

# Belfast Metropolitan Transport Study

Modelling Report

DfI

May 2020



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# Contents

Chapter	Page
<b>Introduction</b>	<b>6</b>
<b>1. Introduction</b>	<b>7</b>
1.1. Project Overview	7
1.2. This Report	7
<b>Belfast Metropolitan Area Objectives</b>	<b>8</b>
<b>2. Belfast Metropolitan Area Objectives</b>	<b>9</b>
2.1. Introduction	9
2.2. Approach to Objective development	9
2.3. Transport Objectives	10
<b>Model Development</b>	<b>11</b>
<b>3. Model Development</b>	<b>12</b>
3.1. Introduction	12
3.2. BSTM Overview	12
3.3. BSTM Overview	12
3.4. BSTM Model Updates	18
<b>Baseline Conditions</b>	<b>19</b>
<b>4. Baseline Conditions</b>	<b>20</b>
4.1. Introduction	20
4.2. Model Outputs	20
4.3. Selection of Model Outputs	21
4.4. Baseline Network Performance	25
4.5. Summary	26
<b>Planning Development Scenarios</b>	<b>27</b>
<b>5. Planning Development Scenarios</b>	<b>28</b>
5.1. Introduction	28
5.2. 2013 Demand	28
5.3. PDS Coding	28
5.4. PDS1 – Business As Usual	30
5.5. PDS2 – Planned Council Growth	31
5.6. PDS3 – Planned Council Growth (PT Focus)	32
5.7. PDS Outputs	33
5.8. Reference Demand	35
5.9. Summary	37
<b>Illustrative Measures</b>	<b>38</b>
<b>6. Illustrative Measures</b>	<b>39</b>
6.1. Introduction	39
6.2. IM Coding Overview	39
6.3. Model Outputs	52
6.4. Total Demand and Network Travel Time	53
6.5. Change in Demand within Belfast City Council	56

6.6.	Conclusion	56
<b>Appraisal Framework</b>		<b>57</b>
<b>7.</b>	<b>Appraisal Framework</b>	<b>58</b>
7.1.	Introduction	58
7.2.	Objectives	58
7.3.	Indicators	59
7.4.	Summary Comments	59
<b>Illustrative Measures 2030 Assessment</b>		<b>60</b>
<b>8.</b>	<b>Illustrative Measures 2030 Assessment</b>	<b>61</b>
8.1.	Introduction	61
8.2.	IM2030 Appraisal Framework	61
8.3.	IM2030 Appraisal Framework Summary	72
<b>Alternative Networks</b>		<b>73</b>
<b>9.</b>	<b>Alternative Networks</b>	<b>74</b>
9.1.	Introduction	74
9.2.	Coding Overview	74
9.3.	Model Outputs	74
9.4.	2030 AN Appraisal Framework	78
9.5.	Alternative Networks - Appraisal Framework Summary	89
9.6.	Summary	89
<b>Summary and Conclusions</b>		<b>90</b>
<b>10.</b>	<b>Summary and Conclusions</b>	<b>91</b>
10.1.	Introduction	91
10.2.	Summary	91
10.3.	Conclusion	91
<b>Appendices</b>		<b>93</b>
<b>Appendix A.</b>	<b>Layouts</b>	<b>94</b>
A.1.	Belfast Cordon Locations	94
A.2.	Belfast AQMA	95
A.3.	Belfast Select Journey Times	96
A.4.	Simulation Network	97
<b>Tables</b>		
Table 2-1	- Belfast Metropolitan Area Policy Documents	9
Table 3-1	- BSTM: Summary of Main Components and Scope	12
Table 4-1	- Model Outputs	20
Table 5-1	-2013 Productions and Attractions	28
Table 5-2	- Planning Development Scenario Coding Overview	29
Table 5-3	-PDS1 Change in Productions and Attractions from 2013 Base	30
Table 5-4	- PDS2 Change in Productions and Attractions from 2030 PDS1	31
Table 5-5	- PDS3 Change in Productions and Attractions from 2030 PDS1	32
Table 6-1	- Illustrative Measure Coding Overview	40
Table 8-1	- IM Appraisal Framework Overview	72

Table 9-1 – Alternative Network Coding Overview	74
Table 9-2 – AN Appraisal Framework Overview	89

## Figures

Figure 2-1 – Appraisal Framework Development Methodology	9
Figure 3-1 – BSTM Zoning Overview	13
Figure 3-2 – Belfast Model Coverage	14
Figure 3-3 – Belfast Model Network	15
Figure 3-4 – BMA AM 2013 Base Delay Flow	16
Figure 3-5 - BMA AM 2013 Base VOC Percentages	16
Figure 3-6 – Google Traffic Review	17
Figure 4-1 – 2013 DoMin BCC 24hr Mode Choice	22
Figure 4-2 – 2013 DoMin BCC AM Mode Choice	23
Figure 4-3 – Belfast Metropolitan Area Cordon Location	24
Figure 4-4 – 2013 DoMin BMA Cordon Flows	24
Figure 4-5 – 2013 DoMin BCC Travel Times by Mode	25
Figure 4-6 – 2013 AM DoMin Delay	26
Figure 4-7 – 2013 AM DoMin VOC	26
Figure 5-1 – Model Trips	33
Figure 5-2 – Average Trip Length Travel Time in Seconds	34
Figure 5-3 – Effect of Forecast Growth	35
Figure 5-4 – 2030 PDS3 AM DoMin Delay	36
Figure 5-5 – 2030 PDS3 – 2013 DoMin Delay Difference Plot	36
Figure 5-6 – 2030 PDS3 AM DoMin VOC	37
Figure 5-7 – 2030 PDS3 – 2013 DoMin Delay Difference Plot	37
Figure 6-1 – AM Peak – Network Wide Travel Times and Matrix Demand – Highway	53
Figure 6-2 – AM Peak – Network Wide Travel Times and Matrix Demand – Bus	54
Figure 6-3 – AM Peak – Network Wide Travel Times and Matrix Demand – Rail	55
Figure 6-4 – Total Change in Demand within BCC (AM Peak) by Mode	56
Figure 7-1 – Appraisal Framework Development Methodology	58
Figure 7-2 – Appraisal Framework Indicators	59
Figure 9-1 – 24hr BCC Mode Split	75
Figure 9-2 – 2030 AN01 - 2030 PDS3 DoMin Delay Difference Plot	76
Figure 9-3 – 2030 AN01 - 2030 PDS3 DoMin VOC Difference Plot	76
Figure 9-4 – 2030 AN02 - 2030 PDS3 DoMin Delay Difference Plot	77
Figure 9-5 – 2030 AN02 - 2030 PDS3 DoMin VOC Difference Plot	77

# Introduction



# 1. Introduction

## 1.1. Project Overview

The Department for Infrastructure (hereafter known as DfI) has commissioned Atkins to provide technical support, to inform the preparation of the new Belfast Metropolitan Transport Study (BMTS) under the Strategic Transport Planning and Modelling – Managed Services Framework. The purpose of this commission was to undertake transport modelling to understand the potential effects of different types of transport measures. The results of the modelling were used to identify those measures that would best support the future local development plan for the Belfast Metropolitan Area.

Atkins' brief for the BMTS comprised a list of twelve main Illustrative Measures (IMs) to be tested in the Belfast Strategic Transport Model (BSTM). These IMs were tested with both the Base Year demand and a preferred 2030 Planning Development Scenario (PDS) derived as part of this commission. Initially, operational outputs from the model were used to confirm the model was operating satisfactorily and producing logical results. An appraisal framework was also developed from locally derived objectives. The appraisal framework was populated with outputs from the model and used to compare the performance of the IMs. From the results of these model runs four Alternative Networks (ANs) were developed as a compilation of the initial twelve IMs. The results from the model runs were subsequently used by DfI to inform the conclusions of the Transport Study for the Belfast Metropolitan Area.

## 1.2. This Report

This report acts as a compilation report extracting the relevant key information from each technical note to present a comprehensive summary document for the study.

The remainder of this report is therefore set out as follows:

- **Chapter 2** provides an overview of the Belfast Metropolitan Area Vision and Objectives used to inform the Appraisal Framework;
- **Chapter 3** gives an overview of the model including its' capabilities and any updates applied as part of this commission;
- **Chapter 4** illustrates a brief overview of the 2013 base year conditions in the model;
- **Chapter 5** sets out a summary of the Planning Development Scenarios;
- **Chapter 6** presents a summary of the Illustrative Measures which have been coded along with a selection of model outputs;
- **Chapter 7** presents an overview of the Appraisal Framework;
- **Chapter 8** presents the 2030 IM Appraisal Framework;
- **Chapter 9** sets out the Alternative Networks and their Appraisal Framework; and
- **Chapter 10** is the summary and conclusions of this report.

# Belfast Metropolitan Area Objectives





## 2. Belfast Metropolitan Area Objectives

### 2.1. Introduction

The model produces a number of outputs relating to the operational performance of the transport networks. However, an Appraisal Framework (AF) is required to provide an indication as to how the various transport networks perform in relation to Transport Objectives. The process for developing this AF is set out in Figure 2-1.

**Figure 2-1 – Appraisal Framework Development Methodology**



As set out in Figure 2-1 the first stage in developing the AF is to identify the Transport Objectives that the proposed transport strategy is seeking to deliver. The objectives for the Belfast Metropolitan Transport Study (BMTS) have been identified in consultation with DfI using current policy documents. This chapter summarises the key policy documents which have been considered when developing the study objectives.

These objectives then form the basis for the Appraisal Framework which is reported further in Chapter 7 of this report. They are then used to assess the performance of a series of transport interventions so that the relative performance of each intervention against each objective can be assessed. This then allows a strategy to be identified by selecting those transport interventions that perform best against each of the objectives.

### 2.2. Approach to Objective development

The formation of the BMTS Vision and Objectives has been undertaken with careful consideration of the following key policy documents:

- Programme for Government Consultation Document (NI Executive);
- Regional Development Strategy 2035 (DRDNI);
- Ensuring a Sustainable Transport Future: A New Approach to Regional Transportation (DfI); and
- Northern Ireland Changing Gear – A Bicycle Strategy for Northern Ireland (DfI).

To ensure that the objectives are reflective of the local needs and aims of the Belfast Metropolitan Area (BMA), the BMA documents set out in Table 2-1 were also considered:

**Table 2-1 - Belfast Metropolitan Area Policy Documents**

Council Area	Document Titles
Belfast City	<ul style="list-style-type: none"> <li>• Local Development Plan 2020-2035 – Preferred Options Paper (January 2017); and</li> <li>• “The Belfast Agenda – Your Future City” – Community Plan</li> </ul>
Lisburn & Castlereagh City	<ul style="list-style-type: none"> <li>• Local Development Plan – Preferred Options Paper (March 2017)</li> <li>• Lisburn &amp; Castlereagh Community Plan 2017-2032</li> </ul>
Antrim & Newtownabbey	<ul style="list-style-type: none"> <li>• Local Development Plan 2030 - Preferred Options Paper; and</li> <li>• “Love Living Here” – Community Plan</li> </ul>
Ards & North Down	<ul style="list-style-type: none"> <li>• Local Development Plan – Preferred Options Paper (March 2019); and</li> <li>• “The Big Plan for Ards and North Down” – Community Plan April 2017</li> </ul>
Mid & East Antrim	<ul style="list-style-type: none"> <li>• Local Development Plan - Preferred Options Paper (June 2017); and</li> <li>• “Putting People First” – Community Plan (April 2017)</li> </ul>



## 2.3. Transport Objectives

The Objectives developed in conjunction with DfI in relation to this commission are set as follows:

**Objective 1:** Enhance accessibility by road and public transport from the centre of Belfast to Londonderry, gateways and hubs to support greater levels of inward investment

**Objective 2:** Ensure financially viable and sustainable public transport accessibility to essential services for people living in Belfast City Council Area

**Objective 3:** Ensure there are attractive and safe active travel networks (walking and cycling) linking all residential, retail, leisure, culture, office and commercial uses within the urban areas of the Belfast City Council area

**Objective 4:** Deliver high quality public realm in Belfast City Centre and in district centres with reduced vehicle dominance, to make them attractive, shared spaces to live and work and improve safety for active modes

**Objective 5:** Enhance transport accessibility and manage traffic congestion to Belfast City Centre and to district centres to strengthen Belfast's role as the regional economic driver

**Objective 6:** Enhance safety for all modes of travel and reduce the number and severity of casualties

**Objective 7:** Protect and enhance the built and natural environment by ensuring our transport systems operate sustainably and can integrate climate change adaptation requirements

Further information on how these objectives will be assessed is provided in Chapter 7

# Model Development



## 3. Model Development

### 3.1. Introduction

The specification for the BMTS was developed on the basis that the Belfast Strategic Transport Model (BSTM) is the best available tool for undertaking the study. The BSTM is clearly focused on the Belfast Metropolitan Area (BMA) and so most of the validation comparisons are therefore specific to Belfast.

This chapter provides an overview of the BSTM model. An overview of the updates applied to the model throughout the duration of the BMTS commission are also included in this chapter.

### 3.2. BSTM Overview

The Transport Planning and Modelling unit, part of the Department for Infrastructure (DfI) appointed Atkins as Lead Modelling Specialist (LMS) to oversee the construction of the Belfast Strategic Transport Model (BSTM). The other specialist roles were the Demand Modelling Specialist (DMS) and the Supply Modelling Specialist (SMS). Both of these roles were undertaken by consultant Mott MacDonald.

In summary, the BSTM modelling framework comprises:

- A trip end model for estimating base year and forecast year travel demand from demographic data;
- A travel demand model to forecast changes in mode, destination (distribution);
- A highway assignment model to assign trips to the highway network and determine routes used and to output journey costs and times for each zone pair; and
- A public transport assignment model to assign trips to the public transport network and determine routes used and output journey times for each zone pair.

Table 3-1 sets out an overview of the main components of the BSTM.

**Table 3-1 - BSTM: Summary of Main Components and Scope**

Component	Demand Unit	Time period	Modes
Trip End model	Productions & Attractions (PAs)	24 hour	All modes (personal travel)
Demand model	Productions & Attractions (PAs)	24 hour	All modes (personal travel)
Highway assignment	Origin - Destination (ODs): vehicle trips	Hour in time period	Car / light vehicles Goods vehicles
PT assignment	Origin - Destination (ODs): person trips	Hour in time period	All PT passengers

These components are integrated to form a modelling framework implemented using the CUBE and SATURN transport modelling software packages.

Additionally, the BSTM includes the following components:

- It has a parking model of Belfast City centre that can redistribute demand between zones based on the generalised cost of parking.
- It has a broad representation of walking and cycling within Belfast to the extent that these active modes are represented within the demand model. There is no assignment of walking or cycling demand.

While the model does have networks and matrices of the AM, inter-peak and PM peak time periods, the focus on the model performance throughout the BMTS has been for the AM peak only.

### 3.3. BSTM Overview

To gain an understanding of the suitability of the BSTM to assess the IMs this chapter presents a review of the traffic model and its' base year assignment:

- The coding definition within the model
- The base year delay; and
- The base year network Volume/Capacity (V/C) ratios to identify any highly utilised highway links.

### 3.3.1. Model Zoning

The zone system for BSTM was defined from administrative spatial definitions consistent with those adopted for the provision of the 2011 Census of Population data. Following a discussion with the NISRA statisticians, Atkins were advised that working with Super Output Areas was preferable to using ward boundaries as these are viewed as more statistically reliable and less likely to change through time.

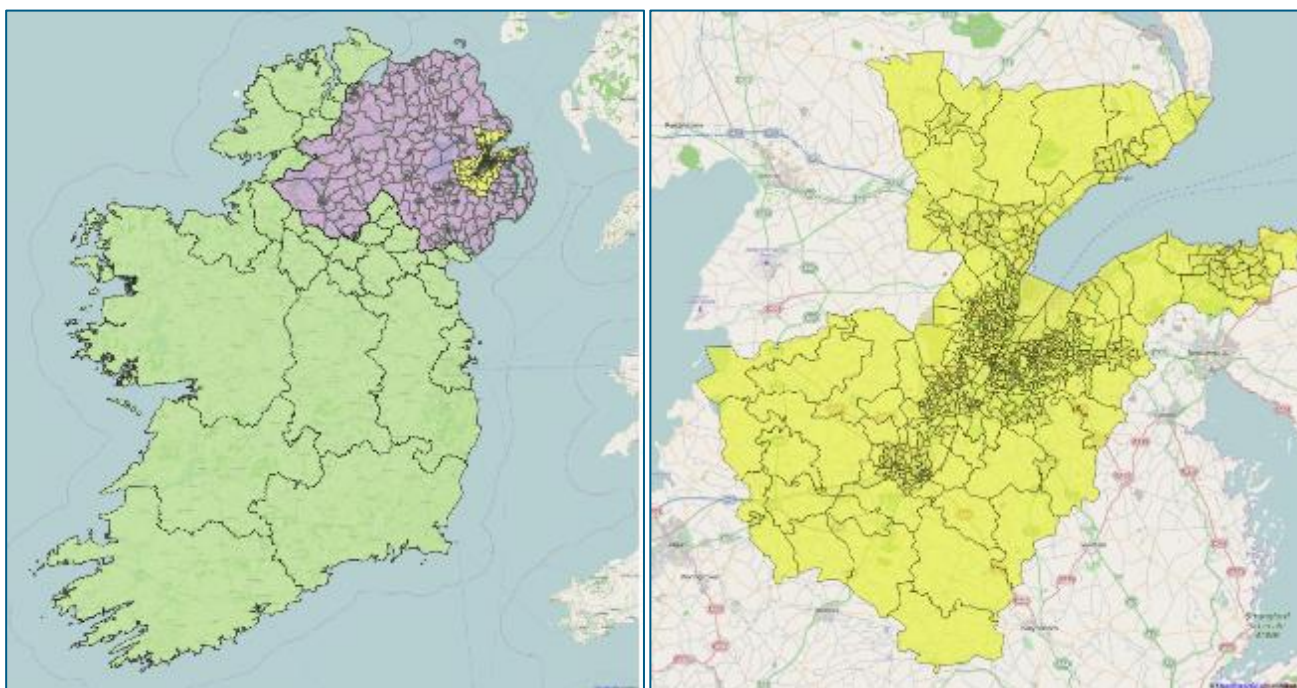
Northern Ireland currently has 890 Super Output Areas (SOA's) and so Atkins undertook a process of aggregating the least densely populated SOAs and disaggregating the most densely populated SOAs in order to create a zoning system with around 900 zones.

This aggregation and disaggregation process was undertaken in the following steps:

- The administrative boundaries were taken as the basis for the zoning within Belfast. More detail was retained in the locations closest to Belfast with more distant locations represented in aggregate;
- Zones having less than 800 address points (households) or a population more than 10,000 were filtered. Around 500 zones (SOA) having less than 800 address points (households) were found. There were no SOAs with a population exceeding 10,000; and
- Zones having less than 800 households and close to each other were aggregated. It was made sure that household aggregation doesn't exceed a maximum limit of 1,800.

An overview of the zone system is shown in Figure 3-1.

**Figure 3-1 – BSTM Zoning Overview**



### 3.3.2. Network Coding

Within SATURN the more detailed 'simulation' level of coding includes details on the junction specification which can result in quite realistic operational performance within the model. When this is applied across an urban area it provides the model with the ability to accurately replicate observed journey times and identify congestion hot spots. However, in many instances, this level of detail is not considered necessary and the additional cost and time to provide detailed coding is not warranted. This 'buffer' level of coding contains a reasonable level of detail for the highway links but includes no junction detail at the intersections of these links.

This section presents a summary of the geographic coverage and coding of the model.

TAG M3.1 makes a distinction between the Fully Modelled Area and the External Area:



- **The Fully Modelled Area** is the area over which the proposed interventions have influence. For the Belfast Model this would reflect the Belfast Metropolitan area. A general model of this type would be best suited to model packages of schemes at a broad level but may require further more detailed development to be able to be used on specific interventions.
- The **External Area** in which the impacts of interventions would be so small as to be reasonably assumed to be negligible.

With regard to the Belfast Model the following applies:

- **Core Area** – The new Belfast Council District, extending to cover Newtownabbey to the north, Lisburn to the south and Dundonald to the east (consistent with the settlement limits identified in BMAP). This will correspond to the areas where demand is fully represented as is feasible within the limits of model spatial representation and SATURN simulation modelling would provide an accurate representation of impacts such as queues and delays at junctions.
- **Collar Buffer** – The remaining extent of the current Belfast Metropolitan Area. Buffer coding but with speed flow curves. This would include the inter-urban links around Belfast where demand is fully represented but where more detailed junction coding is not applicable.
- **External Buffer** – Buffer with Fixed Speeds. This would be for those areas of the model where demand is not fully represented and would extend to include movements to / from the Republic of Ireland (but with very limited spatial detail)

Figure 3-2 presents the extent of the Core Area and the Collar Buffer.

**Figure 3-2 – Belfast Model Coverage**

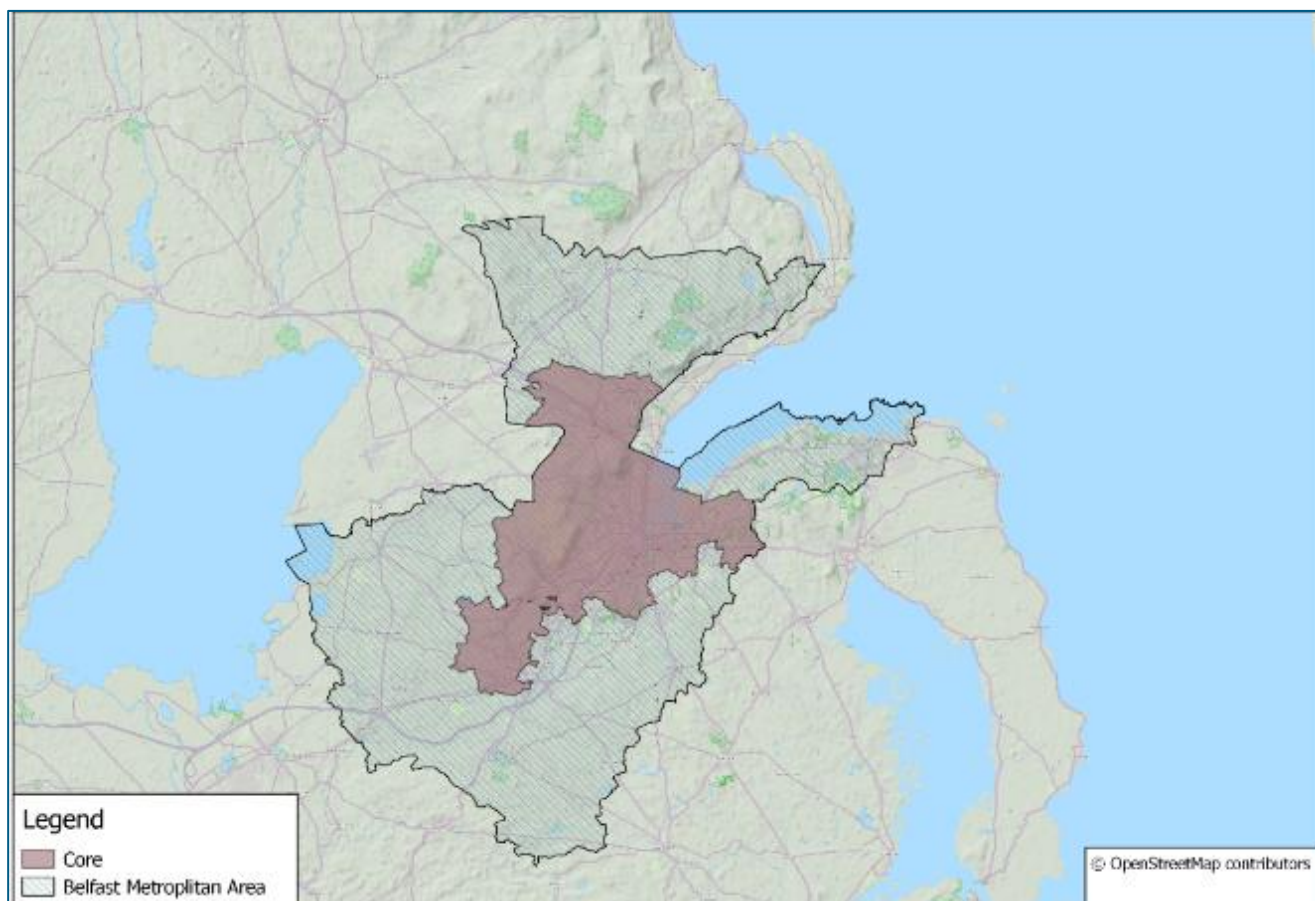
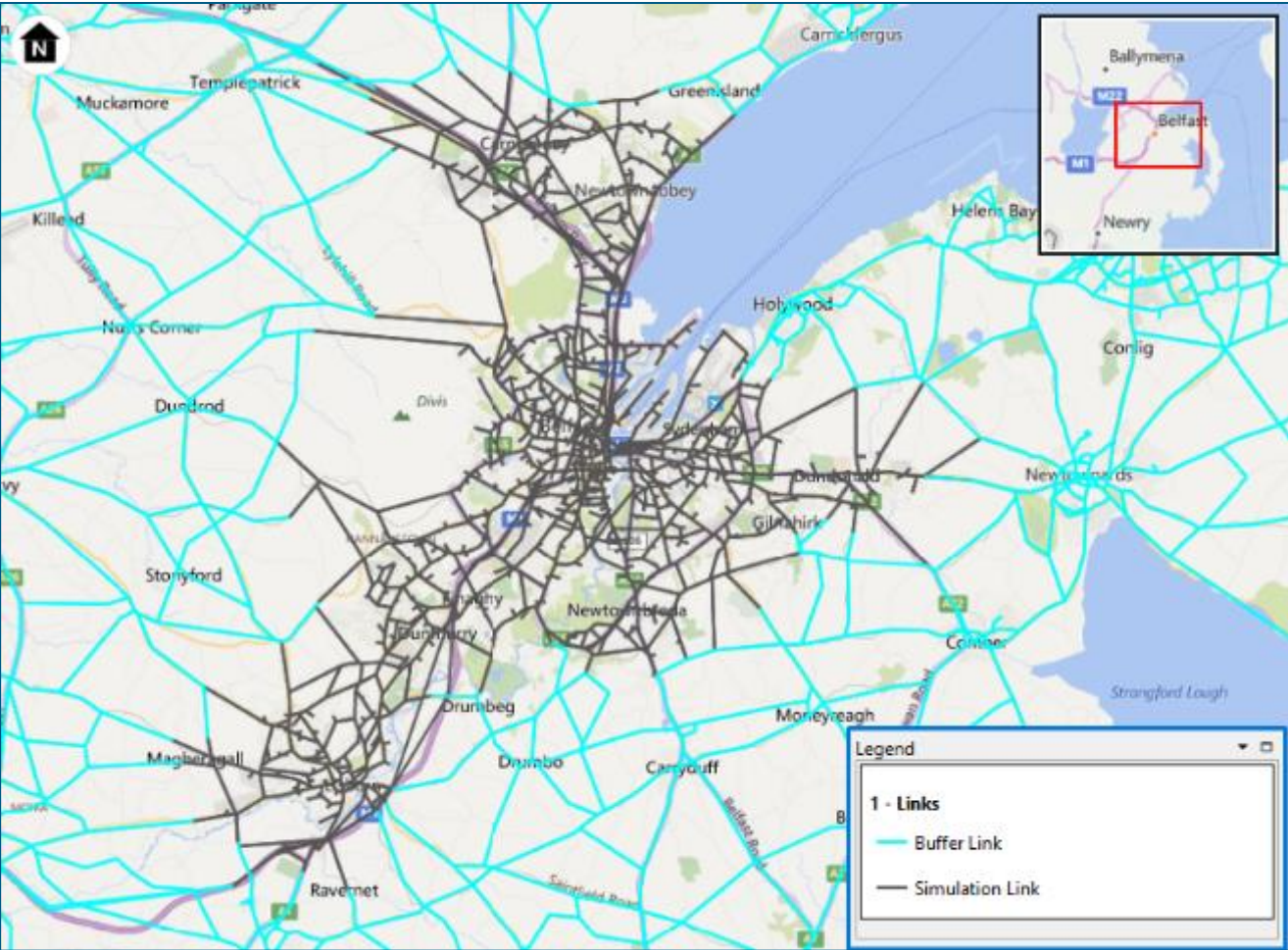


Figure 3-3 presents the full extent of the Belfast model network including the External area network.

Figure 3-3 – Belfast Model Network



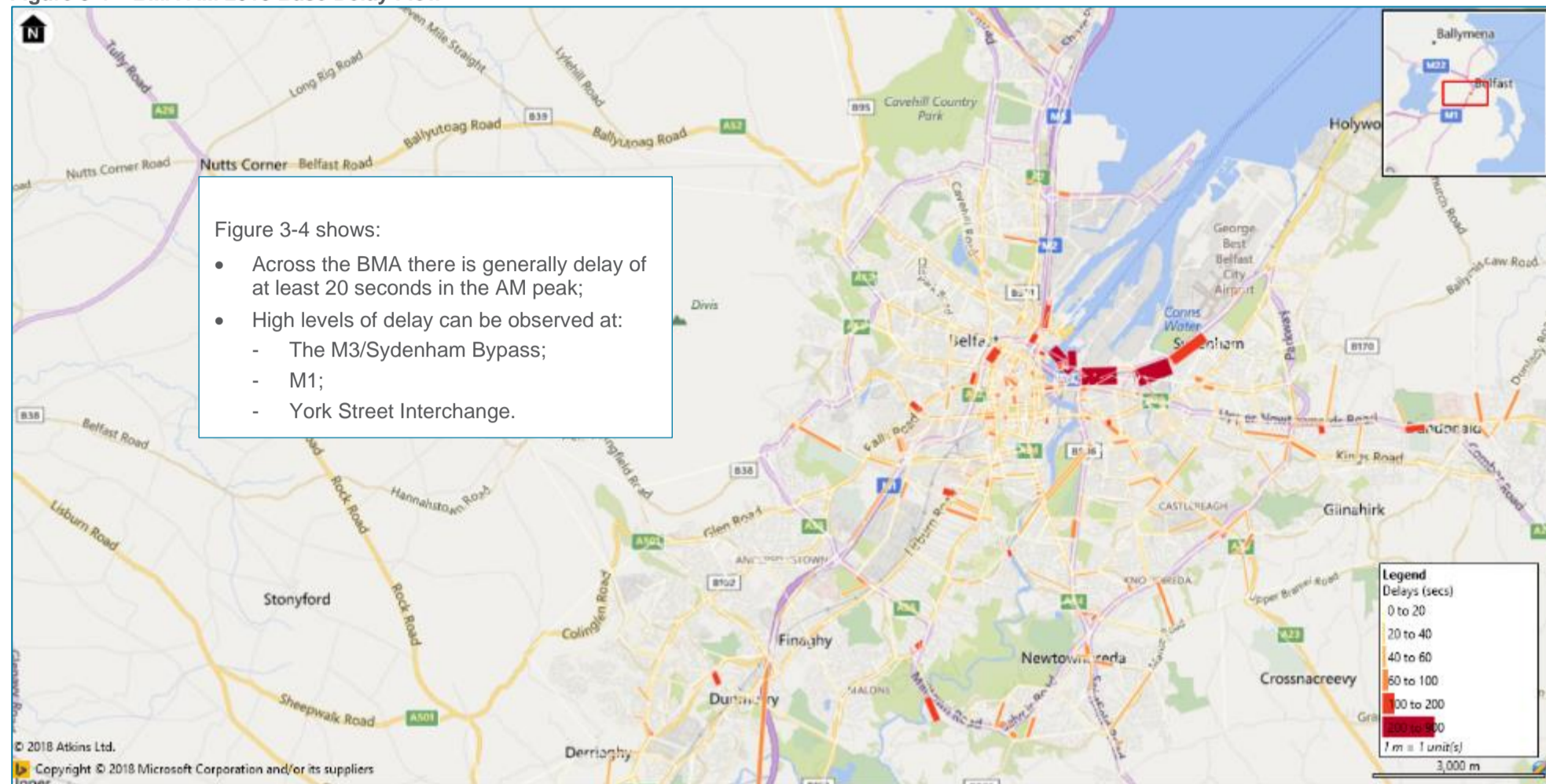


### 3.3.3. Delay Review

A 2013 AM peak base year assignment was undertaken to identify the level of traffic delay that exists on the links across the highway network.

Figure 3-4 shows a plot of these delays in the Belfast Metropolitan Area to ascertain if the relative distribution is reasonably intuitive.

