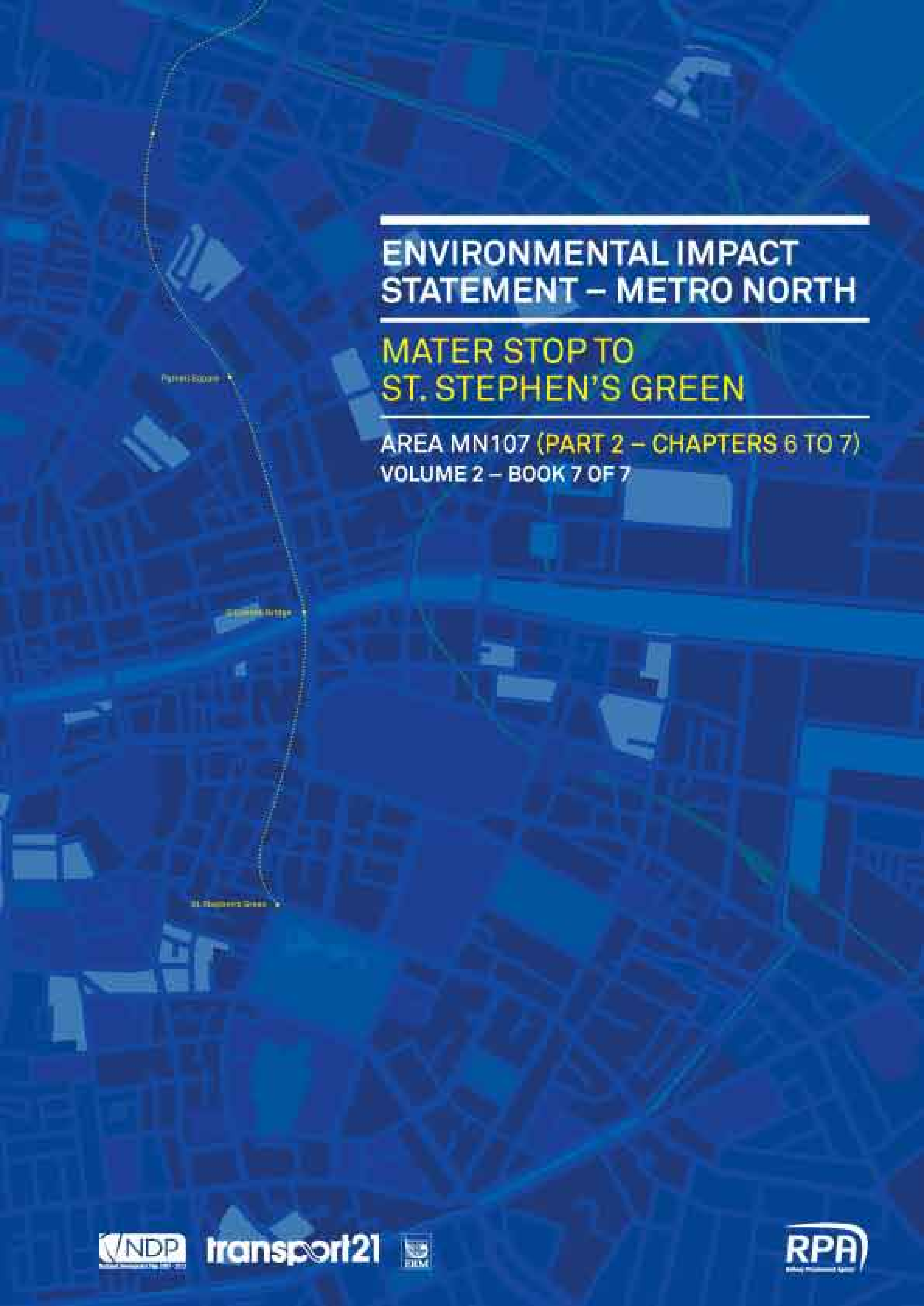


ENVIRONMENTAL IMPACT STATEMENT – METRO NORTH

MATER STOP TO ST. STEPHEN'S GREEN

AREA MN107 (PART 2 – CHAPTERS 6 TO 7)

VOLUME 2 – BOOK 7 OF 7

06 HUMAN BEINGS: RADIATION AND STRAY CURRENT

This chapter of the EIS evaluates the potential for radiation (nuclear and electromagnetic) and stray current impacts to arise due to the construction and operation of the direct current, light rail traction systems associated with the proposed scheme in Area MN107.

