 2-5.

Table 2-5: Observed data used for model calibration and validation

Demand Model	Assignment Models
Tour proportions	Road traffic volumes
Generalised cost distributions	Road journey times
Travel distance distributions	Road trip length distribution
Modal share	Public transport in-vehicle time factors
Journey time distribution	Public transport fares and ticket types
	Public transport passenger flows
	Public transport boardings and alightings
	Public transport journey times
	Public transport interchange/transfers

The calibration and validation process has demonstrated that the Eastern Regional Model is a suitable tool for the forecasting of transport demand and for the testing of strategic transport infrastructure schemes and appropriate transport policies.

2.4.2 Use of ERM for Strategic Transport Planning

The model has many strengths and features that make it the ideal tool to aid the strategic planning process. The ERM has been developed from first principles making best use of the most recently available data (POWSCAR and NHTS) to replicate travel choices and transport network conditions as accurately as possible.

The model considers a number of distinct journey purposes and characteristics including car availability, employment status, and education level to evaluate travel choices more accurately. This carries through to forecasting whereby specific person type demand can be forecast to derive appropriate trip distributions and future year travel conditions.

The model utilises a tour-based approach which allows for more accurate mode choice modelling and consideration of travel costs, particularly with respect to the inclusion of parking charges.

The model includes four main modes of travel: private car, public transport, walking, and cycling. Each mode has been calibrated individually, for each journey purpose, to replicate observed trip cost distributions.

The use of SATURN software in the road model allows for explicit junction modelling to be included in the model which improves typical network representation in congested areas over a link-based approach. Link speeds and delays are transferred to the public transport model which allows journey times of on-street modes (Bus, BRT) to reflect perceived traffic conditions rather than a strict timetable.

The model covers the GDA region plus surrounding counties, and takes full account of travel within, into and out of the GDA area.

As the model is also used as the basis for scheme evaluation, the transport networks represented contain a level of detail beyond that which would be normally required for its use as a strategic transport planning tool.

To account for the availability of parking facilities in Dublin City Centre, both a free workplace parking model and a parking constraint model have been implemented to re-evaluate mode choice based on whether or not parking was available at the travellers' ultimate destination.

2.4.3 Summary

The Eastern Regional Model provides a comprehensive representation of travel patterns across the Greater Dublin Area and is suitable tool for the testing and appraisal of the Strategy. The limitations of strategic transport models are recognised and fully understood. The ERM is considered the appropriate tool for fulfilling the NTA's requirements in terms of its planning and appraisal needs.

3 Strategy Demographic and Demand Inputs

3.1 Introduction

This section outlines the methodology by which population, employment, education places and retail activity have been distributed within the GDA for the purposes of creating the travel demand inputs into the transport modelling process. This involves the disaggregation of the regional figures for 2035, down to the ERM zone level to provide a picture of the GDA for the strategy horizon year. The primary drivers for transport demand are population and employment, from which education and retail are also derived.

The overall process for developing demographic forecasts at local GDA zone level is as follows:

1. National forecasts for the GDA have been developed based on the Central Statistics Office's (CSO) M2F2 'Traditional' Scenario¹;
2. Data from the Regional Planning Guidelines for the Greater Dublin Area 2010 – 2022 was then used to distribute population and employment into the counties within the GDA;
3. The distribution within each county was undertaken through a process of defining settlements and distributing growth locally within these settlements. This was undertaken by the NTA and the local authorities of the GDA.
4. The final step, undertaken by the NTA and local authorities, was to breakdown the forecasts within each settlement to GDA zone level, based on planning data and advice from local authorities.

All future growth was constrained to CSO forecasts, in order to provide a forecast scenario that is consistent with established national projections.

The demographic and demand data are then input into the PDAT and the NTEM to develop base year and forecast year trip ends. As outlined in Section 2.2.3, the PDAT controls the planning data inputs core to the NDFM system, and is used to amend planning data to represent the combination of general changes over time and the relevant land-use planning scenarios. The NTEM then converts the planning data into person trips.

3.2 Greater Dublin Area Projections

The Greater Dublin Area (GDA) total population for 2035, which is the forecast year for the GDA Strategy, has been derived from the CSO forecast for M2F2 and based on 'Traditional' Scenario' presented in the Regional forecasts. Based on these assumptions the population for the GDA in 2035 is estimated to be 43% of the *state*, as show Table 3-1. It is notable that this will result in 67% of the population growth in this period being located within the GDA.

Table 3-1: National and GDA population for 2011 and 2035.

Population	2011	2035	Growth 2011-2035
State	4,588,252	5,307,520	719,268
GDA	1,804,156	2,286,869	482,713
GDA % of State	39.32%	43.09%	67.11%

¹ Taken from the CSO Regional Population and Labour Force Projections 2016-2046, April 2013. The M2F2 Traditional scenario represents a set of assumptions in relation to migration and fertility which are considered the most probable.

The employment forecasts relate to fixed places of employment to which the population travelled. Using the 2011 POWSCAR data the proportion of fixed employment places was 35% of the population. It was assumed that this proportion remains constant and is used to derive the fixed places of employment for 2035. Table 3-2 shows the employment estimates for the State and the GDA.

Table 3-2: National and GDA employment for 2011 and 2035.

Employment	2011	2035	Growth 2011-2035
State	1,362,742	1,594,282	231,540
GDA	627,877	795,869	167,992
GDA % of State	46.07%	49.92%	72.55%
GDA Empl. as prop of Pop	34.8%	34.8%	34.8%

3.3 Distribution to County Level

3.3.1 Population

The GDA consists of seven local authority areas: Dublin City, South Dublin, Fingal, Dun Laoghaire-Rathdown, Kildare, Meath and Wicklow. The Regional Planning Guidelines for the Greater Dublin Area 2010 - 2022 (RPG) provides guidance on the future growth of population within each of the areas covered by the local authorities. The local authorities, working with these guidelines, have developed “core strategies” which provides strategic direction as to where future housing will be provided within each county. Working with the Local Authorities for the purposes of the transport model, the 2035 GDA population has been distributed in accordance with the RPG. Table 3-3 shows that the proportions of population within each county are planned to remain broadly similar in 2035 when compared to 2011.

Table 3-3: GDA Population within Each Local Authority for 2011 and 2035

Population	Population 2011	% of GDA 2011	Population 2035	% of GDA 2035	Growth 2011 to 2035	% Growth 2011 to 2035
Dublin City	527,612	29%	637,246	28%	109,634	21%
South Dublin	265,205	15%	332,722	15%	67,517	25%
Fingal	273,991	15%	350,036	15%	76,045	28%
Dún Laoghaire-Rathdown	206,261	11%	257,073	11%	50,812	25%
Kildare	210,312	12%	282,408	12%	72,096	34%
Meath	184,135	10%	235,707	10%	51,572	28%
Wicklow	136,640	8%	191,666	8%	55,026	40%
GDA	1,804,156	100%	2,286,858	100%	482,702	27%

3.3.2 Employment

In terms of employment, the RPG provides guidance on the consolidation of development into a planned settlement hierarchy. The future growth in employment follows this hierarchy and keeps a similar proportion of employment in 2035 that existed in 2011 from Local Authority areas;

however, the distribution of future employment is concentrated into the planned settlements within the Local Authority areas. Table 3-4 shows the employment distribution for 2035 by Local Authority area.

Table 3-4: GDA Employment within Each Local Authority for 2011 and 2035

Employment	Jobs 2011	% of GDA 2011	Jobs 2035	% of GDA 2035	Growth 2011 to 2035	% Growth 2011 to 2035
Dublin City	287,788	46%	364,787	46%	76,999	27%
South Dublin	77,699	12%	98,488	12%	20,789	27%
Fingal	79,452	13%	100,710	13%	21,258	27%
Dún Laoghaire-Rathdown	68,626	11%	86,987	11%	18,361	27%
Kildare	52,260	8%	66,242	8%	13,982	27%
Meath	34,478	5%	43,703	5%	9,225	27%
Wicklow	27,574	4%	34,952	4%	7,378	27%
GDA	627,877	100%	795,869	100%	167,992	27%

3.3.3 Education and Retail

For education and retail, the total figures were derived by relating the numbers in education, and the numbers employed in retail to the total population and jobs figures, according to the evidence from the CSO, e.g. 7% of the National Population were of Secondary School going age. Numbers employed in retail is used as an indicator of retail activity rather than floor space, as the various retail formats mean floor space is less useful as an indicator of travel demand than retail employment.

3.4 Distribution within Each County

3.4.1 Settlements

As a means of distributing each demographic variable below the Local Authority level, the NTA defined a number of settlements in the region. Any Hinterland town with a population of over 2,000 people was defined as a settlement, while the Metropolitan Area was split on a more informal geographical basis. An example of the settlements in Dún Laoghaire-Rathdown is shown in Figure 3-1.

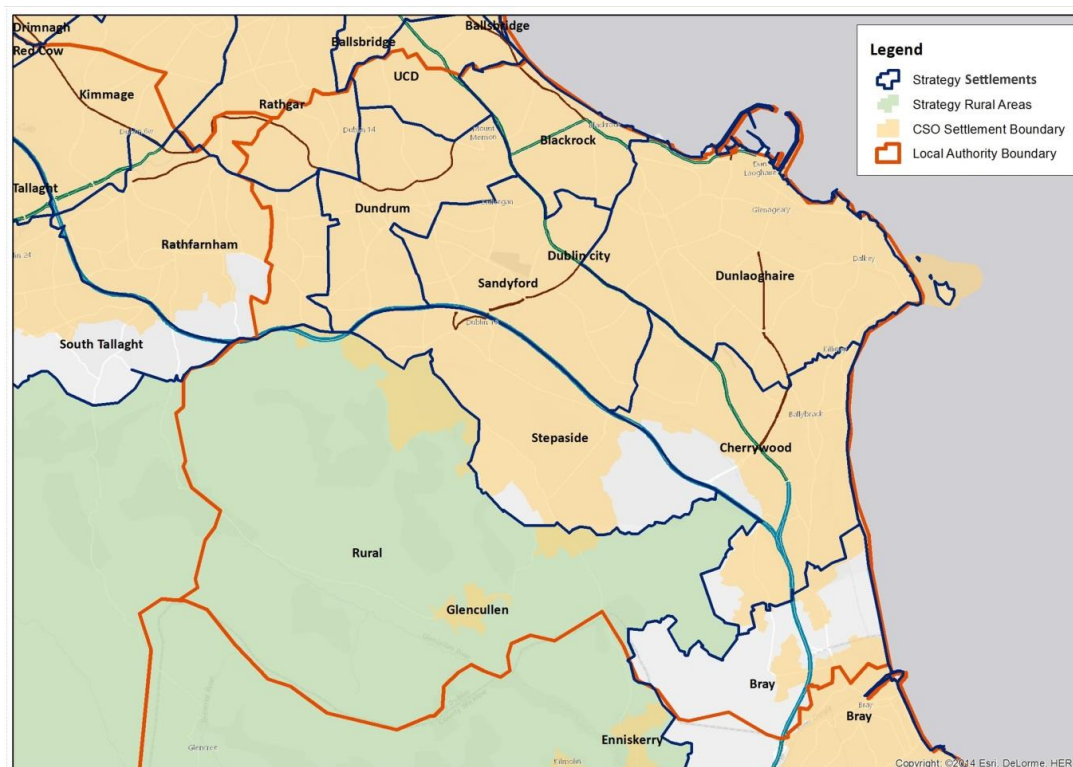


Figure 3-1: Examples of the Settlements from Dún Laoghaire-Rathdown

3.4.2 Population and Employment Breakdown

In order to distribute the total population and employment figures assumed for each county, the local authorities assigned growth to each of the NTA settlements, within their county, on a percentage basis. The total population and employment figures for each settlement are set out in A1.1.1 and A1.1.2, respectively. Retail and education were distributed to settlements based on existing patterns (proportion of population to retail and education in each settlement) and the assigned growth in population.

3.5 Distribution into NTA Model Zones

At this point, the NTA had the distribution of land use at settlement level across the region. The next and final step involved breaking these settlement figures down into NTA model zones. These zones were based on the CSA, and as such represent a very fine level of detail. In collaboration, once again, with the Local Authorities, and on examination of land use zoning patterns across the region, each model zone was allocated a percentage of each settlements population, employment, education and retail on the basis of available planning data and advice from the local authorities.

An example of the worksheets used (in advance of being filled out by Meath County Council) for the settlement of Navan is shown in Figure 3-2. The red line represents the NTA settlement boundary while the black lines show the NTA model zones. A value for each land use was allocated to each of these zones by the Local Authorities.

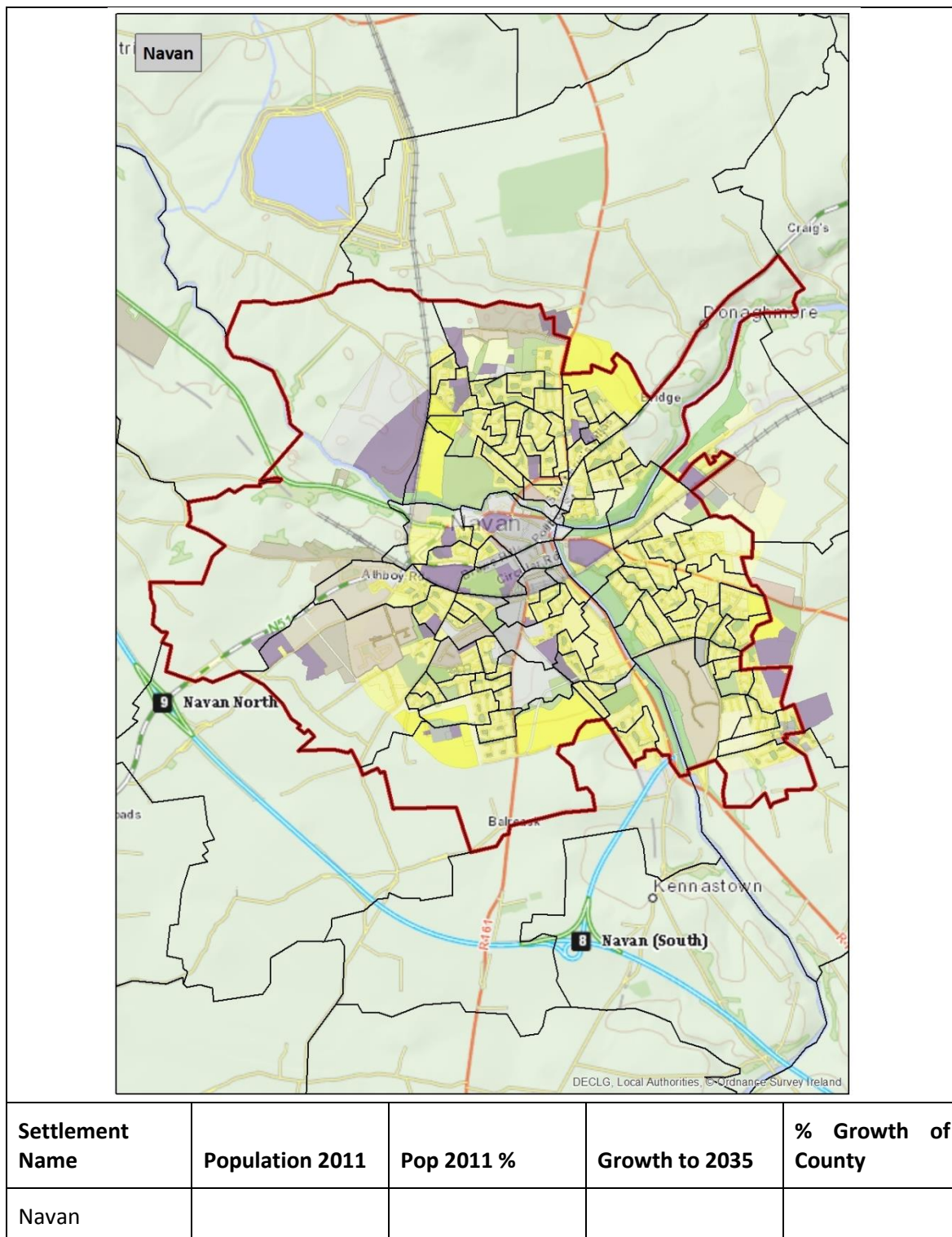


Figure 3-2: Example of Navan Distribution Worksheet

A density map showing the distribution of population and employment into the NTA model zones is provided in Figure 3-3 and Figure 3-4 respectively.

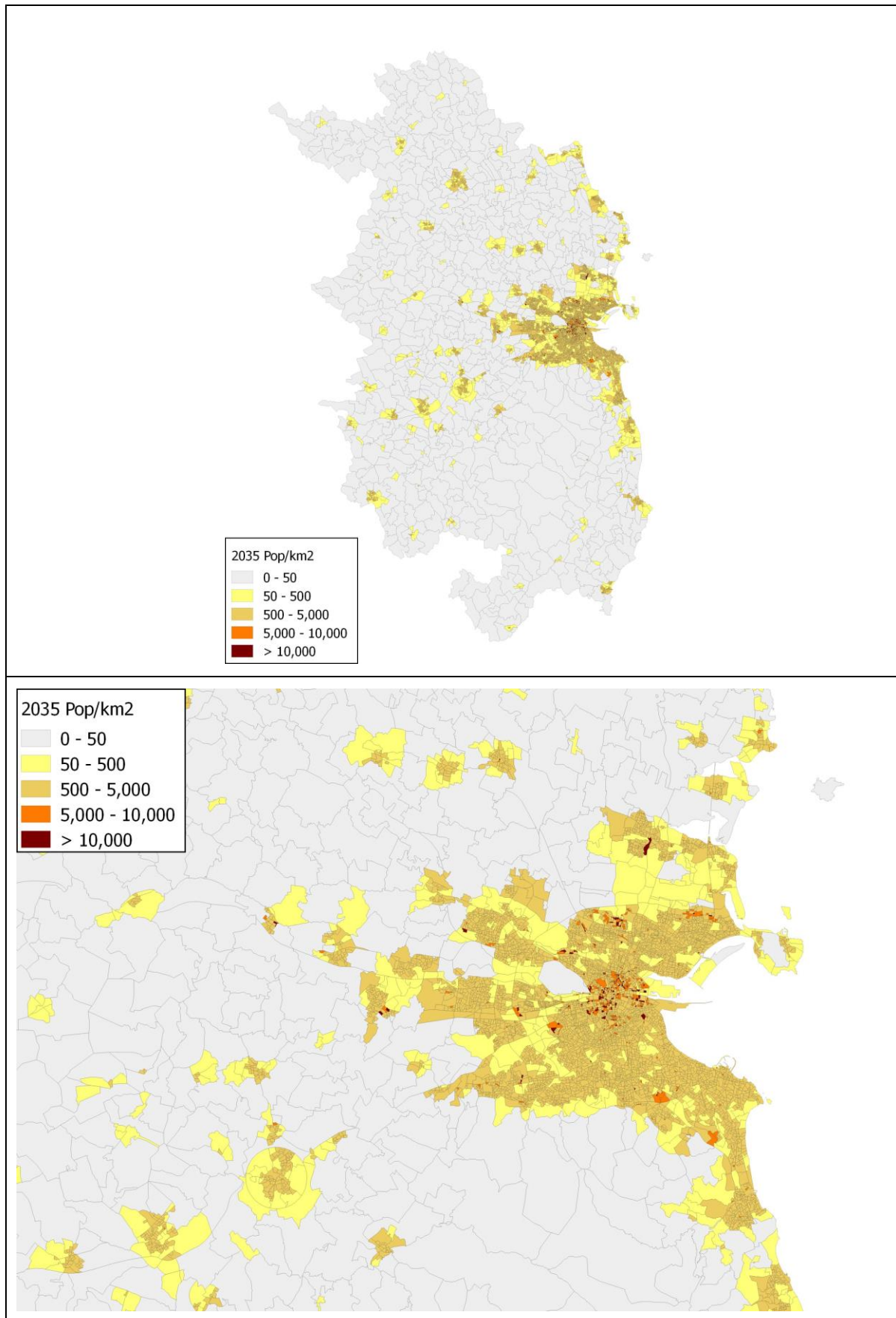


Figure 3-3: 2035 Population Distribution Density Maps

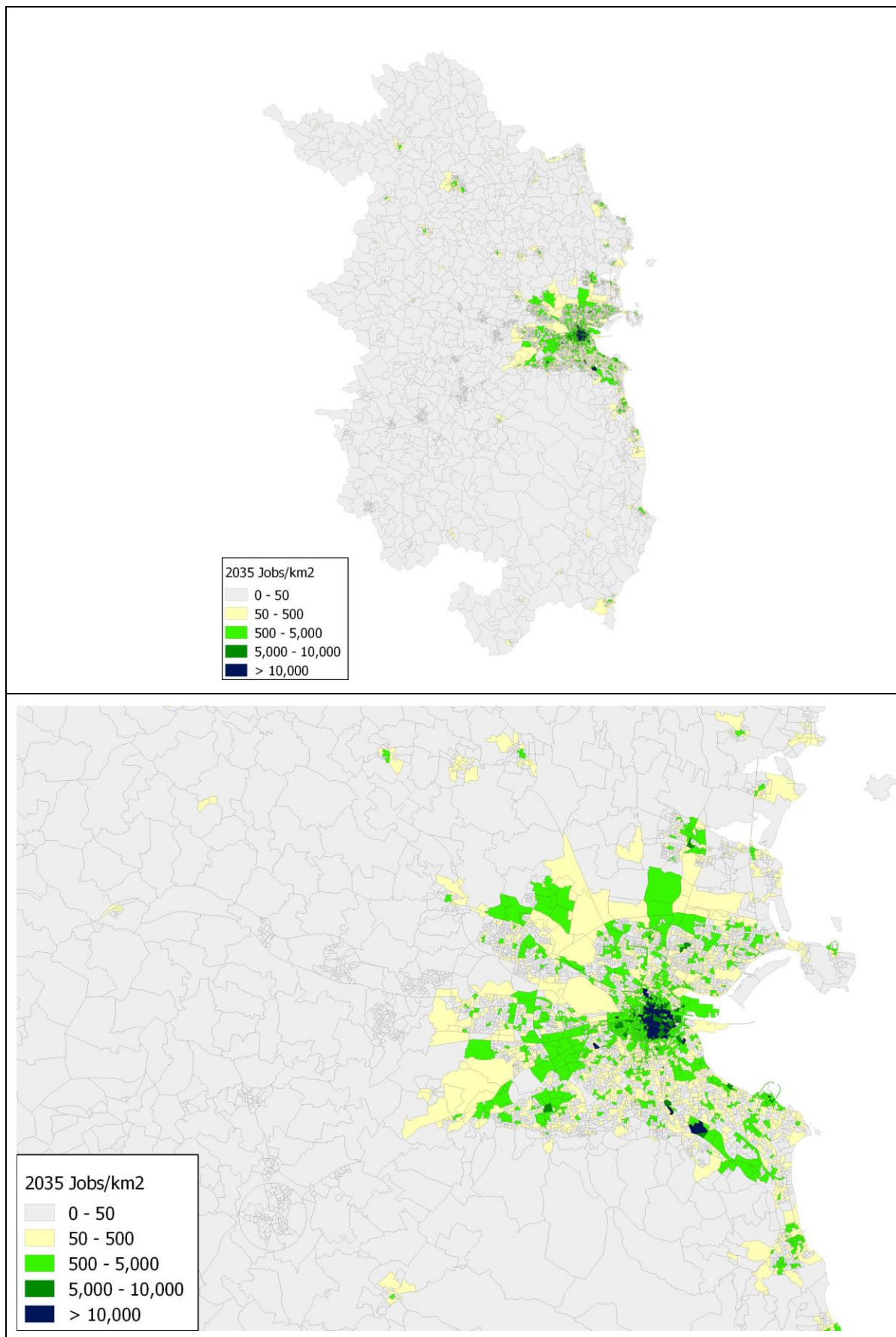


Figure 3-4: 2035 Employment Distribution Density Map

3.6 Creating the Demand Forecast for Use within the Model

Following the allocation of population, employment, education places and retail activity within the GDA for the Strategy horizon year, the National Demand and Forecasting Model (NDFM) was used to predict the future year national trip demand.

The NDFM includes the set of models and tools that are used to derive levels of trip making (nationally) from planning data for input to each of the regional models. The NDFM outputs levels of trip making at the smallest available spatial aggregation (CSA).

Within the NDFM, the Planning Data Adjustment Tool (PDAT) was used to adjust the base year planning input data to reflect the new forecast year. The planning sheet was updated and adjusted based on forecasts for the following 6 planning variables:

- Population;
- Primary School Students;
- Secondary School Students;
- Tertiary Students;
- Retail Employment; and
- Non-Retail Employment.

Adjustments were made at the CSA level within the GDA area and at the NUTS3 (Nomenclature of Territorial Units for Statistics) Regional level outside of the GDA area for the rest of Ireland. Table 3-5 to Table 3-7 outline the overall growth across the various regions with the NUTS3 regions presented in Figure 3-5.

