Department for Regional Development - TransportNI

YORK STREET INTERCHANGE

Public Inquiry

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Proof of Evidence:

Traffic and Economic Assessment

by

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1. INTRODUCTION

1.1 Qualifications, Role and Experience

1.1.1.1 My name is Russell Bissland. I am a Chartered Civil Engineer with a Bachelor of Science degree in Civil Engineering. I have been a member of the Institution of Civil Engineers since 1988 and a member of the Institution of Highways and Transportation since 1991.

1.1.1.2 I have more than 38 years' experience in civil engineering projects through my employment with various organisations including British Rail, Local Roads Authorities and Consulting Engineers.

1.1.1.3 I am presently employed by URS as a Technical Director with responsibility for the traffic and economic assessment of major transport improvement schemes.

1.1.1.4 URS was acquired by AECOM in October, 2014. Together AECOM and URS are one of the world's premier, fully integrated infrastructure and support services firms. For the purpose of this Proof of Evidence, any reference to URS may include reference to its former legacy companies, including Scott Wilson.

1.1.1.5 I am responsible for the traffic and economic of major road improvement schemes throughout Scotland, Northern Ireland and the north of England. In Northern Ireland specifically, I have been responsible for undertaking the appraisal of road schemes in Armagh, Enniskillen, Omagh and for the traffic and economic assessment of numerous major road improvement schemes including the A8 Belfast to Larne Improvement, the M2 Motorway Widening, the A1 Beech Hill to Cloghogue Dualling, the A6 Castledawson to Randalstown Dualling, the A6 Londonderry to Claudy Dualling and the A24 Ballynahinch Bypass.

1.2 Scope of Evidence

1.2.1.1 The scope of my evidence concerns the Stage 3 Traffic and Economic Assessment Report, dated 20 January 2015, for the Proposed Scheme.

1.2.1.2 The method adopted for the traffic and economic assessment of the Proposed Scheme is in line with the requirements of the Design Manual for Roads and Bridges (DMRB).

1.2.1.3 The primary objective of the Stage 3 Traffic and Economic Assessment Report is to describe existing traffic conditions in the York Street area, to outline the indicative costs, risks and optimism bias associated with the Proposed Scheme and to describe the modelling work undertaken to develop the various computer models. The report also considers future traffic conditions over the economic life of the Proposed Scheme and presents the results of an operational and economic assessment of the Proposed

Scheme. Given the uncertainty in predicting future traffic conditions, the results from a series of sensitivity tests have also been reported.

2. BACKGROUND AND REPORTING

2.1 Background Policy

2.1.1.1 The Proposed Scheme was identified in the Roads Service Consultation Document 'Expanding the Strategic Road Improvement (SRI) Programme 2015', dated July 2006, as an additional SRI scheme to be added to programme subject to consultation. The Proposed Scheme, referred to as the Westlink / York Street Flyover, would provide a grade separated junction at the last remaining part of the Westlink which has a traffic signalled junction.

2.2 Scheme Development and Reporting

2.2.1.1 The previous Stage 1 Scheme Assessment completed in March 2009 identified that the introduction of grade separation at the existing signalised junction would deliver positive benefit to cost ratios. In the published Preliminary Options Report, six identified Preliminary Options were reported to deliver positive benefit to cost ratios, across a range of projected traffic growth scenarios. It should be noted that the economic assessment did not take account of the economic impact of queues and delays during construction.

2.2.1.2 The Stage 1 Scheme Assessment concluded that the scheme had sufficient merit to be taken forward, with four of the six Preliminary Options recommended for further development and assessment. TransportNI accepted the recommendations made by URS, with the scheme attaining its TransportNI Gateway 0 approval in March 2009.

2.2.1.3 Further to the recommendations arising from the Stage 1 Scheme Assessment, four of the six Preliminary Options were shortlisted for a further Stage 2 Scheme Assessment in line with the recommendations of the Preliminary Options Report. The engineering designs of the options were developed in more detail through consultations with various statutory and non-statutory bodies, with a formal public consultation period held in June 2011 to allow members of the public to view and comment upon the proposals.

2.2.1.4 The developed four options proposed the introduction of grade separation at the existing junction using various alignments. Following their identification and refinement, the options were subject to separate Stage 2 engineering, environmental, traffic and economic assessments in accordance with the requirements of the DMRB. The findings from these assessments were reported in the Preferred Options Report of October 2012.

2.2.1.5 Following the announcement of the Preferred Option, the layout of the scheme was further refined ahead of a Stage 3 Assessment Prior to the Publications Order in accordance with the requirements of the DMRB and the recommendations of the

Preliminary Options Report. The resultant layout presented for Stage 3 Assessment Prior to the Publications Order has been termed the Proposed Scheme.

2.3 Stage 3 Scheme Specific Objectives

2.3.1.1 The following scheme specific objectives have been identified for the Proposed Scheme:

- to remove a bottleneck on the strategic road network;
- to deliver an affordable solution to assist in reducing congestion on the strategic road network;
- to improve reliability of strategic journey times for the travelling public;
- to improve access to the regional gateways from the Eastern Seaboard Key Transport Corridor;
- to maintain access to existing properties, community facilities and commercial interests;
- to maintain access for pedestrians and cyclists; and
- to improve separation between strategic and local traffic.

2.3.1.2 These specific objectives have been used in the development of the Proposed Scheme.

3. STAGE 3 EXISTING CONDITIONS

3.1 Existing Conditions

3.1.1.1 The existing York Street junction in the centre of Belfast is one of the most heavily trafficked junction arrangements in Northern Ireland.

3.1.1.2 Existing conditions in the York Street area are subject to significant congestion during periods of peak traffic demand due to the convergence of traffic from the Westlink, the M2 and M3 motorways and the local surface streets. This demand is controlled by a series of signalised junctions, where signal timings are monitored and adjusted regularly to improve traffic flow during peak periods.

3.1.1.3 As a result of a programme of ongoing improvements in the area, traffic conditions have changed significantly over the past few years. The Westlink improvements were completed in March 2009 and delivers traffic more efficiently to the York Street area. The M2 motorway widening, which was completed in August 2009, also improves the flow of traffic heading towards the existing York Street junction.

3.1.1.4 The study area for the traffic and economic assessment focuses on the immediate area around York Street, York Link, Nelson Street and Great George's Street. This area has been extended to include modelling of the key junctions along Dock Street in the north, Great Patrick Street in the south and the Clifton Street slips in the west to allow consideration of the wider traffic effects of the proposed York Street improvements. The survey area also extends to the Fortwilliam junction to allow modelling of the effects of the proposed changes to the speed limits on the M2 motorway and the effects of potential traffic redistribution at Duncrue Street.

3.1.1.5 A general location of the existing York Street junction and the surrounding road network area is shown in Figure 3.1. A more detailed key location plan is shown in Figure 3.2.

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4. TRAFFIC SURVEYS AND DATA COLLECTION

4.1 Data Collection Surveys

4.1.1.1 A programme of data collection surveys was undertaken in 2012 to assist in establishing traffic volumes, turning flows and vehicle proportions at key junctions in the York Street area.

4.1.1.2 In summary, the survey data included the following:

- Manual Classified Counts;
- Queue Surveys;
- Automatic Traffic Counters; and
- Journey Time Surveys.

4.2 Manual Classified Counts

4.2.1.1 A programme of Manual Classified Counts (MCCs) was carried out at twenty nine locations within the study area on Tuesday 29 May and Wednesday 30 May 2012 to define current traffic volumes and turning movements. This included twenty Junction Turning Counts, three Link Counts and six In/Out Manoeuvre Counts.

4.2.1.2 The MCC data for all sites were collected in 15-minute intervals between 07:00 hours and 19:00 hours during the weekday surveys to provide a 12-hour record of turning movements and link flows.

4.2.1.3 The results from the MCC Surveys are summarised in Table 1.

Table 1: Summary of 12-hour Traffic Volumes – JTC Sites

Site	Description	Total Flow
J1	York Street / Westlink Junction	56,168
J2	Great George's Street / York Street Junction	55,557
J3	Nelson Street / M3 Off-Slip Junction	43,578
J4	York Link / Nelson Street Junction	45,308
	York Street Approach	16,929
	Westlink Approach	36,670
	Nelson Street Approach	29,020 (Including 17,653 from M2 Off-Slip)
	M3 Off-Slip Approach	18,171

4.2.1.4 The locations of the MCCs are shown in Figure 4.1.

4.3 Queue Surveys

4.3.1.1 A programme of Queue Surveys was undertaken at four locations within the study area on Tuesday 29 May 2012 to assist in assessing operating conditions around the York Street gyratory.

4.3.1.2 The results from the Queue Surveys indicates that:

- at Site Q1, which is the Westlink approach to York Street, the maximum queue length was recorded at 16:00 hours where 88 vehicles were observed queuing;
- at Site Q2, which is York Street, the maximum queue length was recorded at 16:45 hours where 84 vehicles were observed queuing;
- at Site Q3, which is the M3 motorway off-slip to Nelson Street, the maximum queue length was recorded at 16:30 hours where 64 vehicles were observed queuing; and
- at Site Q4, which is on Nelson Street, the maximum queue length was recorded at 17:00 hours where 87 vehicles were observed queuing.

4.3.1.3 The locations of the Queue Surveys are shown in Figure 4.2.

4.4 Automatic Traffic Counts

4.4.1.1 Six temporary Automatic Traffic Counters (ATCs) were installed during the survey period at key locations within the study area to define directional, hourly and daily variations in traffic flows.

4.4.1.2 The locations of the temporary ATC Sites are shown in Figure 4.3.

4.4.1.3 The temporary ATCs provide a record of traffic flows generally over a 14 day period between Monday 28 May and Sunday 10 June 2012. It should be noted that the data recorded at temporary ATC Sites 2, 5 and 6 were fragmented with some missing data. Some of this data has therefore been infilled and some has been excluded from the analysis. For the purpose of defining baseline conditions, the ATC at Site 6 was extended for a further week to provide additional information on traffic flows.

4.4.1.4 The results from the temporary ATC Sites are summarised in Table 2.

Table 2: Temporary Automatic Traffic Count Results

ATC Site	5-Day Average 24-Hour Traffic Flow	7-Day Average 24-Hour Traffic Flow
ATC 1	16,539	14,177
ATC 2	21,559	19,942
ATC 3	4,015	3,085
ATC 4	9,962	8,426
ATC 5	48,621	42,815
ATC 6	23,767	21,286

4.5 Journey Time Surveys

4.5.1.1 A survey of current journey times was undertaken in the York Street area, including the Westlink, the M2 motorway and the M3 motorway, to assist in defining current operating conditions within the corridor.

4.5.1.2 The surveys were carried out on Tuesday 29 May and Wednesday 30 May 2012 using two survey vehicles over two routes, namely the Red Route and the Blue Route. Various runs were carried out for the two routes between 07:00 hours and 19:00 hours to record variations in journey times throughout the day. The survey periods were as follows:

- AM Peak Period: 07:00 hours - 10:00 hours;

- Interpeak Period: 11:00 hours – 15:00 hours; and
- PM Peak Period 16:00 hours – 19:00 hours.

4.5.1.3 A total of fifty runs were carried out over the two days for the Red Route and a total of sixty two runs were carried out over the two survey days for the Blue Route.

4.5.1.4 The results of the Journey Time Surveys are summarised in Table 3.

Table 3: Summary of Journey Time Survey Results

Time Period	Red Route Average Speed (mph / kph)	Blue Route Average Speed (mph / kph)
A.M.	16 mph / 26 kph	14 mph / 23 kph
P.M.	16 mph / 26 kph	15 mph / 24kph
Full Day	17 mph / 27 kph	16 mph / 26 kph

4.5.1.5 The limits of the Journey Time Survey routes and the locations of the measurement points are shown in Figure 4.4.

5. THE PROPOSED SCHEME

5.1 Description of the Proposed Scheme

5.1.1 Strategic Movements – Westlink / M2 Motorway / M3 Motorway

5.1.1.1 The Proposed Scheme would provide an uninterrupted link from the Westlink to the M2 motorway and from the M2 motorway to the Westlink. This option would also provide an uninterrupted link from the Westlink to the M3 motorway and from the M3 motorway to the Westlink. The existing link between the M2 and M3 motorways via the Lagan Bridge would be retained.

5.1.2 Local Movements – York Street

5.1.2.1 York Street would be realigned to provide a two-way running arrangement, with a single southbound bus lane in operation between the York Street / M2 motorway junction and Great Patrick Street.

5.1.2.2 On the southern section of York Street, between the junction with Great Patrick Street and the junction with the Westlink / Great George's Street, 3 northbound lanes would be provided to accommodate traffic travelling north on York Street and to the M2 motorway, which would flare to provide two 2-lane approaches at the signalised junction.

5.1.2.3 From the junction with the Westlink / Great George's Street, two continuous northbound lanes would be provided to cater for traffic travelling north on York Street towards Dock Street. In addition, two continuous lanes would also be provided for traffic travelling north between the junction with the Westlink / Great George's Street and the M2 motorway.

5.1.2.4 A signalised junction would be provided at the York Street / Westlink / M2 motorway junction.

5.1.2.5 The existing York Street to York Link / M3 motorway movement would not be directly accommodated within the Proposed Scheme, with traffic diverted via Dock Street and the proposed slip road to the M3 motorway.

5.1.3 Local Movements – Nelson Street / Corporation Street

5.1.3.1 Nelson Street between Dock Street and Great George's Street would be closed to traffic to accommodate the new links to and from the M3 motorway and an access road to the lands between Nelson Street and Corporation Street, where the proposed pumping station would be located.