6.1 INTRODUCTION

This chapter of the EIS evaluates the potential for radiation (nuclear and electromagnetic) and stray current impacts to arise due to the construction and operation of the direct current, light rail traction systems associated with the proposed scheme in Area MN101.

6.2 STUDY AREA

The study area for this chapter is set out in Table 6.1. EMI decreases very quickly with distance from the source at a ratio based on the square of the distance between the source and the receptor.

Disruption of normal household appliances usually occurs when magnetic field strengths of 10 μT or more are present. However, very sensitive equipment such as electronic/laser equipment may be affected if the magnetic field strengths are greater than 0.16 μT. For schemes such as the proposed scheme, in the absence of stray current, magnetic field strengths of 0.16 μT do not persist at distances of more than 100m from the track. Stray current is generally minimised via technical and structural mitigation during construction. Consequently, in the case of this specific scheme and the potential sources that exist, EMI is highly unlikely to have any impact on even the most sensitive equipment at distances of more than 100m.

Table 6.1 Study area

Aspect	Width of study area (on both sides of the alignment)
Potential impacts from Radiation and Stay Current	100m

6.3 IMPACT ASSESSMENT METHODOLOGY

The potential for EMI impacts has been assessed by:

- Step 1: Selecting representative locations (cross sections) of the alignment for detailed analysis;
- Step 2: Identifying representative scenarios for detailed analysis (including failure modes and non-routine events such as accelerating, braking and coasting);
- Step 3: Simulating/calculating the magnetic fields for the chosen locations and scenarios;
- Step 4: Extrapolating the obtained results to assess the potential risk along the entire alignment.

The source and type of potential impacts is described in Section 6.4.1. Mitigation measures to be put in place are defined in Section 6.4.2. The residual effect of each impact is then evaluated in Section 6.4.3 in terms of magnitude and significance.

6.3.1 Magnitude

The criteria used to assess the different impacts associated with this scheme are shown in Table 6.2. The criteria have been defined in consideration of research carried out by the Technical Academy in Wuppertal (1998) in relation to potential EMI impacts from Stadtbahn projects, which are comparable to the proposed scheme.

Table 6.2: Criteria for assessment of impact magnitude.

Criteria	Impact magnitude
Magnetic fields of > 180 μT (*1)	very high
Magnetic fields of > 40 μT	high
Magnetic fields of > 10 μT	medium
Magnetic fields of >0.1 μT	low
Magnetic fields of < 0.1 μT	very low

(*1) In EN 50061 the limit of immunity of pacemakers against magnetic fields is defined as 1 mT. However, the reference document from Technical Academy in Wuppertal demonstrates that pacemakers will be impacted by this value (see the reference document from Technical Academy in Wuppertal).

6.3.2 Significance

The significance of all impacts is assessed in consideration of the magnitude of the impact and the functional value of the receptor upon which the impact has an effect.

6.4 IMPACT ASSESSMENT

6.4.1 Impact identification

The infrastructure equipment associated with the proposed scheme does not include any sources of nuclear radiation and therefore this issue has been scoped out of this assessment and is not considered any further. Any issues relating to radon are detailed in the Soil and Geology chapter of this EIS (Volume 2, Chapter 9).

Electromagnetic radiation can be associated with EMI coupling effects. EMI coupling effects are defined in accordance with EN 50121 as follows:

- Inductive coupling;
- Capacitive coupling;
- Conductive coupling;
- Magnetic and electromagnetic radiation.

Inductive coupling arises from alternating current (AC) systems, such as the power supplies of lighting, ventilation and other auxiliary systems. These types of system are not used in direct current, light rail traction systems and therefore inductive coupling is not relevant to this proposed scheme and is not considered any further. Capacitive and conductive coupling are not be considered because EMI source levels associated with this scheme are too small to generate an impact in this regard.

Any piece of electromagnetic equipment is designed to function in an environment where the earth's magnetic field is present, which is approximately 50μT. The magnitude of the electromagnetic fields in the vicinity of the proposed alignment will be equal to the earth's magnetic field plus any electromagnetic fields generated or propagated by the proposed scheme.