Table 3-5: Population Adjustments

Region	Population		
	2011	2035	%
South-East (IE)	497,578	556,852	12%
Border(IE)	514,891	535,033	4%
Mid-West(IE)	379,327	415,938	10%
South-West (IE)	664,534	744,805	12%
West(IE)	445,356	457,170	3%
Midland(IE)	282,410	310,852	10%
GDA	1,804,156	2,286,858	27%
TOTAL	4,590,263	5,309,544	16%

Table 3-6: Employment Adjustments

	Employment		
	2011	2035	%
South-East (IE)	127,602	139,568	9%
Border(IE)	122,140	132,882	9%
Mid-West(IE)	104,235	112,717	8%
South-West (IE)	195,000	211,020	8%
West(IE)	118,181	128,118	8%
Midland(IE)	67,707	74,107	9%
GDA	627,877	795,869	27%
TOTAL	1,364,753	1,596,317	17%

Table 3-7: Education Adjustments

	Primary Level Students			Secondary Level Students			Tertiary Level Students		
	2011	2035	%	2011	2035	%	2011	2035	%
South-East (IE)	52,631	57,527	9%	34,207	37,205	9%	11,652	12,274	5%
Border(IE)	55,413	60,567	9%	36,304	39,486	9%	12,583	13,255	5%
Mid-West(IE)	38,425	41,999	9%	26,648	28,984	9%	17,131	18,046	5%
South-West (IE)	65,043	71,093	9%	44,751	48,674	9%	25,331	26,684	5%
West(IE)	44,646	48,799	9%	29,285	31,852	9%	16,383	17,258	5%
Midland(IE)	31,219	34,123	9%	19,388	21,088	9%	4,276	4,504	5%
GDA	172,379	217,721	26%	109,925	140,328	28%	81,534	103,344	27%
TOTAL	461,767	533,864	16%	302,519	349,652	16%	170,901	197,401	16%

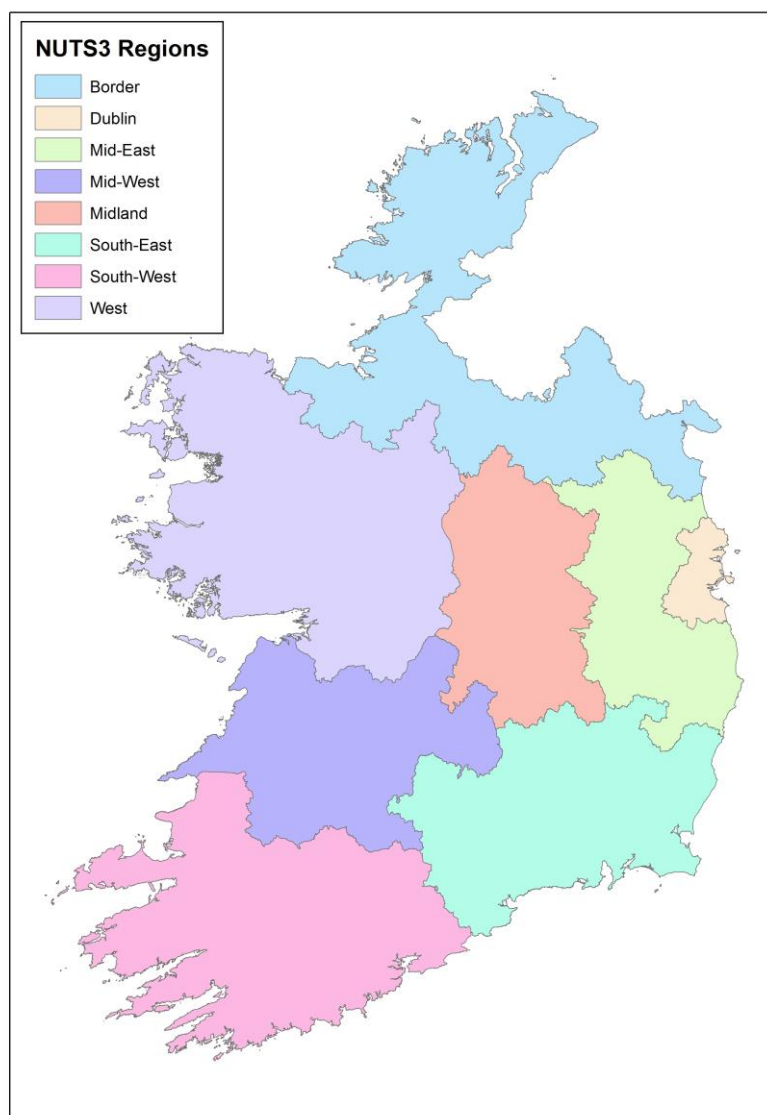


Figure 3-5: NUTS3 Regions

The PDAT allows for the changes that were applied to the above variables to then cascade through all other inter-dependent variables as implicated by the dependency diagram overleaf in Figure 3-6.

The final step before use in the model was to convert the planning data into 24-hour level person trips at the CSA level using the NTEM.

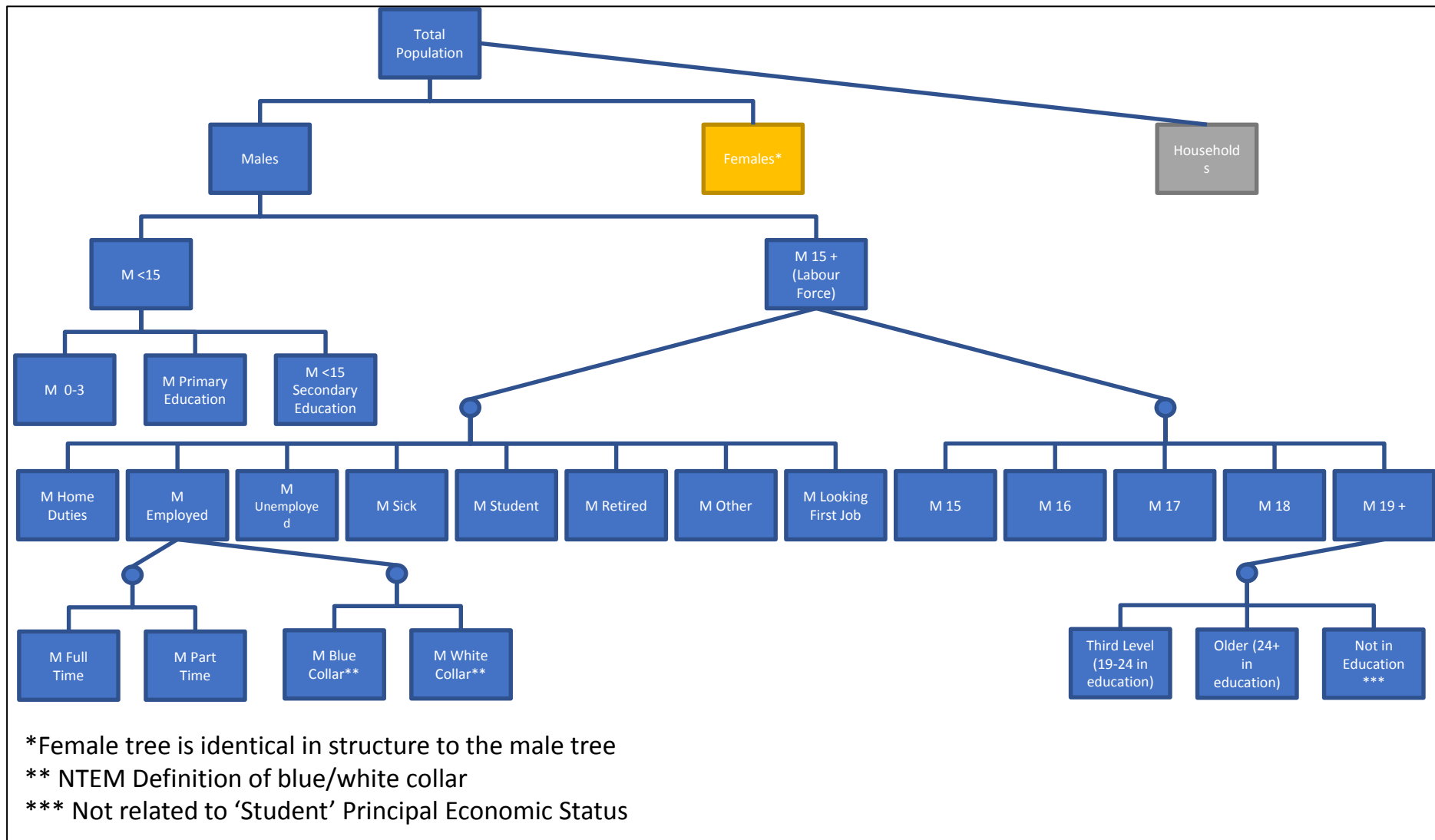


Figure 3-6: PDAT Production Variables Dependency Diagram

4 GDA Transport Strategy Scenarios

4.1 Developing the GDA Strategy Networks

To develop the GDA Transport Strategy proposals, all areas of the GDA were reviewed to identify the appropriate transport options necessary to meet the future demand for travel in these areas. A number of areas were identified which required additional studies. These studies undertook option testing for alternative public transport proposals that could cater for the mobility requirements of each study area and recommendations were made for the preferred public transport option. These studies aimed to provide for all forecast travel growth (for trips over 3km in length) by public transport in an effective, efficient and sustainable manner. The following lists the supporting strategy reports:

- Dublin South West Corridor Study;
- Dublin Inner Orbital Corridor Study;
- Dublin Navan Corridor Study;
- Dublin South East Corridor Study;
- Dublin North West Corridor Study;
- Dublin West Corridor Study;
- Fingal / North Dublin Transport Study;
- Dublin Orbital Movement Strategy;
- Assessment for the Role of Park and Ride in the Greater Dublin Area Transport Strategy;
- Greater Dublin Area Strategy: Transport Demand Management Measures;

4.1.1 Additional Supporting Reports

There are a number of additional studies and reports which have informed the development of the GDA strategy networks which are listed below:

- Dublin City Centre Transport Study;
- Greater Dublin Area Cycle Network Plan;
- NTA Integrated Implementation Plan 2013 – 2018;
- DART Expansion Programme Business Case;
- NTA Core Bus Network Report; and
- Bus Rapid Transit Core Dublin Network Report.

4.2 Description of Do Minimum Scenario

The “Do Minimum” scenario is the infrastructure provision that is set as the baseline against which all of the transport proposals are compared against. In effect the Do Minimum represents the future year situation if the Strategy measures are not implemented and only contains completed and committed schemes. The Do Minimum scenario for the strategy has been coded, using the validated 2012 base year ERM model as a starting point, plus the inclusion of the following schemes:

- Major completed transport schemes delivered 2012-2015;
- Major completed and committed road and traffic management schemes in the GDA;
- Luas Cross City;

- Phoenix Park Tunnel; and
- DART frequency increase on Northern and South Eastern lines.

4.2.1 Major completed transport schemes delivered 2012-2015

The major completed transport schemes delivered in the period from 2012 to 2015 are:

- Lucan Quality Bus Corridor (QBC) Enhancements;
- North Wall Quay Environmental Improvement and Bus Priority Scheme;
- Clanbrassil Patrick St Bride and St QBC;
- Thomas Street / James's Street QBC;
- Custom House Quay Contra Flow Bus Lane;
- Firhouse-Ballycullen QBC; and
- Revised bus services to accommodate Luas Cross City and City Centre traffic management schemes.

4.2.2 Major completed and committed road and traffic management schemes

The major completed and committed transport schemes delivered in the period from 2012 to 2015 are:

- Marlborough Street Bridge;
- Camden Street, Wexford Street and Aungier Street Area Traffic Management;
- N7 Newlands Cross Junction Upgrade;
- Swords Road Phase 1;
- St Stephen's Green Area Traffic Management;
- Lincoln Place, Merrion Street and Westland Row Area Traffic Management;
- Braemor Road Improvement Scheme;
- Sandyford Junctions;
- Holywell Village improvement and associated Distributor Road completion;
- N3 Mulhuddart Interchange Upgrade;
- R132 Swords Road Upgrade: Airport Roundabout to Collinstown Cross; and
- Ratoath Road including Reilly's Bridge.

4.2.3 Luas Cross City

The Luas Cross City is an extension of the existing Luas Green Line beginning at the current Green Line Terminus at St. Stephen's Green, connecting with the Luas Red Line at O'Connell's Street / Abbey Street and continuing to northbound to the DIT Grangegorman Campus, Phibsborough and terminating at the Broombridge Rail Station. Details of the coded service plan data within the model are shown in Table 4-1 below.

4.2.4 Phoenix Park Tunnel

The Phoenix Park Tunnel project involves using the existing tunnel for passenger trains. The Phoenix Park Tunnel is a single bore tunnel with two rail lines. The re-opening will allow for rail connectivity from the Southwest Line to the Southeast Line serving Drumcondra, Connolly Station, Tara Street, Pearse Street and Grand Canal Dock. The trains using the Phoenix Park Tunnel will not stop at Heuston Station. Details of the coded service plan data within the model are shown in Table 4-2 below.

It has been assumed that 4 trains operate inbound in the AM peak with 3 outbound trains, with the reverse operation in the PM peak to accommodate the peak tidal demand. 2 trains per hour will use the tunnel in both directions during the inter-peak.

4.2.5 DART Frequency Increase

The DART frequency increase will provide for increased rail throughput, in particular an increase of up to 17 trains per hour (tph) running across the Loop Line Bridge across the Liffey. Details of the coded service plan data within the model are shown in Table 4-3 below.

Table 4-4: Do Minimum Public Transport Service Plan

Service	Vehicle	AM headway (mins)	IP headway (mins)	PM headway (mins)
DART	DART	10	10	10
Luas Cross City	53m tram	4	6	4
Phoenix Park Tunnel	DART	15 NB and 20 SB	30	15 NB and 20 SB

The Do Minimum public transport proposals are illustrated in Figure 4-1 **Error! Reference source not found.**below.

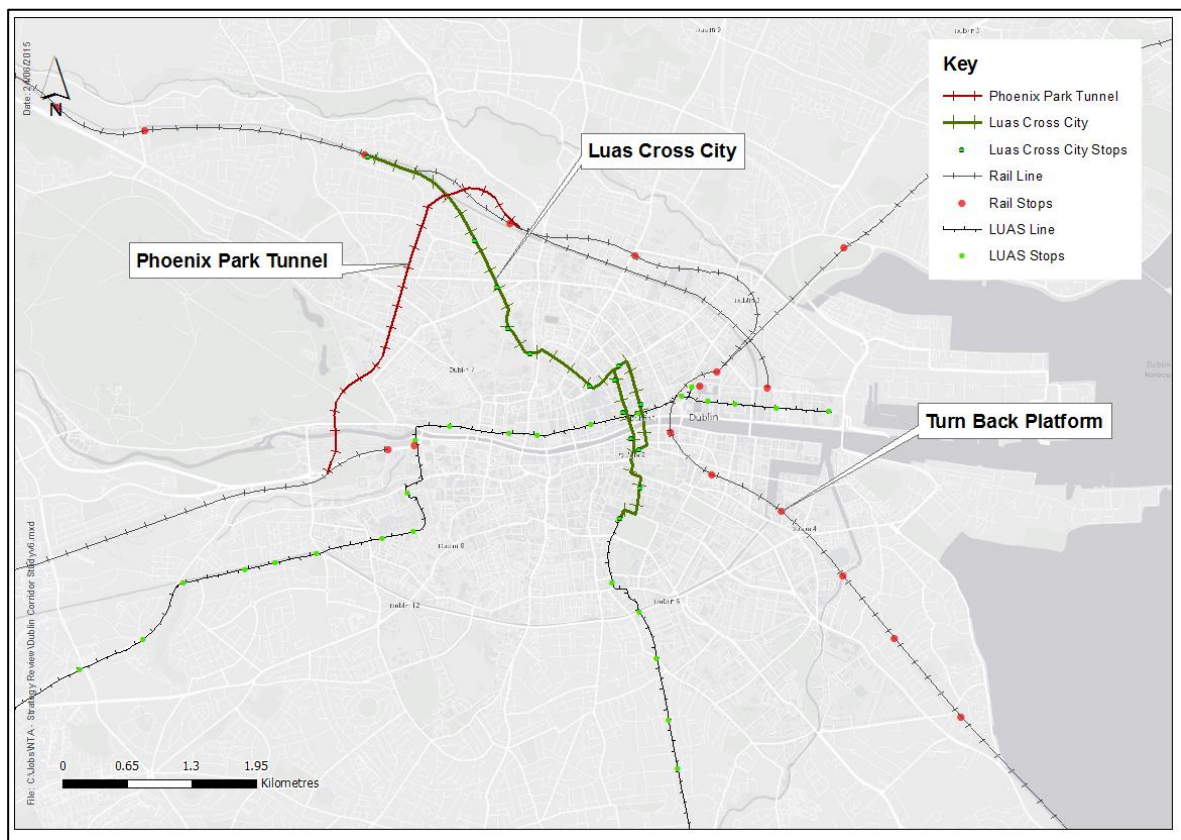


Figure 4-1: Do Minimum Proposed Public Transport Provision

4.3 Description of Do Strategy Proposals

The “Do Strategy” Scenario represents the full implementation of all of the different transport proposals identified in Section 4.2. The following lists the Do Strategy transport proposals:

- Road / traffic management infrastructure upgrades;
- GDA Cycle Network Plan;
- Core Bus Network;
- Swords/Airport-City Centre, Blanchardstown-UCD and Clongriffin-Tallaght Swiftway BRT lines;
- DART Expansion Programme;
- LR7 Optimised Metro North from Fingal / North Dublin Transport Study;
- Dublin Orbital Movement Strategy proposal;
- Dublin Corridor Study proposals; and
- Dublin City Centre Transport Plan.

4.3.1 Road / Traffic Management Infrastructure Upgrades

Table 4-5 lists the road and traffic management proposals included in the Do Strategy scenario and outlines the assumptions for network model coding.

Table 4-5: Assumptions Used for Coding of ‘Do Strategy’ Road Schemes

Road Scheme	Coding Assumptions
Dublin Tunnel – South Port Link Road	Single lane urban route 50kph
M11 - Wicklow – Arklow	Motorway, 120kph, grade separated junctions*
N11 Collector roads (between Dargle Road and Killarney Road and N11 Northbound merge and Fassaroe interchange)	Single lane 60kph, medium roundabouts
M50/M11 Third Lane (Sandyford to N11 Wilford Junction)	3 lanes plus auxiliary as per remainder of M50 & N11 to Wilford junction
N3 Upgrade: Dunboyne to M50	3 lanes plus auxiliary as per M50, upgraded Castaheany junction
M7 Naas to Newbridge Upgrade	3 lanes in each direction between Naas and M9*
Capacity Increase - N7/M7	Assumed upgrade to motorway with increase to 120 kph
Glenamuck District Distributor Road	Single lane 60kph, medium roundabouts*
Leopardstown Link Road Phase 2	Single lane 60kph, medium roundabouts*
Malahide Road / Clare Hall Junction realignment	Grade separated dumbbell interchange at Clare Hall junction
Porterstown Distributor Link Road	Single lane urban route 50kph
N3-N4 Link: Ongar to Barnhill	Urban dual plus bus lanes 60kph, large roundabouts
N3-N4: Barnhill to Leixlip Junction	Urban dual plus bus lanes 60kph, large roundabouts
R126 Donabate Relief Road: R132 to Portrane Demesne	Single lane 60kph, medium roundabouts
R139 conversion to Dual Carriageway	Urban dual plus bus lanes 60kph, large roundabouts
Swords Western Distributor Link Road	Single lane 60kph, medium roundabouts
North-South Road – west of Adamstown SDZ	Urban dual plus bus lanes 60kph, large roundabouts

Road Scheme	Coding Assumptions
linking N81 to N7 to N4 and on to Fingal	
M7 Osberstown / Newhall Interchange	New grade separated junction and link to Sallins*
N81 – M50 to Hollywood Cross	Dual carriageway, 80kph*
Oldcourt LAP Link, Bohernabreena	Single lane urban route 50kph

**as per scheme plans*



Figure 4-2: Strategy Road Schemes

4.3.2 Cycle Network Plan

The major cycle routes of the GDA Cycle Network Plan have been coded into the ERM Active Modes networks. The routes include Primary Routes, Greenways, and Cross-City Routes in Dublin City Centre and the Primary/Secondary routes in the satellite towns. Figure 4-3 illustrates the Strategic Cycle Network, based on the GDA Cycle Network Plan.

The ERM includes a specific cycle network, representing cycling facilities within the modelled area. A quality of service attribute is defined on each cycling facility, then converted into a cycling speed higher than the default one (12km/h) to represent its attractiveness. The assumptions regarding Quality of Service used in the model are summarised in Table 4-6.

Table 4-6: Modelled speeds assumed for each level of Quality of Service

Quality of Service	Modelled Speed (kph)
A+	20.0
A	19.2
B	18.4
C	17.2
D	15.2
No facility	12.0

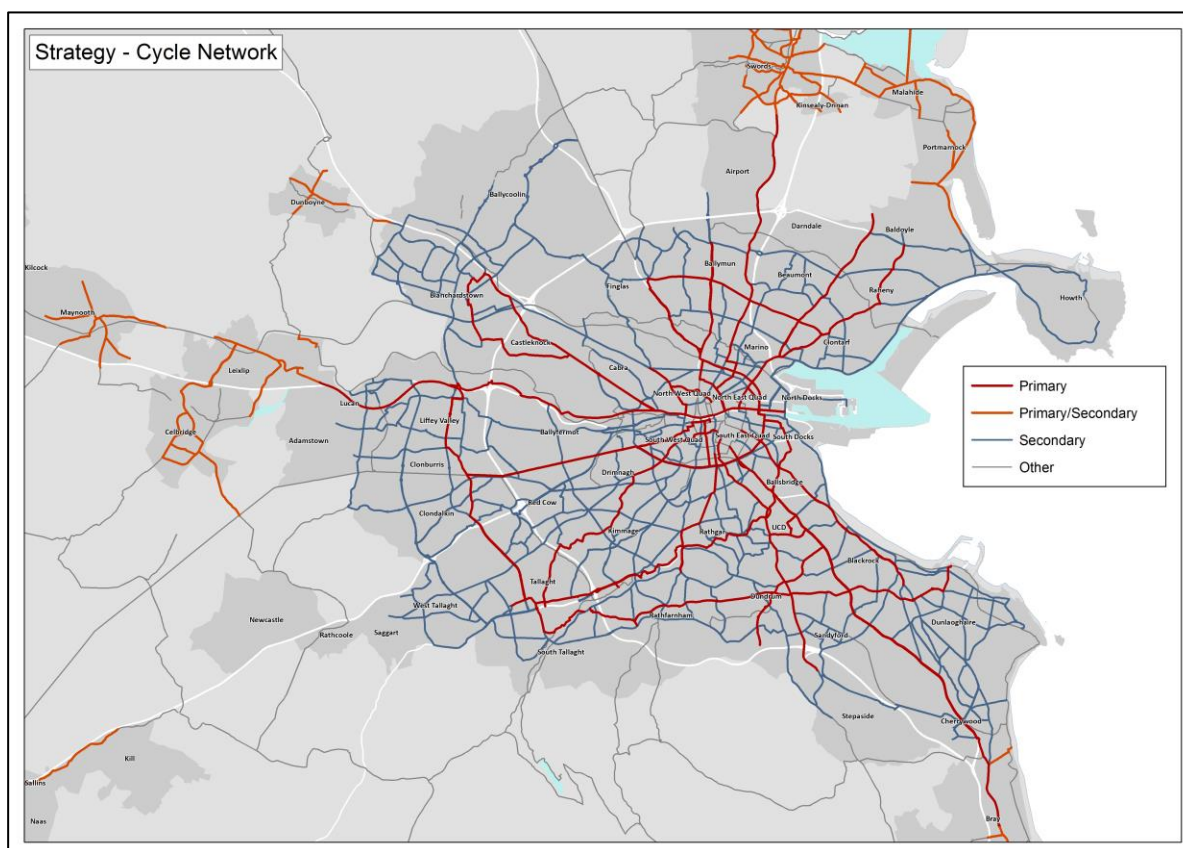


Figure 4-3: Strategy Cycle Network

4.3.3 Core Bus Network

4.3.3.1 Core Radial Bus Network

The proposed Core Radial Bus Network comprises the major radial bus routes into Dublin City Centre. The proposed upgrades involve the provision of full bus priority in both directions along all of the routes shown in Figure 4-4. For the purposes of model coding, it was assumed that this would be achieved through the provision of full bus priority along these routes with no reduction in road capacity accounted for.

Bus speeds in the ERM are taken as 80% of the uncongested speed of the adjacent road network link, where a bus lane is provided. Where there are no bus lanes, the congested road speeds are applied.