Figure 3-4 – BMA AM 2013 Base Delay Flow

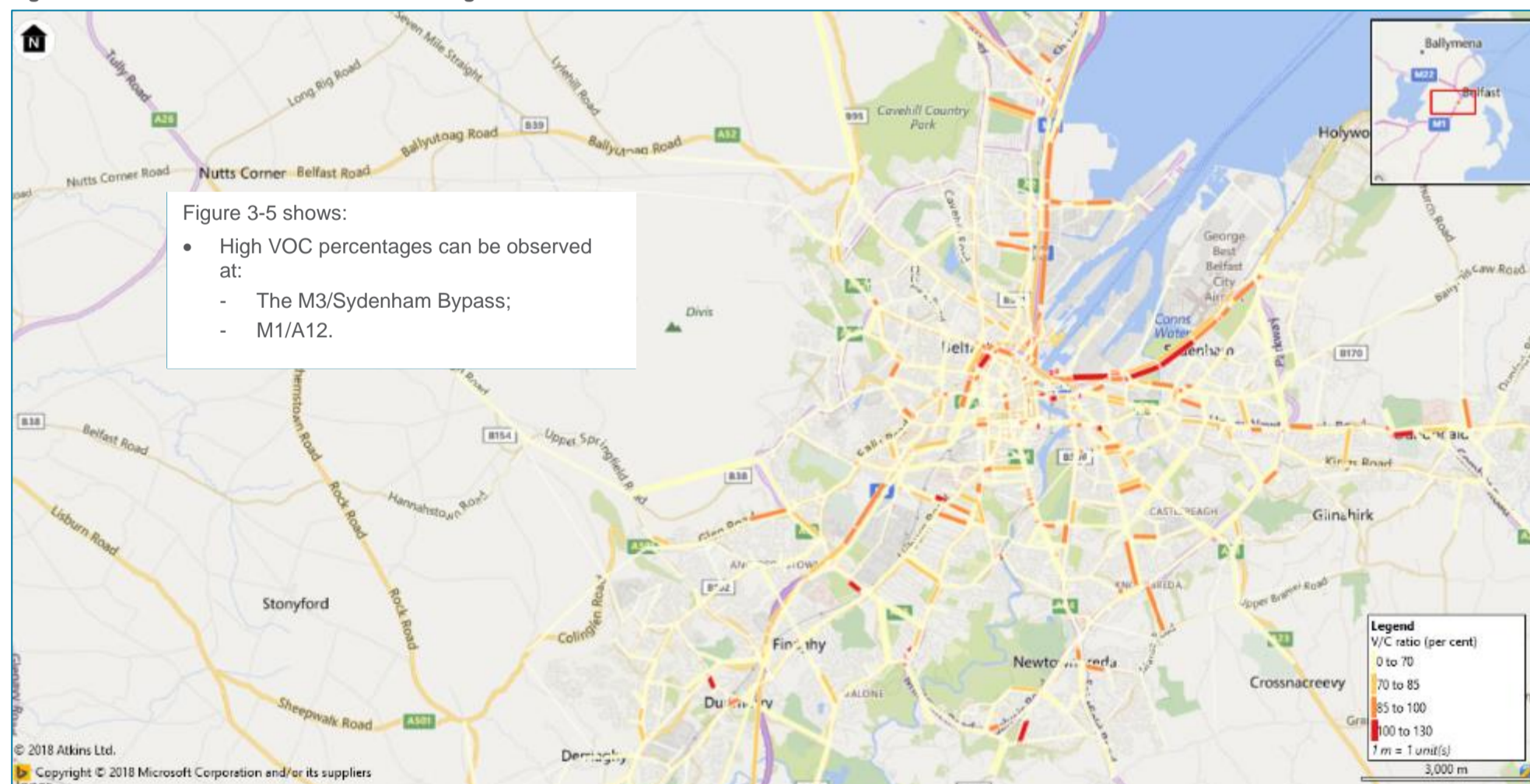


### 3.3.4. VOC Percentage

The Volume over Capacity (VOC) percentage calculates the number of vehicles travelling along each link divided by the capacity of that link. The higher the percentage the smaller the capacity for additional traffic to be accommodated.

Figure 3-5 illustrates the VOC percentages across the BMA.

Figure 3-5 - BMA AM 2013 Base VOC Percentages



### 3.3.5. Typical traffic speeds for the Belfast Metropolitan Area on an average weekday are shown in Google Traffic Review

Figure 3-6 shows an overview of the typical traffic conditions during the weekday AM peak.

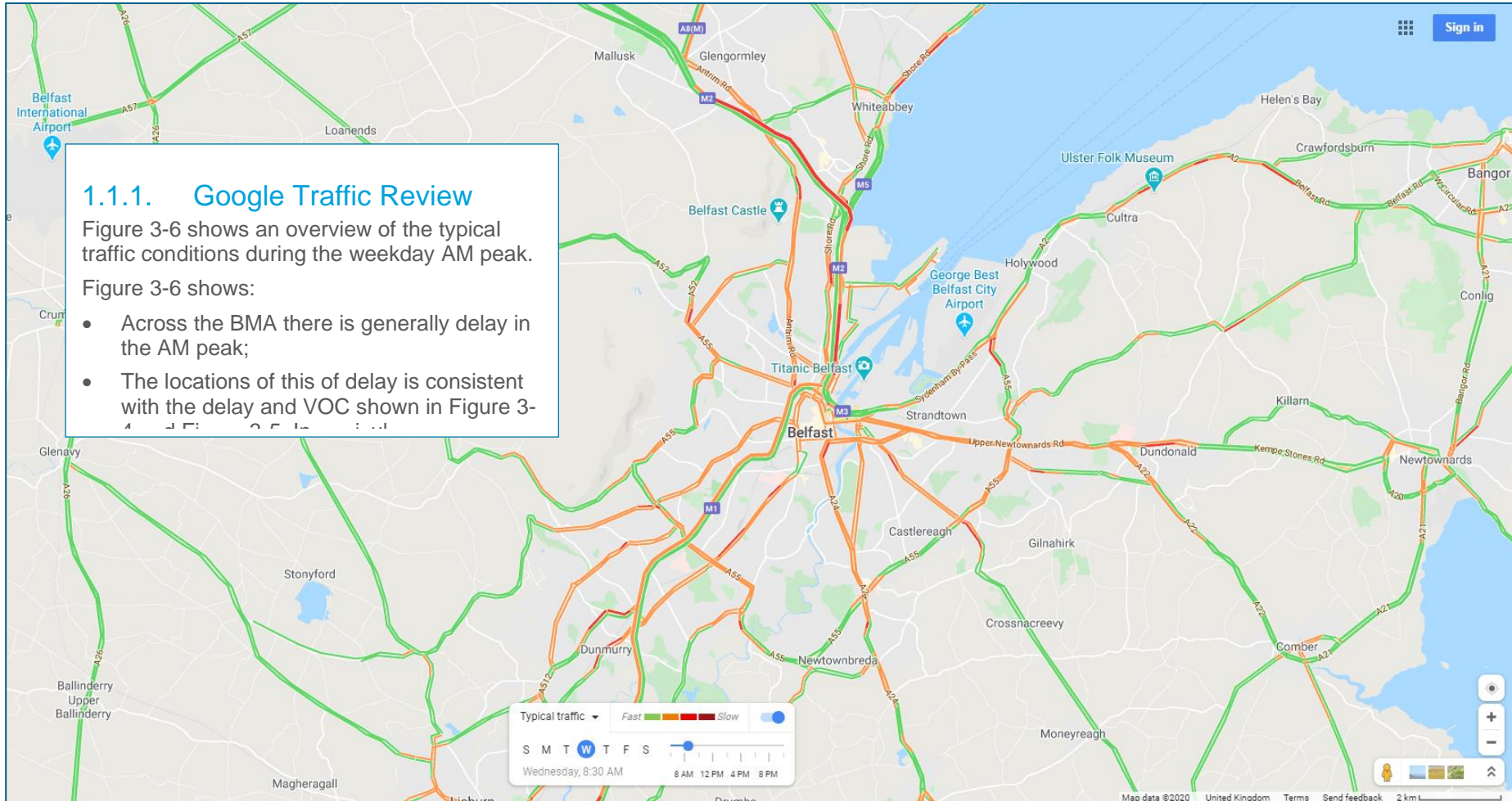
Figure 3-6.



### 3.3.6. Google Traffic Review

Figure 3-6 shows an overview of the typical traffic conditions during the weekday AM peak.

**Figure 3-6 – Google Traffic Review**



The output from this analysis would appear reasonably intuitive, but the omission of known congestion hotspots such as in the city centre is a result of the lack of individual link and junction validation.

## 3.4. BSTM Model Updates

Throughout the BMTS commission various updates and enhancements have been applied to the BSTM to improve the model performance. These changes are set out in the remainder of this section and together form the resulting Do Minimum (DoMin) network. These changes reflect:

- Highway model updates;
- PT service updates;
- Addition of model output modules

### 3.4.1. Model Updates

The following changes were made to the model:

- Value of Time was updated to reflect standard growth for all User Classes in accordance with the latest WebTAG guidance;
- Walk and Cycle Reference Cost Matrices set to match base; and
- Revisions were made to the model to constrain the variability in travel cost options within the model assignment process. This cost damping helps refine the modelling process and can reduce the time required to undertake scenario tests.

The following change has been made to allow the BMTS IMs to be coded:

- Revisions to the model included coding of specific Walk Speed and Cycle Speed parameters to permit walking and cycling speeds to be varied for testing of specific Walk/Cycle IMs (7&8).

### 3.4.2. PT Service Updates

The following updates were made to the PT services in the model:

- Bus lines files were updated in line with 2016 highway network changes; and
- Bus On/Off movements are now Scenario Specific for easier retention of output data.

### 3.4.3. Addition of Model Output Modules

The following updates have been added to the model in order to effectively test the PDS and IMs for the BMTS commission. These outputs are generally model wide with some Belfast City Council area specific elements:

- Outputs module created;
- 12 sectors (11 Local Government Districts (LGDs) and RoI) for Bus and Rail added to outputs module;
- Highway outputs batch added to outputs module;
- Network Travel Time and Total Passengers by Mode added to Outputs module;
- Adapted Cost .MAT Files to carry Actual TranTime to pass to Outputs.

A record of all the changes listed above is summarised in the Changelog Access within the model.

These changes together form the resulting Do Minimum (DoMin) network. The results from this revised network are presented in the following chapter.

# Baseline Conditions



## 4. Baseline Conditions

### 4.1. Introduction

The chapter identified a series of updates and refinements to the 2013 base model to create a new Do Minimum scenario. In this chapter we provide an overview of the outputs that can be generated by BSTM along with presentation of results from this updated 2013 Do Minimum network. Some outputs are specific to the Belfast City Council (BCC) area whereas others are model wide (NI and RoI).

This chapter therefore sets out:

- A summary of all the outputs extracted from the model;
- An overview of a selection of model outputs for the 2013 Do Minimum model run to provide a high-level overview of model performance. This includes:
  - BCC 24hr mode choice;
  - BCC AM peak mode choice;
  - Cordon flows; and
  - Travel times in BCC.
- A summary of the highway network performance for the 2013 Do Minimum model run, including:
  - Delay; and
  - Volume over Capacity percentage.
- The summary and conclusions to be taken from this review

### 4.2. Model Outputs

Table 4-1 sets out a description of each output extracted from the model. This table includes:

- Output Name: The title of the model output to be used throughout this report;
- Units: The output units to be used for each modelled element;
- Description: An overview of the output; and
- Time of Day/ Location: Detail on the modelled time period and geographical coverage of the model output.

These standard outputs provide a range of data for each model run which facilitates the identification of any changes as a result of the illustrative measure being assessed.

**Table 4-1 - Model Outputs**

Output	Units	Description	Time of Day / Location
12x12 Sectors	<ul style="list-style-type: none"> <li>• Highway – PCU<sup>1</sup></li> <li>• Bus – Person Trips</li> <li>• Rail – Person Trips</li> </ul>	These outputs show the sectorised origin-destination matrix where the 12 sectors represent the 11 Local Government Districts (LGDs) and the external zones (RoI) split by highway, bus and rail	<ul style="list-style-type: none"> <li>• AM Peak;</li> <li>• Model Wide (by sector)</li> </ul>
Matrix Totals	<ul style="list-style-type: none"> <li>• Highway – PCU</li> <li>• Bus – Person Trips</li> <li>• Rail – Person Trips</li> </ul>	These outputs give the matrix totals for the morning peak split by highway, bus and rail	<ul style="list-style-type: none"> <li>• AM Peak;</li> <li>• Model Wide</li> </ul>
BCC AM Mode Choice	<ul style="list-style-type: none"> <li>• Highway – PCU</li> <li>• Bus – Person Trips</li> <li>• Rail – Person Trips</li> </ul>	The total demand to/from/within BCC for the AM peak hour	<ul style="list-style-type: none"> <li>• AM Peak;</li> <li>• Model Wide (by sector with a focus on BCC)</li> </ul>
Mode Choice	<ul style="list-style-type: none"> <li>• All modes – Person Trips</li> </ul>	These outputs show the total 24hr total trips for highway, PT, walking and cycling	<ul style="list-style-type: none"> <li>• 24hr;</li> <li>• Model Wide</li> </ul>

<sup>1</sup> PCU – Vehicle movements are converted to Passenger Car Units (PCUs) to account for the different size of vehicles utilising the highway network.

Output	Units	Description	Time of Day / Location
Cordon Flows	<ul style="list-style-type: none"> <li>Highway – PCU</li> <li>Bus – Person Trips</li> <li>Rail – Person Trips</li> </ul>	The inbound and outbound traffic flow across the cordons for the morning peak are split into an inner and outer cordon. These cordons are shown in Appendix A	<ul style="list-style-type: none"> <li>AM Peak;</li> <li>Belfast Cordons</li> </ul>
BCC Mode Choice	<ul style="list-style-type: none"> <li>All modes – Person Trips</li> </ul>	These outputs show the total 24hr total trips from BCC for highway, PT, walking and cycling	<ul style="list-style-type: none"> <li>24hr;</li> <li>Belfast City Council</li> </ul>
Journey Times	<ul style="list-style-type: none"> <li>Seconds</li> </ul>	Journey times on select routes have been extracted from the highway model. These select routes are shown in Appendix A	<ul style="list-style-type: none"> <li>AM Peak;</li> <li>Select Routes: <ul style="list-style-type: none"> <li>M2/A2</li> <li>Newtownards Road;</li> <li>Ormeau Road;</li> <li>Lisburn Road;</li> <li>M1/A12</li> <li>Crumlin Road</li> </ul> </li> </ul> (Routes are shown in Appendix A)
Network Travel Times	<ul style="list-style-type: none"> <li>Highway – PCU Hours</li> <li>Bus – Person Hours</li> <li>Rail – Person Hours</li> </ul>	The outputs give the total time travelled across the network in the morning peak hour by each mode	<ul style="list-style-type: none"> <li>AM Peak;</li> <li>Model wide</li> </ul>
Demand by Belfast	<ul style="list-style-type: none"> <li>Highway – PCU</li> <li>Bus – Person Trips</li> <li>Rail – Person Trips</li> </ul>	This shows the demand for each mode travelling to Belfast City Council from each LGD and the external zones	<ul style="list-style-type: none"> <li>AM Peak;</li> <li>Model wide (with a focus on BCC)</li> </ul>
Vehicle Emissions	<ul style="list-style-type: none"> <li>Volume (kg)</li> </ul>	These are the total vehicle emissions across the simulation network	<ul style="list-style-type: none"> <li>AM Peak;</li> <li>Simulation Network (shown in Appendix A)</li> </ul>
Air Quality Management Areas	<ul style="list-style-type: none"> <li>Actual Highway Flow (PCUs)</li> </ul>	The flow along key links in AQMA areas	<ul style="list-style-type: none"> <li>AM peak;</li> <li>AQMAs in BCC: <ul style="list-style-type: none"> <li>M1/A12;</li> <li>Ormeau Road;</li> <li>East Bridge Street;</li> <li>Upper Newtownards Road</li> </ul> </li> </ul> (Shown in Appendix A)

### 4.3. Selection of Model Outputs

The remainder of this chapter shows an overview of some of the 2013 Do Minimum model outputs available from the BSTM including:

- **BCC 24hr Mode Choice** – this has been selected to understand the overall proportion of each mode (highway, PT, walk and cycle) being used in BCC across a 24hr period;
- **BCC AM Mode Choice** – this is used to understand the mode choice in BCC in the AM peak hour;
- **Cordon Flows** – The cordon flows provide detail on the number of trips (by highway, bus and rail) crossing both the inner and outer cordons (inbound and outbound) in the AM peak hour;
- **BCC Travel Times** - this has been selected to understand the changes to the total time travelled across the network with a focus on BCC in the AM peak hour by each mode.

These model outputs have been selected to provide a high-level overview of the baseline performance of BSTM.

### 4.3.1. BCC 24hr Mode Choice

This model output shows the total number of 24hr person trips originating in the BCC area split by:

- Car;
- Public Transport;
- Walking;
- Cycling.

This mode split is shown in Figure 4-1.

**Figure 4-1 – 2013 DoMin BCC 24hr Mode Choice**

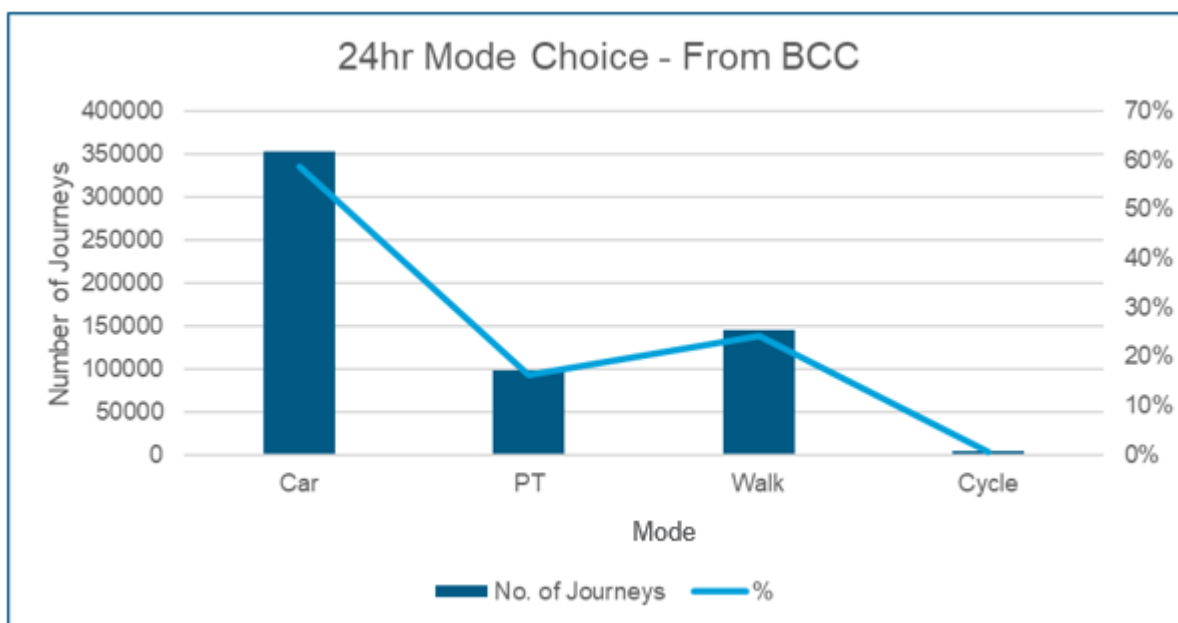


Figure 4-1 shows:

- As expected, the largest number of trips leaving BCC across the 24hrs are made by cars;
- Cycling is the least popular mode of choice;
- Walking is a more popular mode of choice than PT by approximately 10%.

### 4.3.2. BCC AM Mode Choice

This model output shows the AM peak hour flows for highway, bus and rail where highway trips are shown in PCUs and PT trips are shown in person trips. These flows are split into three different scenarios:

- Total trips from the rest of NI and Rol to the BCC area;
- Total trips from BCC to the rest of NI and Rol;
- Total trips within the BCC area.

This mode choice is shown in Figure 4-2.

**Figure 4-2 – 2013 DoMin BCC AM Mode Choice**

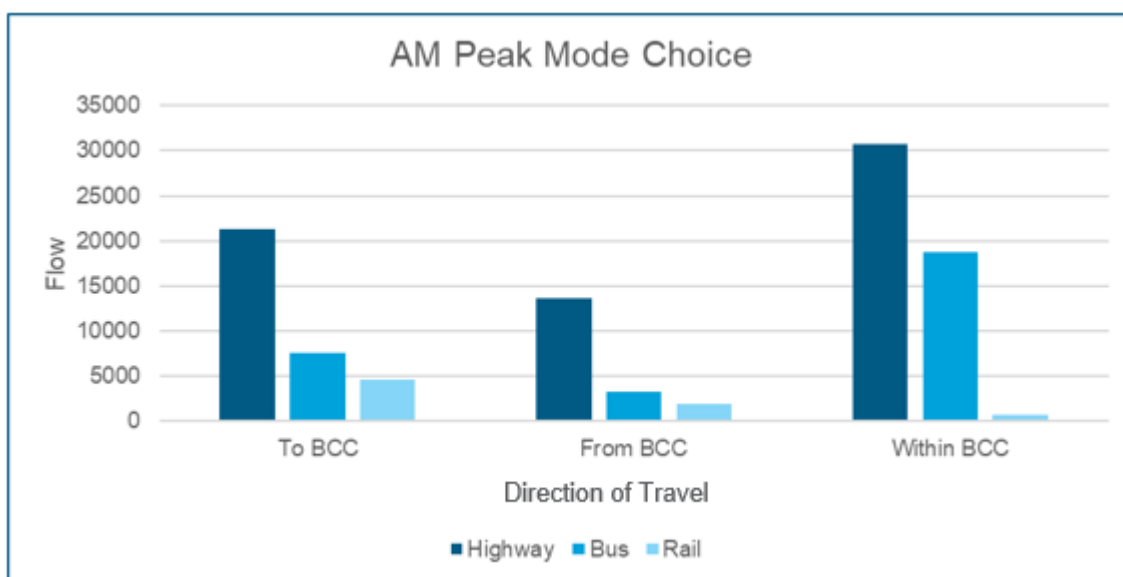


Figure 4-2 shows:

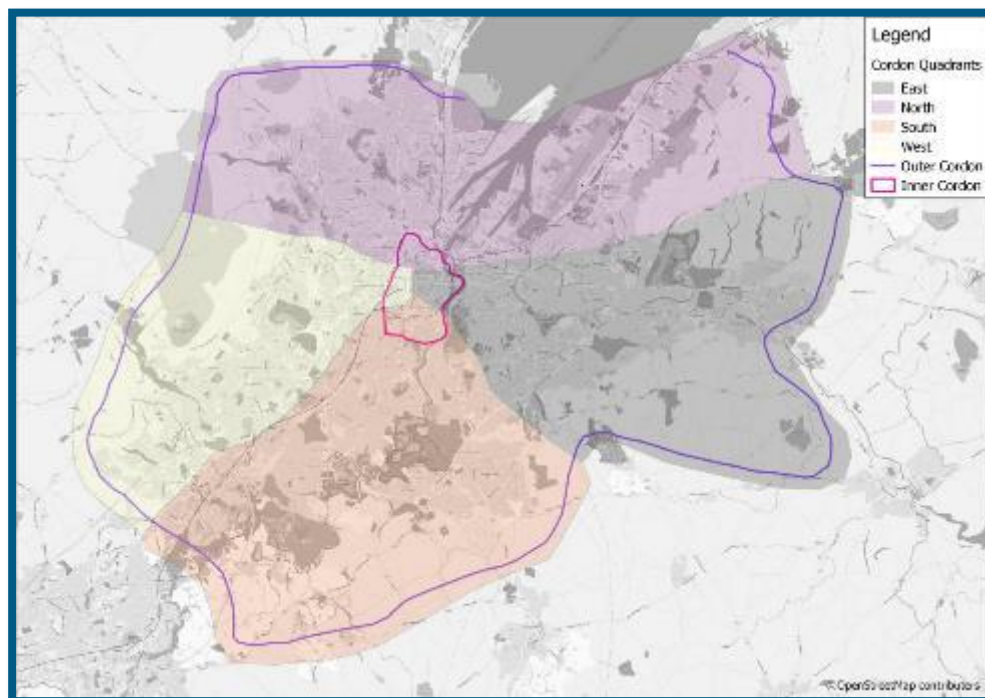
- The majority of trips in all 3 scenarios are made by highway;
- The fewest trips are by rail;
- The largest volume of bus trips is experienced in the within BCC scenario.



### 4.3.3. Cordon Flows

These are the inbound and outbound flows across an inner and outer cordon are split by highway, bus and rail where the highway flows are shown in PCUs and the bus and rail flows are shown in person trips for the AM peak hour. These cordons are shown in Figure 4-3.

**Figure 4-3 – Belfast Metropolitan Area Cordon Location**



It should be noted that rail person trips are not available for the outer cordon.

Figure 4-4 shows the inner and outer cordon flows in the AM peak hour.

**Figure 4-4 – 2013 DoMin BMA Cordon Flows**

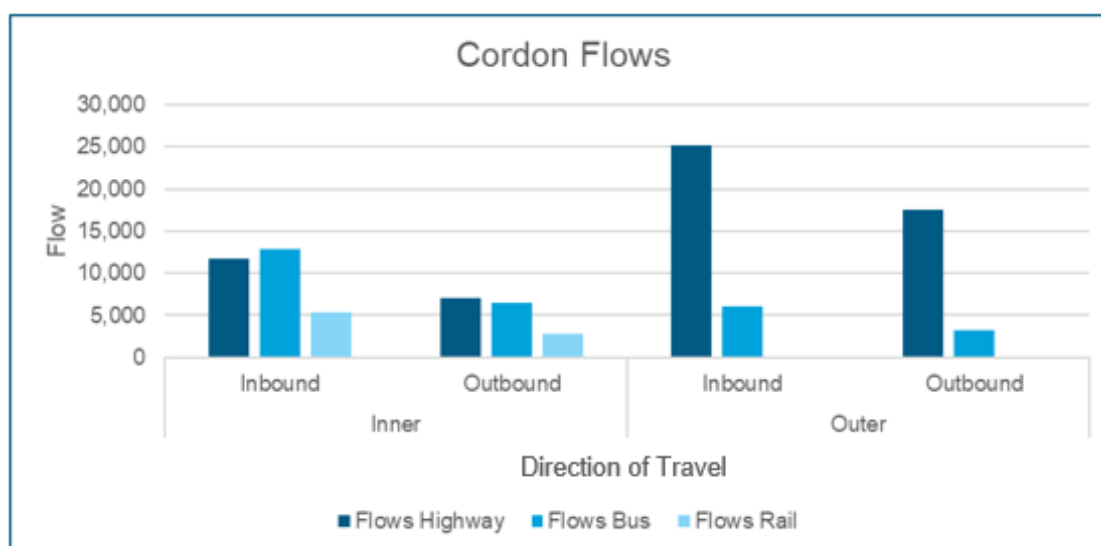


Figure 4-4 shows:

- The majority of trips are highway across the outer cordon in each direction;
- Bus trips are the most popular mode inbound across the inner cordon;
- Across both cordons inbound has a higher proportion of trips than the outbound flow;
- The fewest trips are made by rail.



### 4.3.4. BCC Travel Times

This output shows the total travel time split by highway, bus and rail where the highway travel time is shown in PCU hours and the bus and rail travel times are shown in person hours for the AM peak. These travel times are broken down by:

- Total travel time for journeys to BCC;
- Total travel time for journeys leaving BCC;
- Total travel time for journeys within BCC.

These travel times are shown in Figure 4-5.

**Figure 4-5 – 2013 DoMin BCC Travel Times by Mode**

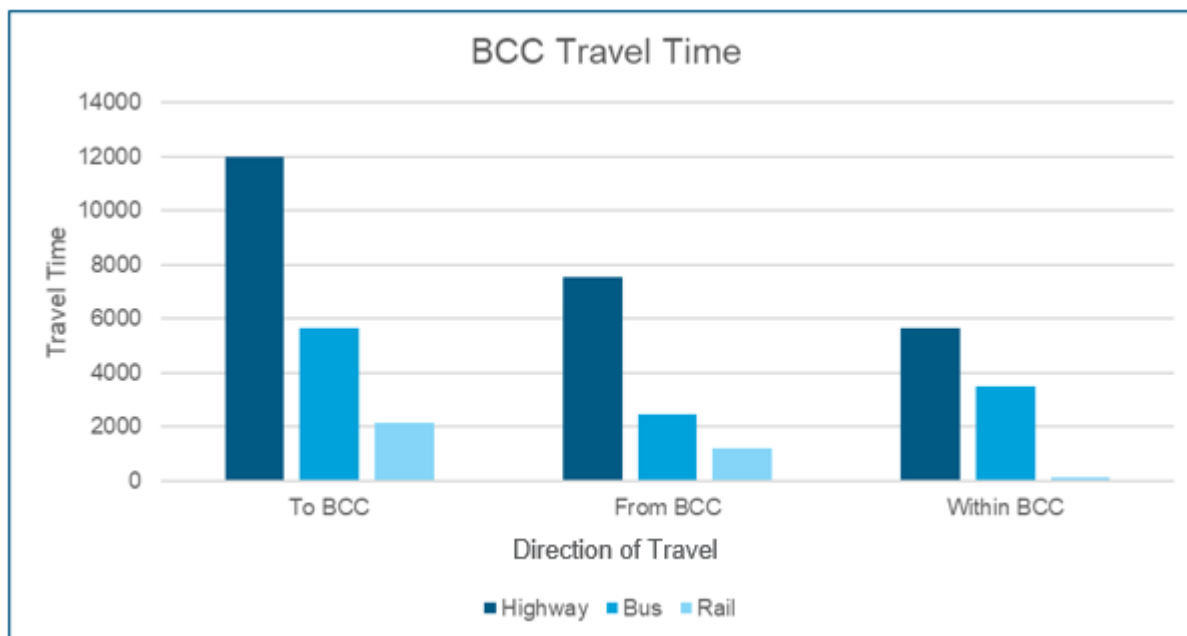


Figure 4-5 shows:

- For each direction of travel highway has the highest travel time;
- The majority of rail travel time is to and from BCC;
- The highest bus travel time is to BCC.

### 4.4. Baseline Network Performance

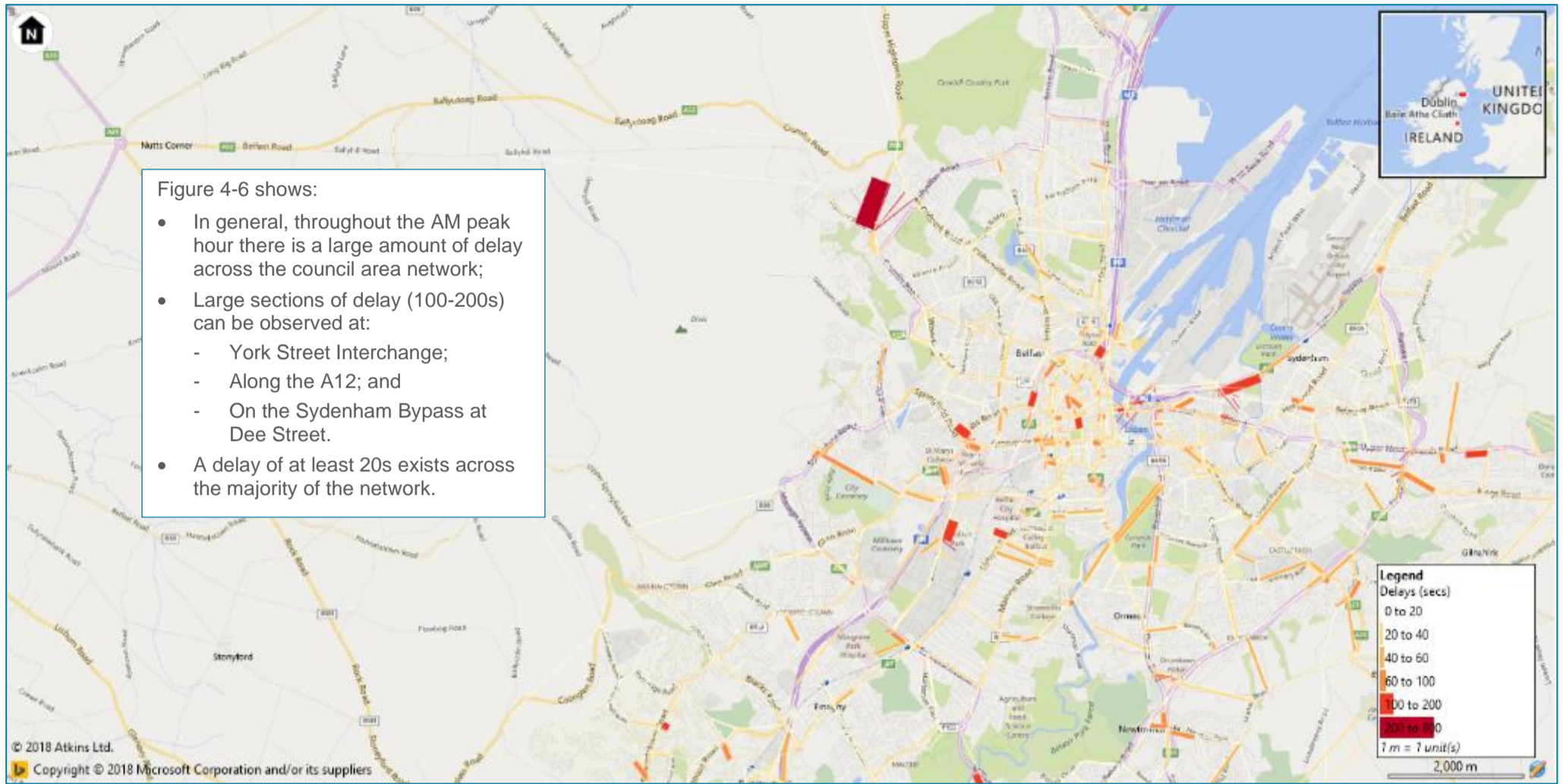
This section sets out a series of network plots showing the baseline 2013 DoMin network performance of the model, including:

- Delay; and
- VoC Percentage.

