Údarás Náisiúnta Iompair
National Transport Authority

Limerick Shannon Metropolitan Area Transport Strategy

Transport Modelling Assessment Report

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1 Introduction

1.1 Background

The National Transport Authority (NTA) is a public body set up under statute and established in December 2009. The role and functions of the NTA are set out in three Acts of the Oireachtas; the Dublin Transport Authority Act 2008, the Public Transport Regulation Act 2009 and the Taxi Regulation Act 2013. In August 2015, the Department of Transport, Tourism and Sport (DTTaS) published its policy document *"Investing in our Transport Future - Strategic Investment Framework for Land Transport"*. Action 4 of that framework states that: *"Regional transport strategies will be prepared by the NTA and provide an input to regional spatial and economic strategies".*

Having regard to its role in relation to transport, and the action placed upon it in the DTTaS policy document, the NTA, in collaboration with Limerick City and County Council and Clare Council, is developing a Transport Strategy for the Limerick and Shannon Metropolitan Area (LSMA) covering the period to 2040. The strategy will align with the over-arching vision and objectives of the National Planning Framework (NPF) and Regional Spatial and Economic Strategy (RSES) and will provide a framework for the planning and delivery of transport infrastructure and services in the LSMA over the next two decades. It will also provide a planning policy for which other agencies can align their future policies and infrastructure investment.

1.2 Purpose of Report

The methodology for the development of the Limerick Shannon Metropolitan Area Transport Strategy (LSMATS) 2040 is undertaken on a step by step basis, from: reviewing the existing policy and transport baseline, undertaking a detailed future demand analysis, developing transport options, optimisation of land use to align with high performing transport corridors, developing the draft Strategy for public consultation and subsequently finalising the Strategy, as shown in Figure 1-1.

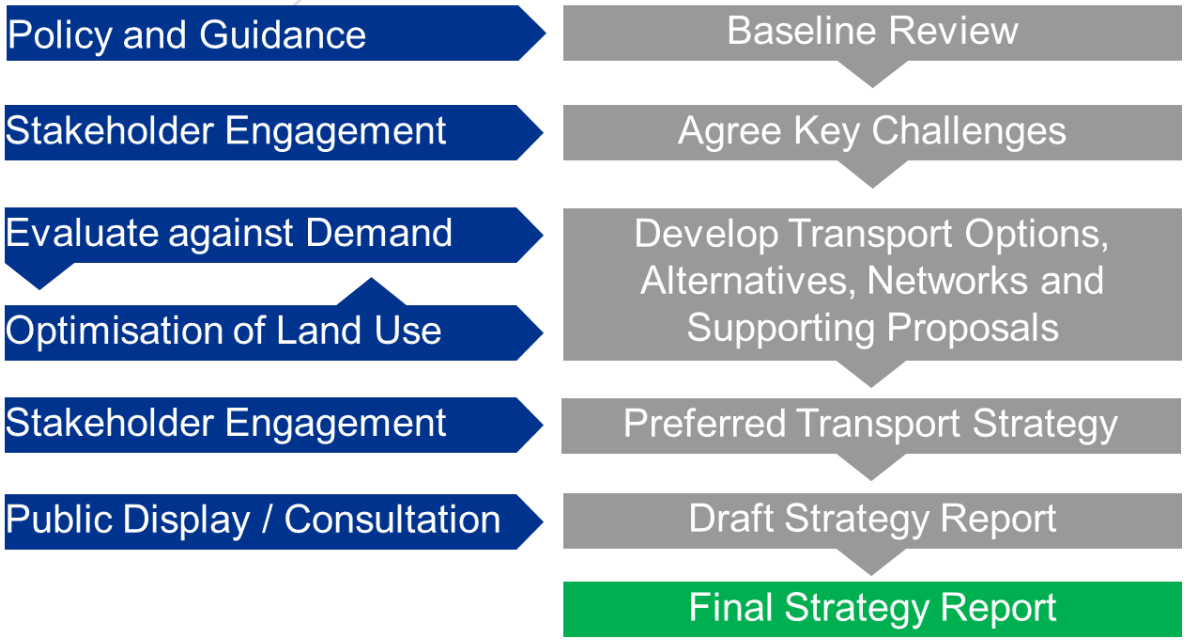


Figure 1-1: Limerick Shannon Metropolitan Area Transport Strategy Methodology

This report describes the process of modelling the proposed transport measures for all modes (public transport, walking, cycling, car and freight) within the National Transport Authority's (NTA) Mid-West Regional Model (MWRM). This modelling process inputted into the development of the transport options (within the "Transport Options and Network Development Report") to serve the anticipated demand requirements for the study area up to 2040. The report also outlines the modelling undertaken as for the preferred draft Transport Strategy as well as the additional modelling undertaken for the final Strategy. The land use and network assumptions are outlined for all modelled scenarios.

An appraisal of the Strategy options, utilising the Regional Modelling System (RMS) appraisal toolkit has been undertaken which provides a quantitative appraisal that aligns with the Department of Transport, Tourism and Sport (DTTAS) Common Appraisal Framework (CAF). Other Key Performance Indicators (KPIs) have also been assessed to understand the performance of the proposed LSMATS network across all modes.

1.3 Model Version Update

Since the development and publication of the draft LSMATS the NTA's Regional Modelling System has been updated to a base year of 2016. As part of this update the regional models, including the MWRM, have undergone significant recalibration resulting in some differences between the new model, V3, and the previous model, V2, used to model and appraise the draft strategy.

As part of the finalisation of the strategy the draft strategy was remodelled using the updated V3 model. The V3 model was also used for any additional modelling undertaken as part of the strategy finalisation. This was to ensure the strategy reflected the latest available modelling and to ensure the robustness of the appraisal of the strategy. Further details on the differences between the model versions can be found in Section 7 of this report.

1.4 Report Structure

The following provides a description of the contents of each section of the report;

- **Section 2** summarises the Transport Network Option Development Methodology which includes the Transport Modelling Assessment.
- **Section 3** provides an overview of the NTA Regional Modelling System (RMS) which includes the Mid-West Regional Transport Model (MWRM) used for the assessment of LSMATS.
- **Section 4** describes the 2040 land use assumptions used in the modelling.
- **Section 5** outlines modelling undertaken to inform the optioneering and refinement of the preferred strategy.
- **Section 6** details the emerging preferred draft strategy;
- **Section 7** outlines the modelling of the final strategy including additional assessments;
- **Section 8** outlines the results of the appraisal of LSMATS under each of the CAF criteria; and
- **Section 9** concludes the report.

2 Transport Network Option Development Methodology

2.1 Option Development and Assessment Methodology

This report describes the modelling process that has been undertaken to inform the development and assessment of the strategy options and refinement of the preferred transport strategy. Figure 2-1 below outlines the methodology for the development and assessment of the strategy options. The upper-limit public transport demand was determined from the "idealised" public transport network model run as discussed in the "Demand Analysis Report". The "idealised" public transport network included very high frequency services on all main corridors into the city and an assumed minimum speed for public transport, intended to be representative of high priority.

The public transport options have been developed based on this "idealised" demand and subsequently updated and re-run in the MWRM. Iterative model runs were undertaken to further refine and assess the options with the outputs partially informing the Multi-Criteria Assessment outlined in this report. The cycling, walking and road network were also modelled, refined and assessed iteratively in combination with the public transport proposals. The resulting outcome of this process is the identification of an Emerging Preferred Strategy Network.

Figure 2-1: Option Development and Assessment Methodology

3 NTA Regional Modelling System

3.1 Introduction

This section describes the NTA Regional Modelling System (RMS), outlining its scope, extent, components, functionality and its suitability for use in developing the LSMATS. The information in this chapter is based on the latest version 3 model used in the appraisal of the final 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 3-1 below.

Table 3-1: Regional Modelling System

Regional Modelling System	Abbreviation	Counties Covered
Eastern Regional Model	ERM	Louth, Monaghan, Cavan, Longford, Westmeath, Meath, Offaly, Laois, Kildare, Dublin, Wicklow, Carlow & Northern Wexford
South East Regional Model	SERM	Wexford, Kilkenny, Waterford & Tipperary South
South West Regional Model	SWRM	Cork & Kerry
Mid-West Regional Model	MWRM	Limerick, Clare & North Tipperary
Western Regional Model	WRM	Galway, Mayo, Roscommon, Sligo, Donegal & Leitrim

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.

The Mid West Regional Model (MWRM), which covers Limerick County & City and Shannon, has been used to support the development of the LSMATS. The figure on the following page illustrates the geographical extent of each of the Regional Models.

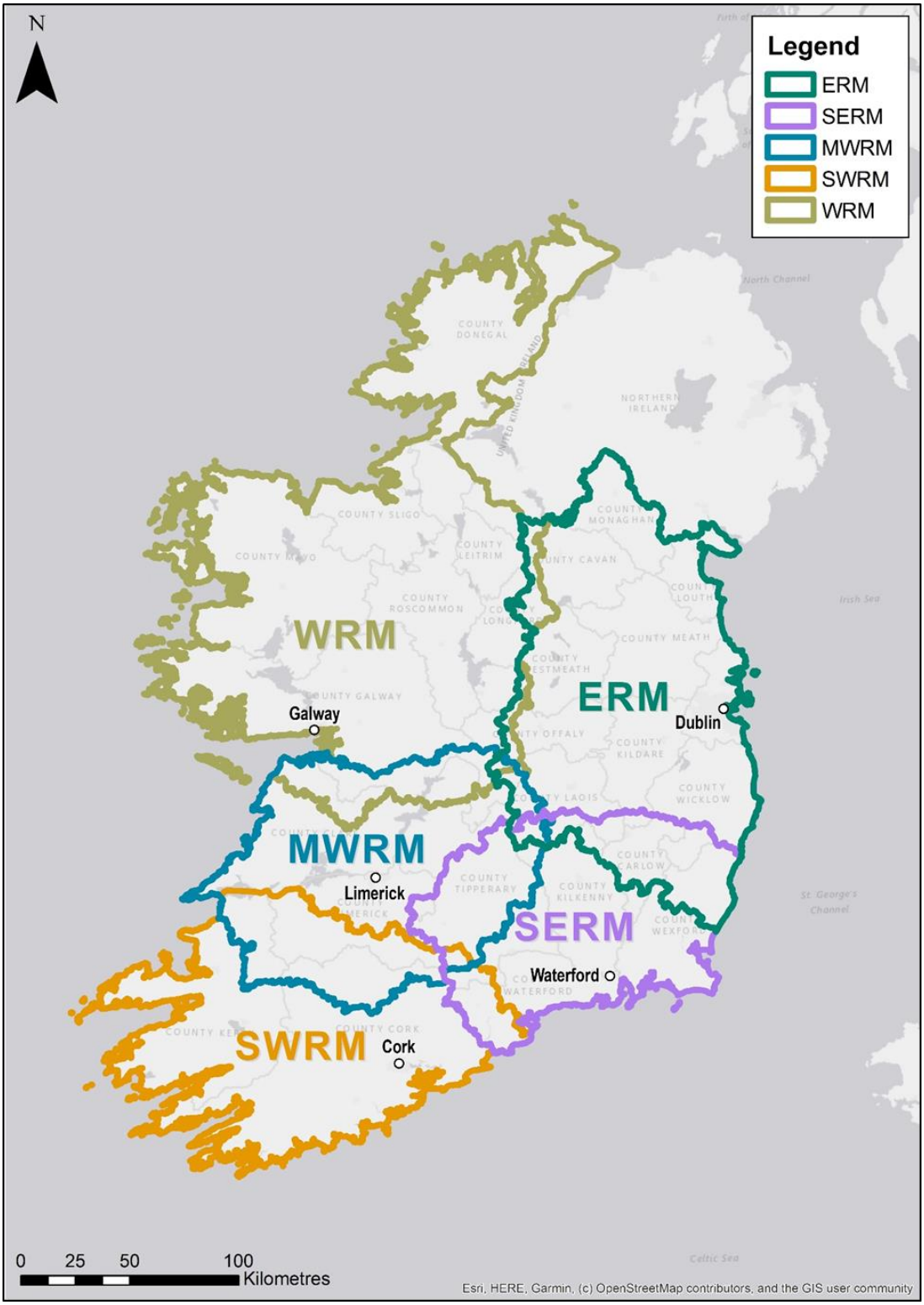


Figure 3-1: Modelling System Regional Model Areas

3.2 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.

3.2.1 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 2016 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 MWRM 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 3-2 shows the MWRM Zone System. External zones represent national demand from areas across the country to/ from the Mid-West (area shown in blue). The two special zones in the model are Foynes Port & Shannon Airport. Further information on the MWRM Zone System can be found in the MWRM zone system development report.[1]

[1] MWRM Zone System Development Report: https://www.nationaltransport.ie/wp-content/uploads/2018/06/MWRM_Zone_System_Development_Report-1.pdf

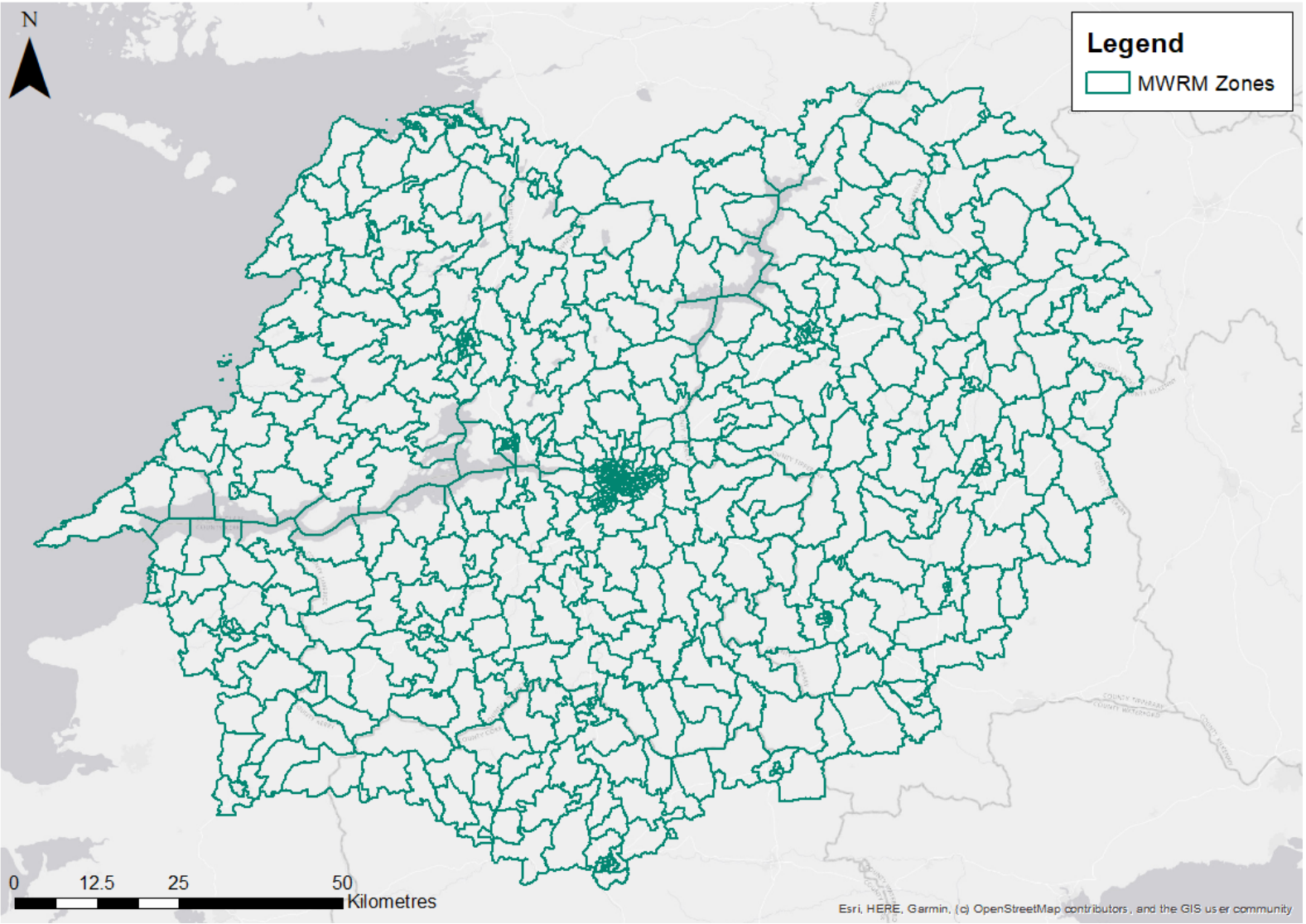


Figure 3-2: MWRM Zone System

3.2.2 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.

3.2.3 Base Year

The base year of each model is 2016 with a nominal month of April. This is largely driven by the date of the Census (POWSCAR) and the National Household Travel Survey (NHTS).

3.2.4 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 3-2 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 3-2: Time Periods

Period	DEMAND MODEL FULL PERIOD	ASSIGNMENT PERIOD
AM Peak	07:00-10:00	Representative 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	Representative 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

3.3 MWRM Structure

3.3.1 Overarching Structure

As mentioned above, the MWRM is the model used to support the development of the LSMATS. All the regional models, including the MWRM, 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 3-3 below.

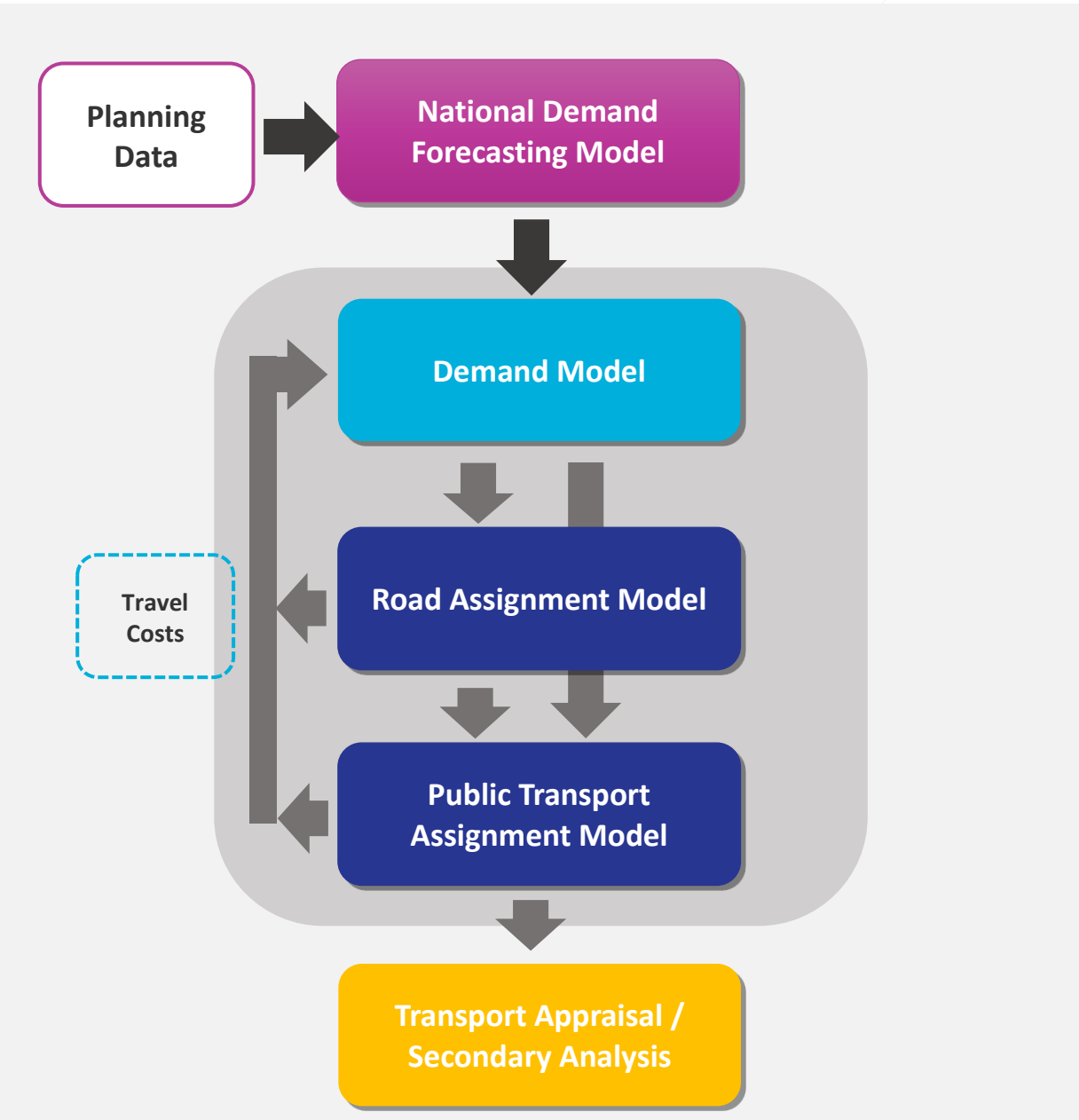


Figure 3-3: Model Structure

3.3.2 Planning Data

The Planning Data referred to above is a national database of 99 demographic and spatial variables for each of the 18,642 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.

3.3.3 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) daily. 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 as outlined in Section 2.

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; and
- The **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 3-4 shows the system of NDFM models and the key regional model components that the NDFM interacts with.

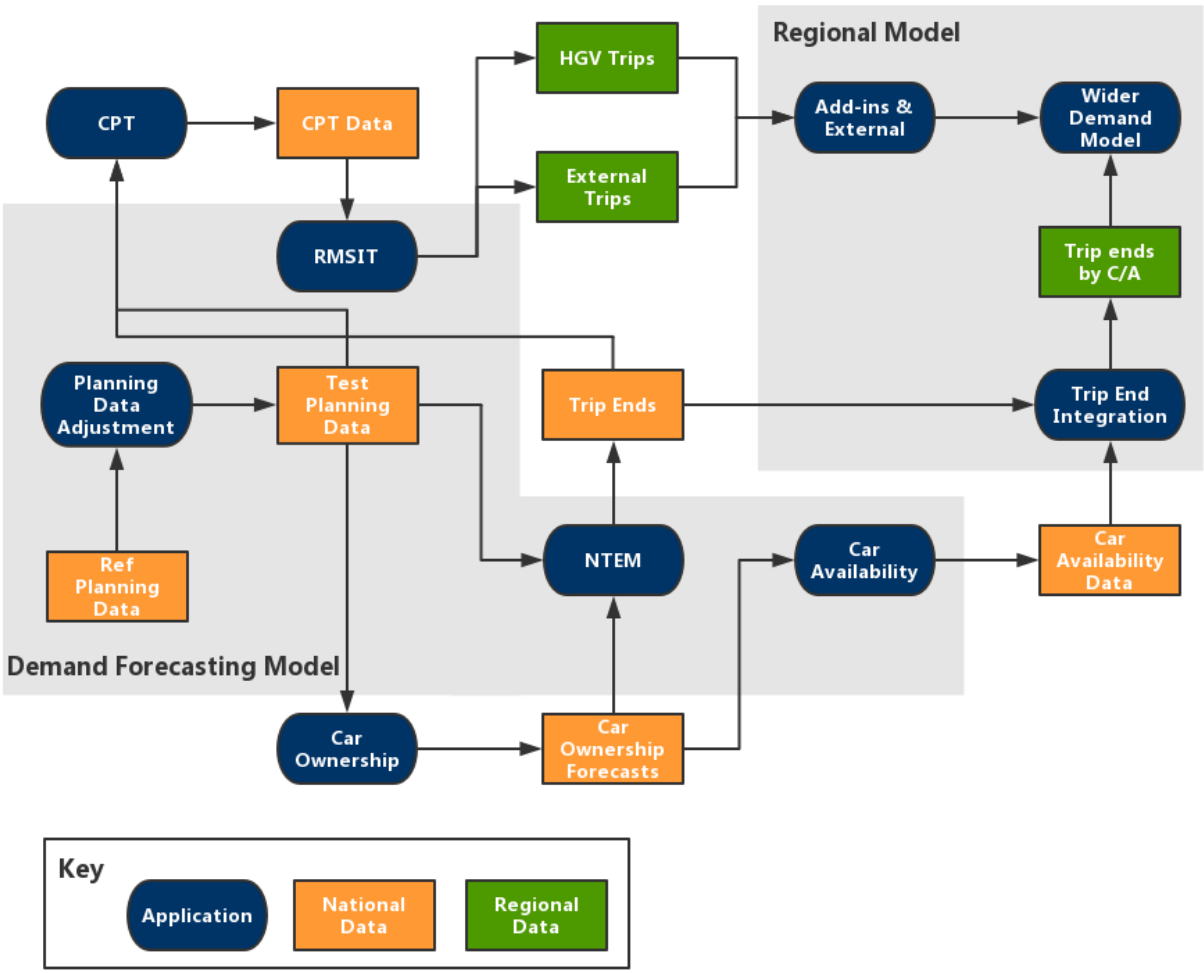


Figure 3-4: NDFM Structure

3.3.4 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 3-3.

Table 3-3: 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
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

No.	Purpose	Car Availability	Third Level of Segmentation
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

3.3.5 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 3-5 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 3-5.

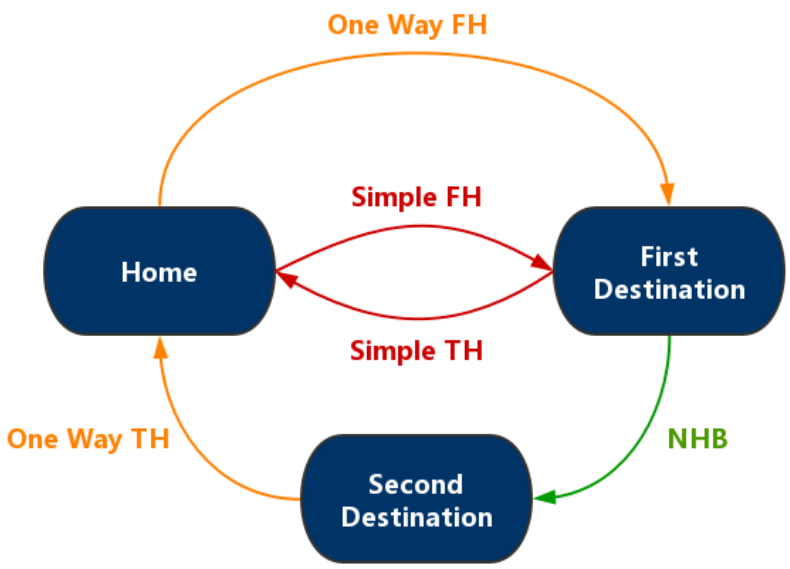


Figure 3-5 Trip Chains

Figure 3-6 shows the most basic relation of origins and destinations with respect to directional trips, comparable to simple tours.

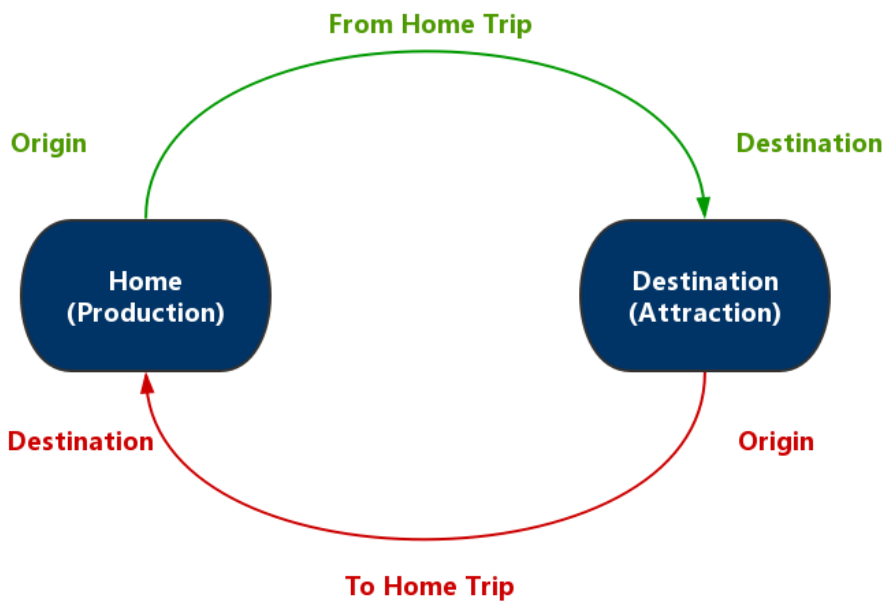


Figure 3-6 PA V OD for Simple Tours

Figure 3-7 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.

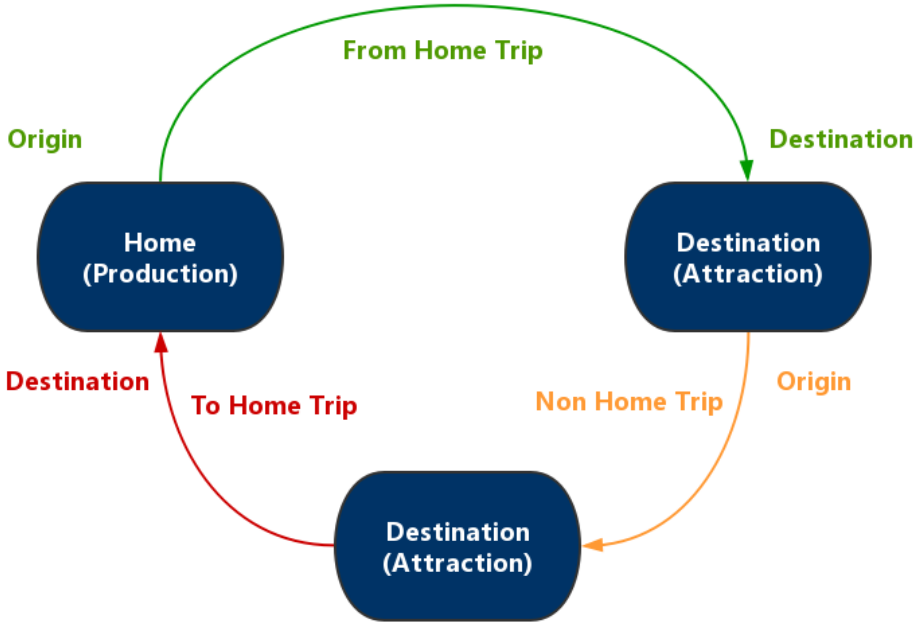


Figure 3-7 PA V OD for Extended Tours

Tours are considered as movements within or from time period to time period as shown in the Tour Grid in Table 3-4. 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 3-4: 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

3.3.6 MWRM 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 several 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 3-8.

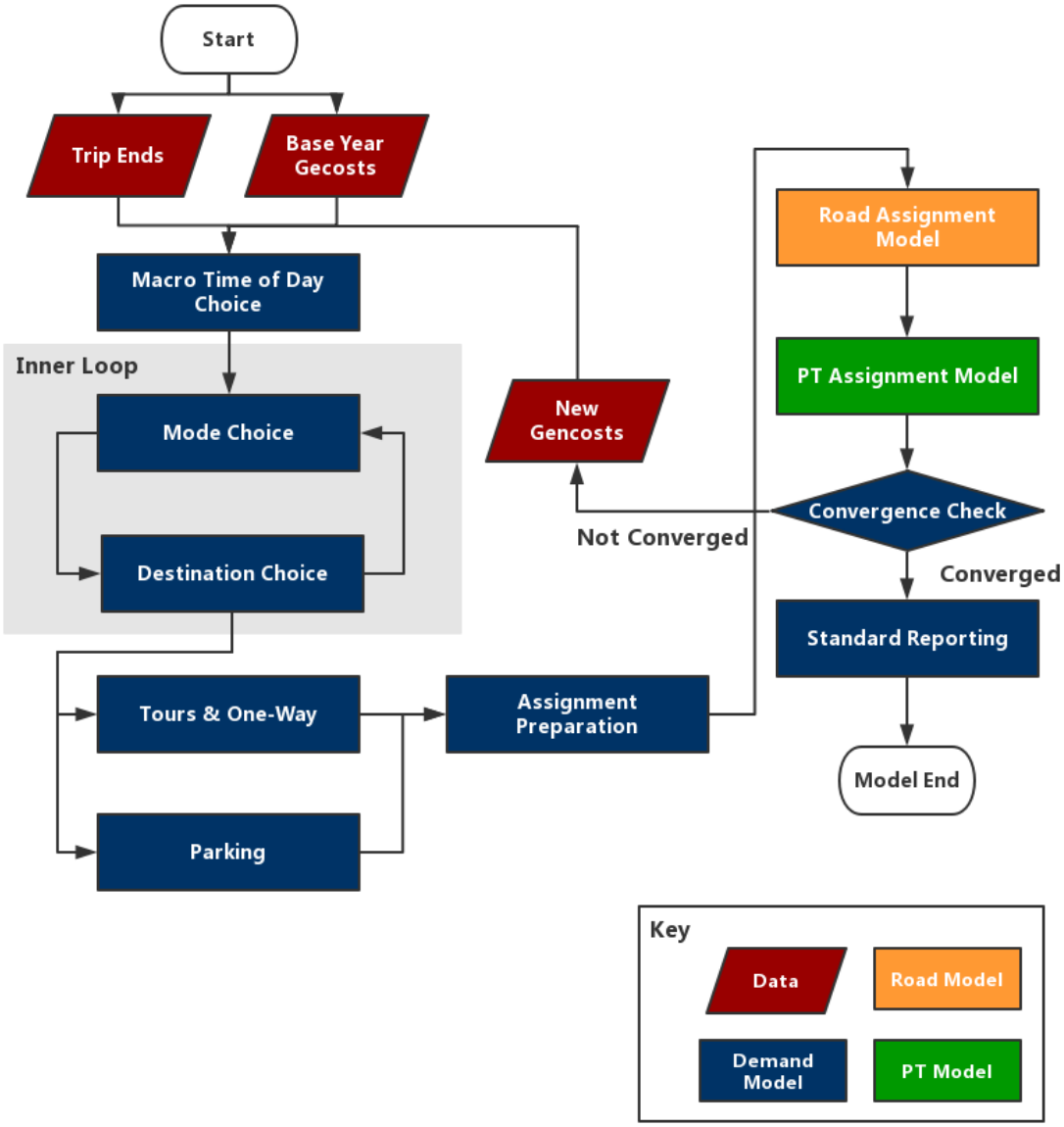


Figure 3-8: Demand Model Structure

3.3.7 MWRM 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.

It should be noted that SATURN is a macroscopic model and considers the aggregate behaviour of traffic flows. It does provide detail on junction delay and queueing along links it is a strategic model used to look at impacts across a wider area. Whilst suitable for the purposes of this strategic assessment it is not suitable for detailed junction modelling which consider the interaction of individual vehicles which should be undertaken using a microscopic model such as VISSIM or PARAMICs.

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.

3.3.8 MWRM Public Transport Assignment Model

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 in Figure 3-9.

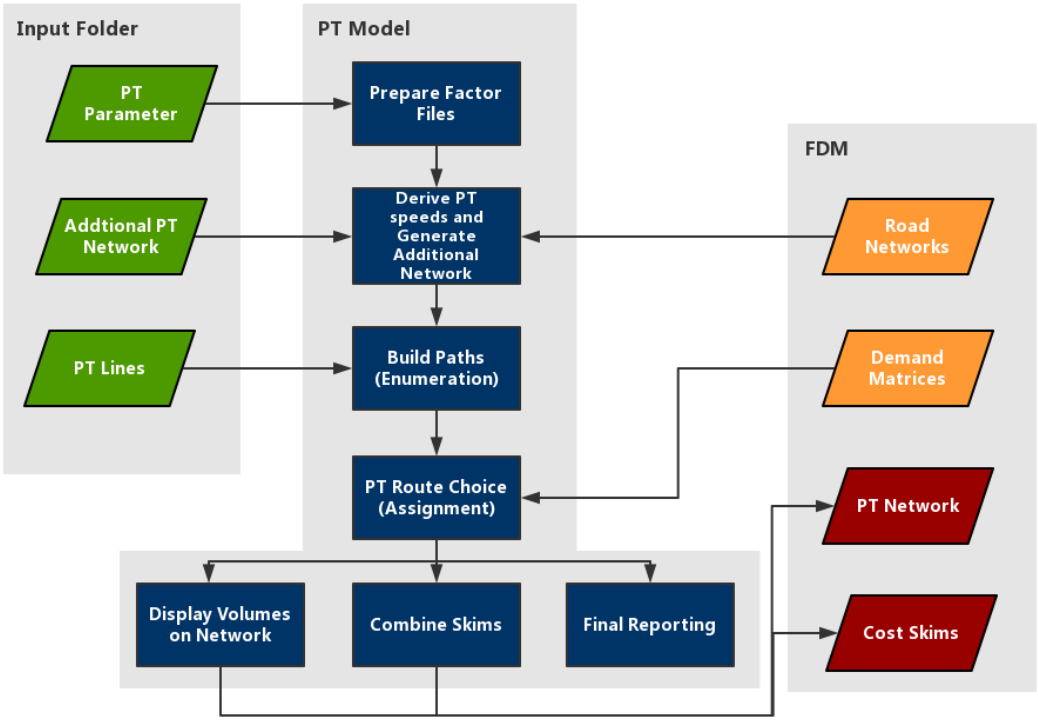


Figure 3-9: PT Model Process

3.3.9 MWRM 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. To generate costs to update the choice model processes, an **active modes assignment** must take place to establish new generalised costs. This active mode 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.

3.4 Suitability of Mid-West Regional Model in Developing the Strategy

3.4.1 Model Calibration and Validation

It is important that a strategic transport model is appropriately calibrated and validated in line with best practice guidelines. The MWRM 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 3-5.

Table 3-5: 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 ensure that the MWRM accurately reflects existing conditions and 'costs' associated with travel. This allows changes in the forecasting of transport demand and strategic transport infrastructure schemes and appropriate transport policies to be modelled and tested using the MWRM.

3.4.2 Use of MWRM for Strategic Transport Planning

The model has many strengths and features that make it the ideal tool to aid the strategic planning process. The MWRM 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.

Several distinct journey purposes and characteristics including car availability, employment status, and education level are considered within the model 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.

Four main modes of travel: private car, public transport, walking, and cycling are included in the model. 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 junction modelling to be included in the model which improves typical network representation in congested areas over an entirely 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 L-SMA region plus surrounding counties, and takes full account of travel within, into and out of the L-SMA 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 Limerick and Shannon City Centre, both a free workplace parking model and a parking constraint model have been implemented to re-evaluate mode choice based on whether parking was available at the travellers' ultimate destination.

There are however, as with all transport models, limitations to what the model can be used to assess. There are a number of potential measures which cannot be assessed using the MWRM. These include, amongst others;

- Intelligent Transport measures which improve wayfinding, management of parking and route choices;
- Behavioural Change Initiatives which influence choice of mode and time of travel;
- Public Transport measures such as Real Time Information and integrated ticketing;
- Public Ream enhancements – which improve the quality of the environment and likelihood for walking/cycling trips.

With respect to the performance of individual junctions SATURN does provide information on the performance of individual junction but operational assessments of junctions should be undertaken at a more localised level using microscopic modelling. However, for the purposes of this strategy this level of detail is not required. Any measures identified in the strategy will need to undergo further assessment as part of their future appraisal which may include further modelling.

3.4.3 Summary

The Mid-West Regional Model (MWRM) provides a comprehensive representation of travel patterns across the Limerick and Shannon Metropolitan Area and is a suitable tool for the testing and appraisal of the Strategy. The limitations of strategic transport models are recognised and fully understood. The MWRM is considered the appropriate tool for fulfilling the NTA's requirements in terms of its planning and appraisal needs.

4 2040 Land-Use Assumptions

4.1 Introduction

The NTA, in association with Limerick City and County Council (LCCC) and Clare County Council (CCC) prepared a Planning Datasheet for the 2040 Land-use Scenario for the application within the LSMA Transport Strategy. This Planning Datasheet has been used as the baseline land-use scenario for all modelling of the strategy options and preferred strategy. This section details the land-use assumptions within the Planning Datasheet and outlines the projected growth assumed in terms of population, employment and education and the distribution of this growth.

4.2 2040 Planning Datasheet Summary

The sections below present population, employment and education numbers for the derived 2040 Baseline Land Use Scenario at a high level for Counties Limerick & Clare, Limerick & Shannon Metropolitan Area and CSO Limerick City and Suburbs Boundary. Comparison between 2016 and 2040 scenario are also made to present the growth between the two scenarios. The areas within the metropolitan area are shown below in Figure 4-1.

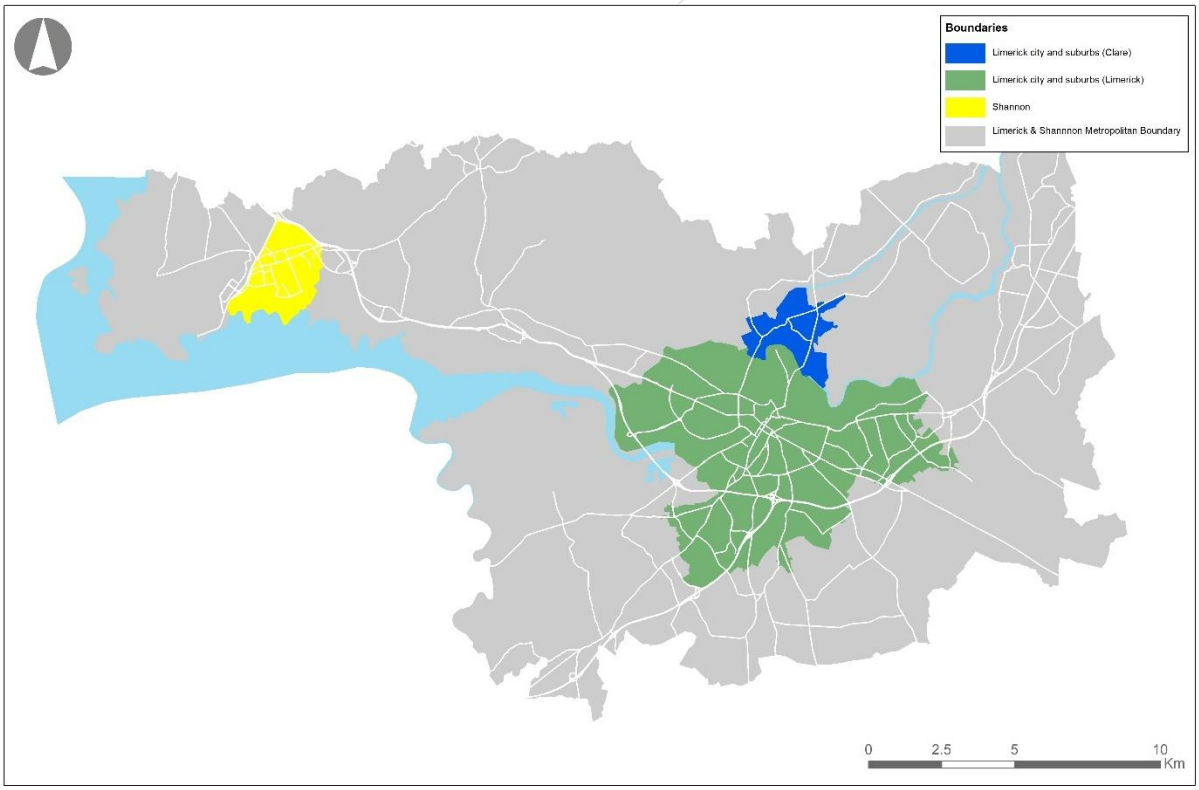


Figure 4-1: Limerick City & Suburbs & Shannon Area Boundaries

4.2.1 Population

Table 4-1 provides a comparison between the 2016 and the 2040 Planning Datasheets for the areas defined above. The table presents a proportional higher growth within the CSO defined Limerick City & Suburbs than in Limerick City & County and County Clare with a significant population increase within urban areas.

Within the remaining Metropolitan Area, there are significant population increases close to the existing City & Suburbs in areas such as Mungret, Annacotty & the proposed South Clare Economic Strategic Development Zone (SDZ) which lie immediately outside the existing CSO city boundaries. Approximately a third of all growth projected for County Clare lies within this proposed SDZ.

Table 4-1: Population Comparison

County	Population		Population Growth	
	2016	2040	2016 to 2040	
Limerick City & County	194,899	261,475	66,576	34%
Clare County	118,817	147,910	29,093	24%
Metropolitan Areas				
L-SMATS Area	132,420	206,444	74,024	56%
-Limerick City & Suburbs	93,102	145,406	52,304	56%
-Limerick City & Suburbs (Limerick)	88,668	139,880	51,212	58%
-Limerick City & Suburbs (Clare)	4,434	5,527	1,093	25%
-Shannon	10,442	13,807	3,365	32%
-Remaining Metropolitan Area	28,876	47,231	18,355	64%

It should be noted that the CSO Limerick City & Suburbs boundary does not align with the boundaries of CSO Small Areas. For the purposes of this comparison the population by SA was needed to compare to 2040. Thus, the population figure given is marginally lower than the official Census population for Limerick City and Suburbs (94,192). It should also be noted that the South Clare SDZ is not considered to be within the boundary of Limerick City and Suburbs and is within the remaining Metropolitan Area, which is partly responsible for the disproportionate increase in population in the remaining Metropolitan Area. There is also significant growth within parts of Mungret and Annacotty which lie outside the boundary of the city and suburbs, as per the CSO definition.

4.2.2 Employment

Table 4-2 provides a comparison between the 2016 and the 2040 Planning Datasheets for the areas defined by the NTA. Overall employment grows at a higher rate than population as the age profile and work force size increases. A higher proportion of growth is concentrated within the Limerick City & Suburbs area. As with the population growth, the high level of growth in the remaining metropolitan area is driven primarily by significant levels of employment growth in Mungret & the South Clare Economic SDZ.

Table 4-2: Job Comparison

County	Employment		Employment Growth	
	2016	2040	2016 to 2040	
Limerick City & County	63,434	84,211	20,777	33%
Clare County	30,914	40,982	10,068	33%
Metropolitan Areas				
L-SMATS Area	57,010	83,680	26,670	47%
-Limerick City & Suburbs	41,983	58,252	16,268	39%
-Limerick City & Suburbs (Limerick)	41,720	57,971	16,251	39%
-Limerick City & Suburbs (Clare)	263	280	17	7%
-Shannon	9,990	13,989	3,999	40%
-Remaining Metropolitan Area	5,037	11,439	6,402	127%

As before it should also be noted that the South Clare SDZ is not considered to be within the boundary of Limerick City and Suburbs and is within the remaining Metropolitan Area, along with

parts of Mungret and Annacotty which experience significant growth which results in a high level of proportional growth within the remaining Metropolitan Area.

4.2.3 Education

Table 2-3 provides a comparison between the 2016 and the 2040 Planning Datasheets for education places which includes primary, secondary and tertiary education. Again, it should also be noted that much of the high growth in the remaining metropolitan area is within the South Clare SDZ, Mungret and Annacotty which lie just outside the boundary of the city and suburbs.

Table 4-3: Education Comparison

County	Education		Education Growth	
	2016	2040	2016 to 2040	
Limerick City & County	49,211	65,201	15,990	32%
Clare County	19,936	24,745	4,809	24%
Metropolitan Areas				
L-SMATS Area	37,911	55,171	17,260	46%
-Limerick City & Suburbs	31,282	44,795	13,513	43%
-Limerick City & Suburbs (Limerick)	31,011	44,325	13,314	43%
-Limerick City & Suburbs (Clare)	271	470	199	73%
-Shannon	2,583	3,217	634	25%
-Remaining Metropolitan Area	4,045	7,159	3,113	77%

4.3 Settlement Level Comparison

The sections below present population, job and education numbers for the 2040 Baseline Land Use Scenario at a more granular detail, showing the distribution of growth at a settlement level. Comparison between the 2016 base and the 2040 scenario are also made to present the growth between the two scenarios.

4.3.1 Limerick City and County and Clare County Settlements

The population, employment and education data at its most disaggregated form consists of 1,566 Census Small Areas (CSAs) for the MWRM. In the interest of simplicity these CSAs were grouped into specific settlements that allowed for sensible analysis of these locations. The settlements do not match Electoral District boundaries but are defined based on a best match between the Mid-West Regional Model Zoning System and the planning data at a CSA level. Additional growth is added at a settlement level in order to test future year scenarios. The settlements are illustrated in Figure 2-2.