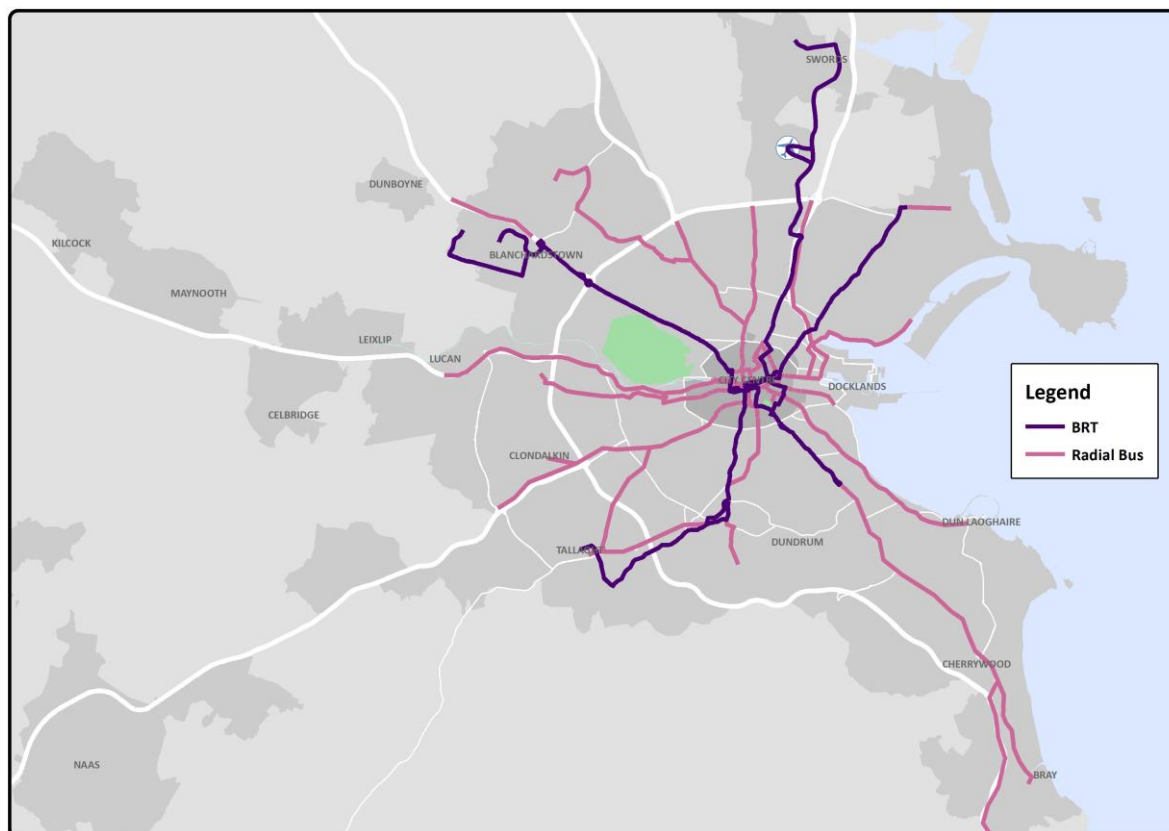


Figure 4-4: Core Radial Bus Network

4.3.3.2 Core Regional Bus Network

Six regional bus corridors have been identified as forming part of the Core Regional Bus Network as follows:

- M1, via Port Tunnel
 - Serves long distances bus routes from Belfast, Dundalk, Derry, Monaghan and Drogheda; and
 - Serves other regional bus routes from Balbriggan, Skerries and East Meath.
- M2, via Port Tunnel
 - Serves regional bus from Ashbourne and Slane.
- M3/ N2, via Navan Road
 - Serves regional bus from Cavan, Navan, Trim, Dunshaughlin, Kells; and

- Serves longer distance bus from Donegal.
- M4/ N4, via Chapelizod Bypass
 - Serves longer distance bus from Galway, Mayo, Sligo and Midlands; and
 - Serves regional bus along M4 corridor.
- M7/ N7, via Long Mile Road
 - Serves longer distance bus from Cork, Limerick, Waterford; and
 - Serves regional bus from Kildare.
- M11/ N11
 - Serves longer distance bus from Wexford; and
 - Serves regional bus from Arklow, Wicklow and N11 corridor.

The regional buses services were coded with assumed headways of 15 mins (AM & PM) and 30 mins (IP) and assumed to be coaches (50 seats). The regional bus corridors forming part of the Core Bus Network are shown in Figure 4-5.



Figure 4-5: Core Regional Bus Network

4.3.4 Swiftway Bus Rapid Transit Schemes

The Swiftway BRT routes modelled are shown schematically in Figure 4-4 and Figure 4-10, with the service plan assumptions outlined in Table 4-7 below. The proposed routes are:

- Swords/Airport to City Centre (SxC);
- Blanchardstown to UCD (BxU); and
- Clongriffin to Tallaght (CxT).

The coding of the BRT routes has accounted for the localised reduction in road capacity associated with the introduction of the BRT routes, where design drawings were available. The detailed design drawings for the SxC Preferred Route (PR) have been coded into the ERM.

The Emerging Preferred Route (EPR) for BxU was coded into the ERM, however there are no design drawings available for the CxT route at present, and therefore no associated reduction in road capacity along this route was coded.

There is currently no EPR for the CxT route and only an indicative alignment has been developed as far as Rathfarnham to date. The section between Rathfarnham and Tallaght was examined as part of the *Dublin South West Corridor Study*. Similarly to BxU, as there are no design drawings available for the CxT route at present, no associated reduction in road capacity along this route was coded.

The assumptions regarding headway and vehicle type for SxC were used for BxU and CxT.

Table 4-7: Proposed Service Plan for Swiftway BRT

Service	Vehicle	AM headway	IP headway	PM headway
Swords to City Centre	BRT (120 pax crush)	4	8	4
Blanchardstown to UCD	BRT (120 pax crush)	4	8	4
Clongriffin to Tallaght	BRT (120 pax crush)	4	8	4

4.3.5 Fingal / North Dublin Transport Study

The preferred scheme from the Fingal / North Dublin Transport Study is the LR7 Optimised Metro North. This has been coded using the assumptions for stops, headway, capacity, etc. taken from the modelling undertaken for the study options. The alignment of LR7 is shown in Figure 4-10 and the service plan is shown in Table 4-8 below.

Table 4-8: Proposed Service Plan for LR7 Optimised Metro North

Service	Vehicle	AM headway	IP headway	PM headway
Swords (Estuary) to St. Stephen's Green	60m tram	2	2	2
St. Stephen's Green to Swords (Estuary)	60m tram	2	2	2

4.3.6 Dublin Orbital Movement Strategy

The preferred schemes for the Dublin Orbital Movement Strategy are shown in Figure 4-6 for the following areas:

- Swords to Blanchardstown;
- Blanchardstown to Tallaght;
- Tallaght to Dundrum; and
- Dundrum to Dun Laoghaire.

Four bus services were developed to accommodate orbital travel demand. These routes have been coded as bus services with the headway and capacity assumptions summarised in Table 4-9.

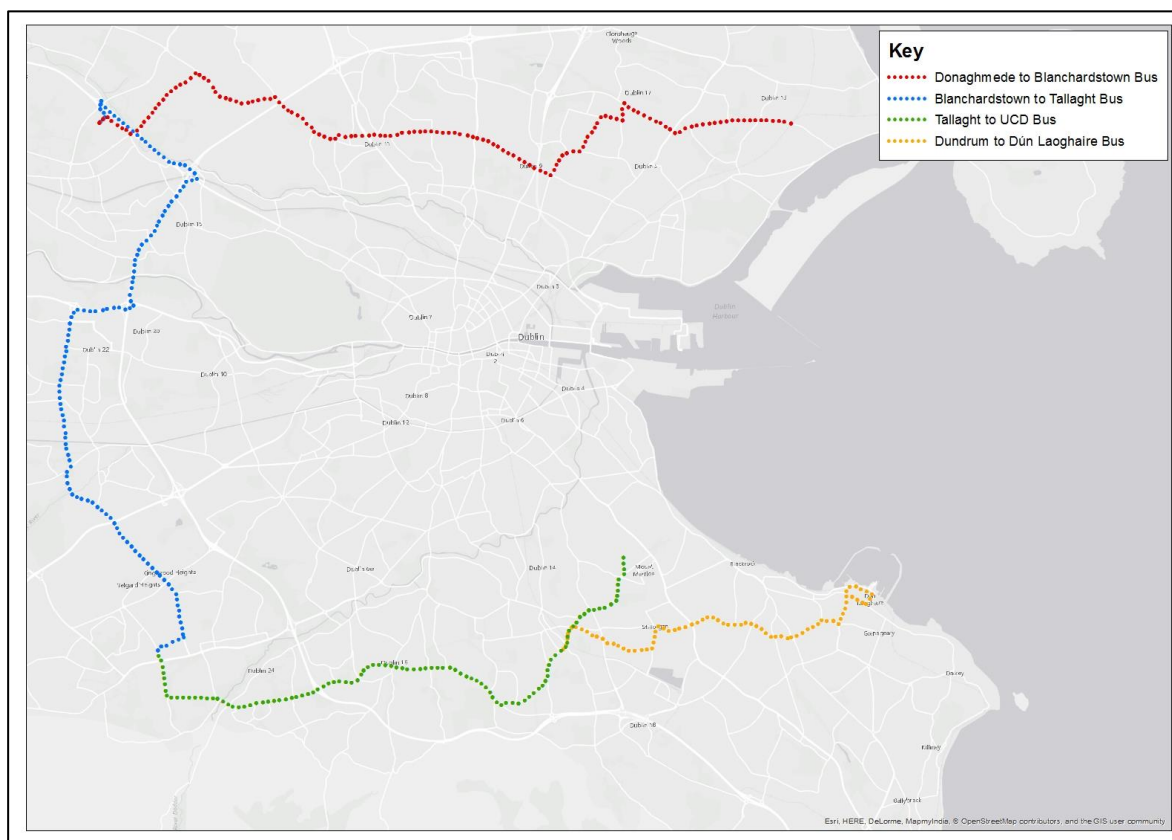


Figure 4-6: Outer Orbital Public Transport Study – Preferred Route

Table 4-9: Proposed service plan for Outer Orbital Services

Service	Vehicle	AM headway	IP headway	PM headway
Donaghmede to Blanchardstown	Double-decker bus	10	10	10
Blanchardstown to Tallaght	Double-decker bus	5	5	5
Tallaght to Dundrum	Double-decker bus	5	5	5
Dundrum to Dún Laoghaire*	Double-decker bus	10	10	10

* to be combined with Inner Orbital Finglas to Dundrum option (see Section 4.3.9)

4.3.7 DART Expansion Programme

The DART Expansion Programme was coded based on the service plan and modelling assumptions developed for the DART Expansion Programme Business Case. The route for DART Underground Tunnel is shown in Figure 4-7 and the heavy rail service plan associated with the DART Expansion Programme is detailed in Table 4-10.

The full DART Expansion Programme consists of:

- An east-west heavy rail tunnel under Dublin City Centre;
- Increased separation of commuter and inter-city services on the line from Heuston station;
- Expansion of electrification to Drogheda, Maynooth and Hazelhatch; and

- Expansion of fleet and depot facilities.

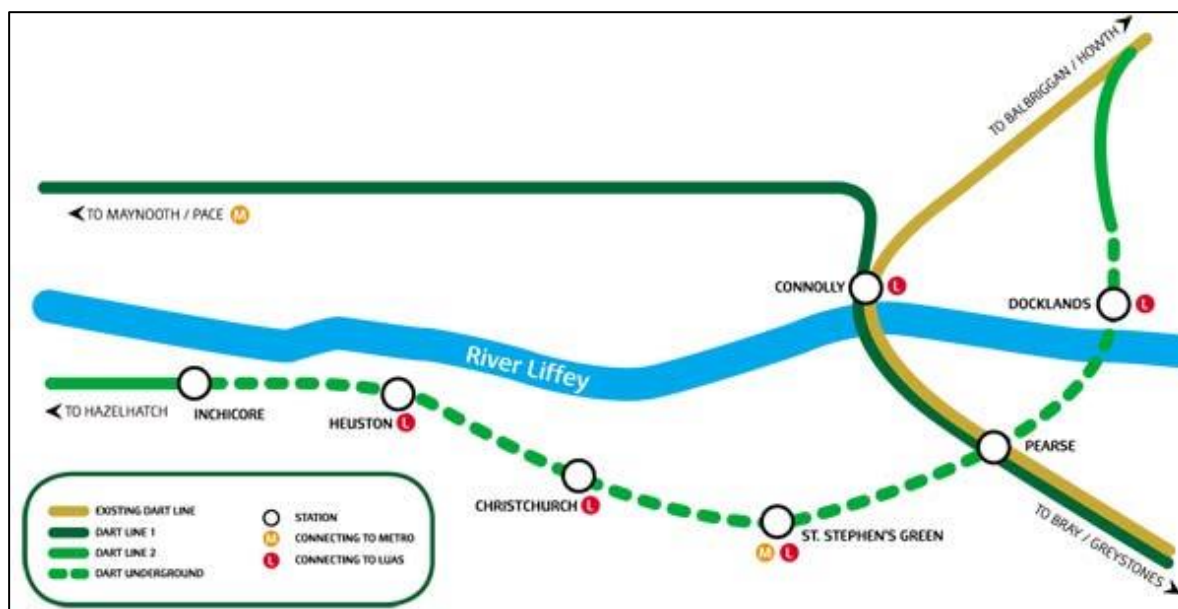


Figure 4-7: DART Underground & Expansion

Table 4-10: Proposed Heavy Rail Service Plan with DART Expansion

Service	AM headway	IP headway	PM headway
DART			
Inchicore to Drogheda – all stops	7.5	15	7.5
Hazelhatch to Clongriffin – all stops	15	30	15
Hazelhatch to Balbriggan – all stops	15	30	15
Drogheda to Inchicore – all stops	7.5	15	7.5
Balbriggan to Hazelhatch – all stops	15	15	15
Clongriffin to Hazelhatch – all stops	15	30	15
Howth to Howth Junction (Shuttle) – all stops	10	20	10
Howth Junction to Howth (Shuttle) – all stops	10	20	10
Maynooth to Bray – all stops	10	20	10
Connolly to Bray – all stops	30	60	30
Maynooth to Greystones – all stops	30	60	30
Greystones to Maynooth – all stops	30	60	30
Bray to Maynooth – all stops	10	20	10
Bray to Connolly – all stops	30	60	30
M3 Parkway to Clonsilla (Shuttle) – all stops	15	30	15
Clonsilla to M3 Parkway (Shuttle) – all stops	15	30	15
Commuter – Northern Line			
Dundalk to GCD – all stops to Malahide then Connolly, Tara, Pearse, GCD	30	30	0

Service	AM headway	IP headway	PM headway
GCD to Dundalk – GCD, Tara, Pearse, Connolly then non-stop to Malahide then all stops to Dundalk	0	30	30
Commuter – Sligo Line			
Maynooth to GCD – all stops	30	0	30
GCD to Maynooth – all stops	30	0	30
Longford to GCD – all stops	60	60	60
GCD to Longford – all stops	60	60	60
Commuter – Cork Line			
Portlaoise to Heuston – all stops to Hazelhatch then Heuston	30	60	60
Heuston to Portlaoise – non-stop to Hazelhatch then all stops to Portlaoise	60	60	60
Kildare to Heuston – all stops to Hazelhatch then Heuston	30	60	30
Heuston to Kildare – non-stop to Hazelhatch then all stops then non-stop to Kildare	30	60	20
Newbridge to Heuston – all stops to Hazelhatch then Heuston	30	0	0
Heuston to Newbridge - non-stop to Hazelhatch then all stops then non-stop to Newbridge	60	0	0
Commuter – South Eastern Line			
<i>Same as Do Minimum</i>			
Intercity			
<i>Same as Do Minimum</i>			

4.3.8 Public Transport Corridor Studies

Six public transport corridor studies for the GDA were undertaken to identify the public transport schemes required to meet the growth in travel demand to 2035 in each of the corridors. These studies aimed to provide for all forecast travel growth (for trips over 3km in length) by public transport in an effective, efficient and sustainable manner. The following lists the corridor study reports:

- Dublin South East Corridor Study;
- Dublin West Corridor Study;
- Dublin Inner Orbital Corridor Study;
- Dublin South West Corridor Study;
- Dublin Navan Corridor Study;
- Dublin North West Corridor Study;

The preferred options from the studies include a range of public transport proposals including new lines and services, upgrades of existing lines, additional services and feeder services.

The major recommendations of the corridor studies have been included in the ERM, and are illustrated in Figure 4-8. The coding of the BRT, LRT and QBC routes has not accounted for any reduction in road capacity associated with the introduction of the schemes. Service plans for the public transport proposals for each of the corridor studies as coded in the PT model are detailed in Table 4-11.

Dublin South East Corridor Study

The public transport proposal for the South East Corridor is to upgrade the existing Luas Green Line to a Metro line. The South East Metro would be grade separated from St. Stephen's Green to Charlemont, and would then continue along the existing Luas Green Line to Bride's Glen, with an extension to Bray. The upgrade of the existing Luas Green Line to Metro, between Charlemont and Bride's Glen has impacts on the Luas Green Line and Luas Cross City services. Therefore Luas Cross City services were assumed to operate between Broombridge and Harcourt. Revised Luas Cross City service plans are detailed in Table 4-11.

Dublin West Corridor Study

The public transport proposal for the Western Corridor is a new Luas line from Trinity College in the City Centre to the Newcastle Road in Lucan. Improvements to the Kildare Commuter Rail line are also recommended, in particular electrification and an increase in rail service frequency and capacity. These are covered as part of the DART Expansion Programme as detailed in section 4.3.7.

Dublin Inner Orbital Corridor Study

The public transport proposal for the Inner Orbital Corridor comprises two parallel orbital bus routes from Dundrum to Finglas and Rathmines to Drumcondra.

Dublin South West Corridor Study

The public transport proposal for the South West Corridor includes an extension of Clongriffin to Tallaght BRT EPR from Rathfarnham to Tallaght Luas stop via Firhouse and Old Bawn.

Dublin Navan Corridor Study

The public transport proposal for the Dublin Navan Corridor is an increase in existing bus service provision from Navan to Dublin City Centre. The bus services to Navan were increased from 5 buses per hour to 8 buses per hour in the AM and PM peak periods.

Dublin North West Corridor Study

The public transport proposal for the North West Corridor involves extending the proposed Luas Cross City beyond its terminus at Broombridge to Charlestown in Finglas. The proposed extension will cater for stops at Potterstown, Cardiffsbridge, Cardiff Castle, Mellows Park and Charlestown P&R.

Further detail on all public transport proposals described above is available in the respective corridor study reports.

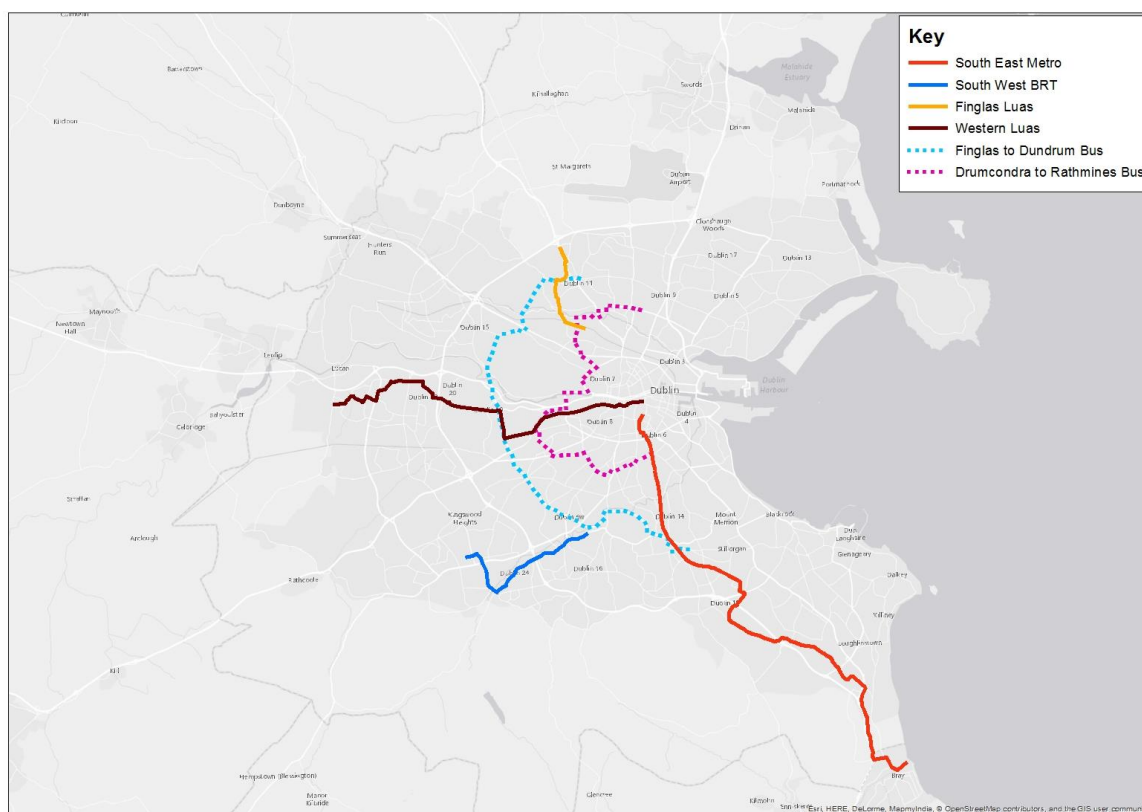


Figure 4-8: Public Transport Corridor Scheme Options

Table 4-11: Proposed Service Plan for Public Transport Corridor Study Services

Service	Vehicle	AM headway	IP headway	PM headway
South East Metro	60m tram	2	2	2
South West BRT	BRT (120 pax crush)	4	8	4
Western Luas	53m tram	4	4	4
Inner Orbital: Drumcondra to Rathmines	Double decker bus	5	5	5
Inner Orbital: Finglas to Dundrum	Double decker bus	10	10	10
Inner Orbital: Finglas to Dún Laoghaire*	Double decker bus	10	10	10
Navan / M3 Corridor	Inter-Urban Bus	7	12	7
Finglas Corridor & revised Luas Cross City	53m tram	4	6	4

* Combined with Outer Orbital Dundrum to Dún Laoghaire Option

4.3.9 Overlapping Services from Parallel Studies

The LR7 Optimised Metro North line (Section 4.3.5) and the South East Metro (Section 4.3.8) overlap at St. Stephen's Green. It is proposed to merge the two metro lines at this point to form a continuous Metro line from Swords (Estuary) to Bray.

The bus route proposals of the Dublin Inner Orbital Corridor Study and Dublin Orbital Movement Strategy overlap at two points on the network. The Finglas to Dundrum Inner Orbital route joins the Dundrum to Dún Laoghaire route at its southern end and there is a short overlap with the Donaghmede to Blanchardstown Outer Orbital route at its northern end.

It is assumed that the Finglas to Dundrum Inner Orbital and the Dundrum to Dún Laoghaire Outer Orbital bus service proposals are merged. This will involve a split service with a 10 minute headway on the Finglas to Dundrum route, and a 10 minute headway service between Finglas and Dún Laoghaire.

The short overlap between the Inner Orbital Finglas to Dundrum route and the Donaghmede to Blanchardstown Outer Orbital route will be accommodated via interchange at Finglas.

4.3.10 Dublin City Centre Transport Study

The Dublin City Centre Transport Study was published for consultation in June 2015. The main elements of the study listed below were coded in the Do Strategy scenario and are shown in Figure 4-9:

- New bus gates at Bachelor's Walk, Aston Quay, and Beresford Place;
- Pedestrianisation of Suffolk Street and use of Grafton Street (northern end) as two-way for public transport;
- Traffic management measures and Public Transport Interchange at Westmoreland Street, D'Olier Street and College Street;
- Public transport only on Westland Row;
- Removal of HGV height restriction on Macken Street;
- Extension of Croppies Acre to the River Liffey and rerouting of traffic from Wolfe Tone Quay to Benburb Street;
- New Docklands Dodder Bridge from Sir John Rogerson Quay to the East Link Toll Road;
- Two-way movements on Pearse Street; and
- A proposed orbital traffic route.

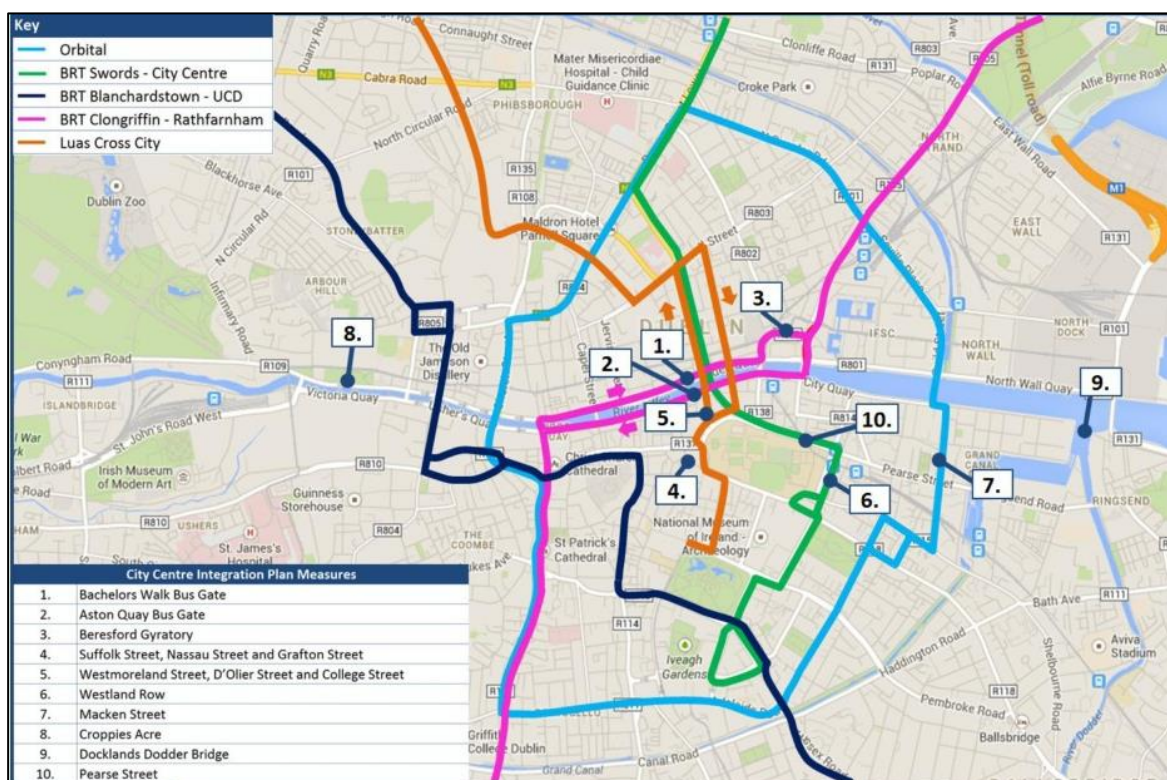


Figure 4-9: Dublin City Centre Transport Plan – Modelled Transport Proposals

4.4 Overall Strategy Transport Proposals

Figure 4-10 illustrates the overall public transport proposals as part of the GDA Strategy.