5.1.3.2 As a consequence of this closure, traffic on Nelson Street would be displaced on to the surrounding road network.

5.1.4 **Local Movements – Duncrue Street**

5.1.4.1 The Proposed Scheme would provide a new link between Duncrue Street and the Westlink.

5.1.4.2 A detailed plan showing the Proposed Scheme and the associated junction arrangements is shown in Figure 5.1.

5.2 Costs, Risks and Optimism Bias

5.2.1.1 Cost estimates were prepared for the Proposed Scheme. These costs, which are based on current rates, were used to define both the total construction cost and total land cost for the Proposed Scheme.

5.2.1.2 A breakdown of the estimated costs of the Proposed Scheme in Quarter 2, 2013 prices, is shown in Table 4.

Table 4: Estimated Proposed Scheme Cost Summary

Item	Scheme Cost (£m's)
Total Construction Cost	£84.603
Total Land Cost	£8.395
Preparation (6% of Total Construction and Land Cost)	£5.580
Supervision (5% of Total Construction and Land Cost)	£4.650
Total Scheme Cost	£103.228

Note: All costs are in Q2, 2013 prices and exclude VAT.

5.2.1.3 Consultations with both NI Water and Translink identified an opportunity to introduce stormwater separation and to undertake strengthening works to several foundations of the Dargan Bridge as part of the Proposed Scheme. The works costs associated with the NI Water and Translink works were estimated to be £4.876m and £3.453m respectively, which increased the Total Scheme Cost to £111.557m. As these works would be funded separately and there are no corresponding transport user benefits, the construction costs and benefits associated with these works have been excluded from the assessment.

5.3 Optimism Bias

5.3.1.1 As there is a tendency for project appraisers to be overly optimistic when assessing total scheme costs, optimism bias has been included in the appraisal to increase the capital

expenditure estimate of the Proposed Scheme and the potential for delays during construction, in accordance with the operational advice concerning H.M. Treasury's New Green Book on Appraisal and Evaluation in Central Government.

5.3.1.2 As schemes progress through the various stages from the identification of a general corridor to the development of various route options and finally the selection of the Proposed Scheme, the level of optimism bias is likely to reduce accordingly.

5.3.1.3 Current Transport NI guidance recommends that the costs used in the economic appraisal of schemes include an upper bound allowance. At this stage of the project, an allowance of 16.5% for optimism bias has been used.

5.3.1.4 A breakdown of the estimated costs of the Proposed Scheme, excluding the NI Water and Translink construction costs and including an allowance of 16.5% for optimism bias, is shown in Table 5. All costs are in Quarter 2, 2013 prices.

Table 5: Estimated Proposed Scheme Cost Summary, Including 16.5% Optimism Bias

Item	Scheme Cost (£m's)
Total Construction Cost	£98.563
Total Land Cost	£9.780
Preparation (6% of Total Construction and Land Cost)	£6.501
Supervision (5% of Total Construction and Land Cost)	£5.417
Total Scheme Cost	£120.261

Note: All costs are in Q2, 2013 prices and exclude VAT.

5.4 Cost Profile

5.4.1.1 For the purpose of the economic appraisal, the cost profile shown in Table 6 has been adopted.

5.4.1.2 The Proposed Scheme is based on a three year construction period.

Table 6: Proposed Scheme Cost Profile

Year	Cost Profile	
	Construction	Land
2017	0%	100%
2018	30%	0%
2019	34%	0%
2020	33%	0%
2021	3%	0%

Note: The construction cost profile is based on typical profile with a 3 year construction period.

6. DEVELOPMENT OF COMPUTER MODELS

6.1 Overview

6.1.1.1 The quantative assessment of the transport economic efficiency and road safety aspects of a proposed road improvement scheme requires the development and application of various computer models. In the case of the Proposed Scheme, this has involved the development of a COBA (Cost Benefit Analysis) model and QUADRO (Queues and Delays at Roadworks) model.

6.1.1.2 In addition to the COBA and QUADRO models, various detailed traffic models were created to assist in the development of the Proposed Scheme.

6.2 The COBA Model

6.2.1.1 COBA is the standard computer model introduced in the 1970s to examine proposed investments in the trunk road network by comparing the costs of the road scheme with the associated road user benefits. The procedures for developing and applying the COBA model are set out in DMRB Volume 13.

6.2.1.2 The overall geographical area of the model, which extends from the Fortwilliam junction in the north, to the M3 motorway slips in the east, to Dunbar Link in the south and to the Clifton Street slips in the west, was defined to encompass the effects of the improvement option being considered.

6.2.1.3 The Proposed Scheme models are based on 12-hour traffic flows and turning movements observed in 2012.

6.2.1.4 The assessment is based on standard COBA default values where these have been considered appropriate. For example, the default proportion of in-work trips has been adopted and default accident rates have been applied to both the Do-Minimum and Do-Something networks.

6.3 The Do-Minimum Network

6.3.1.1 The Do-Minimum network is the based road network against which the Do-Something network is assessed. In the case of the Proposed Scheme, no specific changes to the base road network have been identified and consequently the Do-Minimum network is consistent with the existing Do-Nothing network.

6.3.1.2 The limits of the highway network defined for the Do-Minimum model were defined to encompass the area surrounding the Proposed Scheme that is likely to be significantly affected by the potential reassignment of traffic on to the improved routes.

6.3.1.3 Aerial views of the existing York Street junction captured from the 3-dimensional model of the area are shown in Figure 6.1. The location and identification of the various links and nodes which define the Do-Minimum COBA network are shown in Figure 6.2.

6.4 Model Calibration and Validation

6.4.1.1 The Do-Minimum COBA model was calibrated by varying the characteristics of the links and junctions to obtain a reasonable representation of observed conditions.

6.4.1.2 In the case of the Proposed Scheme, changes in travel times between the Do-Minimum and the Do-Something networks are likely to represent the most significant change in road user economic benefits. It is therefore important to demonstrate that the Do-Minimum model provides a reasonable basis to assess transport conditions within the study area.

6.4.1.3 To demonstrate that the model provides a reasonable representation of existing transport conditions in the area, the observed journey times and modelled times on the network derived from the COBA model were compared. The results of this comparison for the Red and Blue routes are shown in Tables 7 and 8 respectively.

Table 7: Model Calibration and Validation: Comparison of Observed and Modelled Link Time – Red Route

Red Route	Average Total Time (secs)	Average Speed (kph)
Observed	1,304	27.2
Modelled	1,245	28.5
Difference	-59	1.3
% Difference	-4.5%	4.8%

Table 8: Model Calibration and Validation: Comparison of Observed and Modelled Link Time – Blue Route

Blue Route	Average Total Time (secs)	Average Speed (kph)
Observed	840	25.8
Modelled	865	25.0
Difference	25	-0.8
% Difference	2.9%	-2.8%

6.4.1.4 The correlation between the observed times on both the Red and Blue Routes and the modelled times derived from the calibrated model confirms that the model provides a reasonable representation of actual operating conditions on the network.

6.5 COBA Do-Something Model

6.5.1.1 The general layout of the Proposed Scheme, including aerial views captured from the 3-dimensional model of the area, and the corresponding network diagram indicating the locations of the various links and nodes which define the highway network for the COBA Do-Something model are shown in Figures 6.3 and 6.4 respectively.

6.5.1.2 Using the trip assignment model developed for the Do-Minimum scenario, the derived 2012 trip matrix was assigned to the Do-Something network to assist in defining changes in traffic flows and trip patterns resulting from the provision of the Proposed Scheme.

6.6 The QUADRO Model

6.6.1.1 An assessment of the economic effects of the road user delays associated with the construction of the Proposed Scheme has been undertaken using Release 12 of the computer program QUADRO 4 (Queues and Delays at Roadworks) model.

6.6.1.2 For the purpose of the QUADRO assessment, it has been assumed that the construction period for the Proposed Scheme would be as shown in Table 9.

Table 9: QUADRO Do-Something Proposed Scheme Construction Period

Option	Construction Start Date	Construction End Date
Proposed Scheme	1 May 2018	18 February 2021

6.7 Description of Traffic Management

6.7.1.1 Traffic management would be in place for 24 hours per day, 7 days a week for the estimated 3 years construction programme. The traffic management would be implemented in 13 separate phases over a period of 149 weeks with each phase incorporating a series of traffic management measures. These measures would change as the construction of the Proposed Scheme proceeds.

6.7.1.2 Blanket speed limits of between 30mph and 50mph have been applied across the network during the construction programme.

6.8 Diversion Route

6.8.1.1 Within urban road networks in general and the York Street area in particular multiple diversion routes are available within the local road network for road users affected by the Temporary Traffic Management arrangements. A maximum queue delay has therefore been defined in the QUADRO models to reflect the time that road users are willing to be delayed due to the roadworks before selecting an alternative route.

6.8.1.2 For the purpose of the assessment of the Proposed Scheme, a maximum queue delay of 5 minutes has been defined in the QUADRO assessment to reflect the likely level of additional delays that road users are likely to experience. This is considered to be a reasonable estimate of average additional journey time based on the number of route options in the area, the advanced notification of the major road works programme which will extend for a period of 3 years and an assessment of peak and off-peak journey times in the area.

6.9 Modelled Traffic Conditions

6.9.1.1 The QUADRO models are based on the 12-hour traffic flows defined in the COBA assessment using information observed from the May 2012 traffic surveys.

6.9.1.2 The data collected from the temporary automatic traffic counters installed around York Street as part of the May 2012 data collection survey programme as analysed to define local hourly flow traffic profiles to reflect prevailing conditions.

6.9.1.3 It should be noted that TransportNI intends to promote a number of traffic reduction initiatives during the construction of the Proposed Scheme. Several measures were implemented during the construction phase of the Westlink upgrade to reduce the volumes of traffic entering the area including signed alternatives routes for drivers with destinations outwith the city centre, restricting as far as possible other roadworks on roads in the area throughout the duration of the works and the provision of additional Variable Message Signs located at the outer approaches to Belfast to allow users to choose alternative routes. It is assumed that similar measures will be implemented during the construction of the Proposed Scheme. Therefore, a 10% reduction in traffic entering the area during the construction of the Proposed Scheme has been assumed and the observed 12-hour flows in the models have been reduced accordingly.

7. FUTURE CONDITIONS

7.1.1.1 For the purpose of the economic assessment, it has been assumed that construction of the scheme would be undertaken in 2018, 2019 and 2020, with the scheme opening in 2021. This timeframe has been adopted to provide a reasonable basis for the economic assessment of the Proposed Scheme.

7.1.1.2 Although significant changes in land use within the Belfast area occur which would affect traffic conditions within the study area, there is always inherent uncertainty in predicting precisely the nature, scale and implementation programmes for significant developments over such a wide area, particularly given current economic conditions. It should also be noted that in accordance with standard procedures, it is necessary to establish changes in traffic demand over the full economic life of the scheme, which in the case of the Proposed Scheme extends to 60 years from the year of opening.

7.1.1.3 It is therefore considered that the most likely forecast of long term traffic growth within the study area for the assessment of the Proposed Scheme can best be defined by the application of national forecasts of traffic growth. The National Road Traffic Forecasts (NRTF) (1997) of growth have therefore been adopted to provide a reasonable estimate

of long-term future traffic flows within the area over the 60-year economic assessment period.

7.1.1.4 The traffic growth factors defined in COBA under the NRTF central growth traffic forecasts have been adopted for the purpose of the economic assessment of the Proposed Scheme. The growth factors from the 2012 base year to the 2021 opening year and 2035 design year are shown in Table 10.

Table 10: NRTF Growth Factors – Central Growth

Period (Years)	Central Growth
2012 to 2021 Opening Year	1.121
2012 to 2035 Design Year	1.218

7.1.1.5 In the case of York Street, it should be noted that traffic within the area can be constrained by the capacity of the surrounding road network. It is therefore possible that traffic growth could be constrained to less than the National Road Traffic Forecasts. Given the degree of uncertainty in predicting future traffic flows, the Proposed Scheme has also been tested considering NRTF low and high growth projections from the year 2012 onwards.

7.1.1.6 In addition to the above low and high traffic forecast sensitivity tests, a further test has been undertaken to consider the potential effects of releasing any suppressed demand when the Proposed Scheme opens. Therefore, to test the effects of the potential for the release of some suppressed demand on the strategic links in the network when the scheme opens, a 'High Demand' scenario sensitivity test has been undertaken based on a high growth scenario with an applied 5% increase in traffic travelling on the strategic routes between the Westlink, the M2 motorway and the M3 motorway.

8. OPERATIONAL ASSESSMENT

8.1 Traffic Flows

8.1.1.1 The principal operational effect of the Proposed Scheme is to provide improved transport links for strategic traffic movements by providing a grade-separated interchange that avoids the existing signalised junctions on the surface streets with a consequential reduction in delays and congestion for strategic traffic travelling between the Westlink and the M2 and M3 motorways.

8.1.1.2 A comparison of the daily traffic flows estimated for each of the key approach roads to the junction in the 2021 year of opening under the central traffic growth scenario is shown in Table 11.

Table 11: Key Approach Road Traffic Flows – 2021 Year of Opening

Approach Road	Do-Minimum Network (vpd)	Do-Something Network (vpd)
York Street	20,800	18,100
Westlink	45,500	44,600
M2 Southbound Off-Slip	22,100	21,000
Nelson Street	14,200	7,700
M3 Westbound Off-Slip	22,600	22,600

Note 1: Where an equivalent link is not available, the nearest comparable link(s) have been used.

Note 2: Traffic flows on York Street under the Do-Something scenario excludes buses.

Note 3: Traffic flows on Nelson Street are not directly comparable due to road closures.