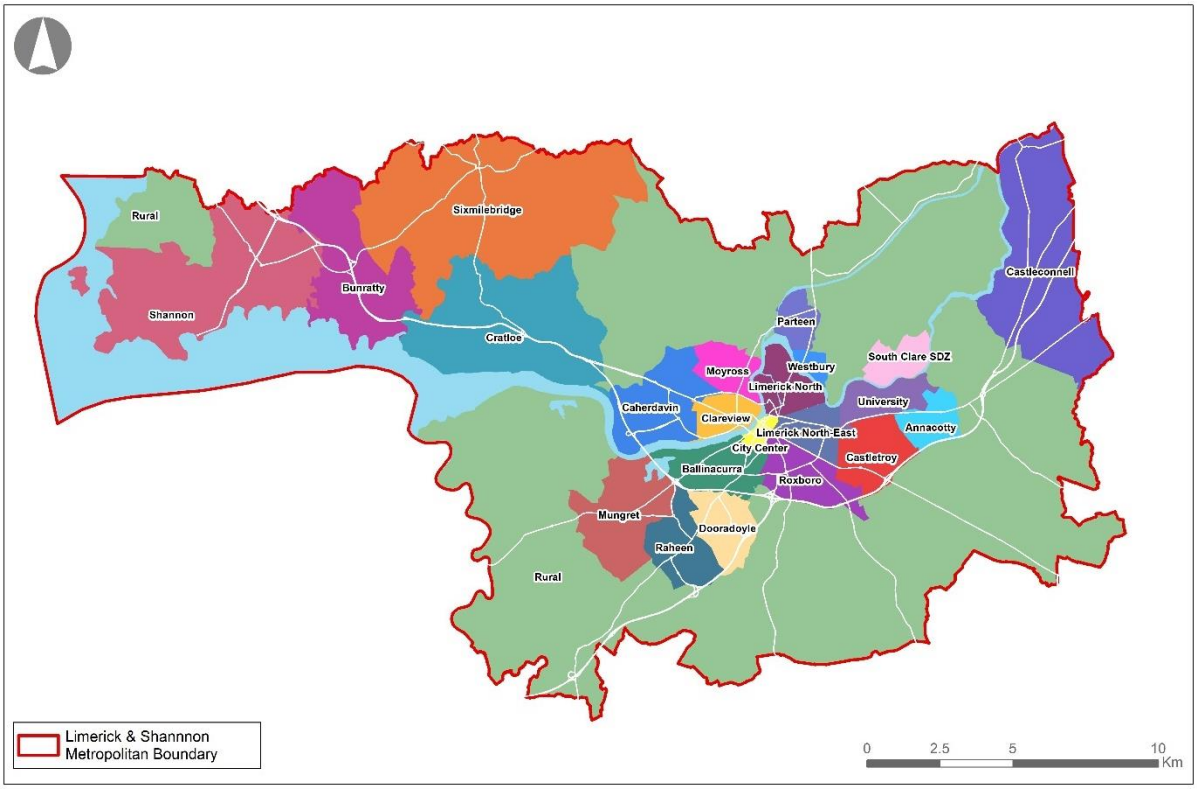


Figure 4-2: Metro Area Settlements

4.3.2 Population

Table 4-4 provides a comparison between the 2016 and the 2040 Planning Datasheets at a settlement level for population. As shown, significant levels of population growth are planned for the proposed South Clare Economic SDZ & Mungret with areas adjacent to the City such as Ballinacurra, Caherdavin, Raheen and Annacotty also experiencing high population growth.

Table 4-4: Population Comparison at a Settlement Level

Metro Settlements	Population		Population Growth	
	2016	2040	2016 to 2040	2016 to 2040 %
Annacotty	5,497	9,146	3,649	66%
Ballinacurra	6,956	13,294	6,338	91%
Bunratty	983	1,092	109	11%
Caherdavin	5,487	10,820	5,333	97%
Castleconnell	3,332	5,722	2,390	72%
Castletroy	5,998	9,120	3,122	52%
City Centre	6,071	8,443	2,372	39%
Clareview	7,035	10,594	3,559	51%
Cratloe	1,514	1,792	278	18%
Dooradoyle	13,350	18,107	4,757	36%
Limerick North	6,803	10,826	4,023	59%
Limerick North-East	12,344	17,518	5,174	42%
Moyross	6,918	10,511	3,593	52%
Mungret	1,259	3,969	2,710	215%
Parteen	1,061	1,338	277	26%
Raheen	3,446	6,335	2,889	84%
Roxboro	7,774	12,045	4,271	55%
Rural	15,887	25,062	9,175	58%
Shannon	10,028	13,404	3,376	34%
Sixmilebridge	3,962	4,769	807	20%
South Clare Economic SDZ	379	3,534	3,155	832%
University	2,963	4,813	1,850	62%
Westbury	3,373	4,189	816	24%
Total	**132,420**	**206,444**	**74,024**	**56%**

The population growth distribution between 2016 and 2040 is shown for each small area in Figure 2-3 and shows the high levels of growth in areas adjacent to the city centre as population intensifies in suburban areas. There is also considerable population growth within Shannon.

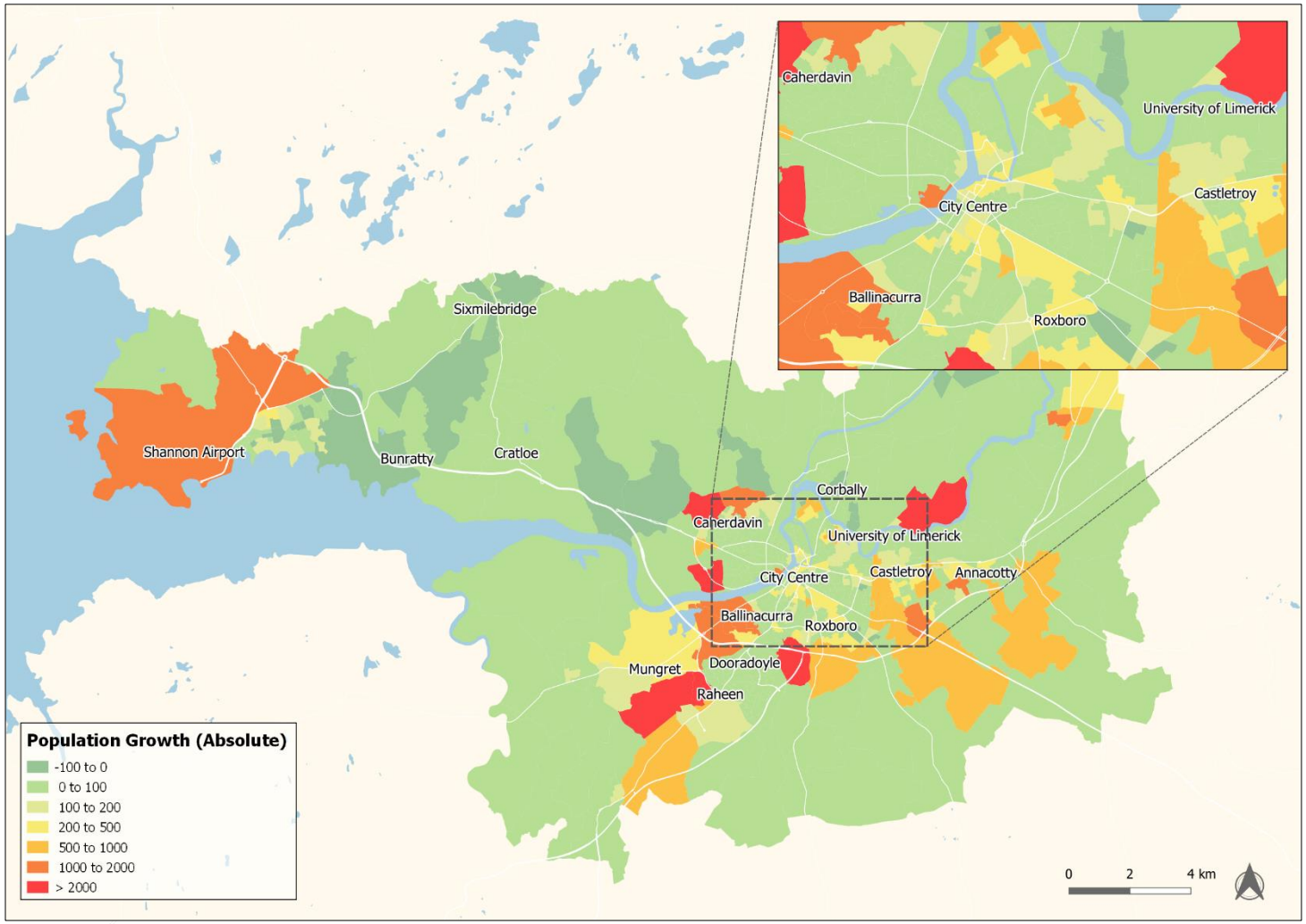


Figure 4-3: Population Growth 2016 to 2040

4.3.3 Employment

Table 4-5 provides a comparison between the 2016 and the 2040 Planning Datasheets at a settlement level for employment. The greatest absolute growth is seen in Ballinacurra which includes the Limerick Docklands. There is also significant employment growth within the City Centre, Mungret, Shannon and the proposed South Clare Economic SDZ.

Table 4-5: Job Comparison at a Settlement Level

Metro Settlements	Employment		Employment Growth	
	2016	2040	2016 to 2040	2016 to 2040 %
Annacotty	1,484	2,586	1,103	74%
Ballinacurra	3,219	9,202	5,982	186%
Bunratty	479	577	98	21%
Caherdavin	900	1,836	936	104%
Castleconnell	295	301	6	2%
Castletroy	767	1,356	589	77%
City Centre	9,842	12,749	2,907	30%
Clareview	1,544	1,517	-27	-2%
Cratloe	207	249	42	20%
Dooradoyle	4,840	5,359	519	11%
Limerick North	1,375	1,555	180	13%
Limerick North-East	3,350	4,597	1,247	37%
Moyross	1,562	1,507	-55	-4%
Mungret	286	4,644	4,358	1523%
Parteen	164	172	8	5%
Raheen	4,606	5,254	649	14%
Roxboro	3,831	5,143	1,312	34%
Rural	3,314	4,160	846	26%
Shannon	9,839	13,794	3,955	40%
Sixmilebridge	229	312	83	36%
South Clare Economic SDZ	28	1,136	1,108	3921%
University	4,750	5,564	814	17%
Westbury	99	108	9	9%
Total	**57,010**	**83,680**	**26,670**	**47%**

The job growth distribution between 2016 and 2040 is represented by CSO small area in Figure 2-4.

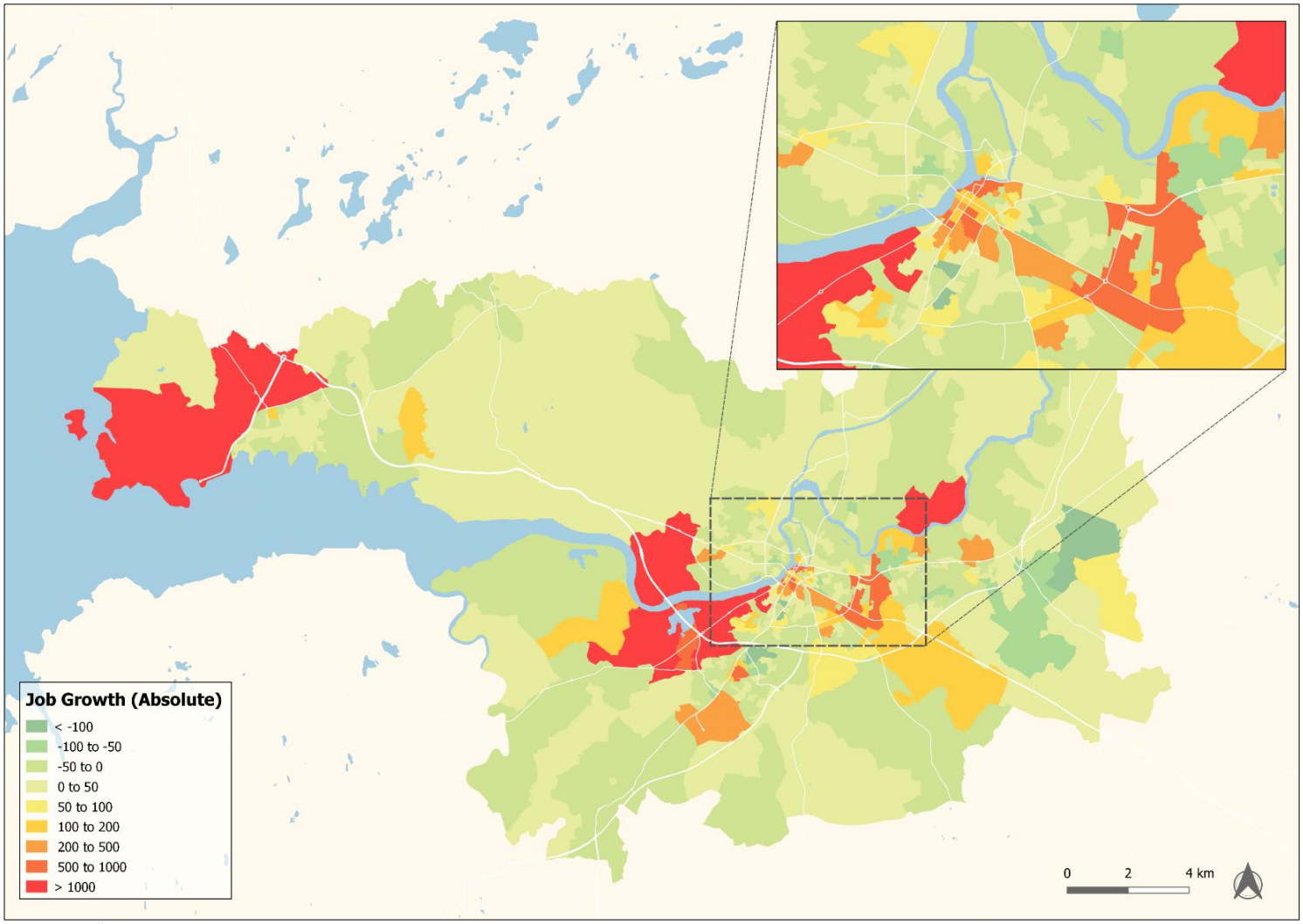


Figure 4-4: Job Growth 2016 to 2040

4.3.4 Education

Table 4-6 provides a comparison between the 2016 and the 2040 Planning Datasheets at a settlement level for education. As before, there is significant growth in education places in the Limerick Suburbs and areas with significant population growth forecast such as Mungret and the proposed South Clare SDZ.

Table 4-6: Education Comparison at a Settlement Level

Metro Settlements	Population		Population Growth	
	2016	2040	2016 to 2040	2016 to 2040 %
Annacotty	1,036	1,693	658	63%
Ballinacurra	5,286	6,894	1,609	30%
Bunratty	131	168	37	28%
Caherdavin	484	1,443	959	198%
Castleconnell	196	637	440	225%
Castletroy	761	1,420	659	87%
City Centre	864	1,582	717	83%
Clareview	2,048	2,627	579	28%
Cratloe	258	311	53	20%
Dooradoyle	1,662	2,598	936	56%
Limerick North	2,469	3,235	765	31%
Limerick North-East	1,919	3,118	1,199	62%
Moyross	3,793	5,245	1,452	38%
Mungret	142	637	494	348%
Parteen	269	315	45	17%
Raheen	706	1,220	514	73%
Roxboro	1,833	2,660	828	45%
Rural	2,171	3,685	1,514	70%
Shannon	2,583	3,200	617	24%
Sixmilebridge	379	525	146	38%
South Clare Economic SDZ	1	502	501	49645%
University	8,916	11,302	2,386	27%
Westbury	2	156	154	7572%
Total	37,911	55,171	17,260	46%

As many small areas have no schools the education absolute growth rather than percentage growth in education places between 2016 and 2040 is represented in Figure 2-5.

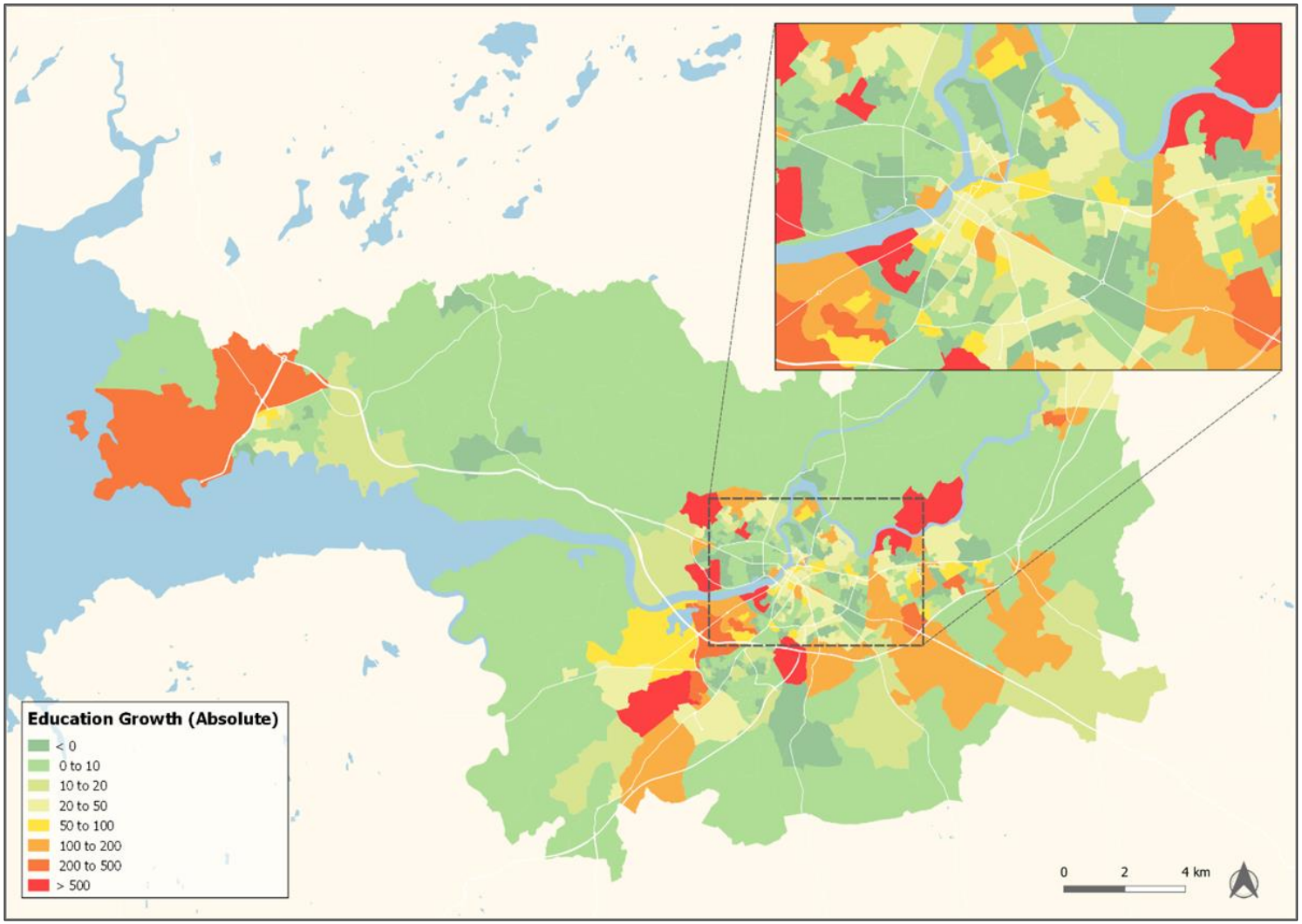


Figure 4-5: Education Growth 2016 to 2040

5 Options Development Modelling for Draft Strategy

5.1 Overview

The following section provides a high-level overview of the supporting modelling undertaken using the NTA's Mid-West Regional Model (MWRM) to aid the options development and assessment. Public Transport options were developed prior to modelling based on the idealised demand outlined and the principles outlined in section 3.3. A number of options were also developed to make best use of the existing available infrastructure, such as existing rail lines.

The modelling was then undertaken iteratively with each run used to refine the inputs and assumptions for the next run. The outputs of these runs were used to inform the options assessment for each corridor and refine the options outlined in Section 3.6-3.11. Further option development detail is provided in the LSMATS Transport Options and Network Development Report.

Improvements to public transport modes were modelled separately and prior to any road improvements to understand the likely maximum demand for public transport, the remaining road congestion issues with an improved PT network in place and the subsequent impact of the road infrastructure on car and public transport demand. The modelling runs undertaken as part of the options development are outlined in Table 3-3 along with the main additional inputs included in each run.

Table 5-1 Options Development – Model Runs

Scenario	LNDR Phase 1	Bus Network & Priority	Cycle Network	Improved Rail Network	City Centre PT Measures	Full LNDR	Foynes to Limerick
Do Min	✓						
It 1: Bus	✓	✓	✓				
It 2: Bus & Rail	✓	✓	✓	✓			
It 3: Bus & City Centre	✓	✓	✓		✓		
It 4: Bus, City Centre & Roads	✓	✓	✓		✓	✓	✓

5.1.1 Model Version

As discussed in the introduction the NTA model has been updated since the option development and publication of the draft strategy. The modelling results outlined here are based on results from the previous V2 model as this was the latest available model at the time the options development was undertaken. However, the modelling and appraisal of the final strategy has been undertaken using the most up to date V3 model to ensure the robustness of the appraisal.

5.2 Scenario Description

5.2.1 Do-Minimum (AAD)

The Do-Minimum run included the existing road, public transport, walking and cycling networks with Phase 1 of the Limerick Northern Distributor Road from Coonagh to Knockalisheen, due to open in 2020. The AM peak mode share for the Metropolitan Area for the 2040 Do-Minimum and 2016 base year are shown in Figure 5-1.

As illustrated, there is a significant increase in the car mode share with a decline in the proportion of walking, cycling and public transport trips. However, in absolute terms there is growth across all modes as illustrated in the total number of trips shown in Figure 5-2.

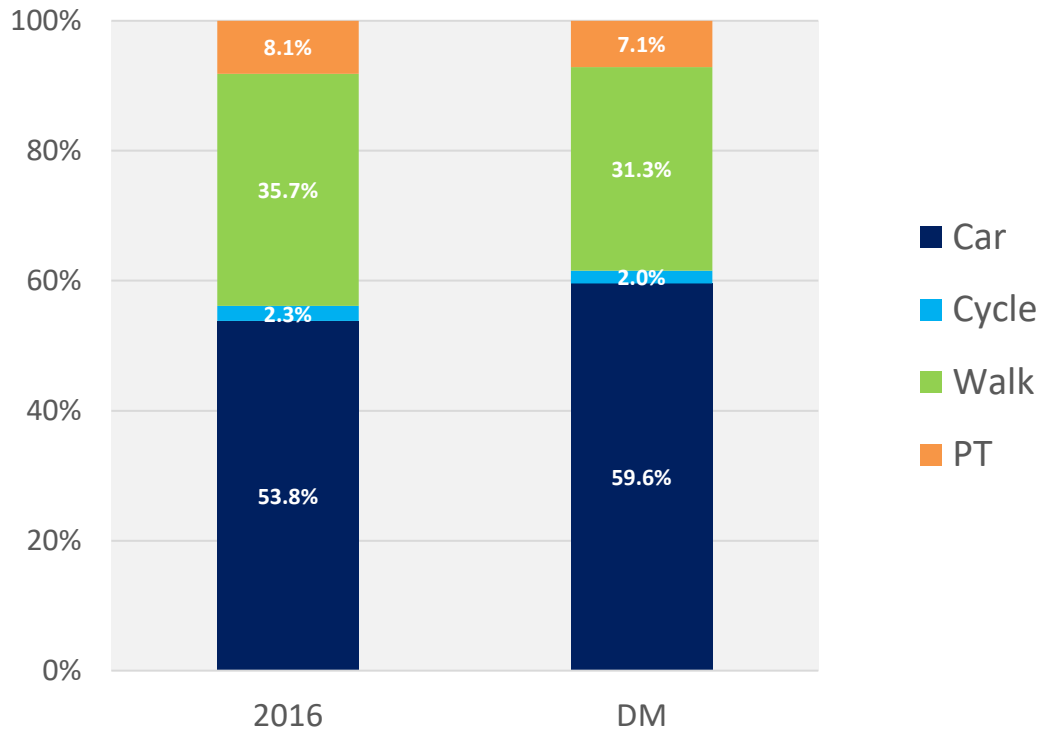


Figure 5-1: Metropolitan Area AM Peak Mode Share – 2016 & 2040 Do-Minimum

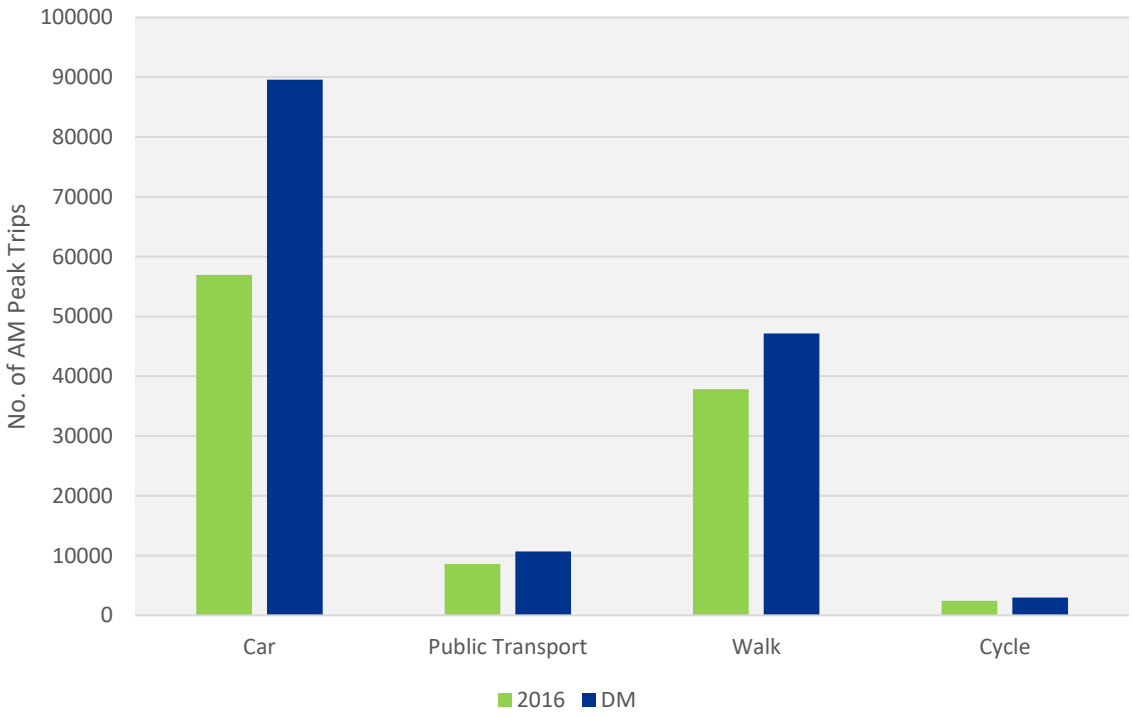


Figure 5-2: Metropolitan Area AM Peak Total Trips by Mode – 2016 & 2040 Do-Minimum

5.2.2 Iteration 1 – Bus (AAE)

Iteration 1 (AAE) included a comprehensive network of frequent radial and orbital bus routes developed to meet targeted maximum public transport demand outlined in the Demand Report and in accordance with the principles outlined in Options Development Report. A high level of bus priority along the network was assumed in addition to the existing road capacity. In reality, this level of priority may not be feasible along the entire network or would likely require some decrease in road capacity and/or traffic management. The initial bus network tested is shown below.

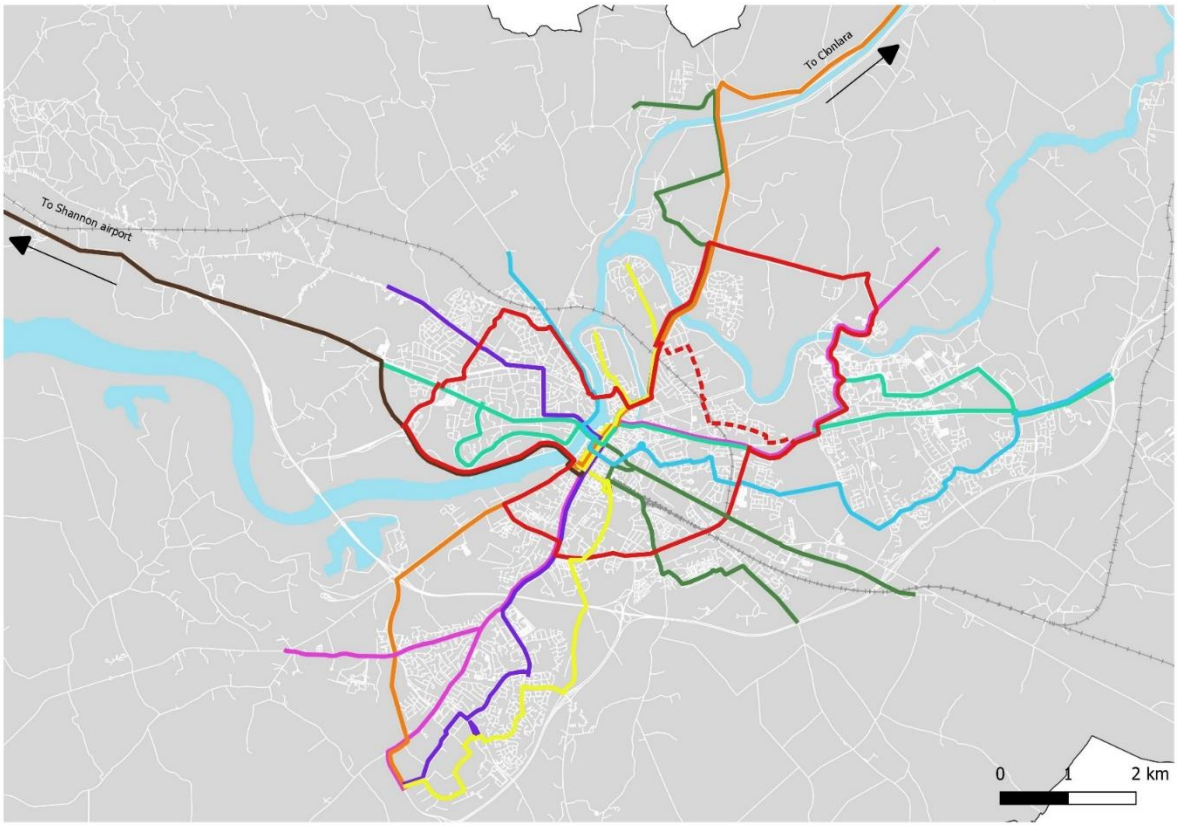


Figure 5-3: Iteration 1 (AAE) – Assumed Bus Network

This run also included an improved cycle network based on the Limerick Metropolitan Cycle network. The mode shares for Iteration 1 (AAE) and the Do-Minimum are outlined for the AM Peak period are outlined in Figure 5-4. As shown the improved bus network increases the public transport patronage by approximately 45% in absolute terms and increases the overall mode share by over 3%. This results in a drop in both walking and driving. The number of cyclists increases by 30% though this represent a small change in its overall mode share.

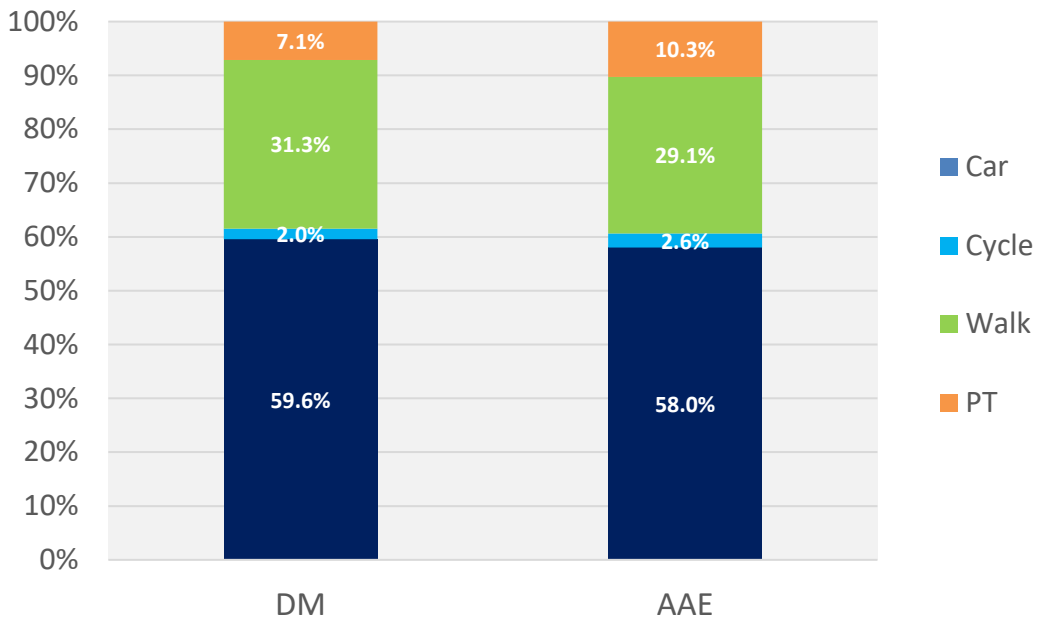


Figure 5-4: Metropolitan Area AM Peak Mode Share –2040 Do-Minimum & AAE

The improved frequency and catchment of the bus routes also results in significant journey time savings to the city centre by public transport. Figure 5-5 & Figure 5-6 show the average journey times by public transport to zones within the city core from across the metropolitan area from the Do-Minimum and Iteration 1 respectively. As shown, there is significant improvement in journey times across the LSMA particularly within Limerick City and wider suburbs. Overall, public transport journey times on average are reduced by 10mins or 27%.

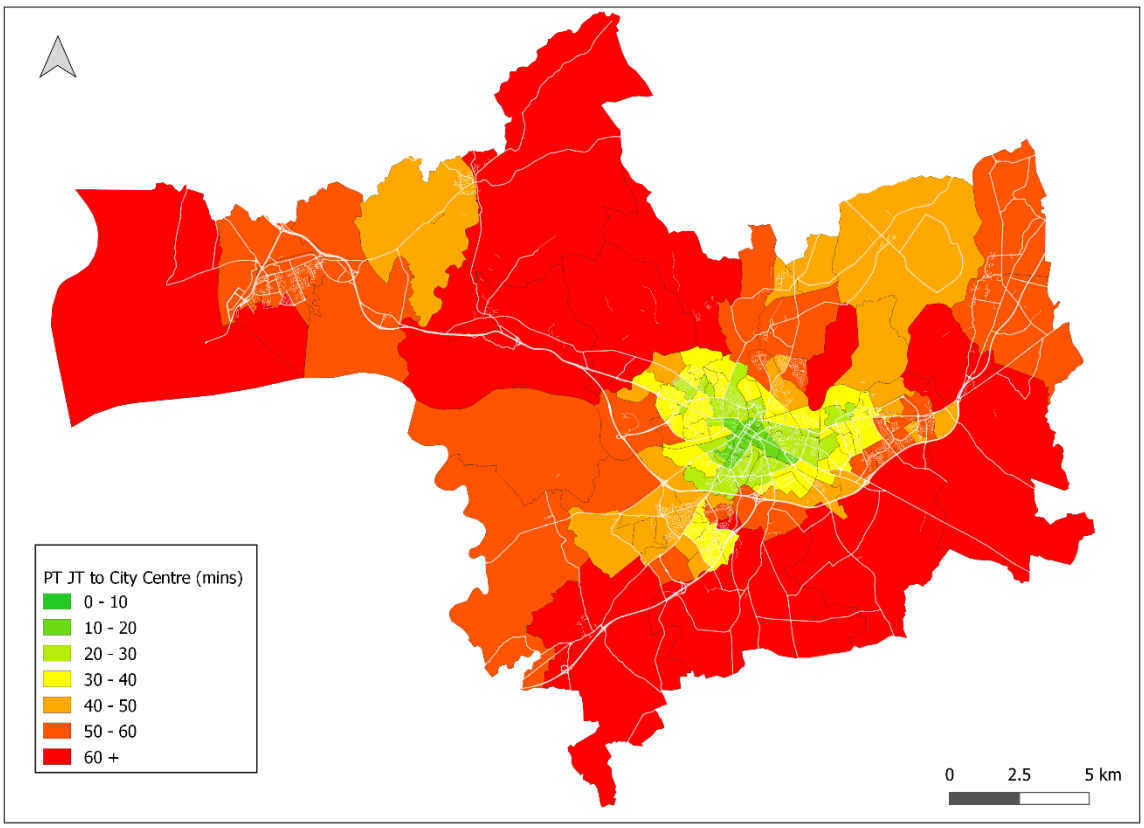


Figure 5-5: 2040 Do-Minimum Average Public Transport Journey Times to the City Centre – AM Peak

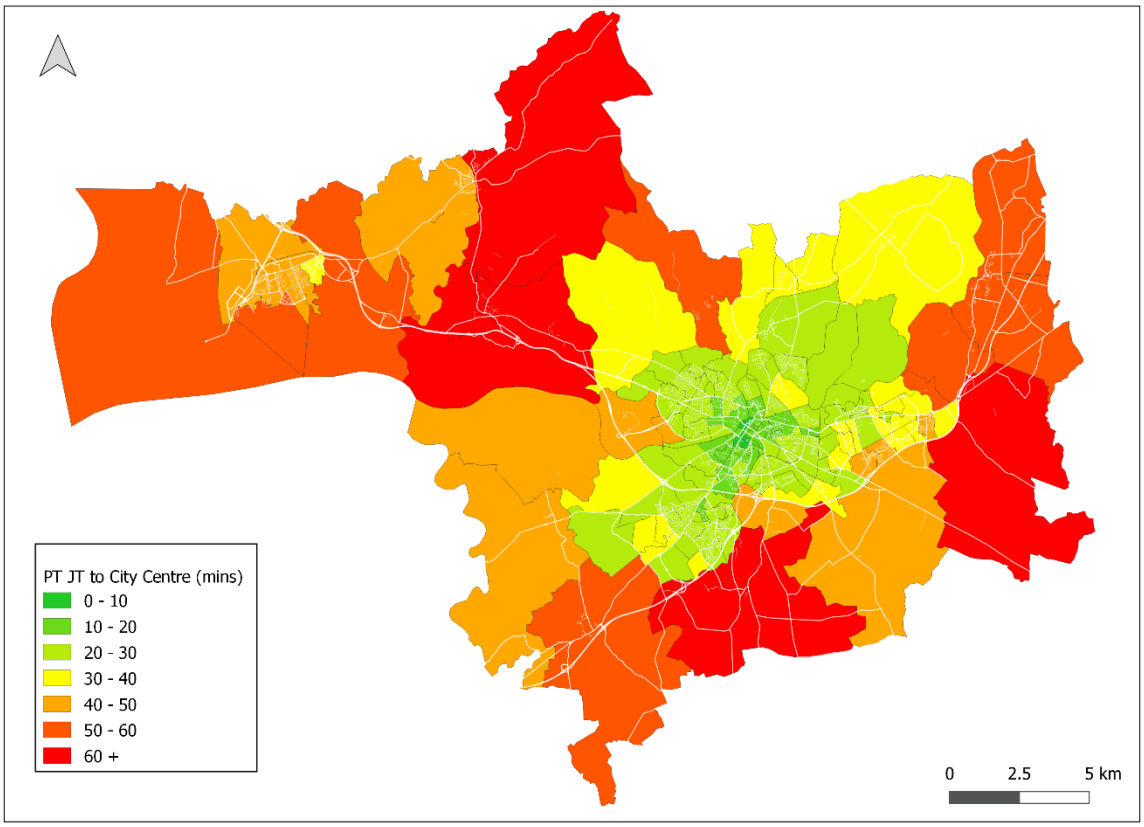


Figure 5-6: Iteration 1 (AAE) Average Public Transport Journey Times to the City Centre – AM Peak

The majority of buses also have a reasonable level of patronage, particularly during the morning and evening peak hour. The passenger volume over design capacity is shown as a percentage for each service for each peak hour, as illustrated by Table 5-2. The pink, purple, orange and brown lines in particular attract significant demand. The brown line to Shannon is over the design capacity in some peak, though under the crush capacity. The yellow and blue 'coverage routes' along with the northern orbital options to do not attract significant demand.

Table 5-2 Passenger Volume/Design Capacity of Improved Bus Services by Peak

Line No.	Line Colour	Max Volume/Design Capacity			
		AM	LT	SR	PM
6010	Dark green line / With north branch / Southbound	63%	32%	49%	41%
6011	Dark green line / With north branch/ Northbound	76%	28%	39%	35%
6012	Dark green line / With south branch / Southbound	58%	32%	58%	48%
6013	Dark green line / With south branch / Northbound	91%	32%	50%	38%
6020	Pink line / With west branch / Southbound	97%	62%	83%	74%
6021	Pink line / With west branch / Northbound	83%	55%	70%	56%
6022	Pink line / With East branch / Southbound	87%	52%	67%	55%
6023	Pink line / With East branch / Northbound	74%	45%	59%	43%
6030	Turquoise line / 2 North branches / Eastbound	61%	31%	40%	35%
6031	Turquoise line / 2 North branches / Westbound	56%	35%	40%	37%
6032	Turquoise line / 2 South branches / Eastbound	45%	27%	42%	42%
6033	Turquoise line / 2 South branches / Westbound	80%	40%	39%	37%
6040	Purple line / Southbound	95%	43%	65%	55%
6041	Purple line / Northbound	90%	59%	78%	56%
6050	Blue line / Eastbound	39%	21%	30%	27%
6051	Blue line / Westbound	44%	20%	27%	23%
6060	Orange line / Southbound	93%	37%	47%	37%
6061	Orange line / Northbound	71%	42%	67%	57%
6080	Yellow line / With west branch / Southbound	31%	13%	23%	22%
6081	Yellow line / With west branch / Northbound	26%	13%	16%	12%
6082	Yellow line / With east branch / Southbound	38%	19%	24%	26%
6083	Yellow line / With east branch / Northbound	32%	13%	18%	25%
6090	Brown line / To Limerick	106%	79%	73%	55%
6091	Brown line / To Shannon	74%	124%	66%	82%
6100	Orbital South / Eastbound	51%	22%	36%	31%
6101	Orbital South / Westbound	58%	22%	35%	28%
6110	Orbital North, option 1 / Eastbound	20%	12%	19%	12%
6111	Orbital North, option 1 / Westbound	22%	11%	20%	13%
6112	Orbital North, option 2 / Eastbound	45%	16%	26%	19%
6113	Orbital North, option 2 / Westbound	41%	20%	36%	29%

5.2.3 Iteration 2 – Bus & Rail (AAF)

Iteration 2 (AAF) included all measures from the previous iteration along with an improved suburban rail network. This included the following:

- Rail Spur to Shannon Airport;
- 20-minute headways from Colbert Station to Limerick Junction, Nenagh, Shannon & Ennis;
- Assumed dual tracking on each of these lines to enable the more frequent services;
- New stations at existing urban settlements along each line including Garryowen, Corbally, Moyross, Cratloe, Bunratty, Castleconnell, Ballysimon, Pallas & Oola.

The AM peak mode share for Iteration 2 (AAF) and the previous runs is outlined in Figure 5-7. As shown, the significant improvement in rail infrastructure has a relatively limited impact in mode shares with an increase of 0.6% in the public transport mode share. The majority of this increase is

due to a shift from walking and cycling which decrease by a combined 0.4%. The car mode share decreases by just 0.2%.

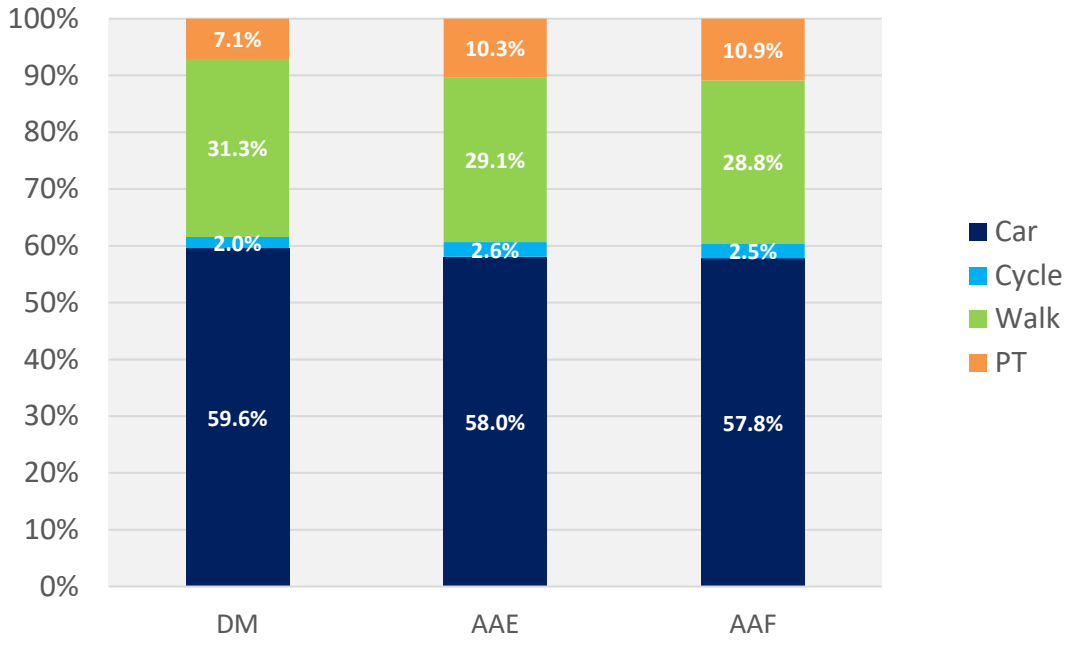


Figure 5-7: Metropolitan Area AM Peak Mode Share –2040 Do-Minimum, AAE & AAF

The patronage of each individual rail service shows that majority of services are well below their design capacity, as outlined in Table 5-3 which illustrates the volume over design capacity of the rail services during each peak.

Table 5-3 Patronage of Improved Rail Services by Peak

Service	Time Period			
	AM	LT	SR	PM
Nenagh to Limerick	26%	6%	7%	9%
Limerick to Nenagh	9%	6%	13%	10%
Ennis to Limerick	53%	11%	15%	14%
Limerick to Ennis	18%	14%	38%	26%
Limerick to Limerick Junction	12%	16%	25%	21%
Limerick Junction to Limerick	34%	14%	14%	13%
Limerick Train Station to Shannon	19%	10%	13%	13%
Shannon to Limerick Train Station	28%	12%	15%	13%

To assess the performance of individual new stations within the metropolitan area, the boardings and alightings from the AM peak have extracted for each proposed station and compared against the equivalent patronage for buses service local to the station. This is outlined in Figure 5-8. The population growth in these areas surrounding these stations, as outlined in Table 4-4, is below or equal to the average growth across the LSMA. To support the level of rail infrastructure proposed in this scenario these areas would require significant intensification of development around the stations.

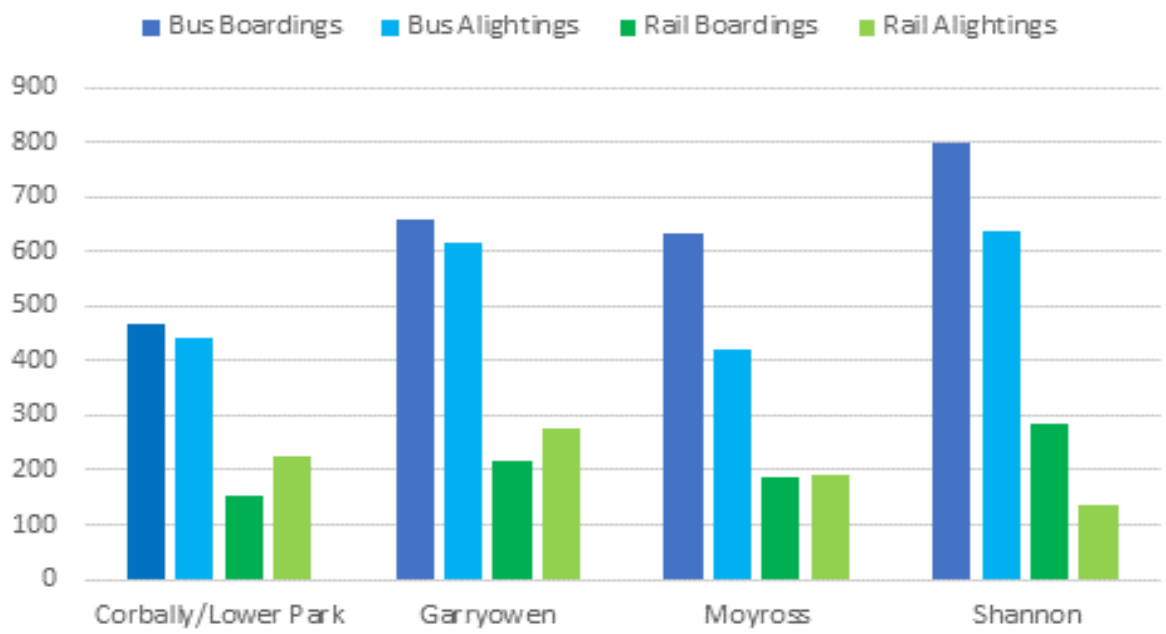


Figure 5-8: AM Peak Boardings and Alightings for proposed Metropolitan Rail Stations

The lower rail boardings and alighting compared to bus at these locations is partly due to the journey times to the city centre. Rail demand terminates in Colbert Station which is removed from the city centre. However, the improved bus network has multiple stops within the core of the city centre and runs and many of the proposed lines run at a higher frequency than that of the rail. As shown, in Figure 5-9: the average journey times by public transport to the City Core are largely unchanged compared to the Iteration 1 journey times presented in Figure 5-6. Overall, there is a 1% average reduction in public transport journey times.