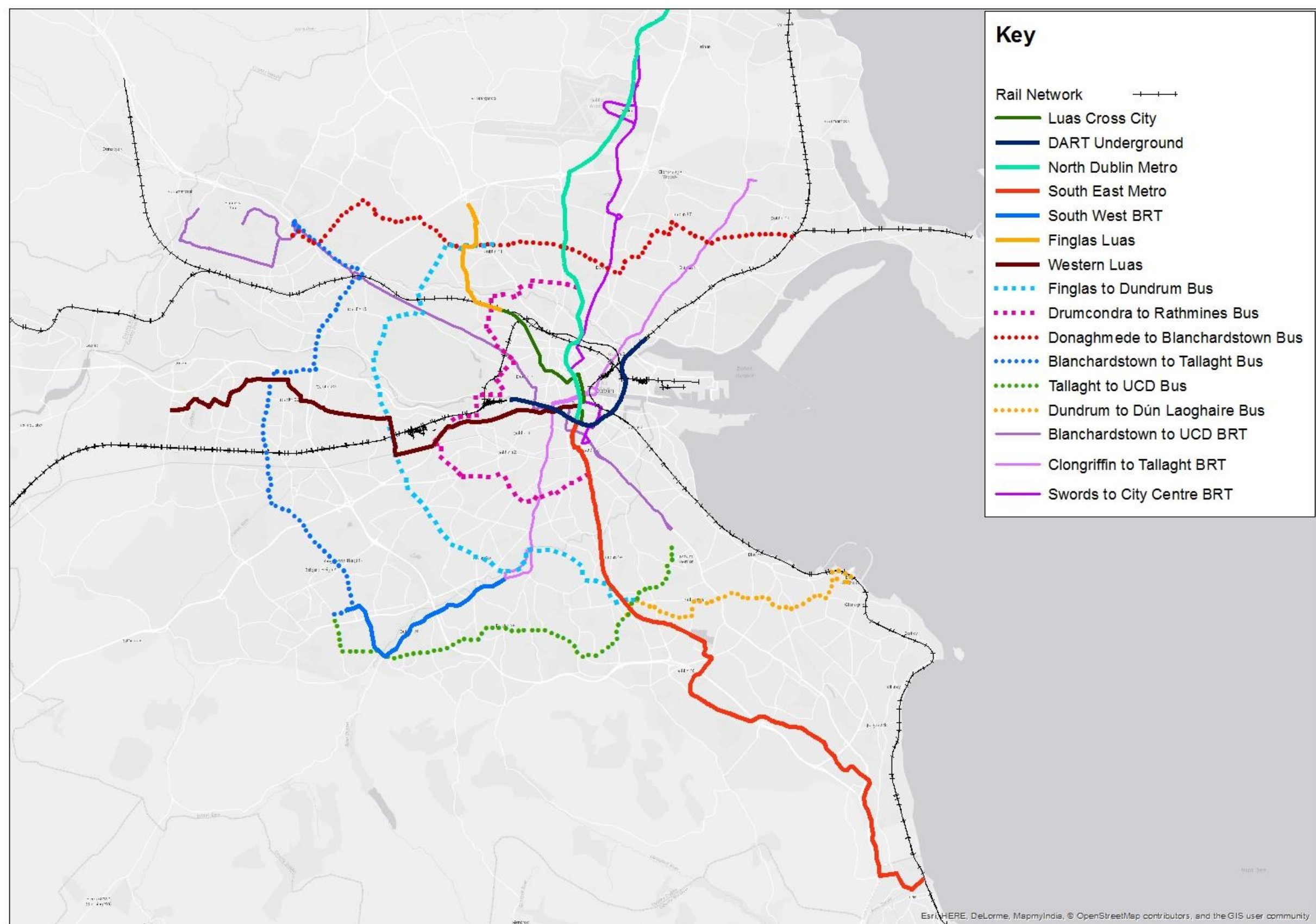


Figure 4-10: GDA Transport Strategy Public Transport Proposals

4.5 Development of GDA Strategy Modelling Scenarios

The modelling for the GDA Transport Strategy was undertaken in a sequential manner. The process involved developing scenarios and analysing outputs to test that all future growth in demand was being catered for by the public transport proposals. Following the analysis of the initial Do Strategy scenario, subsequent scenarios were developed with increases in existing public transport services and road tolling strategies incorporated as required. This ensured that a robust assessment of the GDA Transport Strategy was undertaken.

The following outlines the modelling scenarios, with further sections detailing the methodology and rationale behind each model run.

1. 2012 Base Model;
2. 2035 Do Minimum;
3. 2035 Do Strategy;
4. 2035 Do Strategy & Increased Bus Frequencies; and
5. 2035 Do Strategy, Increased Bus Frequencies & M50 Demand Management.

4.5.1 Run 1: GDA Base Model

This scenario represents the model base year run that was used as part of the calibration and validation of the ERM. Travel demand patterns and mode shares all align with the 2012 base year.

4.5.2 Run 2: Do Minimum

This scenario involves running the Do Minimum supply networks with the 2035 strategy demand trip ends. The scenario includes the proposed Do Minimum transport proposals outlined in Section 4.2. This is scenario that is set as the baseline against which all of the public transport proposals are compared against.

4.5.3 Run 3: Do Strategy

This scenario involves running the Do Strategy supply networks with the 2035 strategy demand trip ends. The scenario includes the proposed Do Strategy transport proposals outlined in Section 0. This model run was used to identify existing base year bus services that were operating close to or above capacity.

4.5.4 Run 4: Do Strategy & Increased Bus Frequencies

Bus services operating close to or above capacity were identified from an analysis of Run 3. Frequency and capacity increases were then applied to these services in the model. The Do Strategy scenario was run again to ensure that the bus services were not operating over capacity.

4.5.5 Run 5: Do Strategy, Increased Bus Frequencies & M50 Demand Management

The GDA Strategy Run 4 showed that the traffic volumes on the M50 would increase significantly above the existing levels and that the operation of the M50 would deteriorate as a result. The proposed multi-point tolling scheme outlined in the National Roads Authority's M50 Demand Management Study was included in the Do Strategy model runs. The toll prices were optimised over multiple model runs in order to ensure that the volumes of traffic on the M50 remained similar to 2012 levels. This ensured that the M50's operation would continue in line with the M50 Demand Management Study's forecasts.

4.5.6 GDA Strategy Model Scenarios Considered

Following the sequential model runs and optimisation of bus service frequencies and M50 tolling levels, the ERM scenarios considered for the assessment of the GDA Strategy are:

- Run 2: 2035 Do Minimum; and
- Run 5: 2035 Do Strategy, Increased Bus Frequencies & M50 Demand Management.

5 GDA Strategy Modelling Results

5.1 GDA Strategy Modelling Assessment

The modelling assessment for the GDA Strategy involves comparing the Do Strategy scenario against the Do Minimum scenario and also against the base year scenario where appropriate. Table 5-1 lists the various criteria and key performance indicators that the GDA Strategy proposals have been assessed against:

Table 5-1: GDA Strategy Assessment: Criteria and associated performance indicators

Criteria	Performance Indicator
Mode Share	Sustainable modes GDA overall mode share Segment mode share Orbital mode share
Strategic Movement	Flows across M50 cordon Flows across Dublin City Centre cordon
Public Transport Network	Network Performance Maximum Line flows Total Passenger Boardings Public Transport Speeds
Road Network	Network Performance Over capacity queuing City Centre Road Network Performance Strategic Road Network Performance
Environment	Emissions Noise
Accessibility	Severance Public Transport Accessibility
Integration	Public Transport Interchange
Economy	Transport user benefits

5.2 Mode Share

5.2.1 Sustainable Modes

Table 5-2 to Table 5-4 outline model outputs of growth in total trips, car trips and growth in trips made by sustainable modes (public transport, walking and cycling). This is presented for the AM, Inter Peak and PM peak periods between the 2012 base year and the 2035 forecast year

The model results indicate that 78% of the AM growth and 73% of the PM growth is accommodated on sustainable modes for the entire GDA. For the Dublin Metropolitan Area the growth in sustainable modes is forecast to be 95% of the AM growth and 88% of the PM. Within

the M50 cordon area the results indicate that the growth in sustainable modes exceeds the total growth.

Table 5-2: AM Peak Public Transport Accommodation of Growth

AM Peak	Total Growth	Growth in trips by Car	Growth in trips by Sustainable Modes	Growth Accommodated by Sustainable Modes
GDA	334,646	72,715	261,931	78%
Metropolitan Area	224,847	11,532	213,314	95%
Inside M50	120,380	-29,503	149,882	125%

Table 5-3: Inter Peak Public Transport Accommodation of Growth

PM Peak	Total Growth	Growth in trips by Car	Growth in trips by Sustainable Modes	Growth Accommodated by Sustainable Modes
GDA	223,906	70,477	153,429	69%
Metropolitan Area	136,446	25,840	110,606	81%
Inside M50	74,733	-3,516	78,245	105%

Table 5-4: PM Peak Public Transport Accommodation of Growth

PM Peak	Total Growth	Growth in trips by Car	Growth in trips by Sustainable Modes	Growth Accommodated by Sustainable Modes
GDA	291,264	79,783	211,480	73%
Metropolitan Area	185,116	22,462	162,654	88%
Inside M50	89,963	-14,254	104,217	116%

5.2.2 GDA Overall Mode Share

This analysis considers the model outputs in terms of mode share by road, public transport and active modes across the GDA (which includes rural hinterland and urban and suburban areas). Figure 5-1 shows the mode share for the 2012 Base, the 2035 Do Minimum and the 2035 Do Strategy scenarios for the AM, IP and PM peak periods².

The mode share for travel by car in the GDA is forecast to reduce from 56% in the base year to 53% in the future Do Minimum scenario, i.e. without the Strategy in place. With the implementation of the GDA Strategy, demand for travel by car is forecast to reduce from 53% to 50% overall in the AM peak.

There is growth of approximately 100,000 public transport trips in the AM peak hour between the base and the Do Strategy scenario. Public transport and active modes share is forecast to increase from 44% to 50%.

² AM peak hour total trip demand increases from 1,623,437 trips in 2012 to 1,858,083 in 2035

IP peak hour total trip demand increases from 1,178,285 trips in 2012 to 1,402,190 in 2035

PM peak hour total trip demand increases from 1,444,979 trips in 2012 to 1,734,623 in 2035

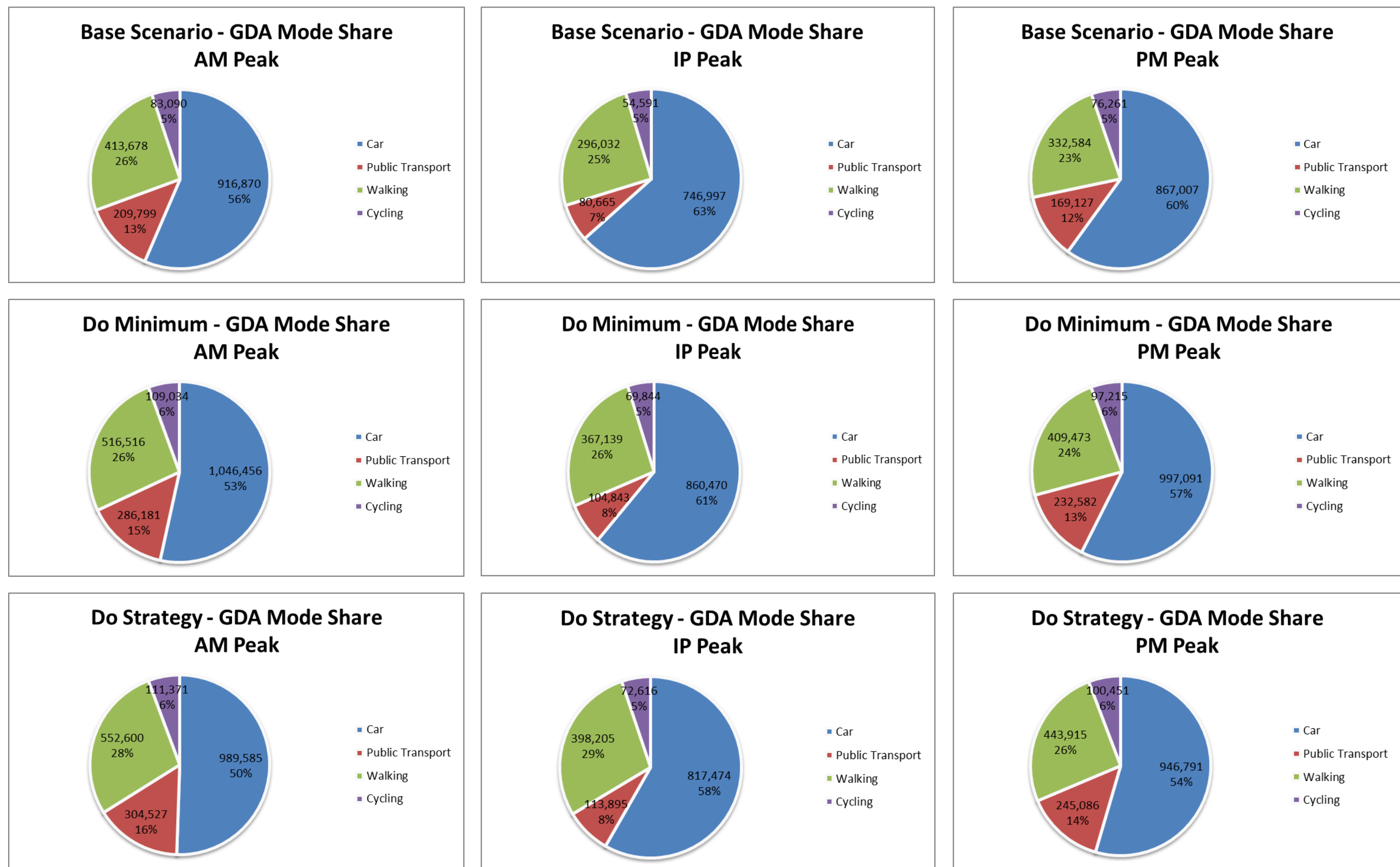


Figure 5-1: Overall Greater Dublin Area Mode Share

5.2.3 Segment Mode Share

Segment based mode share statistics were also extracted from the ERM for the Do Minimum and Do Strategy scenarios. The GDA segments are shown in Figure 5-2 below.

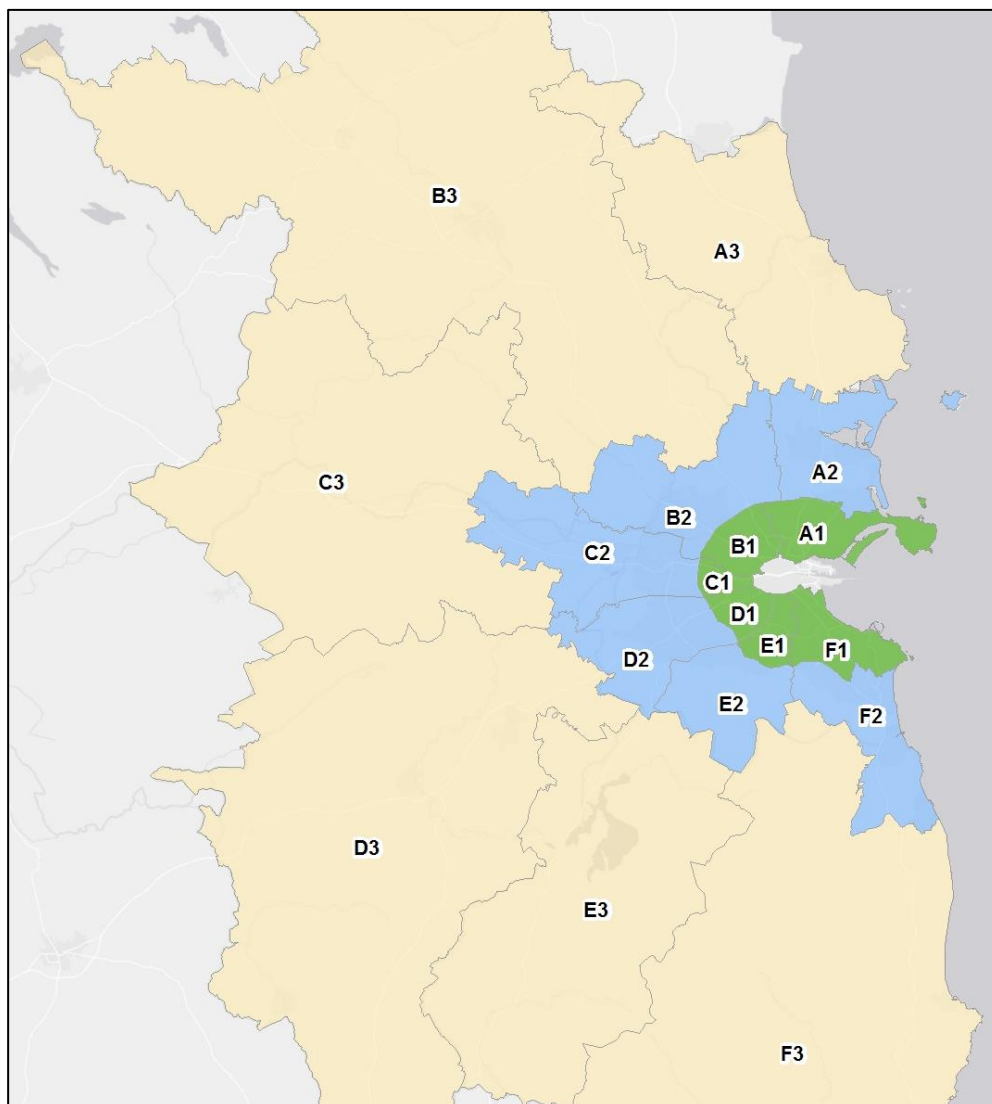


Figure 5-3: GDA Segments

The segment based mode share assessment focuses on the mode share for trips with specific destinations within the GDA Metropolitan area. The areas considered are:

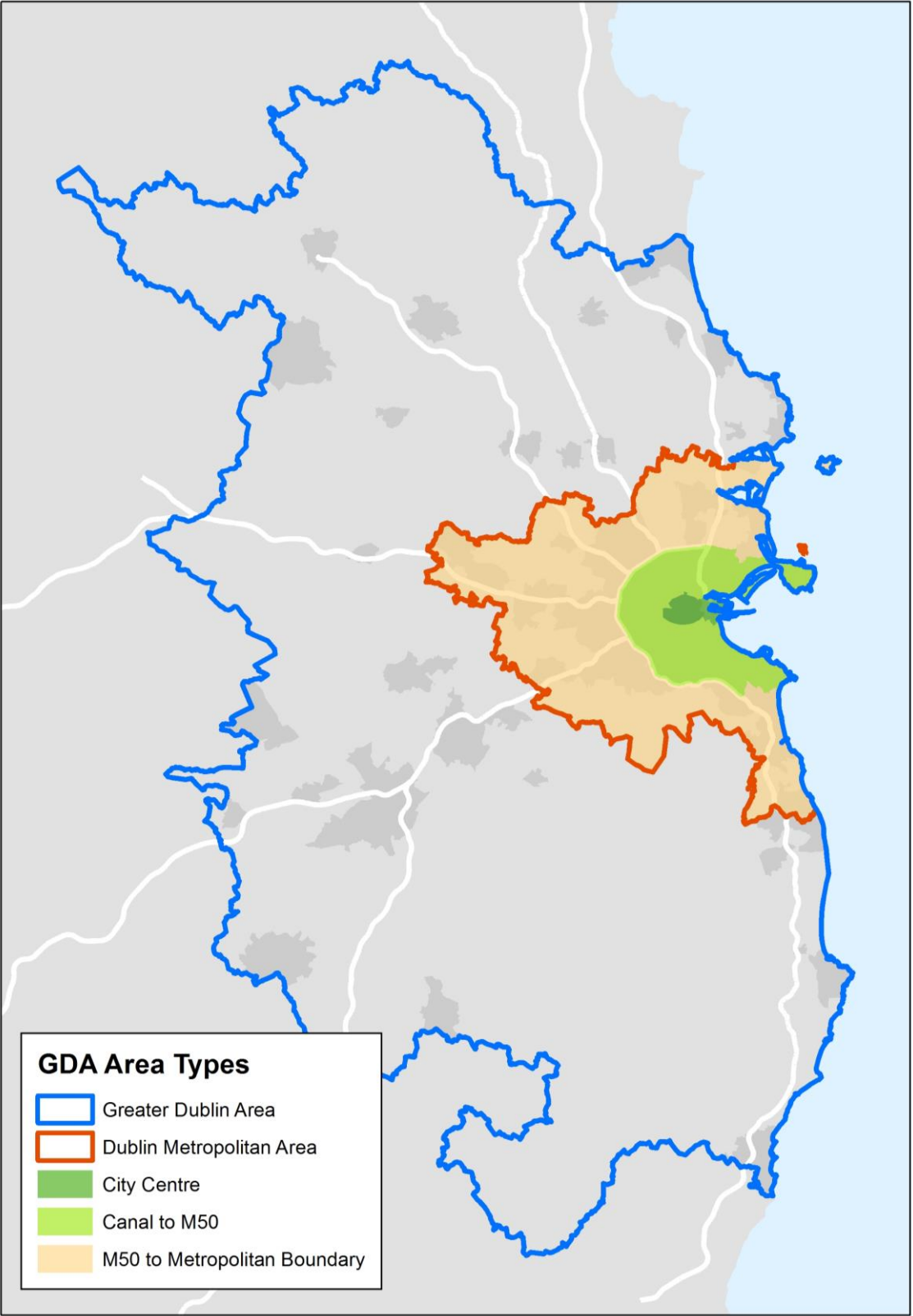
- Dublin Metropolitan Area³;
- Dublin City Centre;
- Dublin City Centre to M50; and
- M50 to Dublin Metropolitan Area boundary.

³ The Dublin Metropolitan Area statistics are the combination of the Dublin City Centre, City Centre to M50 and M50 to Dublin Metropolitan Area boundary regions

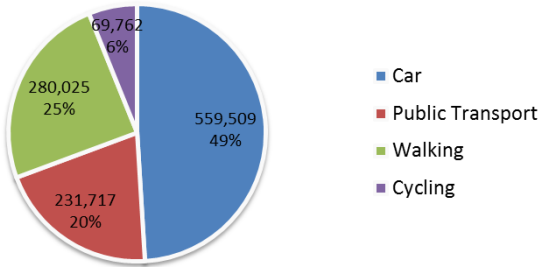
This analysis presents the impacts of the GDA Strategy proposals in urban and suburban areas, which are more conducive to travel by public transport and active modes, than rural areas.

Figure 5-4 to Figure 5-6 illustrate the mode share model outputs for the different segment groupings in the GDA Metropolitan area for the AM, Inter Peak and PM Peak periods respectively. The ERM forecasts a greater use of public transport in all areas in the Do Strategy compared to the Do Minimum scenario.

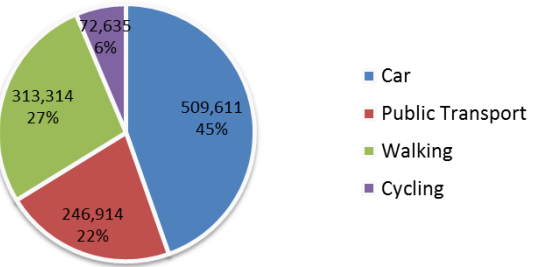
The outputs also indicate that, within the more densely populated urban areas, the share of trips by public transport and active modes is greater than for the Do Minimum scenario. In the City Centre, the model forecasts that 79% of all trips in the AM peak and 71% of trips in the PM peak will be by sustainable modes in the Do Strategy scenario.