#### 4.4.1. Delay

Figure 4-6 shows the 2013 DoMin delay in seconds across Belfast in the AM peak hour.

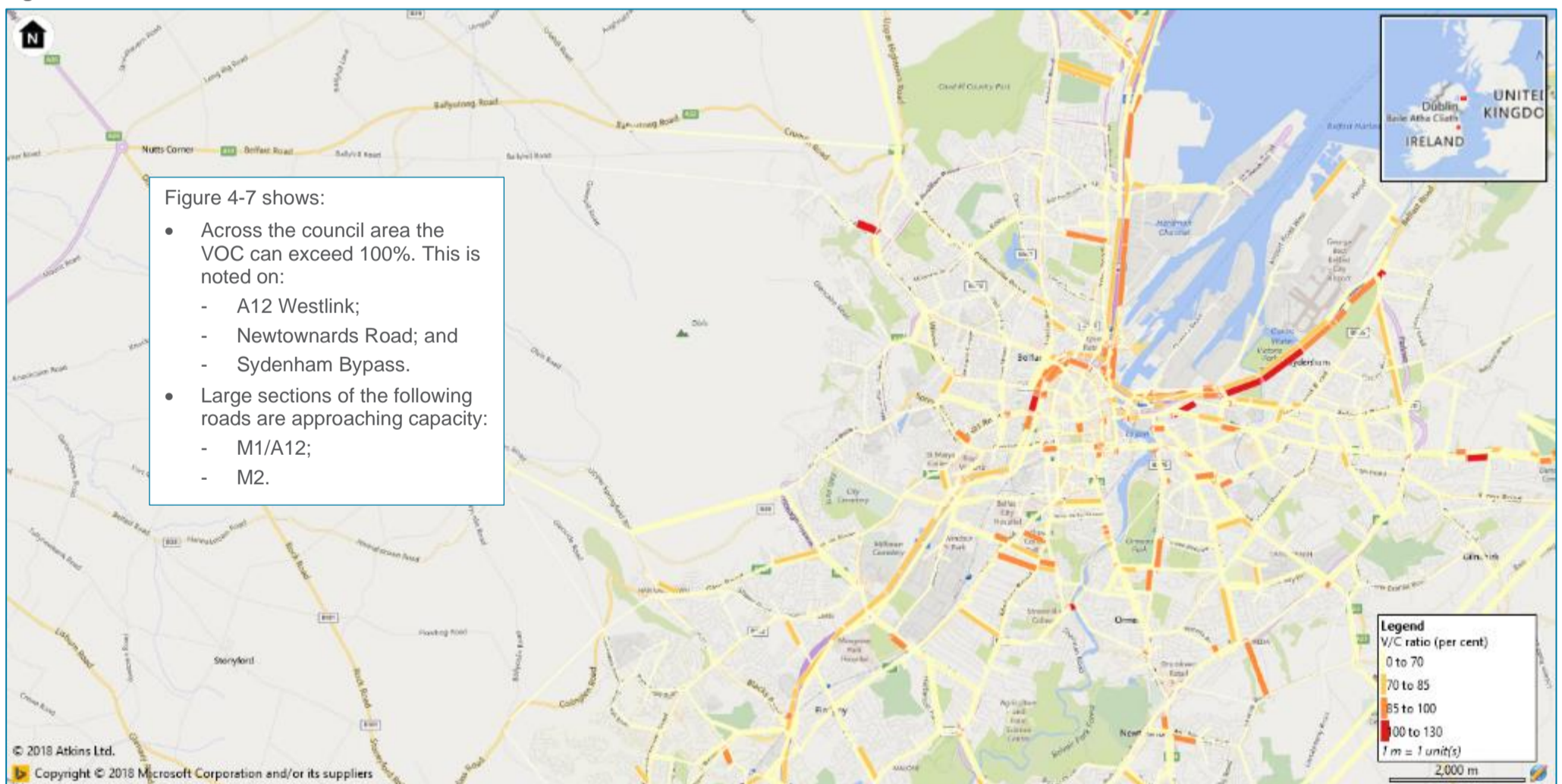
Figure 4-6 – 2013 AM DoMin Delay



#### 4.4.2. VOC

Figure 4-7 shows the 2013 DoMin Volume over Capacity as a percentage across Belfast in the AM peak hour.

Figure 4-7 – 2013 AM DoMin VOC



#### 4.5. Summary

The baseline network performance indicators throughout this section show:

- Confidence that the model is a robust tool to undertake the BMTS PDS and IM assessments and will provide intuitive results.

# Planning Development Scenarios





## 5. Planning Development Scenarios

### 5.1. Introduction

This chapter sets out:

- An overview of the current 2013 demand; and
- The information and methods used to code each of the Planning Development Scenarios (PDS).

A PDS is a method of inputting any major changes to household and employment forecasts by 2030 into the model.

### 5.2. 2013 Demand

The 2013 base year demand added to the model in the form of 24-hour productions and attractions are shown in Table 5-1. It should be noted that whilst these numbers appear very precise, they represent rounded totals aggregated from each modelled zone.

**Table 5-1 –2013 Productions and Attractions**

Council Area	2013 Productions	2013 Attractions
Antrim and Newtownabbey	225,076	228,205
Ards and North Down	242,045	209,339
Armagh and Banbridge	315,062	295,864
Belfast	536,211	684,449
Causeway Coast and Glens	219,310	201,583
Derry and Strabane	219,363	210,526
Fermanagh and Omagh	190,575	185,684
Lisburn and Castlereagh	225,840	221,883
Mid and East Antrim	213,189	196,509
Mid Ulster	216,409	194,861
Newry Mourne and Down	265,114	239,300
<b>NI Total</b>	<b>2,868,194</b>	<b>2,868,202</b>

Table 5-1 shows that, based on 2013 travel demand within the BSTM, there were approximately 2.8 million person trips undertaken in and across Northern Ireland in an average 24-hour period. Based on a population of 1.83m this equates to around 1.53 trips per person.

Unsurprisingly Belfast generates the largest volume of trips whilst Fermanagh and Omagh generates the least. Likewise, some Council Areas generate more trips than they attract whilst others experience the opposite.

### 5.3. PDS Coding

The PDS set out the forecast growth by trip purpose for the whole of Northern Ireland.

This future growth is added to the model via the 24hr productions and attractions, i.e. the total number of trips either produced by a model zone (Productions) or attracted to a model zone (Attractions). These assumptions are based on the following data sources:

- Oxford Economics
- NISRA
- 'Ireland 2040 Our Plan: National Planning Framework'
- Council Preferred Options Papers

Table 5-2 gives an overview of the assumptions used to inform the PDS testing.

**Table 5-2 – Planning Development Scenario Coding Overview**

Scenario	Scenario Overview	Data Source(s)	Modelling Assumptions
1: 'Business as Usual'	Growth set out by Oxford Economics and NISRA distributed through the matrix based on the proportions of current trips	- Oxford Economics - NISRA	<ul style="list-style-type: none"> <li>- Growth by trip purpose was calculated based on the increase in population and employment from 2013 to 2030 (extrapolated from 2014) for each council district.</li> <li>- Growth for each district was distributed to the model zones proportionately, based on the current number of trips in the base model.</li> <li>- Home-based productions used the population growth percentage to calculate the total growth to distribute.</li> <li>- Non-Home-Based Productions and all Attractions used the employment growth to calculate the total growth to distribute.</li> </ul>
2: 'Council Plans'	Planned Council Growth is used, proportioned on the population centres in each council area	- Oxford Economics - NISRA - Planned Council Growth	<ul style="list-style-type: none"> <li>- Growth was based on the planned council growth sourced by DfI largely based on the councils Preferred Options Papers (POP). This growth sets out the expected increase to population and employment in each council area.</li> <li>- The population and employment growth were calculated using a weighted distribution which was skewed towards larger population centres largely based on housing growth in the councils POP.</li> </ul>
3: 'PT Focus'	Planned Council Growth distributed on the base year PT origins	- Oxford Economics - NISRA - Planned Council Growth	<ul style="list-style-type: none"> <li>- The population and employment growth were calculated using a weighted distribution which was skewed towards the base year PT matrix trip origins to calculate the zonal weights for each council.</li> </ul>

## 5.4. PDS1 – Business As Usual

The growth for this scenario is set out by Oxford Economics and NISRA distributed through the matrix based on the proportions of current trips. A summary of the productions and attractions input into the model along with the percentage change from the 2013 base to PDS1 is shown in Table 5-3.

**Table 5-3 –PDS1 Change in Productions and Attractions from 2013 Base**

Council Area	2013		PDS1		2030 PDS1 Change from 2013			
	Productions	Attractions	Productions	Attractions	Productions		Attractions	
					No.	%	No.	%
Antrim and Newtownabbey	225,076	228,205	233,656	233,995	8,580	3.8%	5,790	2.5%
Ards and North Down	242,045	209,339	249,021	209,803	6,976	2.9%	464	0.2%
Armagh and Banbridge	315,062	295,864	361,049	311,943	45,987	14.6%	16,079	5.4%
Belfast	536,211	684,449	566,894	740,837	30,683	5.7%	56,388	8.2%
Causeway Coast and Glens	219,310	201,583	224,108	194,411	4,798	2.2%	-7,172	-3.6%
Derry and Strabane	219,363	210,526	223,449	217,648	4,086	1.9%	7,122	3.4%
Fermanagh and Omagh	190,575	185,684	200,779	184,472	10,204	5.4%	-1,212	-0.7%
Lisburn and Castlereagh	225,840	221,883	255,526	232,748	29,686	13.1%	10,865	4.9%
Mid and East Antrim	213,189	196,509	220,640	196,380	7,451	3.5%	-129	-0.1%
Mid Ulster	216,409	194,861	245,667	198,396	29,258	13.5%	3,535	1.8%
Newry Mourne and Down	265,114	239,300	292,453	248,885	27,339	10.3%	9,585	4.0%
<b>NI Total</b>	<b>2,868,194</b>	<b>2,868,202</b>	<b>3,073,243</b>	<b>2,969,518</b>	<b>205,049</b>		<b>101,316</b>	

Table 5-3 shows:

- In BCC there will be an 5.7% increase in productions and an 8.2% increase in attractions from the 2013 base year.

## 5.5. PDS2 – Planned Council Growth

The growth for this scenario utilises the Planned Council Growth and is proportioned on the population centres in each council area. A summary of the productions and attractions input into the model along with the percentage change from the PDS1 (Business as Usual) for PDS2 is shown in Table 5-4.

**Table 5-4 – PDS2 Change in Productions and Attractions from 2030 PDS1**

Council Area	2030 PDS1		2030 PDS2		2030 PDS2 Change from PDS1			
	Productions	Attractions	Productions	Attractions	Productions		Attractions	
					No.	%	No.	%
Antrim and Newtownabbey	233,656	233,995	237,743	233,995	4,087	1.7%	0	0.0%
Ards and North Down	249,021	209,803	256,253	241,699	7,232	2.9%	31,896	15.2%
Armagh and Banbridge	361,049	311,943	355,685	311,943	-5,364	-1.5%	0	0.0%
Belfast	566,894	740,837	642,489	822,680	75,595	13.3%	81,843	11.0%
Causeway Coast and Glens	224,108	194,411	229,942	228,875	5,834	2.6%	34,464	17.7%
Derry and Strabane	223,449	217,648	243,229	264,152	19,780	8.9%	46,504	21.4%
Fermanagh and Omagh	200,779	184,472	202,700	203,421	1,921	1.0%	18,949	10.3%
Lisburn and Castlereagh	255,526	232,748	254,582	245,080	-944	-0.4%	12,332	5.3%
Mid and East Antrim	220,640	196,380	228,017	227,917	7,377	3.3%	31,537	16.1%
Mid Ulster	245,667	198,396	247,527	220,807	1,860	0.8%	22,411	11.3%
Newry Mourne and Down	292,453	248,885	307,698	271,793	15,245	5.2%	22,908	9.2%
<b>NI Total</b>	<b>3,073,243</b>	<b>2,969,518</b>	<b>3,205,866</b>	<b>3,272,361</b>	<b>132,623</b>		<b>302,843</b>	

Table 5-4 shows:

- In BCC there will be a 13.3% increase in productions and an 11.0% increase in attractions from the 2030 PDS1 demand scenario.

## 5.6. PDS3 – Planned Council Growth (PT Focus)

The growth for this scenario utilises the Planned Council Growth and is distributed on the base year PT origins in each council area. A summary of the productions and attractions input into the model along with the percentage change from the PDS1 (Business as Usual) for PDS3 is shown in Table 5-5.

**Table 5-5 – PDS3 Change in Productions and Attractions from 2030 PDS1**

Council Area	2030 PDS1		2030 PDS3		2030 PDS3 Change from PDS1			
	Productions	Attractions	Productions	Attractions	Productions		Attractions	
					No.	%	No.	%
Antrim and Newtownabbey	233,656	233,995	237,725	233,995	4,069	1.7%	0	0.0%
Ards and North Down	249,021	209,803	256,253	241,699	7,232	2.9%	31,896	15.2%
Armagh and Banbridge	361,049	311,943	355,685	311,943	-5,364	-1.5%	0	0.0%
Belfast	566,894	740,837	642,489	822,680	75,595	13.3%	81,843	11.0%
Causeway Coast and Glens	224,108	194,411	229,968	228,875	5,860	2.6%	34,464	17.7%
Derry and Strabane	223,449	217,648	243,229	264,152	19,780	8.9%	46,504	21.4%
Fermanagh and Omagh	200,779	184,472	204,207	203,421	3,428	1.7%	18,949	10.3%
Lisburn and Castlereagh	255,526	232,748	254,582	245,080	-944	-0.4%	12,332	5.3%
Mid and East Antrim	220,640	196,380	228,087	227,917	7,447	3.4%	31,537	16.1%
Mid Ulster	245,667	198,396	247,831	220,807	2,164	0.9%	22,411	11.3%
Newry Mourne and Down	292,453	248,885	299,737	272,320	7,284	2.5%	23,435	9.4%
<b>NI Total</b>	<b>3,073,243</b>	<b>2,969,518</b>	<b>3,199,794</b>	<b>3,272,888</b>	<b>126,551</b>		<b>303,370</b>	

Table 5-5 shows:

- In BCC there will be a 13.3% increase in productions and an 11.0% increase in attractions from the 2030 PDS1 demand scenario.
- The change in productions and attractions are very similar for both PDS2 and PDS3.

Although the population data are identical for all council districts, differences in the level of disaggregation of this data result in slightly different trip growth percentages, which in turn causes the total productions to differ between the scenarios. The difference in attractions growth in Newry Mourne and Down is due to differing employment growth between PDS2 and PDS3; the method for calculating total growth in attractions is the same.



## 5.7. PDS Outputs

The updated productions and attractions for 2030 are input into the BSTM which produces total 24hr person trips for each PDS. The change in person trips for each 2030 PDS from the 2013 DoMin are shown in Figure 5-1.

**Figure 5-1 – Model Trips**

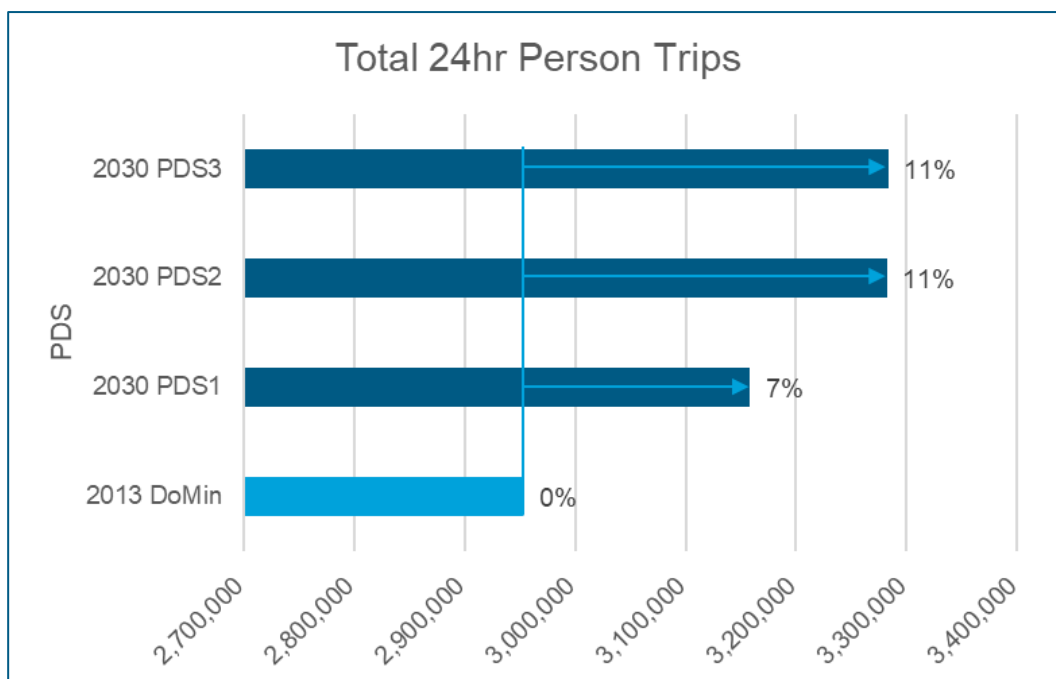


Figure 5-1 shows:

- The change in productions and attractions for each PDS will result in an increase in modelled person trips;
- PDS2 and 3 show a larger increase (11%) in person trips compared to PDS1 (7%).

The effect of this increase in person trips on the highway network with no schemes or measures in place is shown in Figure 5-2. This shows the average trip travel time by highway and bus.

Figure 5-2 – Average Trip Length Travel Time in Seconds

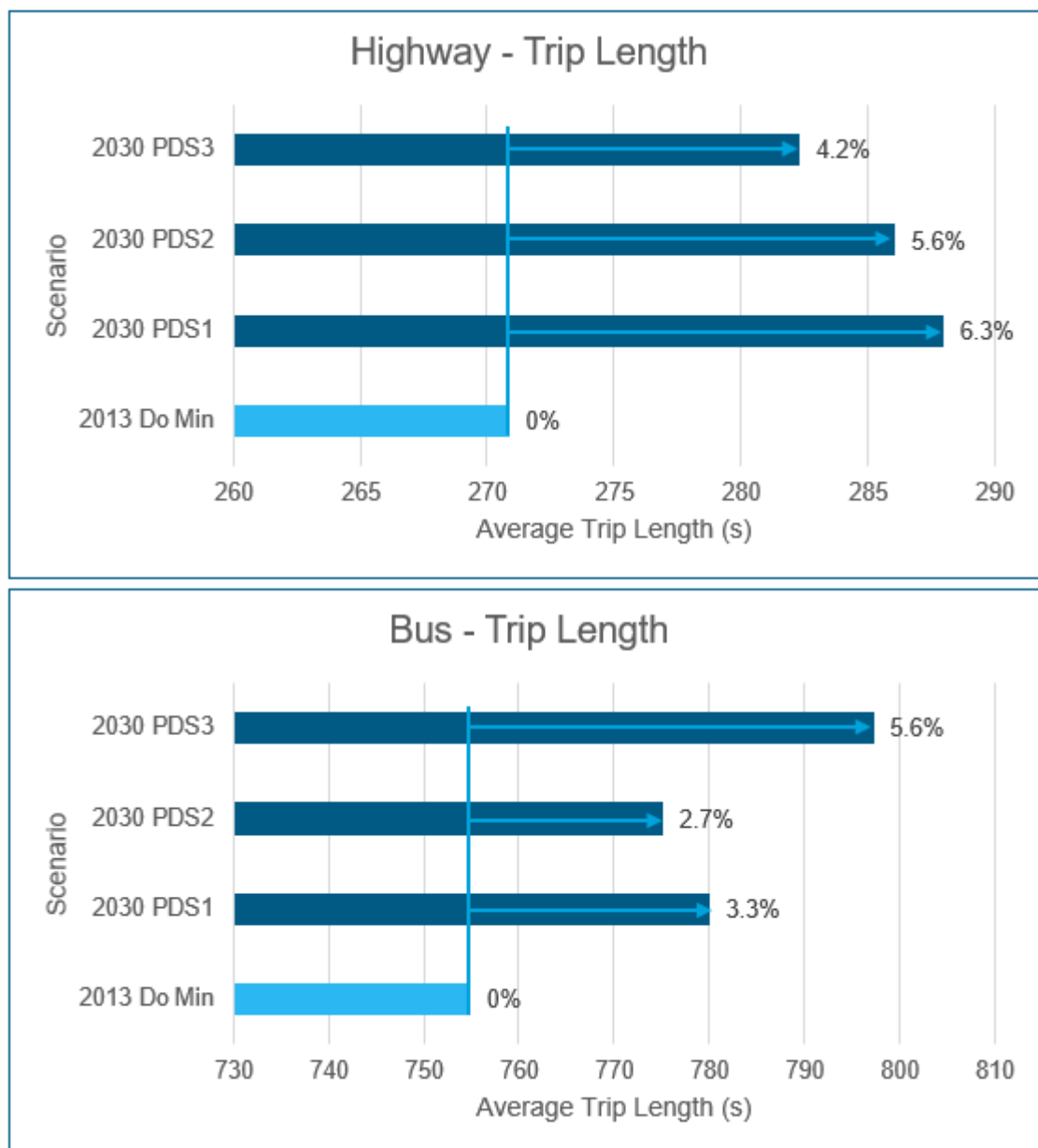
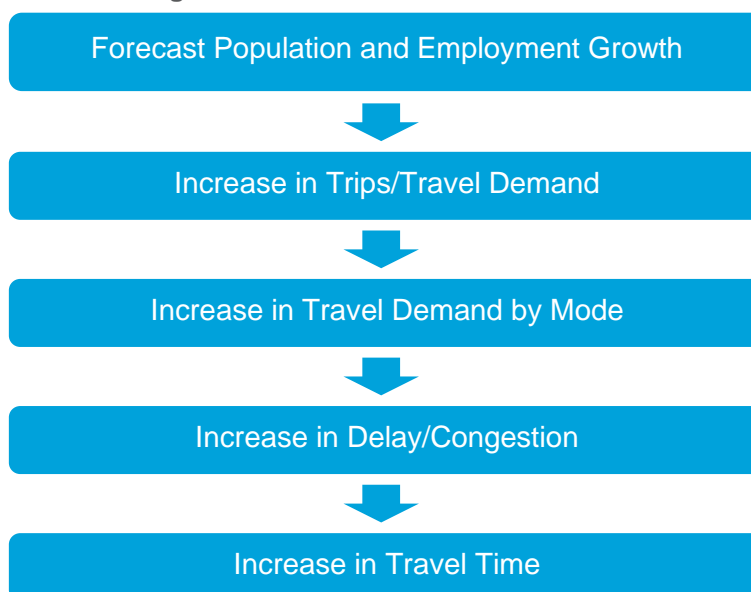


Figure 5-2 shows:

- The average highway trip travel time shows an increase between 4% and 7% across all PDS from the 2013 DoMin;
- The average bus trip travel time shows an increase between 2% and 6% across all PDS from the 2013 DoMin.

The effect of this increase in travel demand in 2030 with no mitigation in place is summarised in Figure 5-3:

**Figure 5-3 – Effect of Forecast Growth**



## 5.8. Reference Demand

Based on the modelling outputs of the PDS scenarios detailed, DfI advised Atkins to proceed with the IM testing using PDS3 as the reference demand.

The remainder of this section sets out a series of network plots showing the 2030 PDS3 DoMin network performance of the model, including:

- Delay; and
- VoC Percentage.

### 5.8.1. Delay

Figure 5-4 shows the 2030 PDS3 DoMin delay in seconds across Belfast in the AM peak hour. Figure 5-5 shows a difference plot of the delay between the 2013 and 2030 PDS3 DoMin networks.

Figure 5-4 – 2030 PDS3 AM DoMin Delay

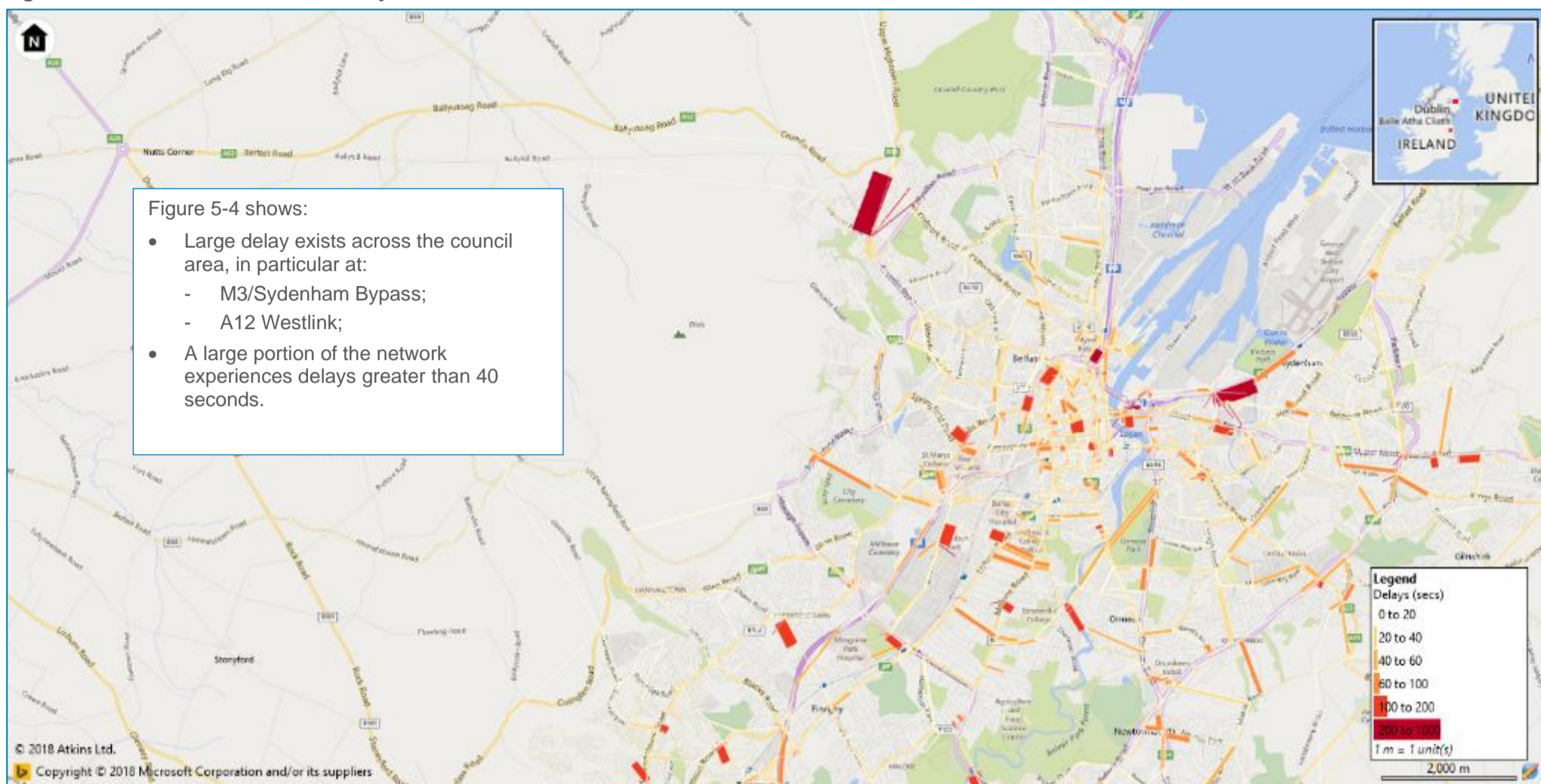
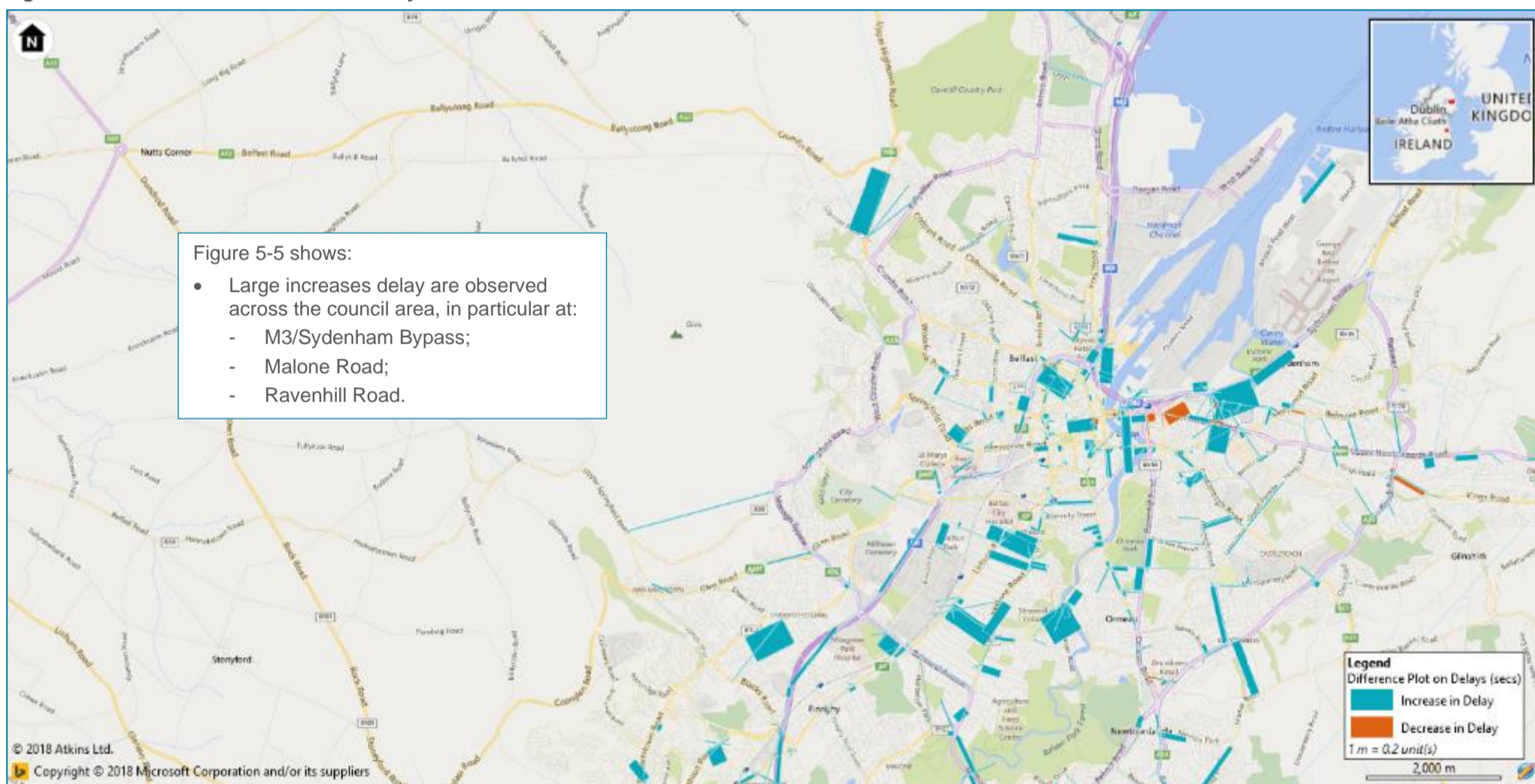