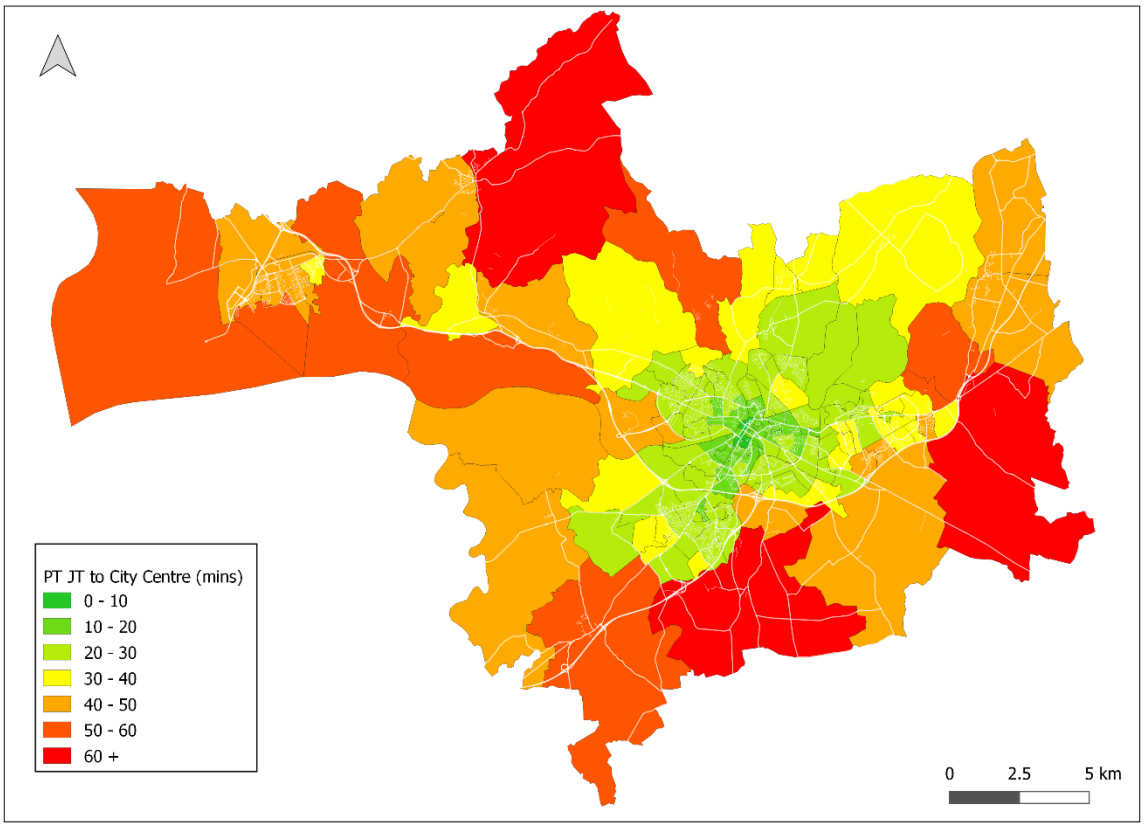
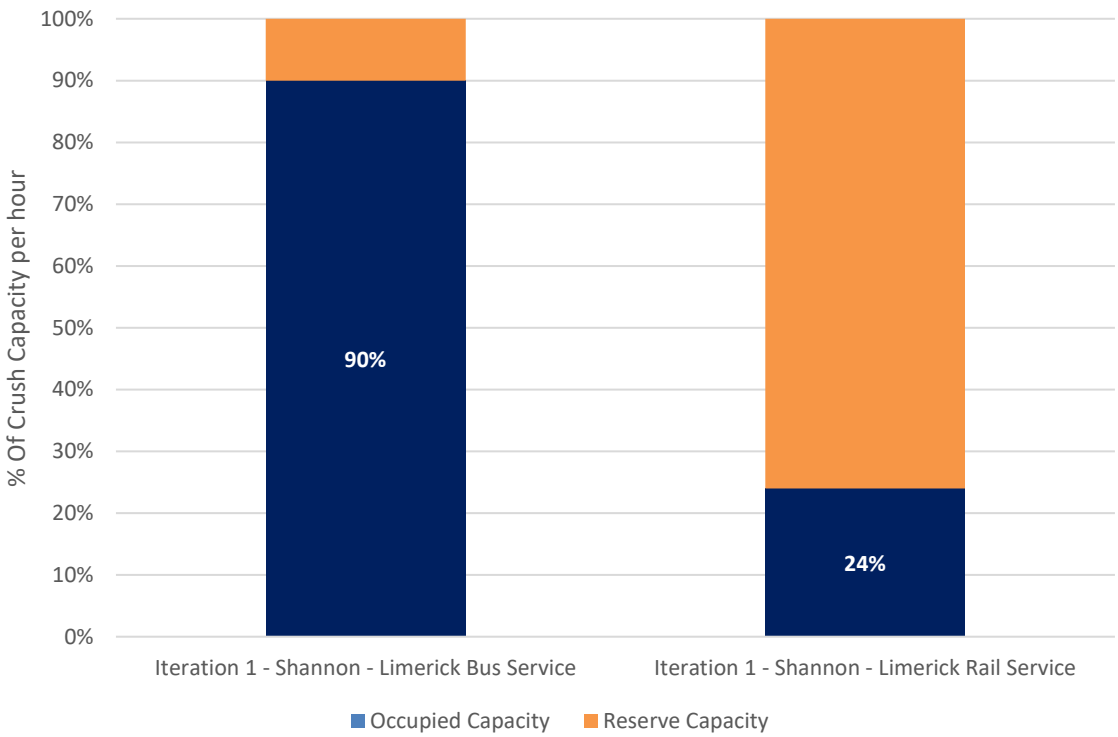


Figure 5-9: Iteration 2 (AAF) Average Public Transport Journey Times to the City Centre – AM Peak

the modelling shows that there is potential for an improved, more frequent service to Ennis, and potentially Limerick Junction, along existing lines based on the below but likely not to the extent assumed for modelling purposes. The new Shannon rail service in particular is unlikely to be feasible given the level of new infrastructure required to facilitate this service. As outlined in Figure 5.10, comparing the efficiency of the morning peak bus and rail services from Shannon to Limerick in Iteration 1 and Iteration 2 in terms of passenger demand as a percentage of crush capacity shows that the rail option would only be 24% occupied whilst the bus would be 90% occupied. Whilst this indicates a more frequent bus service may be required to serve future demand it is very unlikely that investment in rail could be justified by the passenger demand outlined.

Figure 5-10: AM Peak Passenger Demand/Crush Capacity of Shannon Iteration 1 Bus Service vs Iteration 2 Rail Service.



5.2.4 Iteration 3 – Bus & City Centre Strategy (AAG)

Iteration 3 included all measures contained within Iteration 1 along with traffic management measures and additional bus priority within Limerick City Centre. This includes public transport only measures along O'Connell Street and Sarsfield Bridge with Henry Street becoming two-way to general traffic. The rail improvements were not included based on the performance of rail in Iteration 2 which indicated low demand along the higher frequency services and low demand at each of the new rail stations. The city centre measures included are as outlined in Figure 5-11.

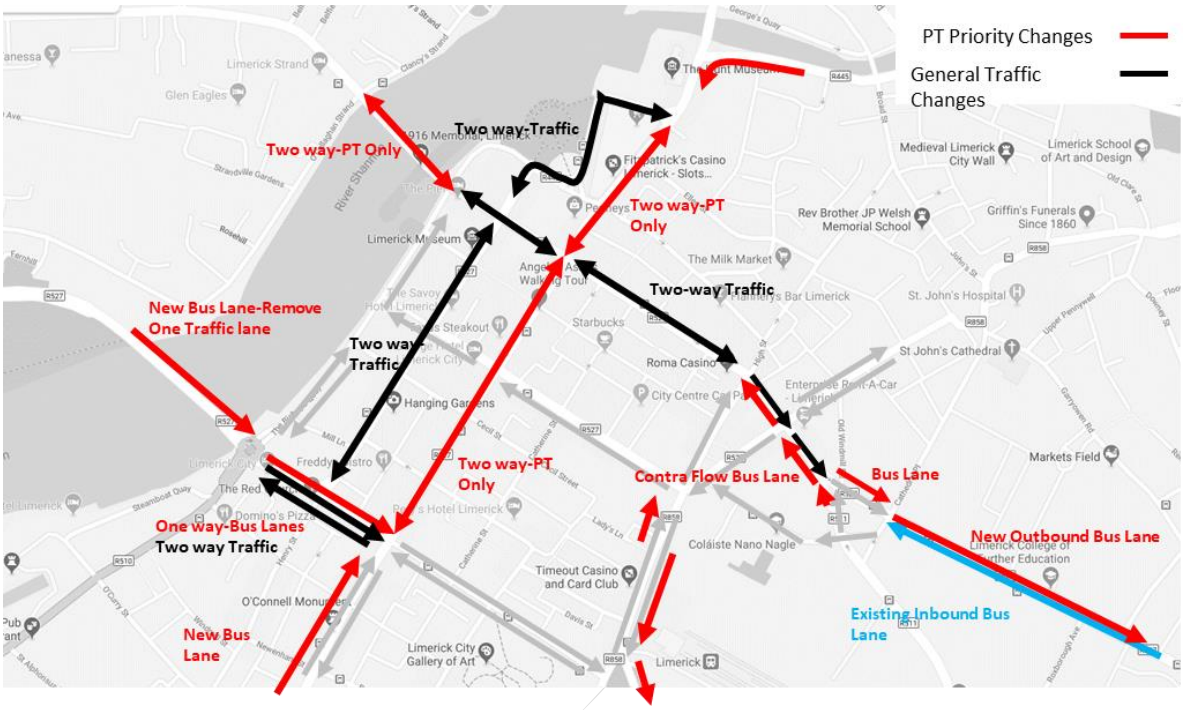


Figure 5-11: Iteration 3 (AAG) – City Centre Traffic Management & Bus Priority

The mode shares for this iteration and previous iterations are shown below.

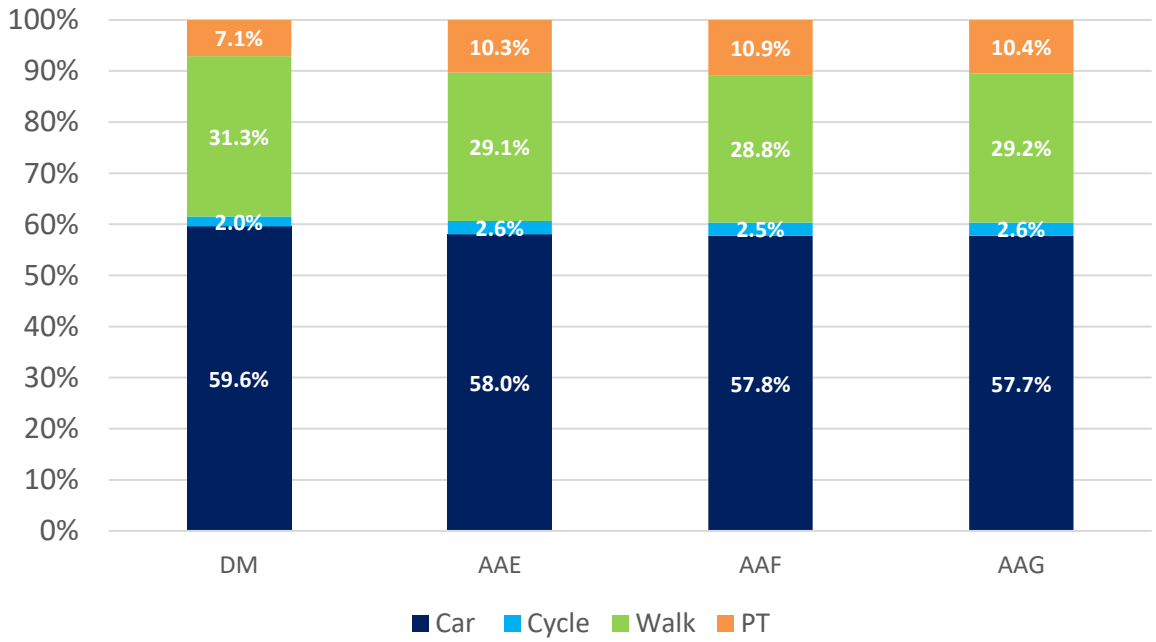


Figure 5-12: Iteration 3 (AAG) Mode Share -AM Peak

As shown, the traffic management measures and increased priority through the city has a greater impact on car mode shares than the provision of additional rail infrastructure. There is also an uplift in walking and cycling as more people choose these modes for shorter distance trips to the city centre.

5.2.5 Iteration 4 – Bus, City Centre Strategy & Roads (AAH)

This included the bus and city centre measures along with the N69 Foynes to Limerick incorporating Adare Bypass and full Limerick Northern Distributor Road (LNDR). The LNDR was modelled as a

80kph dual lane with grade separated junctions. The resultant mode shares for this iteration are shown in Figure 5-13.

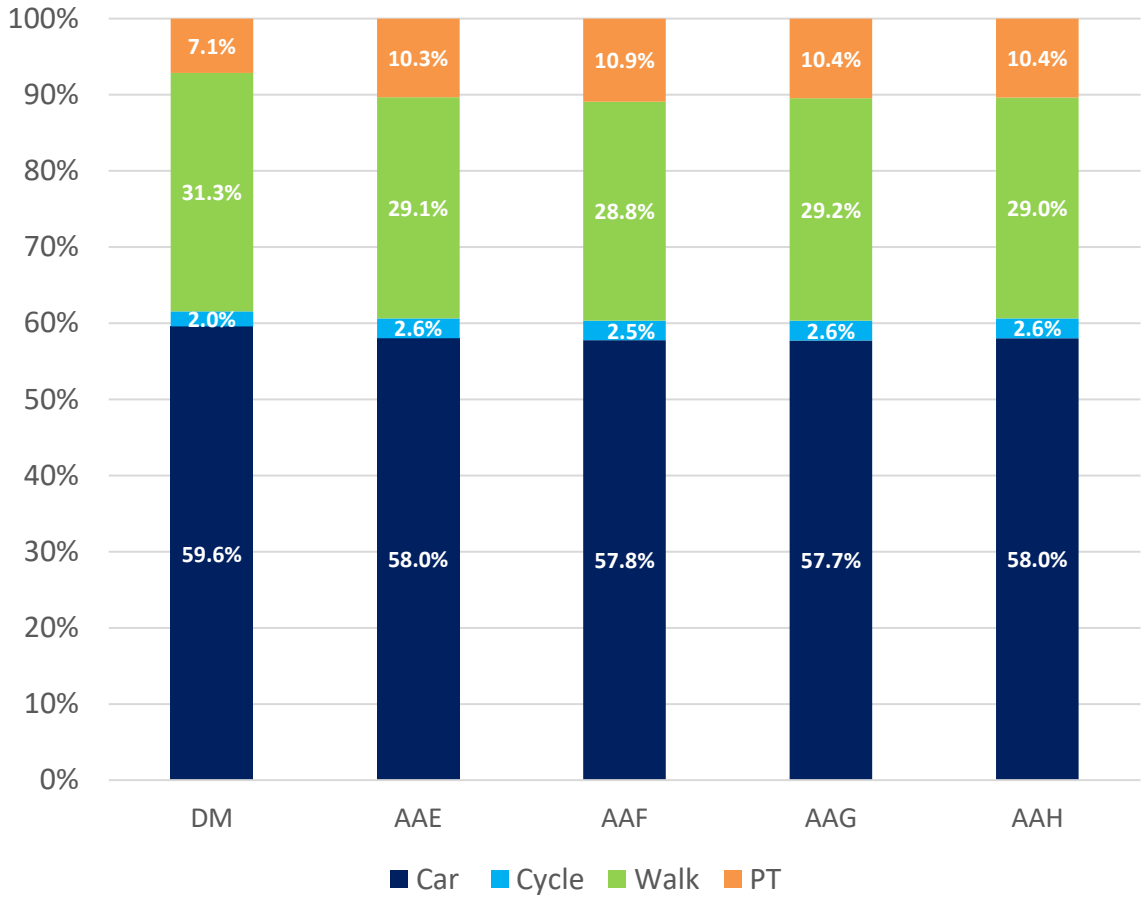


Figure 5-13: Iteration 4 (AAH) Mode Share -AM Peak

As shown, the introduction of the LNDR results in a slight increase in car mode share as a result of a decrease in walking. Public transport and cycling mode shares are unchanged. The would suggest a very slight increase in shorter distance car trips resulting from the scheme. The difference in traffic flows between AAG and AAH was plotted in SATURN for the AM peak and is shown in Figure 5-14. The green bands indicate an increase in traffic volumes and the purple bands a decrease.

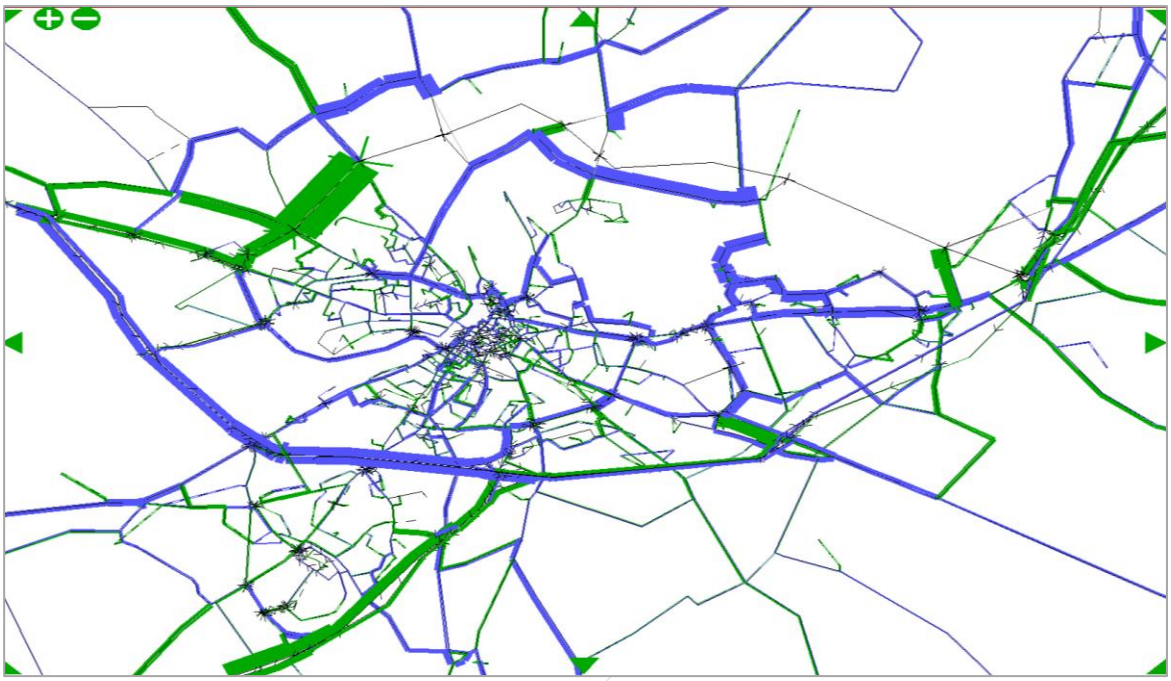


Figure 5-14: AAG vs AAH AM Peak Traffic Flows

As shown, there is a drop-in traffic along the N18 and M7 with an increase in traffic volumes along the Ennis Road. There is also an increase in traffic volumes along the M20 as a result of the N69 upgrade which ties into the M20. To assess these changes in more detail the volumes across each vehicular bridge over the Shannon, including the LNDR, was extracted from each model for the AM peak period, as shown below.

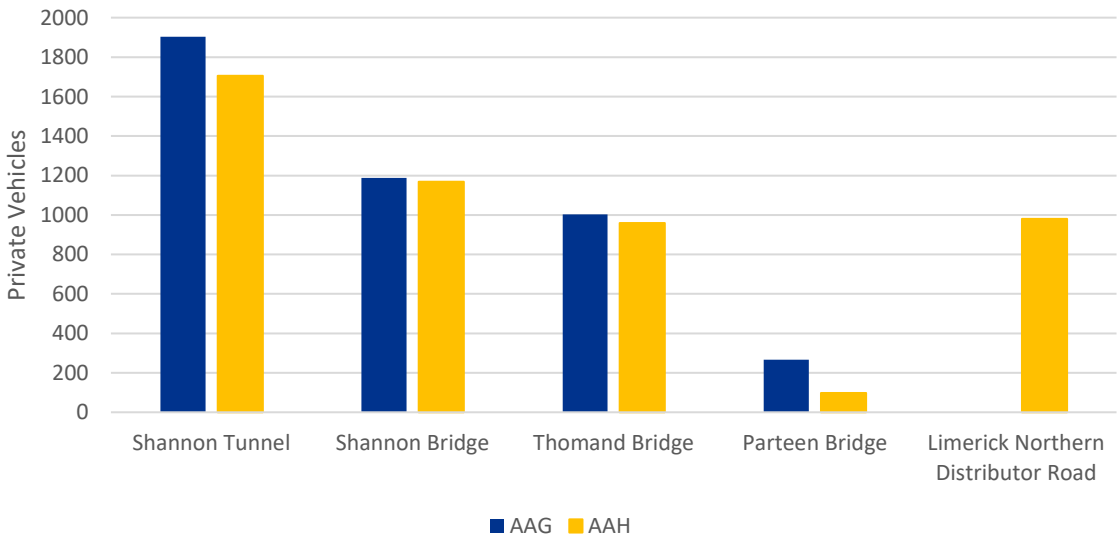


Figure 5-15: AAG vs AAH AM Peak Traffic Flows-Shannon Bridge Crossings

As shown, the LNDR has limited impact in the bridges within the city, Shannon and Thomond bridge, but has a more significant impact on the Shannon Tunnel and Parteen Bridge. Based on these preliminary assessments it is important the implementation of the LNDR and subsequent development of the corridor are carefully managed to ensure that the car mode share doesn't not increase further, undermining the sustainable mode share for the Limerick Shannon Metropolitan Area and the demand through the N18 Shannon Tunnel.

5.3 Draft Strategy & Further Refinements

5.3.1 Public Transport Network Refinement

Based on the results from the initial model runs and feedback from the Strategy Steering group a number of revisions were made to the bus network. Firstly, the northern orbital routes outlined previously were removed due to the poor patronage and journey times along these routes. It was agreed that a frequent, reliable service would be difficult to implement prior to the delivery of the LNDR given the network constraints on the north side of the city. Any northern orbital route provided should run along the LNDR supported by Park & Ride Sites at each end of the route.

There was also consensus that the patronage of the rail service provided to Shannon and the new stations along this route were unlikely to justify the considerable investment needed. As an interim measure, a second bus route was provided to Shannon which would act as a local service alongside an express route. In addition, a local shuttle service would be provided between Sixmilebridge and Shannon Town and Airport serving the rail station.

It is important to note that the bus network has been developed based on the land-use assumption outlined for the purposes of strategy development. The changes to the bus network will be more incremental over time and respond to the evolving land-use. However, development should be prioritised along the core routes outlined.

5.3.2 LNDR Refinement

As outlined, the LNDR as previously modelled results in a drop-in traffic through the Shannon Tunnel. To address this and to help ensure the LNDR fulfils its function as distributor road and not as a bypass for strategic traffic it is proposed that the speed limit, cross section and junction strategy is refined. It is assumed the LNDR will have a 60kph speed limit, single carriageway cross-section for cars, at grade signalised junction and bus priority, walking and cycling provision. With these revised measures in place the decrease in traffic volumes through the Shannon Tunnel is 62 vehicles compared to the previous 200 vehicles decrease. The assessment highlights that the LNDR predominantly provides road-based travel alternative to the tolled Shannon Tunnel and the congested Parteen Bridge. Again, there is a slight increase in car mode share associated with the introduction of the LNDR with an associated reduction in sustainable mode share.

It should be noted that a more detailed, multi-modal modelling assessment of the LNDR will need to be undertaken as part of the future appraisal of the scheme. This assessment should include the need for the scheme, impact on Limerick City-wide public transport usage, LNDR public transport usage, regional and localised car mode shares and on traffic volumes through the Shannon Tunnel. Any likely induced car demand as a result of the scheme should also be assessed. The appraisal should also detail the planned phasing and implementation of the road.

5.3.3 Additional City Centre Public Transport Priority & Parking Restrictions

To ensure the LNDR does not have a negative impact on sustainable mode shares and does not result in the oversupply of road capacity for private vehicles public transport services and priority are proposed to be delivered in advance of the LNDR. The additional priority is proposed to the north of the city in the form of bus gates during the AM morning peak along Bridge Street and Charlotte's Quay, however, further analysis will be required to determine the appropriate form this priority will take.

A restriction on city centre destination parking supply was also tested. This was to reflect the potential removal of on-street parking spaces required to facilitate improved access for walking, cycling and public transport. These measures along with increased priority are intended to be indicative of what could be realistically be implemented for the purposes of the strategy appraisal.

However, a more detailed assessment and appraisal of the impacts would be required before they could be approved and implemented.

The metropolitan area AM peak mode share with each of the refinements in place is outlined in Figure 5-16 and shows a more drop in the car mode share as a result of the additional measures.

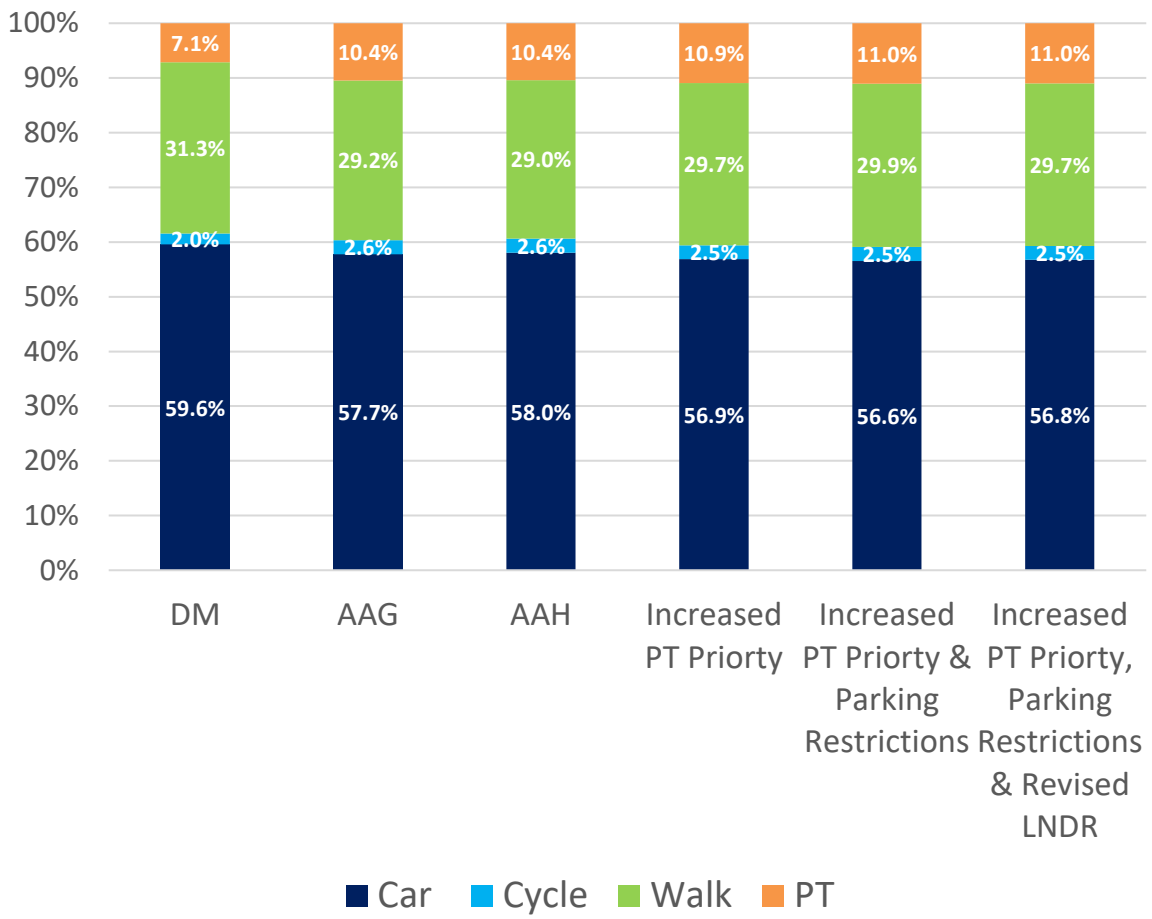


Figure 5-16: Strategy Refinement Mode Share -AM Peak

6 Previous Draft Strategy (Public Consultation Sept 2020)

6.1 Overview

This section outlines the draft transport measures included in the Do-Minimum and Do-Strategy model runs for appraisal purposes which were included in the draft strategy that went to **public consultation in September 2020**. The measures were informed by the optioneering run outlined in the previous chapter as well as feedback from key stakeholder.

6.2 Do-Minimum

The Do-Minimum is as described previously in Section 5.2.1 and includes the existing road, public transport, walking and cycling networks with the Phase 1 of the Limerick Northern Distributor Road from Coonagh to Knockalisheen.

6.3 Draft Do-Strategy

6.3.1 Public Transport

LSMATS proposes a comprehensive network of high frequency bus services providing radial services between corridors either side of the city core and orbital services across the network and is shown in Figure 6-1. The Core Radial Bus Network connect the external corridors to the City Centre and have been refined to pair Cross-City travel demand to maximise the utilisation of the bus services on these corridors. A significant improvement in the frequency of bus services on these radial routes is also proposed.

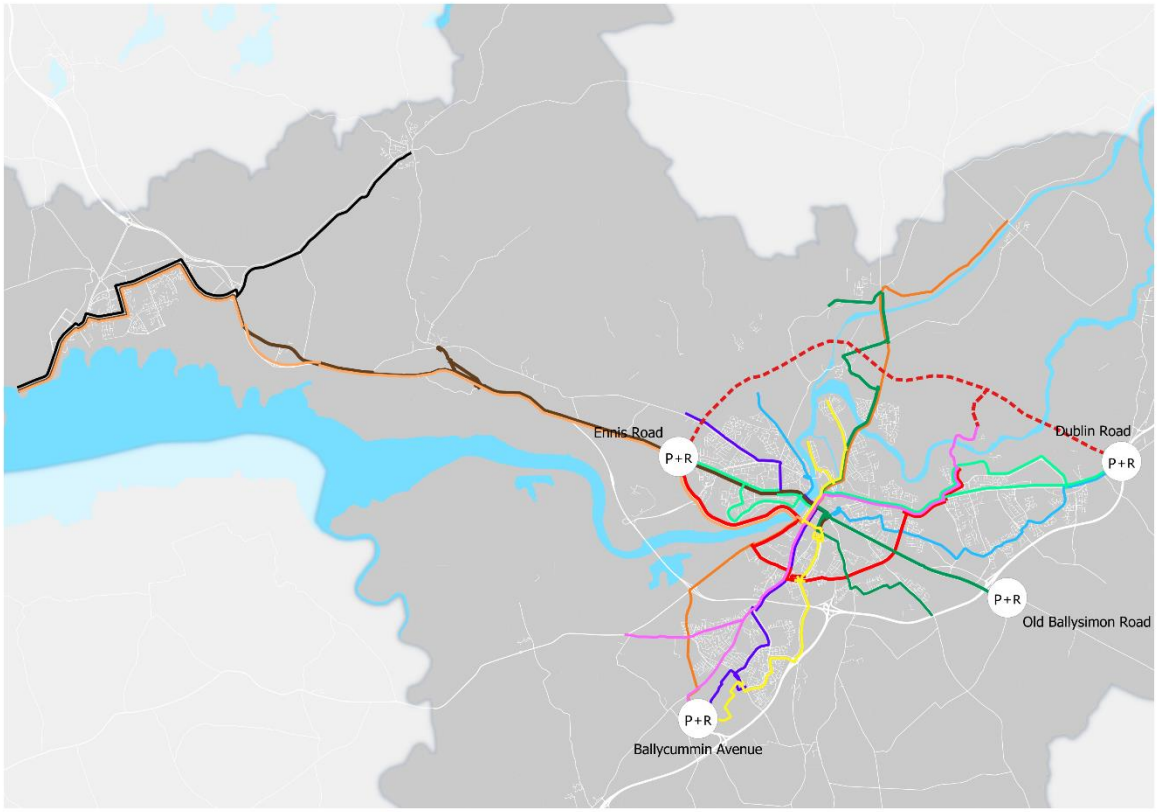


Figure 6-1: LSMATS Bus Connects Network

A number of core and orbital routes will serve strategic Park & Ride sites located along the periphery of the city, as shown in Figure 6-1. This are designed to capture demand travelling to the city that would otherwise be inclined to use car for the entirety of the journey.

The proposed frequencies of the routes are outlined in Table 6-1.

Table 6-1 Proposed Frequency of LSMATS Bus Network

Line No.	Line Name	Modelled Headway
6010	Ballysimon-Ardnacrusha	20
6011	Ardnacrusha - Ballysimon	20
6012	Ardnacrusha - Crossagalla	20
6013	Crossagalla-Ardnacrusha	20
6020	SDZ/UL-Mungret	15
6021	Mungret-SDZ/UL	15
6022	SDZ/UL-Raheen	15
6023	Raheen-SDZ/UL	15
6030	Caherdavin-UL-Annacotty	20
6031	Annacotty-UL-Caherdavin	20
6032	Caherdavin/North Circular-Annacotty	20
6033	Annacotty-Caherdavin/North Circular	20
6040	Ballygrennan-Raheen	7.5
6041	Raheen-Ballygrennan	7.5
6050	Annacotty-Moyross	10
6051	Moyross-Annacotty	10
6060	Clonlara-Raheen	15
6061	Raheen-Clonlara	15
6080	King's Island-Raheen	30
6081	Raheen-King's Island	30
6082	Corbally-Raheen	30
6083	Raheen-Corbally	30
6090	Shannon-Limerick Express	10
6091	Limerick-Shannon Express	10
6114	Shannon-Limerick Local	15
6115	Limerick-Shannon Local	15
6116	Sixmilebridge-Shannon	20
6117	Shannon-Sixmilebridge	20
6100	Southern Orbital Eastbound	10
6101	Southern Orbital Westbound	10
6118	Northern Orbital Eastbound via LNDR	20
6119	Northern Orbital Westbound via LNDR	20

6.3.2 Cycling

The cycle network development for LSMATS is based on the Limerick Metropolitan Cycle Network Study 2015 and Shannon Town and Environs LAP, each was reviewed to ensure integration and alignment with the transport proposals within this strategy and is shown in Figure 6-2 & Figure 6-3. The proposed cycle network was coded into the MWRM in the Do-Strategy scenario to represent the increased cycle speeds associated with the various levels of service provided by the proposed network.

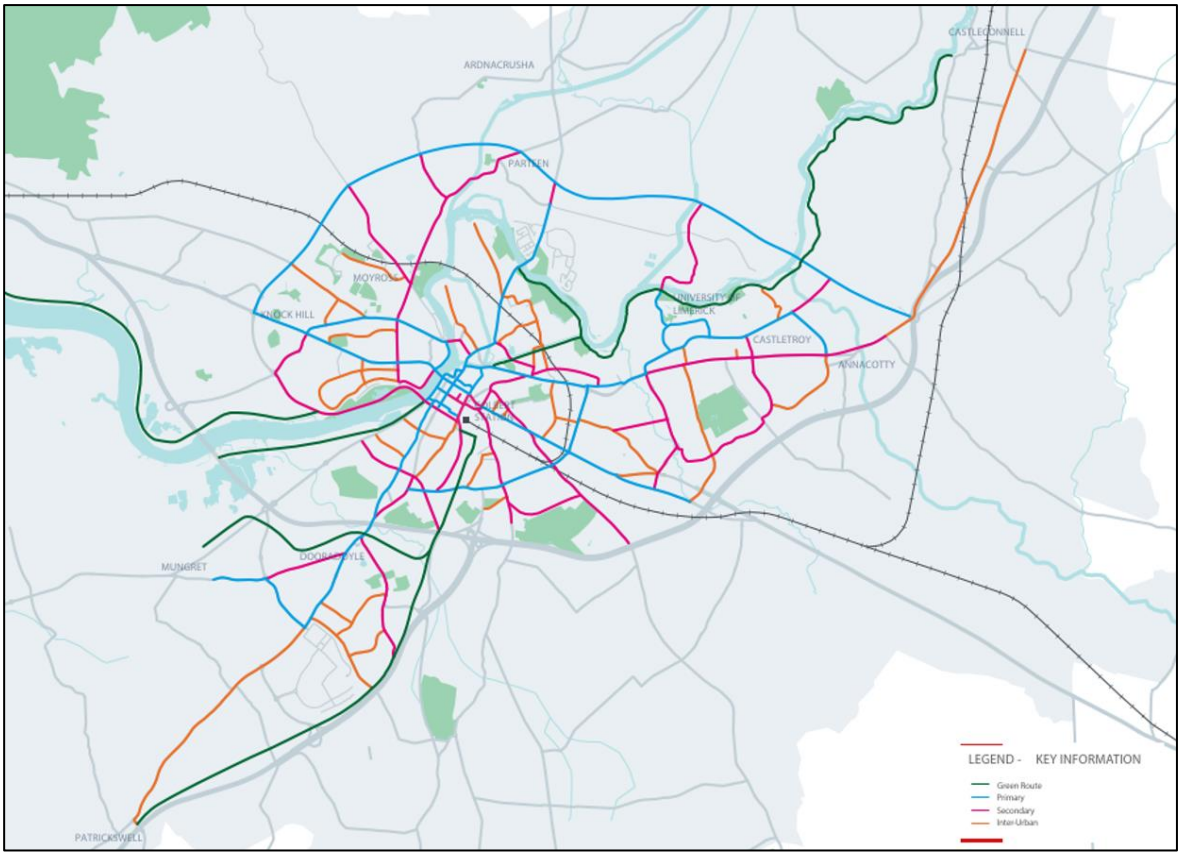


Figure 6-2: LSMATS Cycle Network- Limerick City and Suburbs

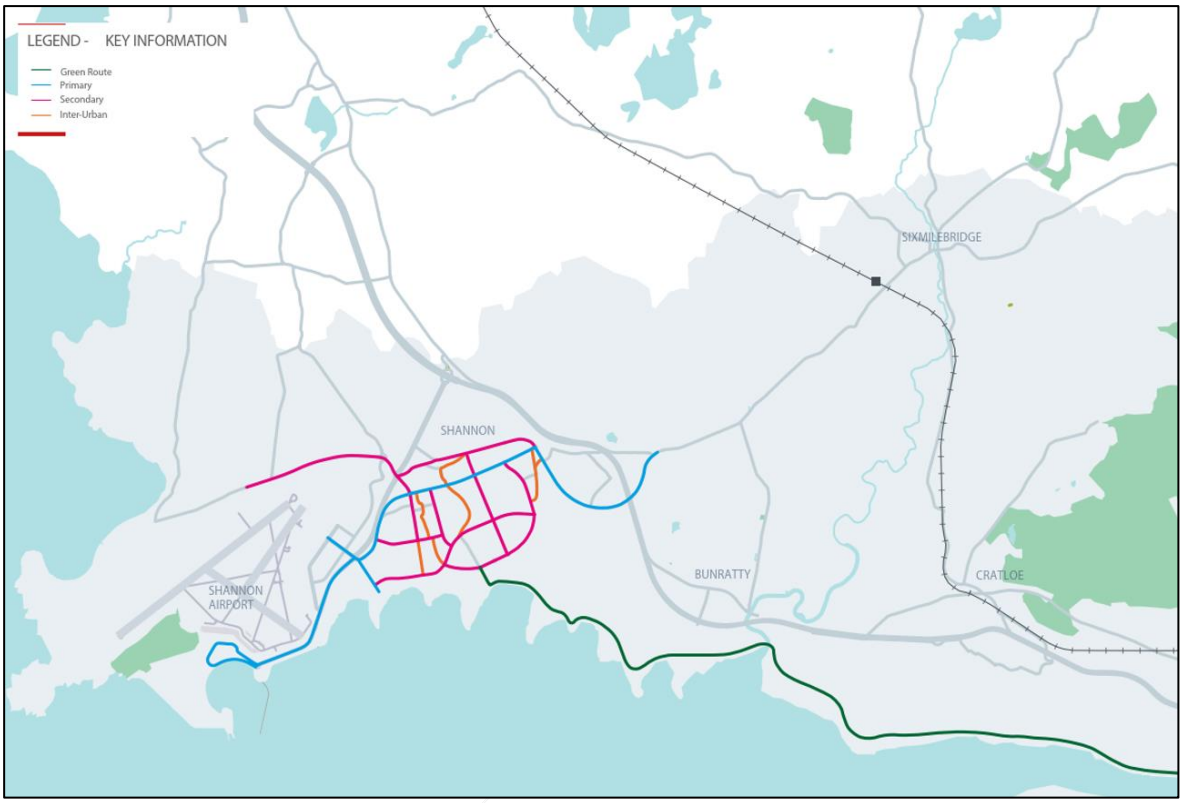


Figure 6-3: LSMATS Cycle Network- Shannon Town

6.3.3 Walking

There are a number of improvements proposed to the walking network including improvements to strategic walking routes connecting residential areas to key areas of employment and third-level education in Limerick City Centre and suburbs. It is envisaged that these will be upgraded in tandem with the provision of the bus priority and enhance the pedestrian (and cycle) network to enable greater levels of walking commuter trips or as part of linked-trips with public transport. The strategic routes include:

- St. Nessan's Road – UHL, Dooradoyle and Ballinacurra Crescent Shopping Centre;
- Ennis Road – connecting the predominantly pedestrian areas of west Limerick to the city centre;
- LIT / Old Cratloe Road Area – Thomond Park / Moyross;
- University of Limerick Area – R445 Dublin Road and Plassey Park Road / Castletroy / Annacotty;
- Ballycummin Road – Raheen Business Park;
- Corbally Road / Athlunkard Street – Kings Island through to the City Centre;
- Canal Route – connecting Shannon Fields to University of Limerick and the City Centre;
- Rhebogue Neighbourhood Greenway;
- Shannon town centre to Shannon Free Zone;
- Childers Road; and
- R527 Ballysimon Road.

The above routes are shown in Figure 6-4 below.

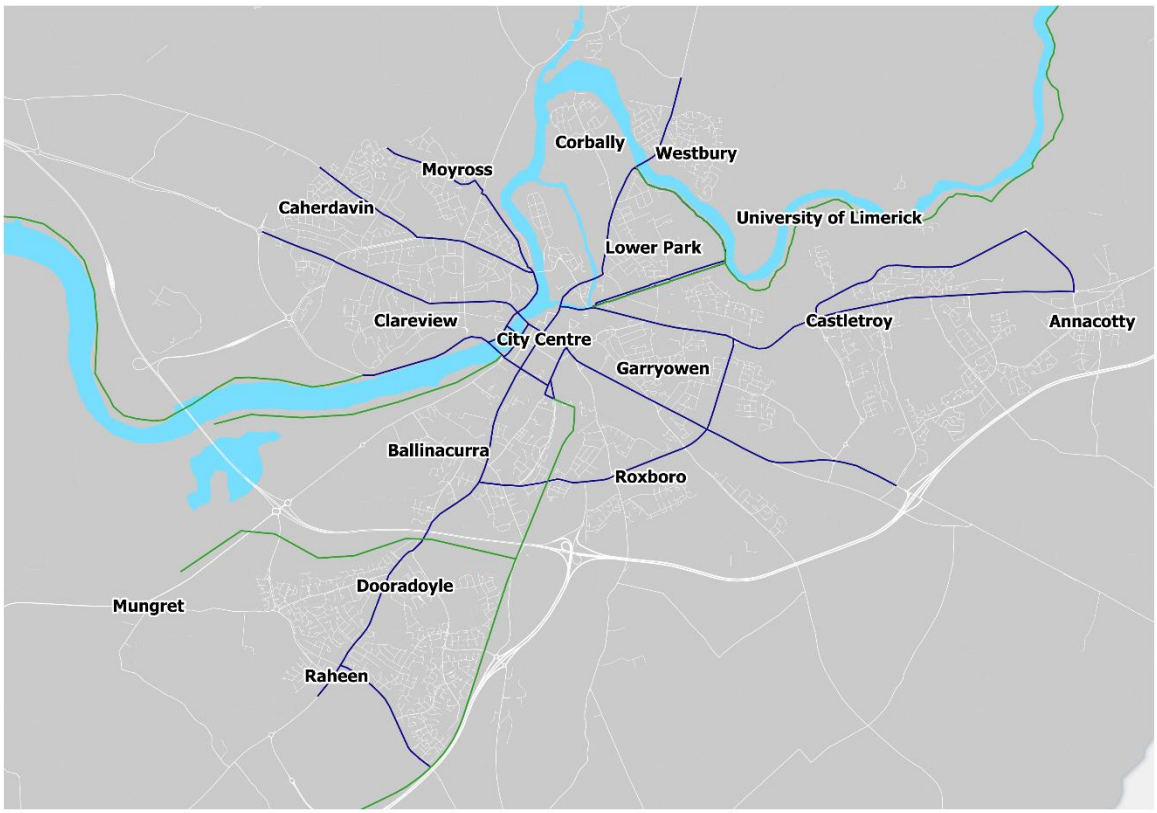


Figure 6-4: Strategic Walking Routes

Improvements are also identified within the city centre of Limerick. Whilst Limerick City Centre's historic core is compact, pedestrian access is inhibited in some areas by a limited number of pedestrian bridges over the River Shannon, substandard crossing facilities, wide multi-lane one-way streets and high volumes of vehicular traffic and speeds on approach roads. Limerick City Centre has significant potential to enhance its walkability due to its favourable flat topography and recent public realm improvements including pedestrian priority areas and improved crossing facilities. Walkability improvements envisaged for the City Centre over the lifetime of the Strategy include:

- O'Connell St. Improvements;
- Re-allocation of road space to prioritise pedestrian movement;
- Key junction improvements to prioritise pedestrian connectivity and permeability;
- Matching crossing facilities with pedestrian desire lines;
- Removal of street clutter;
- Improvements to the city-wide wayfinding network;
- Enforcement of illegal parking on footpaths;
- Undertake regular Walkability Audits with a variety of stakeholder groups;
- World Class Waterfront Project including a new pedestrian/cycle bridge over the River Shannon;
- Enhanced connectivity between the City Centre and Colbert Station; and
- Adequate provision of publicly-accessible toilets, lighting and seating.

There will also be local improvements within towns throughout the LSMA. Given the high level of out-commuting experienced in the Metropolitan towns, walking should be promoted as part of linked trips with public transport. The pedestrian environment around bus stops and train stations should be improved in Cratloe, Shannon, Sixmilebridge and other metropolitan town and village centres. These will be undertaken in tandem with land use proposals that consolidate village centres, strengthen their place function and reduce the ribbon-development patterns evident in

villages like Clarina and Patrickswell. LAP objectives for the pedestrian environment for Castleconnell, Askeaton, Castletroy and Patrickswell are supported by LSMATS.

6.3.4 Roads

LSMATS proposes targeted investment in roads schemes up to 2040 which are summarised below. Further details on the individual schemes is provided in the Main Strategy Report and also in the "Transport Options and Network Development Report".