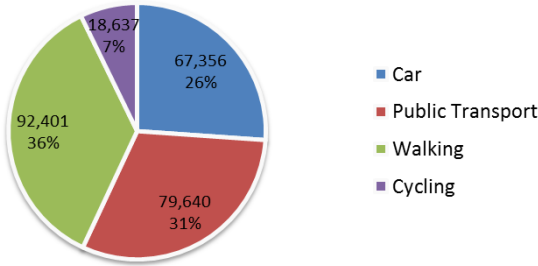
Do Minimum - Metropolitan Area
Mode Share AM Peak



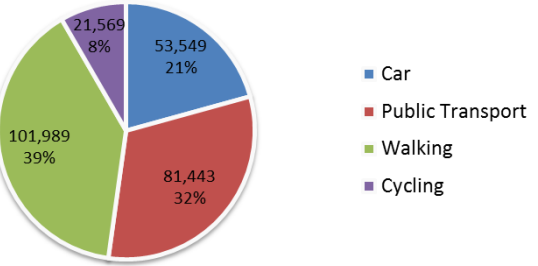
Do Strategy - Metropolitan Area
Mode Share AM Peak



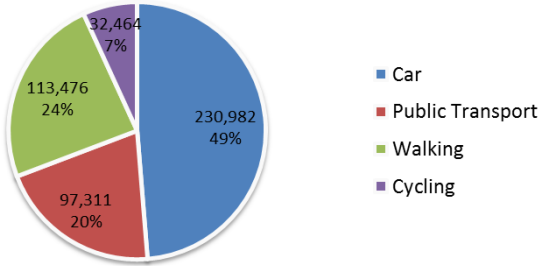
Do Minimum - City Centre
Mode Share AM Peak



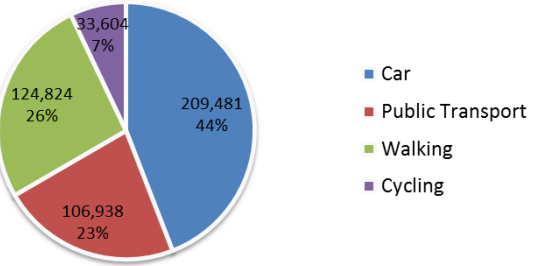
Do Strategy - City Centre
Mode Share AM Peak



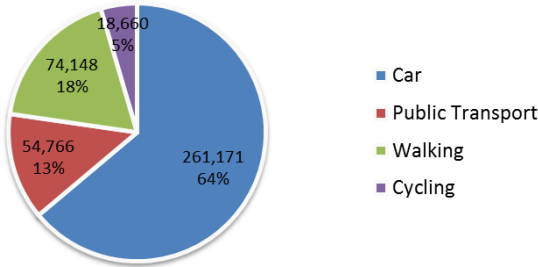
Do Minimum - Canal to M50
Mode Share AM Peak



Do Strategy - Canal to M50
Mode Share AM Peak



Do Minimum - M50 to Metropolitan
Boundary Mode Share AM Peak



Do Strategy - M50 to Metropolitan
Boundary Mode Share AM Peak

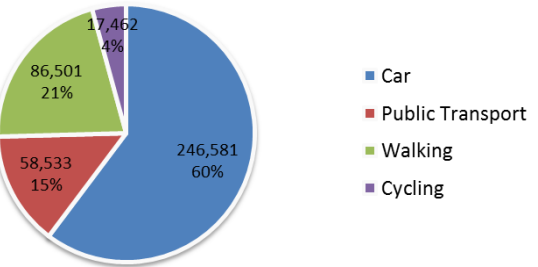
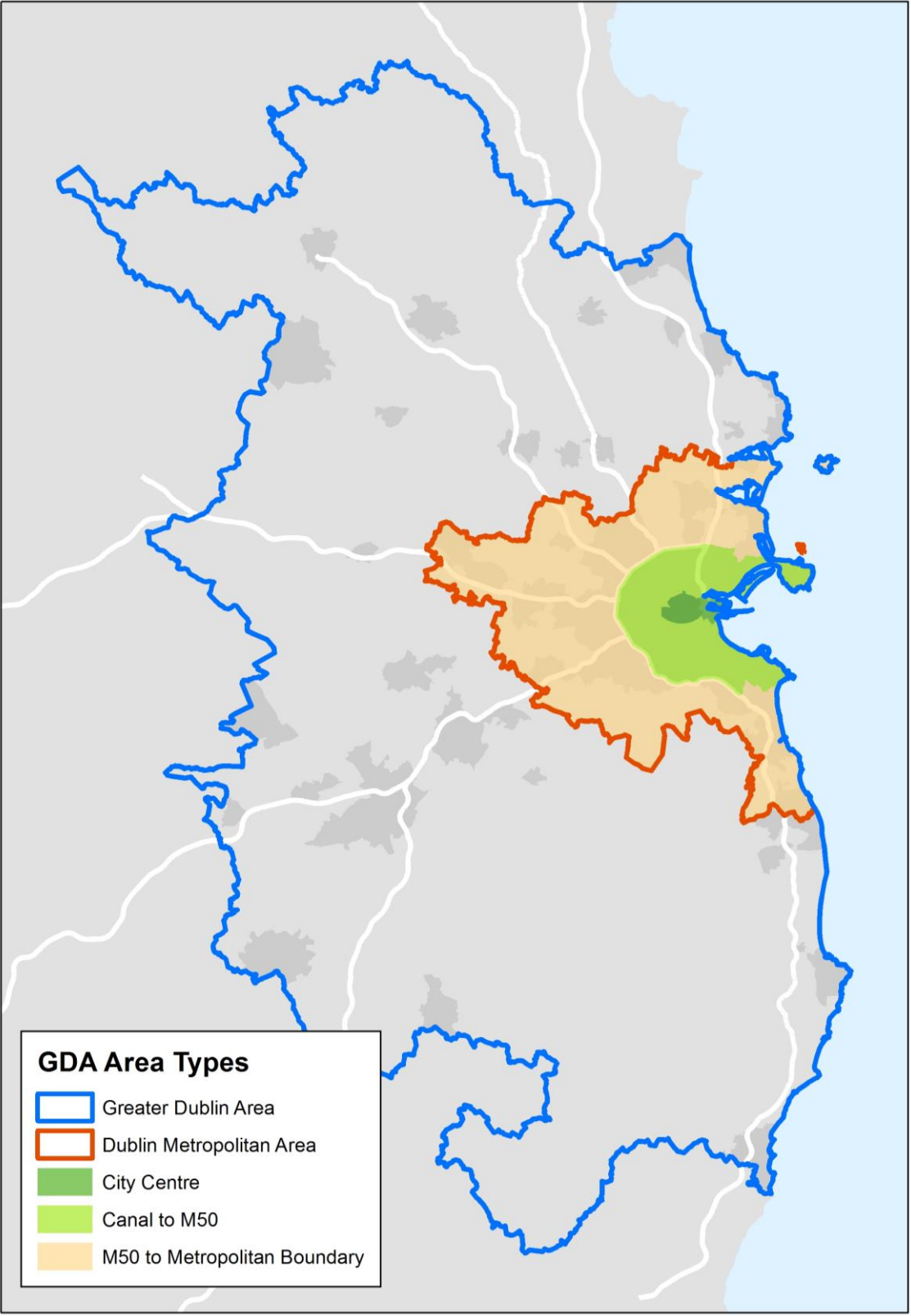
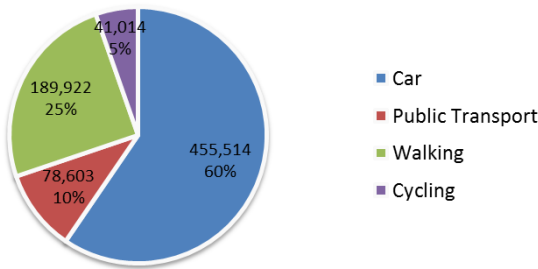


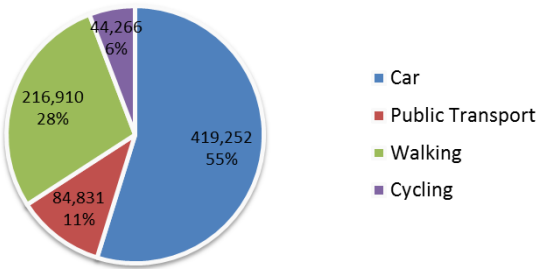
Figure 5-4: AM Peak Segment Based Mode Share Comparison



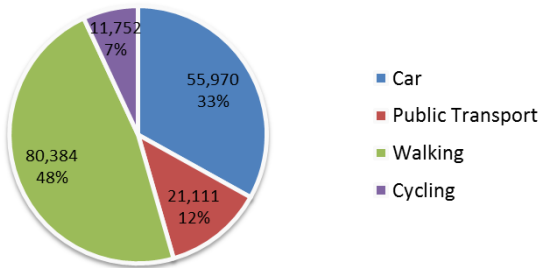
Do Minimum - Metropolitan Area
Mode Share Inter Peak



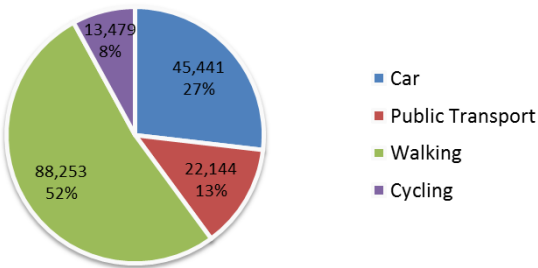
Do Strategy - Metropolitan Area
Mode Share Inter Peak



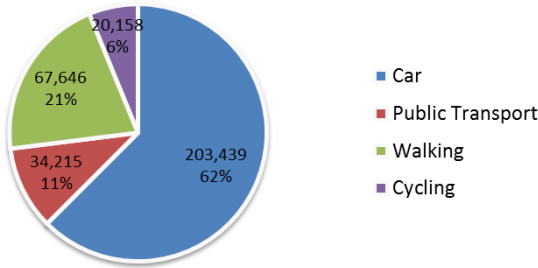
Do Minimum - City Centre
Mode Share Inter Peak



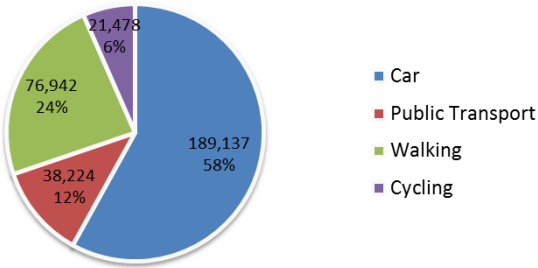
Do Strategy - City Centre
Mode Share Inter Peak



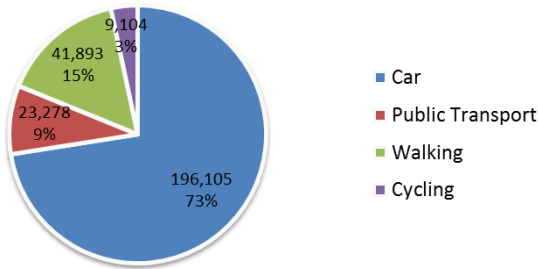
Do Minimum - Canal to M50
Mode Share Inter Peak



Do Strategy - Canal to M50
Mode Share Inter Peak



Do Minimum - M50 to Metropolitan
Boundary Mode Share Inter Peak



Do Strategy - M50 to Metropolitan
Boundary Mode Share Inter Peak

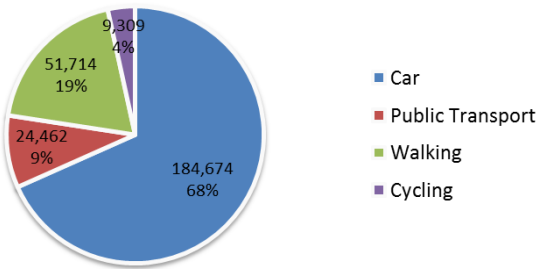
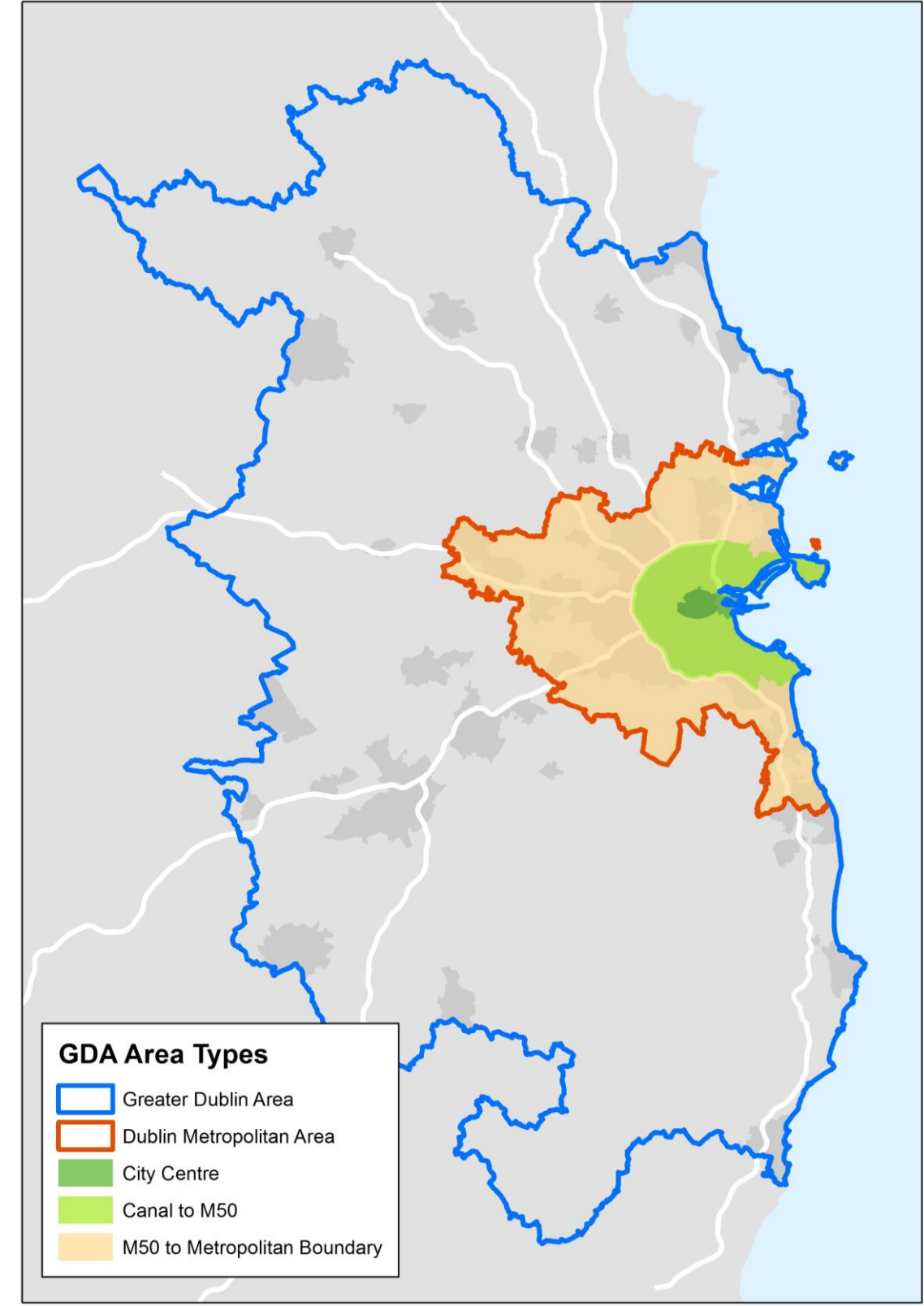
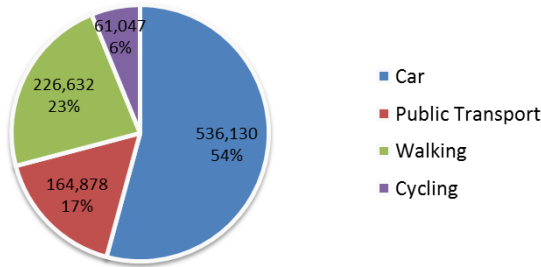


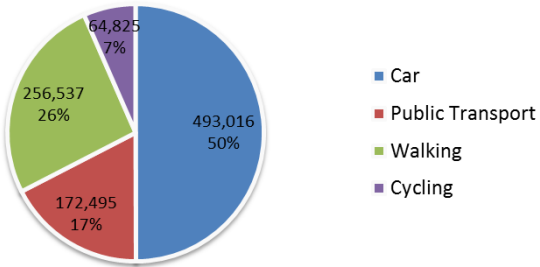
Figure 5-5: Inter Peak Segment Based Mode Share Comparison



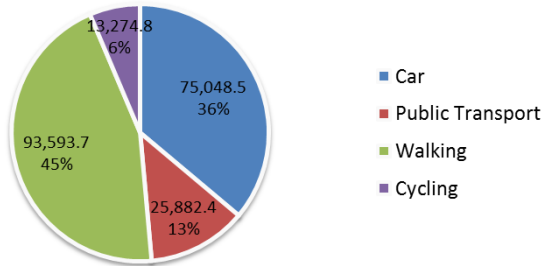
Do Minimum - Metropolitan Area
Mode Share PM Peak



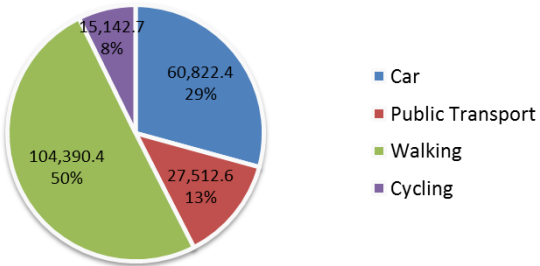
Do Strategy - Metropolitan Area
Mode Share PM Peak



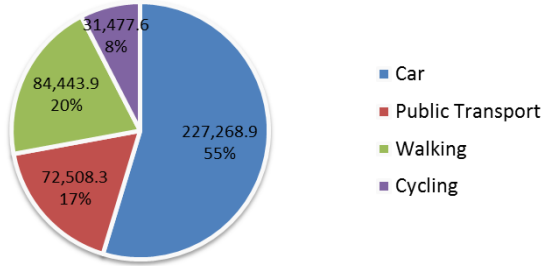
Do Minimum - City Centre
Mode Share PM Peak



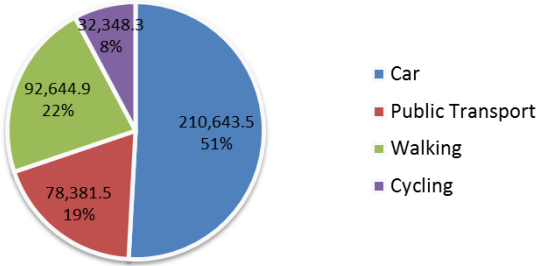
Do Strategy - City Centre
Mode Share PM Peak



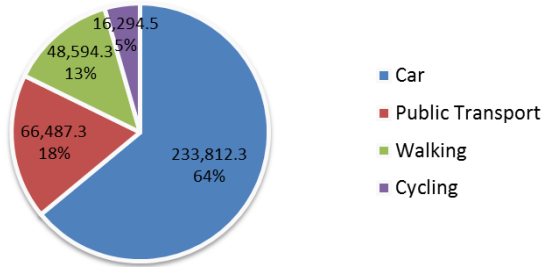
Do Minimum - Canal to M50
Mode Share IP Peak



Do Strategy - Canal to M50
Mode Share PM Peak



Do Minimum - M50 to Metropolitan
Boundary Mode Share PM Peak



Do Strategy - M50 to Metropolitan
Boundary Mode Share PM Peak

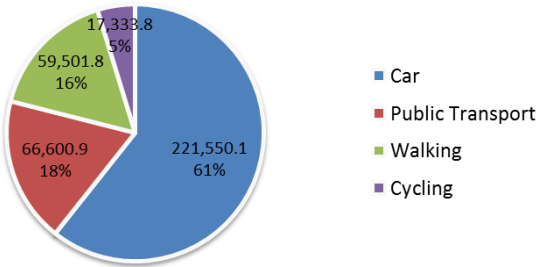


Figure 5-6: PM Peak Segment Based Mode Share Comparison

5.2.4 Metropolitan Orbital Mode Share

A key outcome for the Strategy relates to the provision of a feasible alternative to the private car for orbital trips within Metropolitan Dublin, i.e. movements orbitally between the GDA segments outlined in Figure 5-3: GDA Segments.

Mode share statistics for orbital movements in the Metropolitan area outside the City Centre have been extracted from the model for the AM period and are displayed in Figure 5-7 below.

With the implementation of the Strategy measures, the share of trips undertaken by private car reduces from 55.4% to 45.5% compared to the Do minimum scenario, with a resultant increase in the share of trips by sustainable modes.

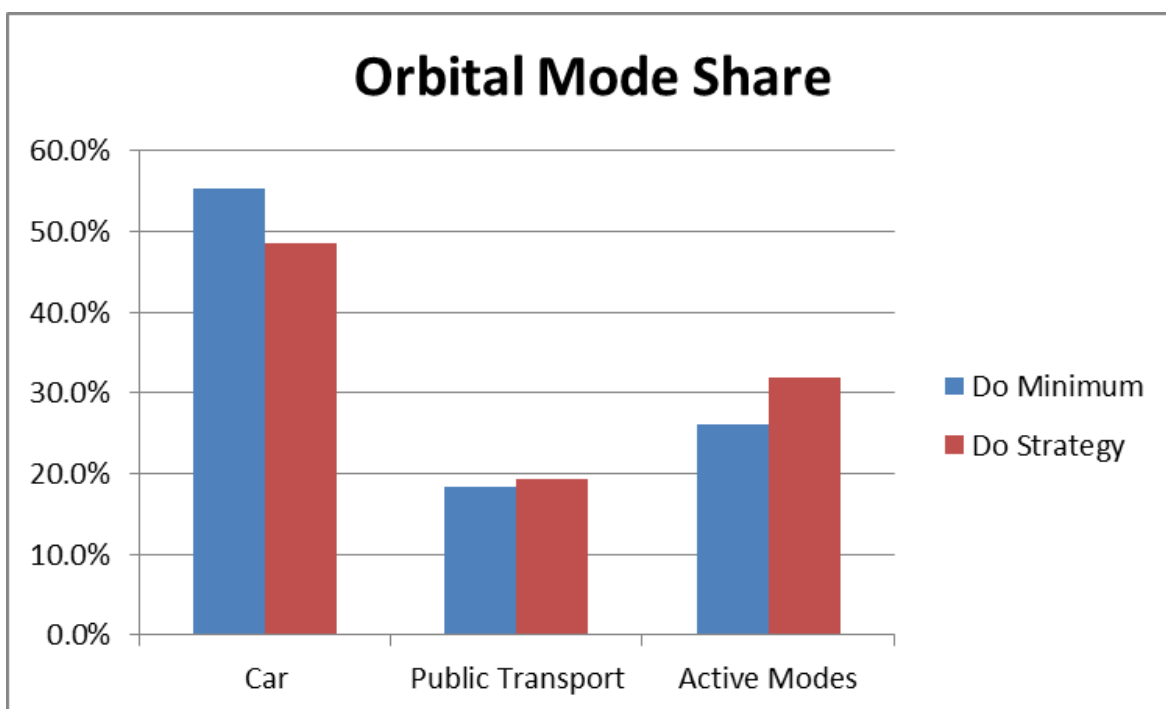


Figure 5-7: Metropolitan Orbital Mode Share

5.3 Strategic Movements

An analysis of key strategic movements within the GDA has been undertaken which involves comparing AM peak hour inbound strategic travel demand across the M50 cordon and the City Centre Canal cordon. Travel demand for car users and public transport passengers is assessed for the Do Minimum and Do Strategy scenarios.

5.3.1 Flows across M50 Cordon

Figure 5-8 presents the modelled AM peak inbound trips by car and public transport crossing the M50 cordon. The analysis indicates that the total demand crossing the M50 is forecast to increase by approximately 6% with the Strategy in place. Car traffic crossing the M50 is forecast to reduce by 3% with total public transport trips to increase by 16%.

The model also forecasts a transfer from conventional bus services to heavy rail, light rail and BRT services.

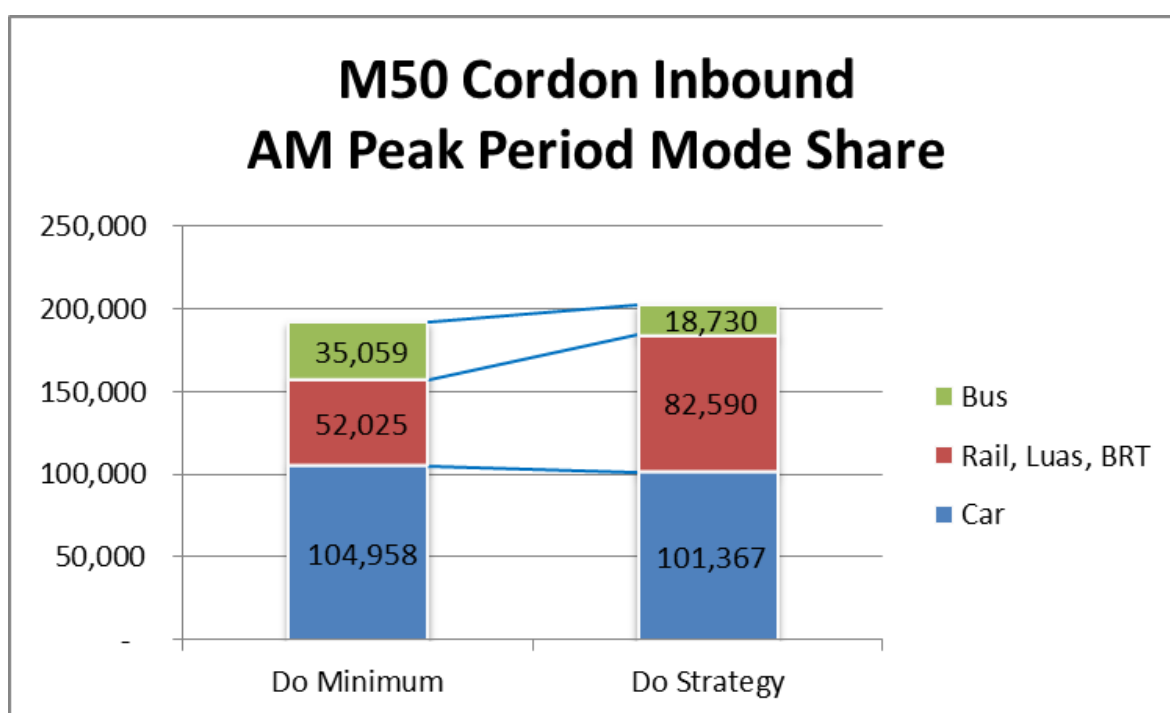


Figure 5-8: AM Peak Period Inbound – M50 Cordon Mode Share Comparison

5.3.2 Flows across Canal Cordon

Figure 5-9 presents the modelled AM peak inbound trips by car and public transport crossing the canal cordon into Dublin City Centre. The analysis indicates that the total demand crossing the canals is forecast to increase by approximately 9% with the Strategy in place. Car traffic crossing the canal cordon is forecast to reduce by 7% with total public transport trips to increase by 18%.