Figure 5-5 – 2030 PDS3 – 2013 DoMin Delay Difference Plot





### 5.8.2. VOC

Figure 5-6 shows the 2030 PDS3 DoMin Volume over Capacity as a percentage across Belfast in the AM peak hour. Figure 5-7 shows the VOC difference plot

Figure 5-6 – 2030 PDS3 AM DoMin VOC

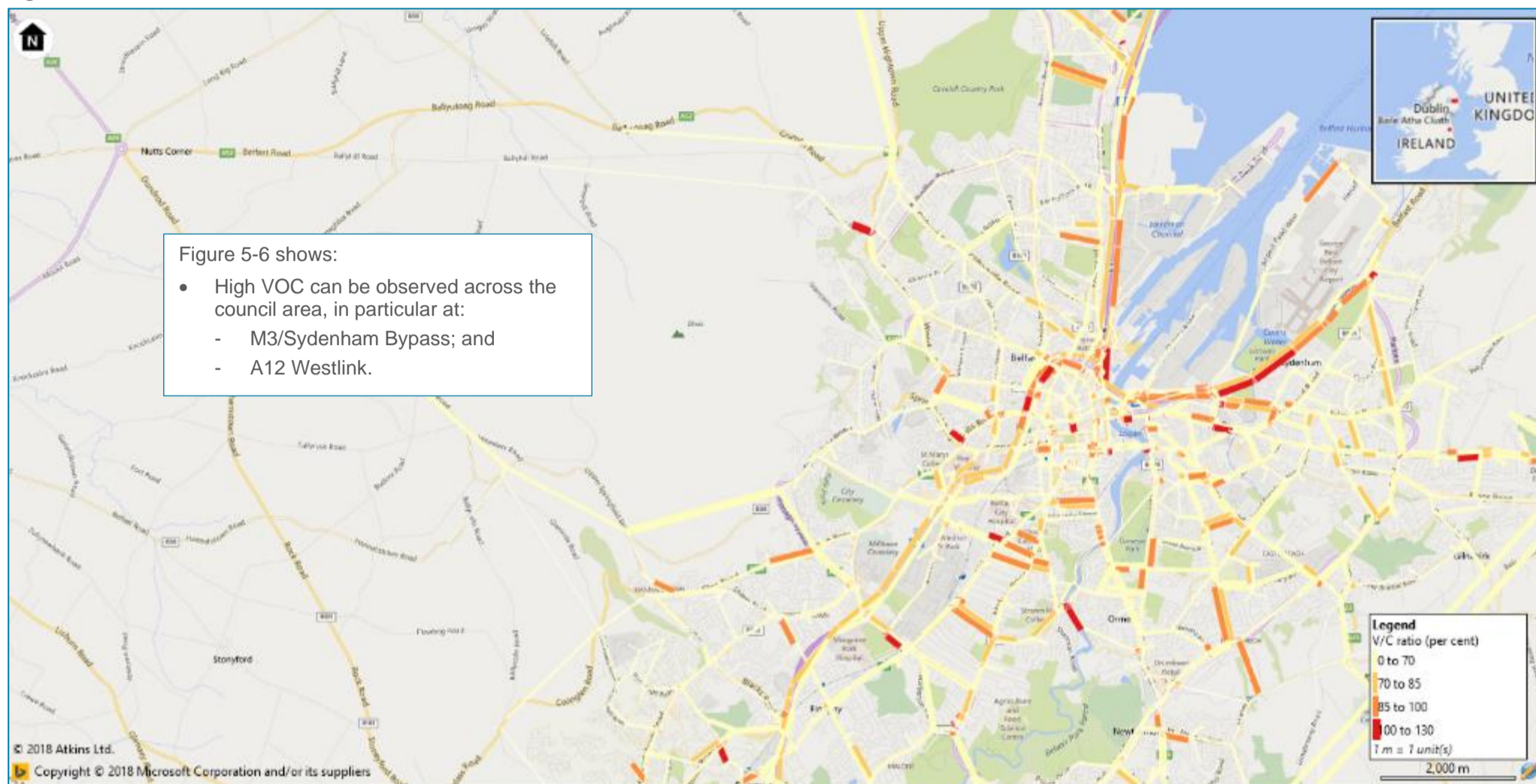
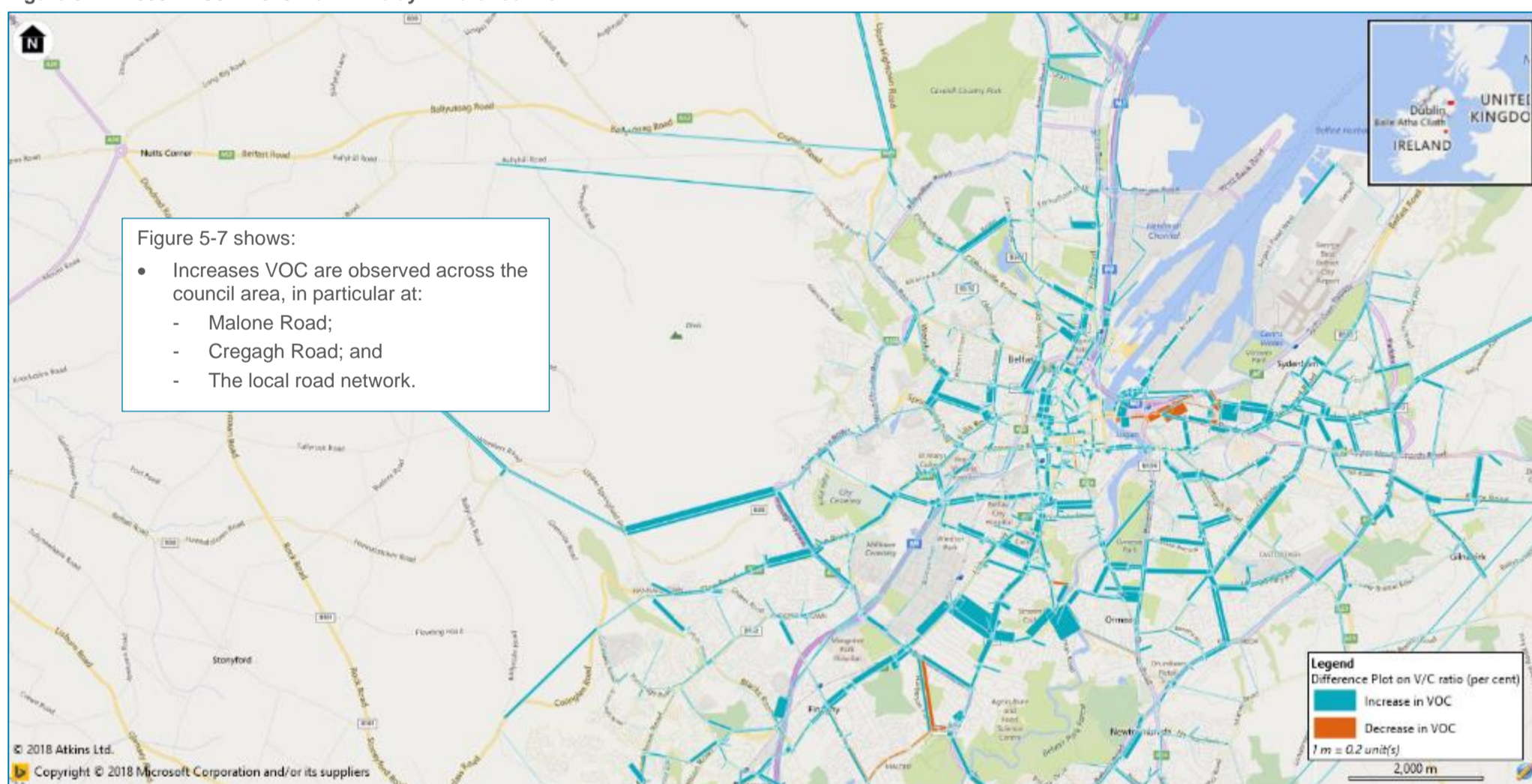


Figure 5-7 – 2030 PDS3 – 2013 DoMin Delay Difference Plot



### 5.9. Summary

The 2030 PDS3 network performance indicators throughout this section show:

- There will be increases in delay across the DoMin network which will in turn lead to increased VOCs across the council area if no action is taken.

# Illustrative Measures





## 6. Illustrative Measures

### 6.1. Introduction

This chapter provides an overview of the information and method used to code each of the IMs.

The following Illustrative Measures were tested:

- IM01 – Highway;
- IM02 – ITS;
- IM03 – Rail A;
- IM04 – Goldline;
- IM05 – BRT Phase 2;
- IM06 – Metro;
- IM07 – Cycling;
- IM08 – Walking;
- IM09 – Demand Management;
- IM10 – Fares;
- IM11 – Rail B;
- IM12 – Demand Management B.

Each of the IMs listed above required a number of coding changes to the DoMin BSTM either in the SATURN highway coding and/or the CUBE Public Transport (PT) coding.

These measures were initially tested using the base 2013 demand to check for coding errors and logical model responses. They were subsequently ran with 2030 PDS3 demand. PDS3 demand utilises the following growth forecasts distributed with a focus on public transport:


- Oxford Economics;
- NISRA;
- Planned Council Growth.

A summary of the results of these 2030 PDS3 IM model runs are presented later in this chapter.

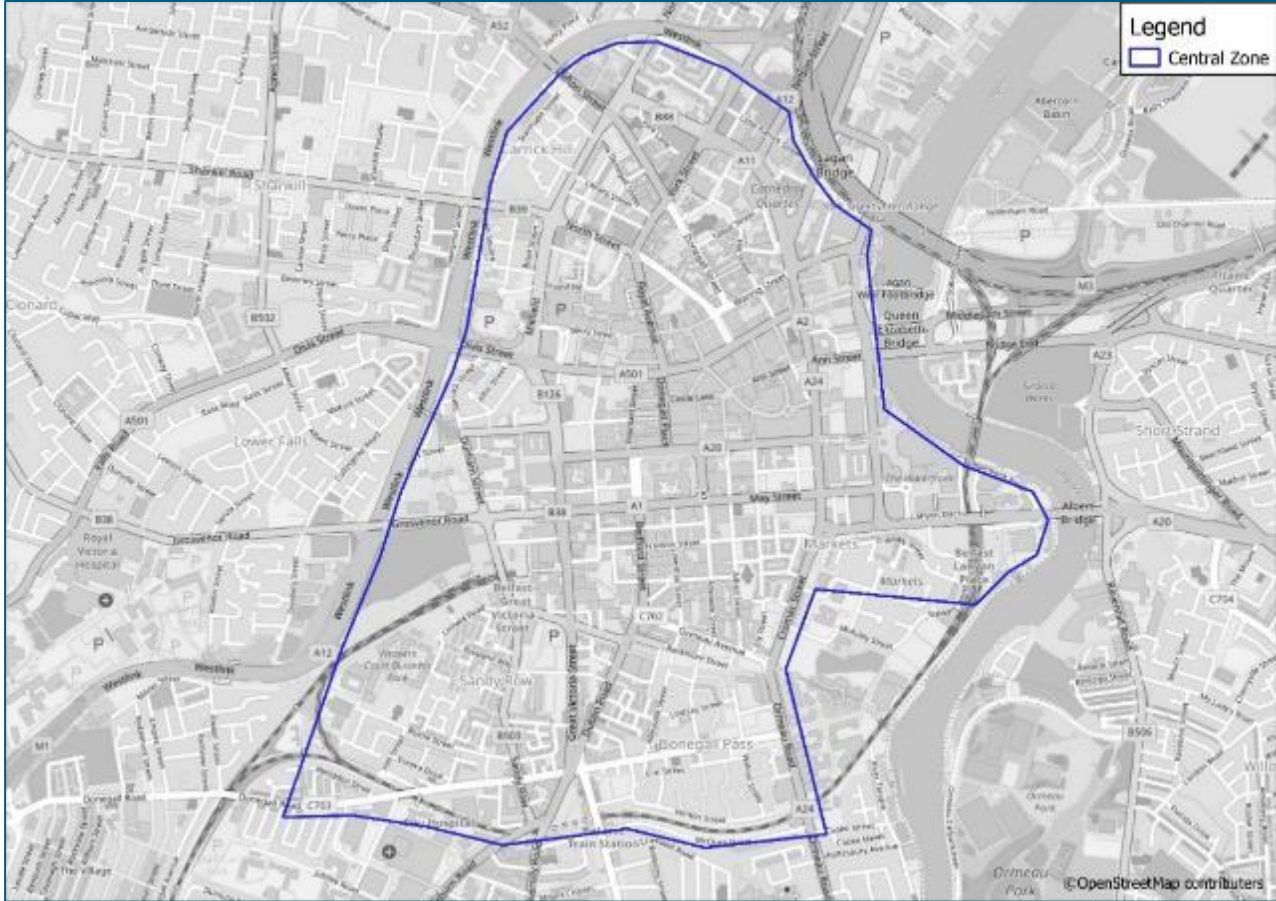
### 6.2. IM Coding Overview


Table 6-1 shows an overview of the coding used to inform the IM testing.


**Table 6-1 – Illustrative Measure Coding Overview**

Primary Mode	Primary Measure	Further Detail
<p><b>IM01 Highway</b></p>	<p><b>Schemes Included</b></p> <ul style="list-style-type: none"> <li>• York Street Interchange – fully grade separated junction between the A12 Westlink/ M2 and M3;</li> <li>• Inner Ring Road – new highway link between Bruce Street and A24 Ormeau Road;</li> <li>• Dualling of A26; and</li> <li>• Radial Capacity Enhancements               <ul style="list-style-type: none"> <li>- A55 Knock Road (2 lanes in each direction);</li> <li>- A2 Sydenham Bypass (3 lanes in each direction and closure of side roads);</li> <li>- M1/A1 Sprucefield Bypass (2 lanes in each direction);</li> <li>- M1 Widening (3 lanes in each direction).</li> </ul> </li> </ul> <p><b>Coding</b></p> <p>These schemes have been directly coded to the SATURN highway network.</p> <p>The majority of the SATURN coding was provided by AECOM via Dfl.</p>	<p><b>Location of Highway Schemes</b></p>  <p><b>Legend</b></p> <p>IM01 - Highway Schemes</p> <p>© OpenStreetMap contributors</p>

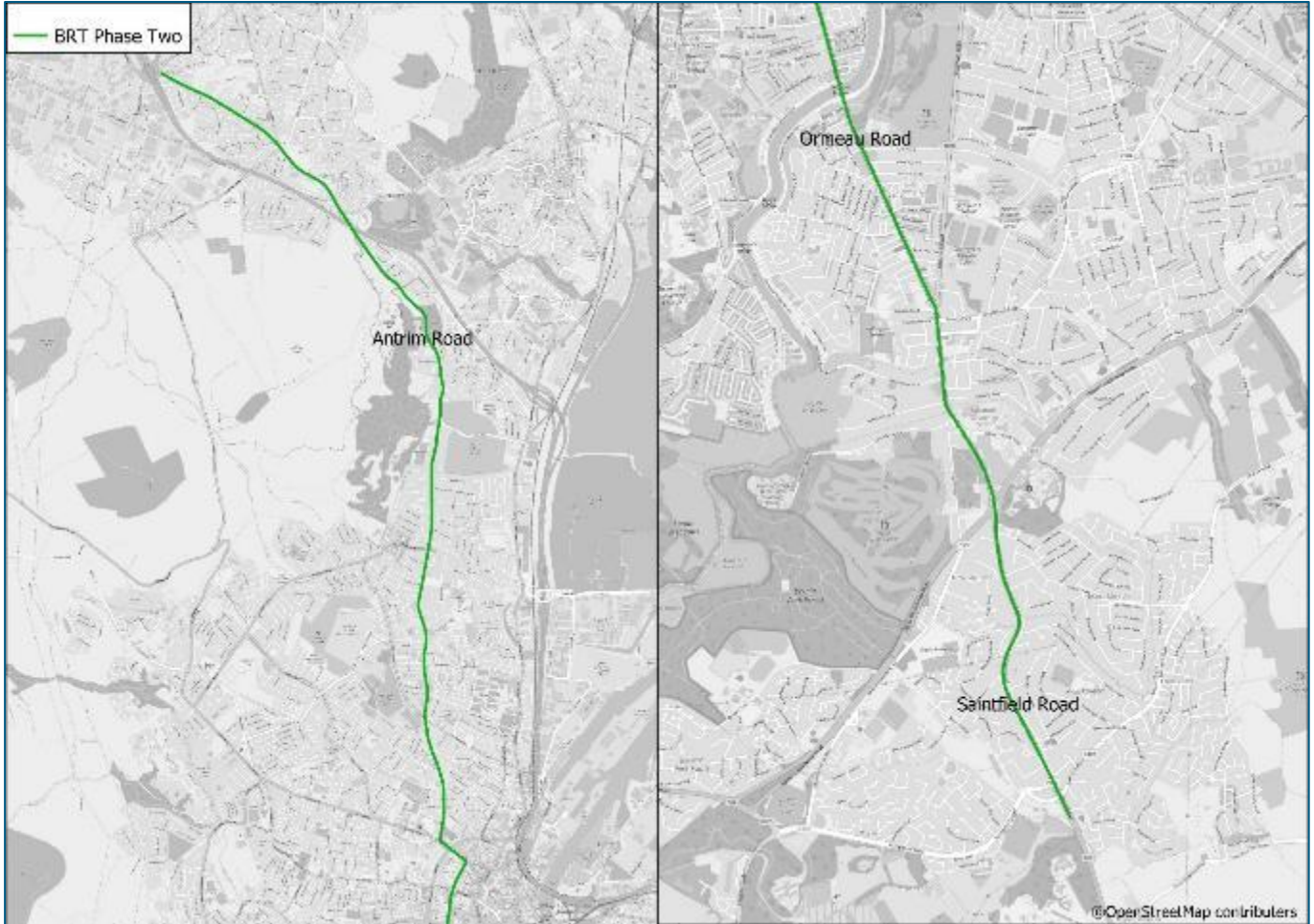


Primary Mode	Primary Measure	Further Detail
<p><b>IM02 Intelligent Transport Systems</b></p>	<p><b>Scheme</b></p> <ul style="list-style-type: none"> <li>Upgraded Urban Traffic Control for the Belfast Central Zone</li> </ul> <p><b>Coding</b></p> <ul style="list-style-type: none"> <li>'SigOpt' has been applied within SATURN to optimise the traffic signals in the Belfast Central Zone to ensure that the signal timings at each signalised junction are optimal for the volume of traffic.</li> </ul> <p>This has the effect of reducing delay through the Belfast Central Zone signalised junctions.</p>	<p><b>Belfast Central Zone</b></p>  <p>The map displays the Belfast Central Zone, a central urban area in Belfast, Northern Ireland. The zone is outlined in blue and encompasses a dense network of streets. Key landmarks and roads visible include the Albert Bridge, Queen's Street Bridge, and the River Lagan. The map also shows various residential and commercial areas, as well as public transport routes. A legend in the top right corner identifies the blue outline as the 'Central Zone'. The map is credited to OpenStreetMap contributors.</p>

Primary Mode	Primary Measure	Further Detail
<p>IM03 Rail A</p>	<p><b>Scheme</b></p> <ul style="list-style-type: none"> <li>All Trains 6 car;</li> <li>Multi-Modal Transport Hub at the Great Victoria Street;</li> <li>Ballymartin Rail Station;</li> <li>Hourly Enterprise Services;</li> <li>New Belfast Metropolitan Area (BMA) stations (Gamble Street, Merville, Monkstown); and</li> <li>Increased Frequency on Larne Line.</li> </ul> <p><b>Coding</b></p> <ul style="list-style-type: none"> <li>The capacity for each rail service has been increased to represent 6 car trains;</li> <li>All new BMA stations have been added to the rail network and any corresponding routes have been amended to call at these additional locations; and</li> <li>The frequencies of all appropriate services have been increased by reducing the headway appropriately;</li> <li>Multimodal Transport Hub coding was provided by AECOM.</li> </ul>	<p>Additional Belfast Metropolitan Stations</p>  <p>The figure is an aerial map of the Belfast Metropolitan Area, divided into three sections. The top-left section shows the Monkstown area with a red dot indicating a station. The top-right section shows the Merville area with a red dot indicating a station. The bottom section shows the Gamble Street area with a red dot indicating a station. A legend in the top-left corner identifies the red dots as 'Belfast Metropolitan Stations'. The map also shows the city's street grid, the River Liffey, and various landmarks.</p>

Primary Mode	Primary Measure	Further Detail
<p><b>IM04 Goldline</b></p>	<p><b>Scheme</b></p> <ul style="list-style-type: none"> <li>• Doubling Current Goldline Frequencies;</li> <li>• M2 Hard Shoulder Running; and</li> <li>• Local Park and Ride.</li> </ul> <p><b>Coding</b></p> <ul style="list-style-type: none"> <li>• The frequencies of all Goldline services have been increased by reducing the headway appropriately;</li> <li>• Hard shoulder bus lanes have been coded to the SATURN highway network; and</li> <li>• 23 local Park and Rides have been added to the appropriate CUBE module to create a drive link to the closest highway node to the park and ride location. The distance and time for these drive links is based on the highway skirts.</li> </ul>	<p><b>Local Park and Ride Locations</b></p>  <p>The map displays the Montreal metropolitan area with a network of roads. A legend in the top-left corner identifies yellow dots as 'Local Park and Rides' and a purple line as 'M2 - Hard Shoulder Running'. The purple line follows the M2 highway through the city. Numerous yellow dots are scattered across the region, representing the locations of 23 local park and ride facilities. The map is credited to OpenStreetMap contributors in the bottom-right corner.</p>

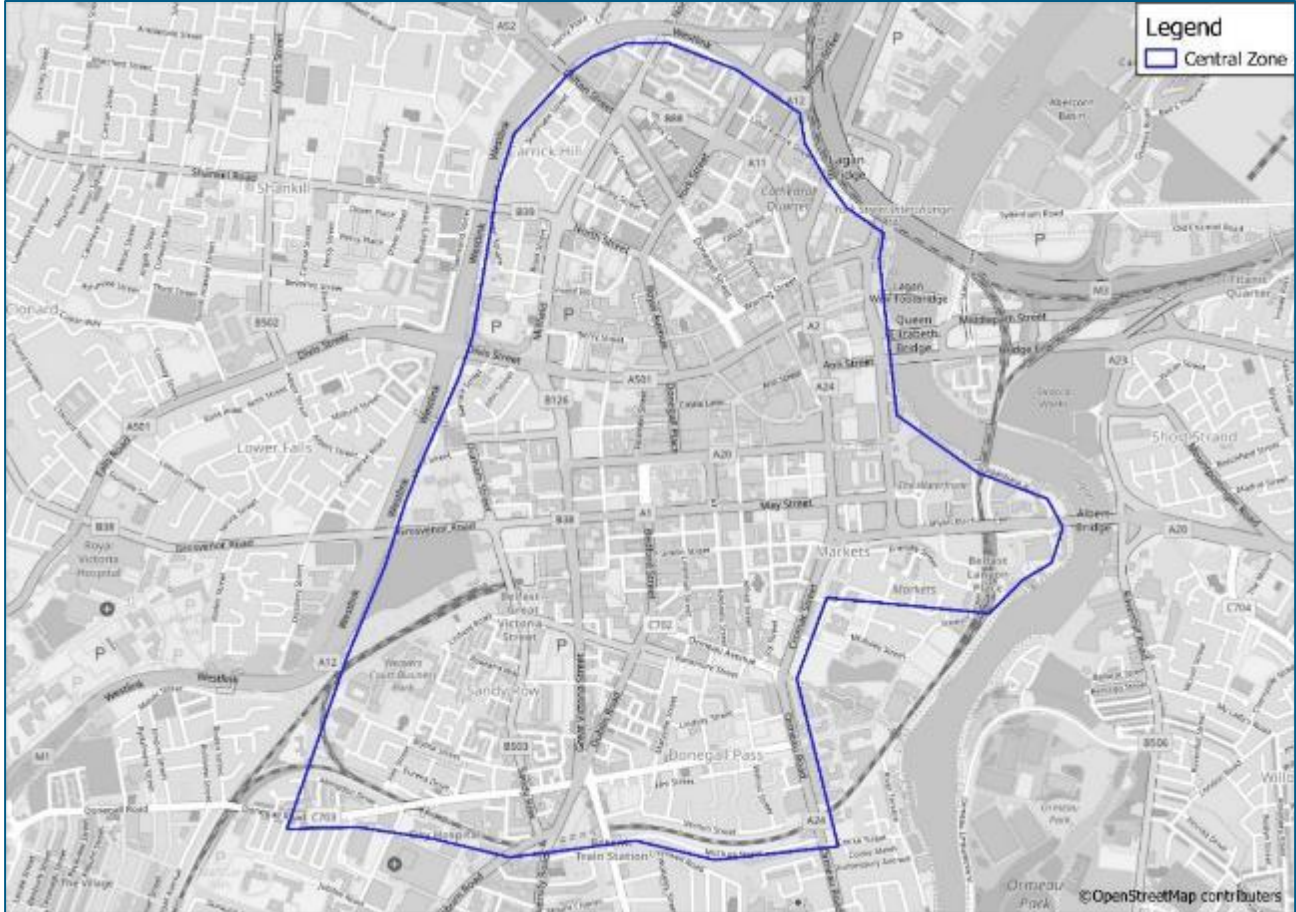


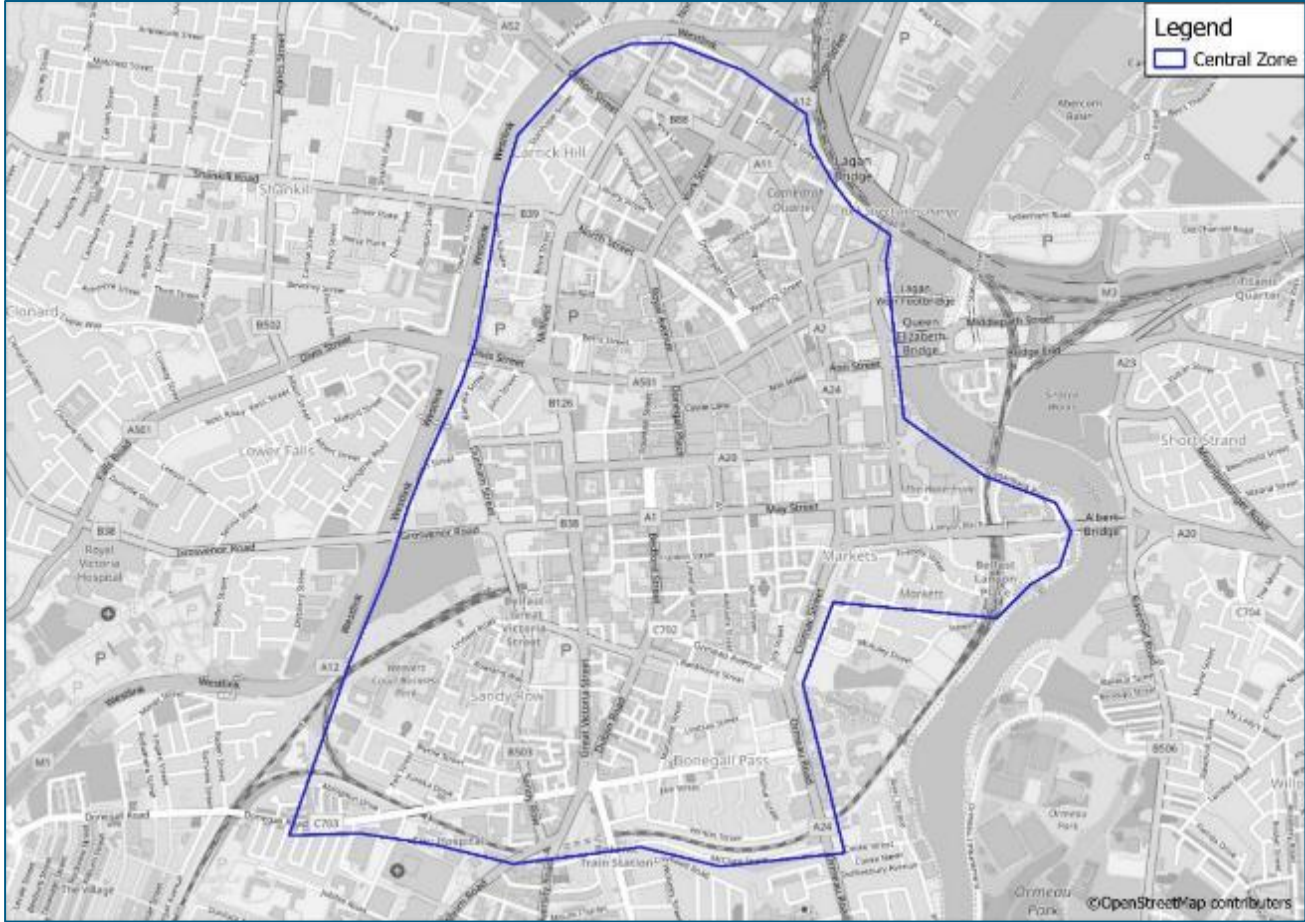
Primary Mode	Primary Measure	Further Detail
<p><b>IM05 BRT Phase 2</b></p>	<p><b>Scheme</b></p> <ul style="list-style-type: none"> <li>• North Route - Antrim Road; and</li> <li>• South Route - Ormeau Road</li> </ul> <p><b>Coding</b></p> <ul style="list-style-type: none"> <li>• The BRT Phase 2 routes have been coded into the highway network, adding bus lanes and changing junction and link capacity where required.</li> <li>• Overall some highway capacity is transferred from highway users towards the new BRT2 services (improved public transport priority).</li> <li>• BRT services have been coded with an 8 minute frequency.</li> <li>• The BRT Phase 2 plans have been agreed with DfI.</li> </ul>	 <p>The figure consists of two side-by-side maps of an urban area. The left map shows a green line representing the BRT Phase Two North Route along Antrim Road. The right map shows a green line representing the BRT Phase Two South Route along Ormeau Road and Saintfield Road. A legend in the top left corner of the left map indicates 'BRT Phase Two' with a green line. The maps are overlaid on a grey background showing street layouts and green spaces. A copyright notice '@OpenStreetMap contributors' is visible in the bottom right corner of the right map.</p>



Primary Mode	Primary Measure	Further Detail
<p>IM06 Metro</p>	<p><b>Scheme</b></p> <ul style="list-style-type: none"> <li>• Double Current Frequencies;</li> <li>• Speed Increase;</li> <li>• Cross City Services; and</li> <li>• Uniform Speed.</li> </ul> <p><b>Coding</b></p> <ul style="list-style-type: none"> <li>• The frequencies of all metro services have been doubled by reducing the headway by half; and</li> <li>• The speed of Metro vehicles was increased;</li> <li>• The following routes have been merged for cross city services: <ul style="list-style-type: none"> <li>- Merge routes 9 and 11</li> <li>- Merge routes 12 and 6</li> <li>- Merge routes 4 and 10</li> <li>- Merge routes 2 and 7</li> </ul> </li> </ul>	

<sup>2</sup> [https://moovitapp.com/index/public-transit-maps/?map=UK\\_NorthernIreland\\_NIRailways\\_schematic\\_map.pdf](https://moovitapp.com/index/public-transit-maps/?map=UK_NorthernIreland_NIRailways_schematic_map.pdf)

Primary Mode	Primary Measure	Further Detail
<p><b>IM07</b> Cycling</p>	<p><b>Scheme</b></p> <ul style="list-style-type: none"> <li>Cycling Masterplan</li> </ul> <p><b>Coding</b></p> <ul style="list-style-type: none"> <li>The distance in the cycle skim was reduced by 25% in the Belfast Central Zone. This is the most appropriate way of modelling an improvement in cycling designed to reflect a range of improvements such as improved cycle priority, cycle route signage.</li> </ul>	<p><b>Belfast Central Zone</b></p> 