Note 4: Nelson Street approach road link accommodates only Nelson Street to M3 motorway traffic under the Do-Something scenario.

8.1.1.3 In comparing the traffic flows across the two networks, the following key issues should be taken into account:

- the absence of a direct link between York Street and the M3 motorway in the Proposed Scheme would result in traffic reassignment over a wide area;
- the closure of Nelson Street to through traffic in the Proposed Scheme would result in traffic reassignment over a wide area; and
- the provision of the new Duncrue Street to the Westlink link road would result in increased traffic flows in the Duncrue Street area.

8.1.1.4 The estimated 24-hour traffic flows for the Do-Minimum network, which are based on observed traffic flows, in the 2012 base traffic year, are shown in Figure 8.1.

8.1.1.5 The estimated 24-hour traffic flows for the Do-Minimum network in the 2021 year of opening, under the NRTF central traffic growth scenario, are shown in Figure 8.2.

8.1.1.6 The estimated 24-hour traffic flows for the Do-Something network in the 2021 year of opening, under the NRTF central traffic growth scenario, are shown in Figure 8.3.

8.2 Journey Times

8.2.1.1 Savings in journey times are generally one of the most significant benefits resulting from the provision of a new transport improvement scheme. Although COBA reports link transit times along predefined routes in the modelled network, this information excludes junction delays, which in the case of the Proposed Scheme is an important consideration when comparing the overall changes in journey time.

8.2.1.2 COBA considers changes in traffic conditions during the day by modelling the 8,760 hours in a year divided into different portions called Flow Groups (FGs). Flow Groups 1-5 represent Weekday Hours, with FG4/5 representing the busiest 522 weekday hours of the year, FG3 representing the next busiest 522 weekday hours, FG2 representing the next busiest 2,088 weekday hours, and FG1 representing the remaining 3,132 weekday hours.

8.2.1.3 Flow Groups 6-10 represent Weekend Hours, with FG9/10 representing the busiest 208 weekend hours of the year, FG8 representing the next busiest 208 weekend hours, FG7 representing the next busiest 832 weekend hours, and FG6 representing the remaining 1,248 weekend hours.

8.2.1.4 To provide a direct comparison between journey times on the Do-Minimum and the Do-Something networks in the 2021 year of opening, the average vehicle speeds for each link in the network and the corresponding junction delays along the route were extracted from the COBA models for light vehicles based on Flow Group 2 and Flow Group 4 traffic flow conditions. Flow Group 2 and Flow Group 4 provide a reasonable representation of operating conditions during the inter-peak and peak period respectively.

8.2.1.5 The comparison of journey times based on the directional routes between the strategic points, namely the Westlink, the M2 motorway and the M3 motorway, for the Proposed Scheme are shown in Tables 12 to 15. This includes details for COBA Flow Group 2 and Flow Group 4 and for the 2021 year of opening and 2035 design year.

Table 12: Reductions in Journey Times: Flow Group 2 – 2021 Year of Opening

Route	Do-Minimum Network Total Journey Time (mins)	Do-Something Reduction in Journey Time	
		(mins)	(%)
Westlink – M2 Motorway	2.35	0.18	8%
M2 Motorway – Westlink	5.04	2.08	41%
Westlink – M3 Motorway	2.53	0.53	21%
M3 Motorway - Westlink	2.52	1.06	42%
M2 Motorway – M3 Motorway	2.62	0.10	4%
M3 Motorway – M2 Motorway	1.56	-0.05	-3%

Note: Westlink = Node 103 / 109, M2 motorway = Node 285 / 287, M3 motorway = Node 124 / 131

Table 13: Reductions in Journey Times: Flow Group 4 – 2021 Year of Opening

Route	Do-Minimum Network Total Journey Time (mins)	Do-Something Reduction in Journey Time	
		(mins)	(%)
Westlink – M2 Motorway	3.19	0.61	19%
M2 Motorway – Westlink	8.04	4.47	56%
Westlink – M3 Motorway	3.51	1.84	53%
M3 Motorway - Westlink	4.44	2.50	56%
M2 Motorway – M3 Motorway	2.85	0.00	0%
M3 Motorway – M2 Motorway	1.81	-0.08	-5%

Note: Westlink = Node 103 / 109, M2 motorway = Node 285 / 287, M3 motorway = Node 124 / 131

Table 14: Reductions in Journey Times: Flow Group 2 – 2035 Design Year

Route	Do-Minimum Network Total Journey Time (mins)	Do-Something Reduction in Journey Time	
		(mins)	(%)
Westlink – M2 Motorway	2.42	0.18	7%
M2 Motorway – Westlink	5.30	2.26	43%
Westlink – M3 Motorway	2.63	0.54	21%
M3 Motorway - Westlink	2.67	1.11	42%
M2 Motorway – M3 Motorway	2.65	0.09	3%
M3 Motorway – M2 Motorway	1.59	-0.06	-4%

Note: Westlink = Node 103 / 109, M2 motorway = Node 285 / 287, M3 motorway = Node 124 / 131

Table 15: Reductions in Journey Times: Flow Group 4 – 2035 Design Year

Route	Do-Minimum Network Total Journey Time (mins)	Do-Something Reduction in Journey Time	
		(mins)	(%)
Westlink – M2 Motorway	3.64	0.91	25%
M2 Motorway – Westlink	10.98	7.36	67%
Westlink – M3 Motorway	5.32	3.02	57%
M3 Motorway - Westlink	6.37	4.41	69%
M2 Motorway – M3 Motorway	2.85	0.00	0%
M3 Motorway – M2 Motorway	1.96	-0.10	-5%

Note: Westlink = Node 103 / 109, M2 motorway = Node 285 / 287, M3 motorway = Node 124 / 131

8.3 Do-Minimum Network Capacity

8.3.1.1 Based on the information obtained from the COBA models, the links and junctions that are reported as being over-capacity have been identified to provide an indication of the traffic conditions on the various networks. The assessment considers the effects of normal variations in traffic demand that occur during the day, as defined by the various Flow Groups, and the effects of growth in traffic from the 2012 base year to the 2021 year of opening and the 2035 design year.

8.3.1.2 The number of over-capacity links and junctions in the Do-Minimum network under NRTF central traffic growth is summarised in Table 16.

Table 16: Number of Over-Capacity Links and Junctions: Do-Minimum Network

Year	Flow Group	Do-Minimum Network	
		Link	Junction
2012	Flow Group 1/2	0	0
	Flow Group 3/4	7	3
	Flow Group 8/9	1	1
2021	Flow Group 1/2	0	0
	Flow Group 3/4	13	6
	Flow Group 8/9	5	2
2035	Flow Group 1/2	1	0
	Flow Group 3/4	18	7
	Flow Group 8/9	7	3

8.3.1.3 Examination of the above results indicates that traffic demand in 2012 Flow Group 3/4 would exceed capacity on 7 links and 3 junctions. By the 2021 year of opening, these numbers would increase to 13 links and 6 junctions and to 18 links and 7 junctions in 2035.

8.3.1.4 The locations of the links and junctions that are over-capacity under the central traffic growth forecasts are shown in Figure 8.4.

8.4 Do-Something Network Capacity

8.4.1.1 The number of over-capacity links and junctions in the Do-Something network under NRTF central traffic growth is summarised in Table 17.

Table 17: Number of Over-Capacity Links and Junctions: Do-Something Network

Year	Flow Group	Do-Something Network	
		Link	Junction
2012	Flow Group 1/2	n/a	n/a
	Flow Group 3/4	n/a	n/a
	Flow Group 8/9	n/a	n/a
2021	Flow Group 1/2	0	0
	Flow Group 3/4	12	3
	Flow Group 8/9	6	1
2035	Flow Group 1/2	0	0
	Flow Group 3/4	18	4
	Flow Group 8/9	9	1

8.4.1.2 Examination of the above results indicates that traffic demand in 2021 Flow Group 3/4 would exceed capacity on 12 links and 3 junctions. By the 2035 design year, these numbers would increase to 18 links and 4 junctions

8.4.1.3 The locations of the links and junctions that are over-capacity under the central traffic growth forecasts are shown in Figure 8.5.

8.5 Road Safety

8.5.1.1 Given the inherent uncertainties in predicting future accident rates and casualty severities over the 60-year economic assessment period, the COBA assessment has been based on the application of default accident rates and costs. These have been applied to both the Do-Minimum and Do-Something networks to provide a reasonable measure of the relative change in road traffic accident characteristics associated with the two networks.

8.5.1.2 The changes in the number of personal injury accidents and the corresponding casualty severities over the 60-year assessment period under NRTF central traffic growth due to the provision of the provision of the Proposed Scheme are shown in Tables 19 and 20. The associated Present Values of Benefit are also shown in this Table.

8.5.1.3 It should be noted that due to the characteristics of some of the new links relative to the existing urban links, the COBA model indicates that the various improvement options would lead to road safety disbenefits. For example, whereas the northbound approach to York Street on the existing Westlink currently has a 50 mph speed limit with a default accident rate of 0.174 Personal Injury Accidents / Million vehicle Kilometres (PIA / mvkm), the Do-Something option reduces the speed limit on this section of the road network to 40 mph with a default accident rate of 1.004 PIAs / mvkm which results in a corresponding increase in accident numbers and associated disbenefits. The characteristic of the model should be taken into account when considering the road safety effects of the Proposed Scheme.

8.5.1.4 The changes in the number of personal injury accidents and the corresponding casualty severities over the 60-year assessment period due to the provision of the Proposed Scheme are shown in Tables 18 and 19.

Table 18: Accident Numbers and Costs

Network	Number of Accidents			Accidents Total Cost (£m's)
	2021 Opening Year	2035 Design Year	60-Year Total	
Do-Minimum	49.5	51.3	3,068.4	174.343
Do-Something	64.7	67.3	4,023.4	223.720
Benefits	-15.2	-16.0	-955.0	-49.377

Table 19: Casualties by Severity

Network	Accident severity			Total Accidents
	Fatal	Serious	Slight	
Do-Minimum	32.4	321.8	4,167.1	3,068.4
Do-Something	36.7	390.6	5,502.3	4,023.4
Benefits	-4.3	-68.7	-1,335.2	-955.0

8.5.1.5 From the above information, the Proposed Scheme would lead to an additional 955 personal injury accidents over the 60-year period, which equates to an economic disbenefit of -£49.4m.

8.5.1.6 The results of the COBA analysis based on the application of default accident rates indicate that the provision of the Proposed Scheme would lead to an increase in road safety costs over the 60-year economic life of the scheme.

8.5.1.7 However, it is recognised that this increase in road safety costs is a characteristic of the default accident rates in the COBA model and it is expected that the Proposed Scheme will contribute positively to road safety.

9. ECONOMIC APPRAISAL

9.1 COBA Appraisal

9.1.1.1 The economic results from the COBA model for the Proposed Scheme, based on the scheme costs defined previously including optimism bias and the application of the National Road Traffic Forecasts (NRTF) central traffic growth projection, are summarised in Table 20.

Table 20: COBA Proposed Scheme Appraisal Summary

Item	Do-Something Network Proposed Scheme
Present Value of Benefits (PVB) (£m's)	**£212.981**
Present Value of Costs (PVC) (£m's)	**£74.942**
Net Present Value (NPV) (£m's)	**£138.039**
Benefit to Cost Ratio (BCR)	**2.842**

Note: Assessment is based on NRTF central growth with results expressed in 2010 prices.

9.1.1.2 In accordance with current government guidelines on the reporting of transport economic efficiency, the results of the economic appraisal are presented in the market prices unit of account that was introduced in COBA11.

9.1.1.3 The principal benefits of the Proposed Scheme result from savings in transit time, which equates to £263.980m. However, due to the characteristics of the new links relative to the existing urban links, this option would also lead to road safety disbenefits of -£49.377m.

9.2 QUADRO Appraisal

9.2.1.1 The economic results from the QUADRO model for the Proposed Scheme, based on the application of the NRTF central traffic growth projection and including 10% optimism bias, are summarised in Table 21.

Table 21: QUADRO Proposed Scheme Appraisal Summary Including 10% Optimism Bias

Item	Do-Something Network Proposed Scheme (£m's)
Present Value of Benefits (PVB) (£m's)	**-£38.410**
Present Value of Costs (PVC) (£m's)	**-£0.150**
Net Present Value (NPV) (£m's)	**-£38.259**

Note: Assessment is based on NRTF central growth with results expressed in 2010 prices.

9.3 COBA/QUADRO Appraisal

9.3.1.1 The economic results based on the combined COBA and QUADRO appraisals including the effects of optimism bias, the application of the NRTF central traffic growth projection and default accident characteristics, are summarised in Table 22.

Table 22: COBA / QUADRO Proposed Scheme Appraisal Summary

Item	Do-Something Network Proposed Scheme
Present Value of Benefits (PVB) (£m's)	**£174.571**
Present Value of Costs (PVC) (£m's)	**£74.792**
Net Present Value (NPV) (£m's)	**£99.780**
Benefit to Cost Ratio (BCR)	**2.334**

Note: Assessment is based on NRTF central growth with results expressed in 2010 prices.

9.3.1.2 The results from the combined COBA and QUADRO appraisal indicate that the Proposed Scheme would deliver a Net Present Value of £99.780m and Benefit to Cost Ratio of 2.334 and therefore represents good value for money.

10. SENSITIVITY TESTS

10.1 Overview

10.1.1.1 A series of sensitivity tests has been undertaken to examine the extent to which the results from the COBA and QUADRO economic appraisals vary under various scenarios. The results of these sensitivity tests are shown below.