National Roads

- N21/N69 Foynes to Limerick incorporating Adare Bypass;
- N18/N19 Shannon;
- M7/N18 Junction Improvements

The N/M20 Cork to Limerick is also supported by the strategy thought not included in the modelling process as the project is still in the earlier stages of the appraisal process.

Regional Roads

Additional regional road network provision needs to undertake a multi-modal function, catering for public transport, walking and cycling in addition to car traffic. The regional road network provision is required to cater for the following:

- Provide access to development lands;
- Cater for walking and cycling linkage;
- Provide access to public transport routes;
- Cater for orbital public transport provision;
- Removal of strategic traffic from Limerick City Centre; and
- Removal of local traffic from strategic road routes.

To achieve this the cross section of these roads should cater equally for active modes, public transport and car traffic as follows:

- Footpath and Cycle lane provision – 33% of cross section;
- Bus lane and priority provision – 33% of cross section; and
- Road traffic lane – 33% of cross section.

The following specific new regional roads have been included in the strategy modelling:

- Limerick Norther Distributor Road (60kph with at grade junctions and bus priority);
- Link road from the Childers Road to Golf Links Road via Bloodmill Road and Groody Road (with bus priority);

As detailed in the options report, it is recommended, subject to future appraisal outcomes, that the LNDR not be delivered in advance of the substantive public transport elements of the Strategy, and that its provision is also linked to the delivery of substantive elements of Clare South East SDZ. As discussed in Section 5.3.2, the modelling undertaken as part of any future appraisal of the LNDR should also include a detailed, multi-modal assessment of the impact of the scheme.

In addition to the new links and national road improvements described above, significant bus priority measures have been included in the MWRM SATURN road model to account for the proposed BusConnects network. For the purposes of model coding, it was assumed that this would be achieved through the provision of 2-way bus lanes along the majority of routes. To ensure this could be achieved, some reductions in road capacity within the model had to be accounted for in areas where full bus priority could not be feasibly accommodated. The following traffic management measures were coded into the model where applicable:

- Reduction in the number of lanes;
- Right-turn bans; and
- Introduction of Peak hour Bus Gates into the City;

Bus speeds in the MWRM 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. The extent of the proposal is shown in Figure 6-5.

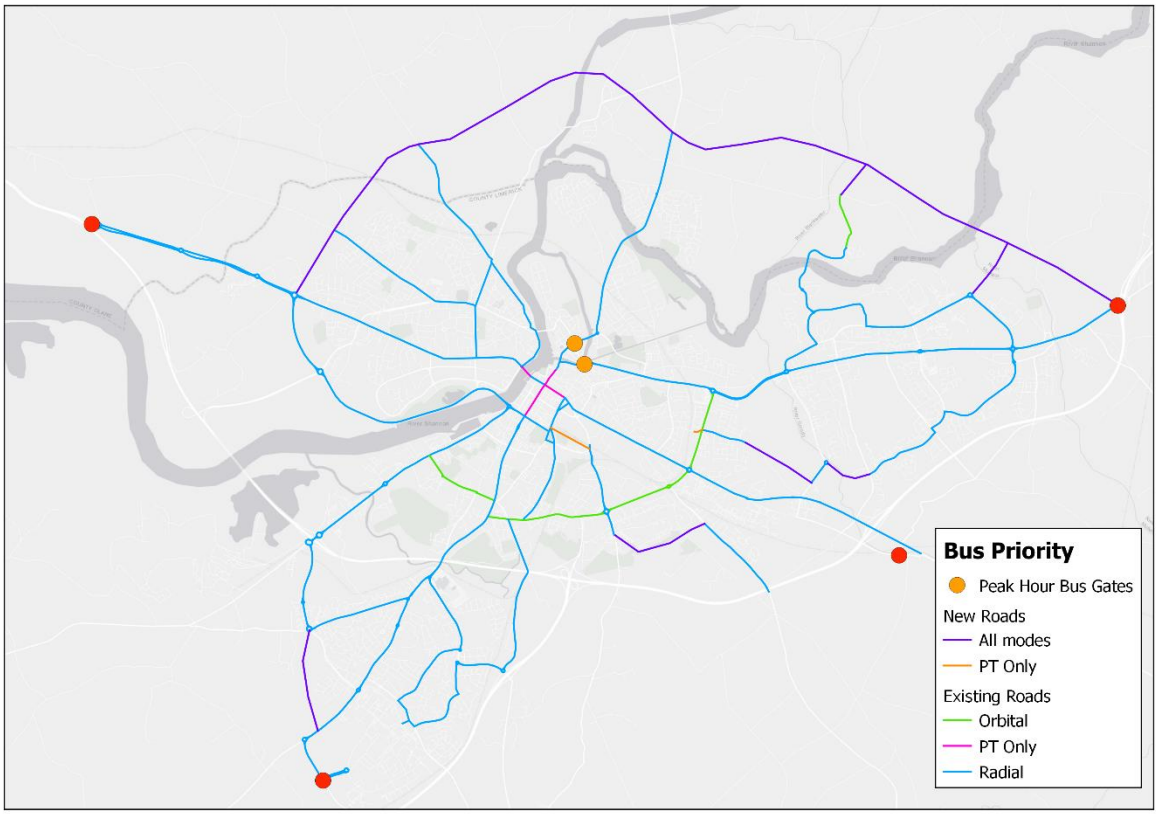


Figure 6-5: LSMATS Bus Priority

6.3.5 City Centre Traffic Management

There are also a number of measures proposed within the City Centre to rationalise the bus network and provide priority. These measures include removal of one-way bus loops where possible and providing a significant level of bus priority. This priority will be required to ensure the competitiveness of public transport as an attractive alternative to car. The proposed measures are shown in Figure 6-6. As illustrated the main change is along O'Connell Street, and part of Patrick's Street, which will become Public Transport only (in addition to walking and cycling) and two-way. As a result, Henry Street becomes two-way for general traffic to accommodate traffic displaced from O'Connell Street. There are a number of changes to the traffic circulation North & South to accommodate these measures. In addition, Sarsfield Bridge is also proposed as a PT only link.

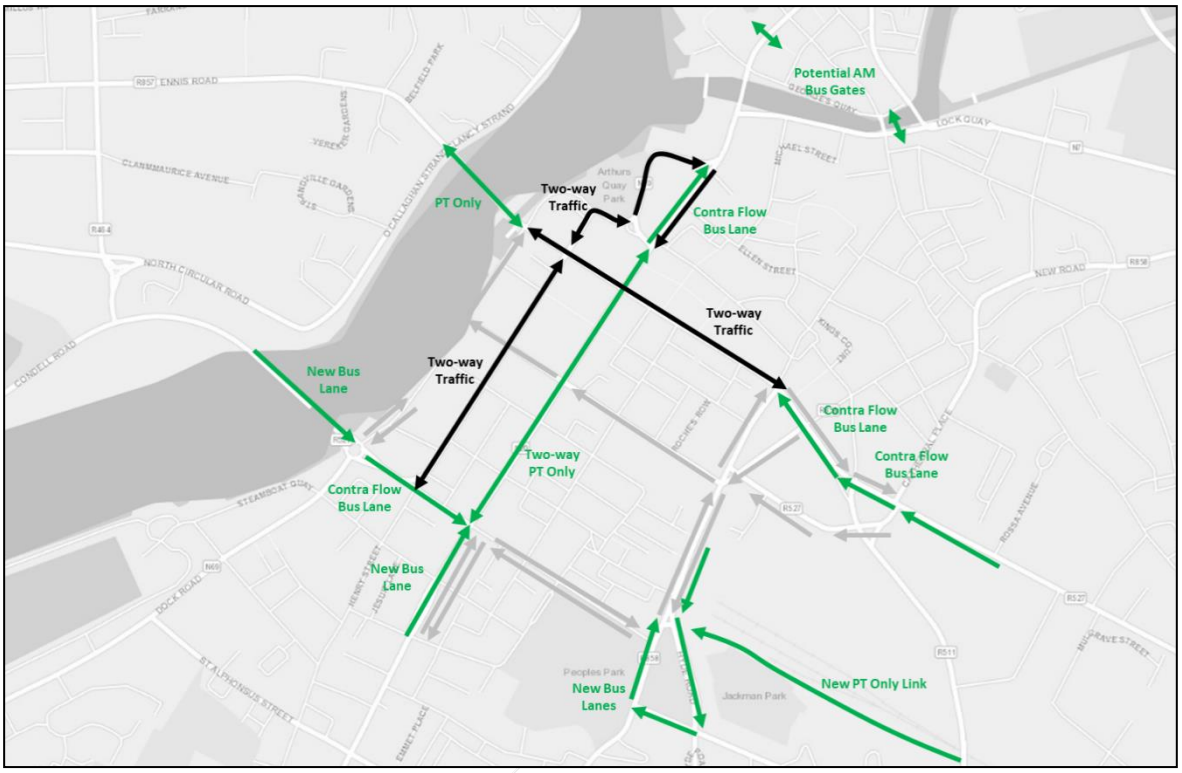


Figure 6-6: Limerick City Centre Priority Measures

6.3.6 HGV Traffic Restrictions

The HGV restrictions are proposed similar to those already implemented in both Dublin & Waterford. HGVs play an integral role in moving goods throughout the LSMA and nationwide. HGV movement can have significant impacts on traffic operations, noise, air pollution and the safety of other road users, particularly within urban environments.

The central area of Limerick City is unsuitable for heavy goods traffic and should be restricted to only those vehicles of a suitable size with an origin or destination in the centre. LSMATS proposes further consideration of restriction of the movement of HGV within the area bounded by the N18, M7 South Ring Road and proposed LNDR.

According to the Limerick HGV Study 2015, banning HGVs from the City Centre from 07:00 to 19:00 would contribute to the creation of a safe and friendly environment for cyclists and pedestrians through the recovery of street space and the reduction of conflicts between modes. The implementation of designated 'lorry routes' on National roads at designated times of the day will also help reduce through traffic and mitigate delays and conflict with other modes.

In addition, regulating delivery times by limiting them to off-peak periods would contribute to off-setting local traffic congestion. This could also bring additional benefits to freight operators in terms of reductions on travel times and operating costs.

6.4 Draft Do-Strategy Plus Demand Management

6.4.1 Overview

In the 2016 census, 34% of commuting trips made by residents of Limerick City and County were under 15mins with 68% recorded under 30mins. This proportion of shorter distance car trips with the LSMA presents a significant challenge in trips of encouraging sustainable trip making and a shift from car to public transport. When comparing the combined walk, wait and travel time for Public

Transport against a short distance car trip it is difficult to increase the attractiveness of public transport even with frequent and high priority services.

Another significant challenge is the high levels of prevailing Car Ownership within the LSMA. In 2016, only 16% of households in Limerick City and County had no car with 43% having more than one car per household. This high level of car ownership further encourages shorter distance commuting and leisure trips by private vehicle.

To address the current level of car ownership with urban area the National Planning Framework states that *'there should also generally be no car parking requirement for new development in or near the centres of the five cities, and a significantly reduced requirement in the inner suburbs of all five'.* To reflect this the Design Standards for New Apartments Guidelines for Planning Authorities, published by the Department of Housing, Planning and Local Government in 2018, proposed significantly reduced parking for development in accessible, urban locations. Accessible locations include sites within easy walking distance (i.e. up to 5 minutes or 400-500m) to/ from high frequency (i.e. min 10-minute peak hour frequency) urban bus services. With the LSMATS bus network implemented the vast majority of Limerick City and Suburbs will therefore be considered to be within accessible locations.

Within the model runs to date the proportion of car ownership has been assumed to remain constant from the base year. To address this and reflect recent changes in national policy the car ownership within accessible locations within the model has been adjusted as described in the following section.

6.4.2 Origin Parking Restrictions

The reduction in Car Ownership has been applied at a Small Areas level broadly based on the corridor/sector structure used in the demand analysis and options assessment. Some larger corridors which contained both urban and more rural locations were split. The areas used to adjust the car ownership are shown below.

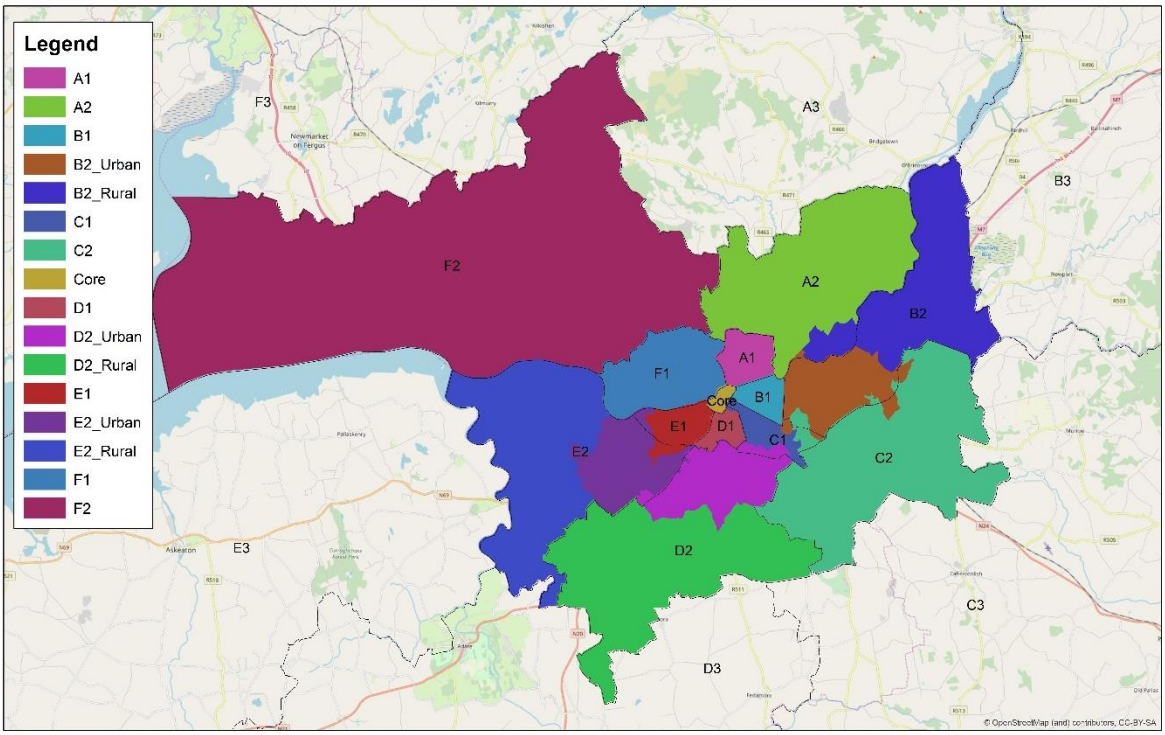


Figure 6-7: Sectors used for Car Ownership Adjustments

The reduction in car ownership (CO) was applied as a factor to all modelled zones within each area to reduce the overall proportion of car available trips. However, each factor was derived based on the certain assumptions around parking constraints on new residential development. The broad assumptions are listed below.

- City Core: Existing households CO reduced by 33% intended as proxy for removal of on-street parking, no cars assumed in any new households;
- A1, B1, C1, D1, E1 & F1: Existing households retain current levels of CO. CO of new households is assumed to be 33% less than existing within each area.
- Urban areas of B2, E2 and D2: CO of existing household is retained. New households are capped at 1 car per household.
- South Clare SDZ: Existing CO remains the same, new households capped at 0.75 cars per household.
- CO of the remaining LSMA continues at the existing proportion.

This results in an overall drop in the number of cars per household. However, it should be noted that the number of cars overall still grow significantly and at a higher rate than population as a reduction in the average household size is assumed between 2016 & 2040.

The number of cars per household in the Do-Minimum, Do-Strategy & Do-Strategy Plus scenario along with reduction as a percentage for each area is outlined in Table 6-2.Table 6-2

Table 6-2 Cars per Household by Area and reduction applied.

	2040 Cars Per Household		
Area	DM/Strategy	Strategy+DM	Reduction
Core	0.47	0.18	-61.3%
A1	1.15	0.98	-14.7%
B1	0.91	0.78	-14.0%
D1	0.73	0.61	-16.0%
C1	0.95	0.80	-15.8%
E1	1.26	0.99	-21.3%
F1	1.14	0.95	-16.4%
A2	1.77	1.77	0.0%
B2 Urban	1.53	1.28	-16.5%
B2 Rural	1.56	1.56	0.0%
C2	1.83	1.83	0.0%
D2 Urban	1.45	1.25	-13.9%
D2 Rural	1.70	1.70	0.0%
E2 Urban	1.51	1.22	-19.1%
E2 Rural	1.84	1.84	0.0%
F2	1.38	1.38	0.0%
South Clare SDZ	1.20	0.79	-33.9%
LSMA	**1.25**	**1.09**	**-12.7%**

6.4.3 Appraisal of Do-Strategy Plus Demand Management

As the measures outlined in the Draft Do-Strategy Plus Demand Management are heavily reliant on the realisation of development in key areas and the enforcement of parking policy at a local level the strategy has been appraised both with and without these measures in place. This ensures that the benefits of the strategy are not overstated but also demonstrates the importance of residential parking policy within Limerick and the associated additional benefits.

6.4.4 Other Supporting Measures

There are a number of other measures proposed as part of the draft strategy which the impact of cannot be captured in the modelling and appraisal process. These measures will have an additional impact on the travel demand and patterns with the LSMA and include the following:

- Mobility Management Measures;
- Wayfinding;
- Intelligent Traffic Systems;
- Cycle & Car Share Schemes;
- Improved Public Transport Stops;
- Integrated/Smart Ticketing;
- Real Time Passenger Information;
- Public Realm Enhancements.

7 Final Strategy Modelling

7.1 Overview

This chapter outlines changes in the modelling undertaken since the publication of the draft strategy in September 2020. It also summarises refinement of the strategy and further modelling as a result of feedback from the draft strategy consultation process.

These additional modelling tests cover the following;

- Update of RMS to v3;
- Rail enhancement informed by the Rail Options assessment;
- Removal of LNDR;
- Demand Management Measures informed by the 5 Cities Demand Management Study; and
- Update of Cycling appraisal.

7.2 Model Version

7.2.1 Model Update

As discussed in the introduction, the NTA have updated their Regional Modelling System since the publication of the draft strategy. The previous model, version 2, was based on a census year of 2011 with the calibration and validation of the model undertaken with observed data from that year. The new model, version 3, is based on a census year of 2016 and observed data from that year.

There were a number of other changes to the model made to improve its accuracy and to represent more recent travel demand and behaviours. Other updates include:

- Refinement of the zone system and model area – the MWRM model now has 650 zones compared to a previous 456 zones and covers a larger geographic area;
- Improved calibration – more observed data was available for the calibration of the new model particularly with regard to public transport usage; and
- The networks were updated to include schemes and services implemented between 2012-2016

7.2.2 RMS V2 and V3 Comparison

The main impact as a result of the change in model is on the demand and mode shares. As a result of the availability of more accurate public transport mode share and usage data the public transport demand has decreased relative to the previous model. Whilst the absolute car demand is similar, the car mode share has increased as a result of total demand reduction.

Figures 7-1 and 7-2 outline the change in total demand and mode shares for the metropolitan area respectively between the models.

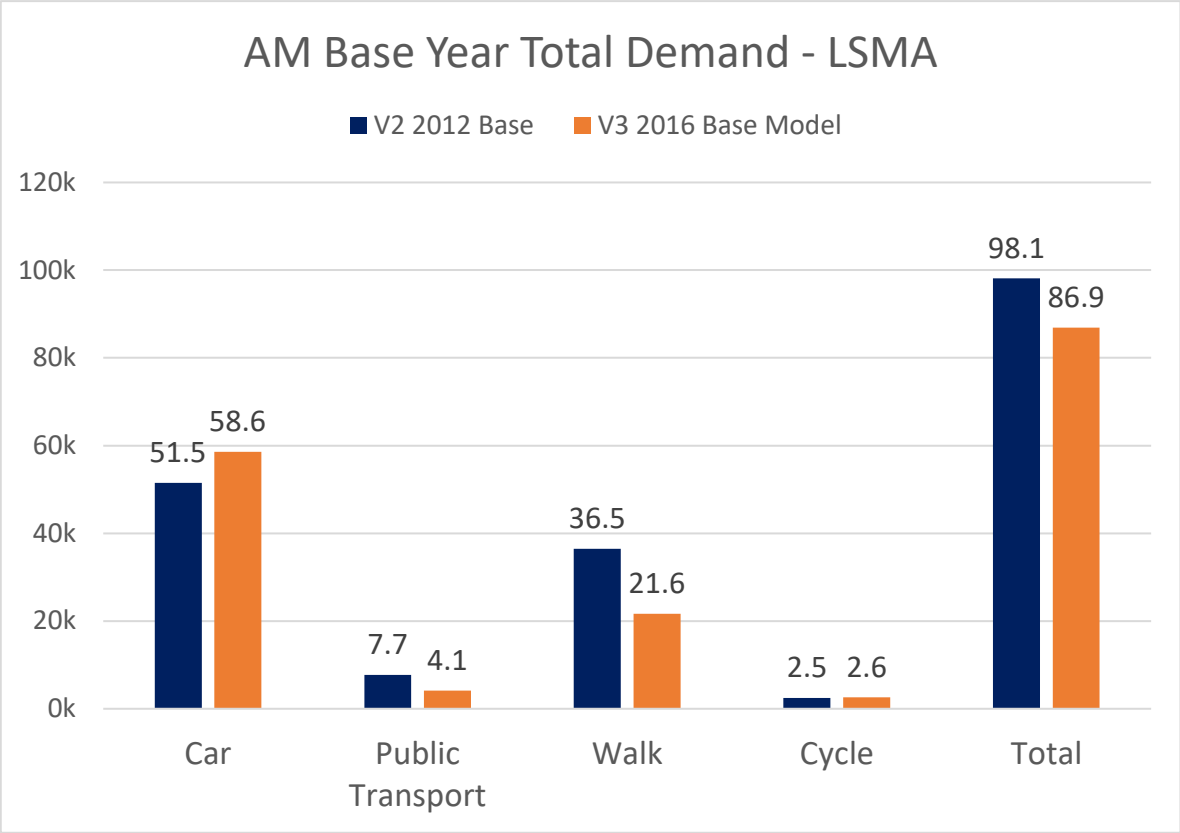


Figure 7-1: MWRM Version 2 & 3 AM Total Demand - LSMA

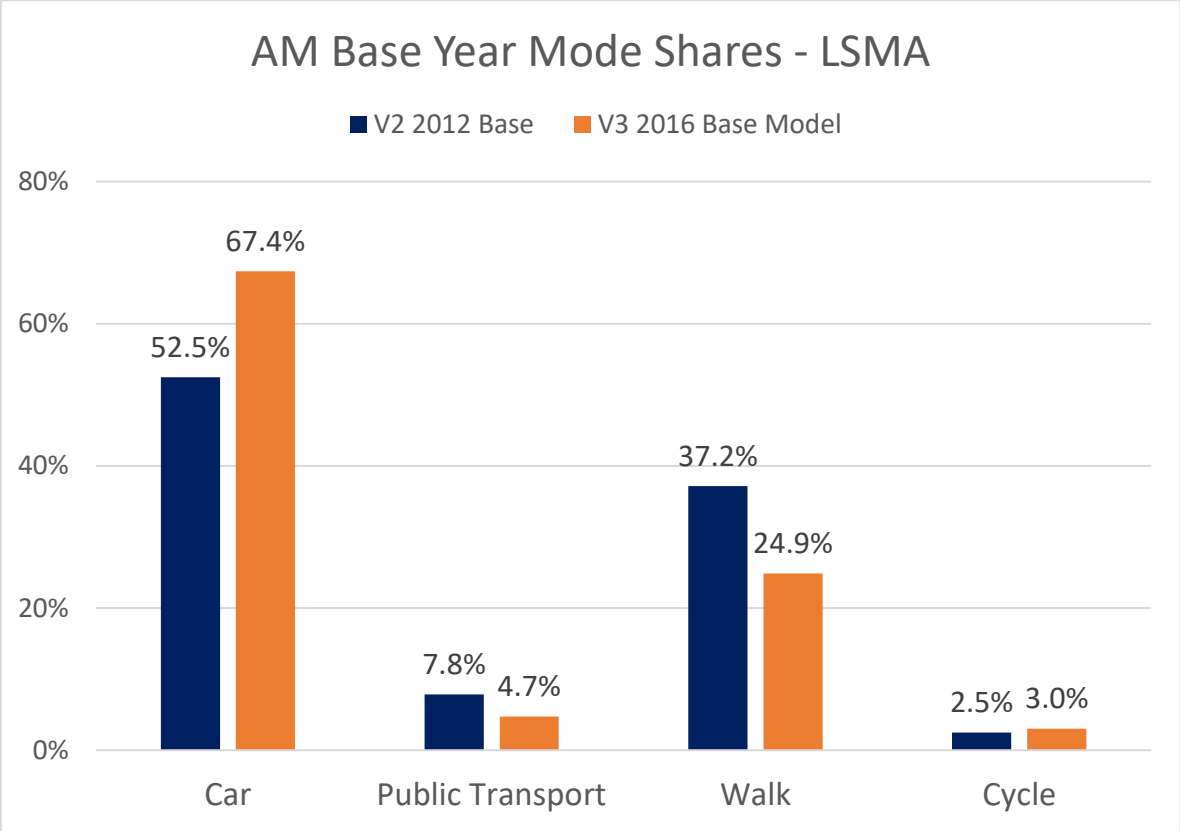


Figure 7-2: MWRM Version 2 & 3 AM Mode Share - LSMA

Whilst the mode share values, particularly for public transport are lower in V3 of the model, the proportional increase in sustainable modes as a result of the implementation of the strategy remains similar. The strategy has been reappraised and delivers similar value for money as previously assessed. Details on the appraisal of the final strategy can be found in Chapter 8.

7.3 Enhanced Rail

7.3.1 Overview

Following Public Consultation of the draft Strategy four options for enhanced rail were assessed for inclusion in the Strategy. The details of these tests and the results of the assessment can be found in the *Limerick Shannon Metropolitan Area Transport Strategy - Rail Assessment & Cost Benefit Analysis Report.*

The main four options tested were:

- **Option 1** – New stations at Moyross and Ballysimon with double tracking to Limerick Junction.

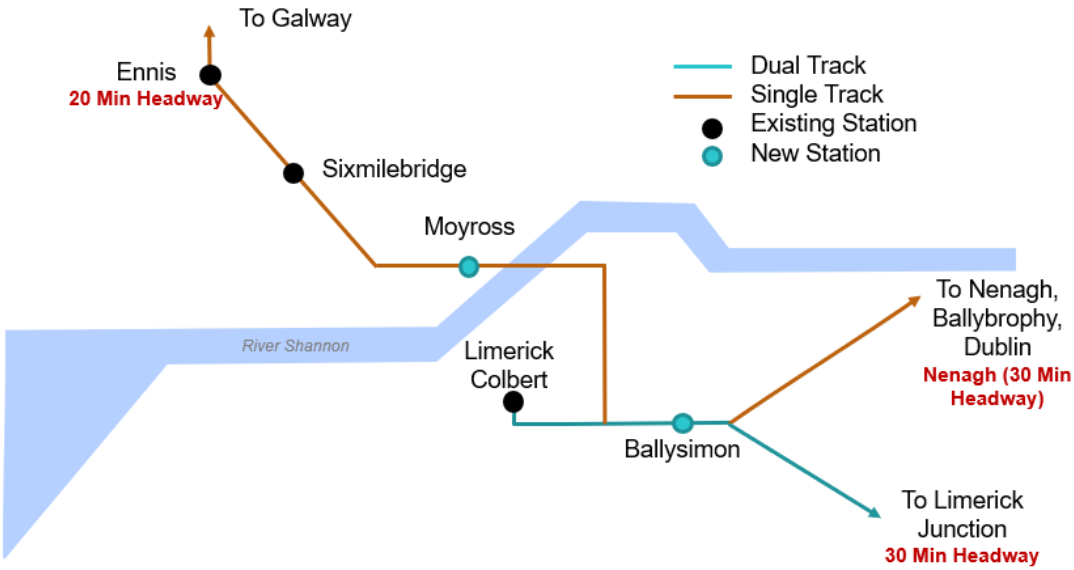


Figure 7-3 Rail Option 1

- **Option 2** – Option 1 with a single-track spur to Shannon.

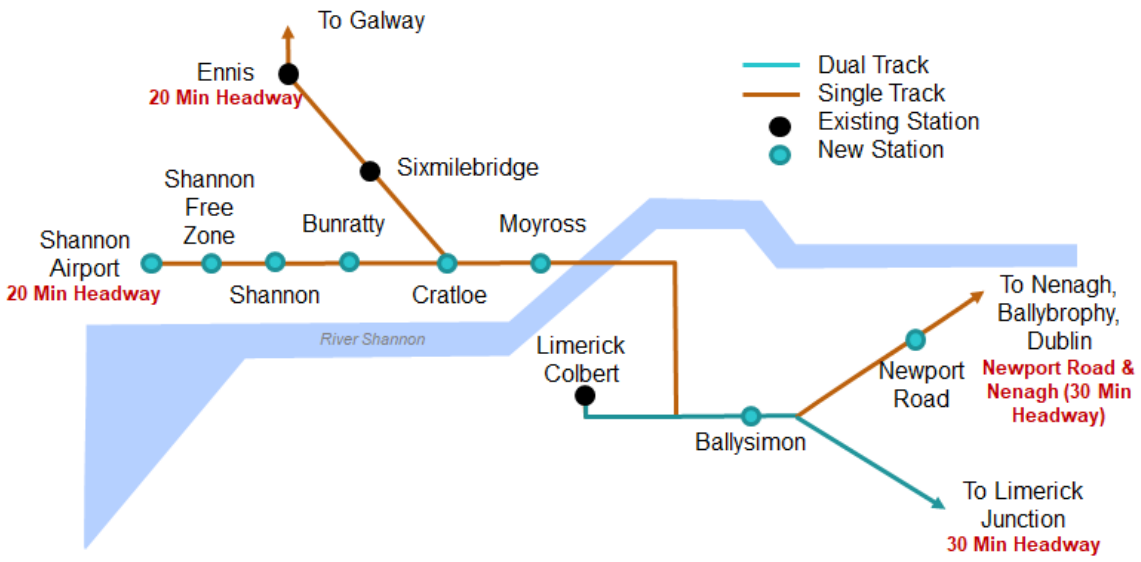


Figure 7-4 Rail Option 2

- **Option 3** – Option 2 with two additional single-track lines to Mungret and Adare.

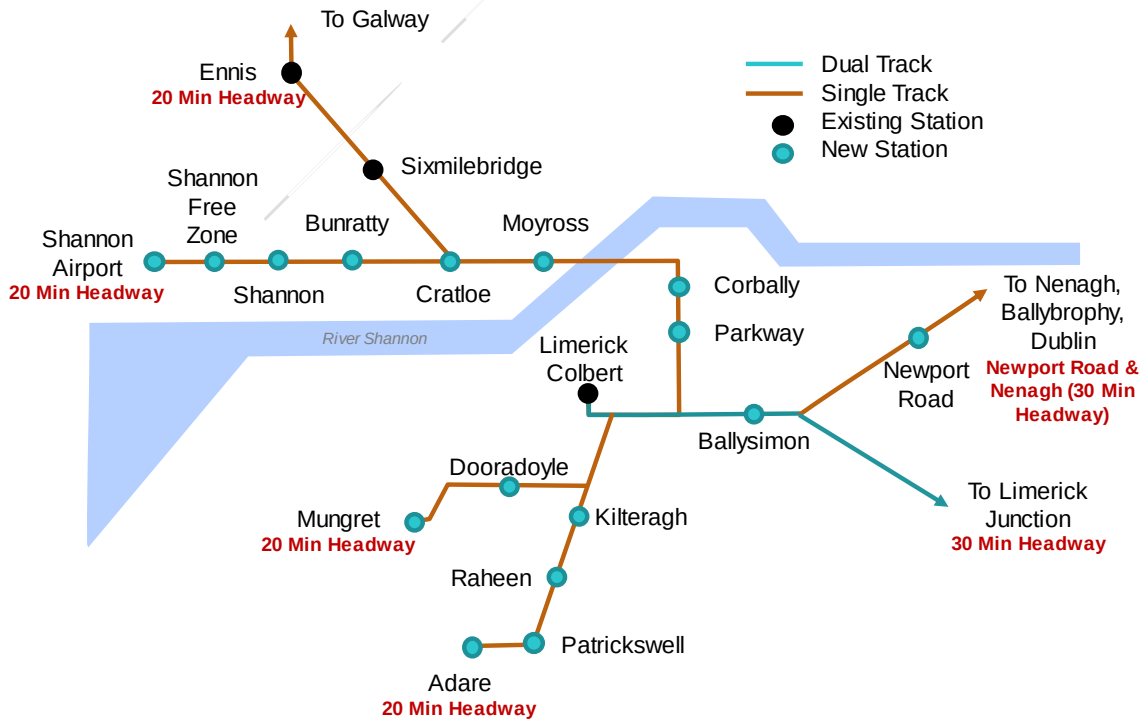


Figure 7-5 Rail Option 3

- **Option 4** – Option 3 with double tracking on all lines.

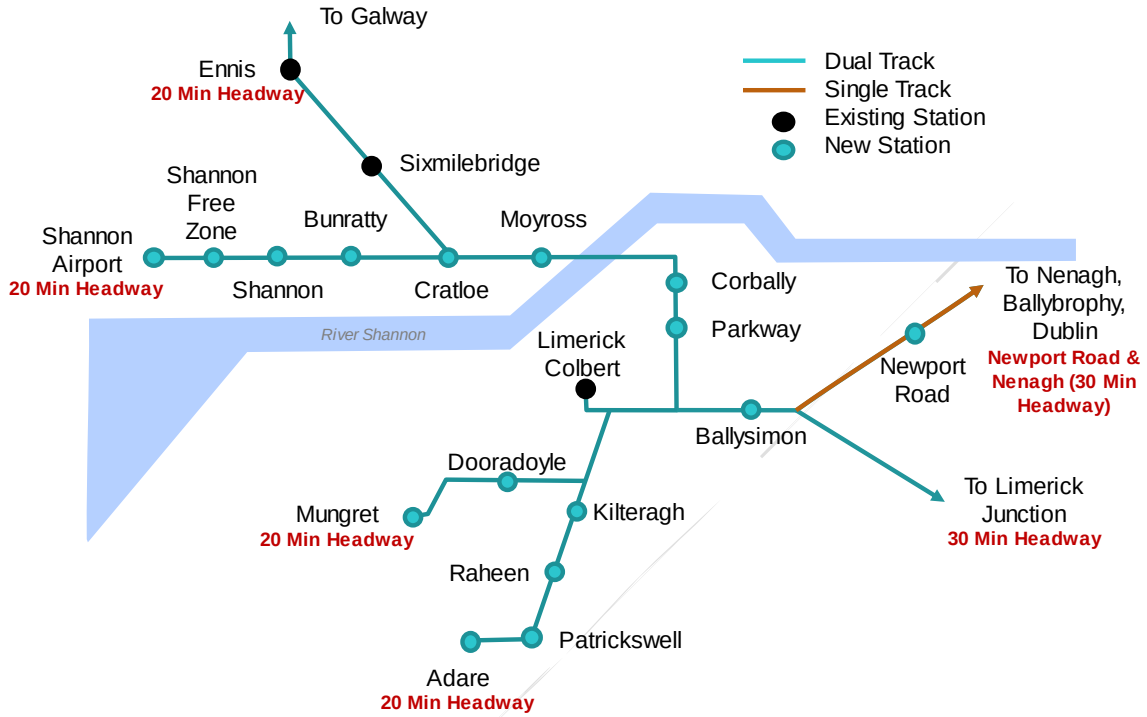


Figure 7-6 Rail Option 4

These options were tested out to 2070, 30 years past the Strategy year. A summary of the results of this assessment is as follows:

- **Option 1** - All services operate with significant levels of spare capacity with no service reaching seated or proposed service capacity in 2040. By 2070, demand on all lines has increased significantly, particularly on the Ennis line which is now the busiest service and the Ballybrophy line which reaches 87% of proposed service capacity.
- **Option 2** - All services operate with significant levels of spare capacity with no service reaching seated or proposed service capacity in 2040. By 2070, the Ennis line is expected to have the highest passenger volume, followed by Shannon reflecting the increase in population growth along these lines in the interim period. The Ballybrophy line is expected to be closest to proposed service capacity by 2070, although the proposed service capacity is lower for this line.
- **Option 3** - All services operate with significant levels of spare capacity with no service reaching seated or proposed service capacity in 2040. By 2070, the demand on all lines has increased significantly, with the Ennis and Ballybrophy lines both above seated capacity and the Ballybrophy line approaching proposed service capacity. Though demand is significantly higher than 2040 the remaining lines do not reach design or seated capacity.
- **Option 4** - Whilst the dual tracking of the network and resultant increase in rail network speeds increases the demand for rail travel compared to option 3, all services still operate with significant levels of spare capacity with no service reaching seated or proposed service capacity in 2040. By 2070, the demand on all lines has increased significantly, with the Ennis and Ballybrophy lines each at 92% and 72% of proposed service capacity respectively.

The outcome of the rail assessments tests was the identification of Option 1 including the additional rail stations at Moyross and Ballysimon as the best option for carrying forward in the strategy. This is seen as a short term strategy with the potential for other stations on the existing rail network to be kept under review, including at Corbally and Parkway. These new stations, coupled with the dual tracking of the line between Limerick Junction and Colbert Stations and an increase in service

frequency on the Nenagh – Ballybrophy and Ennis line, will significantly enhance the rail system in the Limerick Metropolitan area.

There is insufficient demand to support a rail link to Shannon as part of the strategy. However, it is considered that it should be re-assessed in the future as demand for travel to the Town, Free Zone and International Airport increase in the long term.

In addition, the Adare line assessed in the rail assessment for passenger numbers will be reviewed periodically for possible future inclusion. This passenger service could use the same line as the proposed freight line to Port of Foynes that is proposed to be reinstated as part of the strategy.

7.4 Removal of LNDR

As set out in Chapter 14 of the Revised Draft LSMATS 2040 Report, funding for the LNDR does not form part of the Government's National Development Plan 2021-2030. The Minister for Transport has requested the NTA not to include the LNDR in LSMATS on the basis that proceeding with the scheme may undermine investment planned in active travel/public transport and could accentuate a dispersed unsustainable development model in the region.

7.5 Demand Management

7.5.1 Overview

In November 2021 the Department of Transport published the Five Cities Demand Management Study which outlined various demand management measures that could be applied to achieve reduction in car usage.

As a result of this study and following on from Public Consultation a selection of Demand Management measures were identified for assessment in the strategy.

These schemes are;

- Reduction of free workplace parking;
- Introduction of minimum parking charges; and
- Reduced junction signal times in the city to support active modes

7.5.2 Free Work Place Parking Reduction

The Five Cities Demand Management Study advocates a reduction in workplace parking standards for new developments as an effective demand management measure to directly influence commuters' decisions to travel by car.

Free workplace parking (FWPP) is parking that is provided free of charge to employees or students. In the model this allows for a set number of trips to park at their destination for free in the commute and education user classes.

A reduction in FWPP forces trips to find alternative paid parking or swap modes, as such it is an effective means of reducing car attractiveness for commute and education purposes.

The draft strategy already included a 25% reduction in available FWPP compared to the Base, however, to further restrict car attractiveness for commute and education trips, a further reduction was applied on select areas and zones within the model shown in Figure 7-7 below.

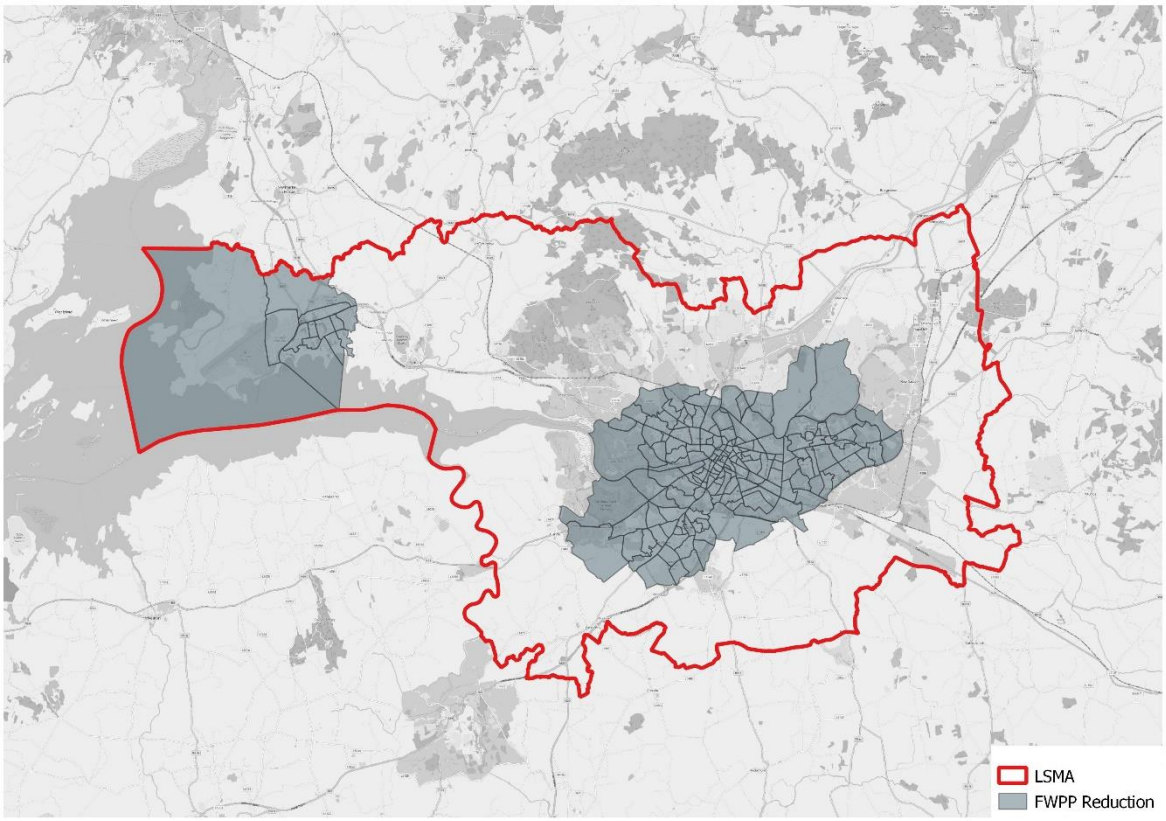


Figure 7-7 Free Work Place Parking reduction zones

In these zones the FWPP was reduced to be equivalent to 50% of 2040 Do Minimum demand or 50% of base supply, whichever provided the greater reduction. While spaces cannot be directly removed this would be achieved through reduction of parking spaces available in future planning applications for new buildings and renovations of existing buildings.

7.5.3 Fixed Parking Charge

The Five Cities Demand Management Study identifies controlling the availability and cost of parking as one of the most widely used and effective means to reduce demand for car based transport and balance use the of limited road space.

A fixed parking charge was tested in the revised strategy using two bands, a high and a low, with the higher rate applying to the city centre and the lower rate applying to other regions of the LSMA as shown in Figure 7-8.

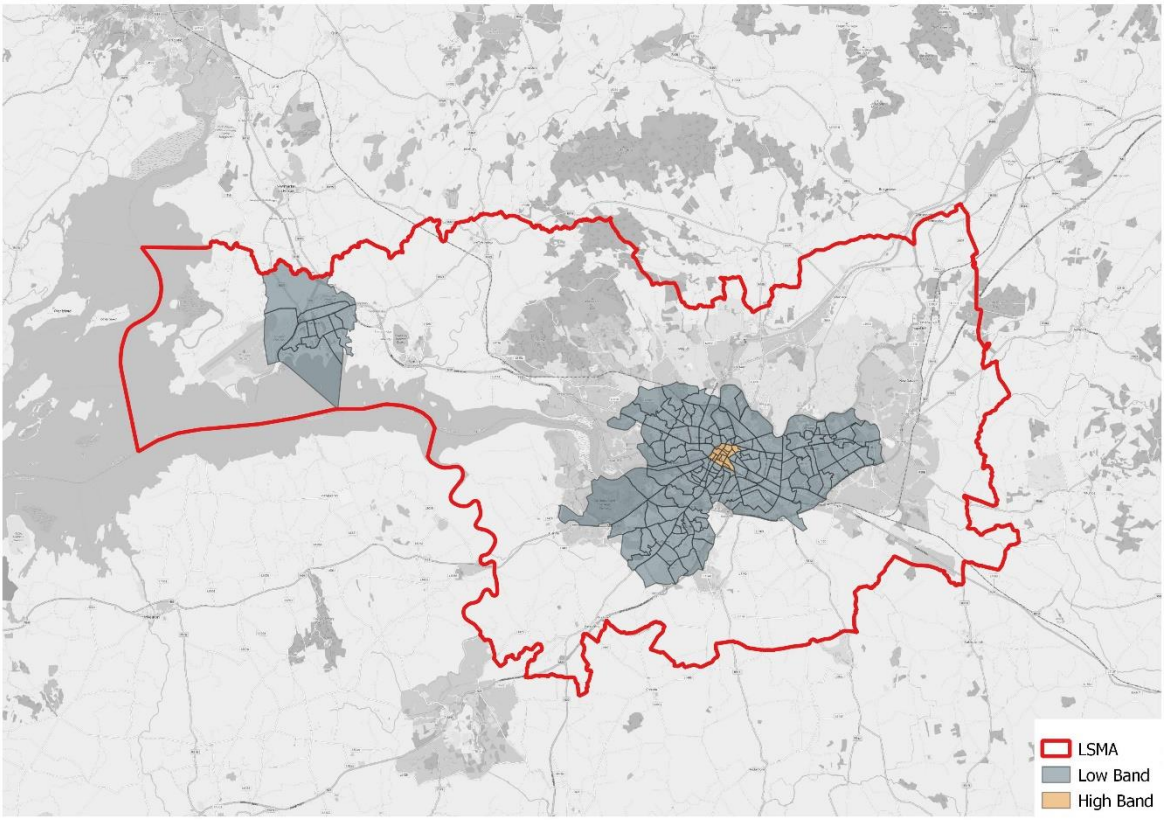


Figure 7-8 Parking Charge Zones

The two prices set to these areas are:

- Hourly Rate - High - €3, Low - €2

The parking charges applied are hourly and in 2016 prices. Charges are applied by multiplying the length of stay by the hourly rate, with length of stay defined by the trip tours. For example, a standard commuting trip arriving at 9AM and departing at 5PM would be charged for 8 hours at the hourly rate. These parking charges apply to all user classes.

7.5.4 Prioritisation of Active Modes

The Five Cities Demand Management Study advocates the 'Healthy Streets' approach for our cities. Healthy Streets aims to improve air quality and congestion, reduce car dependency and make active travel more attractive. Increasing the attractiveness of walking and cycling can be partially achieved through improving the ease of crossings and reducing waiting times at junctions.

Within the model, traffic signal cycle times have been reduced within the city centre to slow journey times while providing more time for pedestrian phases. This measure was included on all junctions within the city centre, as shown in Figure 7-9.