Primary Mode	Primary Measure	Further Detail
<p><b>IM08 Walking</b></p>	<p><b>Scheme</b></p> <ul style="list-style-type: none"> <li>Walking Masterplan</li> </ul> <p><b>Coding</b></p> <ul style="list-style-type: none"> <li>The distance in the walk skim was reduced by 25% in the Belfast Central Zone. This was the most appropriate method of reflecting proposed improvements to walking. IT reflects the general improvement offered by measures such as improved pedestrian priority at junctions and crossings, route signage improvements.</li> </ul>	<p><b>Belfast Central Zone</b></p>  <p>The map displays the Belfast Central Zone, outlined in blue. The zone covers a central urban area of Belfast, including areas like Shankill, Sandy Row, and the city center. Major roads such as the A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17, A18, A19, A20, A21, A22, A23, A24, A25, A26, A27, A28, A29, A30, A31, A32, A33, A34, A35, A36, A37, A38, A39, A40, A41, A42, A43, A44, A45, A46, A47, A48, A49, A50, A51, A52, A53, A54, A55, A56, A57, A58, A59, A60, A61, A62, A63, A64, A65, A66, A67, A68, A69, A70, A71, A72, A73, A74, A75, A76, A77, A78, A79, A80, A81, A82, A83, A84, A85, A86, A87, A88, A89, A90, A91, A92, A93, A94, A95, A96, A97, A98, A99, A100 are visible. The map also shows various landmarks, including the Royal Victoria Hospital, the Belfast City Hall, and the Belfast Lough. A legend in the top right corner identifies the blue outline as the 'Central Zone'. The map is credited to OpenStreetMap contributors.</p>

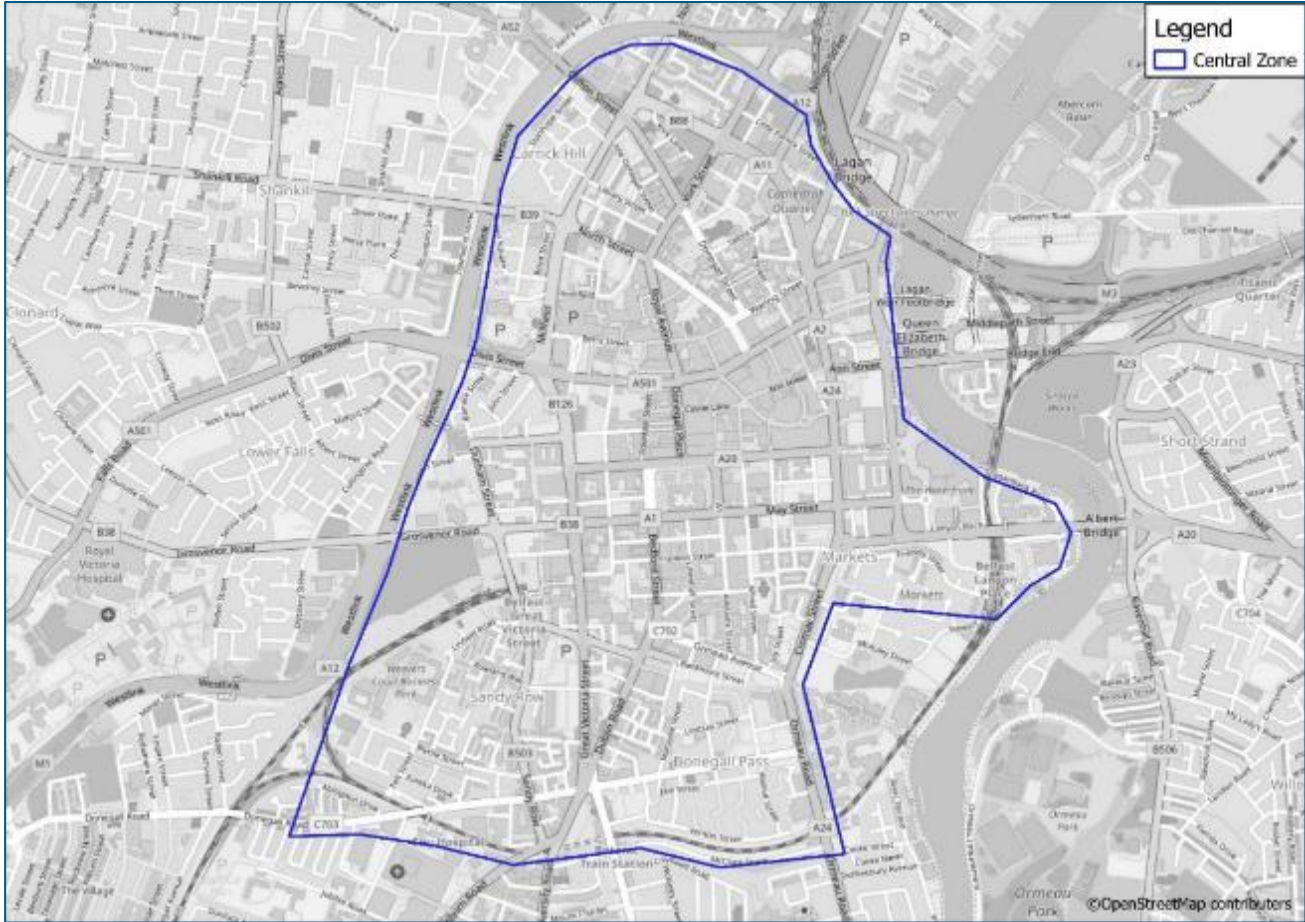


Primary Mode	Primary Measure	Further Detail
<p><b>IM09 Demand Management</b></p>	<p><b>Scheme</b></p> <ul style="list-style-type: none"> <li>• Introduction of Toll Roads;</li> <li>• Motorway Slip Road Closures; and</li> <li>• City centre controlled parking zone.</li> </ul> <p><b>Coding</b></p> <ul style="list-style-type: none"> <li>• Tolls have been added to the strategic road network (including M1, M2, A2 Sydenham Bypass, M5). These have been coded as a time penalty;</li> <li>• Slip roads at Broadway, Divis Street, Crumlin Road and M3 Lagan Bridge have been closed on the strategic road network close to Belfast city centre by banning in the slip road links to highway traffic in the SATURN highway model; and</li> <li>• A 25% increase has been added to the city centre parking charge</li> </ul>	



Primary Mode	Primary Measure	Further Detail
<p><b>IM10 Fares</b></p>	<p><b>Scheme</b></p> <ul style="list-style-type: none"> <li>Reduction in Public Transport (PT) Fares</li> </ul> <p><b>Coding</b></p> <ul style="list-style-type: none"> <li>All public transport fares (bus and rail) have been reduced by 15% across the entire model.</li> </ul>	

Primary Mode	Primary Measure	Further Detail
<p><b>IM11 Rail B</b></p>	<p><b>Scheme</b></p> <ul style="list-style-type: none"> <li>• All Trains 6 car;</li> <li>• Multi-Modal Transport Hub;</li> <li>• Ballymartin Rail Station;</li> <li>• Hourly Enterprise Services; and</li> <li>• Increased Frequency on Larne and Lisburn Lines.</li> </ul> <p><b>Coding</b></p> <ul style="list-style-type: none"> <li>• The capacity for each rail service has been increased to represent the 6 car trains;</li> <li>• Ballymartin Rail Station has been added to the rail network with any appropriate routes amended to call at this location;</li> <li>• The frequencies of all appropriate services on the Larne and Lisburn lines have been increased by reducing the headway appropriately.</li> </ul>	 <p>The map displays the rail network in the Ballymartin area. A legend in the top-left corner identifies blue lines as 'NI Railways' and red dots as 'New Rail Halts'. A prominent blue line runs horizontally across the map, with a red dot marking the 'Ballymartin' station. The map background is a light grey aerial-style view showing roads and buildings.</p>

Primary Mode	Primary Measure	Further Detail
<p><b>IM12 Demand Management B</b></p>	<p><b>Scheme</b></p> <ul style="list-style-type: none"> <li>• City centre controlled parking zone.</li> </ul> <p><b>Coding</b></p> <ul style="list-style-type: none"> <li>• A £20 increase has been added to the city centre parking charge</li> </ul>	

## 6.3. Model Outputs

This section presents summary results of the following outputs:

### Model Wide

- **Network Travel Time** – this has been selected to understand the changes to the total time travelled across the network in the AM peak hour by each mode; and
- **Matrix Totals** – this has been selected to understand the changes to the matrix totals for the morning peak hour split by highway, bus and rail.

### Belfast City Council Area

- **BCC Mode Choice** – this has been selected as it will illustrate the total AM peak hour trips within BCC for highway, bus and rail.

These model outputs have been selected to provide a high-level understanding of the IM assessments and are used to understand if the BSTM is providing intuitive results which can then be considered in greater detail as part of the Appraisal Framework.

These results compare the IM runs with the Do Minimum network ran with 2030 PDS3 demand.



## 6.4. Total Demand and Network Travel Time

### 6.4.1. Highway

Figure 6-1 shows the change in network wide travel times in the AM peak hour along with the demand matrix totals in the AM peak hour for highway.

**Figure 6-1 – AM Peak – Network Wide Travel Times and Matrix Demand – Highway**

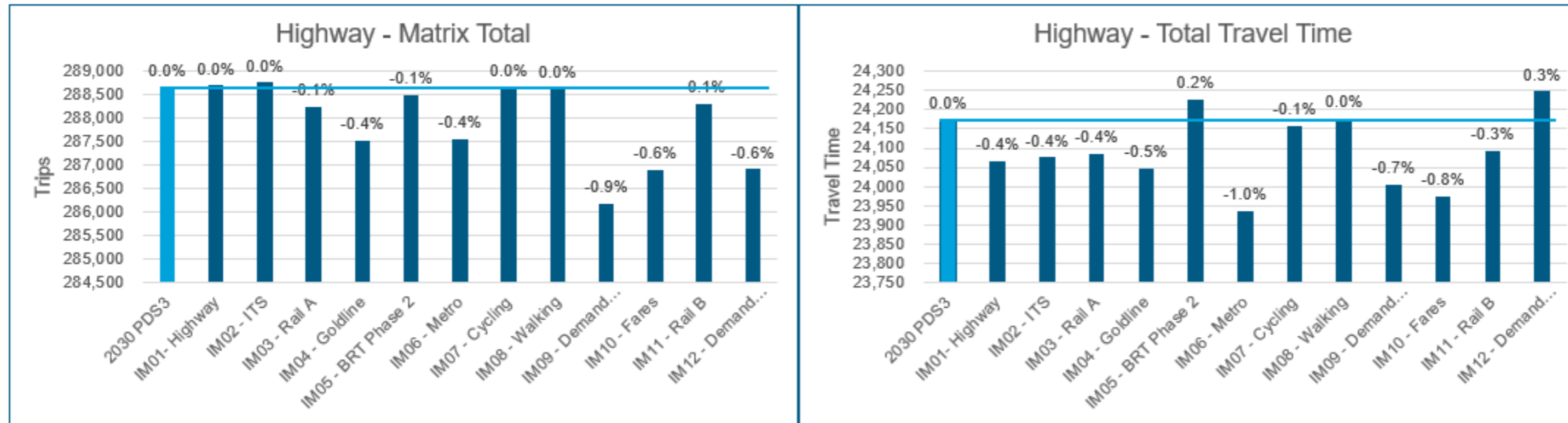


Figure 6-1 shows:

- IM01 shows a decrease in highway travel time along with a small increase in demand indicating that highway travel times are decreasing making it a more attractive mode;
- IM02 shows a decrease in highway travel time along with an increase in highway demand indicating that highway travel times are decreasing and thus suggesting it is a more attractive mode;
- With IM03, the highway matrix has decreased (due to mode shift away from highway) and so the total network travel time has also decreased;
- IM04 shows that less highway trips on the network mean the total highway travel time has decreased;
- IM05 indicates that while less people are choosing to travel by car, the travel time has increased suggesting that the changes to the highway network (i.e. bus lanes) have impacted journey times;
- In IM06 the highway matrix has decreased (due to mode shift away from highway) and so the total travel time has decreased;
- IM07 shows little change to the highway outputs;
- IM08 shows little change to the highway outputs;
- IM09 shows a decrease to the highway demand, and so the total travel time has decreased;
- In IM10 the highway matrix has decreased (due to mode shift away from highway) and so the total travel time has decreased;
- IM11 shows that less highway trips on the network mean the total highway travel time has decreased which is likely to be due to a mode shift to Rail;
- IM12 shows a decrease in highway trips, however the increase in highway travel time suggests that there is more congestion on the network or highway trips are travelling further.

### 6.4.2. Bus

Figure 6-2 shows a change in network wide travel times in the AM peak hour along with the demand matrix totals in the AM peak hour for bus.

Figure 6-2 – AM Peak – Network Wide Travel Times and Matrix Demand – Bus

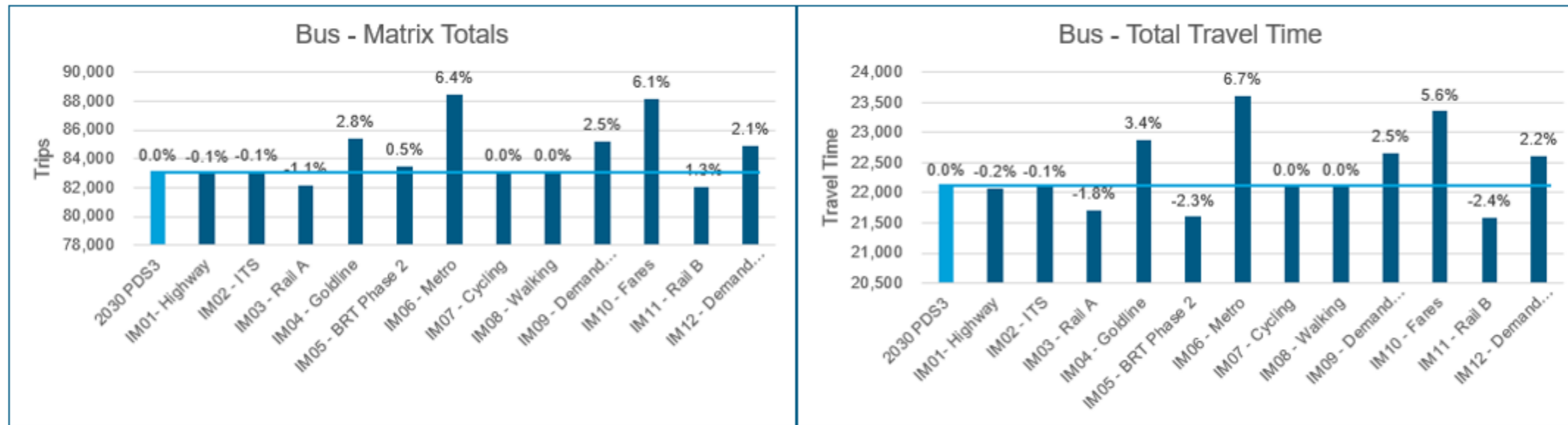


Figure 6-2 shows:

- IM01 shows a decrease in bus travel time along with a decrease in demand indicating that the improvements to the highway network are making bus a less attractive mode;
- IM02 shows a decrease in bus travel time along with a decrease in demand indicating that the improvements to the highway network are making bus a less attractive mode;
- With IM03 the bus matrix has decreased (due to mode shift away from bus) and so the total travel time has experienced a corresponding decrease;
- IM04 shows an increase in bus demand (as Goldline becomes more attractive) and an increase in total bus travel time (reflecting the increase in total bus demand);
- IM05 outlines that while more people are choosing to travel by bus, the travel time has decreased meaning that the network changes have decreased bus travel times;
- IM06 shows more bus trips in the matrix total has increased the total bus travel time;
- IM07 shows little change to the bus outputs;
- IM08 shows little change to the bus outputs;
- IM09 shows a that the highway changes have encouraged a mode shift towards bus and so the total travel time has also increased;
- IM10 shows more bus trips in the matrix total has increased the total bus travel time;
- IM11 the bus matrix has decreased (due to mode shift away from bus) and so the total travel time has decreased;
- IM12 shows a that the highway changes have encouraged a mode shift towards bus and so the total travel time has also increased.

### 6.4.3. Rail

Figure 6-3 shows the change in network wide travel times in the AM peak hour along with the matrix totals in the AM peak hour for Rail.

**Figure 6-3 – AM Peak – Network Wide Travel Times and Matrix Demand – Rail**

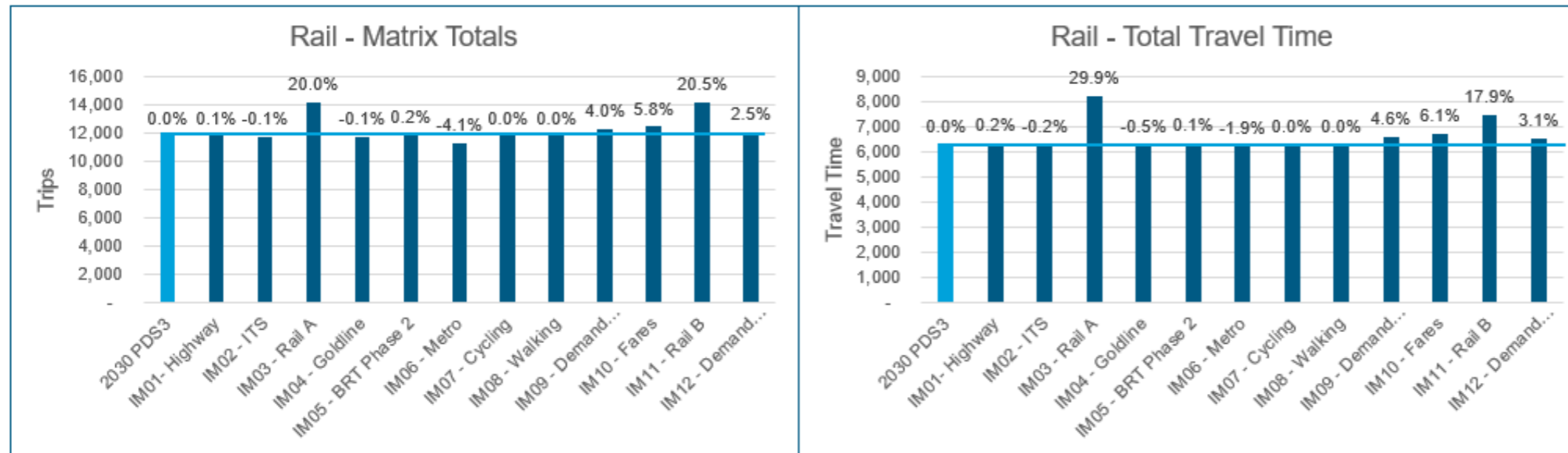


Figure 6-3 shows:

- IM01 (highway) and IM02 (ITS) shows little change to the rail outputs, which is as expected;
- In IM03 the rail demand has increased (due to improvements to the rail network) and so the total travel time has increased (there is a saving in total travel time to existing users but this is outweighed by the rail travel time due to new users transferring to rail).;
- IM04 (Goldline) and IM05 (BRT2) show little change to the rail outputs;
- IM06 shows a small decrease to rail matrix totals as bus has become a more attractive mode;
- IM07 shows little change to the bus outputs;
- IM08 shows little change to the bus outputs;
- IM09 shows a that the highway changes have encouraged a small mode shift towards rail and so the total travel time has also increased;
- IM10 shows more rail trips in the matrix total has increased the total rail travel time;
- IM11 the rail demand has increased (due to improvements to the rail network) and so the total travel time has increased;
- IM12 shows a that the highway changes have encouraged a small mode shift towards rail and so the total travel time has also increased.

## 6.5. Change in Demand within Belfast City Council

Figure 6-4 shows the total change in trips within the Belfast City Council (BCC) area in the AM peak hour. The highway demand is shown in PCUs whereas the bus and rail demand are shown in person trips.

Figure 6-4 – Total Change in Demand within BCC (AM Peak) by Mode

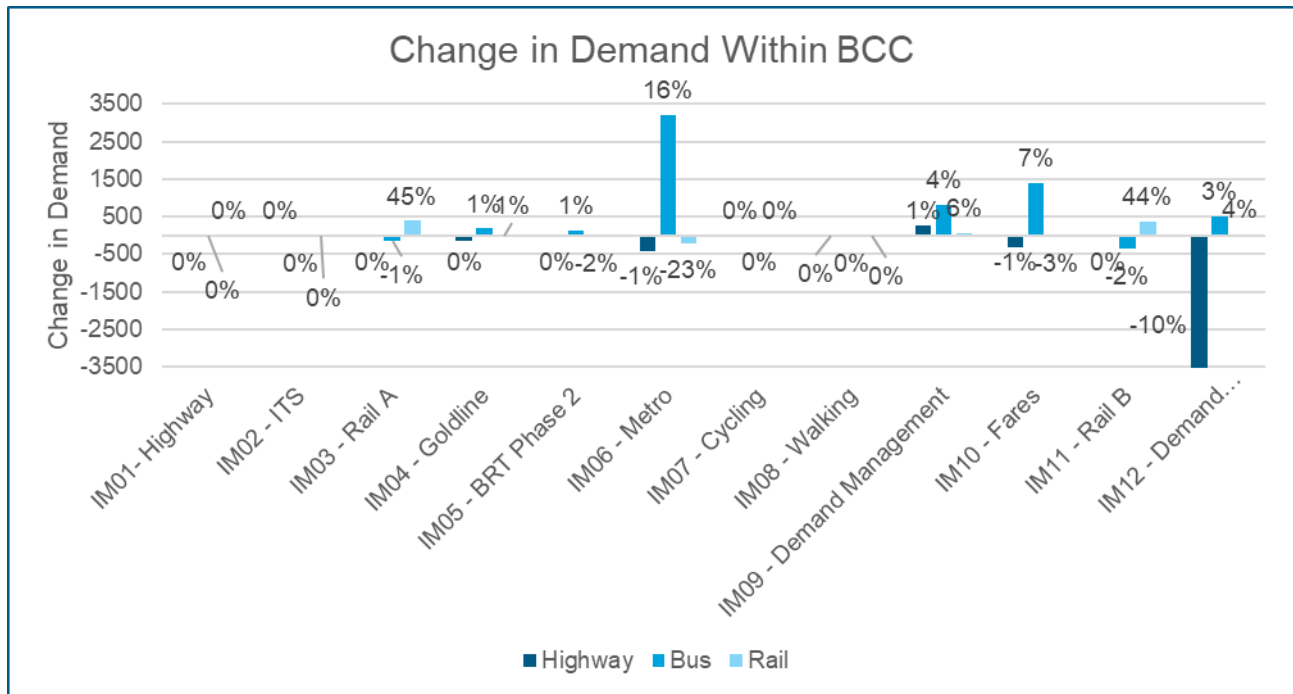


Figure 6-4 shows:

- IM03 (Rail A) and IM11 (Rail B) show a significant increase in rail trips (45% increase in rail) within the council area;
- IM06 (Metro) shows a significant increase in bus person trips (16%), which includes some transfer from rail (a 23% decrease in rail trips);
- IM10 (Fares) shows a 7% increase in bus person trips within the BCC area with a reduction in both highway and rail trips within BCC;
- IM12 (Demand Management B) shows a decrease in highway trips (10%) within the council area.

## 6.6. Conclusion

The modelling outputs in this section have demonstrated that in general:

- Highway related IMs improve the travel time and attractiveness of highway;
- Bus based IMs result in a mode shift towards bus; and
- Rail based IMs result in a mode shift towards rail;
- The Demand Management IMs result in an overall reduction in highway trips and in turn total highway travel time across the network.

On the basis of this high-level model output review it is clear that the BSTM is providing intuitive results. As such, it is reasonable to assume that the BSTM can be used to consider the effectiveness of each respective IM through the Appraisal Framework.



# Appraisal Framework



# 7. Appraisal Framework

## 7.1. Introduction

The purpose of the Appraisal Framework (AF) is to provide an indication as to how the various model runs undertaken perform in relation to the BMTS Vision and Objectives as set out in Chapter 2. The flow chart shown in Figure 7-1 sets out a brief overview of the approach taken to develop the AF for the BMTS.

**Figure 7-1 – Appraisal Framework Development Methodology**



- **Develop Transport Objectives:** These have been formed by considering key regional and local policy documents;
- **Identify Suitable Indicators** – For each of the 7 Objectives Indicators were identified. i.e. outcomes which would help to demonstrate if an Objective is being met successfully or adversely impacted.
- **Pair with Model Outputs** - Each model output from the BSTM has been assessed as to which best align with the Indicators;
- **Appraisal Framework** – The model outputs are then indexed to the relevant ‘base’ scenario to assess the impact of the model run.

The remainder of this section sets out an overview of each element of the Appraisal Framework (AF).

## 7.2. Objectives

There are seven transport **Objectives** for the Belfast Metropolitan Area:

**Objective 1:** Enhance accessibility by road and public transport from the centre of Belfast to Londonderry, gateways and hubs to support greater levels of inward investment

**Objective 2:** Ensure financially viable and sustainable public transport accessibility to essential services for people living in Belfast City Council Area

**Objective 3:** Ensure there are attractive and safe active travel networks (walking and cycling) linking all residential, retail, leisure, culture, office and commercial uses within the urban areas of the Belfast City Council area

**Objective 4:** Deliver high quality public realm in Belfast City Centre and in district centres with reduced vehicle dominance, to make them attractive, shared spaces to live and work and improve safety for active modes

**Objective 5:** Enhance transport accessibility and manage traffic congestion to Belfast City Centre and to district centres to strengthen Belfast's role as the regional economic driver

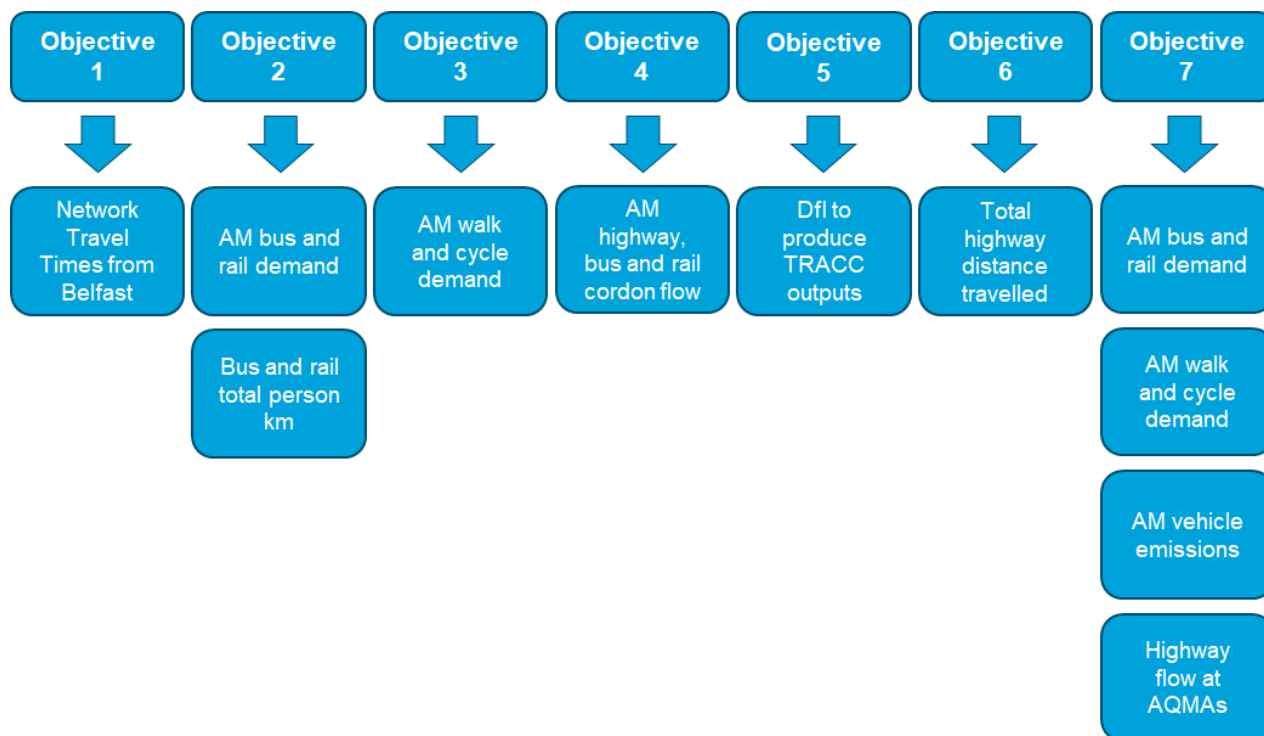
**Objective 6:** Enhance safety for all modes of travel and reduce the number and severity of casualties

**Objective 7:** Protect and enhance the built and natural environment by ensuring our transport systems operate sustainably and can integrate climate change adaptation requirements

### 7.3. Indicators

**Indicators** – The model output being used to assess the performance of each Alternative Network (shown in Figure 7-2). These model outputs have been indexed to show a change from the DoMin (apart from Objective 7 AQMA outputs) i.e. the DoMin outputs are 100 and any change from the DoMin is shown as an increase or decrease from 100.

**Figure 7-2 – Appraisal Framework Indicators**



### 7.4. Summary Comments

**Appraisal Summary Comments** – These set out an overview of the main themes as identified by the model indicators.

# Illustrative Measures 2030 Assessment





## 8. Illustrative Measures 2030 Assessment

### 8.1. Introduction

This section sets out the results of the 2030 IM model runs. These include the following IMs:

- IM01 – Highway;
- IM02 – ITS;
- IM03 – Rail A;
- IM04 – Goldline;
- IM05 – BRT Phase 2;
- IM06 – Metro;
- IM07 – Cycling;
- IM08 – Walking;
- IM09 – Demand Management;
- IM10 – Fares;
- IM11 – Rail B;
- IM12 – Demand Management B.

The following section sets out:

1. The **Objective** being assessed;
2. The model output used as the **Indicator** for this Objective;
3. The model outputs for each IM indexed to the 2030 PDS3 DoMin model run at 100. These have been coloured where:
  - a. **Light Green** represents where a positive contribution (0% - 10%) has been made in support of the Objective;
  - b. **Dark Green** represents where a highly positive contribution has been made in support of the Objective (greater than 10% change);
  - c. **White** represents where no contribution has been made in support of the Objective;
  - d. **Light Red** represents where a negative contribution (0% - 10%) has been made in support of the Objective; and
  - e. **Dark Red** represents where a very negative contribution has been made in support of the Objective (greater than 10% change).
4. The **Appraisal Summary Comments** detail the overall model outputs for each IM, split by mode.

### 8.2. IM2030 Appraisal Framework

The remainder of this section sets out the Appraisal Framework for the 2030 PDS3 IM model runs.