10.2 COBA Appraisal Traffic Forecast Sensitivity Tests

10.2.1.1 As there is an inherent degree of uncertainty in predicting long-term future traffic flows over the 60-year period of the economic assessment, the Proposed Scheme has been tested considering NRTF low, central and high growth projections from the year 2012 onwards.

10.2.1.2 The results of the COBA sensitivity tests based on low and high growth projections are shown in Table 23. The results from the main COBA run, which is based on NRTF central growth, are also included for comparison.

Table 23: COBA Proposed Scheme Appraisal Summary – Traffic Forecast Sensitivity Tests

Item	Do-Something Network Proposed Scheme		
	NRTF Growth Projection		
	Low Growth	Central Growth	High Growth
Present Value of Benefits (PVB) (£m's)	£148.319	**£212.981**	£308.896
Present Value of Costs (PVC) (£m's)	£74.942	**£74.942**	£74.942
Net Present Value (NPV) (£m's)	£73.377	**£138.039**	£233.954
Benefit to Cost Ratio (BCR)	1.979	**2.842**	4.122

Note: Assessment is based on NRTF low / central / high growth with results expressed in 2010 prices.

10.2.1.3 The results of the COBA traffic forecast sensitivity tests indicate that the Net Present Value of the Proposed Scheme improves as the level of future traffic growth increases and that the Proposed Scheme provides a good economic return under a range of future traffic growth forecasts.

10.2.1.4 In addition to the above low and high traffic forecast sensitivity tests, a further test has been undertaken to consider the potential effects of releasing any suppressed demand when the scheme opens.

10.2.1.5 Therefore, to test the effects of the potential for the release of some suppressed demand on the strategic links in the network when the scheme opens, a 'High Demand' scenario sensitivity test has been undertaken based on a high growth scenario with an applied 5% increase in traffic travelling on the strategic routes between the Westlink, the M2 motorway and the M3 motorway.

10.2.1.6 The results of this sensitivity test are shown in Table 24.

Table 24: COBA Proposed Scheme Appraisal Summary – Potential Suppressed Demand Traffic Sensitivity Test

Item	Do-Something Network Proposed Scheme	
	NRTF Growth Projection	
	Central Growth	High Demand
Present Value of Benefits (PVB) (£m's)	**£212.981**	£215.079
Present Value of Costs (PVC) (£m's)	**£74.942**	£74.942
Net Present Value (NPV) (£m's)	**£138.039**	£140.138
Benefit to Cost Ratio (BCR)	**2.842**	2.870

Note: Assessment is based on NRTF central / high demand with results expressed in 2010 prices.

10.2.1.7 The results of the above sensitivity test indicate that the Net Present Value of the Proposed Scheme is similar to that of the main COBA assessment, which is based on NRTF central growth projections.

10.3 QUADRO Appraisal Traffic Forecast Sensitivity Tests

10.3.1.1 The QUADRO models are based on local hourly traffic flow profiles, a maximum queue delay of 5 minutes and a 10% reduction in traffic during construction.

10.3.1.2 To test the sensitivity of the QUADRO assessment to changes in traffic growth, the Proposed Scheme has been tested considering NRTF low, central and high growth projections from the year 2012 onwards.

10.3.1.3 The results of the QUADRO appraisal including 10% optimism bias are shown in Table 25.

Table 25: QUADRO Proposed Scheme Appraisal Summary – Traffic Forecasts Sensitivity Tests, Including 10% Optimism Bias

Item	Do-Something Network Proposed Scheme (£m's)		
	NRTF Growth Projection		
	Low Growth	Central Growth	High Growth
Traffic Reductions During Construction	10%	**10%**	10%
Maximum Queue Delay	5 mins	**5 mins**	5 mins
Present Value of Benefits (PVB)	-£31.370	**-£38.410**	-£43.911
Present Value of Costs (PVC)	-£0.117	**-£0.150**	-£0.176
Net Present Value (NPV)	-£31.253	**-£38.259**	-£43.735

Note: Assessment is based on NRTF low / central / high growth with results expressed in 2010 prices.

10.3.1.4 The results of the QUADRO traffic forecast sensitivity test indicate that as traffic growth increases, the Net Present Value of the Proposed Scheme decreases.

10.4 COBA / QUADRO Appraisal Traffic Forecast Sensitivity Tests

10.4.1.1 The combined COBA and QUADRO results based on the above traffic forecast sensitivity tests, including the effects of optimism bias, the application of the NRTF traffic growth projections and default accident characteristics, are summarised in Table 26.

10.4.1.2 It should be noted that the 'High Demand' scenario is based on the NRTF high growth QUADRO assessment.

Table 26: COBA / QUADRO Proposed Scheme Appraisal Summary – Traffic Forecast Sensitivity Tests

Item	Do-Something Network Proposed Scheme			
	Growth projection			
	Low Growth	Central Growth	High Growth	High Demand
Present Value of Benefits (PVB) (£m's)	£116.949	**£174.571**	£264.985	£171.168
Present Value of Costs (PVC) (£m's)	£74.825	**£74.792**	£74.766	£74.766
Net Present Value (NPV) (£m's)	£42.124	**£99.780**	£190.219	£96.403
Benefit to Cost Ratio (BCR)	1.563	**2.334**	3.544	2.289

Note: Assessment is based on NRTF low / central / high growth with results expressed in 2010 prices.

10.4.1.3 The results of the combined COBA / QUADRO traffic forecast sensitivity test indicate that as traffic growth increases, the Net Present Value of the Proposed Scheme increases.

10.4.1.4 The results from the combined COBA and QUADRO traffic forecast sensitivity test indicate that the Proposed Scheme would deliver a combined positive Net Present Value range of £42.124m to £190.219m, and a Benefit to Cost Ratio range of 1.563 to 3.544.

10.5 Maximum Queue Delay Sensitivity Tests

10.5.1.1 The QUADRO models are based on local hourly traffic flow profiles, a maximum queue delay of 5 minutes and a 10% reduction in traffic during construction.

10.5.1.2 To test the sensitivity of the QUADRO assessment to changes in maximum queue delay, the Proposed Scheme has been tested considering a 10 minute maximum queue delay under NRTF low, central and high growth projections from the year 2012 onwards.

10.5.1.3 The results of the QUADRO appraisal including 10% optimism bias are shown in Table 27.

Table 27: QUADRO Proposed Scheme Appraisal Summary – 10 Minute Maximum Queue Delay Sensitivity Tests, Including 10% Optimism Bias

Item	Do-Something Network Proposed Scheme (£m's)			
	Growth projection			
	Low Growth	Central Growth		High Growth
Traffic Reductions During Construction	10%	**10%**	10%	10%
Maximum Queue Delay	10 mins	**5 mins**	10 mins	10 mins
Present Value of Benefits (PVB)	-£40.139	**-£38.410**	-£50.740	-£62.308
Present Value of Costs (PVC)	-£0.146	**-£0.150**	-£0.193	-£0.248
Net Present Value (NPV)	-£39.993	**-£38.259**	-£50.546	-£62.060

Note: Assessment is based on NRTF low / central / high growth with results expressed in 2010 prices.

10.5.1.4 The results of the QUADRO maximum queue delay sensitivity tests indicate that increasing the maximum queue delay results in a decrease in the Net Present Value.

10.6 COBA / QUADRO Appraisal Maximum Queue Delay Sensitivity Results

10.6.1.1 The combined COBA and QUADRO results based on the above maximum queue delay sensitivity tests, including the effects of optimism bias, the application of the NRTF traffic growth projections and default accident characteristics, are summarised in Table 28. As before, the results of the COBA and QUADRO assessment, which is based on NRTF central growth projections, a maximum queue delay of 5 minutes and a 10% reduction in traffic during construction, is also included for comparison.

10.6.1.2 It should be noted that 'High Demand' scenario is based on the NRTF high growth QUADRO assessment.

Table 28: COBA / QUADRO Proposed Scheme Appraisal Summary – Maximum Queue Delay Sensitivity Tests

Item	Do-Something Network Proposed Scheme				
	Growth Projection				
	Low Growth	Central Growth		High Growth	High Demand
Traffic Reductions During Construction	10%	**10%**	10%	10%	10%
Maximum Queue Delay	10 mins	**5 mins**	10 mins	10 mins	10 mins
Present Value of Benefits (PVB) (£m's)	£108.180	**£174.571**	£162.241	£246.588	£152.771
Present Value of Costs (PVC) (£m's)	£74.796	**£74.792**	£74.749	£74.694	£74.694
Net Present Value (NPV) (£m's)	£33.384	**£99.780**	£87.493	£171.894	£78.078
Benefit to Cost Ratio (BCR)	1.446	**2.334**	2.170	3.301	2.045

Note: Assessment is based on NRTF low / central / high growth with results expressed in 2010 prices.

10.6.1.3 The results of the combined COBA / QUADRO maximum queue delay sensitivity tests indicate that increasing the maximum queue delay from 5 minutes to 10 minutes results in a decrease in the Net Present Value.

10.6.1.4 The results from the combined COBA and QUADRO maximum queue delay sensitivity test indicate that the Proposed Scheme would deliver a positive Net Present Value range of £33.384m to £171.894m, and a Benefit to Cost Ratio range of 1.446 to 3.301.

11. CONCLUSIONS

11.1.1.1 My evidence has described the extensive data collection surveys undertaken over a period of many years throughout the progressive DMRB Stage 1, Stage 2 and Stage 3 Scheme Assessments to define baseline conditions and the level of congestion at the existing signalised junctions at the intersection of the Westlink, M2 and M3 motorways. In addition to describing the development, validation and application of the various industry standard computer models, my evidence has presented the results of the operational and economic assessments of the Proposed Scheme and the results of the various sensitivity tests.

11.1.1.2 The results of the operational assessments indicate that the Proposed Scheme would reduce journey times in the York Street area.

11.1.1.3 The results of the economic assessments indicate that the Proposed Scheme represents good value for money with an overall Net Present Value of £99.780m and a Benefit to Cost Ratio of 2.334 under the NRTF central traffic growth forecast scenario.

11.1.1.4 The results of the various sensitivity tests indicate that the Proposed Scheme would generate a positive Net Present Value over a range of test scenarios where the overall benefits exceed the cost of the scheme.

11.1.1.5 Based on the above results, it is concluded that the Proposed Scheme would improve operating conditions in the York Street area and represents good value for money.

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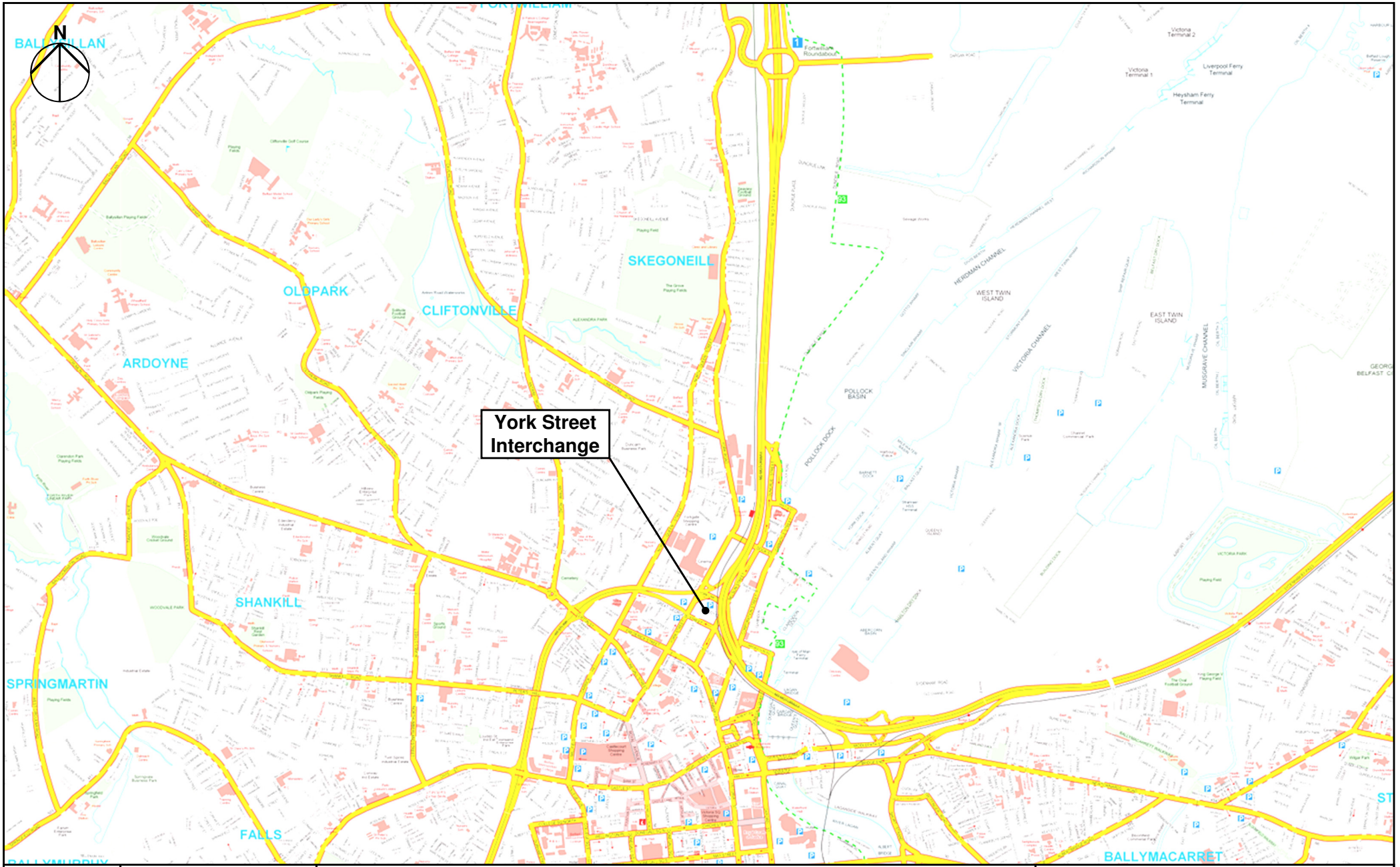