Elements of the proposed scheme that can potentially act as sources and propagators of EMI comprise:

- Construction equipment (tunnel boring machines, lighting, pump stations etc.):
- The bulk power supply and distribution system;
- The traction power supply system (TPSS). When a LMV demands traction energy, the current flows from the traction power station along the Overhead Catenary System (OCS) to the LMV and from the LMV via running rails back again to the substation. This traction current has the potential to generate electromagnetic fields. The TPSS includes substations, feeders, OCS, running rails (regarding return and stray current) and feeding/return current cables between the OCS and running rails to the substation.
- The rolling stock traction equipment, including inverters, traction motors and auxiliaries;
- The signalling and communications equipment.

It is assumed that all equipment is designed according to the standards of the EMC Directive 2004/108/EC and therefore will not cause any significant impact. In light of this fact, only the direct current, light rail traction systems associated with the proposed scheme are considered as potential sources in this assessment.

6.4.2 Mitigation measures

- Measures to minimise stray current have been incorporated into the design specifications and will be implemented during the construction and operation of the proposed scheme. These measures may include the use of a stray current collector system, together with other design measures such as resilient insulating polymer around the rails.
- Monitoring of the earthing system in the tunnel sections is to be carried out to locate any faults in the earthing system. Active and passive measures such as insulated shielding or cathodic protection can be applied to protect any critical components.
- The system contractor(s) will ensure that the electrical systems and equipment associated with this scheme comply with the EMC Directive 2004/108/EC.
- With regard to some types of sensitive electric appliances, relocation of the affected appliance (even a short distance from a railway boundary) may be possible.

6.4.3 Assessment of residual impacts

6.4.3.1 Project scenario: construction phase

Potential levels of EMI and stray current during the construction phase (including the testing and commissioning of the LMV and traction power supply system) are expected to be within those limits detailed in Section 6.3.

6.4.3.2 Project scenario: operational phase

The assessment of residual impacts takes into consideration the reference standards, regulations and guidelines detailed in Table 6.3.

Table 6.3 Reference standards, regulations and other relevant documents

Reference document
2004/108/EC EMC Directive
EN 50121-1 – 5: Railway applications - Electromagnetic compatibility
EN 50122-2: Railway applications - Fixed installations, earthing and bonding – Part 2: Provisions against the effects of stray currents caused by d.c. traction systems
IEC 60050 (161) International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility
Research report: Meßtechnische Ermittlung der elektromagnetischen Felder im Bereich von Gleichstrom-Nahverkehrsbahnen – Forschungsbericht FE-Nr. 70506/96 – Technische Akademie Wuppertal
RPA document: EMC analysis of results of magnetic fields monitoring at IBTS building during Luas Day-One-Run - 03/08/04
RPA document: EMC analysis of results of the system with the outside world 20/06/03
RPA document: Gníomhaireacht Um Fháil Iarnród, Title: New LMV Specification – Appendix 4 – Luas power system

The potential for significant impacts to occur due to stray current is considered to be low provided that the mitigation measures detailed in Section 6.4.2 are put in place.

The EMI calculations arising from direct current (DC) power supply system are based upon the following physical phenomena:

Magnetic fields occur if an electrical current passes through a conductor. The field intensity (strength) depends upon the magnitude of the current and the distance between that conductor (source) and the destination point (receptor). A planar view of two conductors is shown in Figure 6.1. The magnetic field intensity has its maximum magnetic strength at the centre of the conductor, which reduces with increasing distance from its centre.

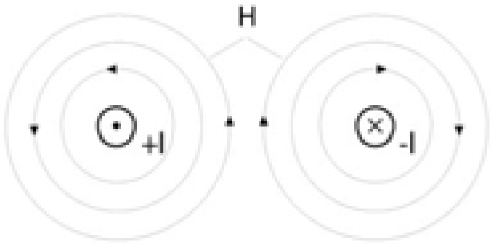


Figure 6.1
Electric conductors with magnetic field streamlines

In case of a conductor with an efficient length, the magnetic field intensity can be calculated as:

$$H = I / (2 * \pi * r)$$

Where:

H: magnetic field intensity
[measured in amps per metre];

I: traction current (Amps A): and

r: distance between source point and destination point (radius of streamlines).