## Objective 1- Enhance accessibility by road and public transport from the centre of Belfast to Londonderry, gateways and hubs to support greater levels of inward investment

### Indicator

The travel time from Belfast to various hubs throughout NI in the AM peak hour, split by highway, bus and rail

Key	IM01 - Highway:			IM02 - Intelligent Transport Systems:			IM03 - Rail A:			IM04 - Goldline:			IM05 - BRT2:			IM06 - Metro:			IM07 - Cycling:			IM08 - Walking:			IM09 - Demand Management:			IM10 - Fares:			IM11 - Rail B:			IM12 - Demand Management B:		
	- York Street Interchange; - Inner Ring Road; - Dualling of A26; - Radial Capacity Enhancements			- Upgraded Urban Traffic Control			- All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - New BM stations (Gamble Street, Merville, Monkstown); - Increased Frequency on Larne Line			- Doubling Current Goldline Frequencies; - M2 Hard Shoulder Running; - Local Park and Ride			- North Route - Antrim Road; - South Route - Ormeau Road			- Double Current Frequencies; - Speed Increase; - Cross City Services; - Uniform Speed			- Cycling Masterplan			- Walking Masterplan			- Tolls; - Motorway Slip Road Closures; - City centre controlled parking zone			- Reduction in PT Fares			- All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - Increased Frequency on Larne and Lisburn Lines			-£20 City centre parking charge		
	Positive Contribution			Neutral Contribution			Negative Contribution			Positive Contribution			Neutral Contribution			Negative Contribution			Positive Contribution			Neutral Contribution			Negative Contribution			Positive Contribution			Neutral Contribution			Negative Contribution		
IM01			IM02			IM03			IM04			IM05			IM06			IM07			IM08			IM09			IM10			IM11			IM12			
Destination Hub	Travel Time			Travel Time			Travel Time			Travel Time			Travel Time			Travel Time			Travel Time			Travel Time			Travel Time			Travel Time			Travel Time					
	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail						
Antrim	99	100	100	101	100	100	100	100	78	100	100	100	101	97	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Ballycastle	100	100	100	101	100	100	100	100	89	100	100	100	100	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Ballymena	99	100	100	101	100	100	100	100	85	100	100	100	100	98	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Ballymoney	100	100	100	101	100	100	100	100	89	100	100	100	100	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Coleraine	100	100	100	101	100	100	100	100	90	100	100	100	100	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Derry	100	100	100	100	100	100	100	100	94	100	100	100	100	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Larne	100	100	100	101	100	100	100	100	94	100	100	100	100	90	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Limavady	100	100	100	100	100	100	100	100	93	100	100	100	100	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Magherafelt	100	100	100	101	99	100	100	100	78	100	100	100	100	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Newtownards	112	100	100	99	101	100	100	100	88	100	100	100	100	97	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Banbridge	99	100	100	98	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Downpatrick	99	100	100	99	100	100	100	100	100	100	100	100	100	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Newcastle	99	100	100	99	100	100	100	100	100	100	100	100	100	91	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Newry	99	100	100	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Armagh City	98	99	100	99	100	100	100	100	84	100	121	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Craigavon	97	98	100	98	100	100	100	100	84	100	106	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Cookstown	100	100	100	100	99	100	100	100	84	100	118	100	100	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Dungannon	98	98	100	99	100	100	100	100	84	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Enniskillen	99	99	100	99	100	100	100	100	84	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Omagh	99	100	100	99	100	100	100	100	84	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Strabane	99	100	100	100	100	100	100	100	94	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		

### Appraisal Summary Comments

#### IM01 - Highway

- **Highway:** Some small improvements to travel times are observed - in particular for travel to the South and West
- **Bus:** Travel times generally remain constant with some slight improvements when travelling towards the west
- **Rail:** Travel times remain constant

#### IM02 - ITS

- **Highway:** Some small improvements to travel times are observed - in particular for travel to the South and West. Some increased travel time noted to the north
- **Bus:** Travel times generally remain constant
- **Rail:** Travel times remain constant

#### IM03 - Rail A

- **Highway:** Travel times generally remain constant
- **Bus:** Travel times generally remain constant
- **Rail:** Notable improvements to travel times in all directions with exception to the south

#### IM04 - Goldline

- **Highway:** Travel times generally remain constant

- **Bus:** Travel times generally remain constant with an increase in some travel times towards the west
- **Rail:** Travel times remain constant

#### IM05 – BRT Phase 2

- **Highway:** Small increases in travel time
- **Bus:** Decreases in travel time across the hubs
- **Rail:** Travel times remain constant

#### IM06 - Metro

- **Highway:** Travel times generally remain constant
- **Bus:** Travel times generally remain constant apart from a notable reduction when travelling to Newtownards
- **Rail:** Travel times remain constant

#### IM07 - Cycle

- **Highway:** Travel times remain constant
- **Bus:** Travel times remain constant
- **Rail:** Travel times remain constant

#### IM08 - Walk

- **Highway:** Travel times remain constant
- **Bus:** Travel times remain constant

- **Rail:** Travel times remain constant

#### IM09 – Demand Management

- **Highway:** Significant increases to travel times
- **Bus:** Increases are shown when travelling North whereas small decreases are observed when travelling West
- **Rail:** Travel times remain constant

#### IM10 - Fares

- **Highway:** Travel times remain constant
- **Bus:** Travel times remain constant
- **Rail:** Travel times remain constant

#### IM11 – Rail B

- **Highway:** Travel times generally remain constant
- **Bus:** Travel times generally remain constant
- **Rail:** Notable improvements to travel times

#### IM12 – Demand Management B

- **Highway:** Small increases in travel time
- **Bus:** Travel times generally remain constant
- **Rail:** Travel times generally remain constant

## Objective 2 - Ensure financially viable and sustainable public transport accessibility to essential services for people living in Belfast City Council Area

### Indicator

The total demand for Bus and Rail trips in the AM peak hour model wide

Key		IM01 - Highway:			IM02 - Intelligent Transport Systems:			IM03 - Rail A:			IM04 - Goldline:			IM05 - BRT2:			IM06 - Metro:		
Positive Contribution		- York Street Interchange; - Inner Ring Road;			- Upgraded Urban Traffic Control			- All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station;			- Doubling Current Goldline Frequencies; - M2 Hard Shoulder Running; - Local Park and Ride			- North Route - Antrim Road; - South Route - Ormeau Road			- Double Current Frequencies; - Speed Increase; - Cross City Services; - Uniform Speed		
Neutral Contribution		- Dualling of A26;						- Hourly Enterprise Services;											
Negative Contribution		- Radial Capacity Enhancements						- New BM stations (Gamble Street, Merville, Monkstown); - Increased Frequency on Lame Line											
		<b>IM01</b>			<b>IM02</b>			<b>IM03</b>			<b>IM04</b>			<b>IM05</b>			<b>IM06</b>		
		AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips		
Mode		From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast
Bus		99	100	100	100	100	100	98	99	99	104	105	101	103	102	101	103	101	116
Rail		100	100	100	100	100	100	109	109	145	101	100	101	100	100	98	95	94	77
		IM07 - Cycling:			IM08 - Walking:			IM09 - Demand Management:			IM10 - Fares:			IM11 - Rail B:			IM12 - Demand Management B:		
		- Cycling Masterplan			- Walking Masterplan			- Tolls; - Motorway Slip Road Closures; - City centre controlled parking zone			- Reduction in PT Fares			- All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station;			-£20 City centre parking charge		
		<b>IM07</b>			<b>IM08</b>			<b>IM09</b>			<b>IM10</b>			<b>IM11</b>			<b>IM12</b>		
		AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips		
Mode		From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast
Bus		100	100	100	100	100	100	106	99	104	105	105	107	98	97	98	114	100	103
Rail		100	100	100	100	100	100	109	103	106	107	105	97	117	116	144	107	101	104

### Appraisal Summary Comments

#### IM01 - Highway

- **Bus:** A decrease in person trips from the Belfast City Council area is observed. Person trips within and to the council area remain constant;
- **Rail:** Person trips remain constant.

#### IM02 - ITS

- **Bus:** Person trips remain constant;
- **Rail:** Person trips remain constant.

#### IM03 - Rail A

- **Bus:** A decrease in person trips can be observed;
- **Rail:** Person trips increase across the model, particularly within the Belfast City Council area.

#### IM04 - Goldline

- **Bus:** Person trips increase across the model;
- **Rail:** An increase in person trips is observed both from and within Belfast.

#### IM05 – BRT Phase 2

- **Bus:** Person trips increase across the model;
- **Rail:** A decrease in person trips is observed within Belfast.

#### IM06 - Metro

- **Bus:** Person trips increase across the model, particularly notable within Belfast;
- **Rail:** Person trips decrease across the model.

#### IM07 - Cycle

- **Bus:** Person trips remain constant;
- **Rail:** Person trips remain constant.

#### IM08 - Walk

- **Bus:** Person trips remain constant;
- **Rail:** Person trips remain constant.

#### IM09 – Demand Management

- **Bus:** Trips from Belfast decrease whereas trips to and within Belfast remain constant;
- **Rail:** Person to Belfast increase, whereas trips from and within remain constant.

#### IM10 - Fares

- **Bus:** Person trips increase across the model, in particular, within Belfast;
- **Rail:** Trips from and to Belfast increase however trips within Belfast decrease.

#### IM11 – Rail B

- **Bus:** A decrease in person trips can be observed;
- **Rail:** Person trips increase across the model, notably within the Belfast City Council area.

#### IM12 – Demand Management B

- **Bus:** An increase in person trips can be observed from and within Belfast;
- **Rail:** Person trips increase across the model.

**Objective 2 (Continued) - Ensure financially viable and sustainable public transport accessibility to essential services for people living in Belfast City Council Area**

Indicator

The total person km travelled by bus and rail for the AM peak hour, model wide

Key												
Positive Contribution	<b>IM01 - Highway:</b> - York Street Interchange; - Inner Ring Road; - Dualling of A26; - Radial Capacity Enhancements	<b>IM02 - Intelligent Transport Systems:</b> - Upgraded Urban Traffic Control	<b>IM03 - Rail A:</b> - All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - New BM stations (Gamble Street, Merville, Monkstown); - Increased Frequency on Larne Line	<b>IM04 - Goldline:</b> - Doubling Current Goldline Frequencies; - M2 Hard Shoulder Running; - Local Park and Ride	<b>IM05 - BRT2:</b> - North Route - Antrim Road; - South Route - Ormeau Road	<b>IM06 - Metro:</b> - Double Current Frequencies; - Speed Increase; - Cross City Services; - Uniform Speed	<b>IM07 - Cycling:</b> - Cycling Masterplan	<b>IM08 - Walking:</b> - Walking Masterplan	<b>IM09 - Demand Management:</b> - Tolls; - Motorway Slip Road Closures; - City centre controlled parking zone	<b>IM10 - Fares:</b> - Reduction in PT Fares	<b>IM11 - Rail B:</b> - All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - Increased Frequency on Larne and Lisburn Lines	<b>IM12 - Demand Management B:</b> -£20 City centre parking charge
Neutral Contribution												
Negative Contribution												
	<b>IM01</b>	<b>IM02</b>	<b>IM03</b>	<b>IM04</b>	<b>IM05</b>	<b>IM06</b>	<b>IM07</b>	<b>IM08</b>	<b>IM09</b>	<b>IM10</b>	<b>IM11</b>	<b>IM12</b>
	<b>Total Person km</b>	<b>Total Person km</b>	<b>Total Person km</b>	<b>Total Person km</b>	<b>Total Person km</b>	<b>Total Person km</b>	<b>Total Person km</b>	<b>Total Person km</b>	<b>Total Person km</b>	<b>Total Person km</b>	<b>Total Person km</b>	<b>Total Person km</b>
<b>Mode</b>												
Bus	100	100	99	103	101	107	100	100	104	106	98	110
Rail	100	100	144	101	100	98	100	100	104	107	124	103

Appraisal Summary Comments

**IM01 - Highway**

- **Bus:** Person km remains constant
- **Rail:** Person km remains constant

**IM02 - ITS**

- **Bus:** Person km remains constant
- **Rail:** Person km remains constant

**IM03 - Rail A**

- **Bus:** The total person km travelled decreases slightly
- **Rail:** A notable increase in person km is shown

**IM04 - Goldline**

- **Bus:** An increase in person km is shown
- **Rail:** A small increase in person km is shown

**IM05 – BRT Phase 2**

- **Bus:** A small increase in person km is shown
- **Rail:** Person km remains constant

**IM06 - Metro**

- **Bus:** Person km travelled increases
- **Rail:** There is a decrease in person km travelled

**IM07 - Cycle**

- **Bus:** Person km remains constant
- **Rail:** Person km remains constant

**IM08 - Walk**

- **Bus:** Person km remains constant
- **Rail:** Person km remains constant

**IM09 – Demand Management**

- **Bus:** A small increase in person km is shown
- **Rail:** A small increase in person km is shown

**IM10 - Fares**

- **Bus:** An increase in person km is shown
- **Rail:** An increase in person km is shown

**IM11 – Rail B**

- **Bus:** The total person km travelled decreases
- **Rail:** A notable increase in person km is shown

**IM12 – Demand Management B**

- **Bus:** The total person km travelled increases
- **Rail:** The total person km travelled increases



### Objective 3 - Ensure there are attractive and safe active travel networks (walking and cycling) linking all residential, retail, leisure, culture, office and commercial uses within the urban areas of the Belfast City Council area

Indicator

The total demand for walk and cycle in the AM peak hour in a Belfast Central Zone.

Key	<p><b>IM01 - Highway:</b> - York Street Interchange; - Inner Ring Road; - Dualling of A26; - Radial Capacity Enhancements</p> <p><b>IM02 - Intelligent Transport Systems:</b> - Upgraded Urban Traffic Control</p> <p><b>IM03 - Rail A:</b> - All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - New BM stations (Gamble Street, Merville, Monkstown); - Increased Frequency on Lame Line</p> <p><b>IM04 - Goldline:</b> - Doubling Current Goldline Frequencies; - M2 Hard Shoulder Running; - Local Park and Ride</p> <p><b>IM05 - BRT2:</b> - North Route - Antrim Road; - South Route - Ormeau Road</p> <p><b>IM06 - Metro:</b> - Double Current Frequencies; - Speed Increase; - Cross City Services; - Uniform Speed</p> <p><b>IM07 - Cycling:</b> - Cycling Masterplan</p> <p><b>IM08 - Walking:</b> - Walking Masterplan</p> <p><b>IM09 - Demand Management:</b> - Tolls; - Motorway Slip Road Closures; - City centre controlled parking zone</p> <p><b>IM10 - Fares:</b> - Reduction in PT Fares</p> <p><b>IM11 - Rail B:</b> - All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - Increased Frequency on Lame and Lisburn Lines</p> <p><b>IM12 - Demand Management B:</b> -£20 City centre parking charge</p>														
	Positive Contribution	Neutral Contribution	Negative Contribution	IM01	IM02	IM03	IM04	IM05	IM06	IM07	IM08	IM09	IM10	IM11	IM12
	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice
Mode	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips
Walk	100	100	98	100	99	95	100	102	98	98	98	98	98	105	
Cycle	100	100	98	99	99	94	103	98	99	97	98	98	104		

Appraisal Summary Comments

**IM01 - Highway**

- **Walk:** Person trips remain constant
- **Cycle:** Person trips remain constant

**IM02 - ITS**

- **Walk:** Person trips remain constant
- **Cycle:** Person trips remain constant

**IM03 - Rail A**

- **Walk:** A decrease in person trips is observed
- **Cycle:** A decrease in person trips is observed

**IM04 - Goldline**

- **Walk:** Person trips remain constant
- **Cycle:** A small decrease in person trips is observed

**IM05 – BRT Phase 2**

- **Walk:** A small decrease in person trips is observed

- **Cycle:** A small decrease in person trips is observed

**IM06 - Metro**

- **Walk:** A decrease in person trips is observed
- **Cycle:** A decrease in person trips is observed

**IM07 - Cycle**

- **Walk:** Person trips remain constant
- **Cycle:** An increase in person trips

**IM08 - Walk**

- **Walk:** An increase in person trips
- **Cycle:** A decrease in person trips is observed

**IM09 – Demand Management**

- **Walk:** A decrease in person trips is observed
- **Cycle:** A decrease in person trips is observed

**IM10 - Fares**

- **Walk:** A decrease in person trips is observed
- **Cycle:** A decrease in person trips is observed

**IM11 – Rail B**

- **Walk:** A decrease in person trips is observed
- **Cycle:** A decrease in person trips is observed

**IM12 – Demand Management B**

- **Walk:** An increase in person trips is observed
- **Cycle:** An increase in person trips is observed

## Objective 4 - Deliver high quality public realm in Belfast City Centre and in district centres with reduced vehicle dominance, to make them attractive, shared spaces to live and work and improve safety for active modes

### Indicator

Traffic flows across the cordons for highway, bus and rail.

Key			IM01 - Highway:			IM02 - Intelligent Transport Systems:			IM03 - Rail A:			IM04 - Goldline:			IM05 - BRT2:			IM06 - Metro:			IM07 - Cycling:			IM08 - Walking:			IM09 - Demand Management:			IM10 - Fares:			IM11 - Rail B:			IM12 - Demand Management B:					
Positive Contribution			- York Street Interchange; - Inner Ring Road; - Dualling of A26; - Radial Capacity Enhancements			- Upgraded Urban Traffic Control			- All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - New BM stations (Gamble Street, Merville, Monkstown); - Increased Frequency on Lame Line			- Doubling Current Goldline Frequencies; - M2 Hard Shoulder Running; - Local Park and Ride			- North Route - Antrim Road; - South Route - Ormeau Road			- Double Current Frequencies; - Speed Increase; - Cross City Services; - Uniform Speed			- Cycling Masterplan			- Walking Masterplan			- Tolls; - Motorway Slip Road Closures; - City centre controlled parking zone			- Reduction in PT Fares			- All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - Increased Frequency on Lame and Lisburn Lines			- £20 City centre parking charge					
Neutral Contribution																																									
Negative Contribution																																									
			IM01			IM02			IM03			IM04			IM05			IM06			IM07			IM08			IM09			IM10			IM11			IM12					
			Cordon Flows			Cordon Flows			Cordon Flows			Cordon Flows			Cordon Flows			Cordon Flows			Cordon Flows			Cordon Flows			Cordon Flows			Cordon Flows			Cordon Flows			Cordon Flows			Cordon Flows		
			Flows			Flows			Flows			Flows			Flows			Flows			Flows			Flows			Flows			Flows			Flows			Flows			Flows		
Cordon	Direction		Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail	Highway	Bus	Rail						
Inner	Inbound		95	108	101	101	100	100	100	99	111	100	103	100	98	104	100	100	127	92	100	100	100	99	100	100	107	103	103	100	107	104	100	97	128	100	103	102			
	Outbound		103	119	101	104	100	100	100	99	117	100	103	101	98	106	100	100	144	92	100	100	100	100	100	100	130	104	107	100	106	105	100	98	137	100	108	105			
	Total		98	112	101	102	100	100	100	99	113	100	103	100	98	105	100	100	133	92	100	100	100	99	100	100	116	103	104	100	106	105	100	97	131	98	104	103			
			Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows		Cordon Flows				
Flows	Direction		Highway	Bus		Highway	Bus		Highway	Bus		Highway	Bus		Highway	Bus		Highway	Bus		Highway	Bus		Highway	Bus		Highway	Bus		Highway	Bus		Highway	Bus		Highway	Bus				
North	IB		90	122		105	100		100	98		100	102		97	105		101	154		100	100		98	100		110	104		100	106		99	97		92	102				
	OB		105	150		106	100		100	98		100	104		102	103		100	180		100	100		99	100		138	103		100	106		100	98		108	102				
South	IB		99	100		92	100		100	99		100	103		96	117		99	121		100	100		99	100		96	102		100	107		100	97		90	104				
	OB		100	99		103	101		100	99		100	103		97	119		100	129		100	100		100	100		107	109		100	106		100	98		105	119				
East	IB		100	92		102	99		100	99		100	103		101	88		99	154		100	100		101	100		100	99		100	106		100	97		95	103				
	OB		107	100		89	96		100	99		100	100		117	94		101	208		99	100		117	99		220	96		101	106		99	98		113	104				
West	IB		118	100		98	100		100	100		100	103		110	100		99	48		100	100		104	100		163	104		99	107		100	98		96	101				
	OB		102	100		108	100		100	100		100	104		79	100		100	58		100	100		99	100		110	105		100	107		100	99		106	104				
	Total		98	112		102	100		100	99		100	103		98	105		100	133		100	100		99	100		116	103		100	106		100	97		98	104				

### Appraisal Summary Comments

#### IM01 - Highway

- Highway:** While there is an increase in highway trips outbound across the cordon, a decrease in inbound trips leads to an overall reduction in highway trips across the inner cordon
- Bus:** There is an increase in bus person trips in both directions across the cordon
- Rail:** There is a slight increase in rail person trips in both directions across the cordon

#### IM02 - ITS

- Highway:** An increase in highway trips is shown across the cordon
- Bus:** Person trips remain constant
- Rail:** Person trips remain constant

#### IM03 - Rail A

- Highway:** Highway trips remain constant
- Bus:** A slight decrease in bus person trips is shown
- Rail:** An increase in person trips is observed

#### IM04 - Goldline

- Highway:** Highway trips remain constant
- Bus:** There is an increase in bus person trips in both directions across the cordon

- Rail:** While inbound rail person trips remain constant, there is an increase in outbound trips

#### IM05 – BRT Phase 2

- Highway:** There is a decrease in highway trips in both directions across the cordon
- Bus:** There is an increase in bus person trips in both directions across the cordon
- Rail:** Person trips remain constant

#### IM06 - Metro

- Highway:** Highway trips remain constant
- Bus:** There is an increase in bus person trips in both directions across the cordon
- Rail:** There is a decrease in bus person trips across the cordon

#### IM07 - Cycle

- Highway:** Highway trips remain constant
- Bus:** Person trips remain constant
- Rail:** Person trips remain constant

#### IM08 - Walk

- Highway:** There is a slight decrease in highway trips
- Bus:** Person trips remain constant
- Rail:** Person trips remain constant

#### IM09 – Demand Management

- Highway:** An increase in highway trips is shown across the cordon
- Bus:** A slight decrease in bus person trips is shown
- Rail:** A decrease in inbound rail trips is shown

#### IM10 - Fares

- Highway:** Highway trips remain constant
- Bus:** There is an increase in bus person trips in both directions across the cordon
- Rail:** An increase in rail person trips in both directions across the cordon

#### IM11 – Rail B

- Highway:** Highway trips remain constant
- Bus:** A decrease in bus person trips is shown
- Rail:** An increase in person trips is observed

#### IM11 – Rail B

- Highway:** While there is an increase in highway trips outbound across the cordon, a decrease in inbound trips leads to an overall reduction in highway trips across the inner cordon
- Bus:** There is an increase in bus person trips in both directions across the cordon
- Rail:** An increase in person trips is observed

## Objective 6 - Enhance safety for all modes of travel and reduce the number and severity of casualties

### Indicator

The total highway distance travelled in the AM peak hour, throughout the simulation network (BMA – See Appendix A.4)

Key	IM01	IM02	IM03	IM04	IM05	IM06	IM07	IM08	IM09	IM10	IM11	IM12
<b>Positive Contribution</b>	<b>IM01 - Highway:</b> - York Street Interchange; - Inner Ring Road; - Dualling of A26; - Radial Capacity Enhancements	<b>IM02 - Intelligent Transport Systems:</b> - Upgraded Urban Traffic Control	<b>IM03 - Rail A:</b> - All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - New BM stations (Gamble Street, Merville, Monkstown); - Increased Frequency on Lame Line	<b>IM04 - Goldline:</b> - Doubling Current Goldline Frequencies; - M2 Hard Shoulder Running; - Local Park and Ride	<b>IM05 - BRT2:</b> - North Route - Antrim Road; - South Route - Ormeau Road	<b>IM06 - Metro:</b> - Double Current Frequencies; - Speed Increase; - Cross City Services; - Uniform Speed	<b>IM07 - Cycling:</b> - Cycling Masterplan	<b>IM08 - Walking:</b> - Walking Masterplan	<b>IM09 - Demand Management:</b> - Tolls; - Motorway Slip Road Closures; - City centre controlled parking zone	<b>IM10 - Fares:</b> - Reduction in PT Fares	<b>IM11 - Rail B:</b> - All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - Increased Frequency on Lame and Lisburn Lines	<b>IM12 - Demand Management B:</b> -£20 City centre parking charge
<b>Neutral Contribution</b>												
<b>Negative Contribution</b>												
	<b>Total Distance Travelled</b>	<b>Total Distance Travelled</b>	<b>Total Distance Travelled</b>	<b>Total Distance Travelled</b>	<b>Total Distance Travelled</b>	<b>Total Distance Travelled</b>	<b>Total Distance Travelled</b>	<b>Total Distance Travelled</b>	<b>Total Distance Travelled</b>	<b>Total Distance Travelled</b>	<b>Total Distance Travelled</b>	<b>Total Distance Travelled</b>
<b>Mode</b>	<b>Distance Travelled</b>	<b>Distance Travelled</b>	<b>Distance Travelled</b>	<b>Distance Travelled</b>	<b>Distance Travelled</b>	<b>Distance Travelled</b>	<b>Distance Travelled</b>	<b>Distance Travelled</b>	<b>Distance Travelled</b>	<b>Distance Travelled</b>	<b>Distance Travelled</b>	<b>Distance Travelled</b>
Highway	101	100	100	100	100	100	100	100	92	100	100	102

### Appraisal Summary Comments

#### IM01 - Highway

- **Highway:** Distance travelled increases slightly across the simulation network

#### IM02 – ITS

- **Highway:** Distance travelled remains constant

#### IM03 - Rail A

- **Highway:** Distance travelled remains constant

#### IM04 – Goldline

- **Highway:** Distance travelled remains constant

#### IM05 – BRT Phase 2

- **Highway:** Distance travelled remains constant

#### IM06 - Metro

- **Highway:** Distance travelled remains constant

#### IM07 - Cycle

- **Highway:** Distance travelled remains constant

#### IM08 - Walk

- **Highway:** Distance travelled remains constant

#### IM09 – Demand Management

- **Highway:** A decrease in distance travelled across the simulation network is shown

#### IM10 - Fares

- **Highway:** Distance travelled remains constant

#### IM11 – Rail B

- **Highway:** Distance travelled remains constant

#### IM12 – Demand Management B

- **Highway:** Distance travelled increases across the simulation network

## Objective 7 - Protect and enhance the built and natural environment by ensuring our transport systems operate sustainably and can integrate climate change adaptation requirements

### Indicator

The vehicle emissions in the AM peak hour throughout the simulation network (BMA – See Appendix A.4)

Key													
Positive Contribution	<b>IM01 - Highway:</b> - York Street Interchange; - Inner Ring Road; - Dualling of A26; - Radial Capacity Enhancements	<b>IM02 - Intelligent Transport Systems:</b> - Upgraded Urban Traffic Control	<b>IM03 - Rail A:</b> - All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - New BM stations (Gamble Street, Merville, Monkstown); - Increased Frequency on Lame Line	<b>IM04 - Goldline:</b> - Doubling Current Goldline Frequencies; - M2 Hard Shoulder Running; - Local Park and Ride	<b>IM05 - BRT2:</b> - North Route - Antrim Road; - South Route - Ormeau Road	<b>IM06 - Metro:</b> - Double Current Frequencies; - Speed Increase; - Cross City Services; - Uniform Speed	<b>IM07 - Cycling:</b> - Cycling Masterplan	<b>IM08 - Walking:</b> - Walking Masterplan	<b>IM09 - Demand Management:</b> - Tolls; - Motorway Slip Road Closures; - City centre controlled parking zone	<b>IM10 - Fares:</b> - Reduction in PT Fares	<b>IM11 - Rail B:</b> - All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - Increased Frequency on Lame and Lisburn Lines	<b>IM12 - Demand Management B:</b> -£20 City centre parking charge	
Neutral Contribution													
Negative Contribution													

Pollutant	Vehicle Emissions Volume	Vehicle Emissions Volume	Vehicle Emissions Volume	Vehicle Emissions Volume	Vehicle Emissions Volume	Vehicle Emissions Volume	Vehicle Emissions Volume	Vehicle Emissions Volume	Vehicle Emissions Volume	Vehicle Emissions Volume	Vehicle Emissions Volume	Vehicle Emissions Volume	Vehicle Emissions Volume
CO	99	100	100	100	100	99	100	100	99	99	100	101	101
CO <sub>2</sub>	100	100	100	100	100	99	100	100	96	99	100	101	101
NO <sub>x</sub>	100	100	100	100	100	99	100	100	96	100	100	102	102
HC	99	100	100	100	100	99	100	100	99	99	100	101	101
Pb	99	100	100	100	100	99	100	100	98	99	100	101	101
PM <sub>10</sub>	99	100	100	100	100	99	100	100	98	99	100	101	101

### Appraisal Summary Comments

#### IM01 - Highway

- **Highway:** A slight decrease in vehicle emissions is shown across the simulation network

#### IM02 - ITS

- **Highway:** There is no change in vehicle emissions

#### IM03 - Rail A

- **Highway:** There is no change in vehicle emissions

#### IM04 - Goldline

- **Highway:** There is no change in vehicle emissions

#### IM05 – BRT Phase 2

- **Highway:** There is no change in vehicle emissions

#### IM06 - Metro

- **Highway:** A slight decrease in vehicle emissions is shown across the simulation network.

#### IM07 - Cycle

- **Highway:** There is no change in vehicle emissions.

#### IM08 - Walk

- **Highway:** There is no change in vehicle emissions.

#### IM09 – Demand Management

- **Highway:** While there is a general decrease in vehicle emissions there is a slight increase in Carbon Monoxide and Hydrocarbon outputs.

#### IM10 - Fares

- **Highway:** A slight decrease in vehicle emissions is shown across the simulation network.

#### IM11 – Rail B

- **Highway:** There is no change in vehicle emissions.

#### IM12 – Demand Management B

- **Highway:** There is an increase in vehicle emissions across the simulation network.



## Objective 7 (continued) - Protect and enhance the built and natural environment by ensuring our transport systems operate sustainably and can integrate climate change adaptation requirements

### Indicator

The AM peak hour actual highway flow at the AQMAs in Belfast City Council

Key	IM01 - Highway:	IM02 - Intelligent Transport Systems:	IM03 - Rail A:	IM04 - Goldline:	IM05 - BRT2:	IM06 - Metro:	IM07 - Cycling:	IM08 - Walking:	IM09 - Demand Management:	IM10 - Fares:	IM11 - Rail B:	IM12 - Demand Management B:
Positive Contribution	- York Street Interchange; - Inner Ring Road; - Dualling of A26; - Radial Capacity Enhancements	- Upgraded Urban Traffic Control	- All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - New BM stations (Gamble Street, Merville, Monkstown); - Increased Frequency on Lame Line	- Doubling Current Goldline Frequencies; - M2 Hard Shoulder Running; - Local Park and Ride	- North Route - Antrim Road; - South Route - Ormeau Road	- Double Current Frequencies; - Speed Increase; - Cross City Services; - Uniform Speed	- Cycling Masterplan	- Walking Masterplan	- Tolls; - Motonway Slip Road Closures; - City centre controlled parking zone	- Reduction in PT Fares	- All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - Increased Frequency on Lame and Lisburn Lines	-£20 City centre parking charge
Neutral Contribution												
Negative Contribution												

	Actual Flow AQMA 1	Actual Flow AQMA 2	Actual Flow AQMA 3	Actual Flow AQMA 4	Actual Flow AQMA 1	Actual Flow AQMA 2	Actual Flow AQMA 3	Actual Flow AQMA 4	Actual Flow AQMA 1	Actual Flow AQMA 2	Actual Flow AQMA 3	Actual Flow AQMA 4
<b>AQMA 1</b>												
A12 at Clifton St NB	23	6	2	0	65	-1	1	-4	-357	0	1	-54
A12 at Clifton St SB	264	52	-8	1	-48	-8	1	2	-601	-9	-4	-7
A12 at Broadway NB	112	88	0	-12	134	-9	0	21	-225	-9	-1	67
A12 at Broadway SB	75	12	-2	0	13	-8	-3	11	80	-9	0	112
M1 at Blacks Road SB	72	28	-2	0	21	-3	-6	1	-1080	-6	-4	333
M1 at Blacks Road NB	50	-9	6	-19	0	-16	3	0	-1337	-13	1	30
<b>AQMA 1 Total</b>	<b>595</b>	<b>175</b>	<b>-5</b>	<b>-30</b>	<b>186</b>	<b>-45</b>	<b>-5</b>	<b>32</b>	<b>-3520</b>	<b>-46</b>	<b>-7</b>	<b>481</b>
<b>AQMA 2</b>												
Ormeau Road at University Street SB	-59	30	0	-2	-65	-1	-2	-34	142	-4	0	53
Ormeau Road at University Street NB	7	-23	1	-1	-9	-6	2	1	-61	-2	1	-85
Ormeau Road at Ormeau Embankment SB	-39	18	-1	-2	-90	-4	-2	-36	231	-3	-1	45
Ormeau Road at Ormeau Embankment NB	15	-20	0	-3	-4	-8	2	0	-1	-4	1	-56
Ormeau Road at Annadale Avenue SB	-45	-9	1	1	-320	-18	0	-9	-6	-3	-4	69
Ormeau Road at Annadale Avenue NB	-8	4	-1	-5	-70	1	-3	-7	29	-2	-2	-23
<b>AQMA 2 Total</b>	<b>-128</b>	<b>0</b>	<b>0</b>	<b>-11</b>	<b>-559</b>	<b>-36</b>	<b>-3</b>	<b>-85</b>	<b>334</b>	<b>-19</b>	<b>-4</b>	<b>4</b>
<b>AQMA 3</b>												
East Bridge Street (west of bridge) EB	38	-46	-1	-1	89	4	-6	97	678	4	-4	55
East Bridge Street (west of bridge) WB	1	61	2	-5	14	-21	6	14	-26	-6	4	-132
East Bridge Street (east of bridge) EB	38	-57	-1	-1	85	4	-6	95	548	4	-4	73
East Bridge Street (east of bridge) WB	5	65	2	-9	28	-34	9	22	-18	-11	6	-137
Short Strand at East Bridge Street SB	79	17	-4	2	-58	-8	0	-2	-460	-3	2	-3
Short Strand at East Bridge Street NB	-11	196	-2	-8	-39	25	-16	-37	94	14	-22	-147
Albertbridge Road at East Bridge Street EB	51	-69	-1	-2	124	-5	-6	71	317	-3	-2	80
Albertbridge Road at East Bridge Street WB	30	178	2	-9	-17	0	-5	-2	6	8	-11	-189
<b>AQMA 3 Total</b>	<b>231</b>	<b>344</b>	<b>-4</b>	<b>-34</b>	<b>226</b>	<b>-36</b>	<b>-24</b>	<b>258</b>	<b>1140</b>	<b>7</b>	<b>-31</b>	<b>-401</b>
<b>AQMA 4</b>												
Hawthornden Way at Nards Road SB	-224	0	-2	2	20	-1	0	-1	-2	0	-2	16
Hawthornden Way at Nards Road NB	-44	-10	3	-4	-3	-9	1	-2	53	-4	2	14
Upper Nards Road east of Hawthornden Way EB	-16	-8	-1	3	8	-6	-1	4	73	-3	-2	65
Upper Nards Road east of Hawthornden Way WB	-35	20	-1	4	5	5	-3	2	114	2	0	5
Knock Road at Nards Road SB	-107	-14	0	4	12	0	3	5	137	1	-3	5
Knock Road at Nards Road NB	-150	-2	2	-6	2	-12	-1	-3	96	-7	-1	23
Upper Nards Road west of Hawthornden Way WB	-29	32	-1	-4	1	4	-4	1	83	-1	-3	-6
Upper Nards Road west of Hawthornden Way EB	213	-18	1	2	-9	-4	1	8	140	-2	0	34
Upper Nards Road at Eastwood Road EB	239	-14	1	0	9	-4	1	10	181	-2	0	52
Upper Nards Road at Eastwood Road WB	-92	63	0	-5	3	4	-10	-6	50	-1	-8	-80
Upper Nards Road at Stoney Road EB	19	-8	-1	3	9	-7	-1	4	68	-3	-1	64
Upper Nards Road at Stoney Road WB	-24	0	0	0	-4	0	0	-2	-31	1	1	4
Knock Road at Shandon Park SB	-242	-14	1	-3	6	-7	1	2	67	-8	-3	-17
Knock Road at Shandon Park NB	-194	-5	3	-9	4	-16	-3	-5	119	-10	-2	32
<b>AQMA 4 Total</b>	<b>-686</b>	<b>22</b>	<b>2</b>	<b>-13</b>	<b>63</b>	<b>-52</b>	<b>-16</b>	<b>18</b>	<b>1149</b>	<b>-37</b>	<b>-21</b>	<b>210</b>