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Notes

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Figure 3.1
General Location Plan

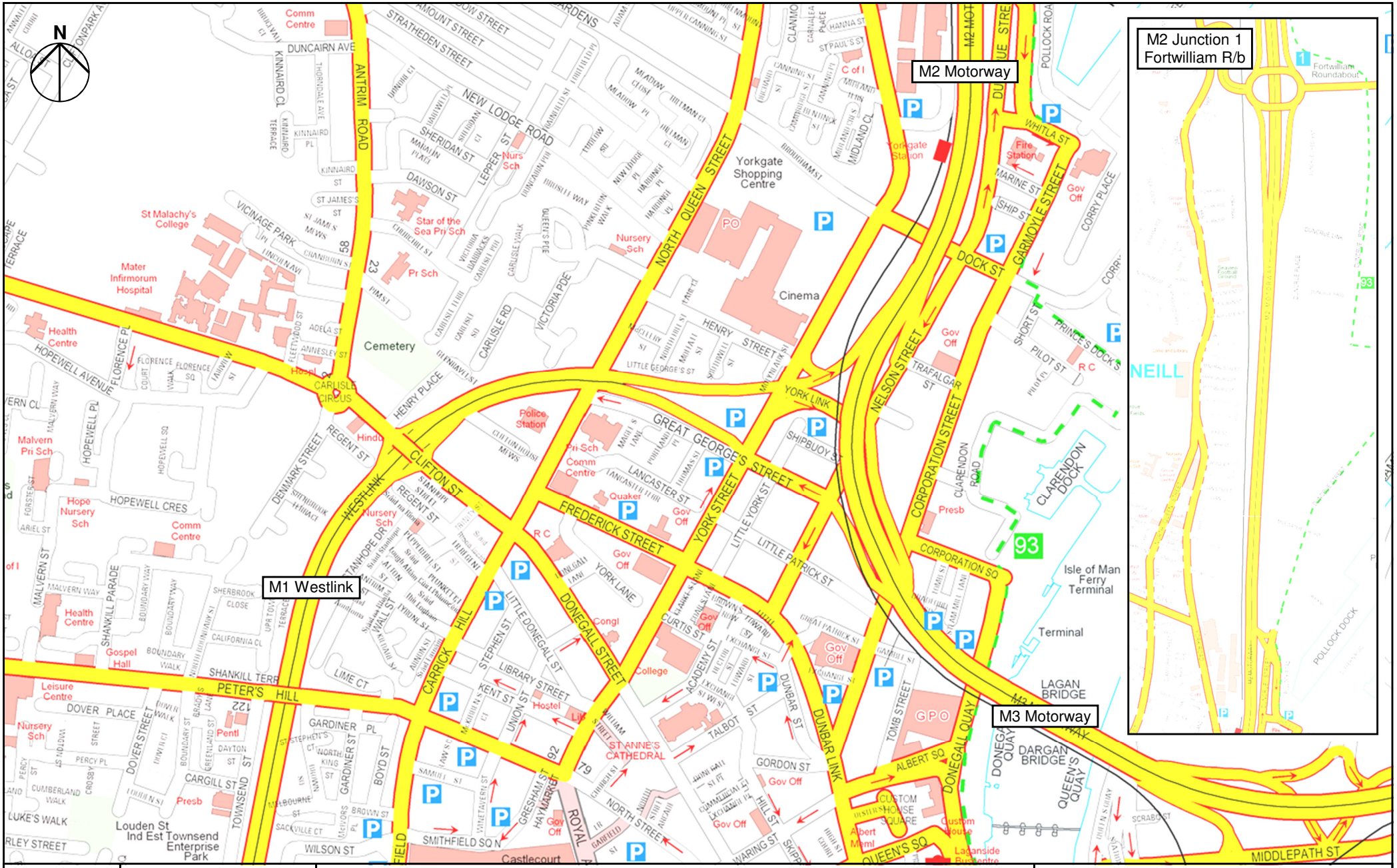

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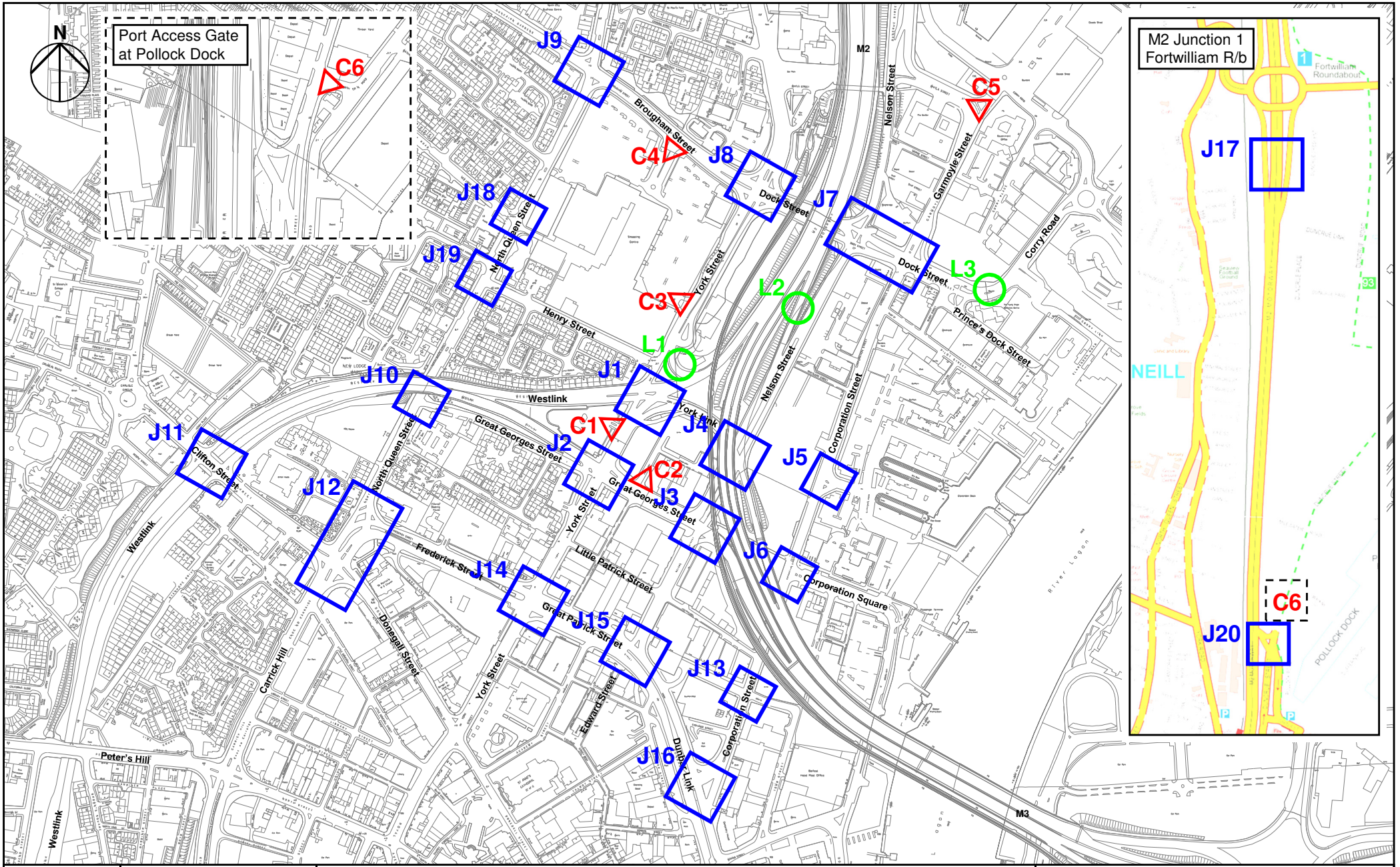
Figure 3.2
Key Location Plan



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Notes
- Junction Turning Count
- Link Count
- In/Out Turning Count

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Figure 4.1
Manual Classified Counts Locations – May 2012