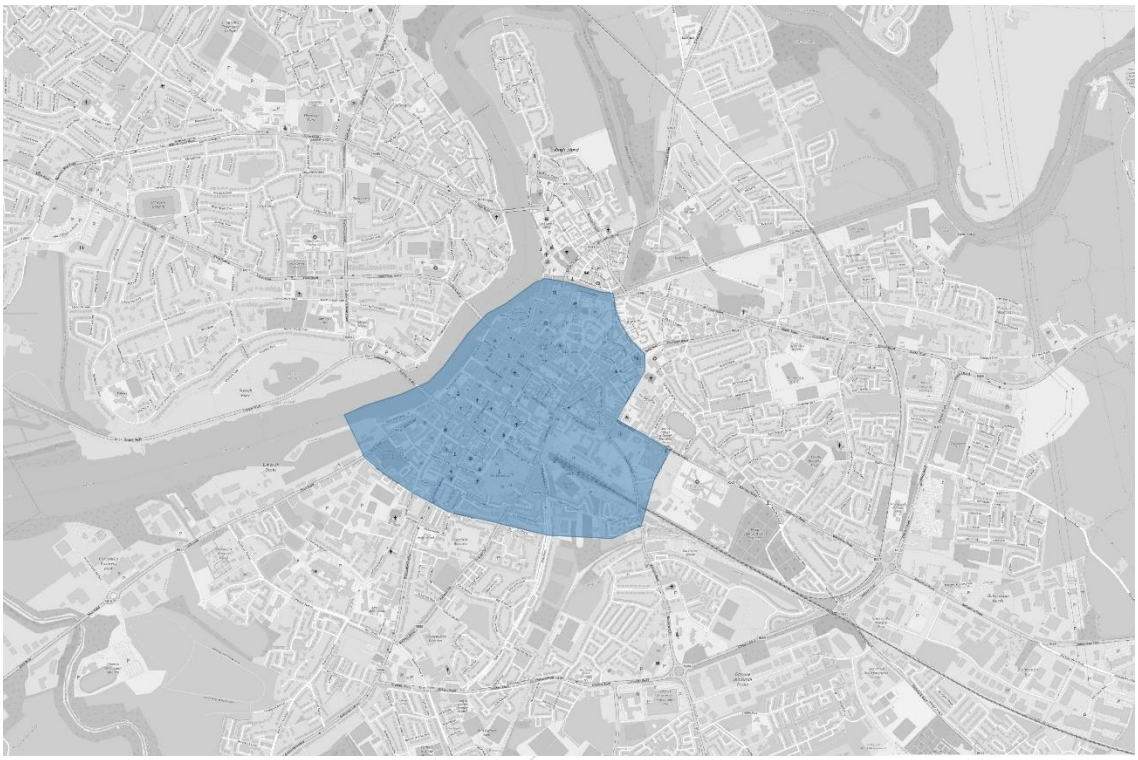


Figure 7-9 Area covered by the prioritisation of active modes as signals

All junctions within this area had their cycle time adjusted to provide greater priority to pedestrians, with existing phasing for motorised vehicles reduced proportionally across all phases. Two situations arose where manual readjustment of the signals was required to correct proportional change:

- Where green time was reduced below a minimum threshold that effectively closed the access.

  In this case a minimum green time was applied with the time taken evenly from other movements.
- Where inter-green times were higher than average, or occurred after multiple phases, to accommodate pedestrians on larger junctions with longer cycle times.

  Where this arose, the adjustment to the cycle time was not applied as the junction was deemed to already provide enhanced priority to pedestrians.

7.6 Improved Cycling

7.6.1 Overview

NTA policy objectives, including those in support of climate change action, are seeking to encourage rapid growth in cycle use and a step-change increase in cycle mode share through the removal of barriers to cycling.

This is likely to be driven by the availability of cycle facilities (such as cycle hire schemes, cycle parking and shower facilities), infrastructure improvements, and also by changes in behavioural attitudes. Most of the impacts of these drivers of cycle demand are not easily captured in generalised cost changes currently used as inputs to the NTA's Regional Model System (RMS) suite of transport modelling and forecasting tools.

In response to this, the NTA has developed a version of its Regional Modelling System which adjusts behavioural parameters that feed its standard forecasting mechanisms to take account of higher

propensity to cycle among the general population[2]. These adjustments are based on extensive research, that concluded there is significant potential to increase cycle mode shares by:

- Increasing female cycle share to match that of male (through appropriate policies focussing on cycle safety and security, amongst others);
- Increasing urban cycling rates amongst under-20s and over 40s to be closer to those of 20-39 year olds (especially primary students, again through dedicated cycleway provision, safety and security measures as well as attitudinal campaigns);
- Increasing use of cycle by part-time workers;
- Promoting cycle use for trips where a car is available;
- Increasing cycle use in lower income bands (possibly through purchase schemes, increased cycle hire provision and promotional campaigns); and
- Facilitating household cycle availability through purchase schemes, cycle parking and storage provision and promotional campaigns.

7.7 Additional Model Runs

7.7.1 Overview

The model scenario runs in Table 7-1 below were carried out to test the implementation of the transport measures outlined above in this section. The corresponding NTA Runs IDs are provided in Annex A.

Table 7-1 Revised Strategy Runs

	Enhanced Rail	Improved Cycling	FWPP Reduction	Parking Charges	Prioritisation of Active Modes
Report Section Reference	7.3	7.6	7.5.22	7.5.33	7.6.1
Draft Strategy	*No*	*No*	*25%*	*No Change*	*No*
Option A – Test Rail enhancement	Yes	No	25%	No Change	No
Option B – Test improved cycling	Yes	Yes	25%	No Change	No
Option C – Test additional Demand management measures	Yes	Yes	50%	€2/3	Yes

7.7.2 Results

The four tests were analysed based on Mode Share and Trip Rates with results presented below for All Day and the AM Period (0700-1000) for the Metropolitian Area shown in Figure 7-10 below.

[2] For further information see NTA report 20210820_NTA_CyclingModelling_v6.1_issue.docx

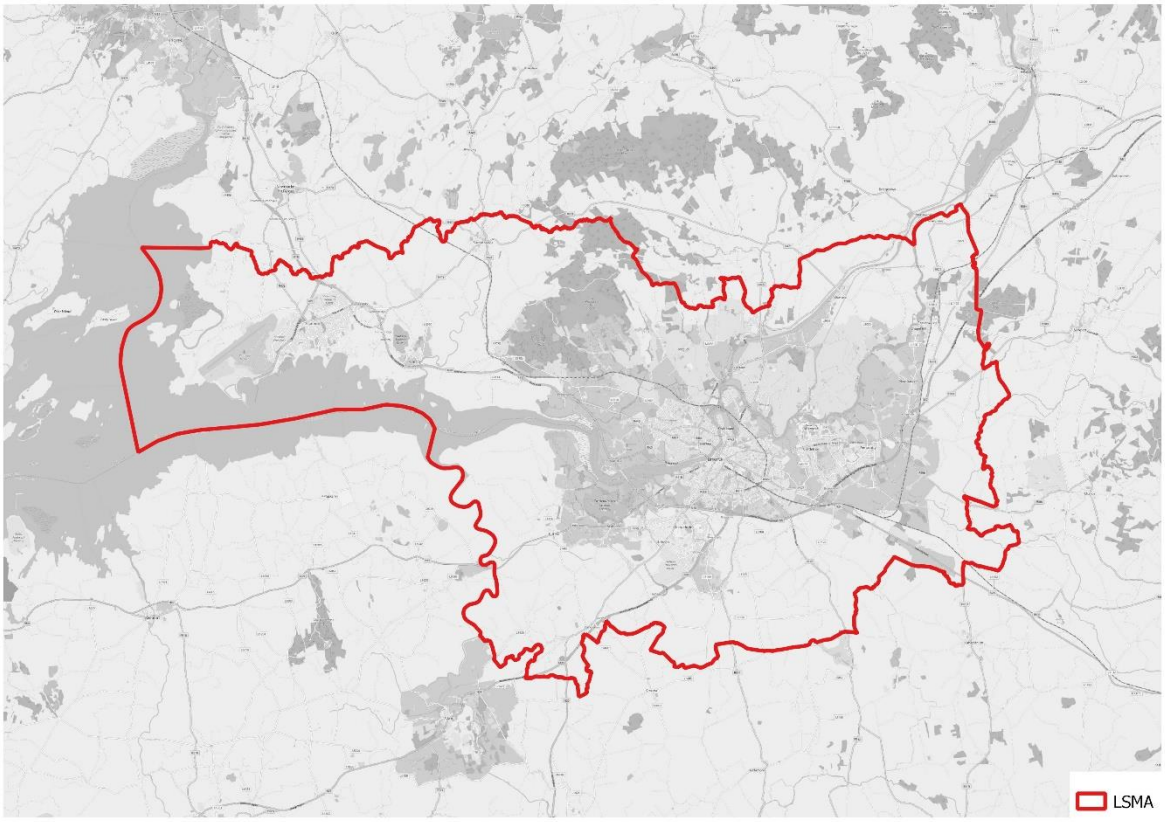


Figure 7-10 Limerick Shannon Metropolitan Area (LSMA)

The results for all day are shown in Figure 7-11 to Figure 7-12 below.

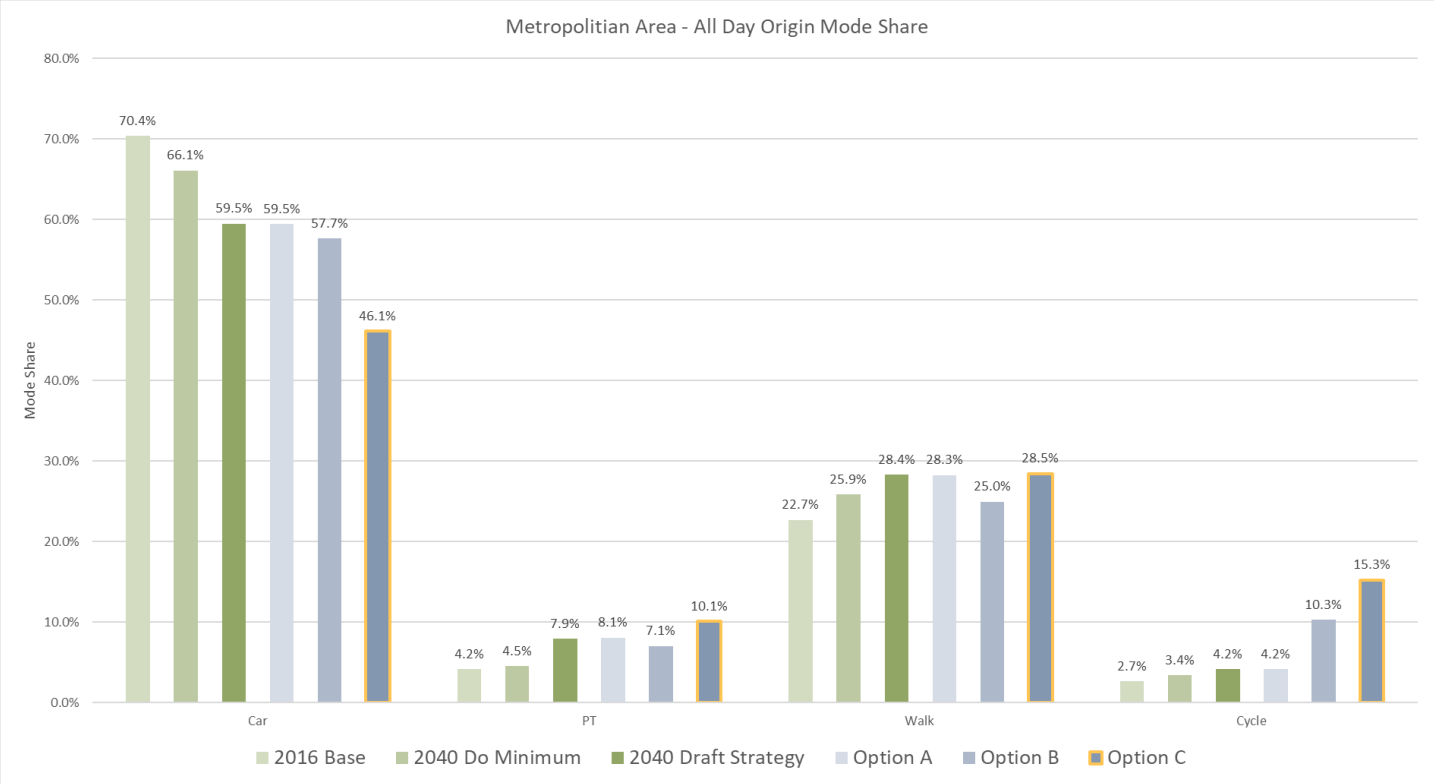


Figure 7-11 All Day Origin Mode Share

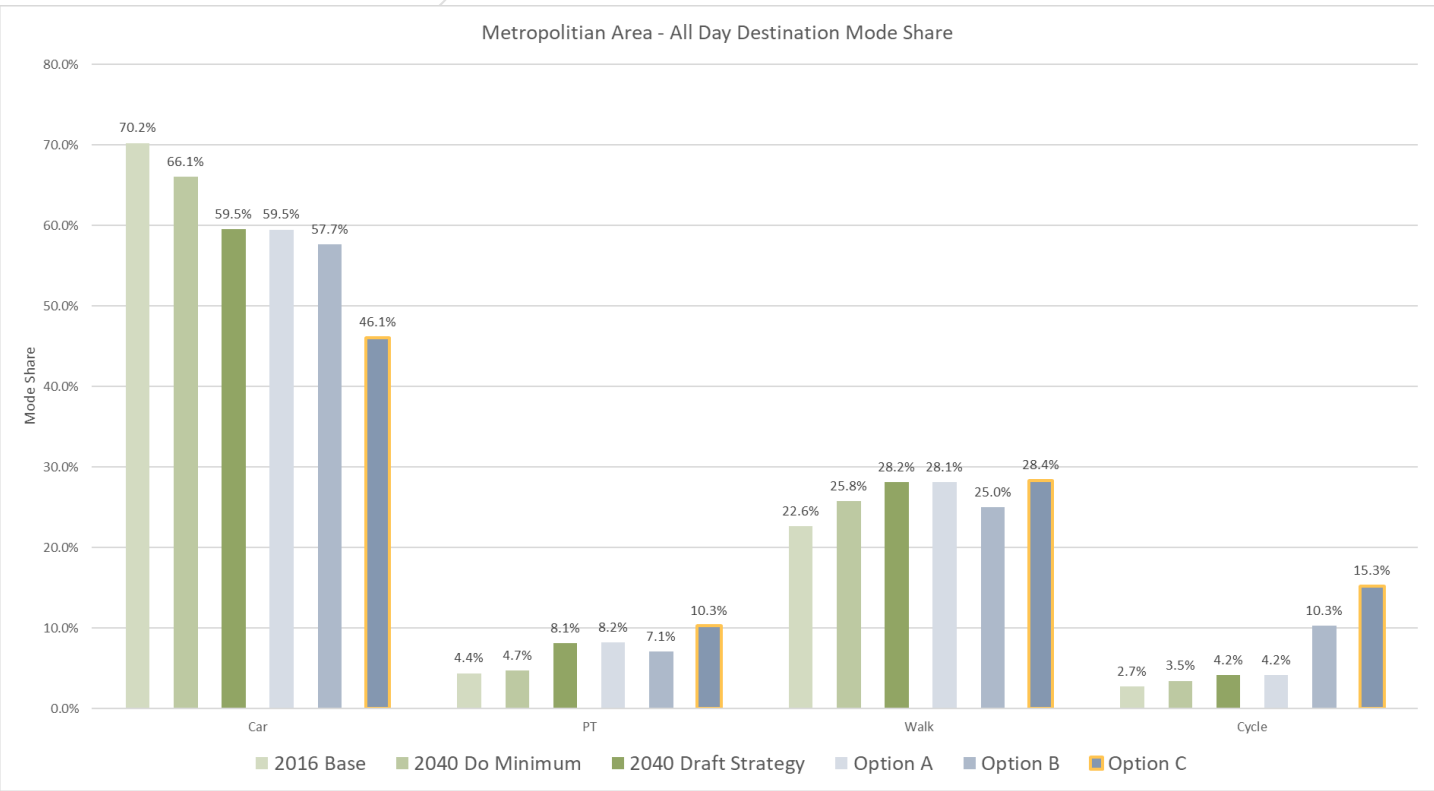


Figure 7-12 All Day Destination Mode Share

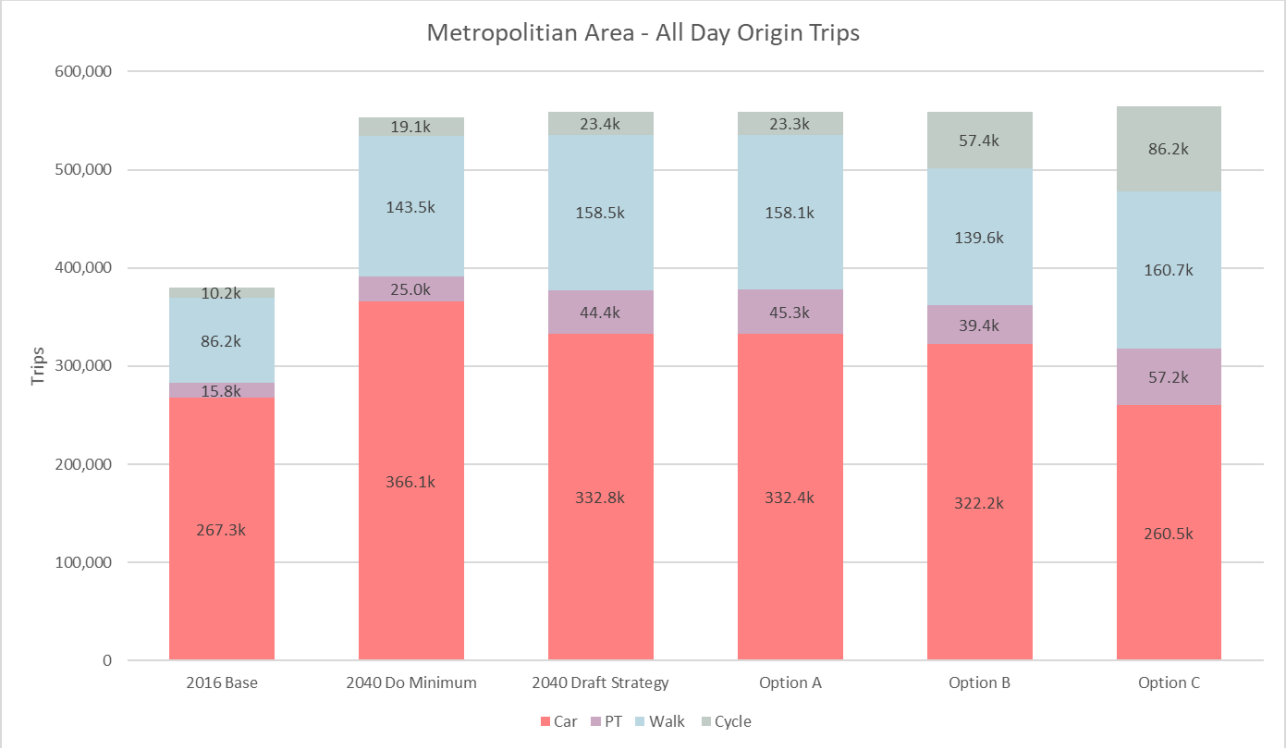


Figure 7-13 All Day Trip Rate Origins

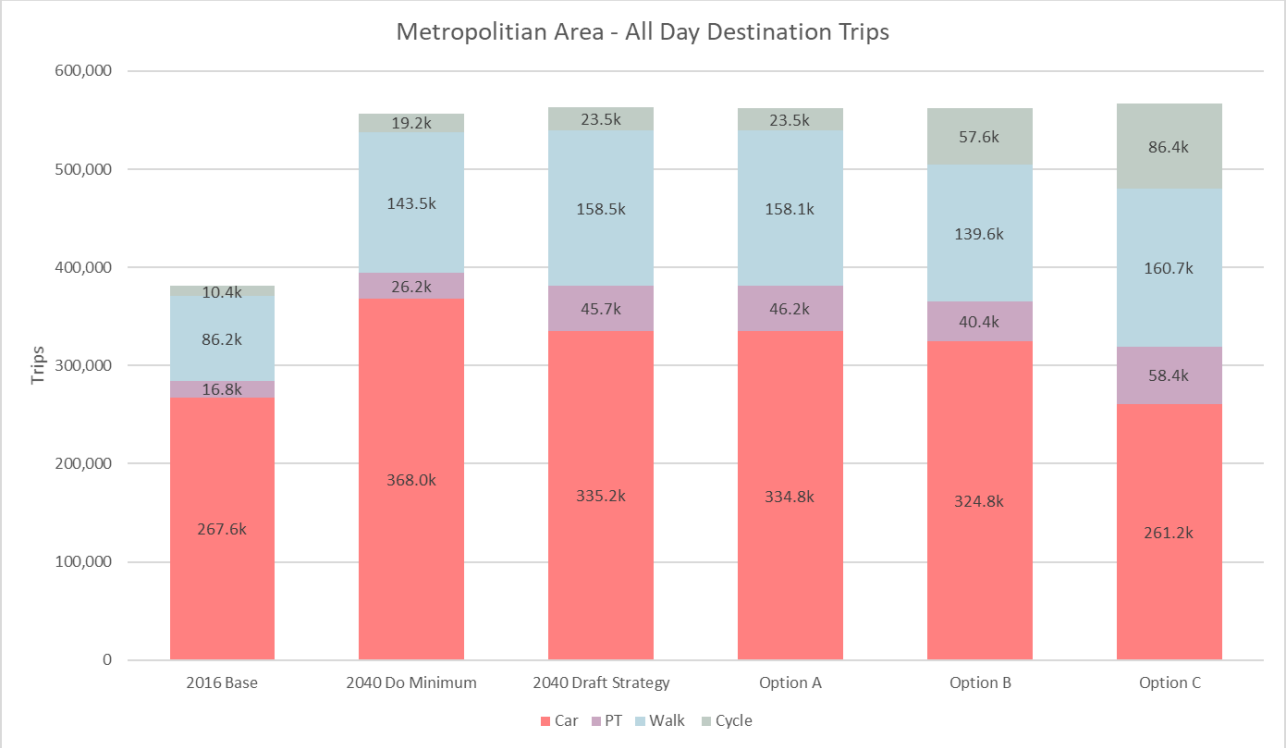


Figure 7-14 All Day Trip Rate Destinations

Option A introduces enhanced rail to the previously published draft Strategy. This has a minimal impact on the All Day Mode Share with a small increase in PT mode share of 0.2% and 0.1% for Origins and Destinations. This equates to 900 and 500 additional PT trips across the day respectively.

Table 7-2 Comparison of previous Strategy to Option A change in All Day Trips

	Car	PT	Walk	Cycle
Origin Change in Trips	-235	493	-142	-12
% Change (compared to Previous Strategy)	0%	4%	0%	0%
Change in Mode Share	-0.2%	0.3%	-0.1%	0.0%
Destination Change in Trips	-120	221	-136	8
% Change (compared to Previous Strategy)	0%	2%	0%	0%
Change in Mode Share	-0.1%	0.1%	-0.1%	0.0%

Option B introduces improved cycling on top of Option A, resulting in a substantial increase in cycle trips, with approximately 34,000 additional trips amounting to a 145% increase in cycling across the LSMA. This results in an increase of cycle mode share up to 10%, drawing trips from all other modes but more predominantly from walking. Table 7-3 below shows the trip numbers shift toward cycling.

Table 7-3 Comparison of Option A to Option B change in All Day Trips

	Car	PT	Walk	Cycle
Origin Change in Trips	-10,175	-5,814	-18,552	34,087
% Change (compared to Option A)	-3%	-13%	-12%	146%
Change in Mode Share	-1.8%	-1.0%	-3.3%	6.1%
Destination Change in Trips	-10,032	-5,804	-18,552	34,088
% Change (compared to Option A)	-3%	-13%	-12%	145%
Change in Mode Share	-1.8%	-1.0%	-3.3%	6.1%

There is also movement away from PT services, with a 1% lower PT mode share against Option 1, however this mode share remains 2.9% higher than the Base PT mode share and 2.5% higher than the Do Minimum mode share with the benefits of a 7.6% and 6.8% increase in Cycle Mode share against the Base and Do Minimum respectively.

Option C introduces a number of additional Demand Management measures on top of Option B aimed at further reducing car utilisation and shifting users onto PT and active modes. These changes result in an increase in sustainable mode use but more predominantly an increase in PT usage, increasing trips by 4.2k and mode share by 2% compared to the previous strategy.

Table 7-4 Comparison of Option B to Option C change in All Day Trips

	Car	PT	Walk	Cycle
Origin Change in Trips	-18,866	5,679	7,417	11,104
% Change (compared to Option B)	-23%	42%	20%	70%
Change in Mode Share	-14.3%	3.4%	4.0%	6.9%
Destination Change in Trips	-24,231	7,569	7,449	11,723
% Change (compared to Option B)	-24%	54%	20%	73%
Change in Mode Share	-15.2%	4.4%	4.1%	6.8%

In addition to the All Day results, results for the AM period (0700 – 1000) are provided in Figure 7-5 to Figure 7-6 below.

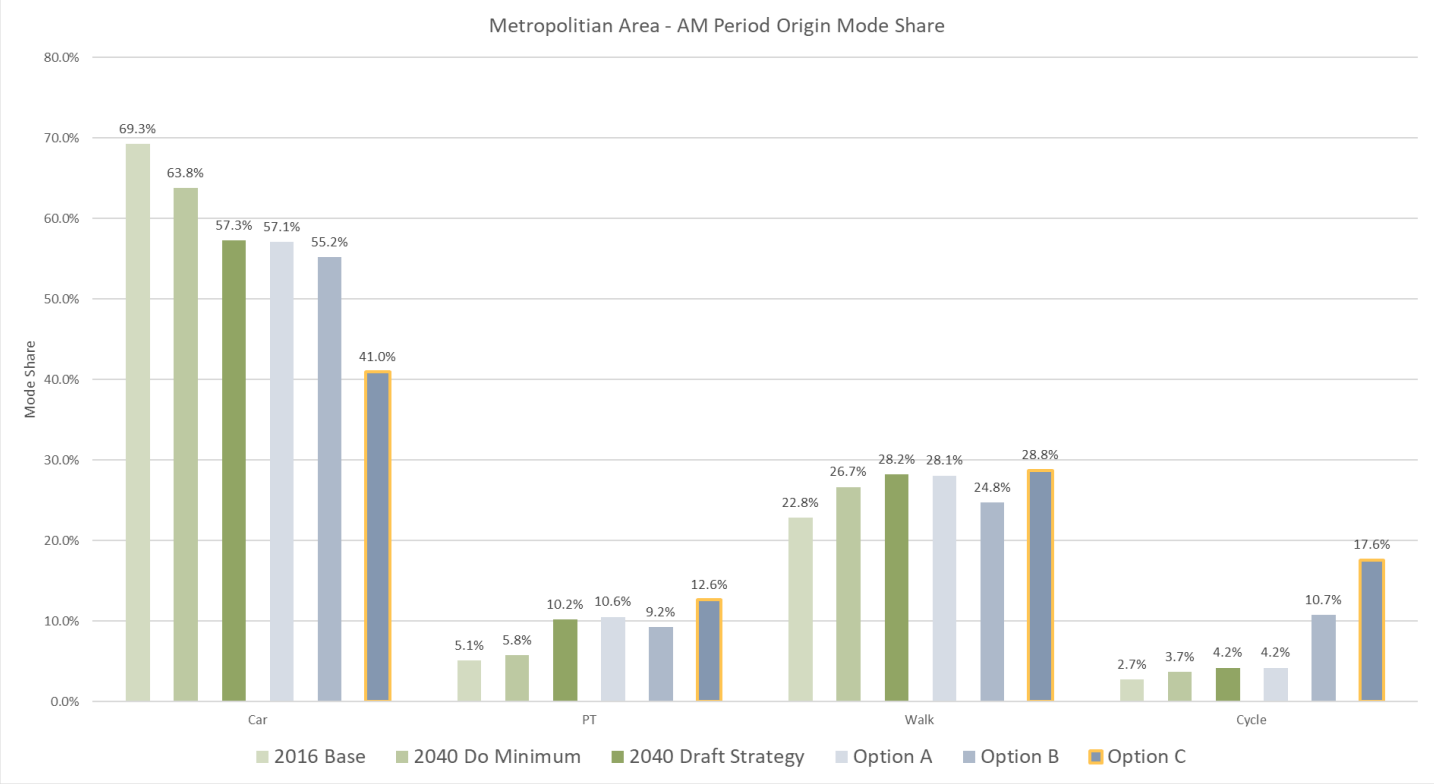


Table 7-5 AM Period Origin Mode Share

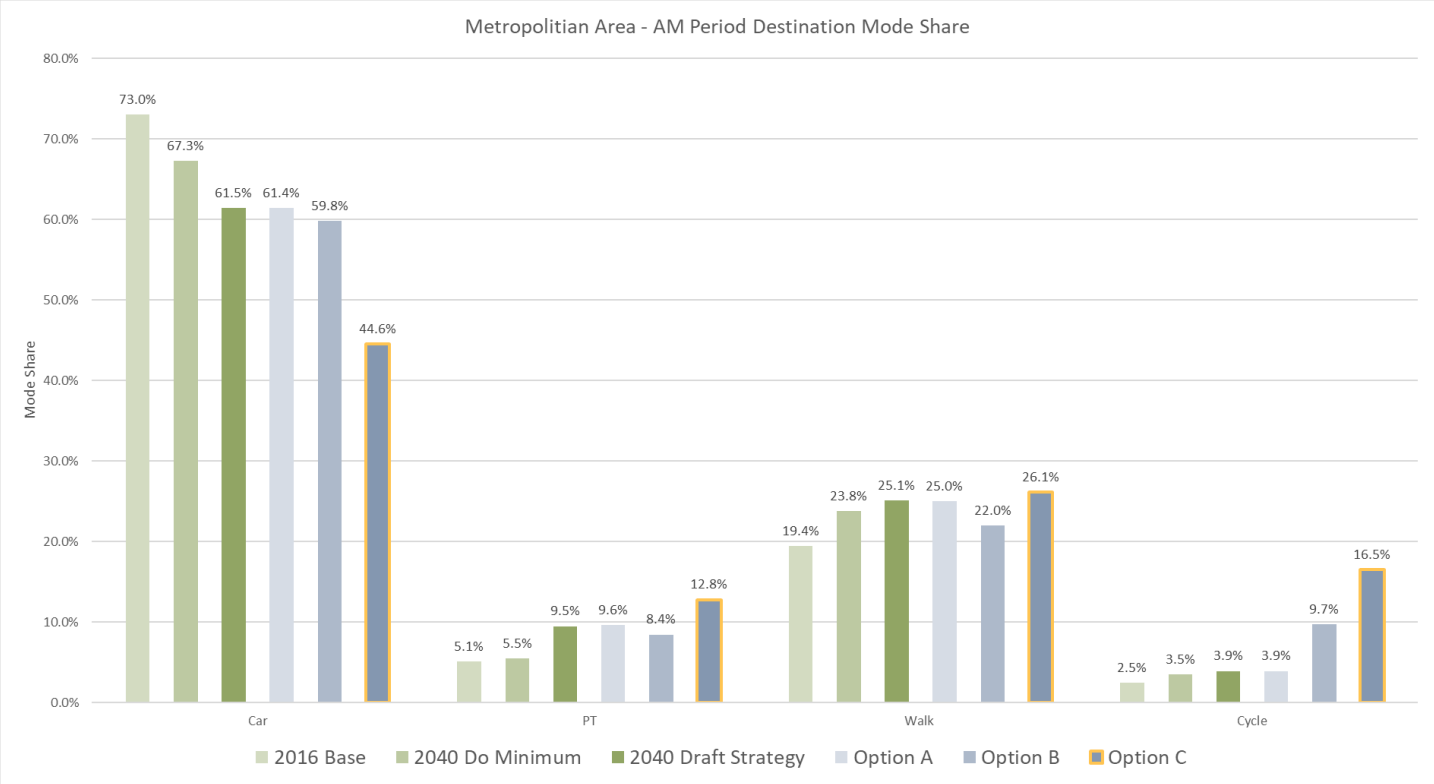


Table 7-6 AM Period Destination Mode Share

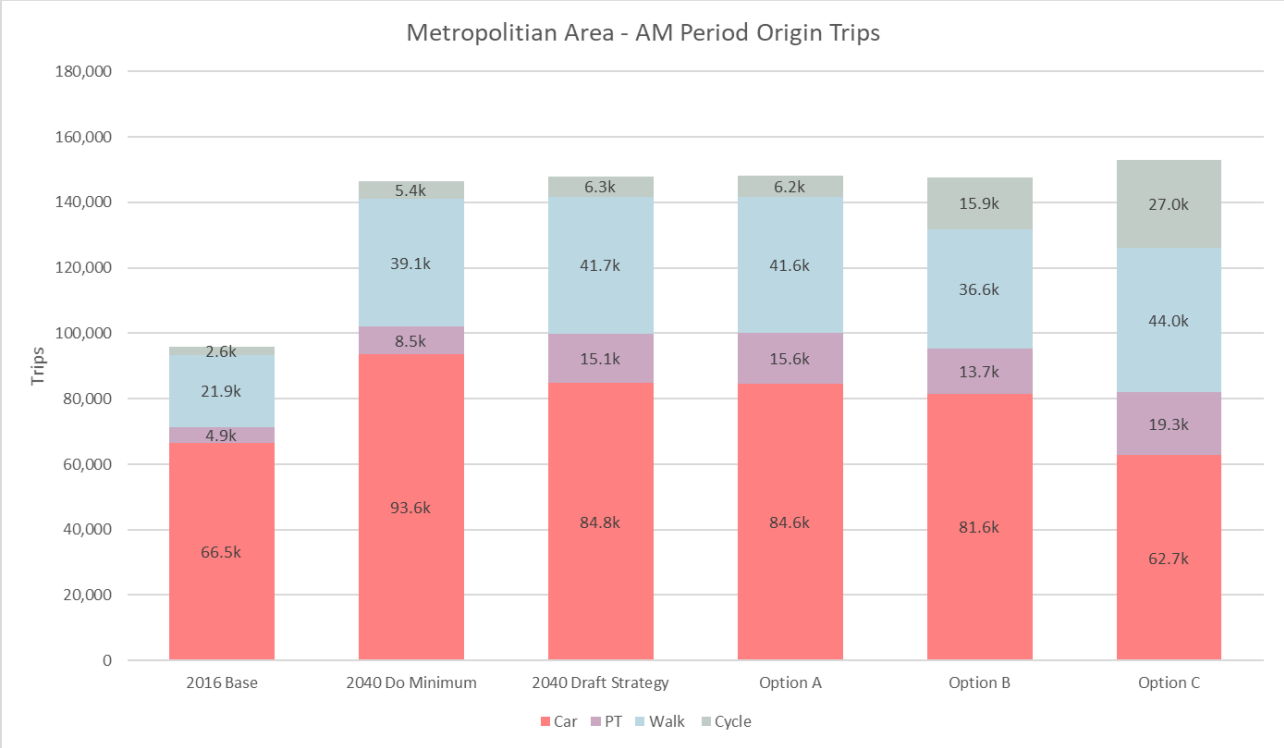


Figure 7-15 AM Period Origin Trips

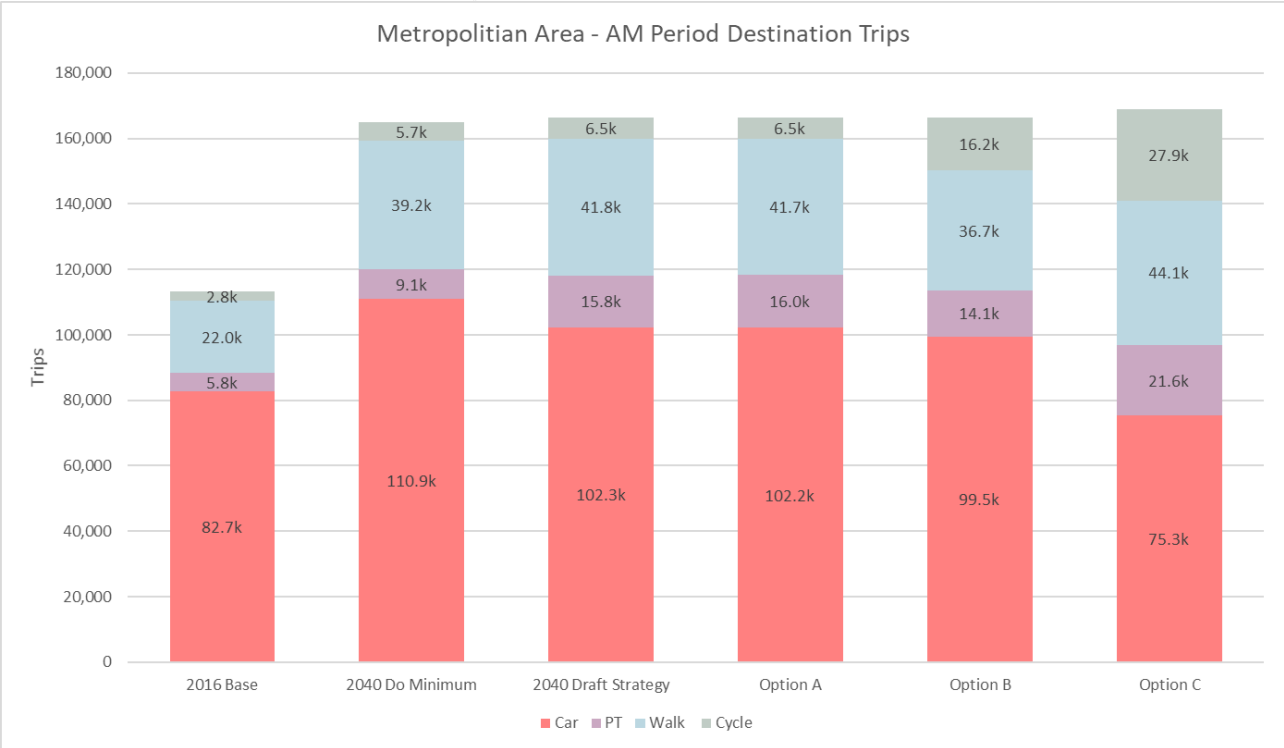


Figure 7-16 AM Period Destination Trips

The results in the AM period are similar to the All Day profile for mode shares and trips with the introduction of improved cycling leading to a sharp increase in the number of cycle trips and the respective mode share of cycle. As with the All Day results these additional trips are drawn from all three modes with the most coming from Walk, then car and the least from PT.

A break down to the results is provided in the table below;

Table 7-7 Results of additional modelling

Test	Change from Previous	Result
Draft Strategy	None	As Previously Reported
Option A	Rail Option 1 added to Draft Strategy	Greatest impact in AM period with an increase of 0.4% PT Mode share for Origins equating to approx. 500 additional PT trips. Negligible impact on Active Modes.
Option B	Introduction of improved cycling	Cycle mode share more than doubles across the day with an additional 34k cycle trips. These trips are split across the three modes with approx. -10k car trips, -18k walk trips and -6k PT trips.
Option C	Introduction of FWPP constraint, €2/€3 Parking Fee and 60 Second Cycle Time	Shift away from car toward other modes, walk gains back mode share lost to cycling improvements.

7.8 Final Emerging Strategy

As a result of the additional modelling work, detailed above, the Emerging Strategy is to take forward **Option C**.

Table 7-8 Emerging Strategy Schemes

	Enhanced Rail	Cycle Propensity	Free Workplace Parking Reduction	Parking Charges	60 Second Cycle Time
Option C	Yes	Yes	50%	€2/3	Yes

Option C provides the best candidate for the final emerging strategy as it promotes strong use of sustainable modes with the majority of trips across the day taken by sustainable modes, 53.9%. While the introduction of improved cycling in Option B led to a mode shift from PT and Walk to cycling, the introduction of the additional demand management measures has resulted in the PT and Walk mode shares surpassing the previous strategy, for PT, or matching it, for walking.

These results can be seen in the summary of mode shares in Figure 7-17 and Figure 7-18.

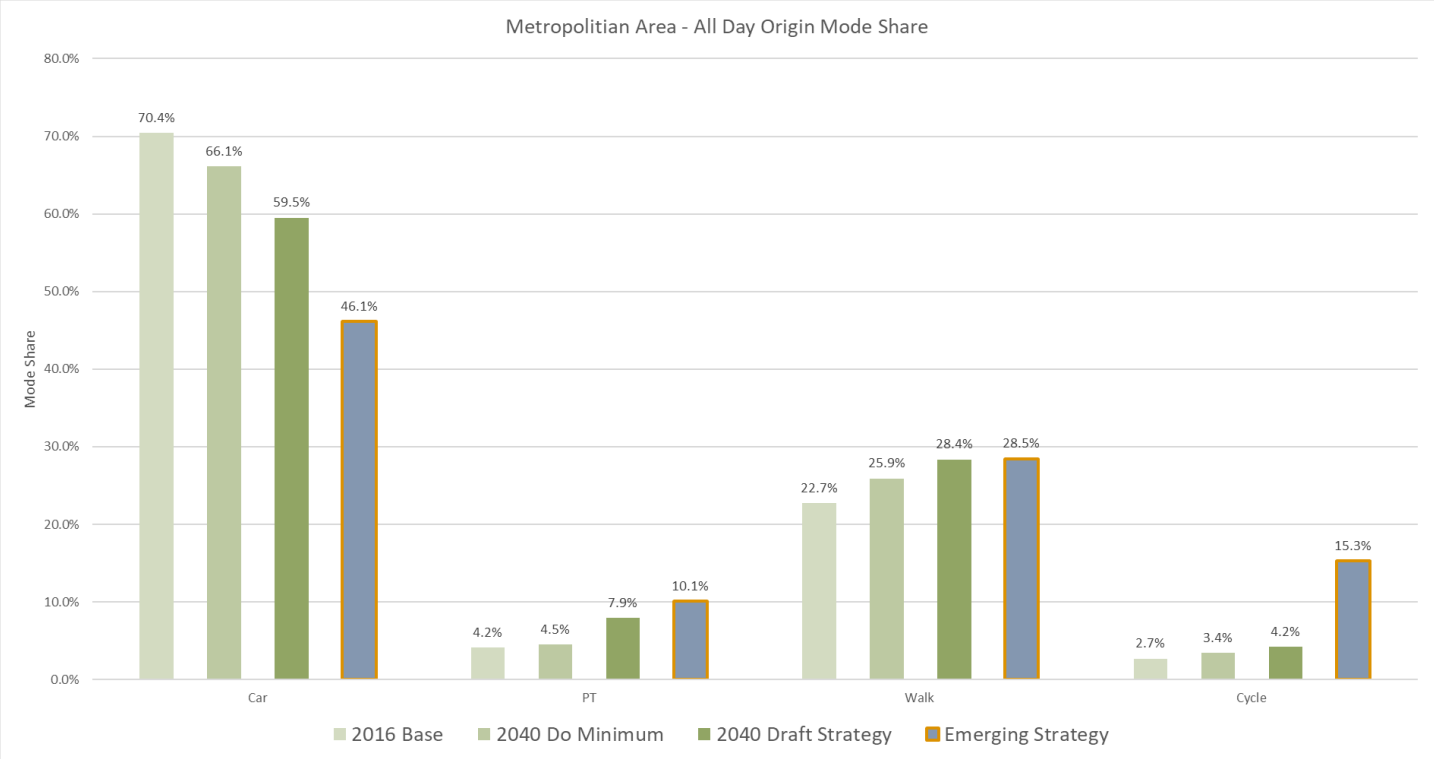


Figure 7-17 Emerging Strategy All Day Origin Mode Shares

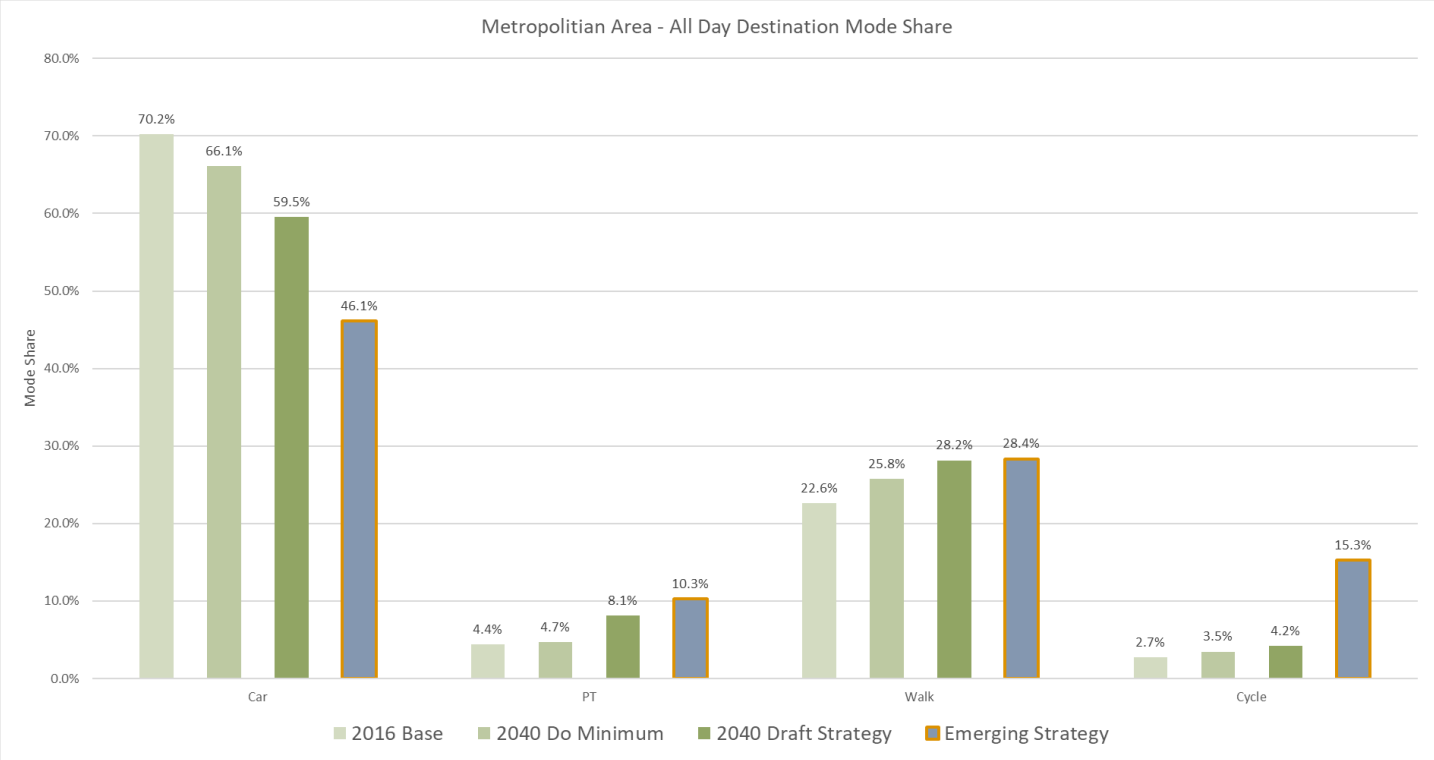


Figure 7-18 Emerging Strategy All Day Destination Mode Shares

A table of mode shares is presented below in Table 7-9 for the Draft Strategy and Table 7-10 for the Emerging Strategy.

Table 7-9 Draft Strategy Mode Shares

LSMA All Day Mode Share Draft Strategy	Car	PT	Walk	Cycle
Origin	59.5%	7.9%	28.4%	4.2%
Destination	59.5%	8.1%	28.2%	4.2%

Table 7-10 Emerging Strategy Mode Shares

LSMA All Day Mode Share Emerging Strategy	Car	PT	Walk	Cycle
Origin	46.1%	10.1%	28.5%	15.3%
Destination	46.1%	10.3%	28.4%	15.3%

7.9 Alternative Future Sensitivity Test

7.9.1 Overview

In order to account for uncertainty in future transport demand, for example the impact of behavioural change (as evidenced through the Pandemic where more people may decide to work from home), an Alternative Future demand scenario was tested with the Do Minimum scenario and Final Emerging Strategy (Option C).

To achieve this the trips rates were adjusted according to the NTA research paper titled 'Alternative Futures'[3].

Changes made in the previously presented 'Business as Usual' (BAU) demand set to represent demand management measures on home car parking (see Section 6.4) were also applied to the AltF demand set.

7.9.2 Results

The results of the Alternative Future (AltF) sensitivity tests are presented below.