### Appraisal Summary Comments

#### IM01 - Highway

- **Highway:** AQMA 1 and 3 show an increase in actual flow whereas AQMA 2 and 4 show a decrease

#### IM02 - ITS

- **Highway:** A general increase in actual flow is shown across the AQMAs, particularly in AQMA 1 and 3

#### IM03 - Rail A

- **Highway:** A slight increase in actual flow is shown across the AQMAs

#### IM04 - Goldline

- **Highway:** A slight decrease in actual flow is shown across each AQMA

#### IM05 - BRT Phase 2

- **Highway:** While AQMA 1, 3 and 4 show an increase in highway actual flow, AQMA 2 shows a large decrease

#### IM06 - Metro

- **Highway:** A general decrease in actual highway flow is shown

#### IM07 - Cycle

- **Highway:** A small decrease in actual flow across the AQMAs is shown

#### IM08 - Walk

- **Highway:** While AQMA 1, 3 and 4 show an increase in highway actual flow, AQMA 2 shows a decrease

#### IM09 - Demand Management

- **Highway:** While AQMA 2, 3 and 4 show an increase in highway actual flow, AQMA 1 shows a large decrease

#### IM10 - Fares

- **Highway:** A general decrease in actual flow is shown across the AQMAs with the exception of AQMA 3 where there is a slight increase

#### IM11 - Rail B

- **Highway:** A slight increase in actual flow is shown across the AQMAs

#### IM12 - Demand Management B

- **Highway:** An increase in actual flow is shown at AQMA1, 2 and 4. AQMA 3 shows a decrease in flow

## Objective 7 (continued) - Protect and enhance the built and natural environment by ensuring our transport systems operate sustainably and can integrate climate change adaptation requirements

### Indicator

The total demand for Bus and Rail trips in the AM peak hour model wide

Key		IM01 - Highway:			IM02 - Intelligent Transport Systems:			IM03 - Rail A:			IM04 - Goldline:			IM05 - BRT2:			IM06 - Metro:		
Positive Contribution		- York Street Interchange; - Inner Ring Road; - Dualling of A26; - Radial Capacity Enhancements			- Upgraded Urban Traffic Control			- All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - New BM stations (Gamble Street, Merville, Monkstown); - Increased Frequency on Larne Line			- Doubling Current Goldline Frequencies; - M2 Hard Shoulder Running; - Local Park and Ride			- North Route - Antrim Road; - South Route - Ormeau Road			- Double Current Frequencies; - Speed Increase; - Cross City Services; - Uniform Speed		
Neutral Contribution																			
Negative Contribution																			
		<b>IM01</b>			<b>IM02</b>			<b>IM03</b>			<b>IM04</b>			<b>IM05</b>			<b>IM06</b>		
		AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips		
Mode		From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast
Bus		99	100	100	100	100	100	98	99	99	104	105	101	103	102	101	103	101	116
Rail		100	100	100	100	100	100	109	109	145	101	100	101	100	100	98	95	94	77
		<b>IM07 - Cycling:</b>			<b>IM08 - Walking:</b>			<b>IM09 - Demand Management:</b>			<b>IM10 - Fares:</b>			<b>IM11 - Rail B:</b>			<b>IM12 - Demand Management B:</b>		
		- Cycling Masterplan			- Walking Masterplan			- Tolls; - Motorway Slip Road Closures; - City centre controlled parking zone			- Reduction in PT Fares			- All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station;			-£20 City centre parking charge		
		<b>IM07</b>			<b>IM08</b>			<b>IM09</b>			<b>IM10</b>			<b>IM11</b>			<b>IM12</b>		
		AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips			AM Peak Person Trips		
Mode		From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast
Bus		100	100	100	100	100	100	106	99	104	105	105	107	98	97	98	114	100	103
Rail		100	100	100	100	100	100	109	103	106	107	105	97	117	116	144	107	101	104

### Appraisal Summary Comments

#### IM01 - Highway

- Bus:** A decrease in person trips from the Belfast City Council area is observed. Person trips within and to the council area remain constant;
- Rail:** Person trips remain constant.

#### IM02 - ITS

- Bus:** Person trips remain constant;
- Rail:** Person trips remain constant.

#### IM03 - Rail A

- Bus:** A decrease in person trips can be observed;
- Rail:** Person trips increase across the model, particularly within the Belfast City Council area.

#### IM04 - Goldline

- Bus:** Person trips increase across the model;
- Rail:** An increase in person trips is observed both from and within Belfast.

#### IM05 – BRT Phase 2

- Bus:** Person trips increase across the model;

- Rail:** A decrease in person trips is observed within Belfast.

#### IM06 - Metro

- Bus:** Person trips increase across the model, particularly notable within Belfast;
- Rail:** Person trips decrease across the model.

#### IM07 - Cycle

- Bus:** Person trips remain constant;
- Rail:** Person trips remain constant.

#### IM08 - Walk

- Bus:** Person trips remain constant;
- Rail:** Person trips remain constant.

#### IM09 – Demand Management

- Bus:** Trips from Belfast decrease whereas trips to and within Belfast remain constant;
- Rail:** Person to Belfast increase, whereas trips from and within remain constant.

#### IM10 - Fares

- Bus:** Person trips increase across the model, in particular, within Belfast;
- Rail:** Trips from and to Belfast increase however trips within Belfast decrease.

#### IM11 – Rail B

- Bus:** A decrease in person trips can be observed;
- Rail:** Person trips increase across the model, notably within the Belfast City Council area.

#### IM12 – Demand Management B

- Bus:** An increase in person trips can be observed from and within Belfast;
- Rail:** Person trips increase across the model.

## Objective 7 (continued) - Protect and enhance the built and natural environment by ensuring our transport systems operate sustainably and can integrate climate change adaptation requirements

### Indicator

The total demand for walk and cycle in the AM peak hour in a Belfast Central Zone.

Key	IM01 - Highway:	IM02 - Intelligent Transport Systems:	IM03 - Rail A:	IM04 - Goldline:	IM05 - BRT2:	IM06 - Metro:	IM07 - Cycling:	IM08 - Walking:	IM09 - Demand Management:	IM10 - Fares:	IM11 - Rail B:	IM12 - Demand Management B:
Positive Contribution	- York Street Interchange; - Inner Ring Road;	- Upgraded Urban Traffic Control	- All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - New BM stations (Gamble Street, Merville, Monkstown); - Increased Frequency on Lame Line	- Doubling Current Goldline Frequencies; - M2 Hard Shoulder Running; - Local Park and Ride	- North Route - Antrim Road; - South Route - Ormeau Road	- Double Current Frequencies; - Speed Increase; - Cross City Services; - Uniform Speed	- Cycling Masterplan	- Walking Masterplan	- Tolls; - Motorway Slip Road Closures; - City centre controlled parking zone	- Reduction in PT Fares	- All Trains 6 car; - Multi-Modal Transport Hub; - Ballymartin Rail Station; - Hourly Enterprise Services; - Increased Frequency on Lame and Lisburn Lines	-£20 City centre parking charge
Neutral Contribution	- Dualling of A26; - Radial Capacity Enhancements											
Negative Contribution												

	IM01	IM02	IM03	IM04	IM05	IM06	IM07	IM08	IM09	IM10	IM11	IM12
	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice	Central Zone Mode Choice
Mode	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips	Number of Trips
Walk	100	100	98	100	99	95	100	102	98	98	98	105
Cycle	100	100	98	99	99	94	103	98	99	97	98	104

### Appraisal Summary Comments

#### IM01 - Highway

- **Walk:** Person trips remain constant
- **Cycle:** Person trips remain constant

#### IM02 - ITS

- **Walk:** Person trips remain constant
- **Cycle:** Person trips remain constant

#### IM03 - Rail A

- **Walk:** A decrease in person trips is observed
- **Cycle:** A decrease in person trips is observed

#### IM04 - Goldline

- **Walk:** Person trips remain constant
- **Cycle:** A small decrease in person trips is observed

#### IM05 – BRT Phase 2

- **Walk:** A small decrease in person trips is observed

- **Cycle:** A small decrease in person trips is observed

#### IM06 - Metro

- **Walk:** A decrease in person trips is observed
- **Cycle:** A decrease in person trips is observed

#### IM07 - Cycle

- **Walk:** Person trips remain constant
- **Cycle:** An increase in person trips

#### IM08 - Walk

- **Walk:** An increase in person trips
- **Cycle:** A decrease in person trips is observed

#### IM09 – Demand Management

- **Walk:** A decrease in person trips is observed
- **Cycle:** A decrease in person trips is observed

#### IM10 - Fares

- **Walk:** A decrease in person trips is observed
- **Cycle:** A decrease in person trips is observed

#### IM11 – Rail B

- **Walk:** A decrease in person trips is observed
- **Cycle:** A decrease in person trips is observed

#### IM12 – Demand Management B

- **Walk:** An increase in person trips is observed
- **Cycle:** An increase in person trips is observed

### 8.3. IM2030 Appraisal Framework Summary

The Appraisal Framework used the following key model outputs:

- Network Travel Times from Belfast

Table 8-1 provides a summary overview of the outcomes of the Appraisal Framework.

- AM bus and rail demand
- Bus and rail total person km
- AM walk and cycle demand
- AM highway, bus and rail cordon flow

- Total highway distance travelled
- AM vehicle emissions
- Highway flow at AQMAs

**Table 8-1 – IM Appraisal Framework Overview**

Illustrative Measure	Objective 1 - Enhance accessibility by road and public transport from the centre of Belfast to Londonderry, gateways and hubs to support greater levels of inward investment	Objective 2 - Ensure financially viable and sustainable public transport accessibility to essential services for people living in Belfast City Council Area	Objective 3 - Ensure there are attractive and safe active travel networks (walking and cycling) linking all residential, retail, leisure, culture, office and commercial uses within the urban areas of the Belfast City Council area	Objective 4 - Deliver high quality public realm in Belfast City Centre and in district centres with reduced vehicle dominance, to make them attractive, shared spaces to live and work and improve safety for active modes.	Objective 5 - Enhance transport accessibility and manage traffic congestion to Belfast City Centre and to district centres to strengthen Belfast's role as the regional economic driver	Objective 6 - Enhance safety for all modes of travel and reduce the number and severity of casualties.	Objective 7 - Protect and enhance the built and natural environment by ensuring our transport systems operate sustainably and can integrate climate change adaptation requirements
IM01 – Highway	✓			✓	Dfl to Produce TRACC Outputs	x	
IM02 – ITS				x			
IM03 – Rail A	✓	✓	x	✓			✓
IM04 – Goldline		✓	x	✓			✓
IM05 – BRT Phase 2		✓	x	✓			
IM06 – Metro		✓	x	✓			✓
IM07 – Cycle			✓				✓
IM08 – Walk			✓	✓			
IM09 – Demand Management	x	✓	x				✓
IM10 – Fares		✓	x	✓			✓
IM11 – Rail B	✓	✓	x	✓			✓
IM12 – Demand Management B		✓	✓	✓			x
Summary Table Colour	Outcome Type						
✓	Positive Contribution						
	Neutral Contribution						
x	Negative Contribution						

Table 8-1 – demonstrates:

- IM01 (Highway) shows a positive contribution in Objectives 1 and 3 with a negative contribution on Objective 6;
- IM02 (ITS) shows a negative contribution on Objective 4;
- IM03 (Rail A) shows a positive contribution in Objectives 1, 2, 4 and 7 with a negative contribution on Objective 3;
- IM04 (Goldline) shows a positive contribution in Objectives 2, 4 and 7 with a negative contribution on Objective 3;
- IM05 (BRT Phase 2) shows a positive contribution in Objectives 2 and 4 with a negative contribution on Objective 3;
- IM06 (Metro) shows a positive contribution in Objectives 2, 4 and 7 with a negative contribution on Objective 3;

- IM07 (Cycle) shows a positive contribution in Objectives 3 and 7;
- IM08 (Walk) shows a positive contribution in Objectives 3 and 4;
- IM09 (Demand Management) shows a positive contribution in Objectives 2 and 6 with a negative contribution on Objectives 1 and 3;
- IM10 (Fares) shows a positive contribution in Objectives 2, 4 and 7 with a negative contribution on Objective 3;
- IM11 (Rail B) shows a positive contribution in Objectives 1, 2, 4 and 7 with a negative contribution on Objective 3;
- IM12 (Demand Management B) shows a positive contribution in Objectives 2, 3 and 4 with a negative contribution on Objective 6



# Alternative Networks



## 9. Alternative Networks

### 9.1. Introduction

As previously outlined, the Alternative Networks (ANs) were developed by combining a series of IMs and assessing their respective performance under 2030 PDS3 conditions. These ANs were developed by Dfl based on the modelling results of the IM and PDS model runs.

### 9.2. Coding Overview

Table 9-1 gives an overview of the relevant IM and PDS coding included in the ANs.

**Table 9-1 – Alternative Network Coding Overview**

AN	IM Included		PDS Used
AN01	<ul style="list-style-type: none"> <li>• IM01 – Highway;</li> <li>• IM02 – ITS;</li> <li>• IM04 – Goldline;</li> <li>• IM05 – BRT Phase 2;</li> <li>• IM06 – Metro;</li> </ul>	<ul style="list-style-type: none"> <li>• IM07 – Cycling;</li> <li>• IM08 – Walking;</li> <li>• IM10 – Fares;</li> <li>• IM11 – Rail B</li> </ul>	PDS3
AN02	<ul style="list-style-type: none"> <li>• IM01 – Highway;</li> <li>• IM02 – ITS;</li> <li>• IM04 – Goldline;</li> <li>• IM05 – BRT Phase 2;</li> <li>• IM06 – Metro;</li> </ul>	<ul style="list-style-type: none"> <li>• IM07 – Cycling;</li> <li>• IM08 – Walking;</li> <li>• IM10 – Fares;</li> <li>• IM11 – Rail B;</li> <li>• IM12 - £20 Parking Charge</li> </ul>	PDS3

Table 9-1 shows

- The 2030 transport demand remains the same in both ANs;
- The transport networks remain the same in both ANs but AN02 additionally includes IM12 (£20 parking charge in the city centre).

### 9.3. Model Outputs

This section sets out a series of network plots showing the performance of the AN in relation to the 2030 PDS DoMin model runs, including:

- 24hr Mode split;
- Delay; and
- VoC Percentage.

### 9.3.1. 24 BCC Mode Split

Figure 9-1 shows the mode share in the Belfast City Council area across a 24hr period.

**Figure 9-1 – 24hr BCC Mode Split**

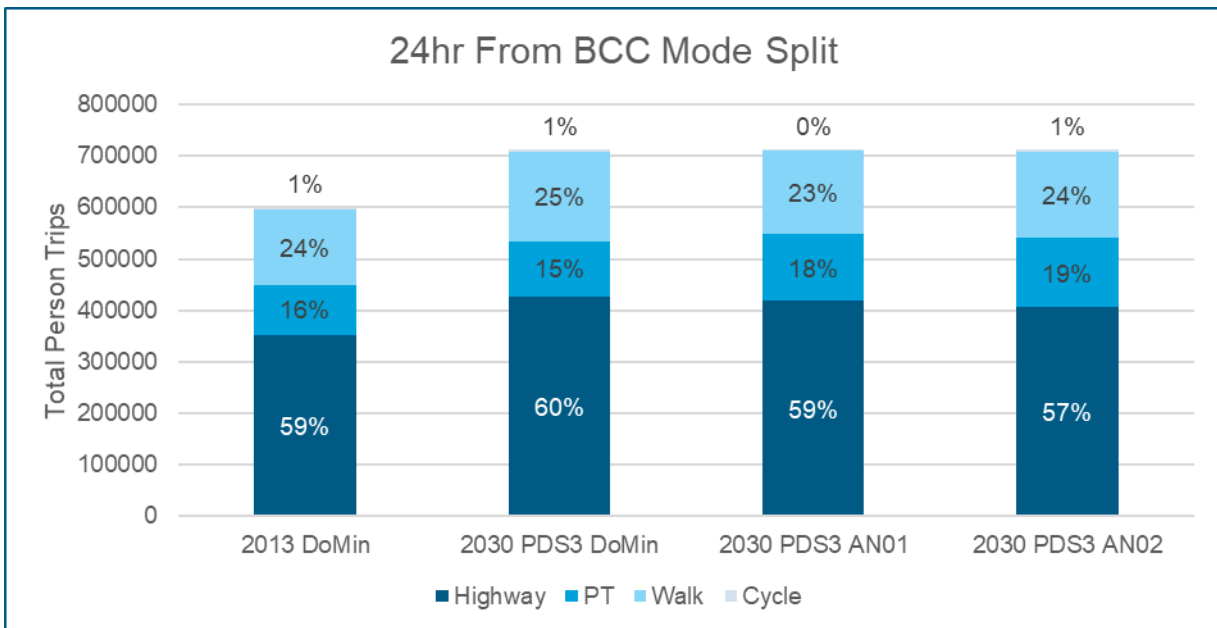


Figure 9-1 shows:

- Compared with the 2013 DoMin the highway mode share:
  - Increases in 2030 PDS3 DoMin;
  - Remains constant in AN01; and
  - Decreases in AN02
- AN01 and AN02 show an increase in PT compared to 2013 DoMin and 2030 PDS3 DoMin.



9.3.2. AN01 Difference Plots

Figure 9-2 shows a difference plot of the delay between the 2030 PDS3 DoMin and 2030 AN01 networks.

Figure 9-2 – 2030 AN01 - 2030 PDS3 DoMin Delay Difference Plot

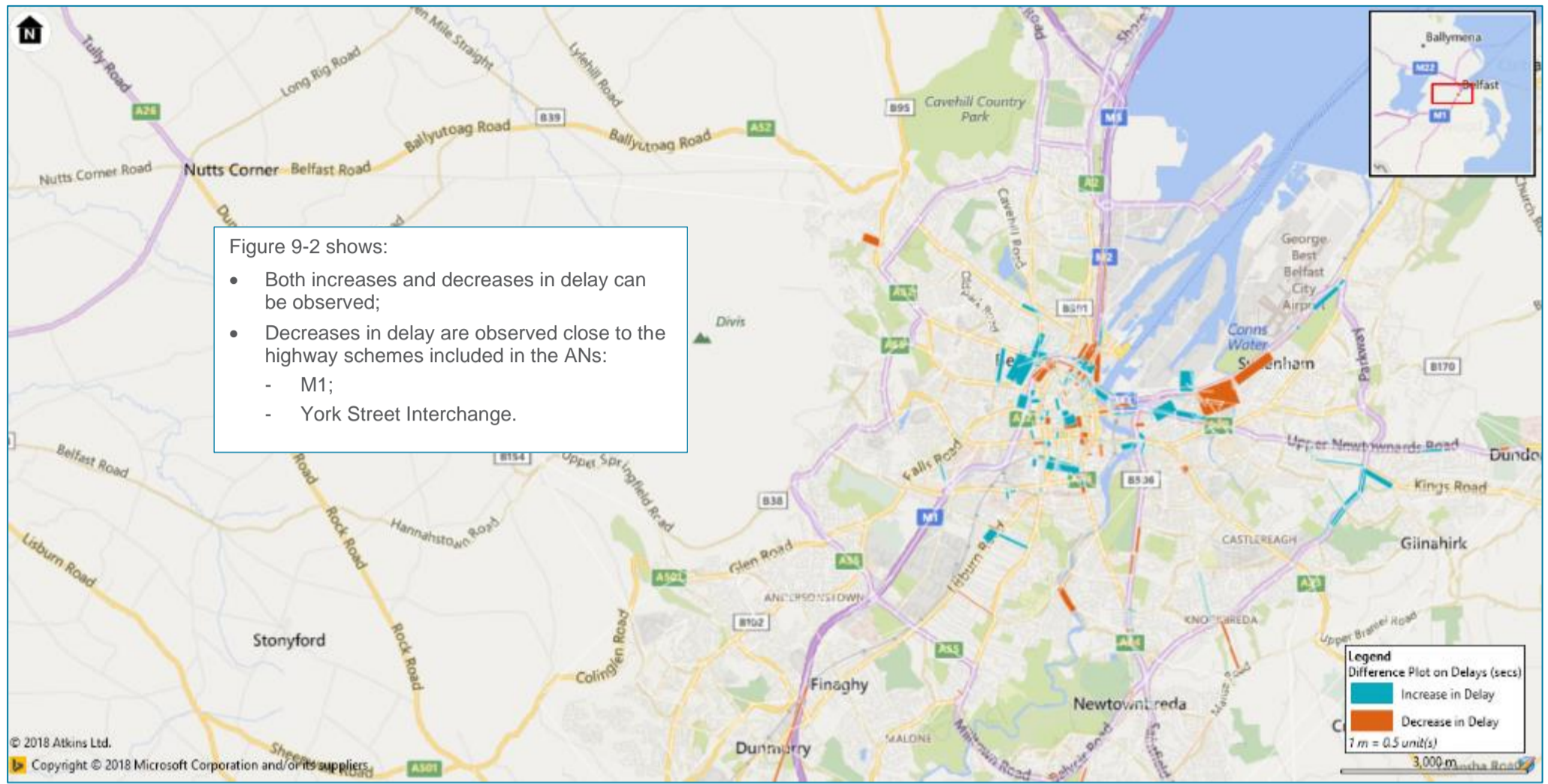
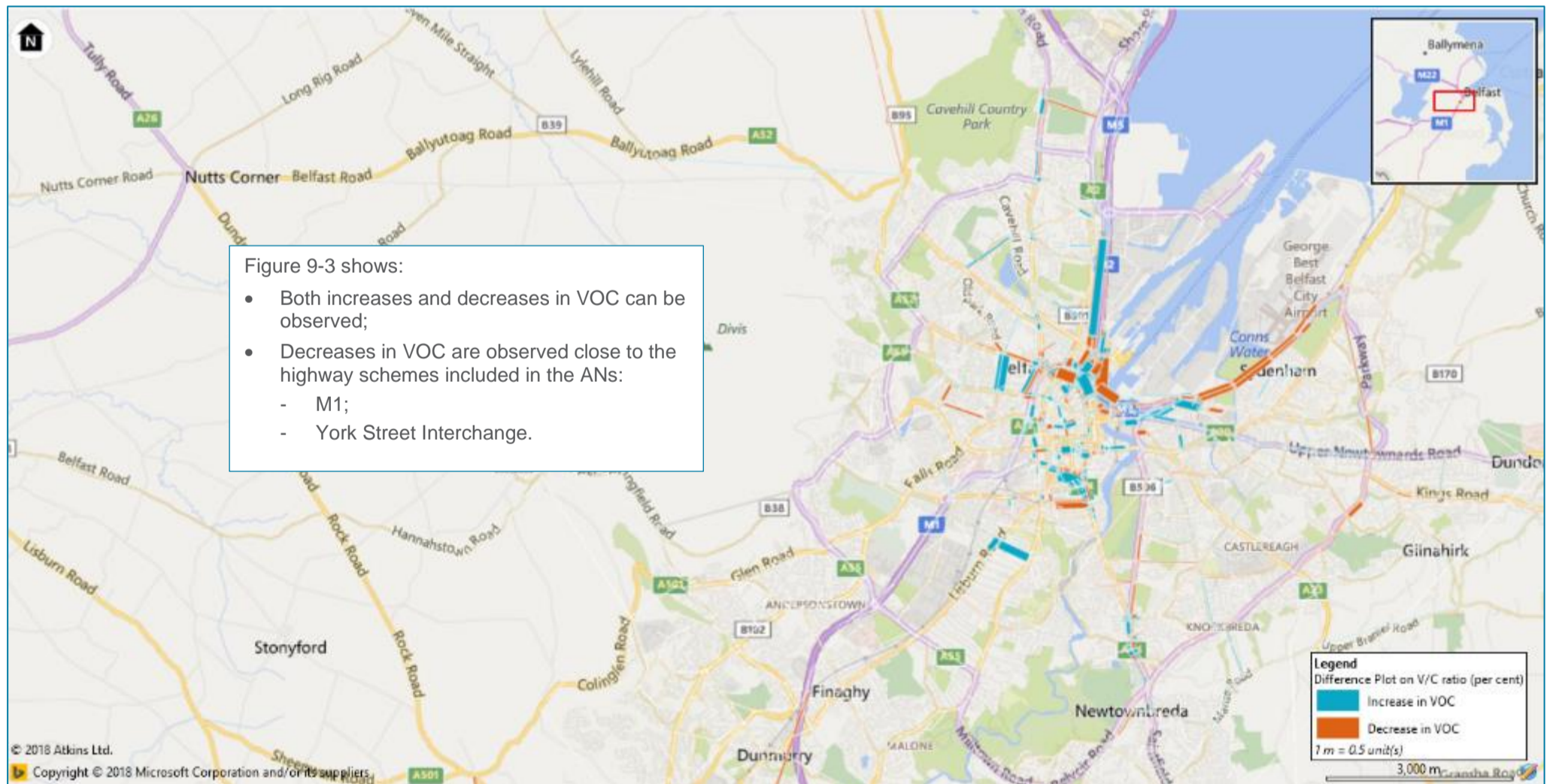


Figure 9-3 shows a difference plot of the VOC between the 2030 PDS3 DoMin and 2030 AN01 networks.

Figure 9-3 – 2030 AN01 - 2030 PDS3 DoMin VOC Difference Plot





### 9.3.3. AN02 Difference Plots

Figure 9-4 shows a difference plot of the delay between the 2030 PDS3 DoMin and 2030 AN02 networks.

Figure 9-4 – 2030 AN02 - 2030 PDS3 DoMin Delay Difference Plot

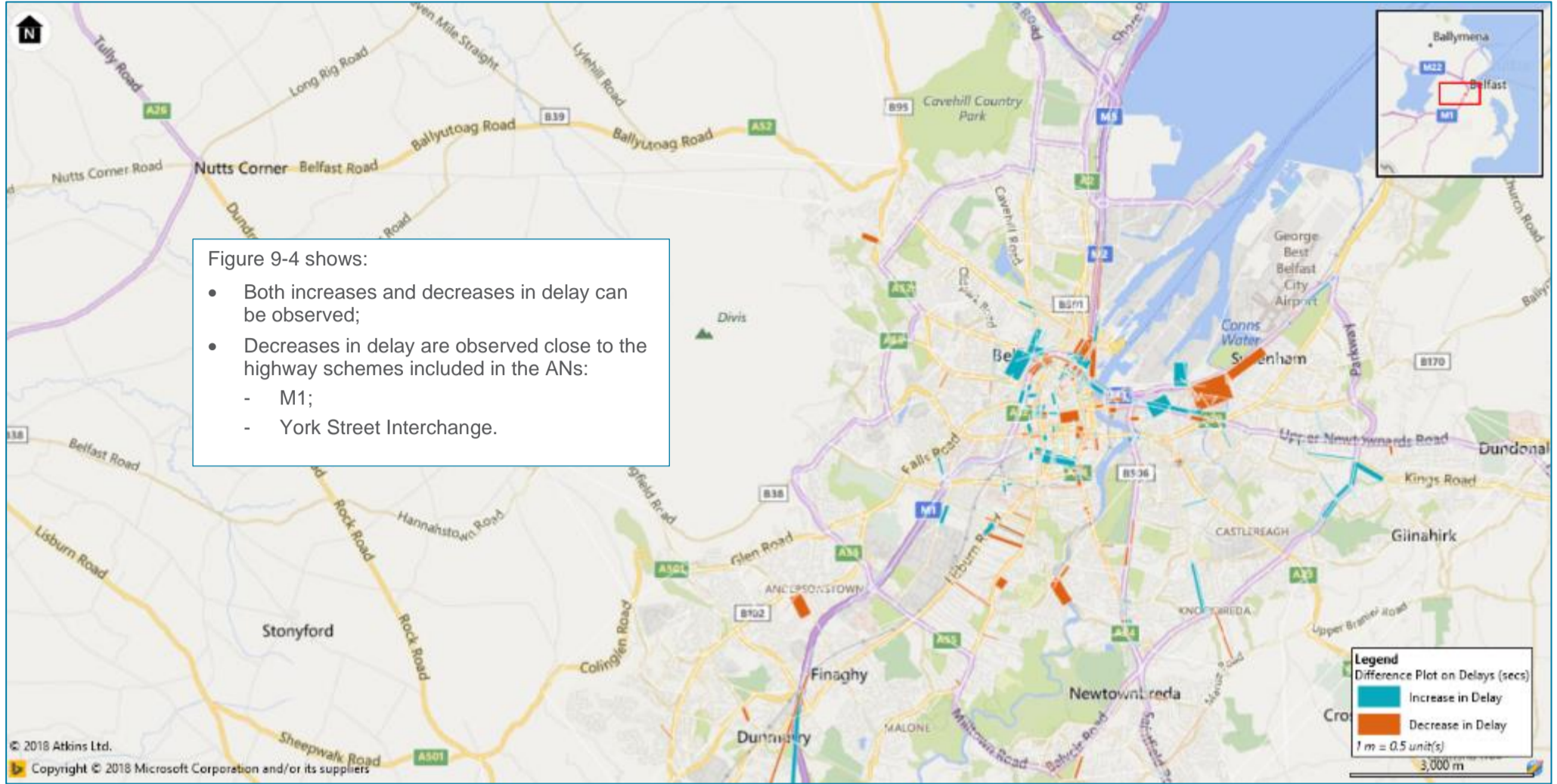
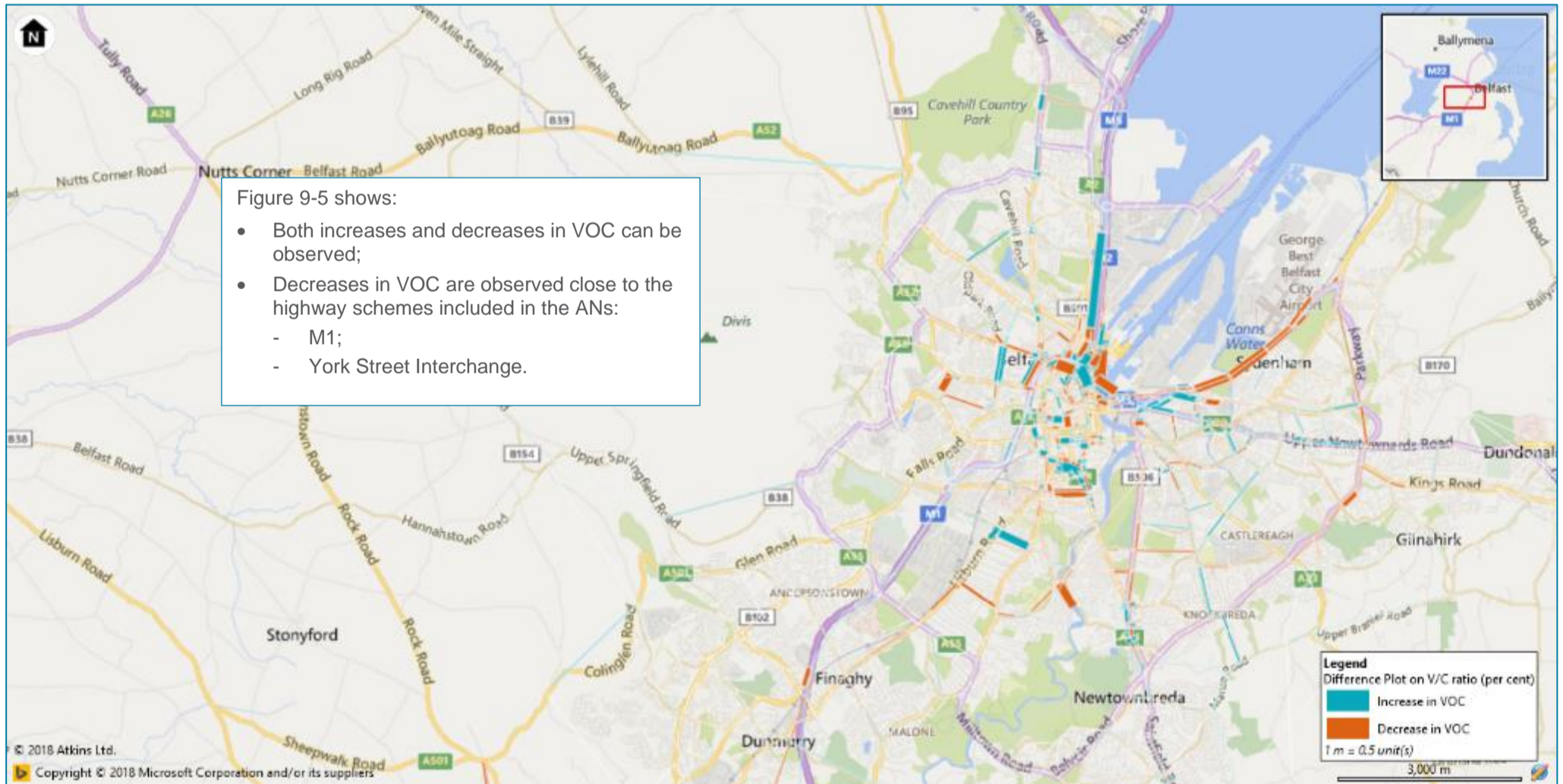


Figure 9-5 shows a difference plot of the VOC between the 2030 PDS3 DoMin and 2030 AN02 networks.