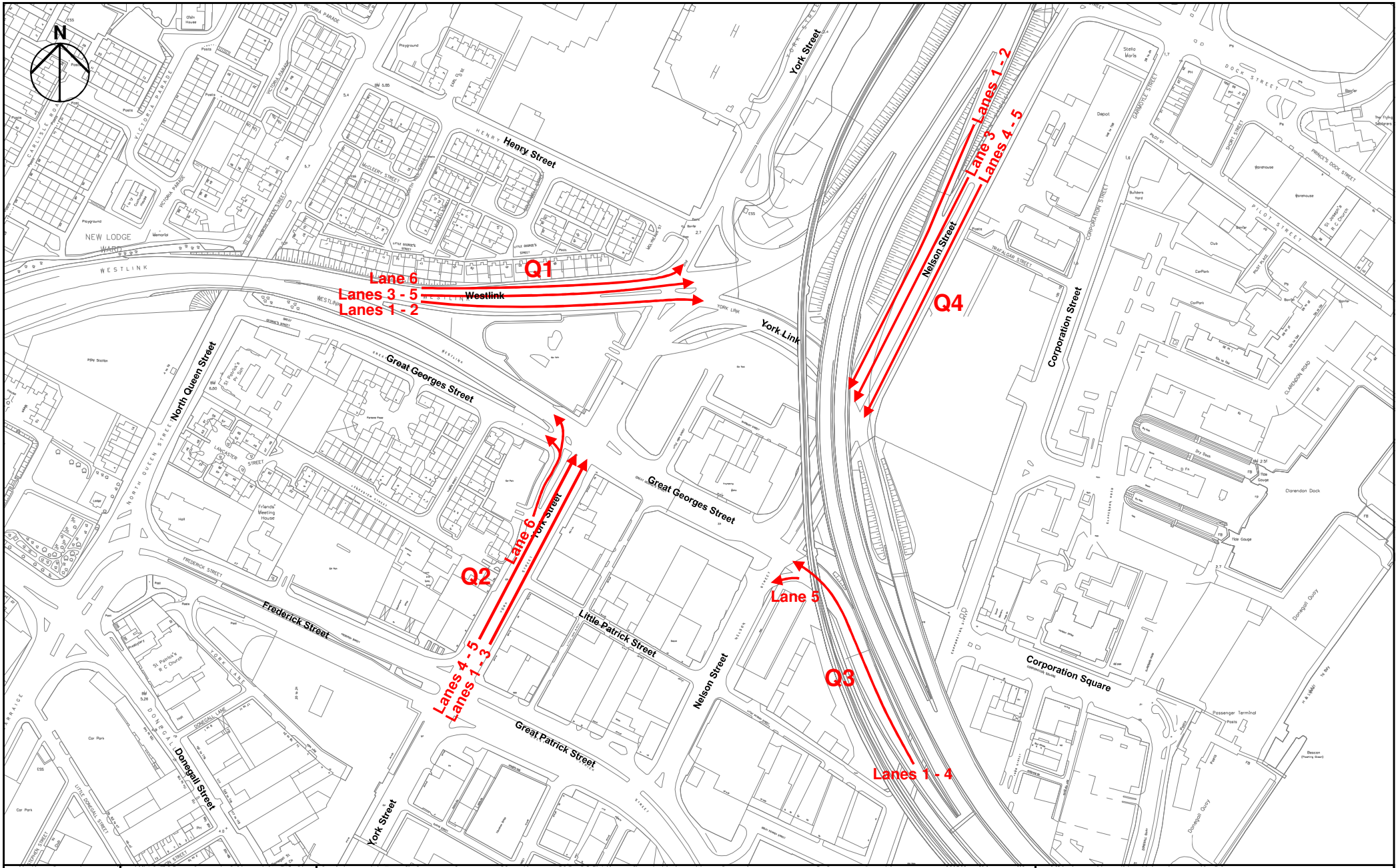

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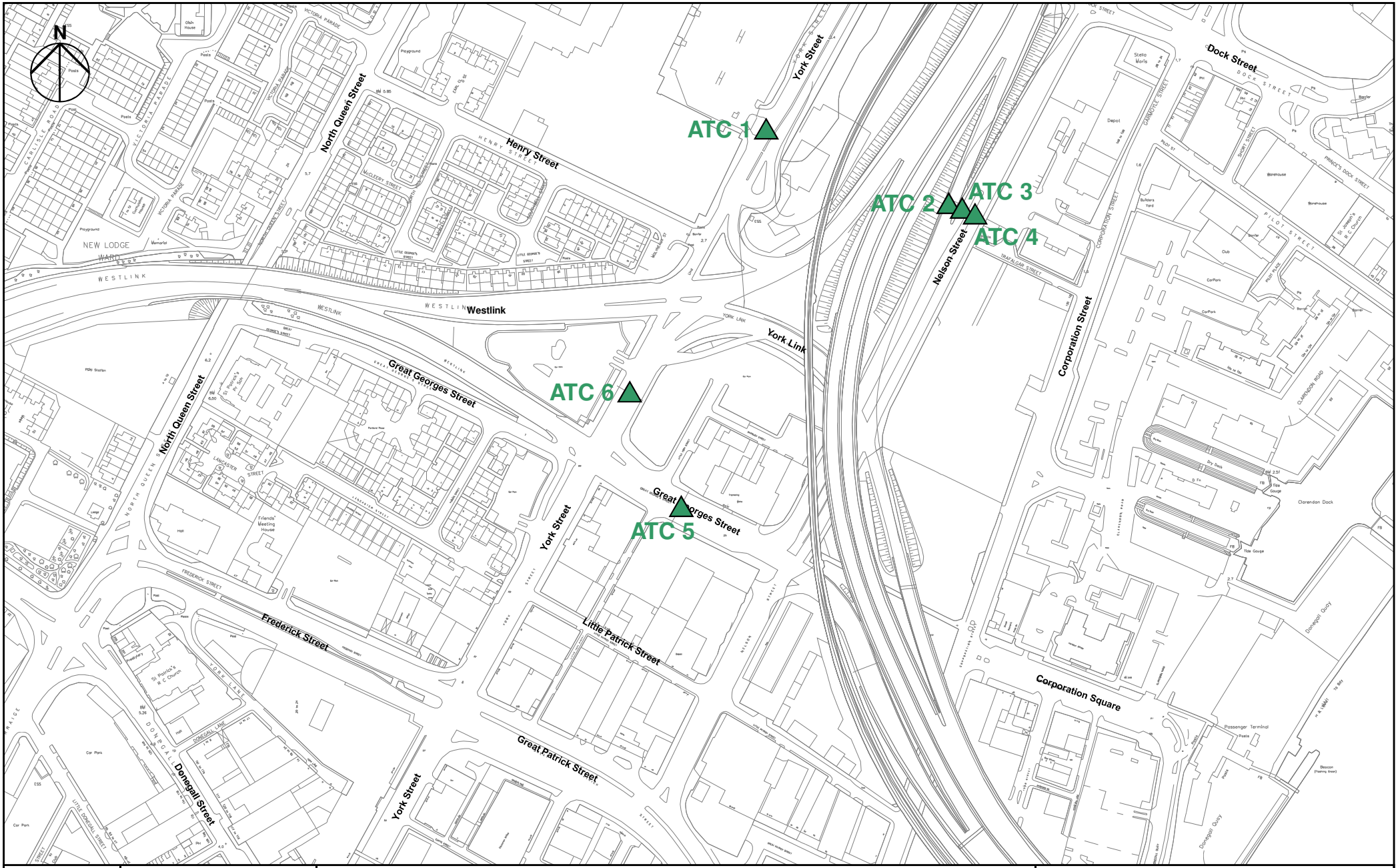
Figure 4.2
Queue Surveys Locations – May 2012



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▲ Temporary Automatic Traffic Count Location

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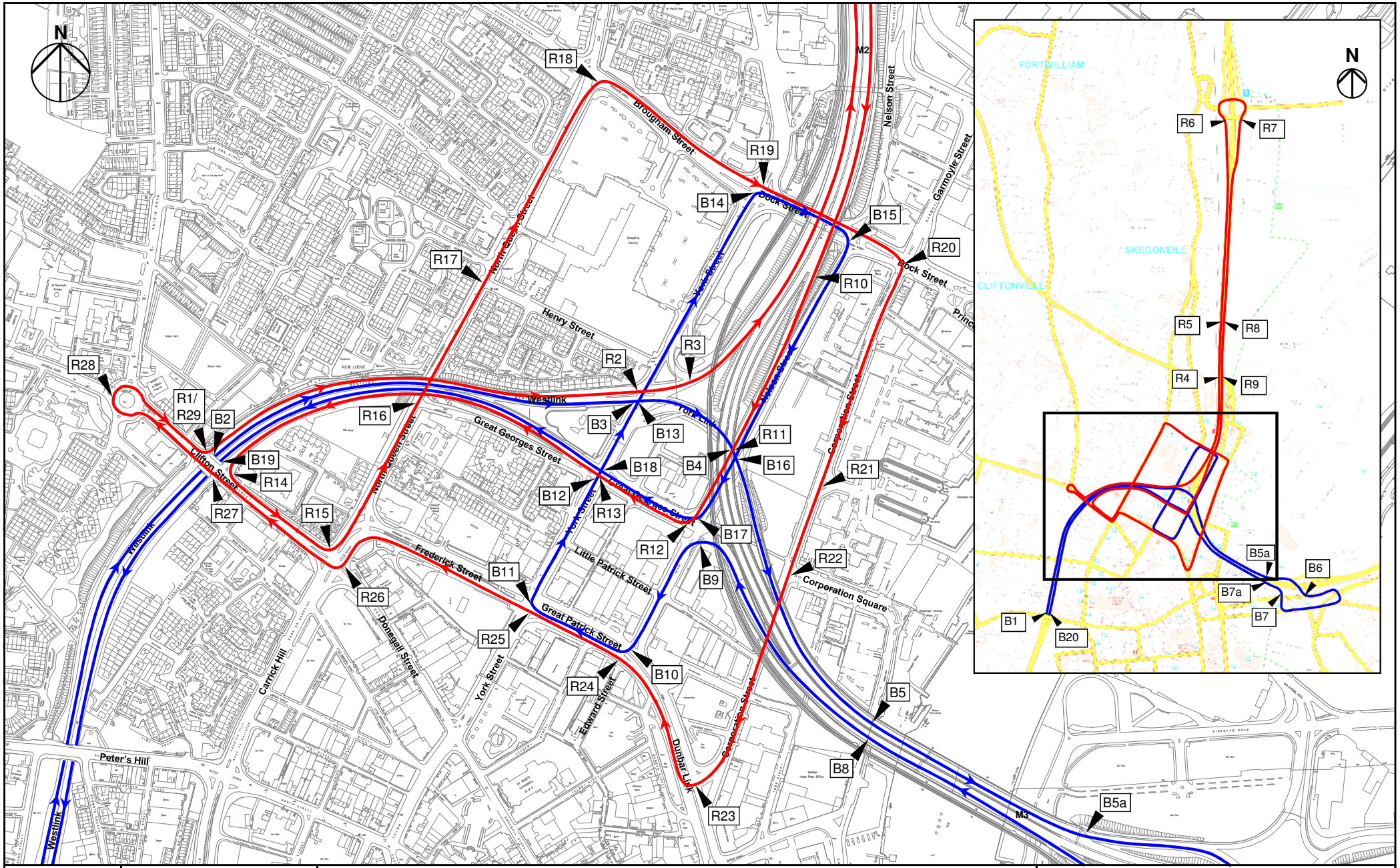
Figure 4.3
Temporary Automatic Traffic Count Locations – May / June 2012



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Notes

Journey Time Survey Route

Journey Time Survey Measurement Point

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Figure 4.4
Journey Time Survey Locations – May / September 2012

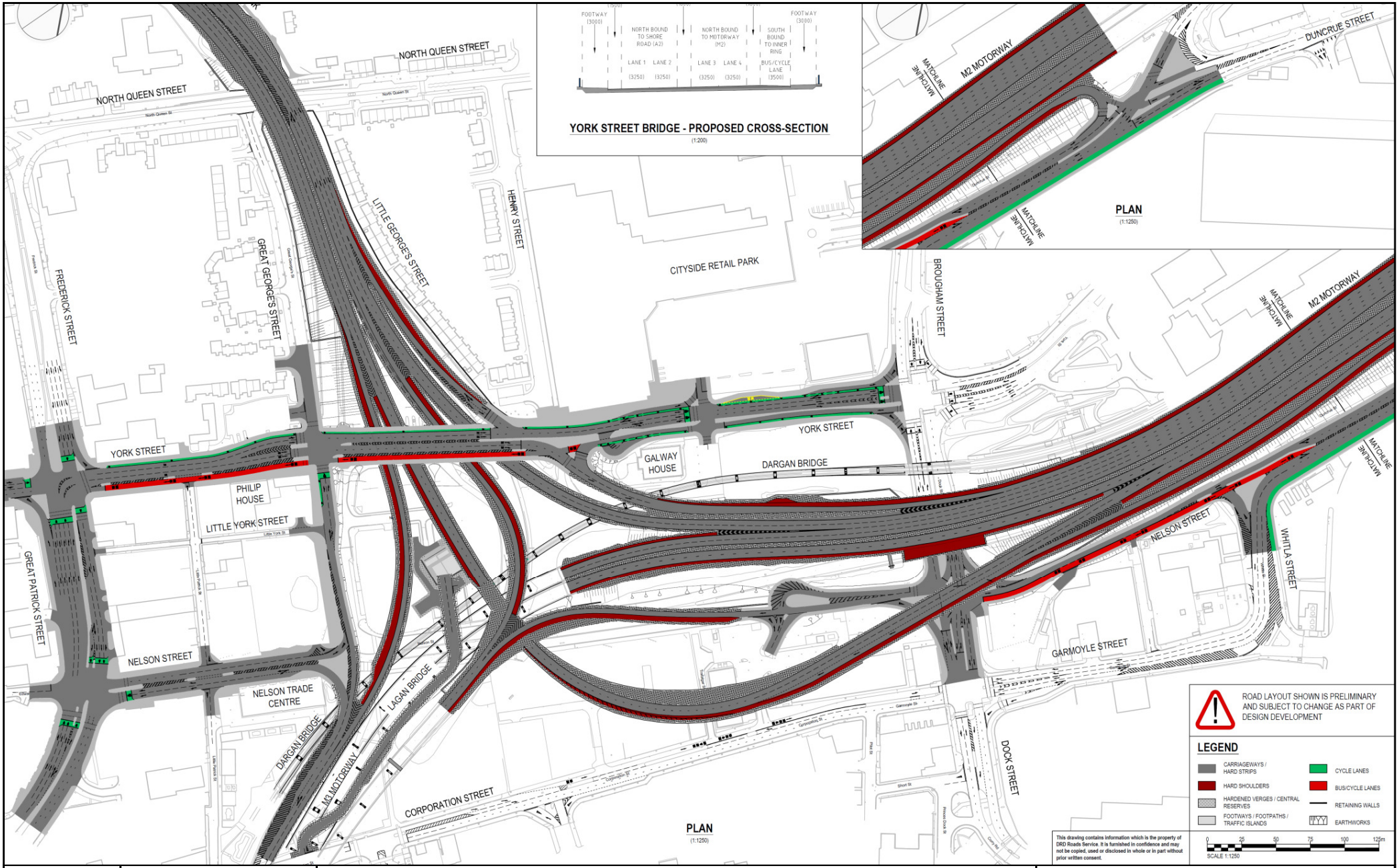

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Figure 5.1
Proposed Scheme






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Notes

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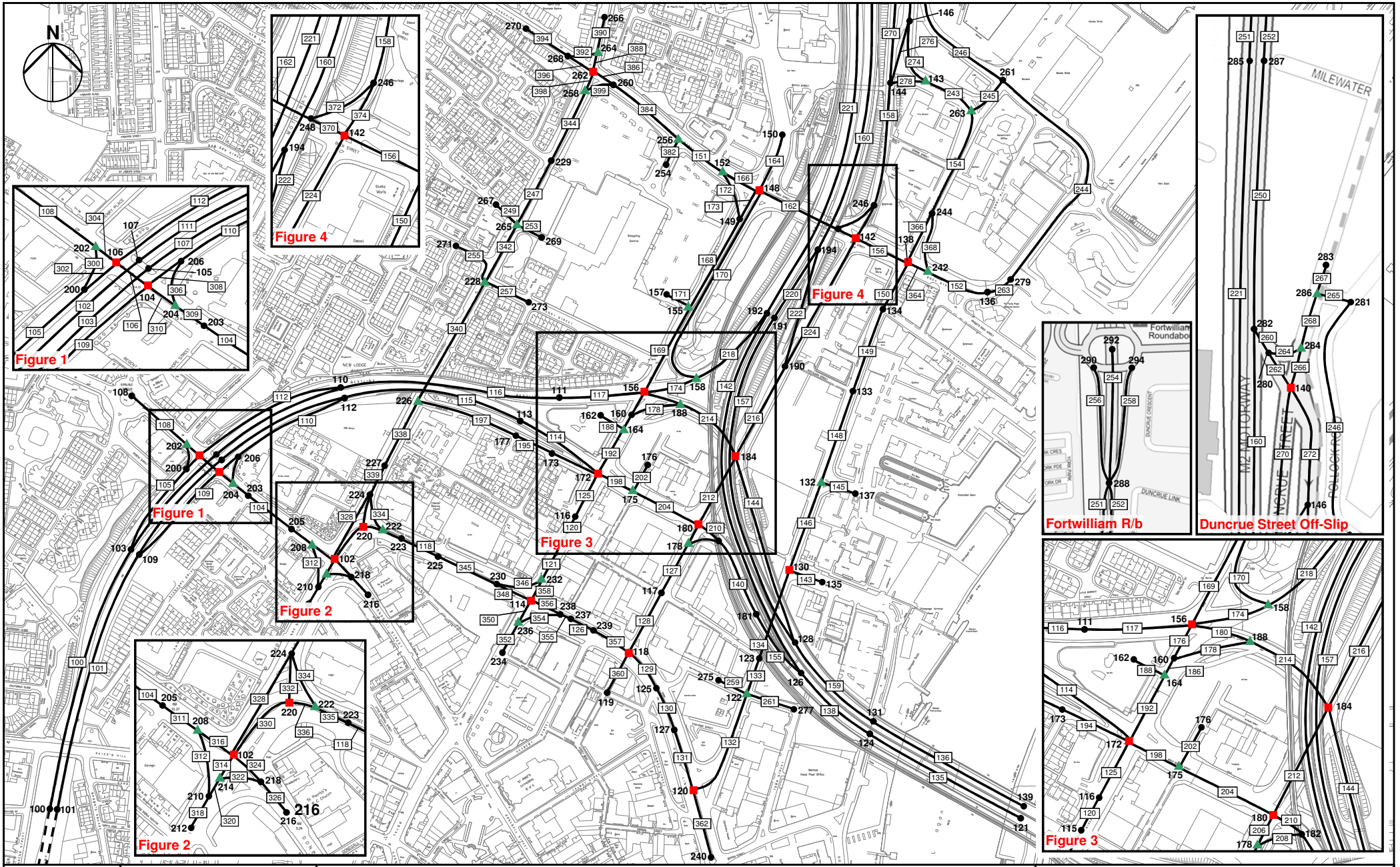
Figure 6.1
Do-Minimum Network
3-Dimensional Computer Model Screenshots