Again, the model forecasts a transfer from conventional bus services to heavy rail, light rail and BRT services.

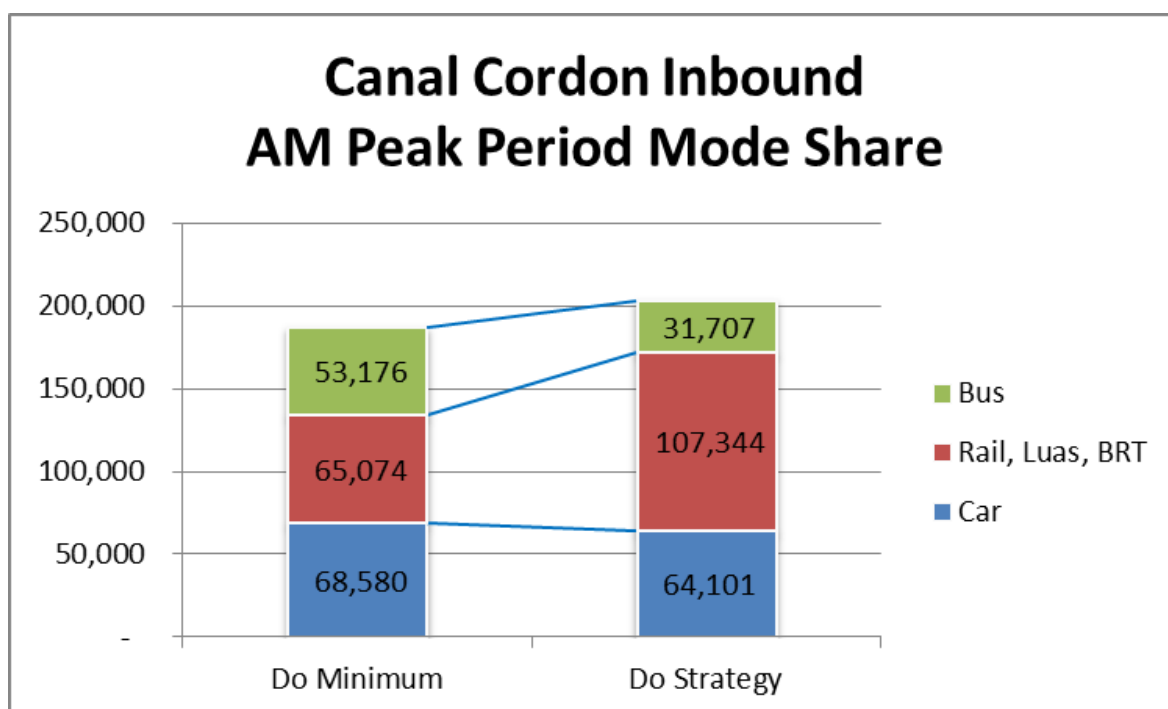


Figure 5-9: AM Peak Inbound – Canal Cordon Mode Share Comparison

5.4 Public Transport Network

5.4.1 Network Performance

Table 5-5 details the total public transport network statistics for the Do Minimum and the Do Strategy scenarios in the AM, Inter-Peak (IP) and PM peak hours.

The increase in demand for public transport on the modelled network described previously is reflected in increased total travel time and distance on public transport services for all time periods.

Table 5-5: Public Transport Global Network Statistics

	Do Minimum	Do Strategy
AM Peak		
Total PT Passenger Distance (pas.km)	956,312	1,124,583
Total PT Passenger Time (pas.hrs)	28,581	30,031
Inter Peak		
Total PT Passenger Distance (pas.km)	687,382	756,858
Total PT Passenger Time (pas.hrs)	18,808	18,630
PM Peak		
Total PT Passenger Distance (pas.km)	794,189	886,787
Total PT Passenger Time (pas.hrs)	24,350	23,790

5.4.2 Line Flows

An analysis of modelled line flows for the major GDA Strategy public transport proposals is presented in Table 5-6 below for the AM peak hour. The analysis summarises the maximum forecast AM peak passengers flow on each public transport proposal, in the Do Strategy scenario.

The proposed rail, Metro, Luas, BRT and bus proposals are forecast to accommodate significant passenger numbers in peak hours.

Table 5-6: Maximum Public Transport Passenger Numbers

	Maximum Passenger Flow
South East Metro (Northbound)	6,431
LR7 Optimised Metro North (Southbound)	5,753
DART Underground (Southbound)	9,513
Western Luas (Eastbound)	2,657
Luas Red Line (Eastbound)	2,632
Finglas Luas (Southbound)	2,599
Clongriffin – Tallaght BRT (Northbound)	1,430
Swords – City Centre BRT (Southbound)	1,782
Blanchardstown – UCD BRT (Eastbound)	2,173

Figure 5-10 and Figure 5-11 show the line flows as bandwidths, as output from the ERM for the AM peak hour.

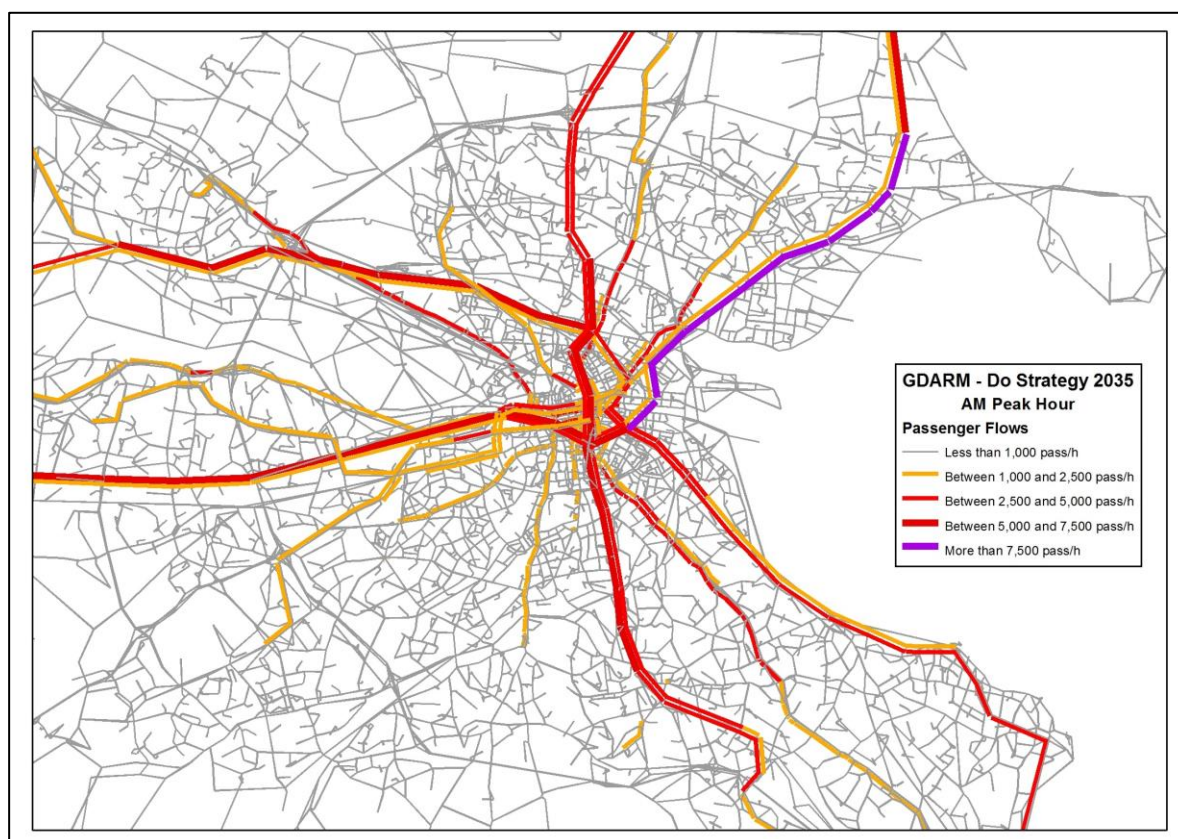


Figure 5-10: Public Transport Proposals – AM Peak Passenger Numbers

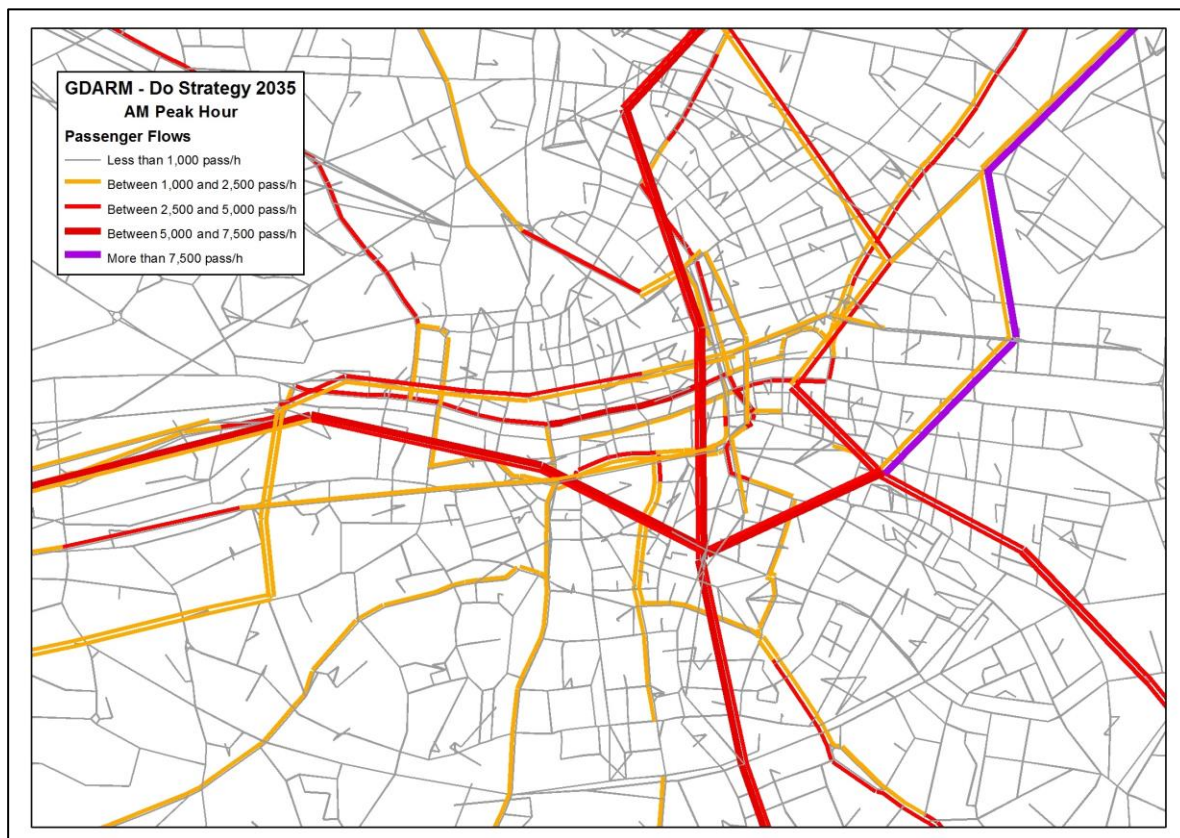


Figure 5-11: Public Transport Proposals – AM Peak Passenger Numbers within City Centre

Figure 5-12 and Figure 5-13 below show the average ratio of passenger load to available capacity on the public transport network, as output from the ERM for the AM peak hour, for the Base Year and Do Strategy scenarios.

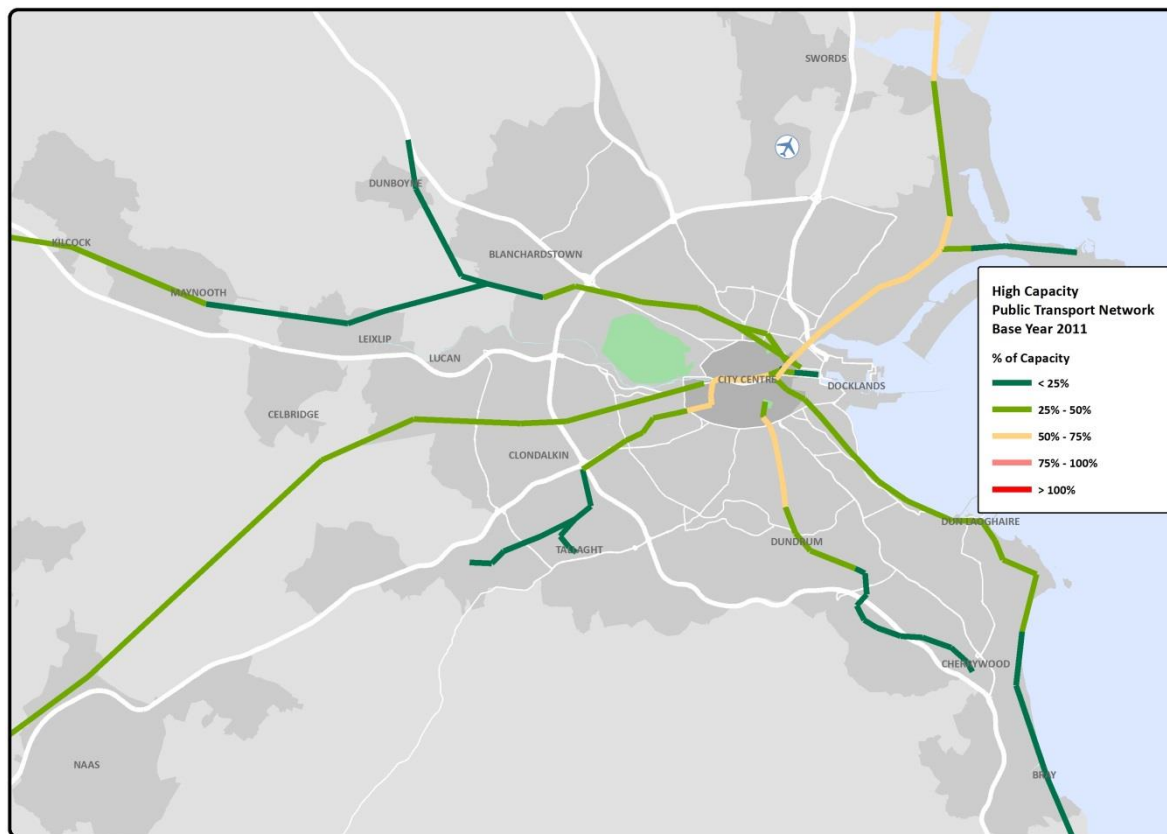


Figure 5-12: Base Year – AM Peak Public Transport Network Capacity

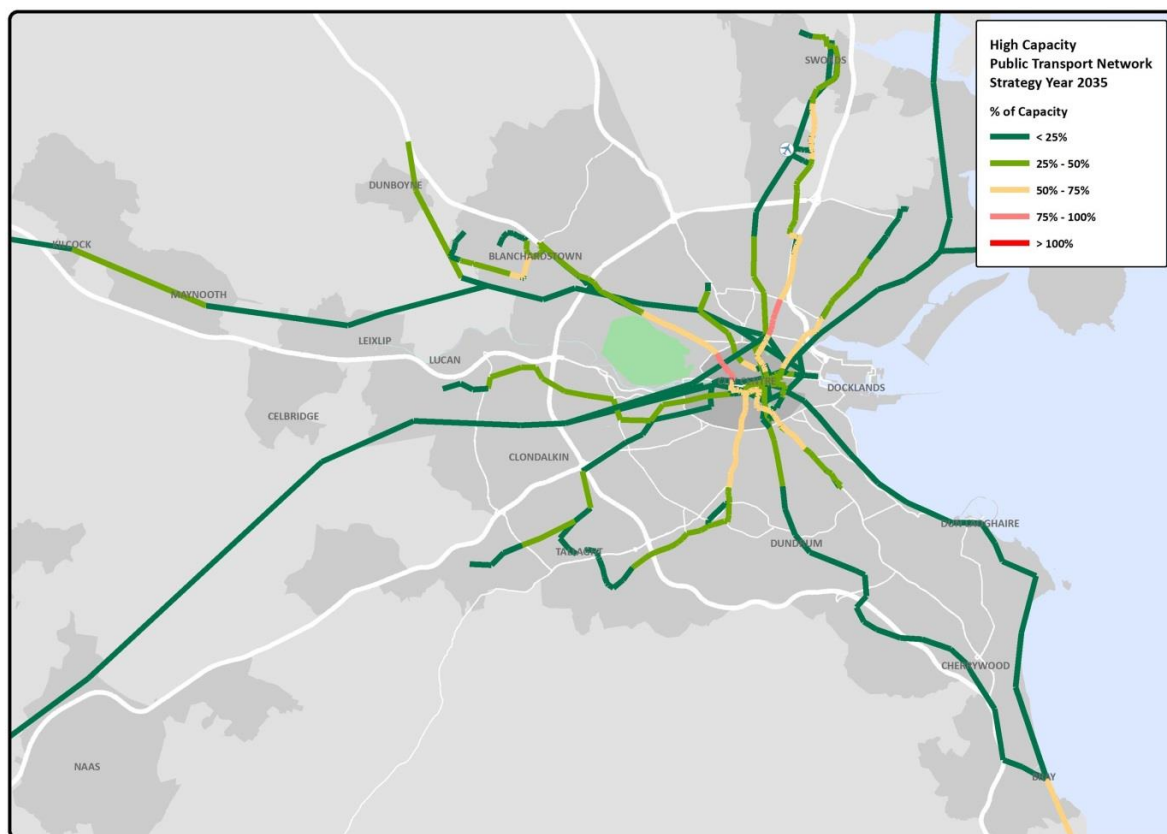


Figure 5-13: Do Strategy – AM Peak Public Transport Network Capacity

5.4.3 Total Passenger Boardings

Table 5-7 shows the total passenger boardings for the AM, IP and PM peak hours, for each of the main public transport sub-modes for the Do Minimum and Do Strategy scenarios.

Overall the Do Strategy public transport proposals are forecast to accommodate an increase in passenger boardings of between 38,000 and 30,000 in the AM and PM peak hours respectively. The IP hour also sees an increase in passenger boardings of approximately 14,000. Luas boardings are forecast to reduce, as a result of the proposal to upgrade much of the existing Luas Green Line to Metro. The results also indicate a transfer from commuter rail services to DART due to the extension of the DART network to Maynooth, Kildare and Drogheda as part of the DART Expansion Programme.

Table 5-7: Boarding and Alighting Totals for each public transport sub-mode

	AM Peak		IP Peak		PM Peak	
	Do Min	Do Strat	Do Min	Do Strat	Do Min	Do Strat
Luas	28,115	19,364	8,314	5,957	24,410	15,594
DART	23,177	44,661	7,335	11,205	20,016	35,692
BRT	0	16,213	0	6,700	0	14,655
Metro	0	22,993	0	8,081	0	20,176
Rail	26,517	12,431	5,407	2,921	19,836	7,934
Total	77,809	115,661	21,056	34,864	64,262	94,050

5.4.4 Public Transport Speeds

This analysis outlines the percentage change in the average speed for public transport sub-mode services from the Do Minimum to the Do Strategy scenario. Model results are presented in Table 5-8.

The model results indicate increases in DART, Dublin Bus and Inter-Urban Bus speeds as a result of the DART Expansion Programme and the forecast improvements in road network operation. There are negligible impacts forecast on Heavy Rail and Luas average speeds.

Table 5-8: Modelled change in average speed on public transport services

Public Transport Mode	% change in average speed	
	AM Peak	PM Peak
DART	+13%	+13%
Other Heavy Rail	0%	0%
Luas	0%	0%
Dublin Bus	+14%	+17%
Inter-Urban Bus	+6%	+7%

5.5 Road Network

5.5.1 Network Performance

Table 5-9 details the total modelled road network statistics for the Do Minimum and the Do Strategy scenarios in the AM, Inter-Peak (IP) and PM peak hours.

Reductions in road travel time and distance are forecast in the Do Strategy scenario, indicating a reduction in congestion when compared to the Do Minimum scenario for all time periods.

Table 5-9: AM Peak Summary Network Statistics

AM Peak	Do Minimum	Do Strategy
AM Peak		
Total Road Travel Time (pcu.hrs)	210,296	204,683
Total Road Distance Travelled (pcu.km)	9,346,091	9,326,942
Inter Peak	AM Peak	AM Peak
Total Road Travel Time (pcu.hrs)	100,620	98,728
Total Road Distance Travelled (pcu.km)	5,478,515	5,417,038
PM Peak	AM Peak	AM Peak
Total Road Travel Time (pcu.hrs)	190,292	186,977
Total Road Distance Travelled (pcu.km)	8,890,976	8,812,032

5.5.2 Overcapacity Queues

Overcapacity queues are queues that do not clear during the course of the model assignment period due to the junction in question being over capacity. These queues are simulated as growing linearly over the course of the simulation period. The extent of overcapacity queues is used as an indicator to compare the performance of the Do Minimum and the Do Strategy modelled road networks.

Table 5-10 details the comparison of the total time spent by vehicles in overcapacity queues for the GDA network. It shows that in the Do Strategy scenario overcapacity queued time reduces in the AM peak and IP hours, with minimal impacts in the PM peak.

Table 5-10: Overcapacity Queued Time

Overcapacity Queued Time (pcu.hrs)	Do Min	Do Strat
AM Peak	19,937	17,398
Inter Peak	1,181	1,069
PM Peak	16,535	16,746

5.5.3 Road Journey Times

This section assesses the journey times for road traffic comparing the difference between the Do Minimum and the Do Strategy scenarios for the AM, IP and PM peak hours. The journey time routes used are based on a selection of key radial routes to the city centre and are presented in Table 5-11.

The journey times are forecast to improve or remain broadly similar for the Do Strategy scenario during the AM, IP and PM Peaks.

Table 5-11: AM Peak Journey Times

Radial Routes	AM		IP		PM	
	Do Min	Do Strat	Do Min	Do Strat	Do Min	Do Strat
Portmarnock to City Centre	01:12:31	01:04:01	00:37:07	00:36:32	00:55:17	00:53:32
Finglas to City Centre	00:42:08	00:35:19	00:27:06	00:25:21	00:31:50	00:30:46
Dunshaughlin to City Centre	01:00:05	00:50:52	00:33:52	00:32:42	00:41:09	00:39:42
Lucan to City Centre	00:41:44	00:32:34	00:20:07	00:18:24	00:42:49	00:38:42
Firhouse to City Centre	00:51:29	00:47:39	00:26:12	00:25:57	00:39:51	00:38:31
Dun Laoghaire to City Centre	00:42:26	00:43:20	00:22:52	00:29:10	00:32:14	00:32:09

5.5.4 City Centre Road Network Performance

To measure the performance of the road network in the city centre, travel time data were extracted from the Do Minimum and Do Strategy scenarios for city centre only links. Figure 5-14 presents a comparison of total travel time within the city centre for the AM, IP and PM hours.

The analysis indicates that with the implementation of the Strategy, travel time on the city centre road network reduces by approximately 2% in the AM, 5% in the IP and 4% in the PM.