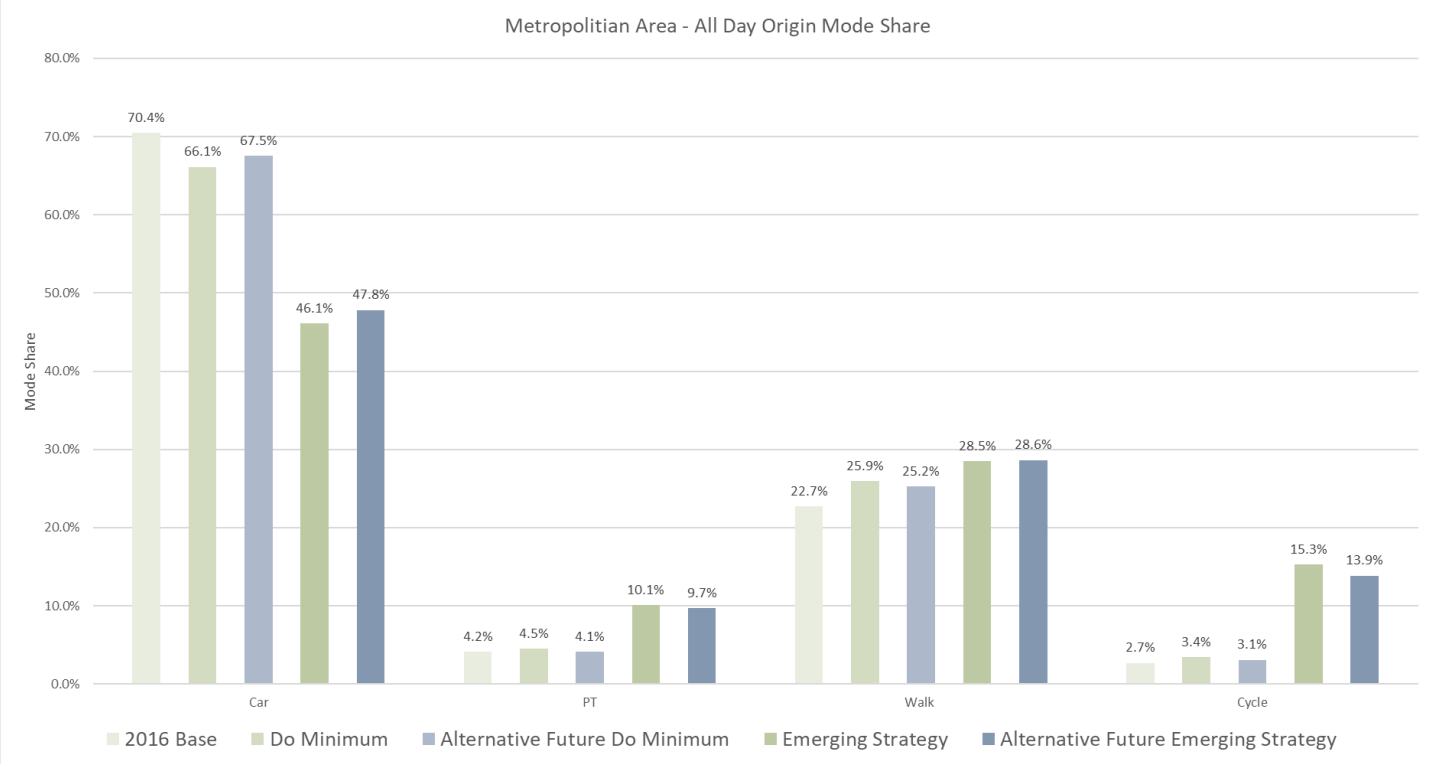


Figure 7-19 Alternative Future Sensitivity Test Origin Mode Shares

[3] https://www.nationaltransport.ie/wp-content/uploads/2021/03/Alternative-Scenario-Development-Note-v-6.1_Final.pdf

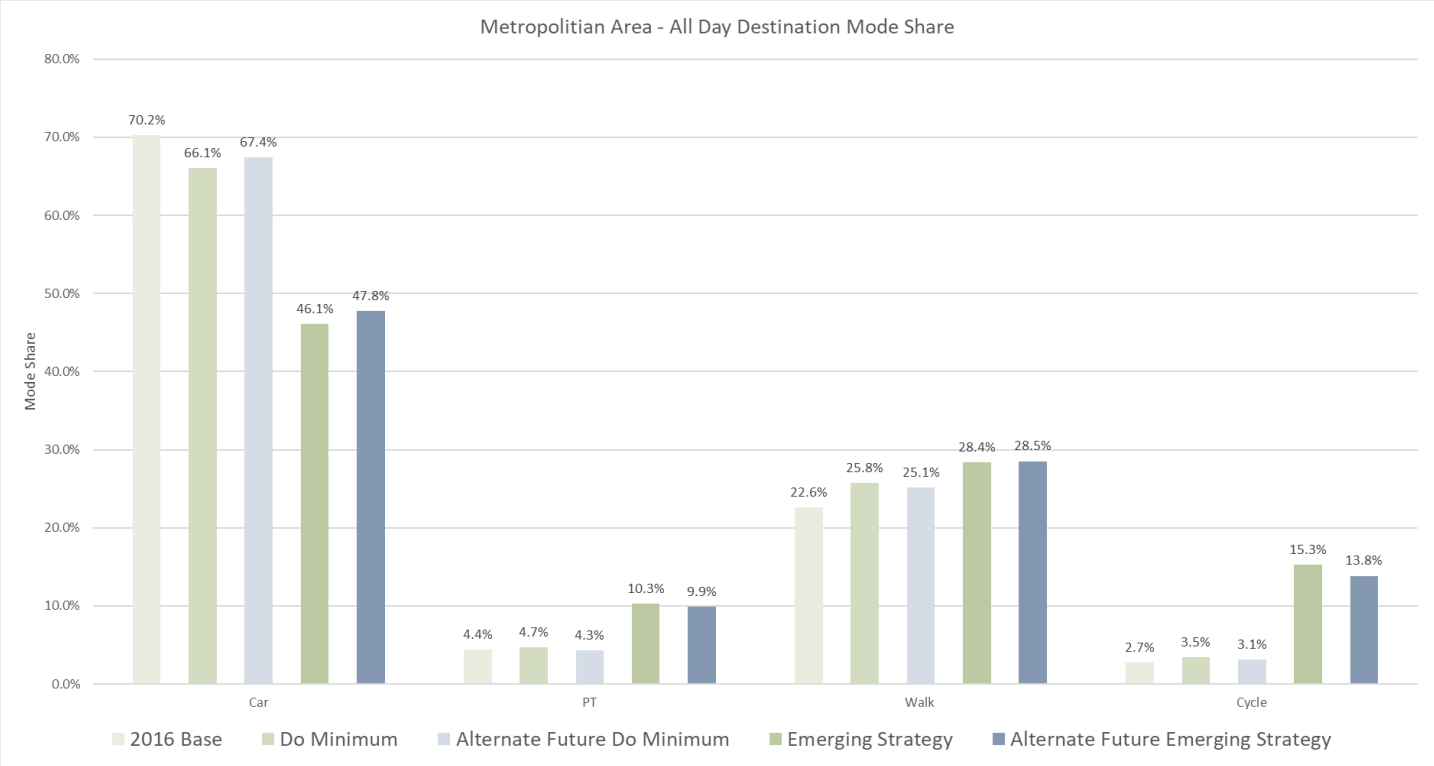


Figure 7-20 **Alternative Future Sensitivity Test Destination Mode Shares**

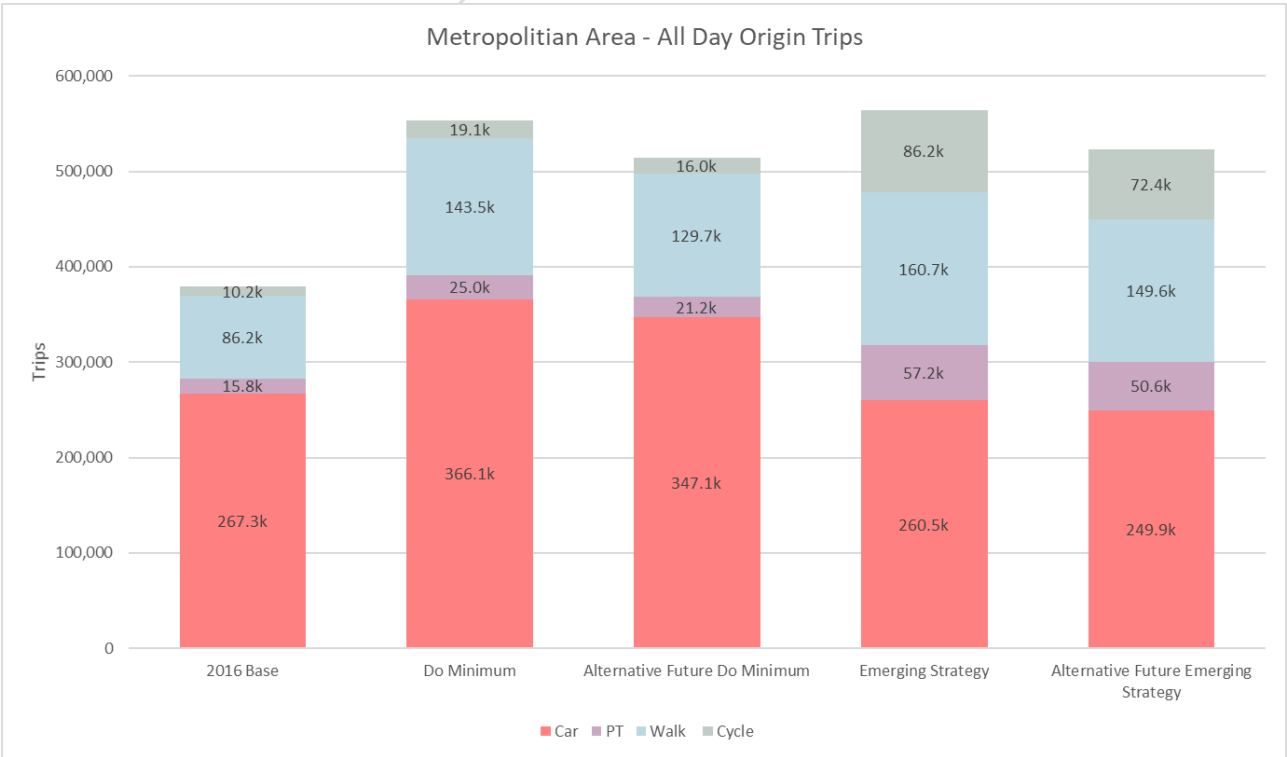


Figure 7-21 **Alternative Future Sensitivity Test Origin Trips**

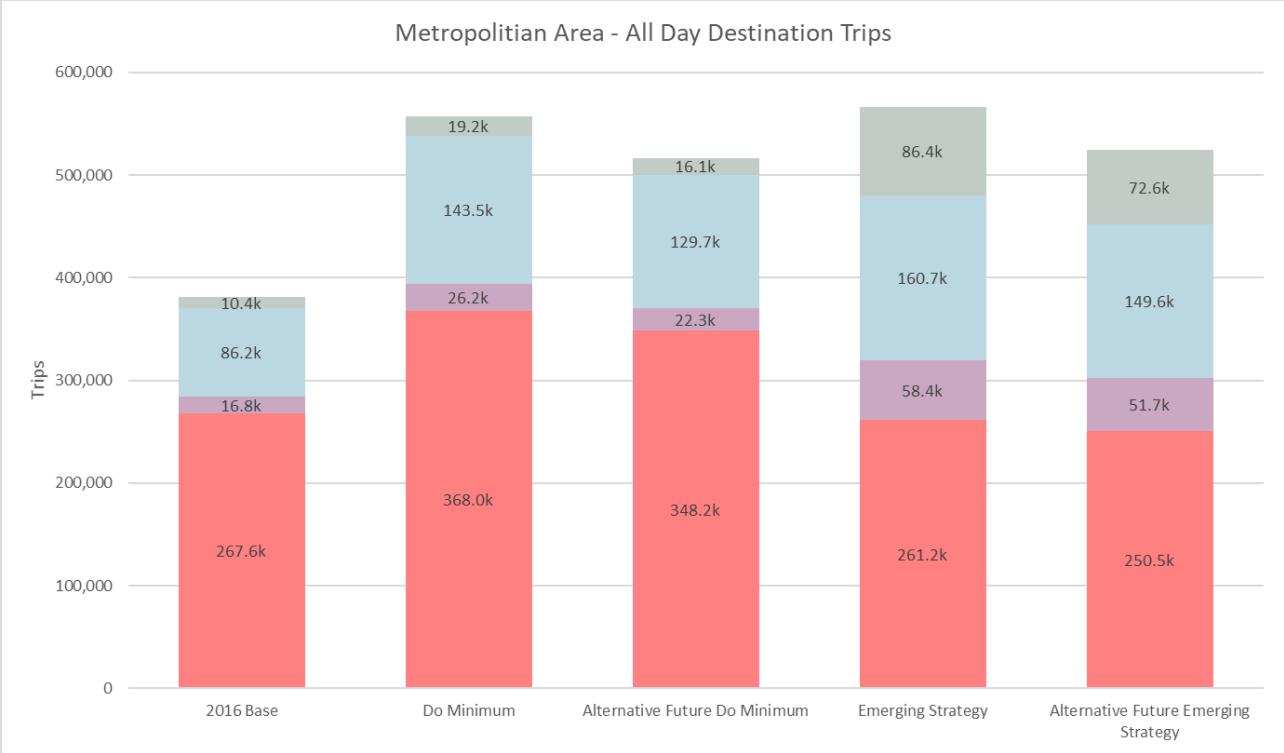


Figure 7-22 Alternative Future Sensitivity Test Destination Trips

The Emerging Strategy (Option C) sees less of an increase in sustainable mode shares in the AltF scenario than the BAU scenario when compared against the base, however it still sees a sizable increase in mode share for sustainable modes.

The reasons for the lower increase in sustainable mode trips in the AltF is that the overall demand for travel in the AltF scenario is lower than the BAU scenario. The AltF Do minimum scenario has 39.6k Origin and 40.6k Destination trips less than the BAU Do Minimum for the LSMA.

This lower rate of trips reduces the overall road demand, which in turn lowers delays across the road network making the car more attractive.

While the AltF test results do not provide the same level of shift from car to sustainable modes it should be noted that substantial gains have still been made towards reduced car mode share and onto PT and active modes and that overall car trip rates are substantially lower across the LSMA.

Whilst the AltF scenario does result in a reduction in PT demand, the BusConnects solution with rail enhancements as set out in Option C, remains an appropriate strategy for Limerick in both the AltF and BAU future scenarios.

7.10 Climate Action Performance

7.10.1 Overview

The climate action plan requires the transport sector to achieve a reduction in emissions of 51% by 2030 relative to 2018 values. In order to test the strategies impact on these targets a test was carried out delivering the strategy schemes by 2030.

The demand used for this test was the 2030 Alternative Future demand. In addition, The Car availability reduction applied in the 2040 strategy were applied in the same proportion to the 2030 demand.

7.10.2 Fleet Assumptions

Fleet assumptions used in this test are in line with those adopted for the Climate Action Plan project. A breakdown of this fleet is shown in Table 7-11 below. The bus fleet is assumed to be converted to zero emission vehicles by 2030 through battery electric, hydrogen fuel cell or hybrid buses running on battery within the LSMA.

Table 7-11 2030 Fleet Profile

	Petrol	Diesel	Hybrid	Zero
Car	32.6%	24.7	16.1%	26.5%
LGV	0.0%	86.7%	0.0%	13.3%
HGV	0.0%	91.0%	0.0%	9.0%

7.10.3 Approach

In order to tie into the Climate Action Plan work, the emissions were calculated using a 'stepping stone' approach, which sequentially examines the impact of changes in land use, improvements in vehicle technology and the transport strategy measures.

Emissions were calculated using the NTA's Environment Module which uses ENEVAL to calculate emissions by road link based on speed and flow.

In total, there are 4 stepping stone elements included in the results presented for this test;

- **Step1: Background Growth** –As set out within Section 4 of this report, the LSMATS area is set to undergo a substantial increase in population and employment by 2040. Based on a linear growth profile, it is assumed a proportion of this growth will be achieved by 2030. This will result in a growth in demand for travel and increase in vehicle km between 2018 and 2030. The initial growth in demand for travel and resultant increase in vehicle km has been tested by using a 2030 Do Minimum model and the base year fleet in ENEVAL.
- **Step 2: Fleet Improvements** – As set out above, changes in fleet technology with zero or lower emission vehicles will take place between the base year and 2030. This was tested by running the 2030 Do Minimum model with the 2030 Fleet in ENEVAL.
- **Step 3: Biofuels** – Biofuels allow for a carbon offset based on their proportion of diesel and petrol fuel versus fossil fuels. While Biofuels still produce CO_2, the process of making the fuels removes CO_2 from the atmosphere making it carbon neutral. In 2018, 7% of Diesel was biofuel, this is expected to rise to 20% by 2030. For petrol there is currently no biofuel, this is expected to increase to 5% by 2030.
- **Step4: Strategy Impacts** – Finally, the impact of the strategy measures on CO_2 reduction was examined. This was tested by using the 2030 Strategy run and the base year fleet profile.

7.10.4 Results

The results of the stepping stone tests are presented in Table 7-12 below;

Table 7-12 Climate Impact Assessment for 2030 – CO_2 emission percentage changes 2018-2030

	Individual Impacts				Cumulative Impacts			
	Car	Goods	Bus	**Total**	Car	Goods	Bus	**Total**
Background Growth	18%	40%	-1%	**25%**	18%	40%	-1%	**25%**
Fleet Improvements	-39.5%	-11.0%	-100.0%	**-30.4%**	-28.4%	24.2%	-100.0%	**-13.2%**
Biofuels	-6.2%	-11.0%	-11.0%	**-11.0%**	-32.9%	10.5%	-100.0%	**-22.7%**
Strategy Measures	-24.3%	-1.2%	-23.7%	**-15.8%**	-49.2%	9.2%	-100.0%	**-34.9%**

As can be seen from the Table 7-12 above, the results of the step 1 assessment, indicates that the planned growth in population and employment by 2030 will lead to an overall 25% increase in CO_2 emissions by 2030 based on the existing fleet profile and without the implementation of strategy measures.

The step 2 planned fleet improvements will result in a reduction of 30.4% in CO_2 emissions when compared to 2018 CO_2 emissions. When considering the increase in CO_2 emissions arising from the planned growth in population and employment, the cumulative reduction in Co2 emissions is 13.2% when compared to 2018 levels.

As an individual measure, the inclusion of Biofuels under step 3 results in a reduction of 11% CO_2 emissions when compared to 2018 CO_2 emissions. When considering the estimated growth in population/ employment combined with the expected changes in fleet profile, the cumulative reduction in CO_2 emissions is 22.7% when compared to 2018 levels.

Finally, the implementation of the strategy measures alone will result in a 15.8% reduction in CO_2 emissions when compared to 2018 CO_2 emissions. When considering the estimated growth in population/ employment combined with the expected changes in fleet profile and inclusion of Biofuels, the cumulative reduction in CO_2 emissions with the strategy in place is 34.9% when compared to 2018 levels.

This equates to a reduction from 0.27MT of CO_2 in the 2018 base year to 0.18MT of CO_2 in 2030. This leaves a shortfall of 16.1% or 0.044MT of CO_2.

Much of this shortfall is driven by the growth in goods emissions between the base and 2030 which itself is tied to economic growth within the LSMA.

Several additional measures were tested to understand what is required to make up the shortfall. These tests covered three areas;

- Fuel price increase;
- Additional zero emission vehicles; and
- Road pricing.

The first measure exploring fuel price increase, looks at a percentage increase in the price of fuel relative to 2016 values. Fuel price increases are effective at reducing emissions as they encourage

mode shift toward sustainable modes, more efficient use of ICE vehicles and the uptake of zero emission vehicles.

More efficient use of vehicles for private car can be achieved by driving at lower speeds and making less trips. While for goods vehicles, efficiency gains can be achieved through higher utilisation of vehicles, through reduction in empty running and consolidation of logistics lines.

The scale of fuel price increase required to achieve the 51% target is substantial but would be phased in over time leading up to 2030. Fuel price increases are a national government mater rather than a regional strategy one and will be considered further under the Climate Action Plan reviews.

The second measure; addition zero emission vehicles, looks at the possibility of accelerating adoption of zero emissions vehicles, particularly among the goods sector. With goods traffic expected to grow substantially between the base and 2030, focusing this growth on zero emission vehicles would have a substantial impact.

Battery electric goods vehicles are currently feasible in LGVs, however Battery operated HGVs is not yet a viable solution due to the vehicle weight and long ranges involved. Instead, adoption of hydrogen technology for HGVs presents a potentially feasible option though high costs are currently associated with hydrogen fuel.

The final option tested was road pricing, this is the introduction of tolling or congestion charging to promote a mode shift towards sustainable modes. One option explored is to toll radial and orbital routes in conjunction with the implementation of park and ride sites. The intention being that this will encourage use of park and ride for the last leg of journeys into Limerick.

This is, however, only one of the options that could be explored and would require detailed evaluation in conjunction with the national strategies being delivered under the Climate Action Plan.

8 Final Emerging Strategy Measures

8.1 Overview

This section outlines the measures included in the final emerging strategy. An outline of these measures is provided in Table 8-1 below;

Table 8-1 Final Strategy Measures

Category	Name	Change from Draft Strategy
Public Transport	High Frequency comprehensive bus network	Increased frequency for bus services
Public Transport	Two new rail stations at Moyross and Ballysimon	Not in Draft Strategy
Public Transport	New Park and Ride sites on radial approaches	No Change
Active Modes	Comprehensive cycle network with proactive promotion of cycling.	Proactive promotion of cycling as an alternative mode.
Active Mode	Improved walking network	No Change
Roads	N21/N69 Foynes to Limerick incorporating Adare Bypass, N18/N19 Shannon and M7/N18 Junction Improvements	No Change
Roads	Additional Regional roads to cater for strategy measures	No Change
Traffic Management	PT only streets within City Centre	No Change
Traffic Management	HGV ban within City Centre	No Change
Traffic Management	Prioritisation of active modes at junctions within the City Centre	Not in Draft Strategy
Demand Management	Reduced origin parking for new developments aimed at reducing car ownership	Included in previous Strategy as the + Demand Management
Demand Management	Reduced free workplace parking within the LSMA	Increased from 25% to 50% reduction.

Demand Management	Introduction of €3 parking charging for city centre and €2 parking charge for other Urban areas within LSMA	Not in Draft Strategy

8.2 Public Transport

8.2.1 Bus

LSMATS proposes a comprehensive network of high frequency bus services providing radial services between corridors either side of the city core and orbital services across the network and is shown in Figure 8-1. The Core Radial Bus Network connect the external corridors to the City Centre and have been refined to pair Cross-City travel demand to maximise the utilisation of the bus services on these corridors. A significant improvement in the frequency of bus services on these radial routes is also proposed.

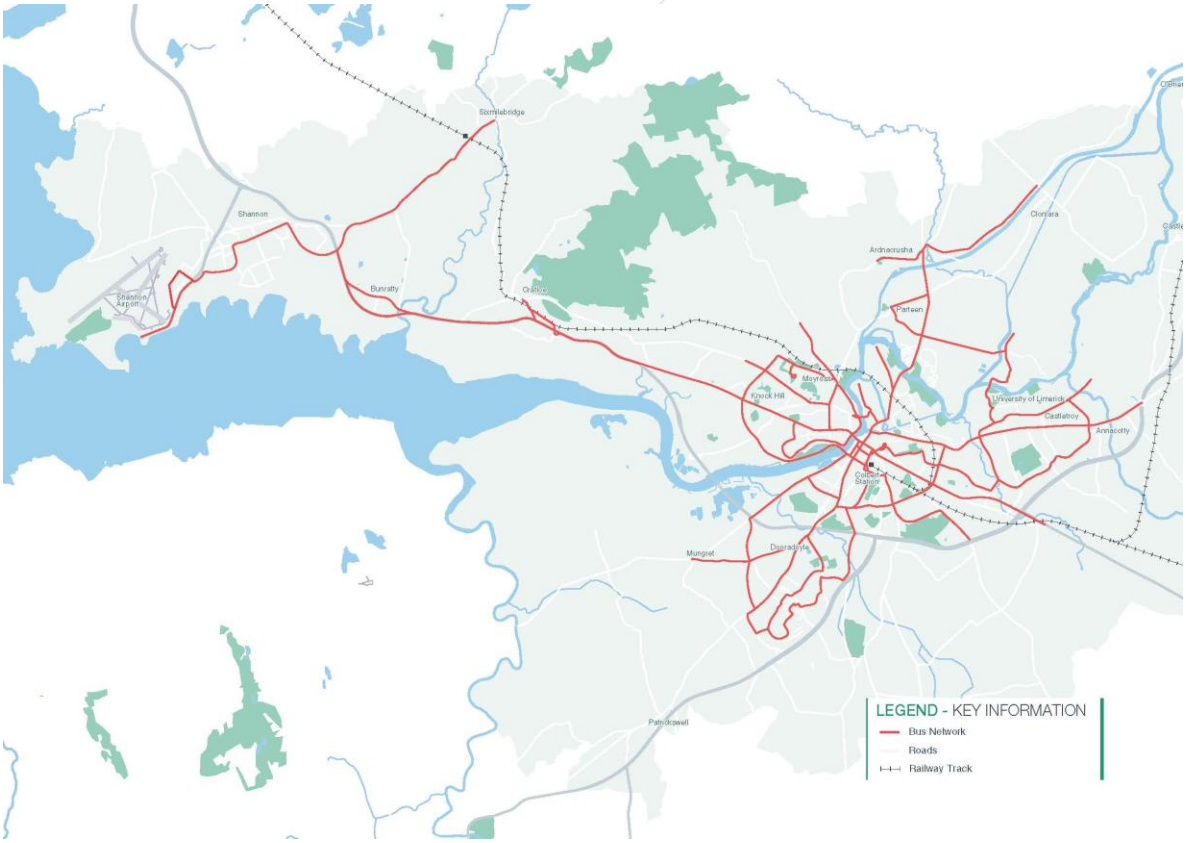


Figure 8-1 LSMATS Bus Connects Network

A number of core and orbital routes will serve strategic Park & Ride sites located along the periphery of the city, as shown in Figure 8-1. This are designed to capture demand travelling to the city that would otherwise be inclined to use car for the entirety of the journey.

The proposed frequencies of the routes are outlined in Table 8-2.

Table 8-2 Frequency of LSMATS Bus Network

Line No.	Line Name	Peak Hour Headway (mins)
6010	Ballysimon-Ardnacrusha	10
6011	Ardnacrusha - Ballysimon	10
6012	Ardnacrusha - Crossagalla	10
6013	Crossagalla-Ardnacrusha	10
6020	SDZ/UL-Mungret	8
6021	Mungret-SDZ/UL	8
6022	SDZ/UL-Raheen	8
6023	Raheen-SDZ/UL	8
6030	Caherdavin-UL-Annacotty	10
6031	Annacotty-UL-Caherdavin	10
6032	Caherdavin/North Circular-Annacotty	10
6033	Annacotty-Caherdavin/North Circular	10
6040	Ballygrennan-Raheen	4
6041	Raheen-Ballygrennan	4
6050	Annacotty-Moyross	5
6051	Moyross-Annacotty	5
6060	Clonlara-Raheen	8
6061	Raheen-Clonlara	8
6080	King's Island-Raheen	15
6081	Raheen-King's Island	15
6082	Corbally-Raheen	15
6083	Raheen-Corbally	15
6090	Shannon-Limerick Express	5
6091	Limerick-Shannon Express	5
6114	Shannon-Limerick Local	8
6115	Limerick-Shannon Local	8
6116	Sixmilebridge-Shannon	10
6117	Shannon-Sixmilebridge	10
6100	Southern Orbital Eastbound	5
6101	Southern Orbital Westbound	5

8.2.2 Rail

LSMATS proposes two new stations at Moyross and Ballysimon, with park and ride facilities also provided for at Ballysimon. The proposed future rail network is shown in Figure 8-2 below;

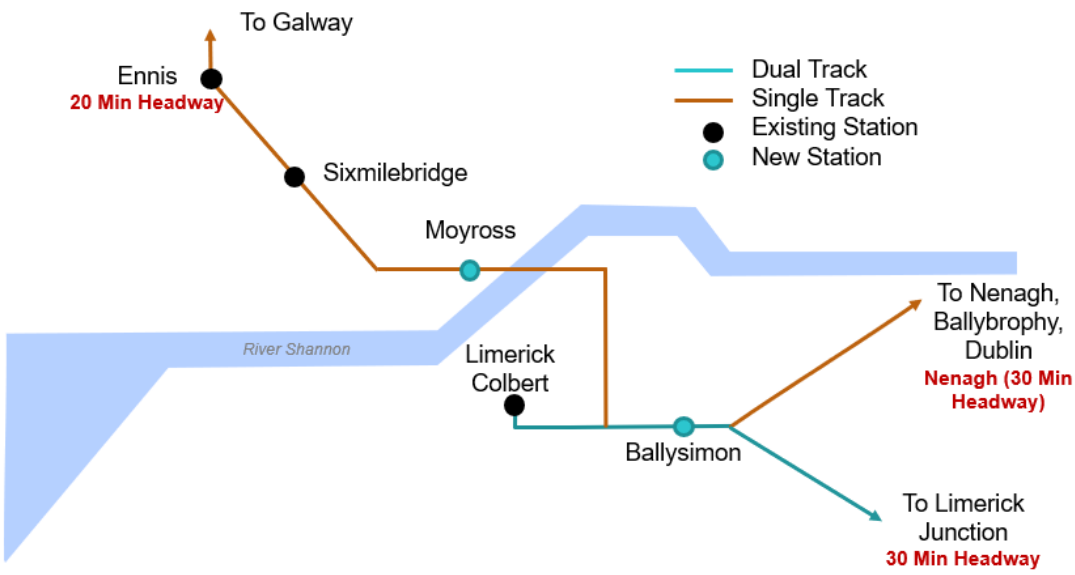


Figure 8-2 Final Strategy Rail Option

8.3 Active Modes

8.3.1 Cycling

The cycle network development for LSMATS is based on the Limerick Metropolitan Cycle Network Study 2015 and Shannon Town and Environs LAP, each was reviewed to ensure integration and alignment with the transport proposals within this strategy and is shown in Figure 8-3 and Figure 8-4.

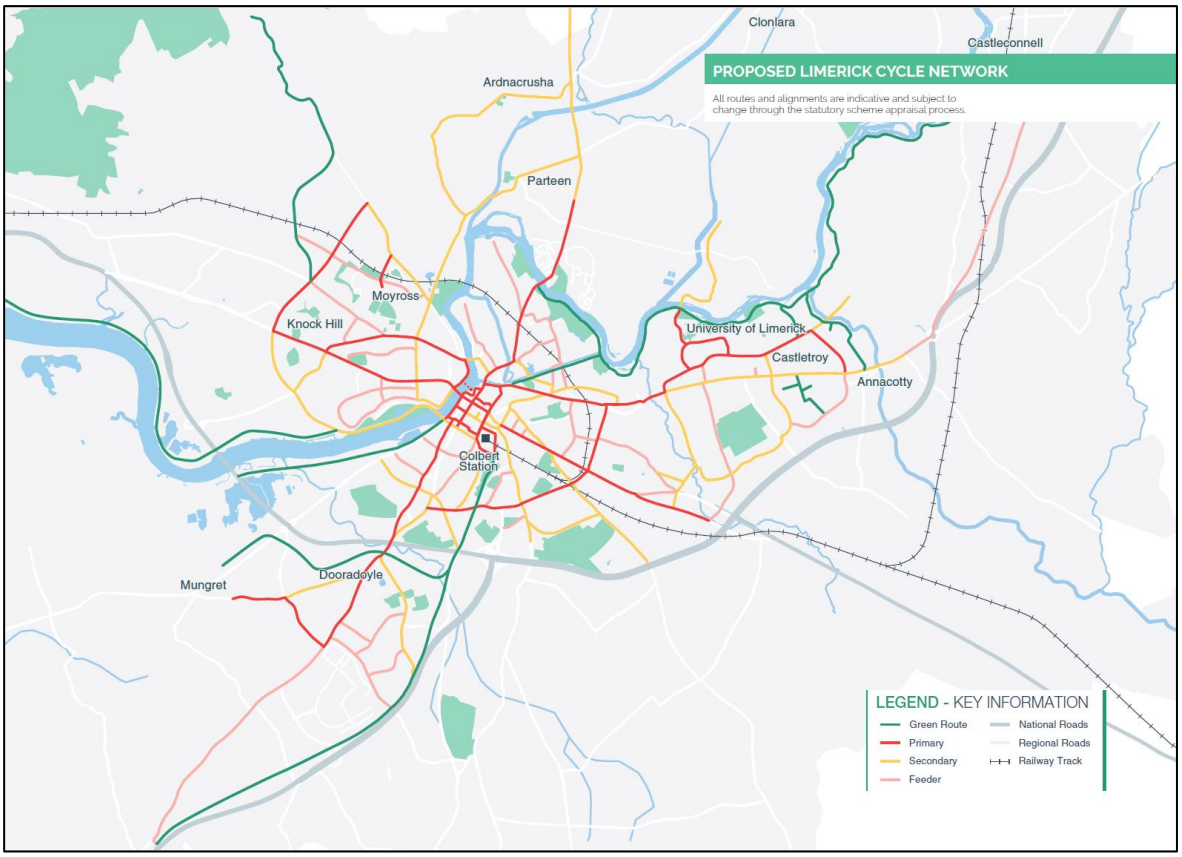


Figure 8-3: LSMATS Cycle Network- Limerick City and Suburbs

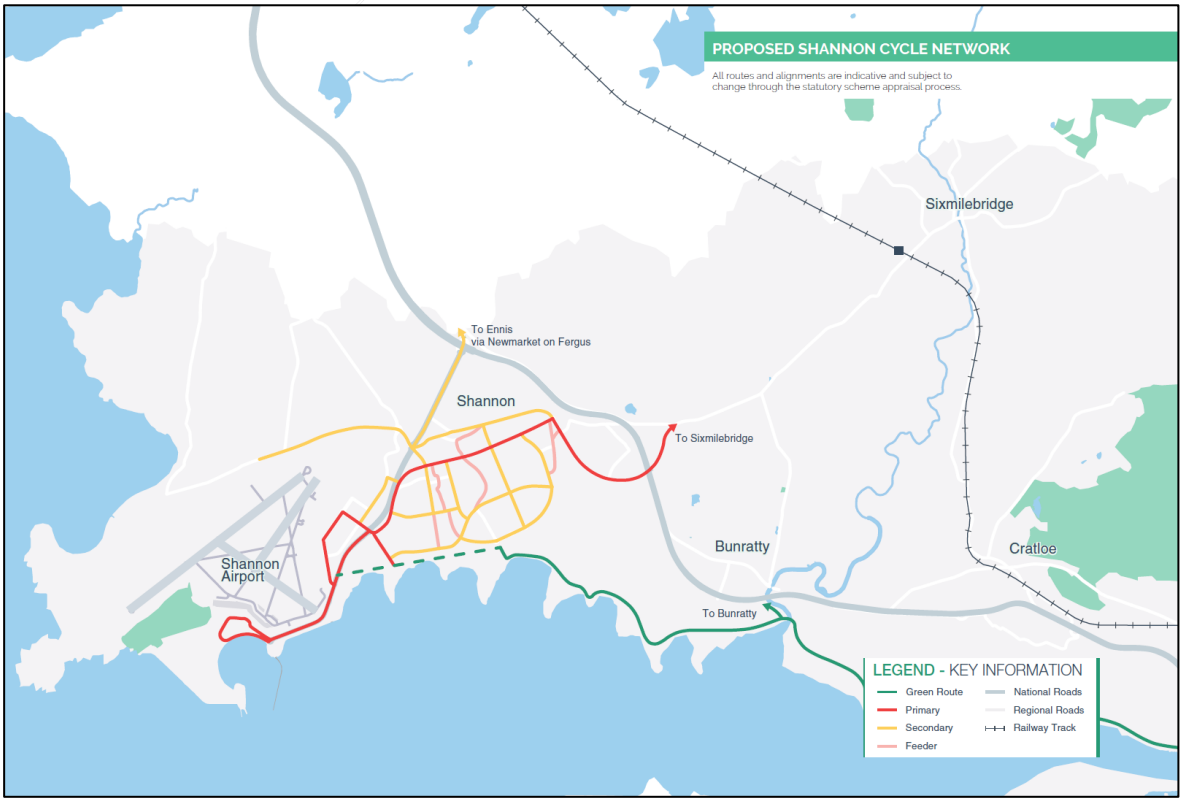


Figure 8-4: LSMATS Cycle Network- Shannon Town

8.3.2 Walking

There are a number of improvements proposed to the walking network including improvements to strategic walking routes connecting residential areas to key areas of employment and third-level education in Limerick City Centre and suburbs. It is envisaged that these will be upgraded in tandem with the provision of the bus priority and enhance the pedestrian (and cycle) network to enable greater levels of walking commuter trips or as part of linked-trips with public transport. The strategic routes include:

- St. Nessan's Road – UHL, Dooradoyle and Ballinacurra Crescent Shopping Centre;
- Ennis Road – connecting the predominantly pedestrian areas of west Limerick to the city centre;
- LIT / Old Cratloe Road Area – Thomond Park / Moyross;
- University of Limerick Area – R445 Dublin Road and Plassey Park Road / Castletroy / Annacotty;
- Ballycummin Road – Raheen Business Park;
- Corbally Road / Athlunkard Street – Kings Island through to the City Centre;
- Canal Route – connecting Shannon Fields to University of Limerick and the City Centre;
- Rhebogue Neighbourhood Greenway;
- Shannon town centre to Shannon Free Zone;
- Childers Road; and
- R527 Ballysimon Road.

The above routes are shown in Figure 8-5 below.

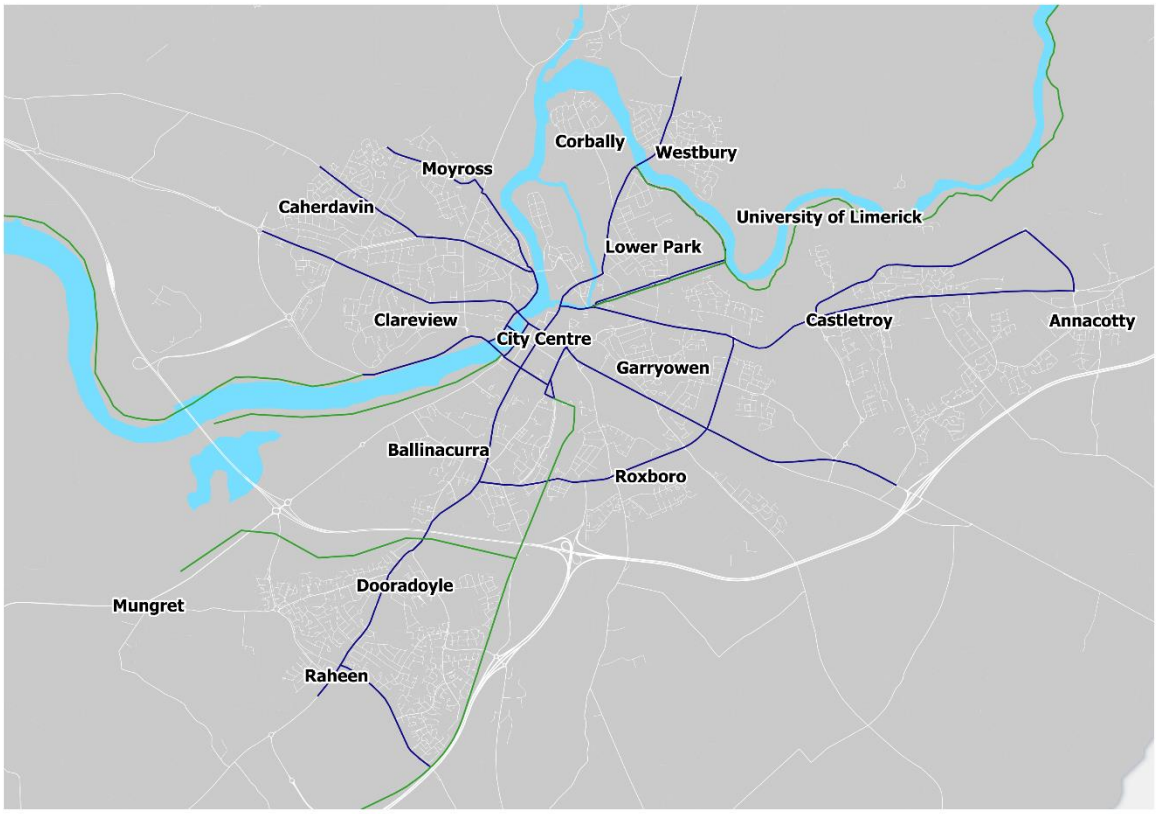


Figure 8-5: Strategic Walking Routes

Improvements are also identified within the city centre of Limerick. Whilst Limerick City Centre's historic core is compact, pedestrian access is inhibited in some areas by a limited number of

pedestrian bridges over the River Shannon, substandard crossing facilities, wide multi-lane one-way streets and high volumes of vehicular traffic and speeds on approach roads. Limerick City Centre has significant potential to enhance its walkability due to its favourable flat topography and recent public realm improvements including pedestrian priority areas and improved crossing facilities. Walkability improvements envisaged for the City Centre over the lifetime of the Strategy include:

- O'Connell St. Improvements;
- Re-allocation of road space to prioritise pedestrian movement;
- Key junction improvements to prioritise pedestrian connectivity and permeability;
- Matching crossing facilities with pedestrian desire lines;
- Removal of street clutter;
- Improvements to the city-wide wayfinding network;
- Enforcement of illegal parking on footpaths;
- Undertake regular Walkability Audits with a variety of stakeholder groups;
- World Class Waterfront Project including a new pedestrian/cycle bridge over the River Shannon;
- Enhanced connectivity between the City Centre and Colbert Station; and
- Adequate provision of publicly-accessible toilets, lighting and seating.

There will also be local improvements within towns throughout the LSMA. Given the high level of out-commuting experienced in the Metropolitan towns, walking should be promoted as part of linked trips with public transport. The pedestrian environment around bus stops and train stations should be improved in Cratloe, Shannon, Sixmilebridge and other metropolitan town and village centres. These will be undertaken in tandem with land use proposals that consolidate village centres, strengthen their place function and reduce the ribbon-development patterns evident in villages like Clarina and Patrickswell. LAP objectives for the pedestrian environment for Castleconnell, Askeaton, Castletroy and Patrickswell are supported by LSMATS.

8.4 Roads

LSMATS proposes significant investment in roads schemes up to 2040, which are summarised below. Further details on the individual schemes is provided in the Main Strategy Report and also in the "Transport Options and Network Development Report".

An overview of road changes is shown in Figure 8-6 below;

Figure 8-6 Final Strategy Road Changes

8.4.1 National Roads

- N21/N69 Foynes to Limerick incorporating Adare Bypass;
- N18/N19 Shannon;
- M7/N18 Junction Improvements

The N/M20 Cork to Limerick is also supported by the strategy thought not included in the modelling process as the project is still in the earlier stages of the appraisal process.

8.4.2 Regional Roads

Additional regional road network provision needs to undertake a multi-modal function, catering for public transport, walking and cycling in addition to car traffic. The regional road network provision is required to cater for the following:

- Provide access to development lands;
- Cater for walking and cycling linkage;
- Provide access to public transport routes;
- Cater for orbital public transport provision;
- Removal of strategic traffic from Limerick City Centre; and
- Removal of local traffic from strategic road routes.

To achieve this the cross section of these roads should cater equally for active modes, public transport and car traffic as follows:

- Footpath and Cycle lane provision – 33% of cross section;
- Bus lane and priority provision – 33% of cross section; and
- Road traffic lane – 33% of cross section.

As part of the strategy, a link road with bus priority has been included from Childers Road to Golf Links Road via Bloodmill Road and Groody Road.

As set out in Section 7.4 of this modelling report, the Minister for Transport has requested the NTA not to include the LNDR in LSMATS on the basis that proceeding with the scheme may undermine investment planned in active travel/public transport and could accentuate dispersed development patterns.

In addition to the new links and national road improvements described above, significant bus priority measures were included in the MWRM SATURN road model to account for the proposed BusConnects network. For the purposes of model coding, it was assumed that this would be achieved through the provision of 2-way bus lanes along the majority of routes. To ensure this could be achieved, some reductions in road capacity within the model had to be accounted for in areas where full bus priority could not be feasibly accommodated. The following traffic management measures were coded into the model where applicable:

- Reduction in the number of lanes;
- Right-turn bans; and
- Introduction of Peak hour Bus Gates into the City;

The extent of the proposal is shown in Figure 8-7.

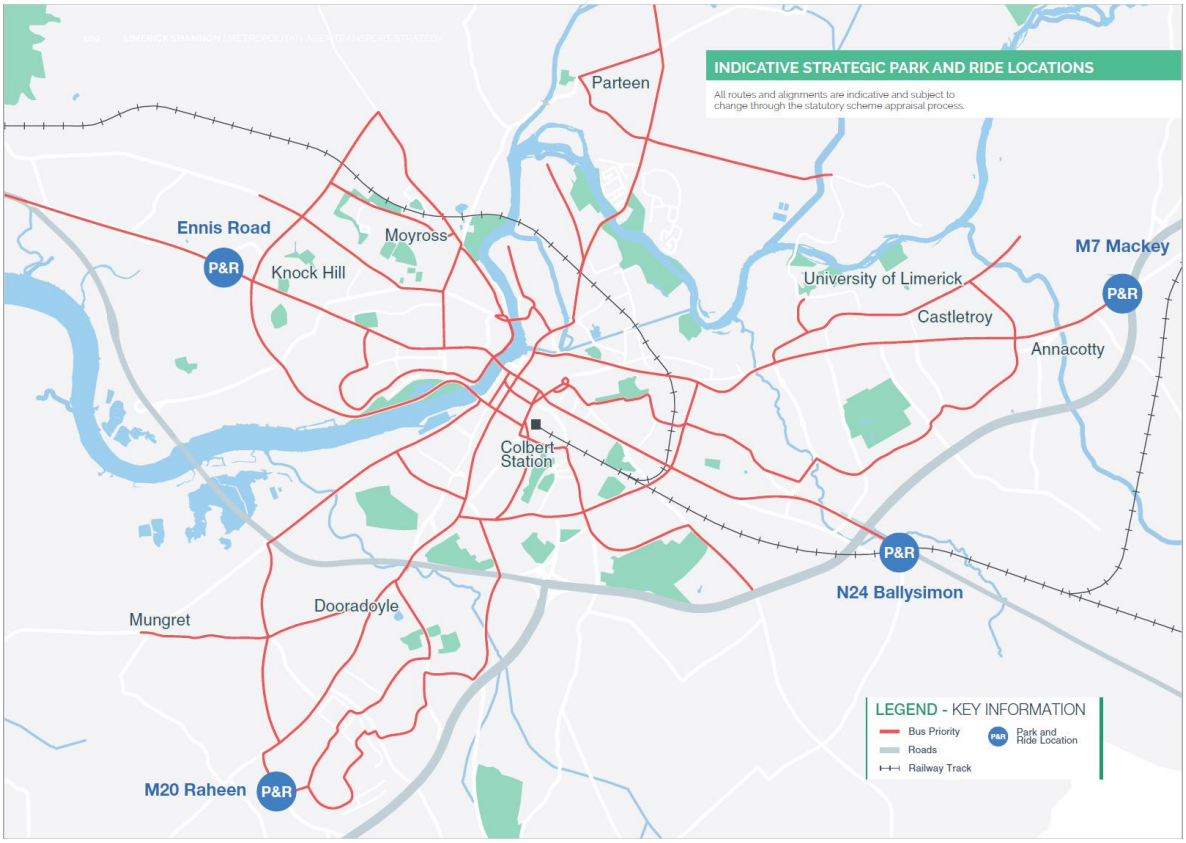


Figure 8-7: LSMATS Bus Priority

8.5 City Centre Traffic Management

There are also a number of measures proposed within the City Centre to rationalise the bus network and provide priority. These measures include removal of one-way bus loops where possible and providing a significant level of bus priority. This priority will be required to ensure the

competitiveness of public transport as an attractive alternative to car. The proposed measures are shown in Figure 8-8.

As illustrated the main change is along O'Connell Street, and part of Patrick's Street, which will become Public Transport only (in addition to walking and cycling) and two-way. As a result, Henry Street becomes two-way for general traffic to accommodate traffic displaced from O'Connell Street. There are a number of changes to the traffic circulation North & South to accommodate these measures. In addition, Sarsfield Bridge is also proposed as a PT only link.

In addition, LSMATS proposes prioritisation of signals within the city centre to favour active mode users.