Figure 9-5 – 2030 AN02 - 2030 PDS3 DoMin VOC Difference Plot





As the model coding remains consistent with that for each IM Atkins are content that the BSTM is producing robust model outputs for each AN.

## 9.4. 2030 AN Appraisal Framework

The remainder of this section sets out:

1. The **Objective** being assessed;
2. The model output used as the **Indicator** for this Objective;
3. The model outputs for each AN indexed to the 2030 PDS3 DoMin model run at 100. These have been coloured where:
  - a. **Light Green** represents where a positive contribution (0% - 10%) has been made in support of the Objective;
  - b. **Dark Green** represents where a highly positive contribution has been made in support of the Objective (greater than 10% change);
  - c. **White** represents where no contribution has been made in support of the Objective;
  - d. **Light Red** represents where a negative contribution (0% - 10%) has been made in support of the Objective; and
  - e. **Dark Red** represents where a very negative contribution has been made in support of the Objective (greater than 10% change).
4. The **Appraisal Summary Comments** detail the overall model outputs for each AN, split by mode.

The remainder of this section sets out the Appraisal Framework for the 2030 PDS3 AN model runs.

## Objective 1- Enhance accessibility by road and public transport from the centre of Belfast to Londonderry, gateways and hubs to support greater levels of inward investment

### Indicator

The travel time from Belfast to various hubs throughout NI in the AM peak hour, split by highway, bus and rail

Key	AN01:			AN02:		
	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B)			- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B); - IM12 (£20 Parking Charge)		
	AN01			AN02		
Destination Hub	Travel Time			Travel Time		
	Highway	Bus	Rail	Highway	Bus	Rail
Antrim	100	98	78	101	98	78
Ballycastle	100	99	89	100	99	89
Ballymena	100	98	85	101	98	85
Ballymoney	100	99	89	100	99	89
Coleraine	100	99	90	100	99	90
Derry	100	100	94	100	100	94
Larne	100	91	94	101	91	94
Limavady	100	101	93	100	101	93
Magherafelt	100	99	78	101	99	78
Newtownards	110	91	80	110	91	80
Banbridge	102	100	100	103	100	100
Downpatrick	102	87	80	103	87	80
Newcastle	101	91	100	101	91	100
Newry	101	100	100	102	100	100
Armagh City	100	121	81	101	122	81
Craigavon	100	110	81	101	111	81
Cookstown	100	137	81	100	137	81
Dungannon	100	98	81	101	98	81
Enniskillen	100	99	81	100	99	81
Omagh	100	101	81	100	101	81
Strabane	100	101	94	100	101	94

### Appraisal Summary Comments

#### AN01

- **Highway:** Travel time increases towards hubs in the south;
- **Bus:** Travel time generally decreases towards hubs in the south and increases towards hubs in the west;
- **Rail:** Travel time decreases.

#### AN02

- **Highway:** Travel time generally decreases;
- Travel time generally decreases towards hubs in the south and increases towards hubs in the west;
- **Rail:** Travel time decreases.

## Objective 2 - Ensure financially viable and sustainable public transport accessibility to essential services for people living in Belfast City Council Area

### Indicator

The total demand for Bus and Rail trips in the AM peak hour model wide

Key	AN01:	AN02:
Positive Contribution	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2);	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2);
Neutral Contribution	- IM06 (Metro); - IM07 (Cycling); - IM08 (Walking);	- IM06 (Metro); - IM07 (Cycling); - IM08 (Walking);
Negative Contribution	- IM10 (Fares); - IM11 (Rail B)	- IM10 (Fares); - IM11 (Rail B); - IM12 (£20 Parking Charge)

	AN01			AN02		
	AM Peak Person Trips			AM Peak Person Trips		
Mode	From Belfast	To Belfast	Within Belfast	From Belfast	To Belfast	Within Belfast
Bus	108	108	119	121	108	122
Rail	123	117	116	131	119	121

### Appraisal Summary Comments

#### AN01

- **Bus:** Total demand increases;
- **Rail:** Total demand increases.

#### AN02

- **Bus:** Total demand increases;
- **Rail:** Total demand increases.

## Objective 2 (Continued) - Ensure financially viable and sustainable public transport accessibility to essential services for people living in Belfast City Council Area

### Indicator

The total person km travelled by bus and rail for the AM peak hour, model wide

Key	AN01:	AN02:
Positive Contribution	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B)	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B); - IM12 (£20 Parking Charge)
Neutral Contribution		
Negative Contribution		

	AN01	AN02
	Total Person km	Total Person km
Mode		
Bus	112	122
Rail	133	137

### Appraisal Summary Comments

#### AN01

- **Bus:** Total person km increases;
- **Rail:** Total person km increases.

#### AN02

- **Bus:** Total person km increases;
- **Rail:** Total person km increases.

**Objective 3 - Ensure there are attractive and safe active travel networks (walking and cycling) linking all residential, retail, leisure, culture, office and commercial uses within the urban areas of the Belfast City Council area**

Indicator

The total demand for walk and cycle in the AM peak hour in a Belfast Central Zone.

<b>Key</b>		
<b>Positive Contribution</b>	<b>AN01:</b> - IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B)	<b>AN02:</b> - IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B); - IM12 (£20 Parking Charge)
<b>Neutral Contribution</b>		
<b>Negative Contribution</b>		
	<b>AN01</b>	<b>AN02</b>
	<b>Central Zone Mode Choice</b>	<b>Central Zone Mode Choice</b>
<b>Mode</b>	<b>Number of Trips</b>	<b>Number of Trips</b>
Walk	93	98
Cycle	91	95

Appraisal Summary Comments

**AN01**

- **Walk:** Central zone trips decreases;
- **Cycle:** Central zone trips decreases.

**AN02**

- **Walk:** Central zone trips decreases;
- **Cycle:** Central zone trips decreases.



**Objective 4 - Deliver high quality public realm in Belfast City Centre and in district centres with reduced vehicle dominance, to make them attractive, shared spaces to live and work and improve safety for active modes**

Indicator

Traffic flows across the cordons for highway, bus and rail.

Key	AN01:	AN02:
Positive Contribution	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2);	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2);
Neutral Contribution	- IM06 (Metro); - IM07 (Cycling); - IM08 (Walking);	- IM06 (Metro); - IM07 (Cycling); - IM08 (Walking);
Negative Contribution	- IM10 (Fares); - IM11 (Rail B)	- IM10 (Fares); - IM11 (Rail B); - IM12 (£20 Parking Charge)

AN01	AN02
------	------

		AN01 Cordon Flows			AN02 Cordon Flows		
		Flows			Flows		
Cordon	Direction	Highway	Bus	Rail	Highway	Bus	Rail
Inner	Inbound	95	142	129	86	146	131
	Outbound	103	171	140	110	181	147
Total		98	151	133	95	157	136

		AN01 Cordon Flows		AN02 Cordon Flows	
		Highway	Bus	Highway	Bus
North	IB	93	171	79	176
	OB	115	217	123	222
South	IB	91	145	81	149
	OB	96	148	97	166
East	IB	102	116	102	119
	OB	108	197	117	203
West	IB	120	90	135	92
	OB	83	103	94	111
Total		98	151	95	157

Appraisal Summary Comments

AN01

- **Highway:** Cordon flows decrease inbound and increase outbound;
- **Bus:** Cordon flows increase;
- **Rail:** Cordon flows increase.

AN02

- **Highway:** Cordon flows decrease inbound and increase outbound;
- **Bus:** Cordon flows increase;
- **Rail:** Cordon flows increase.

## Objective 6 - Enhance safety for all modes of travel and reduce the number and severity of casualties

### Indicator

The total highway distance travelled in the AM peak hour, throughout the simulation network (BMA – See Appendix A.4)

Key	AN01:	AN02:
Positive Contribution	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2);	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2);
Neutral Contribution	- IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B)	- IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B); - IM12 (£20 Parking Charge)
Negative Contribution		
	<b>AN01</b>	<b>AN02</b>
	<b>Total Distance Travelled</b>	<b>Total Distance Travelled</b>
<b>Mode</b>	<b>Distance Travelled</b>	<b>Distance Travelled</b>
Highway	100	102

### Appraisal Summary Comments

#### AN01

- **Highway:** Distance travelled remains constant.

#### AN02

- **Highway:** Distance travelled increases.

## Objective 7 - Protect and enhance the built and natural environment by ensuring our transport systems operate sustainably and can integrate climate change adaptation requirements

### Indicator

The vehicle emissions in the AM peak hour throughout the simulation network (BMA – See Appendix A.4)

Key	AN01:	AN02:
Positive Contribution	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B)	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B); - IM12 (£20 Parking Charge)
Neutral Contribution		
Negative Contribution		

AN01	AN02
------	------

Pollutant	AN01	AN02
	Vehicle Emissions Volume	Vehicle Emissions Volume
CO	97	98
CO <sub>2</sub>	98	99
NO <sub>x</sub>	98	100
HC	97	98
Pb	98	98
PM <sub>10</sub>	98	98

### Appraisal Summary Comments

#### AN01

- **Highway:** All vehicle emissions decrease.

#### AN02

- **Highway:** In general vehicle emissions decrease.

## Objective 7 (continued) - Protect and enhance the built and natural environment by ensuring our transport systems operate sustainably and can integrate climate change adaptation requirements

### Indicator

The AM peak hour actual highway flow at the AQMAs in Belfast City Council

Key	AN01:	AN02:
Positive Contribution	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B)	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B); - IM12 (E20 Parking Charge)
Neutral Contribution		
Negative Contribution		

	AN01	AN02
	Actual Flow	Actual Flow
<b>AQMA 1</b>	<b>AQMA 1</b>	<b>AQMA 1</b>
A12 at Clifton St NB	118	110
A12 at Clifton St SB	275	273
A12 at Broadway NB	187	231
A12 at Broadway SB	53	247
M1 at Blacks Road SB	68	396
M1 at Blacks Road NB	-9	45
<b>AQMA 1 Total</b>	<b>693</b>	<b>1301</b>
<b>AQMA 2</b>	<b>AQMA 2</b>	<b>AQMA 2</b>
Ormeau Road at University Street SB	-76	-64
Ormeau Road at University Street NB	-14	-74
Ormeau Road at Ormeau Embankment SB	-107	-102
Ormeau Road at Ormeau Embankment NB	-14	-63
Ormeau Road at Annadale Avenue SB	-322	-328
Ormeau Road at Annadale Avenue NB	-92	-107
<b>AQMA 2 Total</b>	<b>-625</b>	<b>-739</b>
<b>AQMA 3</b>	<b>AQMA 3</b>	<b>AQMA 3</b>
East Bridge Street (west of bridge) EB	99	120
East Bridge Street (west of bridge) WB	108	50
East Bridge Street (east of bridge) EB	47	103
East Bridge Street (east of bridge) WB	65	65
Short Strand at East Bridge Street SB	36	49
Short Strand at East Bridge Street NB	-165	-273
Albertbridge Road at East Bridge Street EB	116	178
Albertbridge Road at East Bridge Street WB	26	-98
<b>AQMA 3 Total</b>	<b>331</b>	<b>195</b>
<b>AQMA 4</b>	<b>AQMA 4</b>	<b>AQMA 4</b>
Hawthornden Way at Nards Road SB	-269	-302
Hawthornden Way at Nards Road NB	-65	-49
Upper Nards Road east of Hawthornden Way EB	-28	13
Upper Nards Road east of Hawthornden Way WB	-45	-36
Knock Road at Nards Road SB	-113	-104
Knock Road at Nards Road NB	-167	-170
Upper Nards Road west of Hawthornden Way WB	-43	-69
Upper Nards Road west of Hawthornden Way EB	230	300
Upper Nards Road at Eastwood Road EB	257	337
Upper Nards Road at Eastwood Road WB	-104	-151
Upper Nards Road at Stoney Road EB	5	42
Upper Nards Road at Stoney Road WB	-13	-8
Knock Road at Shandon Park SB	-268	-287
Knock Road at Shandon Park NB	-219	-190
<b>AQMA 4 Total</b>	<b>-841</b>	<b>-674</b>

### Appraisal Summary Comments

#### AN01

- **Highway:** Actual flow increases in AQMA 1 and 3 and decreases in AQMA 2 and 4.

#### AN02

- **Highway:** Actual flow increases in AQMA 1 and 3 and decreases in AQMA 2 and 4.

**Objective 7 (continued) - Protect and enhance the built and natural environment by ensuring our transport systems operate sustainably and can integrate climate change adaptation requirements**

Indicator

The total demand for Bus and Rail trips in the AM peak hour model wide

<b>Key</b>						
<b>Positive Contribution</b>						
<b>Neutral Contribution</b>						
<b>Negative Contribution</b>						
	<b>AN01:</b>			<b>AN02:</b>		
	- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B)			- IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B); - IM12 (£20 Parking Charge)		
	<b>AN01</b>			<b>AN02</b>		
	<b>AM Peak Person Trips</b>			<b>AM Peak Person Trips</b>		
<b>Mode</b>	<b>From Belfast</b>	<b>To Belfast</b>	<b>Within Belfast</b>	<b>From Belfast</b>	<b>To Belfast</b>	<b>Within Belfast</b>
Bus	108	108	119	121	108	122
Rail	123	117	116	131	119	121

Appraisal Summary Comments

**AN01**

- **Bus:** Total demand increases;
- **Rail:** Total demand increases.

**AN02**

- **Bus:** Total demand increases;
- **Rail:** Total demand increases.



## Objective 7 (continued) - Protect and enhance the built and natural environment by ensuring our transport systems operate sustainably and can integrate climate change adaptation requirements

### Indicator

The total demand for walk and cycle in the AM peak hour in a Belfast Central Zone.

<b>Key</b>		
<b>Positive Contribution</b>	<b>AN01:</b> - IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B)	<b>AN02:</b> - IM01 (Highway); - IM02 (ITS); - IM04 (Goldline); - IM05 (BRT Phase 2); - IM06 (Metro); - IM07 (Cycling); - IM08 (Walking); - IM10 (Fares); - IM11 (Rail B); - IM12 (£20 Parking Charge)
<b>Neutral Contribution</b>		
<b>Negative Contribution</b>		
	<b>AN01</b>	<b>AN02</b>
	<b>Central Zone Mode Choice</b>	<b>Central Zone Mode Choice</b>
<b>Mode</b>	<b>Number of Trips</b>	<b>Number of Trips</b>
Walk	93	98
Cycle	91	95

### Appraisal Summary Comments

#### AN01

- **Walk:** Central zone trips decreases;
- **Cycle:** Central zone trips decreases.

#### AN02

- **Walk:** Central zone trips decreases;
- **Cycle:** Central zone trips decreases.

## 9.5. Alternative Networks - Appraisal Framework Summary

The Appraisal Framework used the following key model outputs:

- Network Travel Times from Belfast
- AM bus and rail demand
- Bus and rail total person km
- AM walk and cycle demand
- AM highway, bus and rail cordon flow

- Total highway distance travelled
- AM vehicle emissions
- Highway flow at AQMAs

Table 9-2 provides a summary overview of the outcomes of the AN Appraisal Framework.

**Table 9-2 – AN Appraisal Framework Overview**

Illustrative Measure	Objective 1 - Enhance accessibility by road and public transport from the centre of Belfast to Londonderry, gateways and hubs to support greater levels of inward investment	Objective 2 - Ensure financially viable and sustainable public transport accessibility to essential services for people living in Belfast City Council Area	Objective 3 - Ensure there are attractive and safe active travel networks (walking and cycling) linking all residential, retail, leisure, culture, office and commercial uses within the urban areas of the Belfast City Council area	Objective 4 - Deliver high quality public realm in Belfast City Centre and in district centres with reduced vehicle dominance, to make them attractive, shared spaces to live and work and improve safety for active modes.	Objective 5 - Enhance transport accessibility and manage traffic congestion to Belfast City Centre and to district centres to strengthen Belfast's role as the regional economic driver	Objective 6 - Enhance safety for all modes of travel and reduce the number and severity of casualties.	Objective 7 - Protect and enhance the built and natural environment by ensuring our transport systems operate sustainably and can integrate climate change adaptation requirements
AN01: • IM01 – Highway; • IM02 – ITS; • IM04 – Goldline; • IM05 – BRT Phase 2; • IM06 – Metro; • IM07 – Cycling; • IM08 – Walking; • IM10 – Fares; • IM11 – Rail B		✓	x	✓	DfI to Produce TRACC Outputs		✓
AN02: • AN01 • IM12 - £20 Parking Charge		✓	x	✓		x	✓

Summary Table Colour	Outcome Type
✓	Positive Contribution
	Neutral Contribution
x	Negative Contribution

Table 9-2 demonstrates:

- AN01 shows a positive contribution in Objectives 1, 2 and 4 with a negative contribution on Objective 3;
- AN02 shows a positive contribution in Objectives 2 and 4 with a negative contribution in Objectives 3 and 7.

## 9.6. Summary

The AN model runs and Appraisal Framework has shown:

- Even with all the PT and highway measures in place in AN01 some modelled links within the council area show increases in delay and VOC in comparison to the 2030 PDS3 DoMin model run. The highway mode share also remains consistent with the 2013 DoMin;
- In AN02 with the introduction of a parking charge the highway mode share decreases compared to the 2013 DoMin. This suggests that while implementing a selection of IMs reduces the growth of car trips demand management measures are required if there is to be a reduction in car mode share.

# Summary and Conclusions



# 10. Summary and Conclusions

## 10.1. Introduction

DfI commissioned Atkins to provide professional services in relation to developing a Belfast Metropolitan Transport Study (BMTS) under the Strategic Transport Planning and Modelling – Managed Services Framework. The purpose of this commission was to undertake transport modelling to understand the potential effects of different types of transport measures. The results of the modelling were used to identify those measures that might best support the future local development plan for the council area.

Atkins' brief for the BMTS comprised a list of twelve main Illustrative Measures (IMs) to be tested in the Belfast Strategic Transport Model (BSTM). These IMs were then tested in both the base year demand and a preferred 2030 Planning Development Scenario (PDS) derived as part of this commission. Initially operational outputs from the model were used to confirm the model was operating satisfactorily and producing logical results. An appraisal framework was also developed from locally derived objectives. The appraisal framework was populated with outputs from the model and used to compare the performance of the IMs. From the results of these model runs four Alternative Networks (ANs) were developed as a compilation of the initial twelve IMs. The results from the model runs were subsequently used by DfI to inform the conclusions of the Transport Study for the Belfast Metropolitan Area.

## 10.2. Summary

This report has set out an overview of:

- The approach to developing the Vision and Objectives for the Belfast Metropolitan Area along with a summary of the seven key Transport Objectives;
- The Belfast Strategic Transport Model (BSTM) development along with a summary of its capabilities and limitations;
- Updates applied to the BSTM since initial construction;
- The baseline conditions of the model including:
  - Mode Choice;
  - Cordon Flows;
  - Travel Times.
- The data sources and methodology used to inform the Planning Development Scenario (PDS) build;
- The schemes and coding that compile the Illustrative Measures (IMs);
- The model outputs that are used to assess the performance of each model run to inform the Appraisal Framework. These include:
  - Network Travel Times from Belfast
  - AM bus and rail demand
  - Bus and rail total person km
  - AM walk and cycle demand
  - AM highway, bus and rail cordon flow
  - Total highway distance travelled
  - AM vehicle emissions
  - Highway flow at AQMAs
- The Appraisal Framework for the 2030 (PDS3) IM model runs;
- The breakdown of the Alternative Network (AN) compilation and their performance using the Appraisal Framework.

## 10.3. Conclusion

This report has concluded:

- While the BSTM is a strategic model and does not contain a detailed level of coding and validation it is still considered a robust tool to undertake the BMTS assessment – output results have been consistent and intuitive;

- In conjunction with DfI seven Transport Objectives were developed following a review of the local and regional policies. These Objectives have formed the basis of an Appraisal Framework (AF). This AF provides an indication as to how each model run performs in relation to each objective using a series of model indicators;
- While three PDS were tested in the model, PDS3 – PT focus, was considered the best option for future year model runs. This PDS option utilised the council growth plans while distributing the increase in trips in line with the base year PT distribution. While this scenario encourages the use of public transport, it still shows an increase in highway trips across the modelled area. This increase in trips leads to increases in delay and congestion and so impacts the total travel time for each road user. This effect on the road network shows that measures will need to be taken to counteract this deterioration in performance of the highway network;
- Twelve Illustrative Measures were then tested using the 2030 PDS3 demand to gain a level of understanding of their performance. A review of the model outputs for each IM was undertaken to ensure that the BSTM was showing intuitive results. This review concluded that the BSTM IM outputs were suitable and could be interrogated using the Appraisal Framework;
- The outcomes of the IM AF led to the development of two Alternative Networks. These ANs are as follows:

**AN01:**

- |                       |                   |
|-----------------------|-------------------|
| - IM01 – Highway;     | - IM07 – Cycling; |
| - IM02 – ITS;         | - IM08 – Walking; |
| - IM04 – Goldline;    | - IM10 – Fares;   |
| - IM05 – BRT Phase 2; | - IM11 – Rail B.  |
| - IM06 – Metro;       |                   |

**AN02:**

- |                       |                              |
|-----------------------|------------------------------|
| - IM01 – Highway;     | - IM07 – Cycling;            |
| - IM02 – ITS;         | - IM08 – Walking;            |
| - IM04 – Goldline;    | - IM10 – Fares;              |
| - IM05 – BRT Phase 2; | - IM11 – Rail B;             |
| - IM06 – Metro;       | - IM12 - £20 Parking Charge. |

- The ANs were then assessed using the AF. This concluded:
  - The addition of the PT IMs improved reliability and reduced travel times by bus and rail. This in turn increased the passenger demand by these modes;
  - However, these PT improvements have had a negative impact on the use of sustainable travel due to the improved attractiveness of bus and rail travel;
  - It should be noted that even with the implementation of the AN01 measures, the share of highway demand remained consistent with the base year mode share;
  - The inclusion of the IM12 Demand Management initiative did however have an impact on the level of car use, actually reducing use to less than the base year proportion.

In conclusion, the assessment of both the IMs and ANs has revealed that, whilst the introduction of new PT schemes and a reduction in fares can stimulate PT use, car use remains stubbornly high unless more intrusive measures are taken to make it less easy to use the private car.

Finally, while the BSTM has been used to demonstrate the high-level impact of the forecast growth and proposed mitigation measures, further work will be required to determine the detail of the proposed schemes.

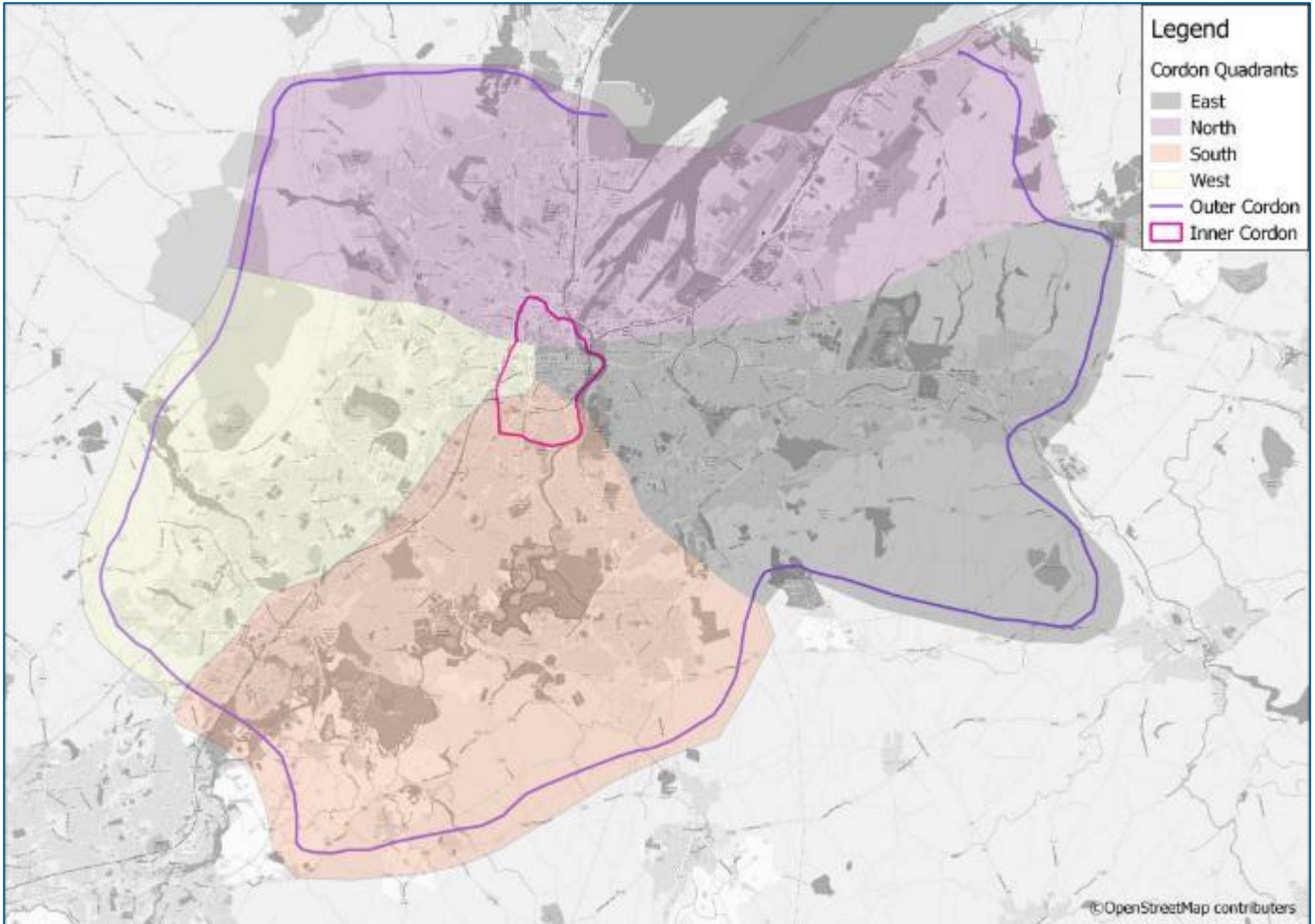


# Appendices



# Appendix A. Layouts

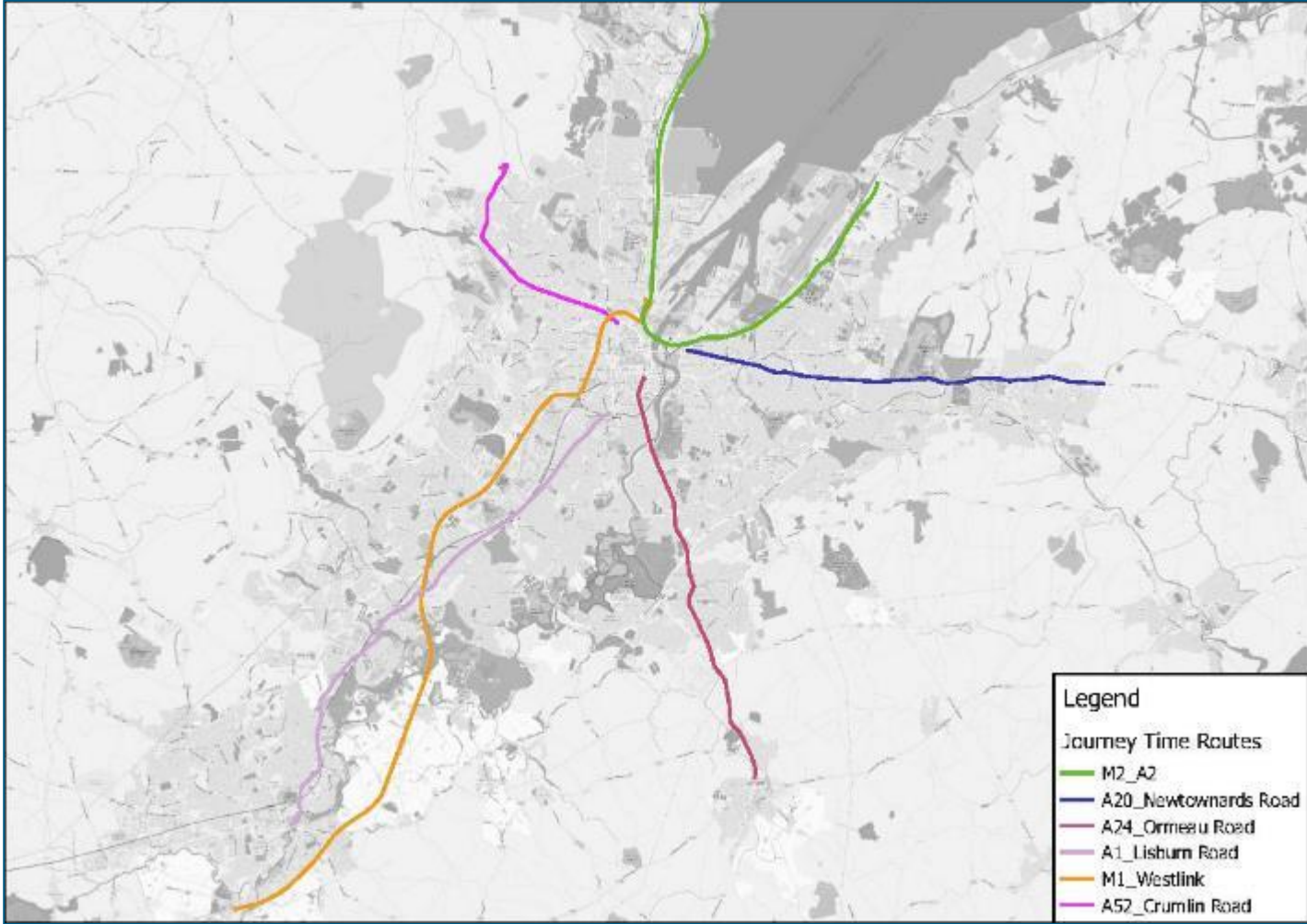
## A.1. Belfast Cordon Locations



## A.2. Belfast AQMA



### A.3. Belfast Select Journey Times





## A.4. Simulation Network

Simulation network is shown in black with the buffer network shown in blue.





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