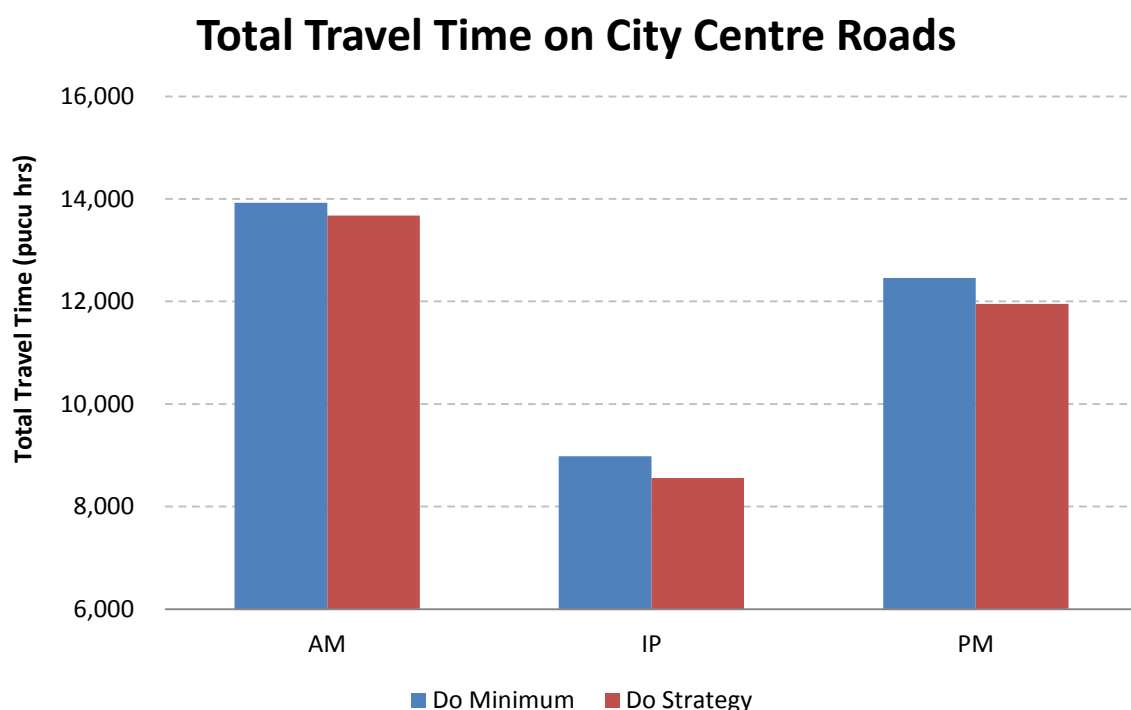


Figure 5-14: Total Travel Time on City Centre Road Links

5.5.5 Strategic Road Network Performance

To measure the performance of the strategic road network in the GDA, travel time data was extracted from the model for the Do Minimum and Do Strategy scenarios for the GDA motorway

links. Figure 5-15 presents a comparison of total travel time on GDA motorways for the AM, IP and PM hours.

The analysis indicates that with the Strategy in place, travel time on the GDA motorway network reduces by approximately 18% in the AM, 21% in the IP and 19% in the PM.

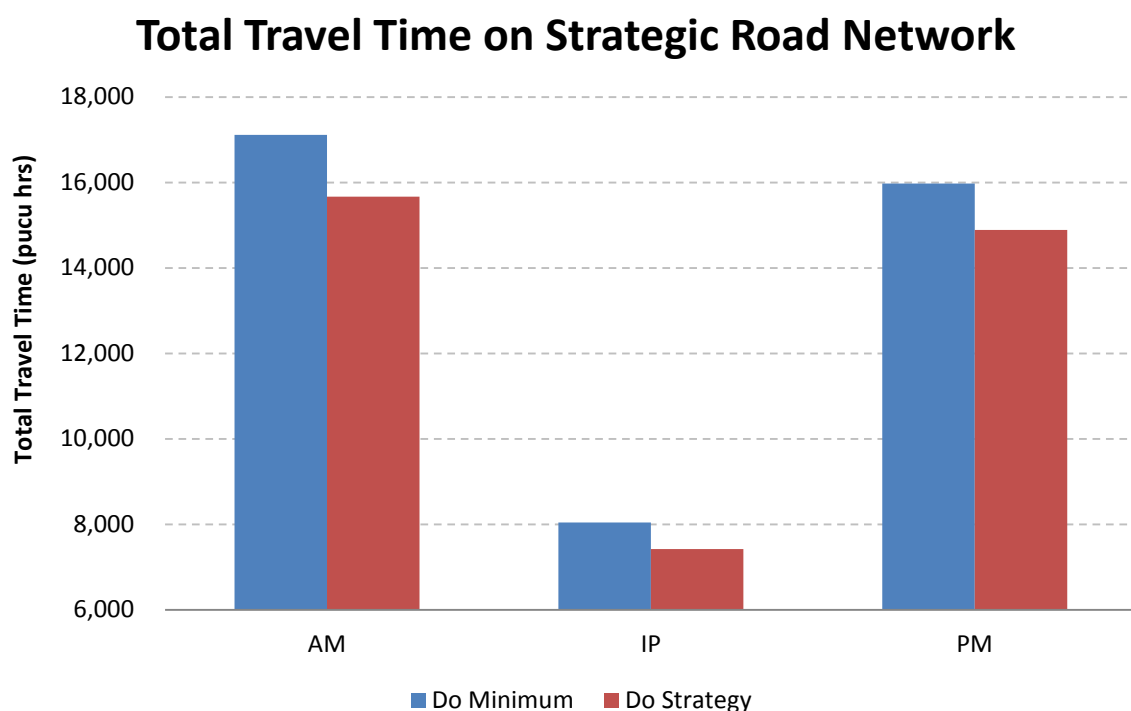


Figure 5-15: Total Travel Time on the Strategic Road Network

5.6 Environment

An assessment of the environmental indicators from the ERM for the GDA Strategy was also undertaken. The environmental review has considered vehicle emissions and noise forecasts.

5.6.1 Emissions

Table 5-12 details the comparison of vehicle emissions for the GDA for the AM, Inter Peak (IP) and PM peak hours, for the Do Minimum and the Do Strategy scenarios. The model outputs indicate that all types of vehicle emissions reduce in the Do Strategy scenario.

Table 5-12: GDA Network Emissions

Pollutants	AM		IP		PM	
	Do Min	Do Strat	Do Min	Do Strat	Do Min	Do Strat
CO	32,582.	31,318	17,121	16,396	29,748	28,804
CO2	344,288	337,624	204,462	198,866	322,848	316,549
NOX	7,318	7,178	4,506	4,327	6,883	6,644
HC	5,855	5,637	3,118	2,987	5,359	5,188

5.6.2 Noise

This section compares the change in noise levels associated with the change in traffic volumes in the Do Strategy compared to the Do Minimum. The assessment is based on the Design Manual for

Roads and Bridges (DMRB)⁴ and the National Roads Authority (NRA)⁵ guidance on relating change in traffic flows to change in noise.

The DMRB guidance indicates that an increase in AADT of 25% equates to an increase in noise of 1dB, while a reduction of 20% equates to a reduction in noise of 1dB. A change in noise level of ± 3 dB is approximately equivalent to a 100% increase or a 50% decrease in traffic volume. The DMRB outlines that changes of 3dB – 4.9dB are considered as minor, changes of 5dB – 9.9dB are moderate and changes of 10+dB are major.

Figure 5-16 outlines the changes to the noise levels based solely on changes to AADT between the Do Minimum and the Do Strategy. It can be seen that there is significant improvements to noise levels within the Core City Centre network, where the Dublin City Centre Transport Plan measures are implemented. It should be noted that while there is anticipated Major increases to noise levels on some streets, targeted local traffic management may be able to mitigate such increases.



Figure 5-16: Changes to Noise Levels Associated with Traffic Volumes in Dublin City Centre

5.7 Accessibility

An accessibility assessment of the GDA Strategy was undertaken using outputs from the ERM. The assessment considered the impact of changes in traffic levels on the road network and how this relates to severance i.e. changes to the impedance to pedestrians to travel along and across network links in the Do Strategy scenario. The assessment also considered overall access to public transport across the GDA.

⁴ DMRB, Volume 11, Section 3, Part 7

⁵ NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes October 2004

5.7.1 Severance

The Design Manual for Roads and Bridges (DMRB)⁶ provides guidance on quantifying relief to severance based on reductions in traffic volumes. The level of relief is described using a scale of Slight, Moderate or Substantial, based on the reductions in existing traffic levels of <30%, 30-60% and >60%, respectively.

Figure 5-17 illustrates the relief from severance in Dublin City Centre based solely on changes to AADT between the Do Minimum and the Do Strategy. Similar to noise levels, it can be seen that there is significant improvements to severance within the Core City Centre Network, where the Dublin City Centre Transport Plan measures are implemented. Substantial improvements to severance are noted on the quays, and at the Westmoreland Street / D'Olier Street public transport interchange area.

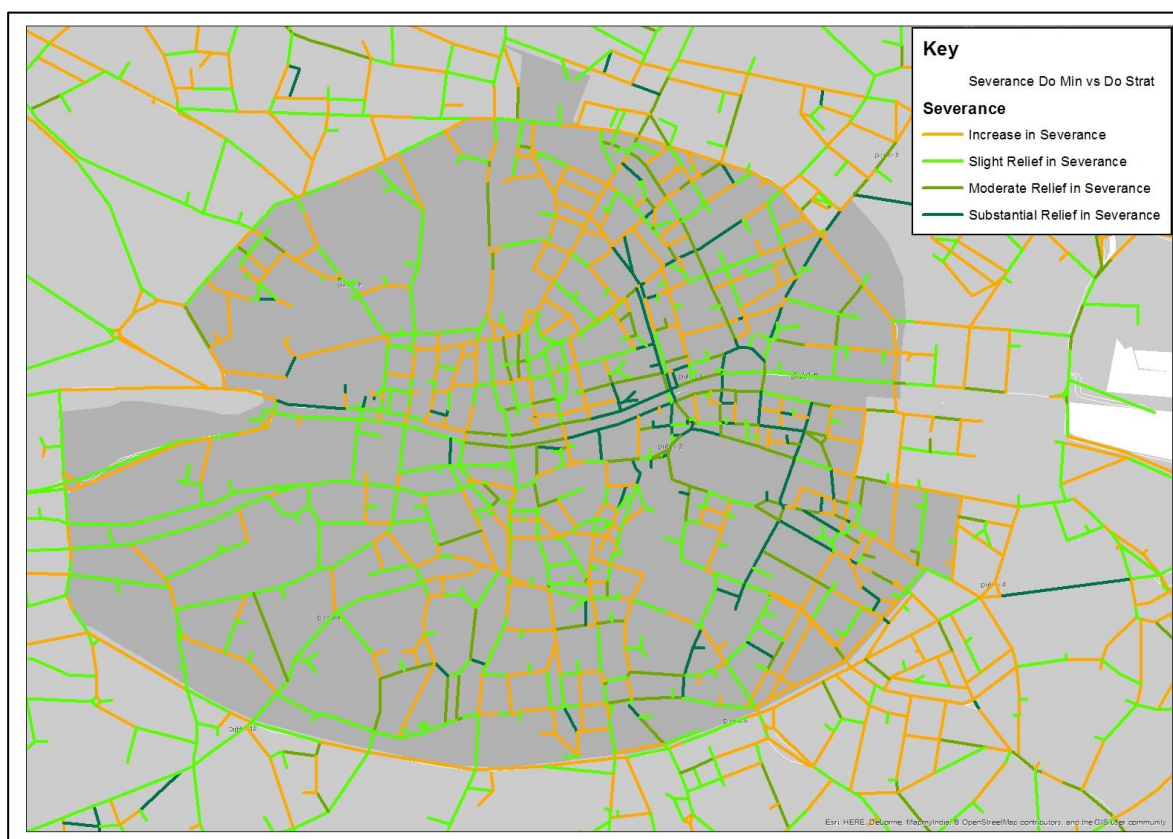


Figure 5-17: Relief from Severance within Dublin City Centre

⁶ DMRB, Volume 11, Section 3, Part 8

5.7.2 Public Transport Accessibility

Figure 5-18 presents estimated public transport journey times to Dublin City Centre (St. Stephen's Green) and to Dublin Airport from the zones throughout the GDA for the AM peak period. The public transport journey times include access time to a public transport service, wait time for the service, transit time to the City Centre and Airport and any walk time to the zone.

The analysis indicates increased public transport accessibility levels across the Dublin Metropolitan area in the Do Strategy scenario. There are improvements forecast to journey times to the City Centre from wider catchments such as Swords, Ballymun, Finglas, Blanchardstown, Lucan, Adamstown, Clondalkin, Tallaght and Cherrywood.

The modelled improvement in public transport accessibility to Dublin Airport in the Do Strategy scenario is also notable.

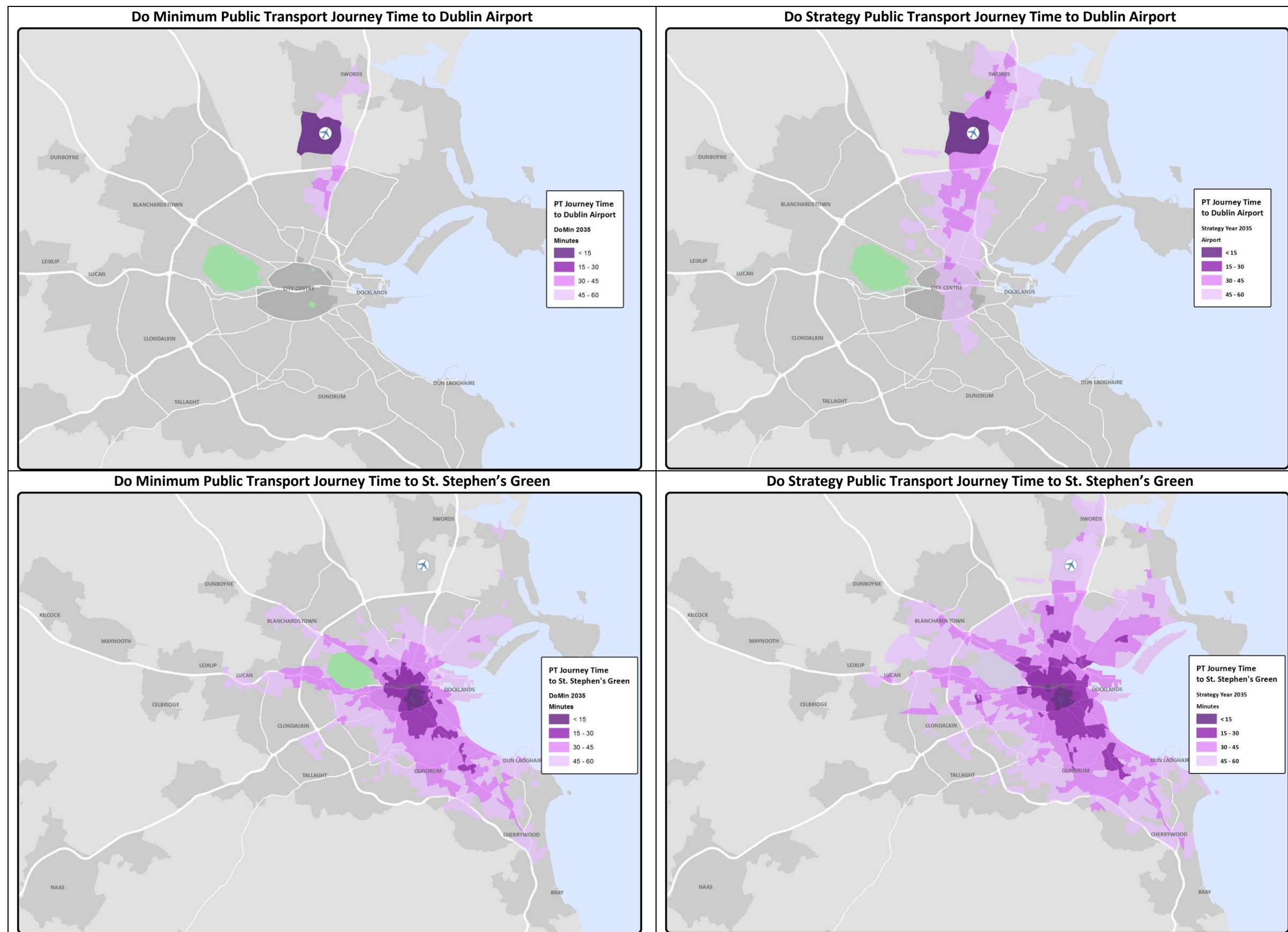


Figure 5-18: Public Transport Journey Times to St Stephen's Green and to Dublin Airport

5.8 Integration

A key indicator of the level of integration within the public transport network is the total number of trips interchanging or transferring between public transport modes, e.g. a commuting journey that involves a DART trip and an interchange/transfer to a bus trip.

Table 5-13 details the total modelled passenger transfers for each public transport mode in the GDA for the AM peak hour for the Do Minimum and the Do Strategy scenarios. The results indicate an increase of 38% in total passenger transfers on the public transport network in the Do Strategy scenario.

There are forecast increases in passenger transfers for bus and rail. The model results indicate a reduction in passenger transfers to Luas as a result of the upgrade of much of the existing Luas Green line to Metro.

Table 5-13: AM Peak Public Transport Passenger Transfers

Public Transport Mode	Do Minimum Transfers	Do Strategy Transfers	% difference
Bus (incl. BRT in Strategy)	7,954	10,209	+28%
Rail	3,365	7,077	+110%
Luas	11,397	8,047	-29%
Metro	-	5,950	-
Total	22,716	31,283	+38%

5.9 Economy

The economy assessment estimates the transport user benefits for the GDA Strategy and compares this to an outline estimate of strategy costs based on cost outcomes for similar projects. This provides an initial high level indication of the performance of the package of strategy infrastructure schemes, i.e. do the benefits of implementing the Strategy exceed the costs.

Full details of the assessment are included in the '*Greater Dublin Area Draft Transport Strategy 2015-2035: Outline Transport User Benefits Assessment*'.

A simple assessment was undertaken to compare the estimated transport user benefits to the set of outline cost estimates available to the NTA as of September 2015.

Generally, if the forecast benefits for the Strategy exceed the estimated costs, then the investment can be considered worthwhile. The results of the assessment of the Strategy are presented in Table 5-14.

Table 5-14: GDA Transport Strategy Economic Assessment (2009 market prices)

	€ '000
Present Value of Transport User Benefits (PVB)	12,404,900
Present Value of Costs (PVC)	9,445,100
Net Present Value (NPV)	2,959,800
Transport User Benefit to Cost Ratio	1.3

The estimated transport user benefits of the GDA Strategy are forecast to exceed the estimated outline strategy costs with a benefit to cost ratio of 1.3:1. This indicates that investment in the GDA Strategy is worthwhile, based on transport user benefits alone.

This assessment does not consider other recognised economic benefits arising from major transport schemes such as:

- Benefits associated with reductions in road collisions;
- Health, absenteeism and journey ambience benefits associated with increased walking and cycling; and
- Wider economic benefits such as agglomeration.

It should be noted that the inclusion of the above would provide significant additional benefits to those forecast in this report. Therefore this is considered a conservative estimate of the overall economic value of the Greater Dublin Area Transport Strategy.

6 Conclusions

A detailed assessment of the transport proposals outlined as part of the Greater Dublin Area Transport Strategy 2015 – 2035 was undertaken using outputs from the Eastern Regional transport model.

As a result of this assessment, the main impacts of the Strategy can be summarised as follows:

- A substantial proportion of projected growth in travel demand in the GDA is accommodated by sustainable transport modes;
- The Strategy is forecast to provide an increase in mode share for sustainable transport modes and a reduction in the demand to travel by private car;
- The public transport network is forecast to operate efficiently with a significant increase in total passenger boardings;
- Travel times on the road network are forecast to reduce as a result of the Strategy;
- The Strategy is forecast to reduce transport related noise and emissions;
- The Strategy is forecast to improve accessibility by reducing severance and increasing the accessibility to public transport;
- A more integrated public transport network provided by the Strategy results in an increased level of public transport interchange; and
- The Strategy represents a worthwhile investment with transport user benefits forecast to exceed the outline estimate cost of delivering the Strategy.

Annex 1 Population, Employment and Settlements

A1.1 Population and Employment Breakdown

A1.1.1 Local Authority Population Settlements and Non-Settlements (Rural) for 2011 and 2035

County	Settlement Type	Settlement Name	Population 2011	Population 2035	Population Growth
DCC	Urban	Baldoyle	11,915	21,738	9,823
DCC	Urban	Ballsbridge	25,303	28,012	2,709
DCC	Urban	Ballyfermot	33,901	42,418	8,517
DCC	Urban	Ballymun	33,589	46,160	12,571
DCC	Urban	Beaumont	34,366	37,512	3,146
DCC	Urban	Cabra	36,573	42,704	6,131
DCC	Urban	Castleknock	129	141	12
DCC	Urban	Clontarf	26,870	29,329	2,459
DCC	Urban	Darndale	8,726	9,525	799
DCC	Urban	Drimnagh	24,395	31,212	6,817
DCC	Urban	Finglas	34,135	37,969	3,834
DCC	Urban	Kimmage	24,930	27,212	2,282
DCC	Urban	Marino	32,281	35,236	2,955
DCC	Urban	North Docks	6,895	12,447	5,552
DCC	Urban	North East Quad	24,360	26,590	2,230
DCC	Urban	North West Quad	25,060	33,848	8,788
DCC	Urban	Raheny	32,805	35,808	3,003
DCC	Urban	Rathgar	31,123	33,972	2,849
DCC	Urban	Red Cow	818	893	75
DCC	Urban	South Docks	17,086	28,146	11,060
DCC	Urban	South East Quad	13,582	14,825	1,243
DCC	Urban	South West Quad	44,090	56,443	12,353
DCC	Urban	UCD	4,680	5,108	428
DCC	Rural	Rural	0	0	0
SDCC	Urban	Adamstown	2,520	17,870	15,350
SDCC	Urban	Ballyfermot	8,585	9,928	1,343
SDCC	Urban	Clonburris	1,242	14,376	13,134
SDCC	Urban	Clondalkin	30,346	37,062	6,716
SDCC	Urban	Kimmage	22,998	23,526	528
SDCC	Urban	Liffey Valley	37,271	37,751	480
SDCC	Urban	Lucan	18,999	22,658	3,659
SDCC	Urban	Newcastle	2,757	5,246	2,489
SDCC	Urban	Rathcoole	4,019	5,458	1,439
SDCC	Urban	Rathfarnham	33,658	35,577	1,919

County	Settlement Type	Settlement Name	Population 2011	Population 2035	Population Growth
SDCC	Urban	Rathgar	2,993	3,089	96
SDCC	Urban	Red Cow	1,049	2,968	1,919
SDCC	Urban	Saggart	2025	3,944	1,919
SDCC	Urban	South Tallaght	41,485	43,404	1,919
SDCC	Urban	Tallaght	29,219	35,935	6,716
SDCC	Urban	West Tallaght	21,665	29,340	7,675
SDCC	Rural	Rural	4,374	4,593	219
FCC	Urban	Airport	1,049	2,532	1,483
FCC	Urban	Balbriggan	19,958	28,573	8,615
FCC	Urban	Baldoyle	3,392	7,967	4,575
FCC	Urban	Ballycoolin	20,043	24,384	4,341
FCC	Urban	Ballymun	5,262	6,826	1,564
FCC	Urban	Blanchardstown	68,494	75,931	7,437
FCC	Urban	Castleknock	8,642	13,496	4,854
FCC	Urban	Donabate	6,555	9,955	3,400
FCC	Urban	Finglas	5,990	7,835	1,845
FCC	Urban	Howth	18,222	19,745	1,523
FCC	Urban	Kinsealy-Drinan	5,384	5,880	496
FCC	Urban	Lusk	6,919	8,537	1,618
FCC	Urban	Malahide	15,254	17,409	2,155
FCC	Urban	Portmarnock	8,921	12,850	3,929
FCC	Urban	Rush	8,901	12,360	3,459
FCC	Urban	Skerries	9,542	11,980	2,438
FCC	Urban	Swords	35,859	56,892	21,033
FCC	Rural	Rural	25,604	26,884	1,280
DLR	Urban	Blackrock	17,483	18,675	1,192
DLR	Urban	Bray	4,205	12,442	8,237
DLR	Urban	Cherrywood	27,368	43,142	15,774
DLR	Urban	Dundrum	29,269	31,816	2,547
DLR	Urban	Dún Laoghaire	56,391	60,496	4,105
DLR	Urban	Rathfarnham	11,533	11,750	217
DLR	Urban	Rathgar	7,274	7,688	414
DLR	Urban	Sandyford	25,877	30,932	5,055
DLR	Urban	Stepaside	19,876	32,658	12,782
DLR	Urban	UCD	4,829	5,211	382
DLR	Rural	Rural	2,156	2,264	108
KCC	Urban	Athy	10,482	14,451	3,969
KCC	Urban	Blessington	218	218	0
KCC	Urban	Celbridge	18,450	29,745	11,295
KCC	Urban	Clane	6,594	8,710	2,116