At any determined point in space, magnetic fields of various sources may interfere with each other. The resulting magnetic field may be amplified or compensated as a result of these interferences.

It is not possible to quantify magnetic field intensity directly; rather the impact of the magnetic field (magnetic flux density) can be detected. This is dependent on the magnetic field intensity:

$$B = \mu r * \mu 0 * H$$

Where:

B: magnetic flux density (measured in Tesla [T]);

μ0: absolute permeability (physical constant);

μr: relative permeability (coefficient of materials).

Selection of representative locations
Four locations along the proposed alignment have been chosen for detailed investigation of EMI. These locations are:

- Seatown Stop (at-grade);
- Albert College Park (cut and cover tunnel);
- Mater (bored tunnel and stop);
- Rotunda Hospital (bored tunnel).

For each of the above locations, specific factors, such as depth of the tunnel sections and distance to housing areas were identified and taken into consideration. The modelling results for these four locations are representative of that which will be experienced across the entire scheme.

Identification of representative scenarios
To cater for the variation and combination of EMI from different LMVs, the calculations for the foreseeable worst case levels are based upon the following operational scenarios:

- one LMV starting and accelerating (peak current) on one track at the same time as one LMV is running at maximum speed (continuous current) on the other track (This is a pessimistic worst case traction power demand at the same longitudinal location on both tracks along the alignment);
- traction power supply system is fed from only one substation (e.g. in case of maintenance), the traction current of both tracks will be in the same direction.

During normal operation the traction power supply is fed from two substations (one at each end of each section), which means that the electric loads are split/shared between two adjacent substations.

For completeness, the emergency failure condition of a short circuit failure of the OCS system has also been considered.

Predicting the magnetic fields for the chosen scenarios and locations
The electromagnetic calculations carried out were based upon the key assumptions set out in Table 6.4 and 6.6. The results are set out in Table 6.7 to 6.11.

Table 6.4 LMV Performance

	Per LMV	Per train (Two coupled LMVs)
Peak Current	1800A	3600A
Continuous RMS Current	1200A	2400A
Maximum braking current	1800A	3600A

Table 6.5 Power Supply Performance

Maximum short circuit current	20000A

Table 6.6 Track and OCS Parameters

Vehicle width	2.4 metres
Track gauge	1435 mm
Track centre distance	4 – 10 metres
Contact wire height	6.0 metres (at grade) and 3.9 metres (within tunnel)

Table 6.7 EMI at Seatown – Normal Operation

Normal operation	1 x 3600 A and 1 x 2400 A	1 x 3600 A and 1 x 2400 A
Destination point	Ground floor of residential houses next the alignment	First Floor of residential houses next the alignment
Distance between top of rail and destination point	20 metres (vertical [y]) and 0 metres (horizontal [x])	20 metres (vertical [y]) and 4 metres (horizontal [x])
Load current	2800A	2800A
EMI	38.1 μT	39.5 μT
Impact magnitude	medium	medium

Table 6.8 EMI at Seatown – Fault Operation

Fault operation	20 000 A	20 000 A
Destination point	Ground floor	First floor
Distance between top of tail and destination point	20 metres (vertical [y]) and 0 metres (horizontal [x])	20 metres (vertical [y]) and 4 metres (horizontal [x])
Load current	20 000A	20 000 A
EMI	129.9 μT	129.9 μT
Impact magnitude	high	high

Table 6.9 EMI at Albert College – Normal Operation

Normal operation	1 x 3600 A and 1 x 2400 A
Destination point	Ground floor
Distance between top of rail and destination point	30 metres (vertical [y]) and 9.7 metres (horizontal [x])
Load current	2800A
EMI	7.4 µT
Impact magnitude	low

Table 6.10 EMI at Mater Hospital – Normal Operation

Normal operation	1 x 3600 A and 1 x 2400 A
Destination point	Ground floor
Distance between top of rail and destination point	100 metres (vertical [y]) and 25.5 metres (horizontal [x])
Load current	3600A
EMI	0.6 µT
Impact magnitude	low

Table 6.11 EMI at Rotunda Hospital – Normal Operation

Normal operation	1 x 3600 A and 1 x 2400 A
Destination point	Ground floor
Distance between top of rail and destination point	0 metres (vertical [y]) and 22.9 metres (horizontal [x])
Load current	3600A
EMI	15.3 µT
Impact magnitude	medium

Extrapolating of the obtained results to assess the potential risk along the entire alignment
The results presented in the tables above show that during normal operations, the electromagnetic impact of the proposed scheme is low and medium, which results in a small increase in the electromagnetic environment in the vicinity of the proposed scheme.