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Notes

- Do-Minimum Link
- **100** Node Number
- [100] Link Number
- Node Point
- Signalised Junction
- Priority Junction

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Figure 6.2
Do-Minimum Network
COBA Link and Node Diagram

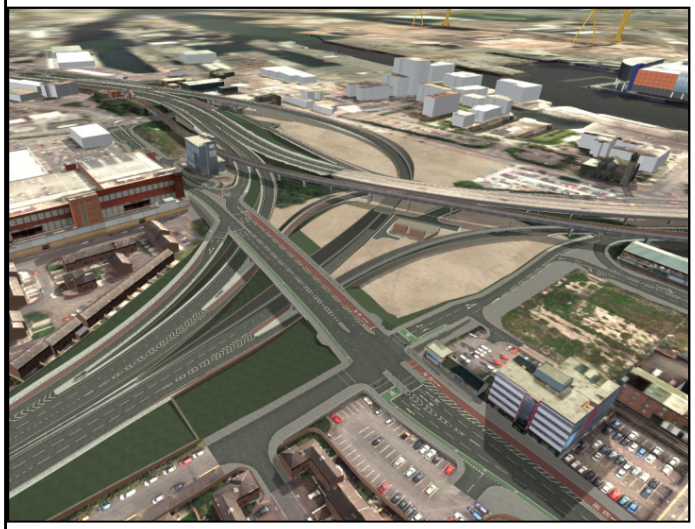

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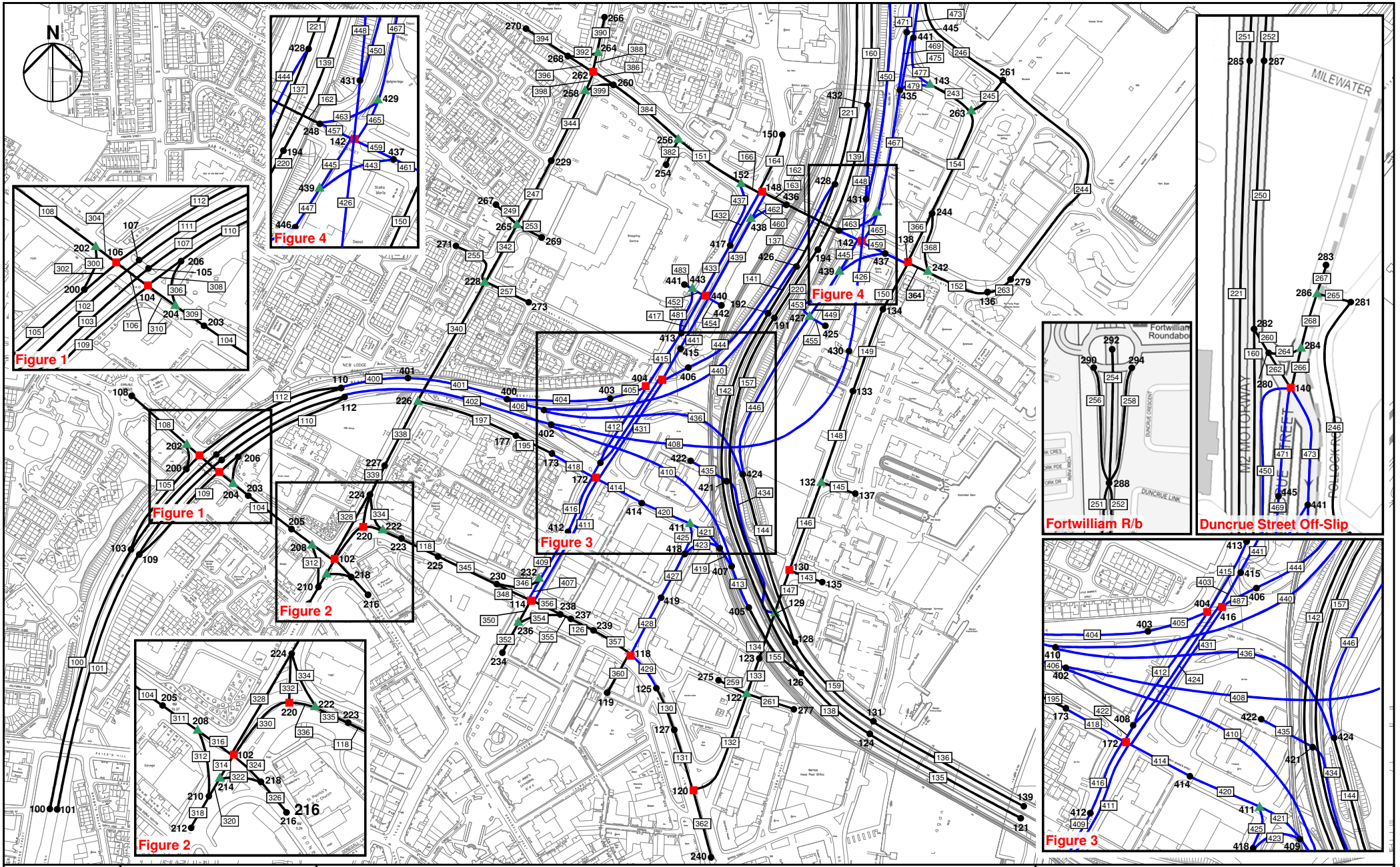
Figure 6.3
Do-Something Network
3-Dimensional Computer Model Screenshots



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Notes

- Do-Minimum Link
- Do-Something Link
- 100 Node Number
- [100] Link Number
- Node Point
- Signalised Junction
- Priority Junction

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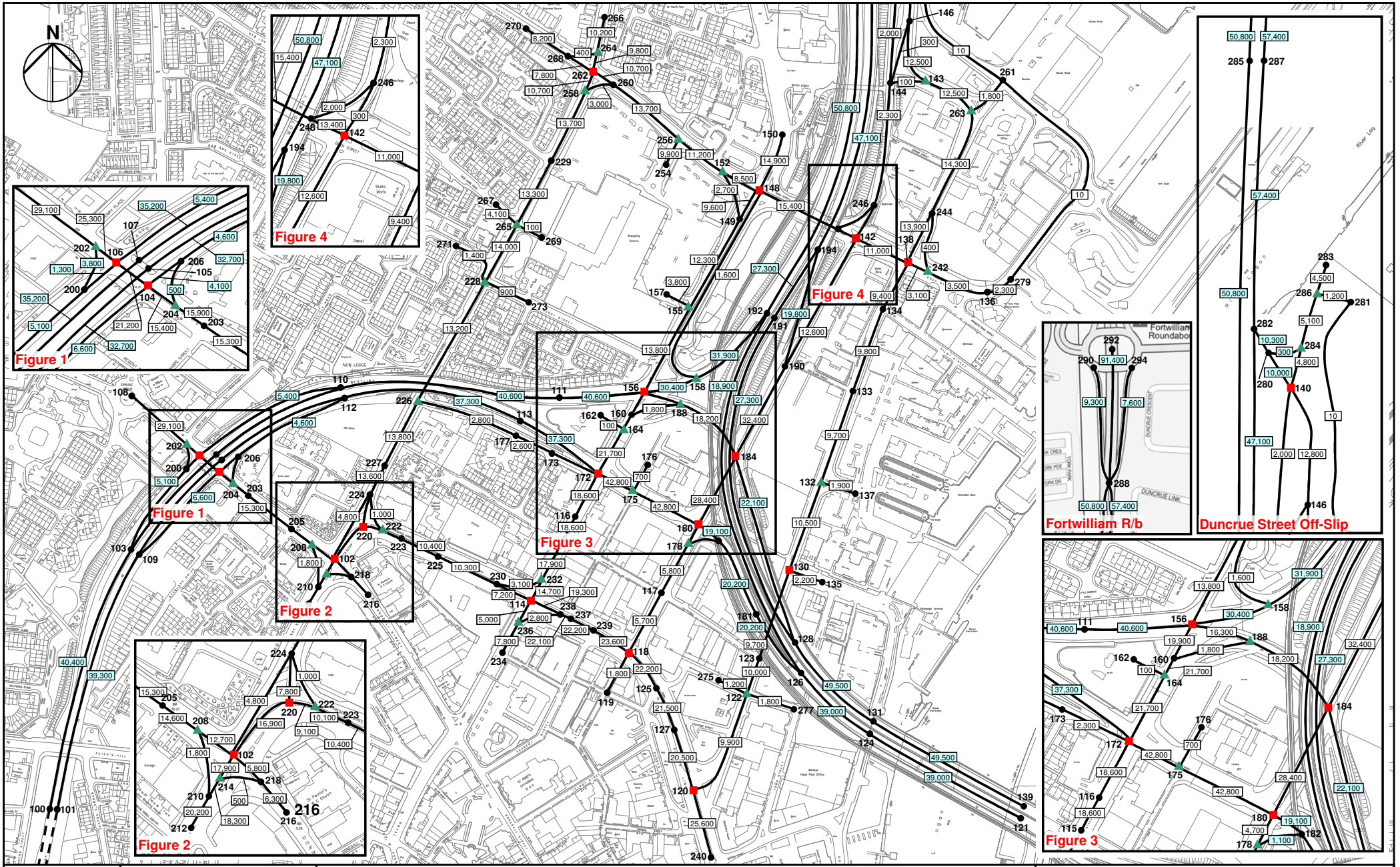
Figure 6.4
Do-Something Network
COBA Link and Node Diagram



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Notes

- Do-Minimum Link
- 100 Node Number
- [100] Link Number
- ● Node Point
- ■ Signalised Junction
- ▲ Priority Junction
- [10,000] 24-Hour Traffic Flows – Surface Street Flows
- [10,000] 24-Hour Traffic Flows – Motorway Flows

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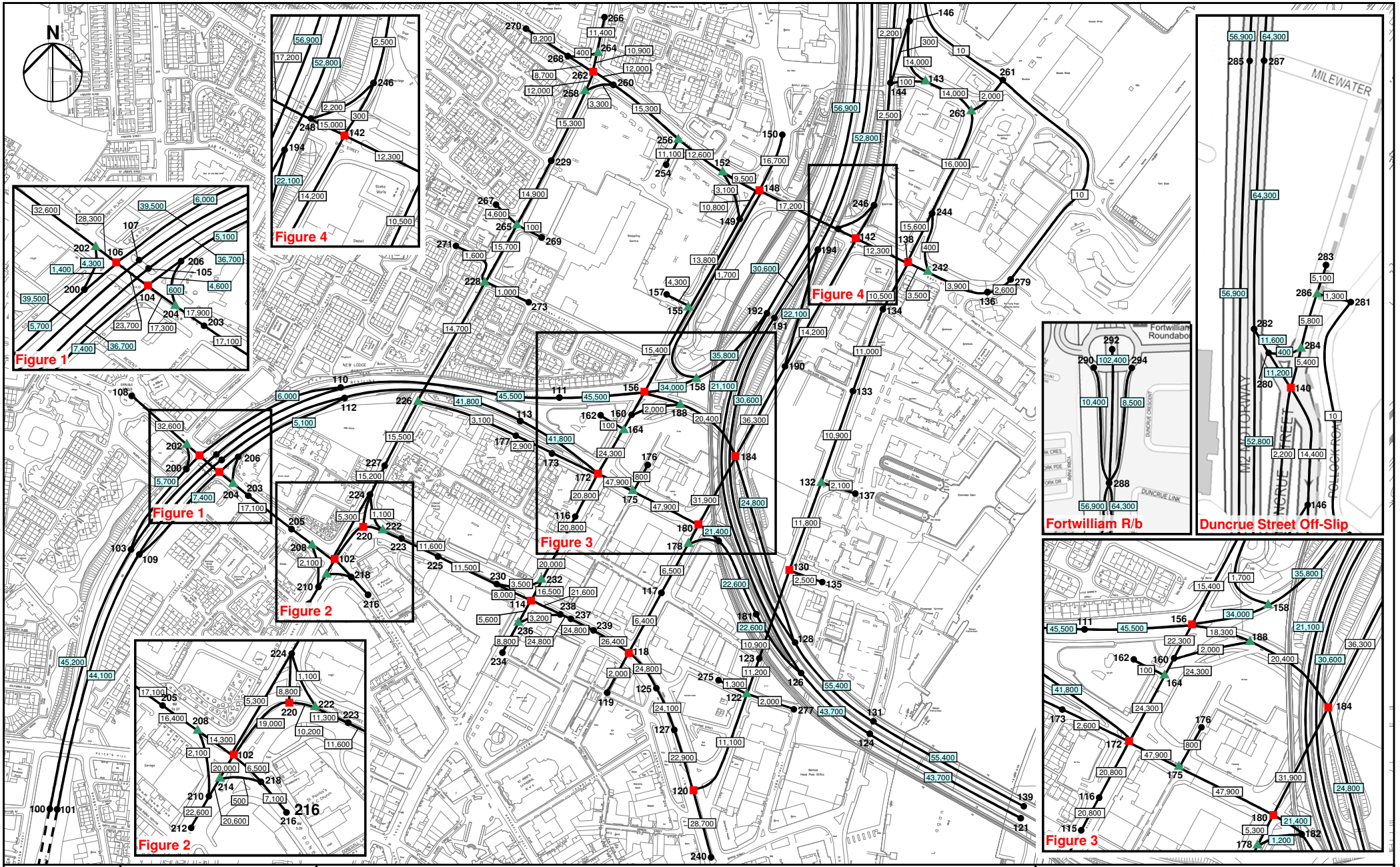
Figure 8.1
COBA Do-Minimum Network
24-Hour Traffic Flows – 2012 Base Year