County	Settlement Type	Settlement Name	Population 2011	Population 2035	Population Growth
KCC	Urban	Kilcock	5,144	7,790	2,646
KCC	Urban	Kilcullen	3,328	4,826	1,498
KCC	Urban	Kildare	7,826	11,532	3,706
KCC	Urban	Kill	2,935	4,082	1,147
KCC	Urban	Leixlip	15,372	24,999	9,627
KCC	Urban	Maynooth	12,600	20,013	7,413
KCC	Urban	Monasterevin	3,338	4,836	1,498
KCC	Urban	Naas	21,204	32,587	11,383
KCC	Urban	Newbridge	22,255	31,167	8,912
KCC	Urban	Prosperous	2,440	3,321	881
KCC	Urban	Rathangan	2,256	3,049	793
KCC	Urban	Sallins	5,169	6,846	1,677
KCC	Rural	Rural	70,701	74,236	3,535
MCC	Urban	Ashbourne	11,368	15,000	3,632
MCC	Urban	Athboy	2,556	3,543	987
MCC	Urban	Drogheda	6,340	10,815	4,475
MCC	Urban	Duleek	3,122	4,512	1,390
MCC	Urban	Dunboyne	6,938	15,182	8,244
MCC	Urban	Dunshaughlin	4,312	6,553	2,241
MCC	Urban	Enfield	2,982	3,725	743
MCC	Urban	Kells	6,217	8,784	2,567
MCC	Urban	Kilcock	218	1,768	1,550
MCC	Urban	Laytown	10,234	13,267	3,033
MCC	Urban	Maynooth	272	1,025	753
MCC	Urban	Navan	27,683	40,362	12,679
MCC	Urban	Ratoath	9,087	9,087	0
MCC	Urban	Stamullen	2,397	3,476	1,079
MCC	Urban	Trim	6,938	10,963	4,025
MCC	Rural	Rural	83,471	87,645	4,174
WCC	Urban	Arklow	13,067	24,463	11,396
WCC	Urban	Baltinglass	2,614	3,982	1,368
WCC	Urban	Blessington	4,579	7,770	3,191
WCC	Urban	Bray	28,321	40,629	12,308
WCC	Urban	Greystones	16,932	24,681	7,749
WCC	Urban	Kilcoole	3,947	4,859	912
WCC	Urban	Newtownmountkennedy	2,251	5,442	3,191
WCC	Urban	Rathnew	2,603	5,098	2,495
WCC	Urban	Wicklow	10,236	20,048	9,812
WCC	Rural	Rural	52,090	54,695	2,605

A1.1.2 Local Authority Employment Settlements and Non-Settlements (Rural) for 2011 and 2035

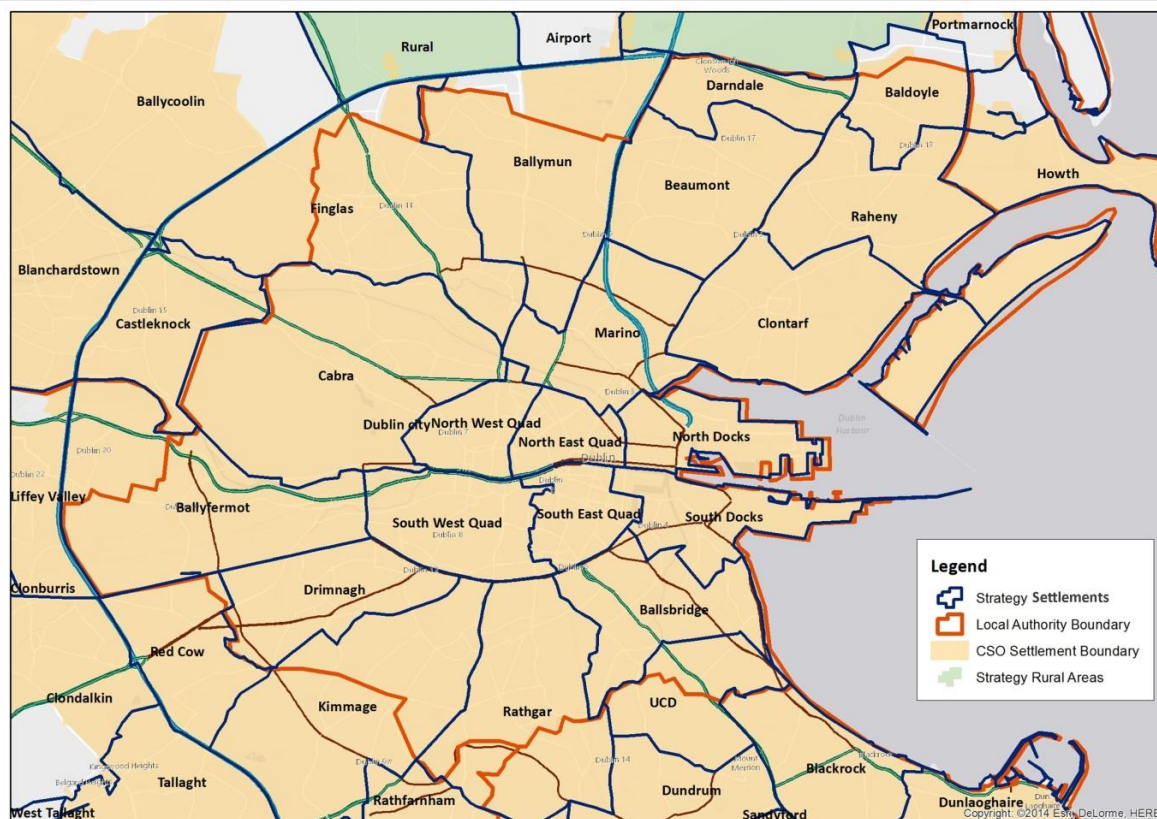
County	Settlement Type	Settlement Name	Employment 2011	Employment 2035	Employment Growth
DCC	Urban	Baldoyle	700	1258	558
DCC	Urban	Ballsbridge	19,005	20,971	1,966
DCC	Urban	Ballyfermot	13,019	16,180	3,161
DCC	Urban	Ballymun	9,082	12,366	3,284
DCC	Urban	Beaumont	8,596	9,356	760
DCC	Urban	Cabra	10,044	11,671	1,627
DCC	Urban	Castleknoch	39	42	3
DCC	Urban	Clontarf	4,368	4,754	386
DCC	Urban	Darndale	3,614	3,934	320
DCC	Urban	Drimnagh	6,423	8,157	1,734
DCC	Urban	Finglas	6,107	6,770	663
DCC	Urban	Kimmage	4,364	4,750	386
DCC	Urban	Marino	6,187	6,734	547
DCC	Urban	North Docks	8,597	20,489	11,892
DCC	Urban	North East Quad	39,685	48,838	9,153
DCC	Urban	North West Quad	15,250	17,140	1,890
DCC	Urban	Raheny	3,269	3,558	289
DCC	Urban	Rathgar	7,073	7,699	626
DCC	Urban	Red Cow	947	1,031	84
DCC	Urban	South Docks	11,393	17,590	6,197
DCC	Urban	South East Quad	73,195	90,077	16,882
DCC	Urban	South West Quad	29,491	43,373	13,882
DCC	Urban	UCD	7,340	8,049	709
DCC	Rural	Rural	0	0	0
SDCC	Urban	Adamstown	805	1,063	258
SDCC	Urban	Ballyfermot	2,379	3,490	1,111
SDCC	Urban	Clonburris	126	454	328
SDCC	Urban	Clondalkin	6,827	11,485	4,658
SDCC	Urban	Kimmage	2,929	3,527	598
SDCC	Urban	Liffey Valley	8,156	10,573	2,417
SDCC	Urban	Lucan	2,761	2,994	233
SDCC	Urban	Newcastle	237	385	148
SDCC	Urban	Rathcoole	786	786	0
SDCC	Urban	Rathfarnham	2,763	3,196	433
SDCC	Urban	Rathgar	446	477	31
SDCC	Urban	Red Cow	14,714	17,750	3,036
SDCC	Urban	Saggart	829	829	0
SDCC	Urban	South Tallaght	5,123	5,984	861

County	Settlement Type	Settlement Name	Employment 2011	Employment 2035	Employment Growth
SDCC	Urban	Tallaght	15,580	18,260	2,680
SDCC	Urban	West Tallaght	7,173	10,868	3,695
SDCC	Rural	Rural	6,065	6,368	303
FCC	Urban	Airport	9,351	17,795	8,444
FCC	Urban	Balbriggan	3,027	4,627	1,600
FCC	Urban	Baldoyle	92	140	48
FCC	Urban	Ballycoolin	17,313	22,539	5,226
FCC	Urban	Ballymun	3,088	3,506	418
FCC	Urban	Blanchardstown	9,676	9,885	209
FCC	Urban	Castleknock	1,621	1,830	209
FCC	Urban	Donabate	527	736	209
FCC	Urban	Finglas	2,316	2,316	0
FCC	Urban	Howth	4,186	4,186	0
FCC	Urban	Kinsealy-Drinan	88	147	59
FCC	Urban	Lusk	425	569	144
FCC	Urban	Malahide	1,722	1,763	41
FCC	Urban	Portmarnock	723	775	52
FCC	Urban	Rush	828	918	90
FCC	Urban	Skerries	1,002	1,158	156
FCC	Urban	Swords	11,746	15,513	3,767
FCC	Rural	Rural	11,721	12,307	586
DLR	Urban	Blackrock	7,023	7,367	344
DLR	Urban	Bray	871	2,096	1,225
DLR	Urban	Cherrywood	6,877	11,932	5,055
DLR	Urban	Dundrum	7,542	9,542	2,000
DLR	Urban	Dunlaoghaire	15,041	15,827	786
DLR	Urban	Rathfarnham	2,091	2,687	596
DLR	Urban	Rathgar	1,570	1,634	64
DLR	Urban	Sandyford	19,418	26,418	7,000
DLR	Urban	Stepaside	1,828	2,672	844
DLR	Urban	UCD	5,939	6,365	426
DLR	Rural	Rural	426	447	21
KCC	Urban	Athy	2,487	3,837	1,350
KCC	Urban	Blessington	0	0	0
KCC	Urban	Celbridge	2,075	2,701	626
KCC	Urban	Clane	1,237	1,284	47
KCC	Urban	Kilcock	603	1,070	467
KCC	Urban	Kilcullen	749	816	67
KCC	Urban	Kildare	1,576	2,444	868
KCC	Urban	Kill	253	320	67

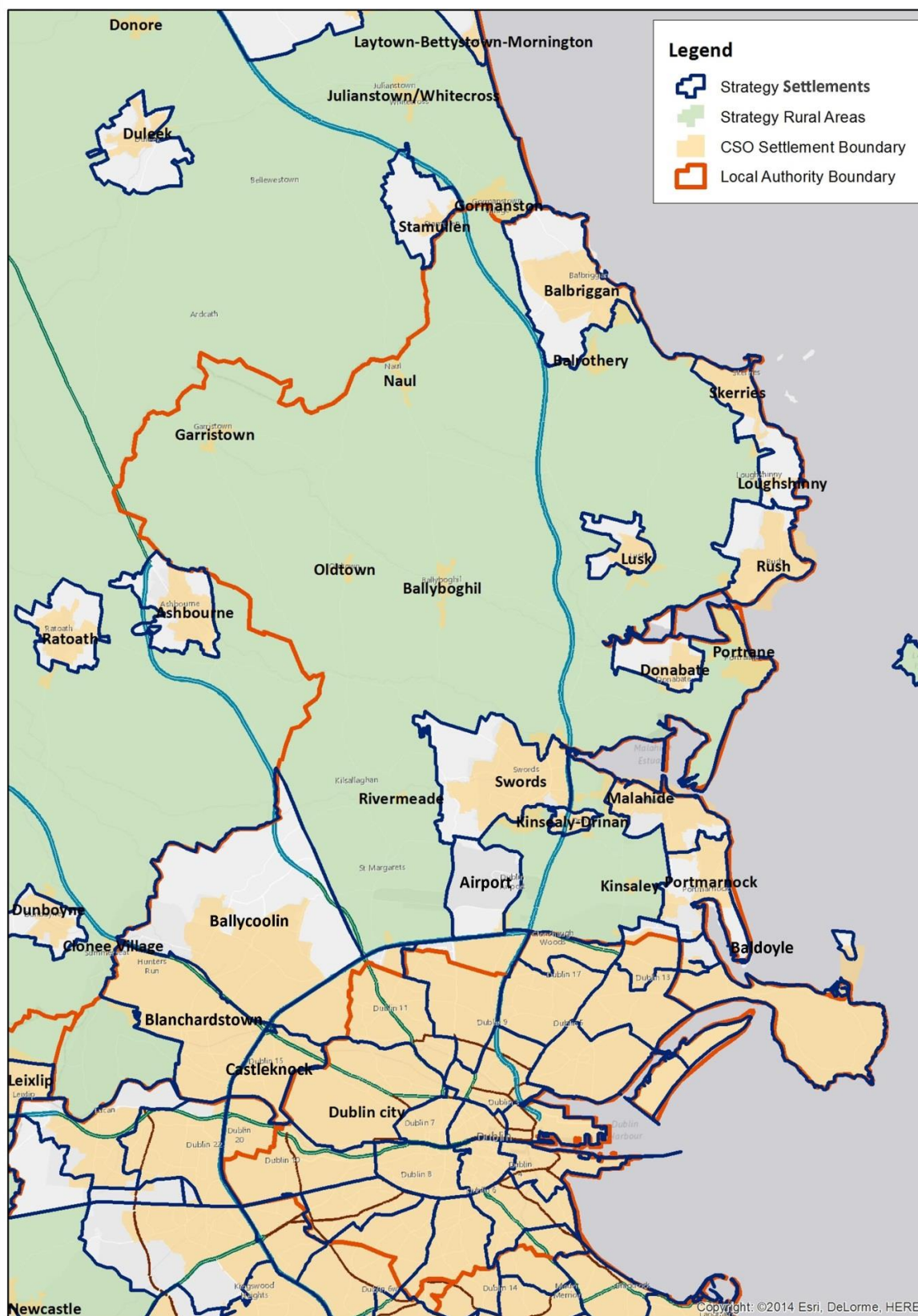
County	Settlement Type	Settlement Name	Employment 2011	Employment 2035	Employment Growth
KCC	Urban	Leixlip	6,671	8,804	2,133
KCC	Urban	Maynooth	3,292	4,841	1,549
KCC	Urban	Monasterevan	412	465	53
KCC	Urban	Naas	10,037	13,197	3,160
KCC	Urban	Newbridge	8,695	11,523	2,828
KCC	Urban	Prosperous	317	334	17
KCC	Urban	Rathangan	349	377	28
KCC	Urban	Sallins	378	445	67
KCC	Rural	Rural	13,129	13,785	656
MCC	Urban	Ashbourne	2,219	2,911	692
MCC	Urban	Athboy	556	671	115
MCC	Urban	Drogheda	650	1,342	692
MCC	Urban	Duleek	411	526	115
MCC	Urban	Dunboyne	1,035	2,651	1,616
MCC	Urban	Dunshaughlin	1,017	1,248	231
MCC	Urban	Enfield	390	621	231
MCC	Urban	Kells	2,134	2,826	692
MCC	Urban	Kilcock	7	122	115
MCC	Urban	Laytown	709	824	115
MCC	Urban	Maynooth	6	352	346
MCC	Urban	Navan	9,039	11,635	2,596
MCC	Urban	Ratoath	692	1,096	404
MCC	Urban	Stamullen	102	333	231
MCC	Urban	Trim	1,802	2,148	346
MCC	Rural	Rural	13,709	14,394	685
WCC	Urban	Arklow	3,285	4,934	1,649
WCC	Urban	Baltinglass	727	922	195
WCC	Urban	Blessington	990	1,363	373
WCC	Urban	Bray	7,583	9,846	2,263
WCC	Urban	Greystones	1,862	2,419	557
WCC	Urban	Kilcoole	871	1,010	139
WCC	Urban	Newtownmountkennedy	561	868	307
WCC	Urban	Rathnew	260	1,198	938
WCC	Urban	Wicklow	2,371	2,876	505
WCC	Rural	Rural	9,064	9,517	453

A1.2 Settlements by Local Authority Area

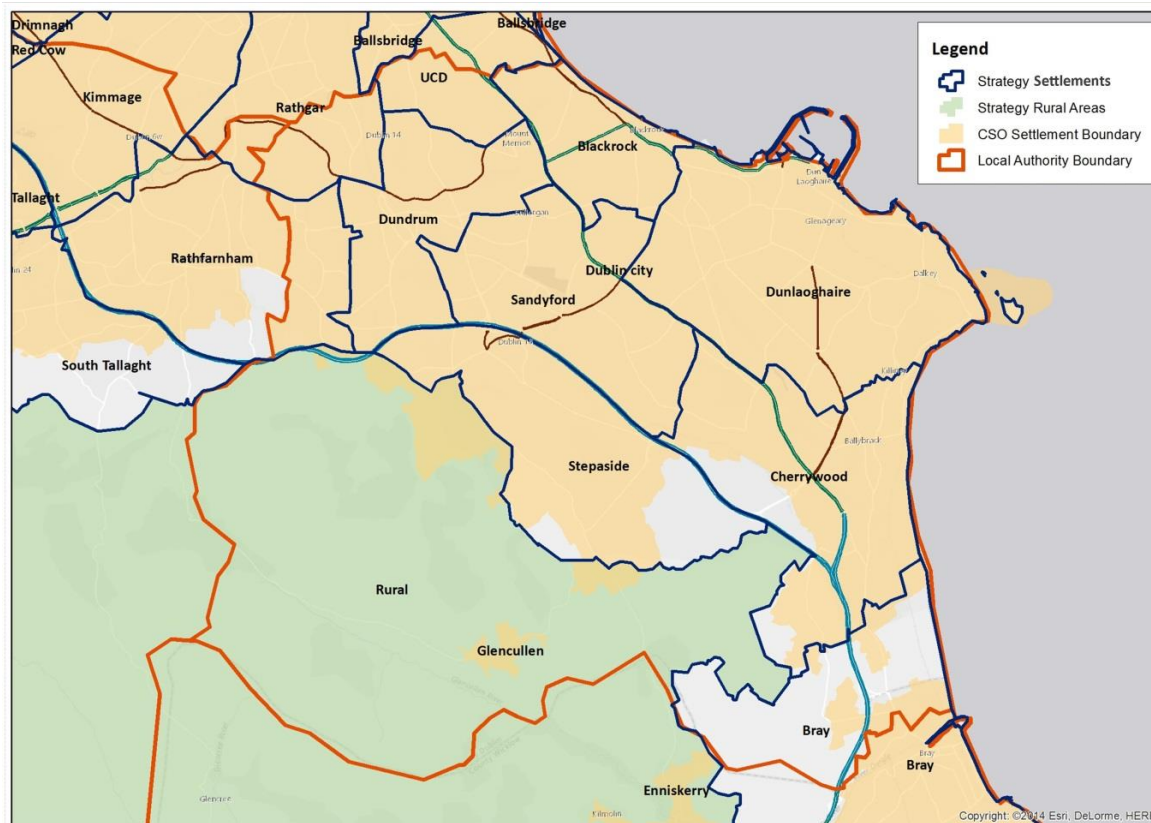
A1.2.1 Dublin City Council



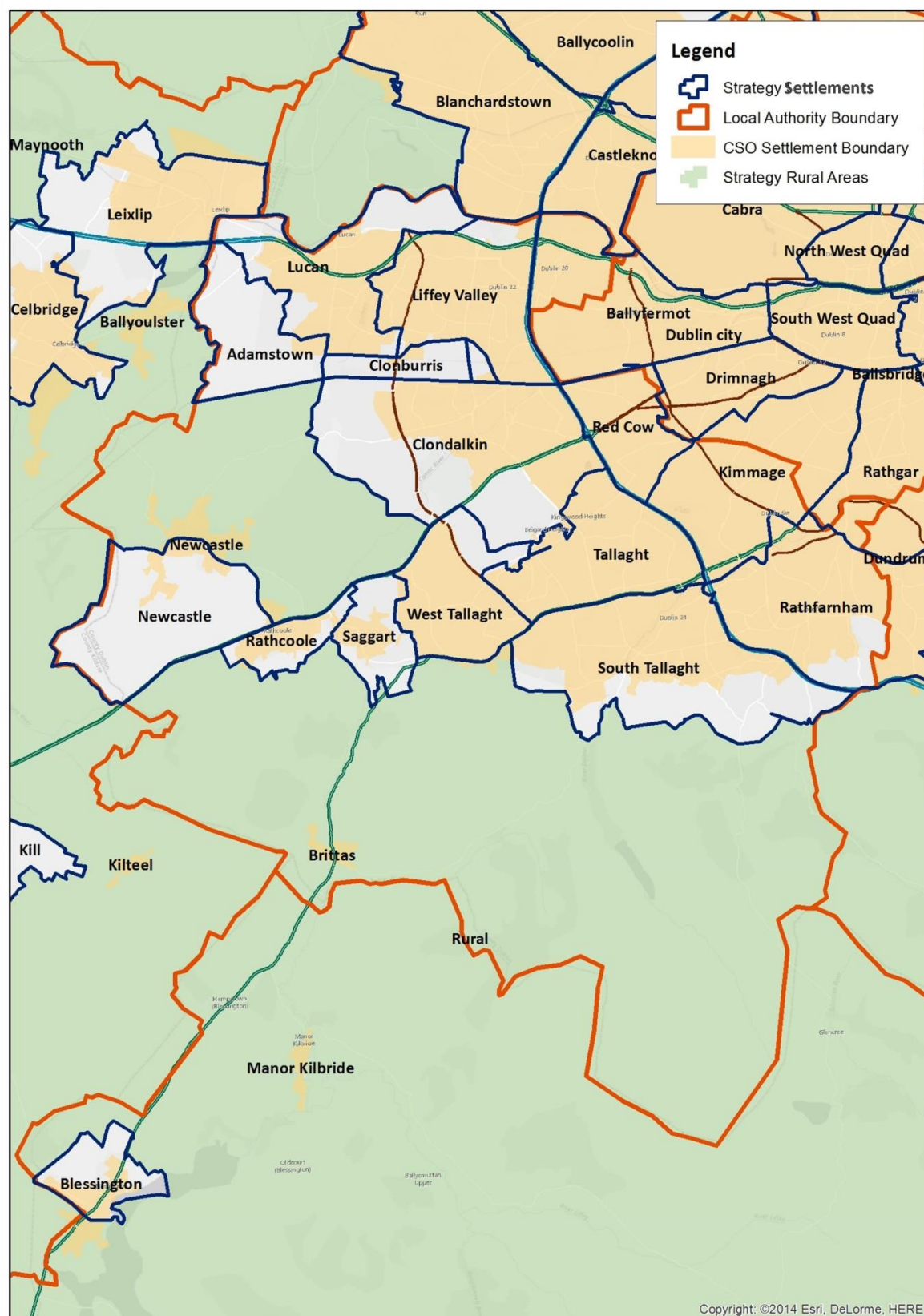
A1.2.2 Fingal County Council



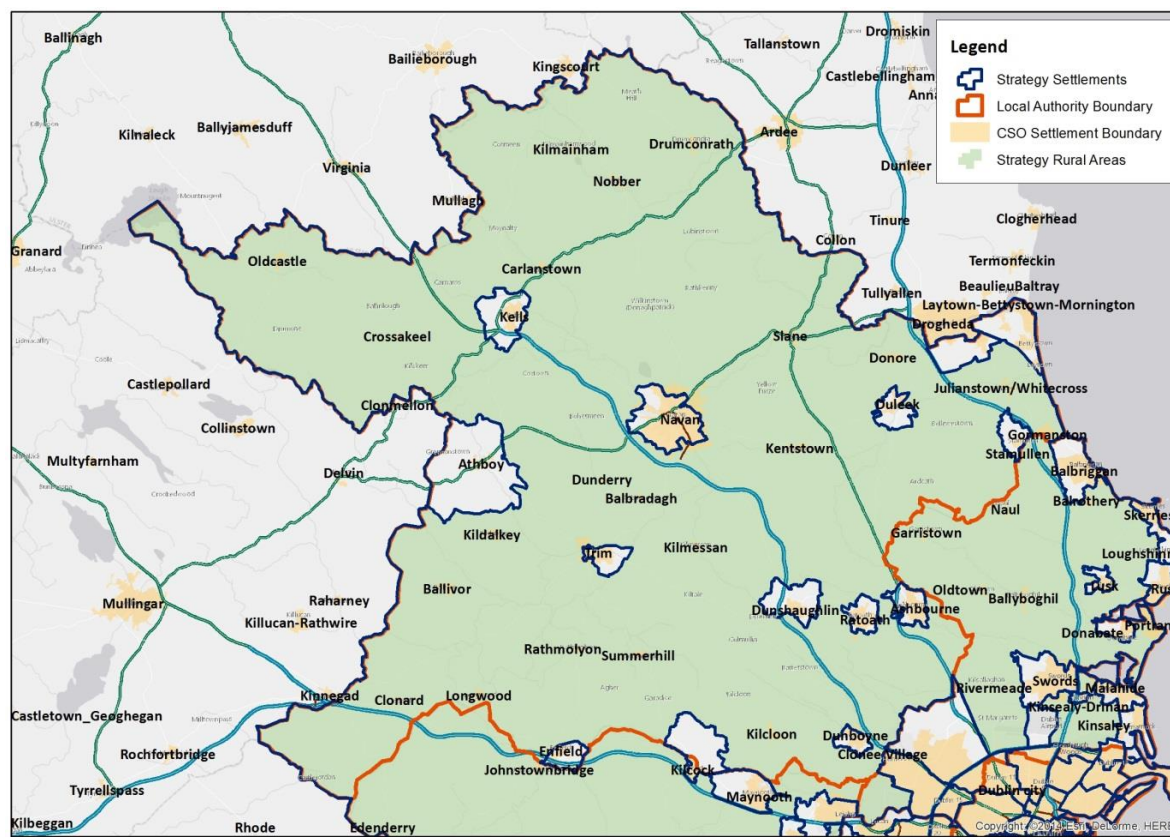
A1.2.3 Dún Laoghaire-Rathdown County Council



A1.2.4 South Dublin County Council



A1.2.5 Meath County Council



A1.2.6 Kildare County Council



A1.2.7 Wicklow County Council