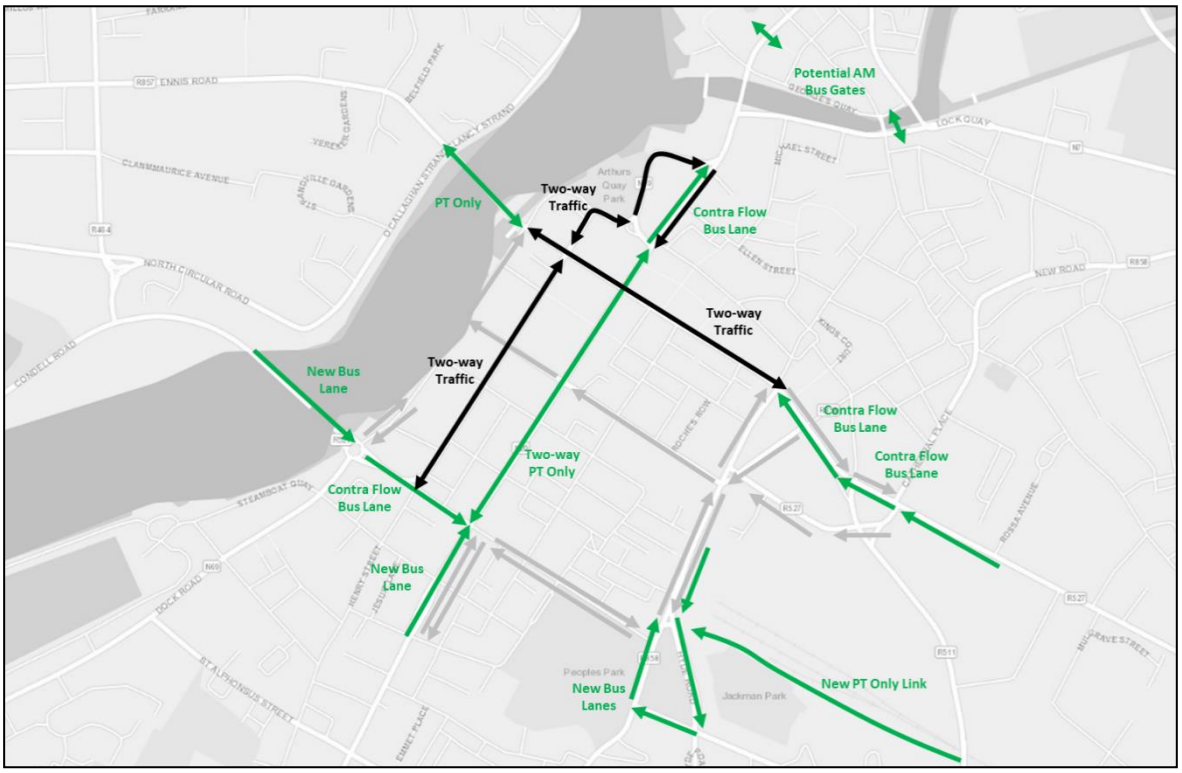


Figure 8-8: Limerick City Centre Priority Measures

8.5.1 HGV Traffic Restrictions

The HGV restrictions are proposed similar to those already implemented in both Dublin & Waterford. HGVs play an integral role in moving goods throughout the LSMA and nationwide. HGV movement can have significant impacts on traffic operations, noise, air pollution and the safety of other road users, particularly within urban environments.

The central area of Limerick City is unsuitable for heavy goods traffic and should be restricted to only those vehicles of a suitable size with an origin or destination in the centre. LSMATS proposes further consideration of restriction of the movement of HGV within the area bounded by the N18, M7 South Ring Road and proposed LNDR.

According to the Limerick HGV Study 2015, banning HGVs from the City Centre from 07:00 to 19:00 would contribute to the creation of a safe and friendly environment for cyclists and pedestrians through the recovery of street space and the reduction of conflicts between modes. The implementation of designated 'lorry routes' on National roads at designated times of the day will also help reduce through traffic and mitigate delays and conflict with other modes.

In addition, regulating delivery times by limiting them to off-peak periods would contribute to off-setting local traffic congestion. This could also bring additional benefits to freight operators in terms of reductions on travel times and operating costs.

8.5.2 Origin Parking Restrictions

The reduction in Car Ownership has been applied at a Small Areas level broadly based on the corridor/sector structure used in the demand analysis and options assessment. Some larger corridors which contained both urban and more rural locations were split. The areas used to adjust the car ownership are shown below.

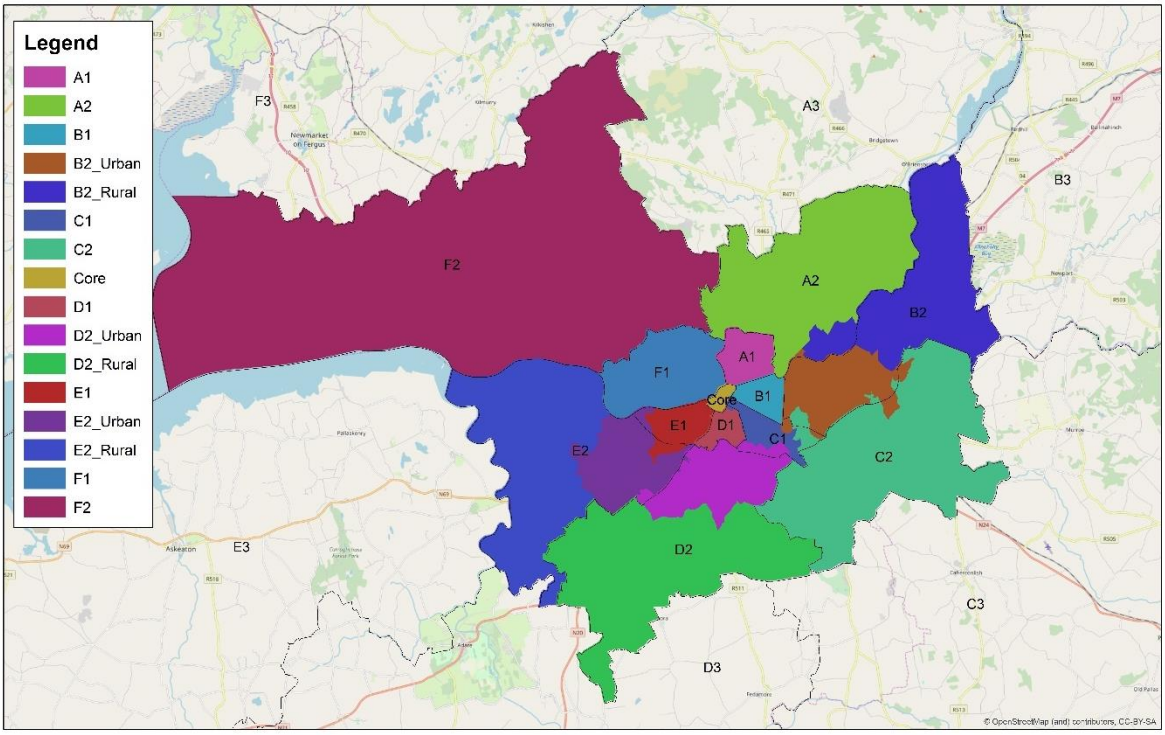


Figure 8-9: Sectors used for Car Ownership Adjustments

The reduction in car ownership (CO) was applied as a factor to all modelled zones within each area to reduce the overall proportion of car available trips. However, each factor was derived based on the certain assumptions around parking constraints on new residential development. The broad assumptions are listed below.

- City Core: Existing households CO reduced by 33% intended as proxy for removal of on-street parking, no cars assumed in any new households;
- A1, B1, C1, D1, E1 & F1: Existing households retain current levels of CO. CO of new households is assumed to be 33% less than existing within each area.
- Urban areas of B2, E2 and D2: CO of existing household is retained. New households are capped at 1 car per household.
- South Clare SDZ: Existing CO remains the same, new households capped at 0.75 cars per household.
- CO of the remaining LSMA continues at the existing proportion.

This results in an overall drop in the number of cars per household. However, it should be noted that the number of cars overall still grow significantly and at a higher rate than population as a reduction in the average household size is assumed between 2016 & 2040.

The number of cars per household in the Do-Minimum and Do-Strategy scenario along with reduction as a percentage for each area is outlined in Figure 8-3.

Table 8-3 Cars per Household by Area and reduction applied.

	2040 Cars Per Household		
Area	DM	Strategy	Reduction
Core	0.47	0.18	-61.3%
A1	1.15	0.98	-14.7%
B1	0.91	0.78	-14.0%
D1	0.73	0.61	-16.0%
C1	0.95	0.80	-15.8%
E1	1.26	0.99	-21.3%
F1	1.14	0.95	-16.4%
A2	1.77	1.77	0.0%
B2 Urban	1.53	1.28	-16.5%
B2 Rural	1.56	1.56	0.0%
C2	1.83	1.83	0.0%
D2 Urban	1.45	1.25	-13.9%
D2 Rural	1.70	1.70	0.0%
E2 Urban	1.51	1.22	-19.1%
E2 Rural	1.84	1.84	0.0%
F2	1.38	1.38	0.0%
South Clare SDZ	1.20	0.79	-33.9%
LSMA	**1.25**	**1.09**	**-12.7%**

8.5.3 Free Work Place Parking Reduction

Workplace parking will be reduced down to 50% of 2040 Demand or 50% of 2016 supply, whichever is the greater decrease. Within the city centre this will be a reduction in the supply of parking spaces, while outside the city centre it will shift employment and education trips into paid parking.

These reductions will apply to the zones shown in Figure 8-10 below.

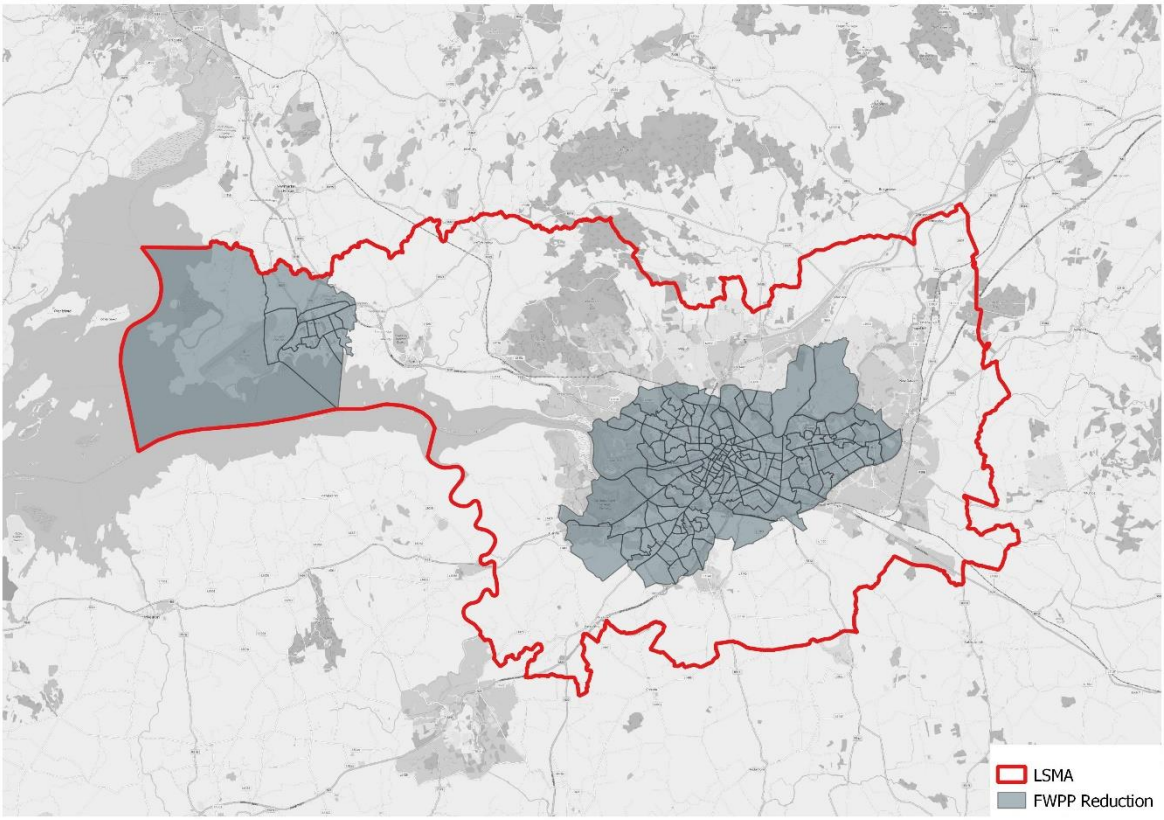


Figure 8-10 Free Work Place parking reduction areas

8.5.4 Parking Charges

Two flat rate parking charges are introduced covering much of the urban area of the LSMA. These two parking charges are split into two bands: €3 per hour and €2 per hour charges.

The higher band will be applied to the city centre area where other traffic management measures are in place to favour public transport and active modes. The lower band will apply to the wider Urban areas served by the improved public transport and active networks.

These two areas are shown in Figure 8-11 below;

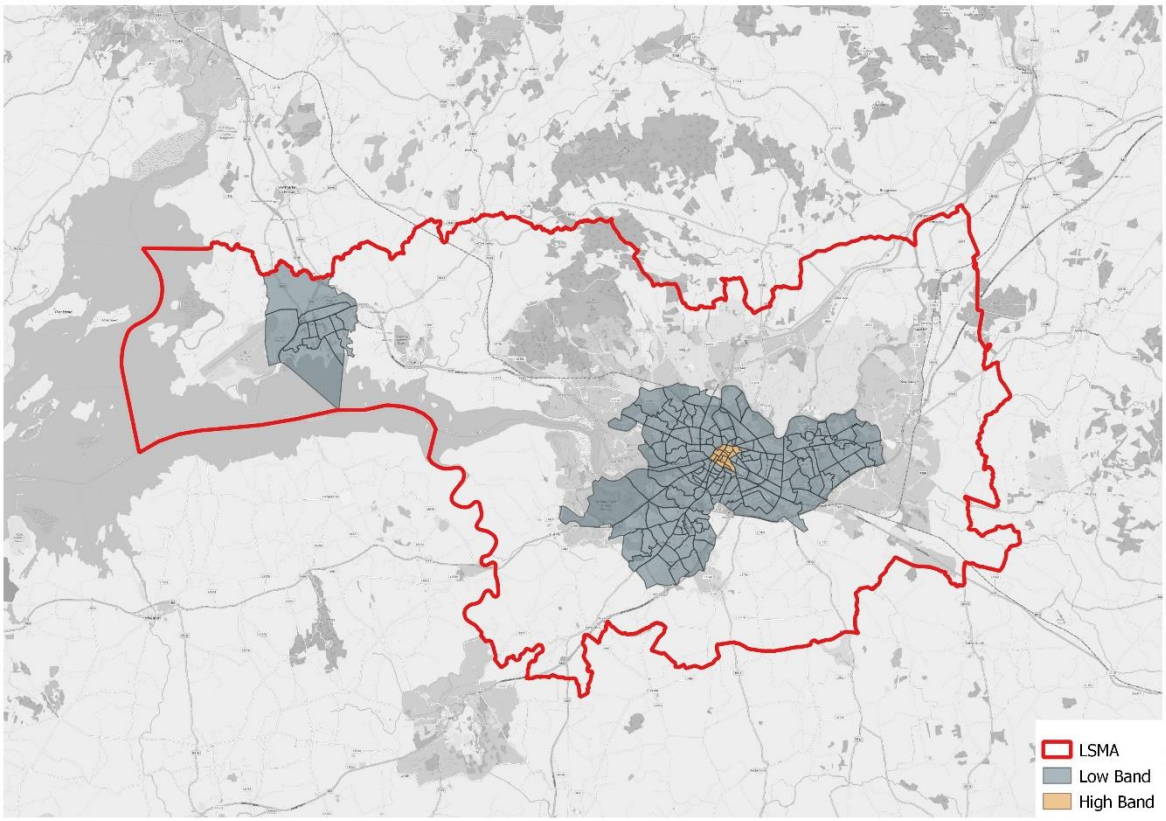


Figure 8-11 Parking Charge Areas

8.6 Other Supporting Measures

There are a number of other measures proposed as part of the draft strategy which the impact of cannot be captured in the modelling and appraisal process. These measures will have an additional impact on the travel demand and patterns with the LSMA and include the following:

- Mobility Management Measures;
- Wayfinding;
- Intelligent Traffic Systems;
- Cycle & Car Share Schemes;
- Improved Public Transport Stops;
- Integrated/Smart Ticketing;
- Real Time Passenger Information;
- Public Realm Enhancements.

9 Final LSMA Transport Strategy Appraisal

9.1 Introduction

This section of the report outlines the appraisal methodology and appraisal criteria that has been used to determine the performance of the LSMATS strategy measures. The results of the evaluation are presented for the Base Scenario, the Do-Minimum Scenario & Do-Strategy for each criterion identified.

9.2 Strategy Appraisal Methodology

9.2.1 Methodology

The procedure for the assessment of LSMATS is guided by the 'Common Appraisal Framework (CAF) for Transport Projects and Programmes, March 2016' published by the Department of Transport, Tourism and Sport (DTTAS), which requires schemes to be appraised under the objective headings below:

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

It should be noted that a more detailed appraisal of the individual public transport schemes identified within LSMATS will be required at a later stage in the planning process for each scheme. The LSMATS has been assessed under the 6 CAF criteria with the Key Performance Indicators (KPIs) and method of measurement for each KPI displayed in Table 9-1.

Table 9-1: LSMATS CAF Criteria and KPIs

CAF Criteria	KPI	Measure
Safety	Safety improvements as a result of the Strategy implementation	Monetised benefits as output from COBALT software within the NTA Safety Appraisal Tool
Physical Activity (Health)	Health Benefits	Monetised Health benefits calculated using the NTA Health Appraisal Tool
Environment	Change in Transport Emissions related to the Strategy implementation	Transport emissions from the ENEVAL Appraisal Tool
Integration	Public Transport Integration	Number of public transport interchange trips
	Transport Policy Integration	Average Mode Shift to Public Transport
Accessibility and Social Inclusion	Accessibility to Key Attractors	Trips to Key Attractors (schools, hospitals etc.) by Public Transport
	Accessibility by PT from Socially Deprived Areas	Trips by Public Transport from Socially Deprived Areas
Economy	Transport User Benefits	TUBA Output
	Cost	Scheme Cost Estimates

In addition to the CAF assessment the transport modelling results have been analysed further to examine the difference in performance compared to the Do-Minimum scenario. This additional analysis is undertaken on selective model outputs and used to better understand the impact of the LSMATS measures. The following additional indicators were assessed using MWRM outputs:

- Demand and Mode Share Analysis;
- Public Transport Network Operations;
- Active Mode Network Operations; and
- Road Network Operations.

9.3 Safety

9.3.1 Road Safety

The Safety Appraisal Module within the RMS Appraisal toolkit was used to assess the Safety benefits associated with the LSMATS measures. The Safety Appraisal Module process is based on a bespoke version of the COBALT spreadsheet. The bespoke version of the COBALT Ireland spreadsheet has been developed by Transport Infrastructure Ireland (TII) for use with the regional transport models. COBALT (Cost and Benefit to Accidents – Light Touch) is a computer program developed by the UK Department of Transport (DfT) to undertake the analysis of the impact on accidents as part of economic appraisal for a road scheme.

Table 9-2 below displays the Safety Appraisal results comparing the Do-Minimum and the Do-Strategy scenarios.

Table 9-2: LSMATS Safety Appraisal Results

Item	Do-Minimum (DM)	Do-Strategy	Savings (DS vs DM)
Economic Summary	€744,293,600	€711,538,100	€32,755,500
Total Accidents	23,751.8	22,537.1	1,214.7
Fatal Injuries (Person)	385.5	372.4	13.1
Serious Injuries (Person)	1,376.6	1,313.3	66.3
Slight Injuries (Person)	33,083.1	31,422.1	1,661.0

In the table above accidents refer to the incident, while the total rate of injury and fatalities are higher than total accidents accounting for involvement of multiple cars and car occupancy.

As shown in the table above, the LSMATS strategy measures result in significant savings (approx. €32.8m) in collision costs. There are also significant reductions in the levels of casualties on the road network, with the reductions of approximately 13 fatal, 66 serious and 1,660 slight casualties.

It should be noted that these savings are greater than previously reported for the draft strategy in September 2020. This is partially related to the change in model version, the V3 model used for the appraisal of the strategy covers a significantly larger area than the previous model. Though the strategy concentrates on the metropolitan area the benefits of it are realised across the model.

9.4 Physical Activity (Health Appraisal)

An increase in walking and cycling can bring about significant benefits for our health and environment. The consideration of health benefits arising from transport is an integral part of the appraisal process adopted to inform transport policy and investment decisions.

Transport related changes to the following factors can have health impacts and have been assessed for LSMATS:

- Physical activity – increased levels of activity can positively impact on reducing the risk of death and occurrence diseases such as heart, diabetes and cancer related illnesses; and
- Absenteeism – this is expected to decrease when more people walk or cycle. Moderate physical activity can lead to a reduction in the number of sick days and a healthier workforce can, in turn, provide benefit to employers and overall economy;

9.4.1 Physical Activity Benefits

The health benefits associated with physical activity are derived from a reduction in the relative risk of premature death - the 'Relative Risk of Mortality' is directly linked to the time spent walking and cycling based on the average length, speed and frequency of new trips encouraged by active travel modes. This indicator provides a calculation of the lives saved due to the health benefits of cycling

and walking. The benefits include walking trips associated with Public Transport (e.g. walking to bus stop).

These benefits also include absenteeism benefits which are derived from the assumption that less time will be lost in sick days because of the resultant increase in health associated with physical activity.

Table 9-3 shows the monetised benefits of the change in walking and cycling based on the relative difference between the Do-Minimum and Do-Strategy scenario. The results of the assessment show moderate positive benefits in the Do Strategy scenario with more significant benefits in the Do-Strategy Plus scenario.

This is as a result of the more significant shift in sustainable mode share as a resultant of the decrease in car mode share. Whilst there is mode shift in the Do-Strategy scenario it is more modest and results in less physical activity.

Table 9-3: LSMATS Monetised Physical Activity Health Benefits

Net Impact per annum (€)		Do Strategy
Physical Activity	Cyclists	€4,983,996
	Walkers	€3,514,461
Absenteeism		€ 3,625,625
Total		**€ 12,124,082**

It should be noted that the attractiveness of walking and cycling is not fully represented within the MWRM and mode choice is based predominantly on perceived cost of travel. In reality, many people may choose to walk or cycle for the health benefits regardless of perceived journey costs particularly given the proposed improvements in the walking and cycling network.

9.5 Environment

9.5.1 Emissions

In both the Do-Minimum and Strategy Scenarios it has been assumed that the composition of the fleet will change in line with government policy on Climate Action, with the vast majority of the car fleet assumed to be electric by 2040, given the ban of the sale of diesel and petrol by 2030. Table 9-4 shows the estimated fleet composition for cars, LGV's and HGV's by 2040. As a result, the change in carbon emissions from 2016-2040 is primarily as a result of the widespread adoption of electric vehicles (EV) with an 84% reduction expected in private car CO_2 emissions. The CO_2 emissions reduction for car and bus combined is 85%. The change in EV uptake is assumed to happen with or without the strategy in place. However, the measures within the strategy relating to EV and EV charging will likely have an impact on the success of the adoption of EV within LSMA and the wider region.

Table 9-4 Fleet Profile for 2040

	Petrol	Diesel	Hybrid	Zero
Car	6.7%	2.2%	9.1%	81.9%
LGV	0.0%	33.6%	0.0%	66.4%
HGV	0.0%	71.0%	0.0%	29.0%

The percentage change in transport emissions arising from the transport strategy has been estimated from modelling outputs using the Environmental module of the RMS appraisal toolkit. The toolkit estimates emission levels for the following emission categories:

- Nitrogen Oxides;
- Particulate Emissions;
- Carbon Monoxide
- Carbon Dioxide;
- Benzene;
- Methane; and
- Butadiene.

Table 9-5 below provides a summary of the annual emissions levels for the 2016 Base and Do-Strategy 2040 in tons. With LSMATS measures in place in 2040 there is a 82% and 13% reduction in key air quality emissions of Nitrogen Oxides (NO_x) and Particulate Matter (PM) respectively. The reduction of PM is less than that of NO_x due to tyre and brake abrasion which remains a source of pollution with zero emission vehicles.

Table 9-5 below show that a 53% reduction in CO_2, and 76% reduction in Methane can be achieved between 2016 and 2040 with the strategy in place.

Table 9-5: LSMATS Environmental Air Quality Emissions Summary

Emissions (Tons)	Nitrogen Oxides	Particulate Matter	Carbon Monoxide	Benzene	Butadiene 1,3
2016 Base	695.86	50.83	544.99	0.69	0.38
2040 Do-Strategy	125.16	44.24	128.92	0.06	0.07
% Difference	-82%	-13%	-76%	-91%	-81%

Table 9-6: LSMATS Environmental Green House Gas Emissions Summary

Emissions (Tons)	Carbon Dioxide	Methane
2016 Base	250,431.31	3.17
2040 Do-Strategy	116,490.32	0.76
% Difference	-53%	-76%

9.6 Accessibility and Social Inclusion

The MWRM model has been used to assess the Accessibility and Social Inclusion benefits associated with the implementation of LSMATS.

Transport investment, by its nature, has a particularly strong role to play in respect of improving accessibility for people living in rural areas with poor access, people who suffer from mobility and

sensory deprivation, connecting young people, particularly those who live in disadvantaged areas, to services, education and work opportunities.

To quantify this, public transport accessibility changes have been extracted from the MWRM for the Do-Minimum and Do-Strategy scenarios and are discussed further below.

9.6.1 Accessibility by Public Transport to Key Attractors

The change in public transport mode share to key trip attractors across the LSMA, has been used to assess accessibility. A summary of the AM Trips to Key Attractors for the Do-Minimum and Do-Strategy by public transport is presented in Table 9-7 below.

Table 9-7 PT Demand to Key Attractors

Key Attractor	Do-Minimum	Do-Strategy
Raheen Business Park	2.4%	4.7%
University Hospital	4.5%	12.1%
City Centre	6.6%	13.4%
University	2.6%	5.8%
Crescent Shopping Centre	2.4%	4.5%
National Technology Park	5.9%	9.1%
Westpark, Shannon Free zone	2.7%	5.7%
Limerick Institute of Technology	1.1%	3.4%

The results of the assessment show substantial improvements in public transport mode share for trips to the key attractors outlined above. Overall, the morning peak public transport mode share increases from 5.8% to 12.6% across the metropolitan area in the Do-Strategy Scenario.

9.6.2 Public Transport Accessibility to Socially Deprived Areas

The social inclusiveness of the transport networks provided in each scenario has been measured by assessing the change in public transport mode share for trips from socially deprived areas across the Limerick & Shannon Metropolitan Area. Areas across the LSMA have been classified based on the POBAL Deprivation Index[4]. The index provides a method of measuring the relative affluence or disadvantage of a particular geographical area using data compiled from various censuses.

Table 9-8 below represents the Average AM PT mode shift between the Do-Minimum and Do-Strategy scenarios disaggregated by social category areas across the LSMA.

[4] Haase, T. and Pratschke, J. (2017) The 2016 Pobal HP Deprivation Index, provide by the NTA under their agreement.

Table 9-8 Average AM PT mode shift between the Do-Minimum and Do-Strategy by area type

Min	Max	Description	Counts	Change in PT Mode Share DS - DM
-30	-20	very disadvantaged	49	9.7%
-20	-10	disadvantaged	59	5.9%
-10	0	marginally below average	140	7.4%
0	10	marginally above average	184	6.8%
10	20	affluent	74	7.8%
20	30	very affluent	14	8.1%
-30	30	**LSMA Average**	**-**	**6.9%**

The results of the assessment show that the overall AM PT mode share changes on average by 6.9% in the LSMA Do-Strategy compared to the Do Minimum. The highest PT mode shift is in areas considered very disadvantaged with a 9.7% increase in mode share.

9.7 Integration

LSMATS aims to support integration between Sustainable Transport and Land Use. In order to assess the integration performance of LSMATS, the percentage change in the modelled sustainable mode share was calculated for each scenario to assess the compatibility with Government transport policies. In addition, the level of interchange between public transport modes was measured for the Do-Minimum and Do-Strategy scenarios to assess how well the LSMATS proposals integrate with one another.

9.7.1 Policy Integration

The percentage change in the modelled sustainable mode share was calculated for each scenario to assess the compatibility with Government transport policy, which aims to prioritise sustainable modes.

Table 9-9 and Table 9-10 below shows the public transport mode share for the Do-Minimum and Do-Strategy scenarios for both the AM peak hour and over a full day for the LSMA. The results show substantial improvement in PT mode share between the two scenarios.

Table 9-9 AM PT mode shift between the Do-Minimum and Do-Strategy- Metropolitan Area

	Do-Minimum	Do-Strategy
AM PT Mode Share	5.8%	12.6%
24hr PT Mode Share	4.5%	10.1%

The PT mode shares for Limerick City and Suburbs are also shown below in Table 9-9 and Table 9-10 and show a slightly greater increase in PT demand proportionally across the full day.

Table 9-10 Average AM PT mode shift between the Do-Minimum and Do-Strategy- City & Suburbs

	Do-Minimum	Do-Strategy
AM PT Mode Share	4.7%	12.3%
24hr PT Mode Share	4.3%	10.3%

9.8 Economy

This section sets out an assessment of estimated transport user benefits for the LSMA Transport Strategy scenario. This provides a high-level indication of whether the proposed investment required for the Strategy is worthwhile. This assessment has taken account of relevant guidance of the Department of Public Expenditure and Reform and the Department for Transport, Tourism and Sport (DTTAS).

The purpose of this assessment is to provide 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. It is undertaken at a level of detail that is appropriate for this stage of transport strategy development, i.e.

- Cost estimates for the proposals are developed based on cost outturns for similar projects rather than detailed design; and
- Benefits are forecast based on outputs from the transport modelling assessment of the proposals which use broad assumptions regarding scheme operation and design.

It should be noted an economic assessment of the Do-Strategy scenario has not been undertaken as there is no associated 'cost' of the proposed changes to parking policies. It is important that the economic benefits are not overestimated or reliant on enforcement of policy standards. The Do-Strategy has been solely assessed to ensure the return on infrastructural costs exceed the investment with or without supporting policy measures which may take time to implement and provide benefits.

9.8.1 Cost Estimate

An outline cost estimate of the Strategy has been prepared based on estimates of per/km costs used for the NTA Greater Dublin Area Transport Strategy, Cork Metropolitan Area Transport Strategy and other studies. The profile of expenditure is based on an estimated programme of works to deliver the Strategy by 2040 and are in line with outline implementation plan provided in the Main Report.

The outline cost estimates are high level estimates based on values from individual scheme development, broad per km rates, and other general assumptions for each strategy option. The estimates are provided for the purposes of this high-level estimate of transport user benefits only and should not be used or relied upon for any other purposes.

More detailed cost estimates will be undertaken at each scheme development stage for each individual scheme included in the Strategy, as appropriate. The estimates of scheme capital costs are presented in Table 9-11 in 2016 prices and exclusive of VAT.

Table 9-11 LSMATS Outline Scheme Cost Estimates

Scheme	Capital Expenditure (€m)
Bus Lanes & Priority	€425
New Buses	€50
New Park & Ride Sites	€7.6
Cycling Network	€68.5
Walking Network	€5.4
Newport/Mackey Roundabout Upgrade	€10
Ballysimon Interchange Improvements	€10
N19/N18 Junction Improvements	€10

Regeneration & LAP Roads	€120
Other Costs (incl. ITS)	€90
Moyross & Ballysimon Rail Stations	€37.1
Sub total	**€ 834**
Contingency & Risk @ 50%	**€ 417**
Total Cost	**€ 1,251**

In addition to the capital costs of the schemes, an allowance was made for appropriate annual operation and maintenance (O&M) costs and an allowance for fleet and infrastructure renewal requirements over the assessment period.

Estimates were developed based on comparative costs of similar schemes and previous experience. The total annual operating cost estimate and fleet renewal cost estimate over the assessment period for the entire LSMA Transport Strategy is detailed in Table 9-12 below.

Table 9-12 LSMATS Operational and Maintenance Costs

Estimate	Cost (€m)
Average Annual O&M Cost/Fleet Renewal	€8.1

9.8.2 Transport User Benefits Appraisal

The Transport User Benefits Appraisal (TUBA) (v1.9.4) program has been used to estimate transport user benefits arising from the Strategy. The assessment compares the "Do-Minimum" scenario (i.e. not to progress with the proposals) with a "Do-Something" scenario (i.e. the scheme) and estimates the benefits resulting from the scheme in terms of:

- Transport user time impacts;
- Vehicle operating cost impacts;
- Transport provider revenue impacts; and
- Impacts related to emissions (greenhouse gases).

TUBA is the 'best practice' software used in transport scheme appraisal across the UK and Ireland and was developed specifically for the purpose of cost benefit analysis and economic appraisal.

Inputs from the Transport Models

In order to calculate the changes in travel costs as a result of the implementation of the Strategy, travel demand and cost skims are extracted from the Do-Minimum and Do-Strategy transport model runs. The demand is split by purpose with common value of time and the travel costs are split into the appropriate sub-components as required in the guidance.

For the purposes of this assessment, it is assumed that all the schemes proposed as part of the Strategy start operating on a phased basis up to 2040. Full details of the phasing of transport schemes is contained in the Main Report.

Standard economic parameters

Standard transport appraisal parameters in Ireland are available from the following documents:

- Department of Public Expenditure and Reform 'Public Spending Code', 2013;
- Department of Transport 'Guidelines on a Common Appraisal Framework for Transport Projects and Programmes', 2020 Update

- NRA 2011 'Project Appraisal Guidelines', 2011 - Unit 6.11 National Parameters Values Sheet.

All general transport appraisal parameters are taken from the above documents. Updated vehicle purpose splits and vehicle occupancy rates were derived from the NTA's National Household Travel Survey (2012).

The other main input assumptions to the assessment are as follows:

- A price base year and present value year of 2016;
- A strategy opening year of 2040;
- A standard appraisal period of 30 years;
- A discount rate of 4% for the first 30 years and 3.5% thereafter as per the DPER 'Public Spending Code';
- Shadow pricing has been included in line with the DPER 'Public Spending Code', i.e. a shadow price of public funds of 130% and a shadow price of labour of 100%;
- All outputs are presented in market prices; and
- Annualisation factors have been developed from a detailed analysis of observed data and transport model outputs.

9.8.3 Cost Benefit Analysis

A simple assessment was undertaken to compare the estimated transport user benefits to the set of outline cost estimates. 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 below in Table 9-13. As shown, the Benefit Cost Ratio of the final strategy is 3.6, representing a positive return on investment.

Table 9-13 Transport Economic Efficiency (TEE) Table

	€ m
Present Value of Transport User Benefits (30 Year)	**€4,188**
Present Value of Strategy Costs (Discounted)	**€1,151**
Net Present Value	**€3,3037**
Transport User Benefit to Cost Ratio	**3.6**

It should be noted that the discount rate, value of time and shadow price of labour have all been updated since the draft strategy appraisal which has a significant impact on the monetisation of the strategy benefits.

9.9 Demand and Mode Share Analysis

9.9.1 Demand Analysis

Figure 9-1 Figure 9-2 below show the Limerick Shannon Metropolitan Area (LSMA) 24Hr and AM Demand Distribution by mode for the Base Year (2016) and the forecast (2040) Do-Minimum and Do-Strategy. The analysis shows an increase in overall trips within the LSMA from approximately 380k trips in the base year 2016 to 558k trips in 2040 – representing a 47% increase in demand.

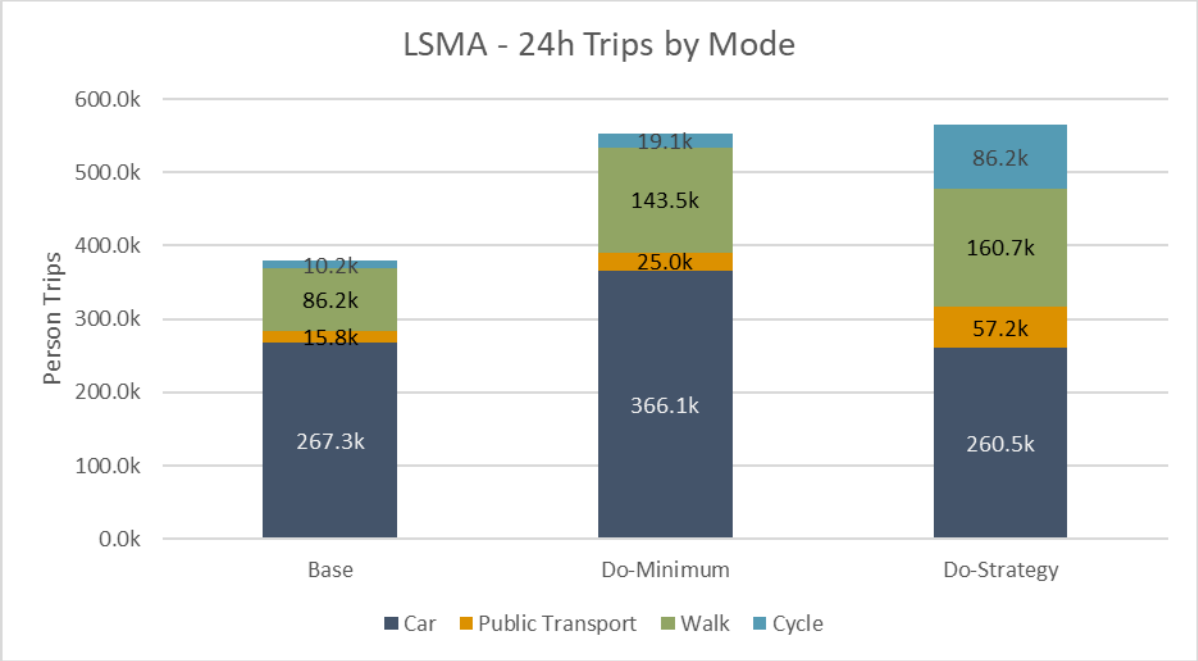


Figure 9-1: LSMA 24Hr Demand Distribution

Trips within the AM time period across the LSMA increase from approximately 96k in the base year 2011 to 148k trips in 2040 – representing a 55% increase in demand.

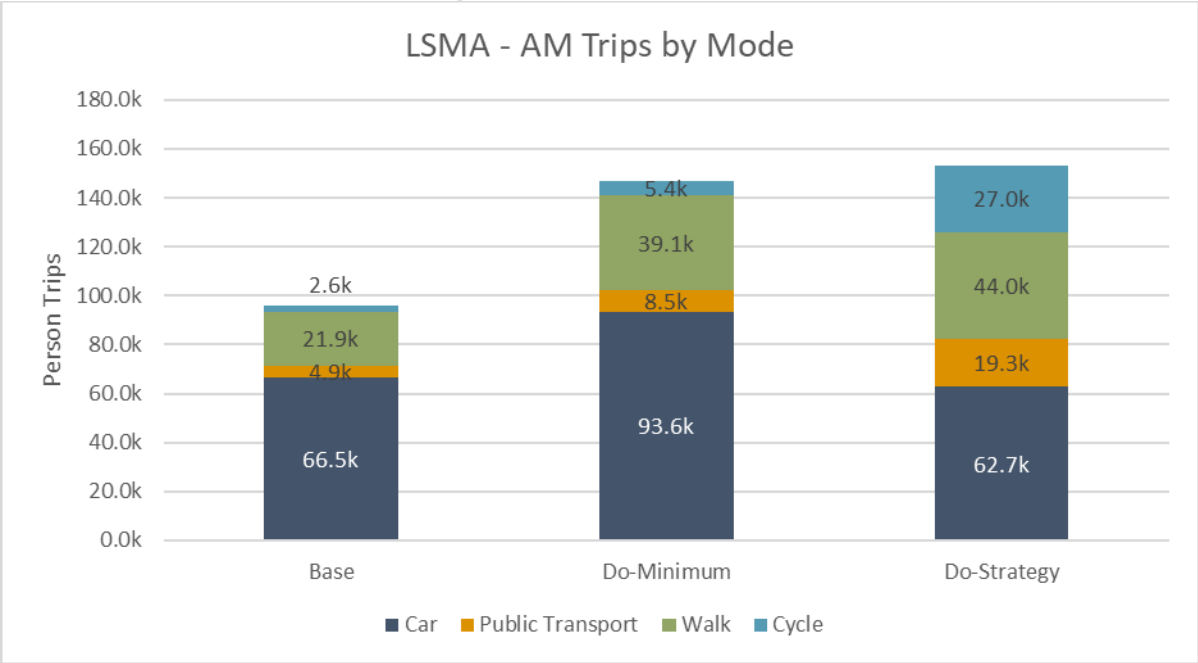


Figure 9-2: LSMA - AM Demand Distribution

While trips increase by nearly 50% by 2040 the Strategy controls the increase in Car trips in favour of sustainable modes as shown in Table 9-14, which shows the percentage increase in all day trips for each mode between 2016 and 2040 for the Do Minimum and Do Strategy scenarios. The results of the modelling assessment indicate that even with a predicted 56% growth in population and 47% growth in employment in the LSMA by 2040, the number of car trips with the full strategy in place is less than the 2016 base year.

Table 9-14: Trip Growth between 2016 and 2040 – All Day

	Car	PT	Walk	Cycle	Total
Do Minimum	37%	59%	66%	86%	46%
Do Strategy	-3%	263%	86%	743%	49%

9.9.2 Mode Share Analysis

This section provides an analysis of mode share for trips within the LSMA in 2040. The mode shares for 24-hour, each individual time period and by area for the Base, Do-Minimum and Do-Strategy scenarios are shown in Figure 9-3 to Figure to Figure 9-11.

In the Do-Strategy scenario the overall 24-hour public transport, walking and cycling mode shares increase by 5.6%, 2.6% and 11.8% respectively against the Do-Minimum. There is a similar pattern observed in each modelled time period and across each area within the LSMA.

This combined shift to sustainable modes results in a 20% drop in metropolitan area car mode share over 24-hours against the Do-Minimum, and a 24.3% drop against the base. There is a similar shift in each time period with the AM car mode share dropping from 63.8% to 41.0%. By area the additional demand management measures included in this strategy have a greater impact on 24hr car mode share against the Do Minimum in Limerick City and Suburbs (22.2% reduction) and Shannon (18.9% reduction), than the more rural areas of the LSMA (10.7%. reduction).