Notes

- Do-Minimum Link
- **100** Node Number
- [100] Link Number
- Node Point
- Signalised Junction
- Priority Junction
- [10,000] 24-Hour Traffic Flows – Surface Street Flows
- [10,000] 24-Hour Traffic Flows – Motorway Flows

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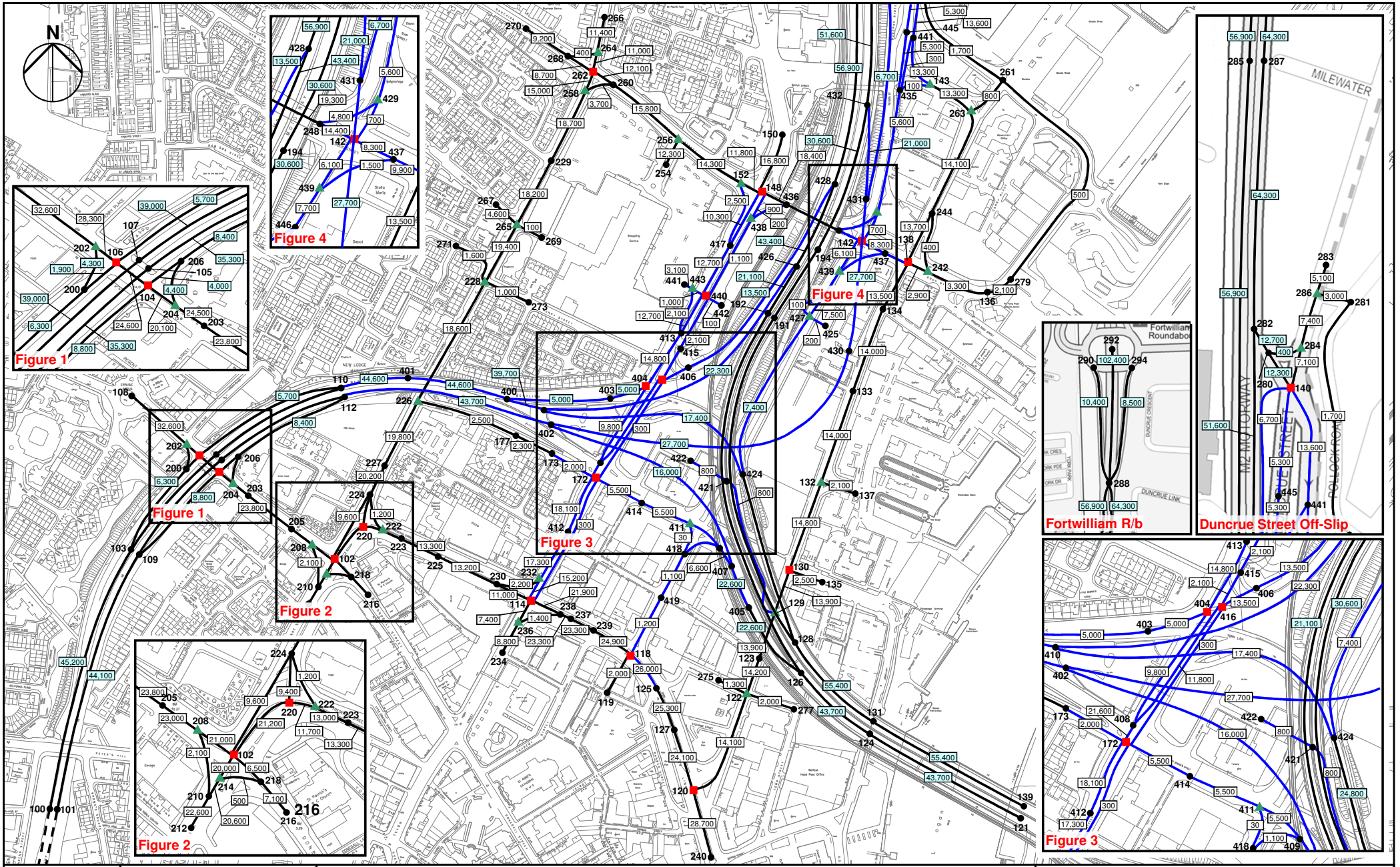
Figure 8.2
COBA Do-Minimum Network
24-Hour Traffic Flows – 2021 Year of Opening



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Notes

- Do-Minimum Link
- 100 Node Number
- [100] Link Number
- Node Point
- Signalised Junction
- Priority Junction
- [10,000] 24-Hour Traffic Flows – Surface Street Flows
- [10,000] 24-Hour Traffic Flows – Motorway Flows

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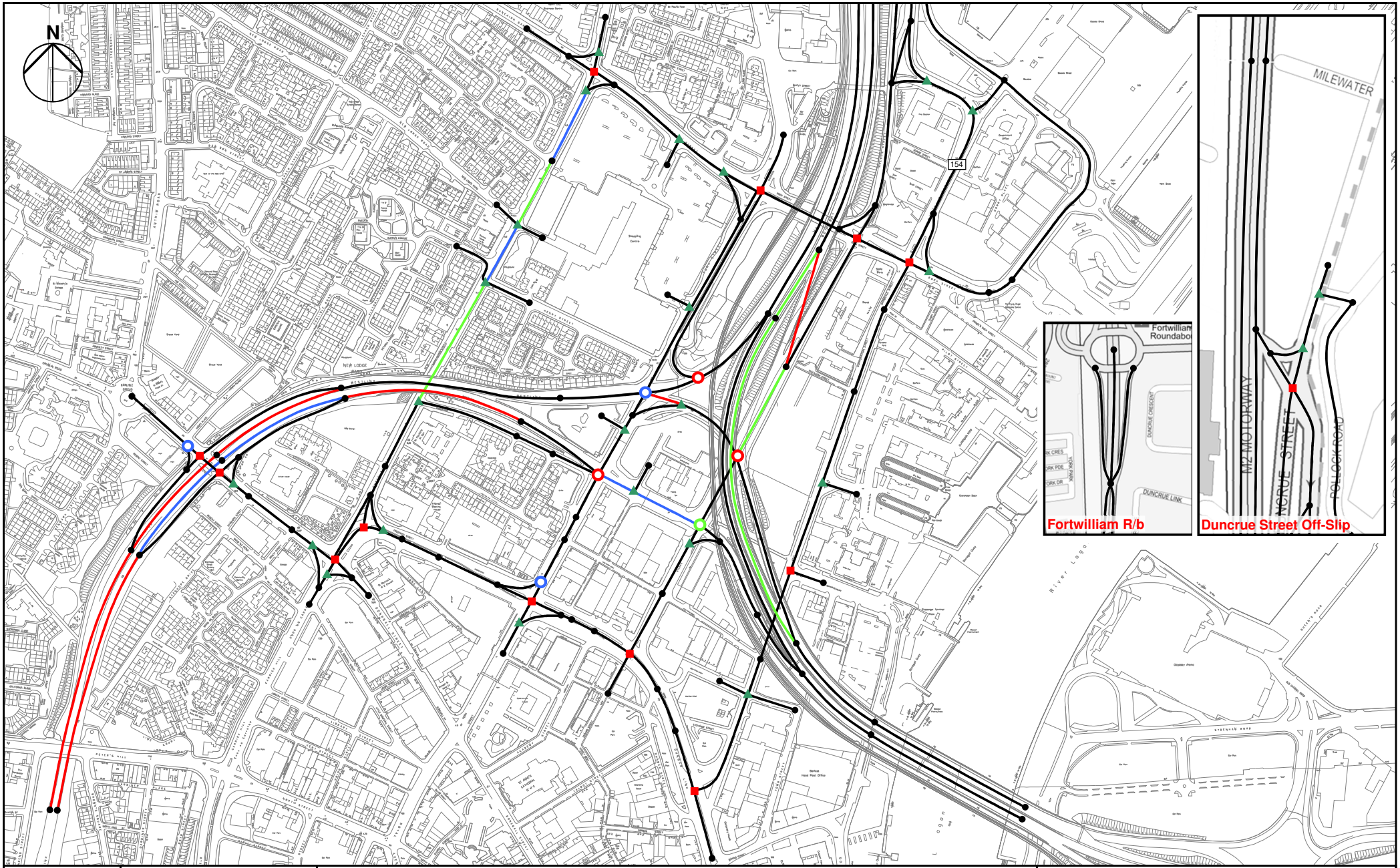
Figure 8.3
COBA Do-Something Network
24-Hour Traffic Flows – 2021 Year of Opening



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- Over-Capacity Link – 2012 Base Year
- Over-Capacity Link – 2021 Year of Opening
- Over-Capacity Link – 2035 Design Year
- Over-Capacity Junction – 2012 Base Year
- Over-Capacity Junction – 2021 Year of Opening
- Over-Capacity Junction – 2035 Design Year

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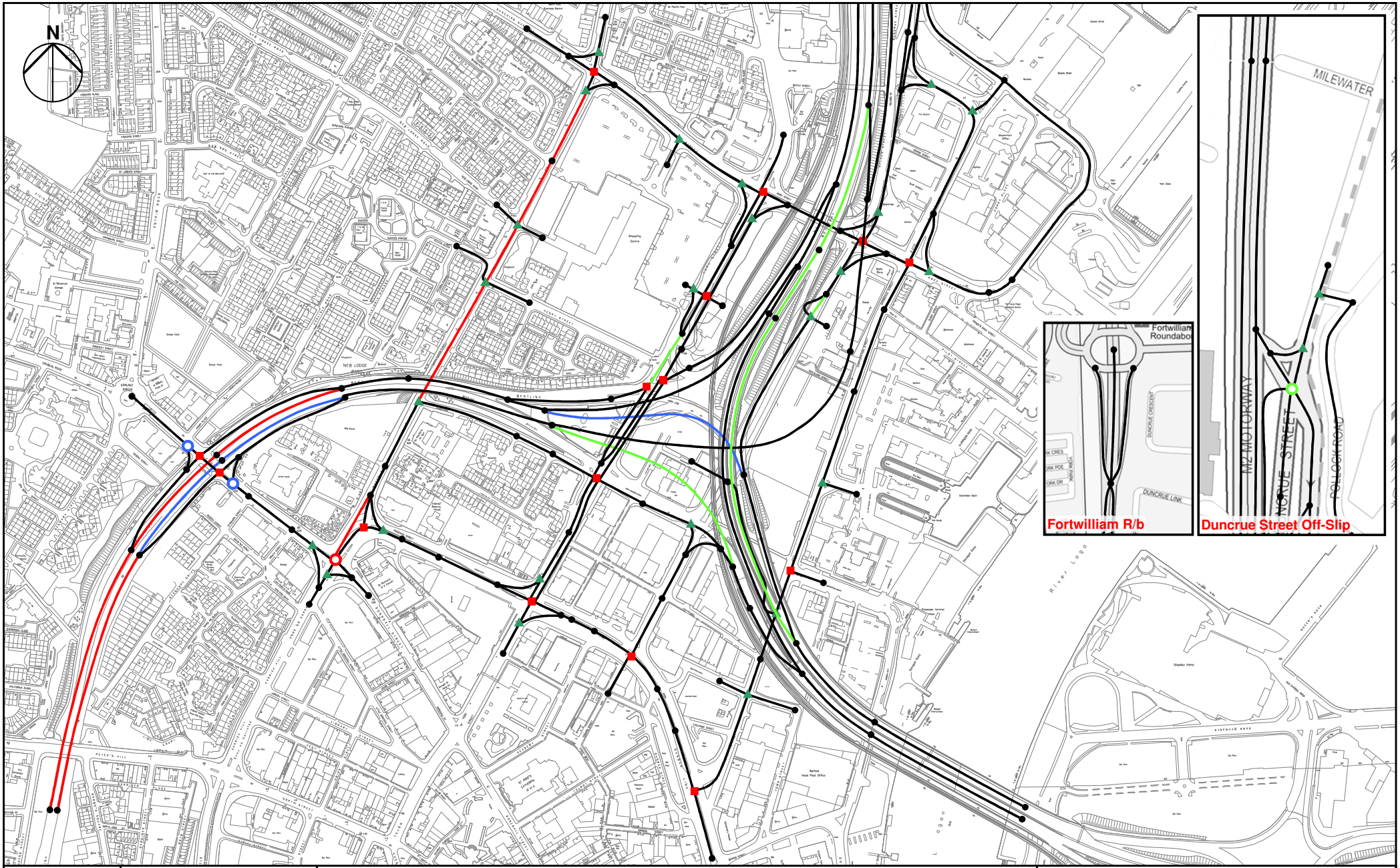
Figure 8.4
Do-Minimum Network
COBA Overcapacity Links and Junctions



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Notes

- Over-Capacity Link – 2012 Base Year
- Over-Capacity Link – 2021 Year of Opening
- Over-Capacity Link – 2035 Design Year
- Over-Capacity Junction – 2012 Base Year
- Over-Capacity Junction – 2021 Year of Opening
- Over-Capacity Junction – 2035 Design Year

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Figure 8.5
Do-Something Network
COBA Overcapacity Links and Junctions