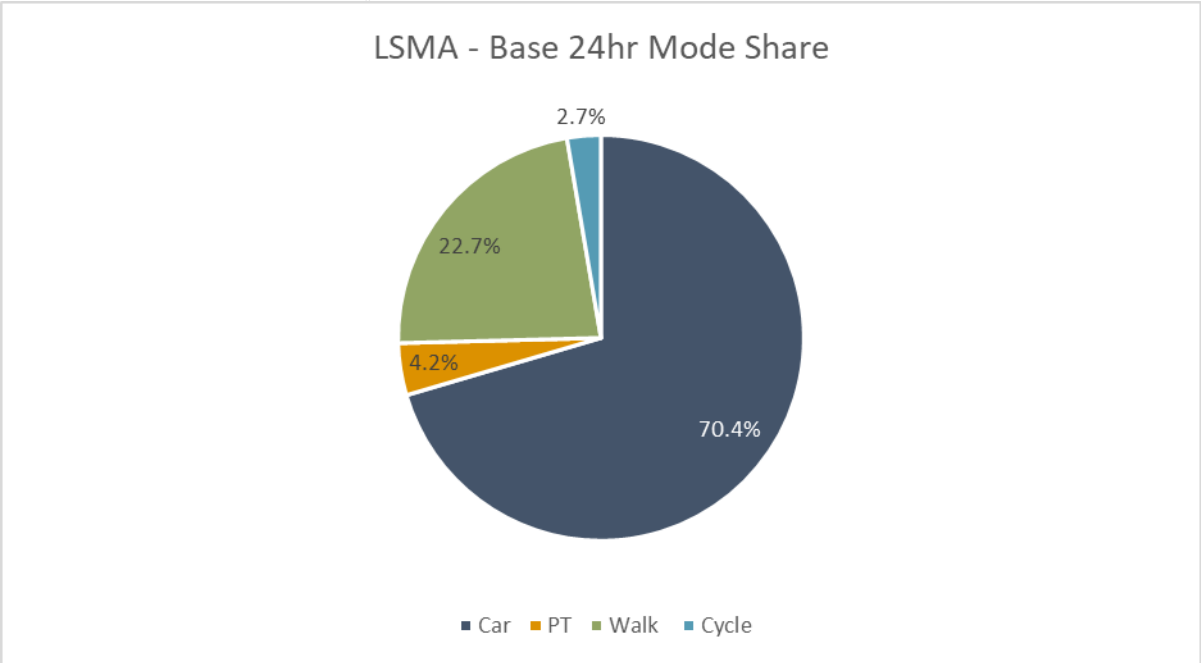


Figure 9-3: 2016 Base - 24 Hr Metropolitan Area Mode Share

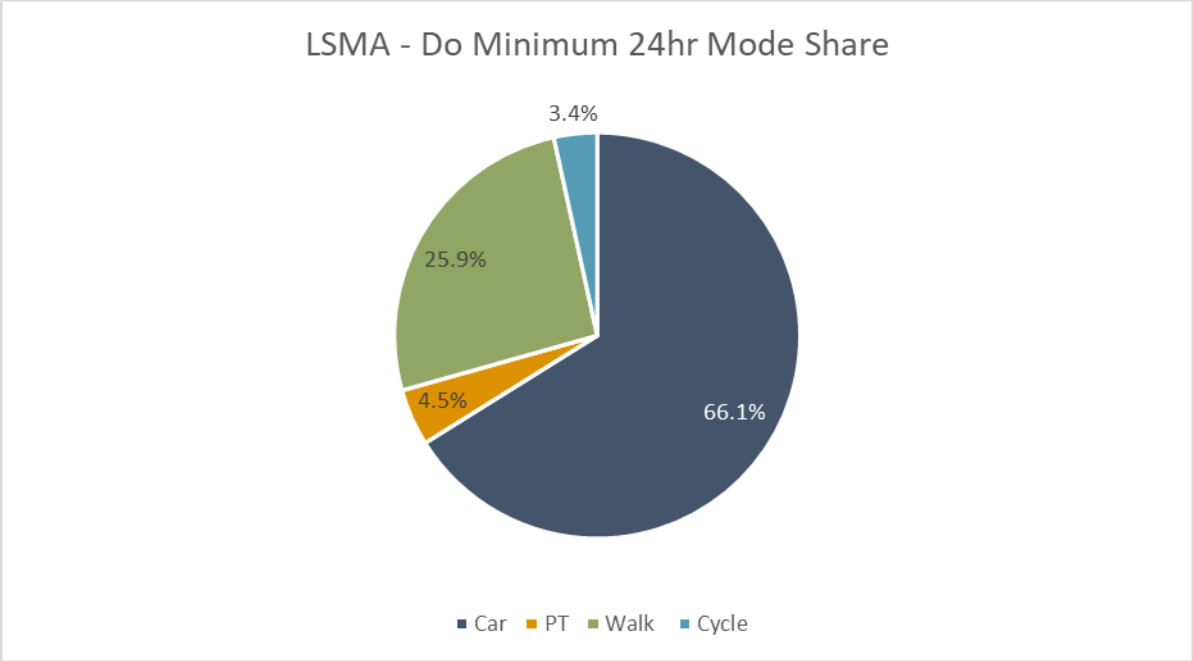


Figure 9-4: Do-Minimum - 24 Hr Metropolitan Area Mode Share

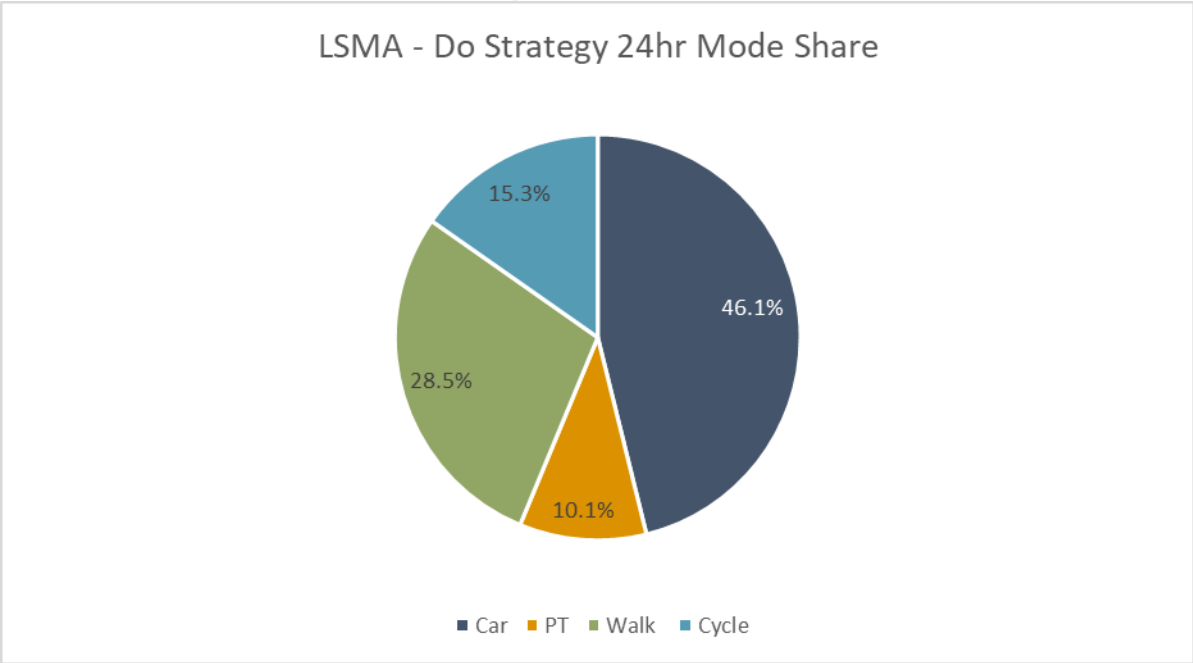


Figure 9-5: Do-Strategy - 24 Hr Metropolitan Area Mode Share

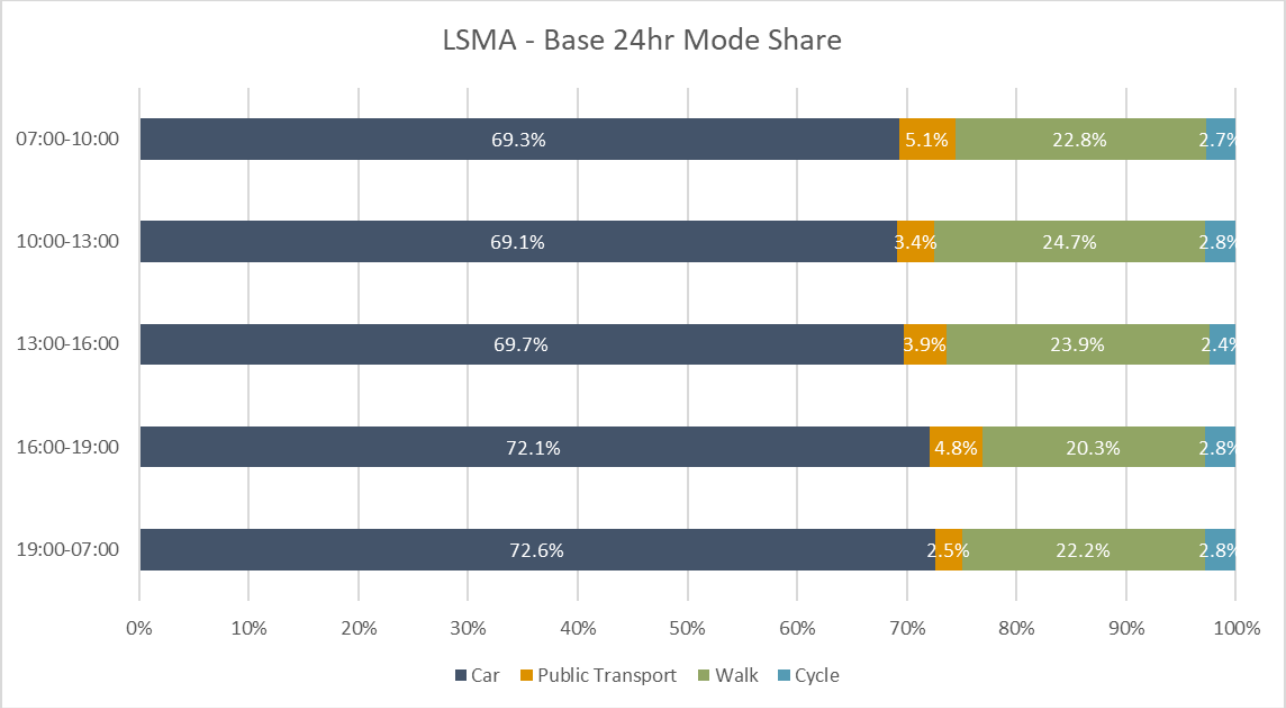


Figure 9-6: Base Metropolitan Area Mode Share by Time Period

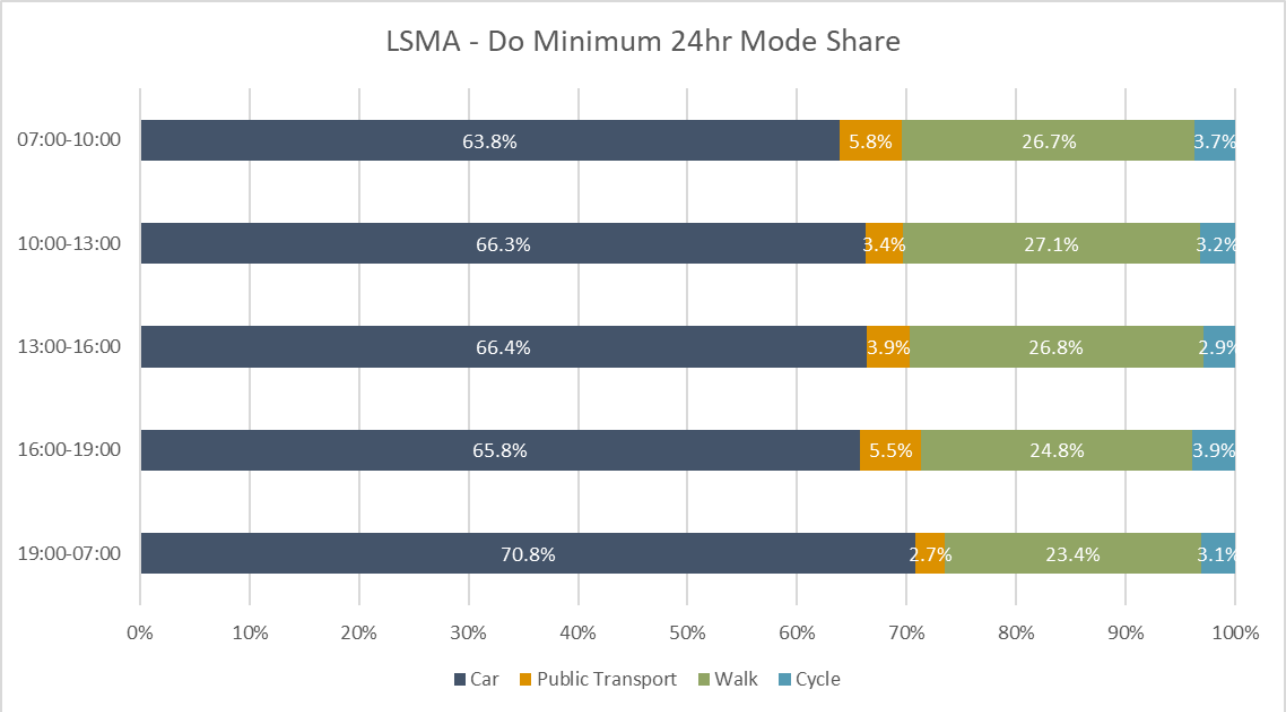


Figure 9-7: Do-Minimum Metropolitan Area Mode Share by Time Period

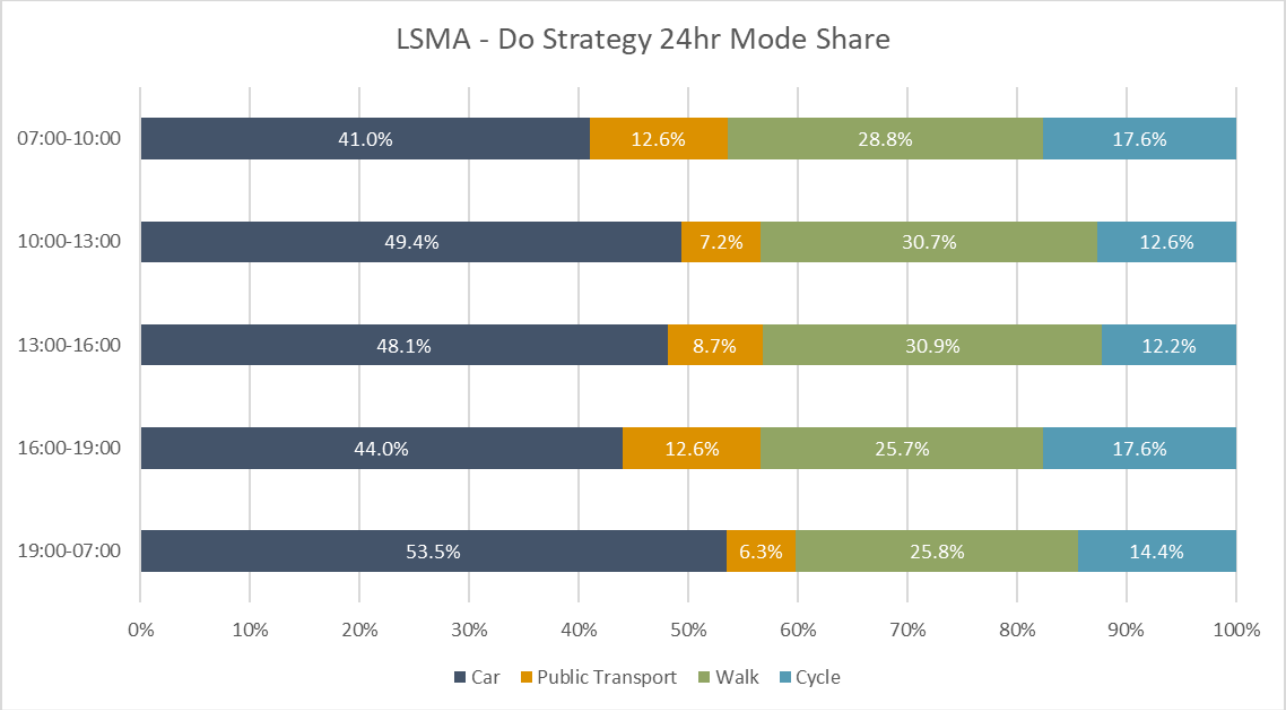


Figure 9-8: Do-Strategy Metropolitan Area Mode Share by Time Period

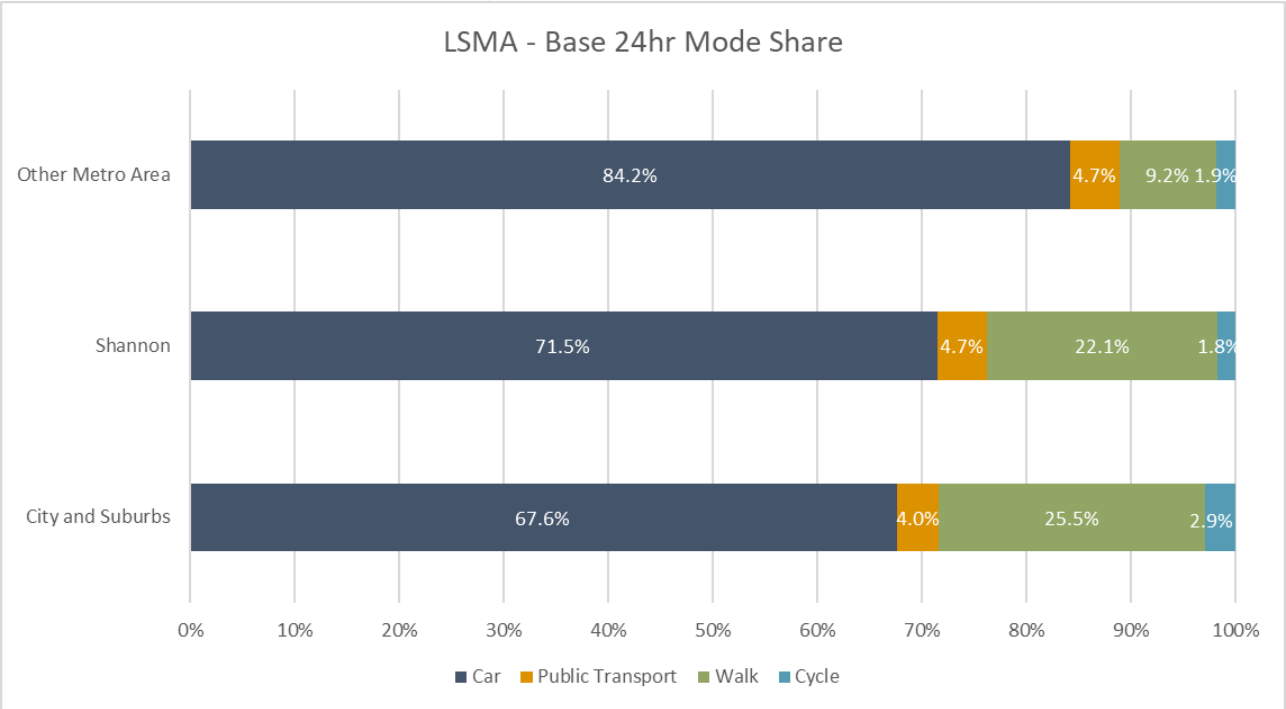


Figure 9-9: Base Metropolitan Area AM Mode Share by Area

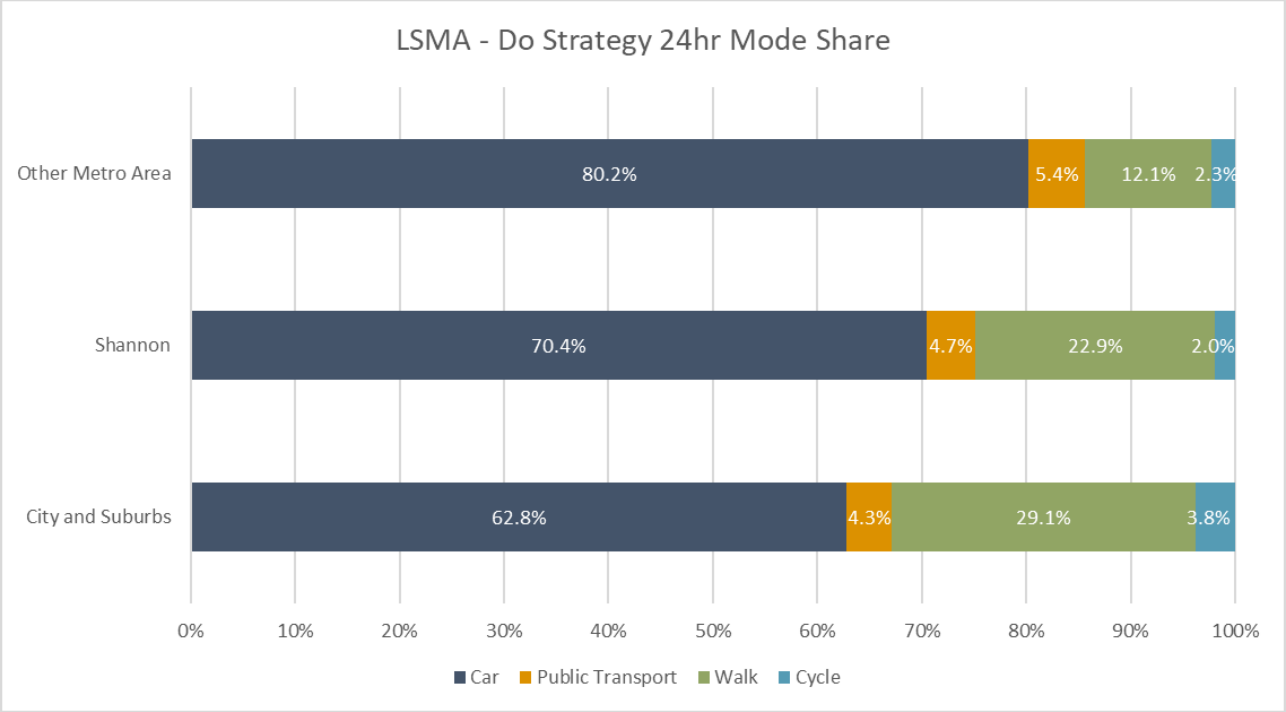


Figure 9-10: Do-Minimum Metropolitan Area AM Mode Share by Area

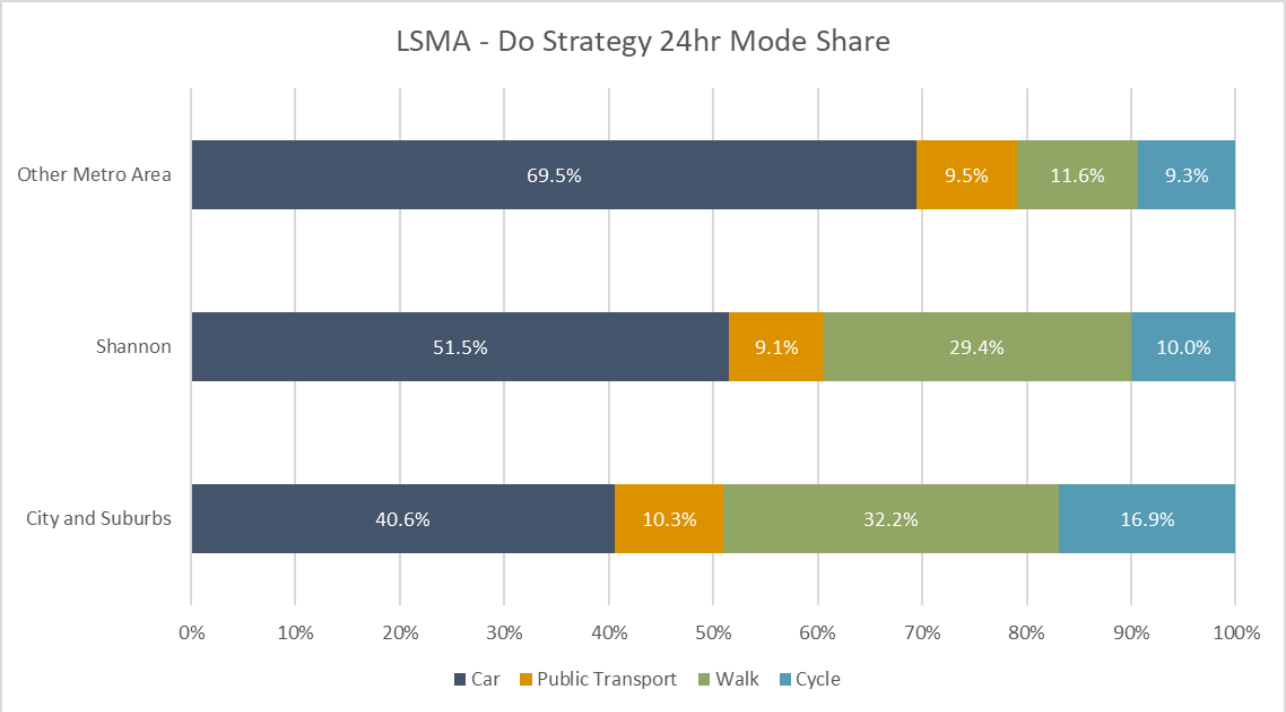


Figure 9-11: Do-Strategy Metropolitan Area AM Mode Share by Area

The mode share for each scenario by MWRM model zone is mapped in Figure 9-12 and Figure 9-13. As shown, there are significant improvements across the Metropolitan Area in the Do-Strategy Scenario relative to the Do-Minimum. This is most notable around Limerick City and Shannon.

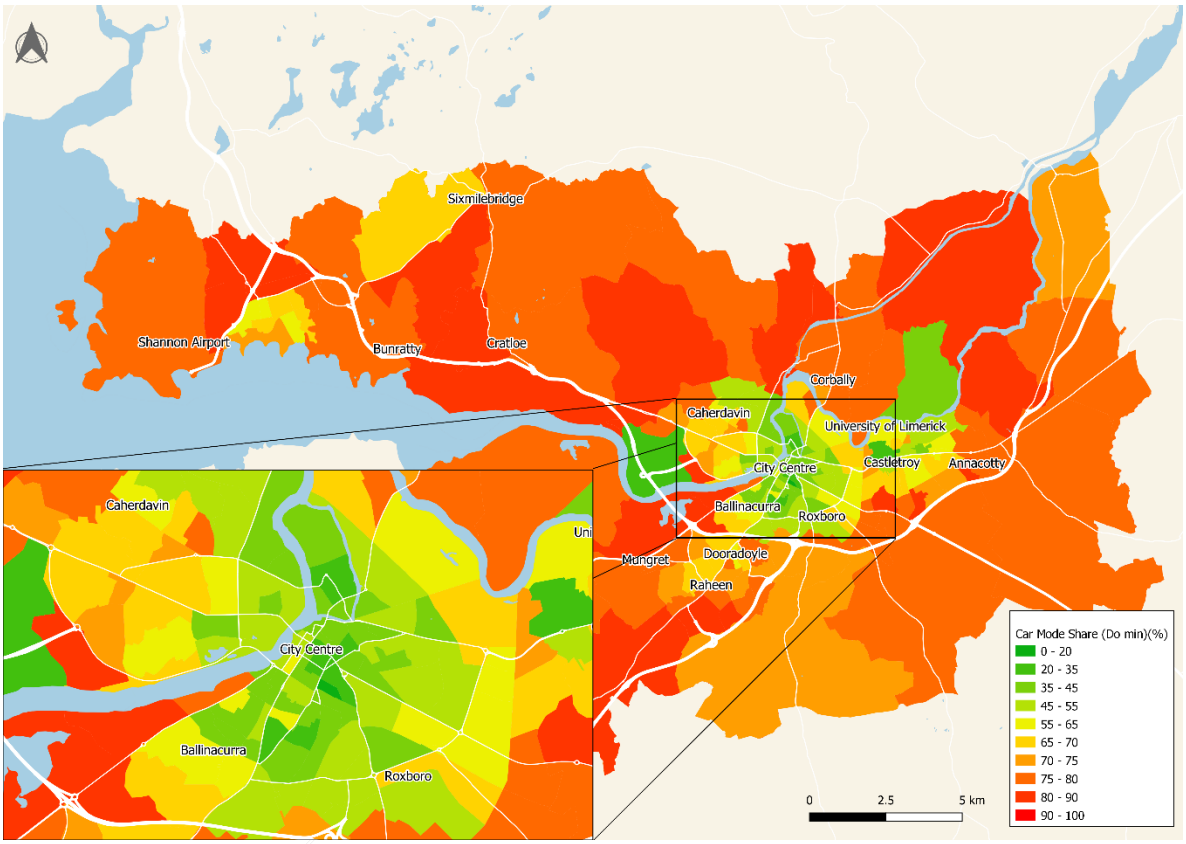


Figure 9-12: Do-Minimum Metropolitan Area AM Mode Share by MWRM Zone

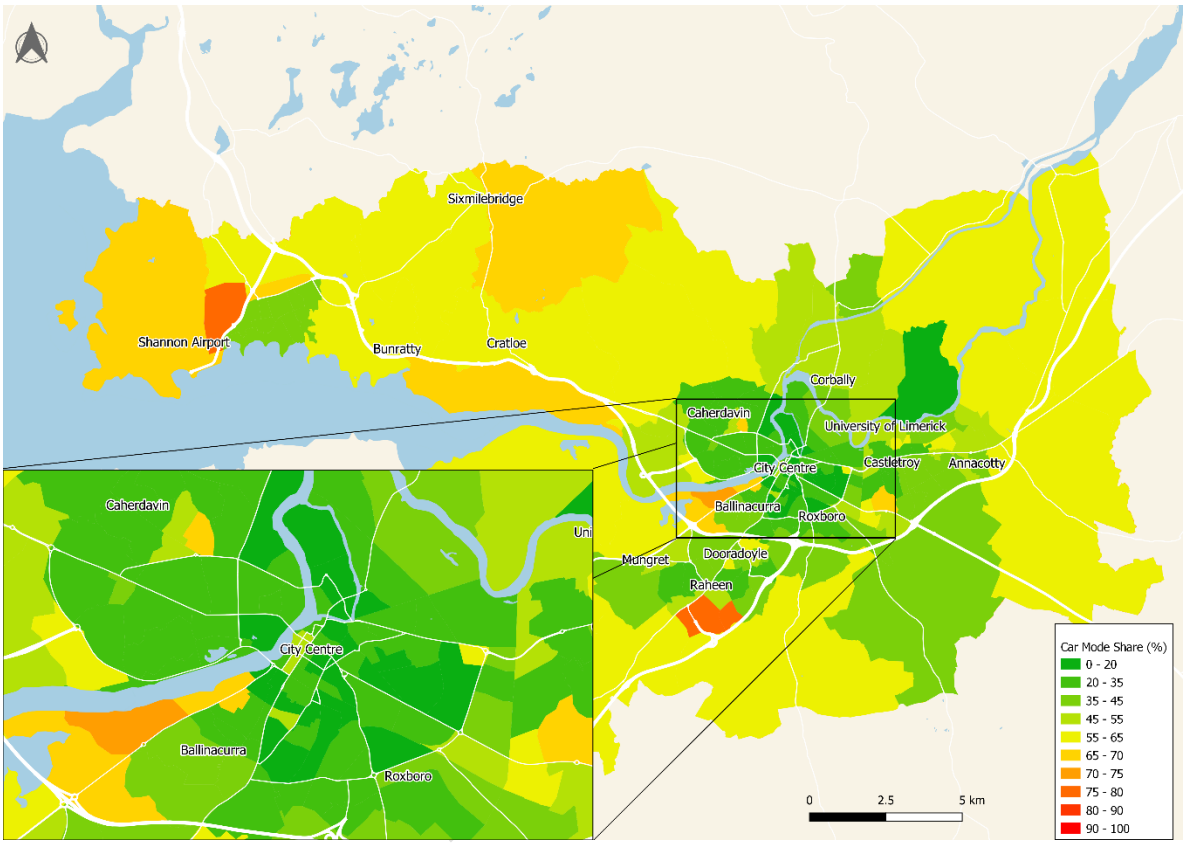


Figure 9-13: Do-Strategy Metropolitan Area AM Mode Share by MWRM Zone

9.9.3 Trip Length Distribution

Another Key Performance Indicator (KPI) used in the assessment is Trip Length Distribution (TLD). TLDs provide detail on the number of trips by journey length for each mode. They can be used to compare scenarios and indicate how trip patterns are changing. The Trip Length Distribution for the Do-Minimum and Do-Strategy for all AM peak trips is displayed in Figure 9-14 below. Overall, the distribution of trips lengths is similar with a slight increase in mid-range length trips, 8-12km, in both Do-Strategy scenarios compared to the Do-Minimum.

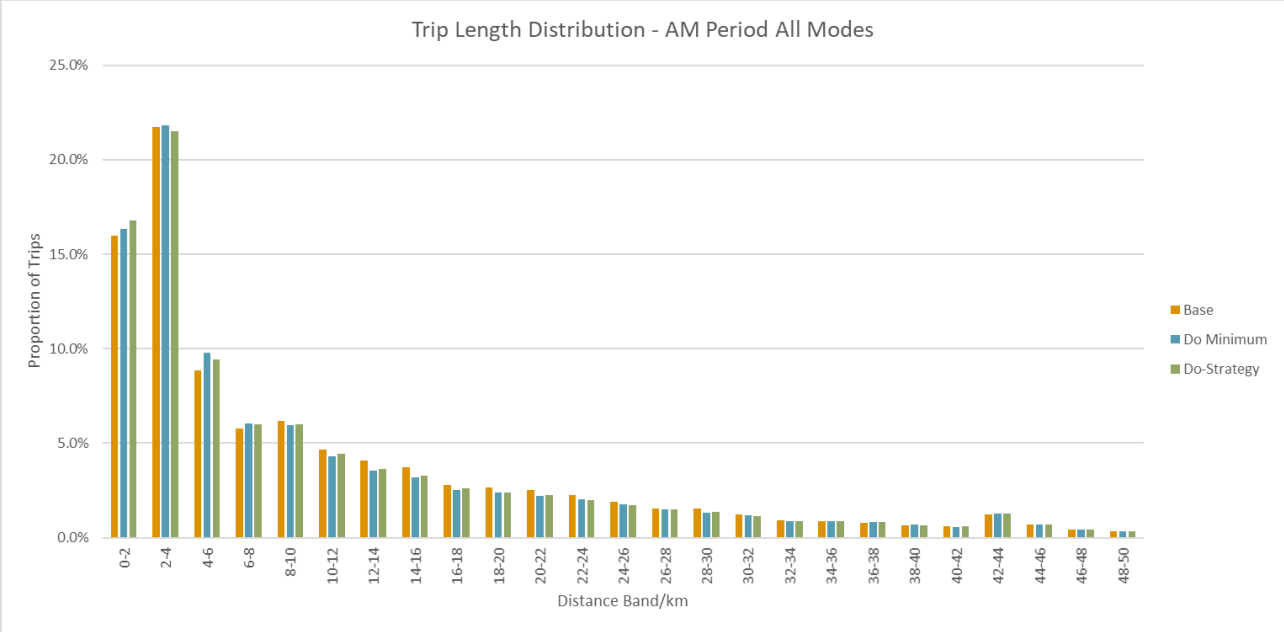


Figure 9-14: Do-Minimum, Do-Strategy Trip Length Distribution

The Trip Length Distribution for each Mode - Car, PT, Walk and Cycle are presented in Figure 9-15 to Figure 9-18 respectively below.

The results show an increase in short PT trips, under 10km, while car trips between the 2-6km reduce but retain a similar distribution at other distances. With active modes, while there is limited redistribution of walk trip distances, there is a substantial redistribution of cycle trips covering a much broader range of distances. These results suggest that the strategy is having a positive impact on providing PT for short trips and increasing range coverage of cycle trips.

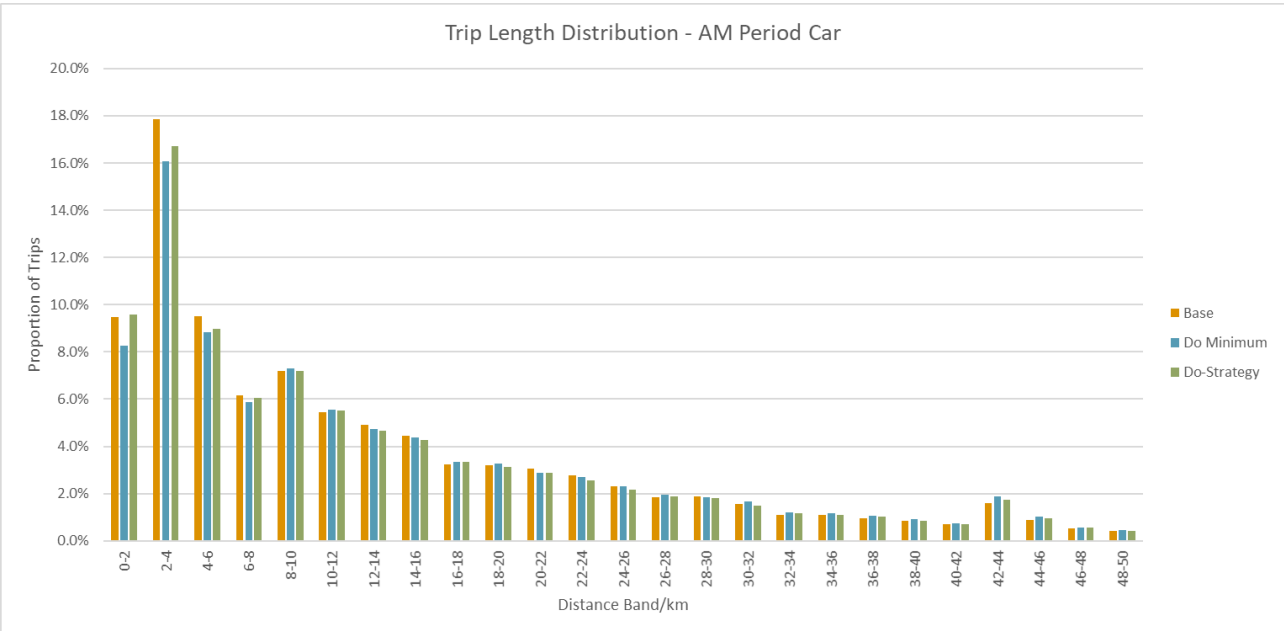


Figure 9-15: Road Trip Length Distribution

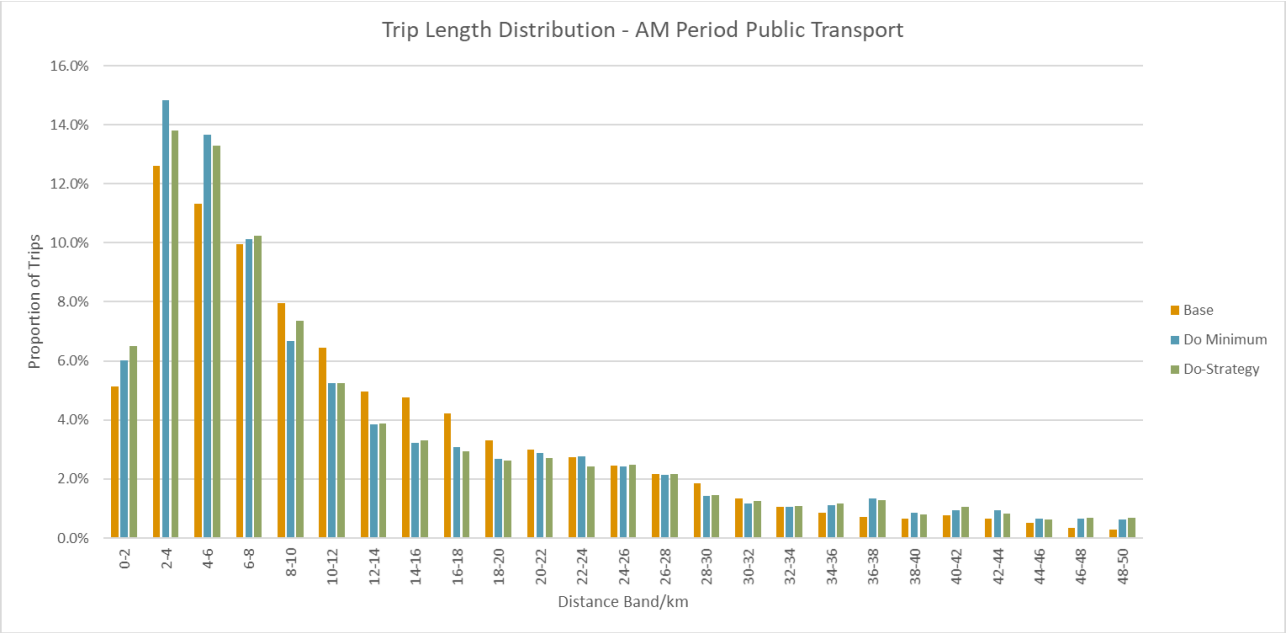


Figure 9-16: PT Trip Length Distribution

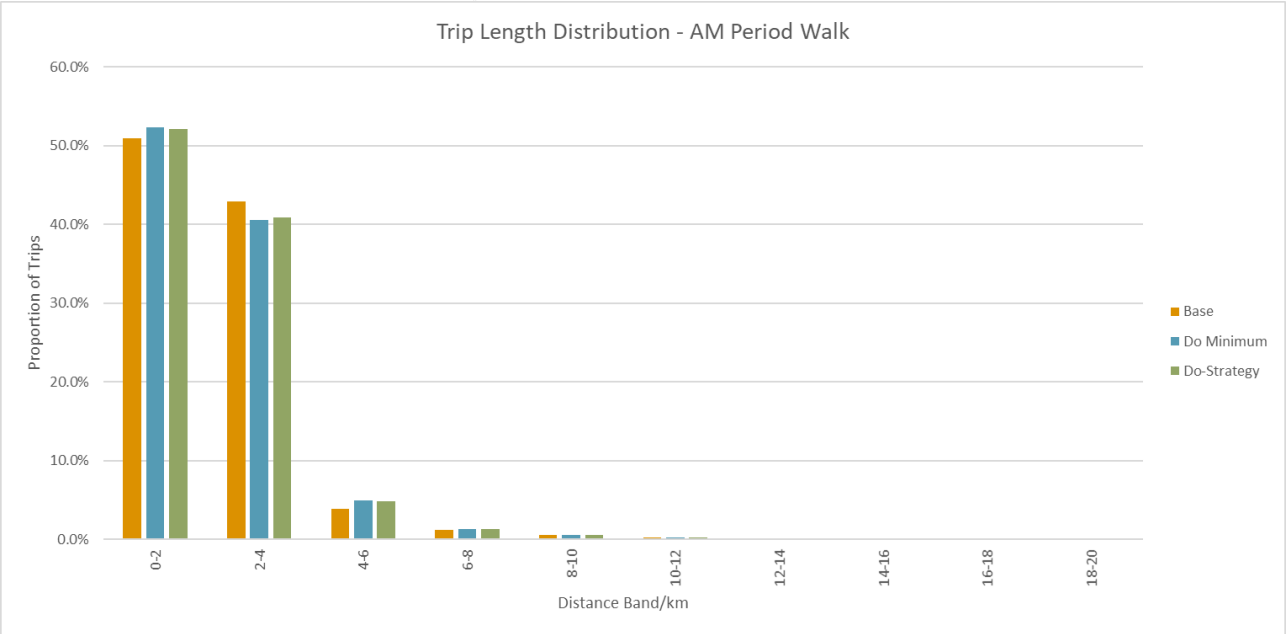


Figure 9-17: Walk Trip Length Distribution

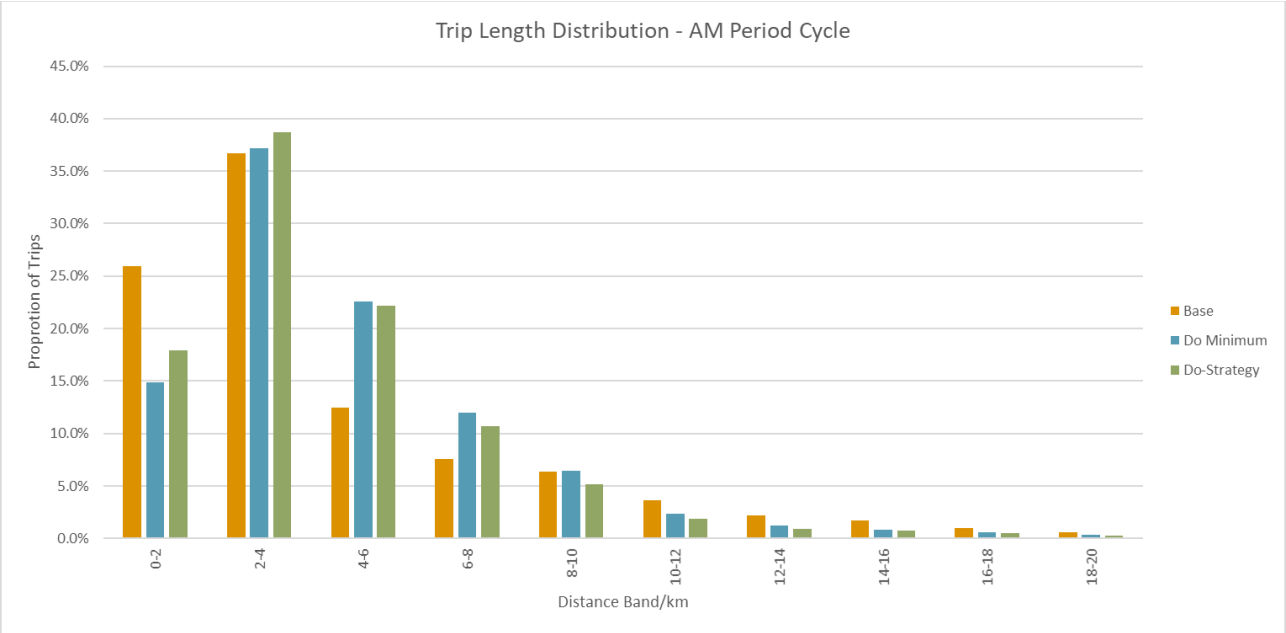


Figure 9-18: Cycle Trip Length Distribution

9.10 Public Transport Network Analysis

This section provides further detail on the performance of the LSMATS Do-Strategy public transport network compared to the Do-Minimum scenario. In the Do-Strategy scenario there is a 128% increase in public transport trips across the 24hr period in the LSMA (32k additional trips) compared to the Do-Minimum scenario.

9.10.1 Bus Network Service Operational Assessment

This section provides a summary of the performance of the proposed BusConnects network within LSMATS.

Figure 9-19: Do Minimum AM Peak Hour - Bus Flow Bandwidths

Figure 9-20: Do Strategy AM Peak Hour - Bus Flow Bandwidths

Figure 9-19 and Figure 9-20 show the AM peak hour flows on the Bus network in the Do Minimum and Do Strategy respectively. The figures show substantial increases in bus network activity across the LSMA. There is a strong increase in demand for bus trips radially into the city, particularly trips along the Limerick to Shannon route. The Sarsfield Bridge sees an increase from 190 to 858 passengers per hour inbound, while outbound sees an increase from 148 to 638 passengers per hour. This and the other main Shannon Crossings are shown in Table 9-15 below.

Table 9-15: Shannon River Crossings Bus Flow in AM

Passenger Flow Both Directions	Limerick Tunnel	R527 Shannon Bridge	R445 Sarsfield Bridge	Thomond Bridge	Total
Do Minimum	33	117	338	1	**489**

Do Strategy	31	718	1,496	258	**2,503**

This shows substantial usage of the bus network across the LSMA with the strategy, with particularly strong increases crossing the river in the AM peak.

9.11 Active Modes Network Operations

9.11.1 Active Modes Assignment

This section provides a summary of the performance of the Active Modes (Walking and Cycling) network within LSMATS. Figure 9-21 and Figure 9-22 present the combined active flows (Walk and Cycle) in the AM Peak hour across the LSMA for the Do-Minimum and Do-Strategy respectively. As shown, there are significant volumes of pedestrians and cyclists throughout Limerick City, particularly through the city centre and along each main arterial route to the city including Corbally Road, Dublin Road, Ballysimon Road, Ballinacurra Road and Ennis Road. There are significant increases in Active mode trips across major connecting bridges as shown in Table 9-16.

Table 9-16: Active Flow over bridges in AM

Person Flow Both Directions	R527 Shannon Bridge	R445 Sarsfield Bridge	Thomond Bridge	Bridge Street	Total
Do Minimum	536	722	385	548	**2,191**
Do Strategy	1,242	1,393	633	994	**4,262**

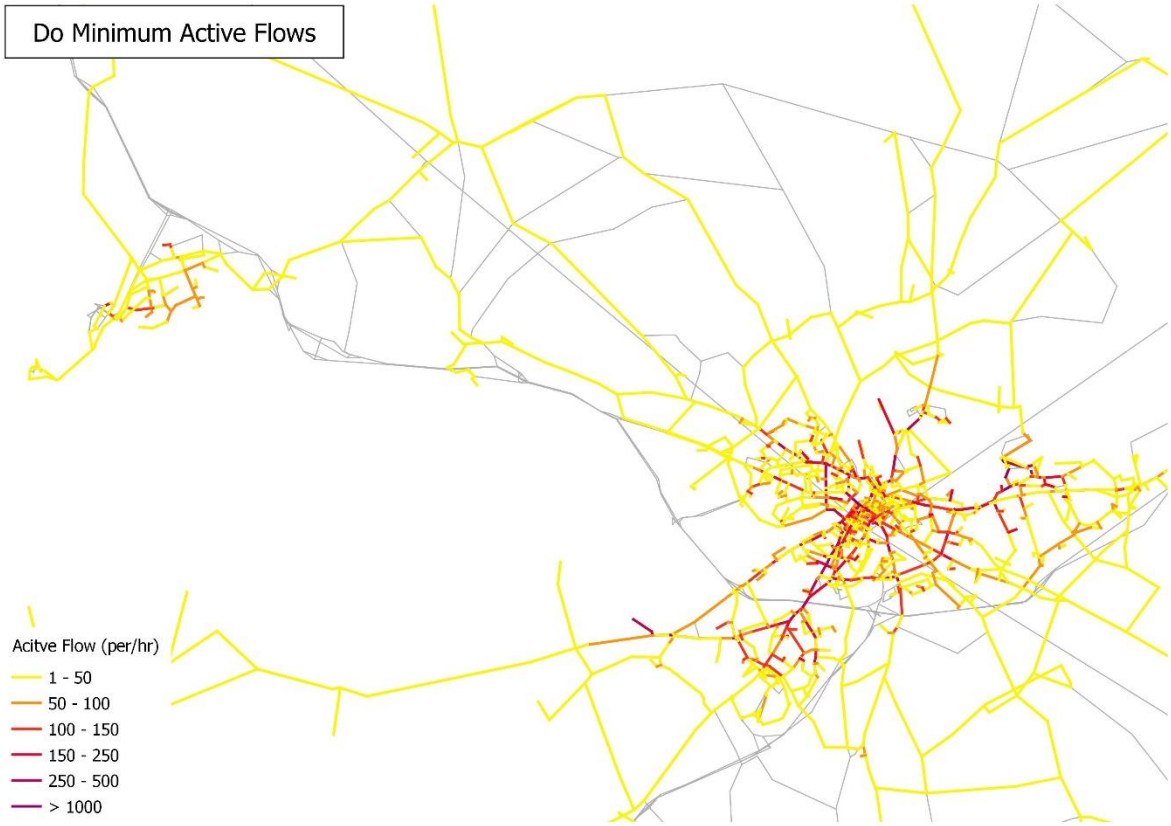


Figure 9-21: Do-Minimum AM Peak Hr Active Mode Flows

Figure 9-22: Do-Strategy AM Peak Hr Active Mode Flows

9.12 Road Network Operations

This section provides detail on the performance of the road network. Table 9-17 below presents High-Level Road Network statistics for the Do-Minimum and Do-Strategy extracted from the MWRM SATURN road model in the AM peak hour for the simulation area, this area includes the LSMA and some additional hinterland.

Table 9-17 AM Road Network Assignment Statistics for the Simulation Area

Assignment Stats	Do-Minimum	Do-Strategy	% Change
Transient Queues (PCU.HRS)	3,986	2,371	-51%
Over-Capacity Queues (PCU.HRS)	2,325	632	-125%
Total Travel Time (PCU.HRS)	14,467	10,238	-33%
Travel Distance (PCU.KMS)	485,682	451,254	-7%
Average Speed (KPH)	34	45	28%

The results show substantial improvements in road network performance between the Do-Minimum and Do-Strategy scenario. Over-capacity queueing – a measure of congestion on the wider road network shows a reduction of 125% in the Do-Strategy compared to the Do-Minimum.

Table 9-18 shows the change in annual Vehicle KM within the LSMA by vehicle type versus the base and the Do Minimum. The overall vehicle Km's travelled reduces by approximately 10%, although it should be acknowledged that there is a slight increase in both light goods and heavy good vehicle km's travelled, potentially reflecting the improved performance of the overall road network.

Table 9-18: Annual Vehicle KM by vehicle type in LSMA

Vehicle KMs	Car	Light Goods	Heavy Goods	Total
Base 2016	2,548,034	280,695	122,808	2,951,537
Do Minimum 2040	3,199,642	482,543	218,403	3,900,588
Strategy	2,796,685	494,075	231,180	3,521,940
Difference to Base	9.8%	76.0%	88.2%	19.3%
Difference to Do Min	-12.6%	2.4%	5.9%	-9.7%

10 Conclusions

A detailed assessment of the transport proposals outlined as part of the Limerick Shannon Metropolitan Area Transport Strategy (LSMATS) was undertaken using outputs from the Mid-West Regional 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 LSMA will be 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 have very high usage with a significant increase in total passenger boardings;
- Journey times to the city centre by public transport are forecast to reduce significantly compared to the Do-Minimum;
- Travel times on the road network are forecast to reduce as a result of the Strategy – compared to the Do-Minimum;
- The Strategy is forecast to reduce transport related emissions, particularly with the additional supporting parking policies;
- The Strategy is forecast to improve accessibility by reducing severance and increasing the accessibility to public transport, particularly from socially deprived areas across the LSMA;
- 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 NTA Model IDs

Scenario	Mode Version	Run ID	Report Section
Do Minimum	V2	AAD	Section 5
Iteration 1	V2	AAE	Section 5
Iteration 2	V2	AAF	Section 5
Iteration 3	V2	AAG	Section 5
Iteration 4	V2	AAH	Section 5
Do Minimum	V3	AAP	Section 7
Draft Strategy	V3	ABO	Section 7
Option 1	V3	ABX	Section 7
Option 2	V3	ABZ	Section 7
Option 3 – Emerging Strategy	V3	ACU	Section 7
Do Minimum (AltF)	V3	ACN	Section 7
Emerging Strategy (AltF)	V3	ACV	Section 7
Climate Action Test	V3	ACW	Section 7