Whilst, a 'hard' short circuit failure of the OCS system (failure condition) leads to a high impact magnitude, this is an extremely unlikely event. This type of fault has never occurred on the Luas scheme since this system commenced operations. If this fault did occur, the duration of the failure would last no longer than 20ms, (the time it takes for the fault to be detected and switched off). This means, that only very short peaks of magnetic fields would occur.

6.4.4 Summary of residual impacts

The technical design of the proposed scheme conforms to current best practice. The described radiation impacts can be regarded of Low significance and do not present any significant safety risk. The potential for significant impacts to occur due to stray current is considered to be low provided that the mitigation measures detailed in Section 6.4.2 are put in place.

07 HUMAN BEINGS: TRAFFIC

This chapter of the EIS examines the transportation impact of the proposed scheme. The impacts on vehicular, pedestrian and cycling traffic and safety arising out of the construction and operation of the proposed scheme are described for Area MN107.

7.1 INTRODUCTION

This chapter of the EIS examines the transportation impact of the proposed scheme. The impacts on vehicular, pedestrian and cycling traffic and safety arising out of the construction and operation of the proposed scheme are presented.

The proposed scheme will have a city wide impact on traffic movement during its construction and operational phases. The impacts will be very beneficial during its operational phase as there will be a general reduction in the number of cars on the road network as some car users will switch to use the proposed scheme. However, the impact will be negative during its construction phase as the construction programme and activity would create considerable levels of traffic disruption, without the introduction of the mitigation measures described herein.

As the cumulative impact of the proposed scheme can only be understood through a strategic understanding of the impact, it is necessary to firstly examine the predicted impacts of the construction and operational phases for the full alignment, as this will inform the local area impact. To fully understand the true extent of the transportation impact, the assessment is, therefore, presented in a two tier manner. The first tier presents the strategic nature of the impact and the second tier presents the localised impact.

The strategic assessment involves identifying the impact of the proposed scheme in its entirety for both construction and operational phases. This provides an understanding to the extent of the zone of influence the impact has and informs on the requirement for overarching strategic mitigations measures. The second tier impact assessment focuses on each of the designated assessment areas and provides a more detailed understanding of the localised impact on all modes of transport.

The predicted construction impact of the proposed scheme could be significant without mitigation measures, as some of the stops will be constructed in sensitive areas where there are high levels of transportation activity. The construction methodology and programme takes cognisance of the potential construction impact on all road users, and has evolved to a point where the potential impact has been minimised to the furthest extent possible. Inherent within the construction methodology and programme of the proposed scheme are generic objectives and associated mitigation measures that aim to minimise the overall strategic transportation impact on all road users. The strategic mitigation measures are also applicable to the operational phase of the proposed scheme.

The strategic mitigation measures are needed to ensure transportation impacts are minimised for all road users throughout the proposed alignment during both construction and operational phases. On an area by area level, further additional mitigation measures will be required to cover localised transportation impacts not addressed within the strategic mitigation measures.

7.1.1 Transportation assessment methodology

Figure 7.1, below, illustrates the transportation assessment methodology. The stages of the methodology are as follows:

Stage 1 of the process is the Impact Assessment Criteria which defines the parameters against which the impact is measured. These criteria were derived from international best practice and industry standard guidelines. A categorisation of effects was established against which the impacts of the construction and operation of the proposed scheme could be assessed on a strategic and local level. These criteria inform both the Strategic Assessment of the Full Alignment and the Area by Area Impact Assessment.

Stage 2 is the Strategic Assessment of the Full Alignment. Within this stage a comprehensive Strategic Mitigation Methodology was developed for the full alignment, the aim of which is to establish traffic management principles that will ensure that the impact of the proposed scheme will be minimised as much as possible. The predicted strategic impact then focuses on traffic statistics, traffic flow change and re-distribution, journey time and speed differences in order to demonstrate the predicted impacts of construction and operation. Following this assessment, recommendations for a series of further mitigation measures are identified in order to reduce the severity of the construction impact.

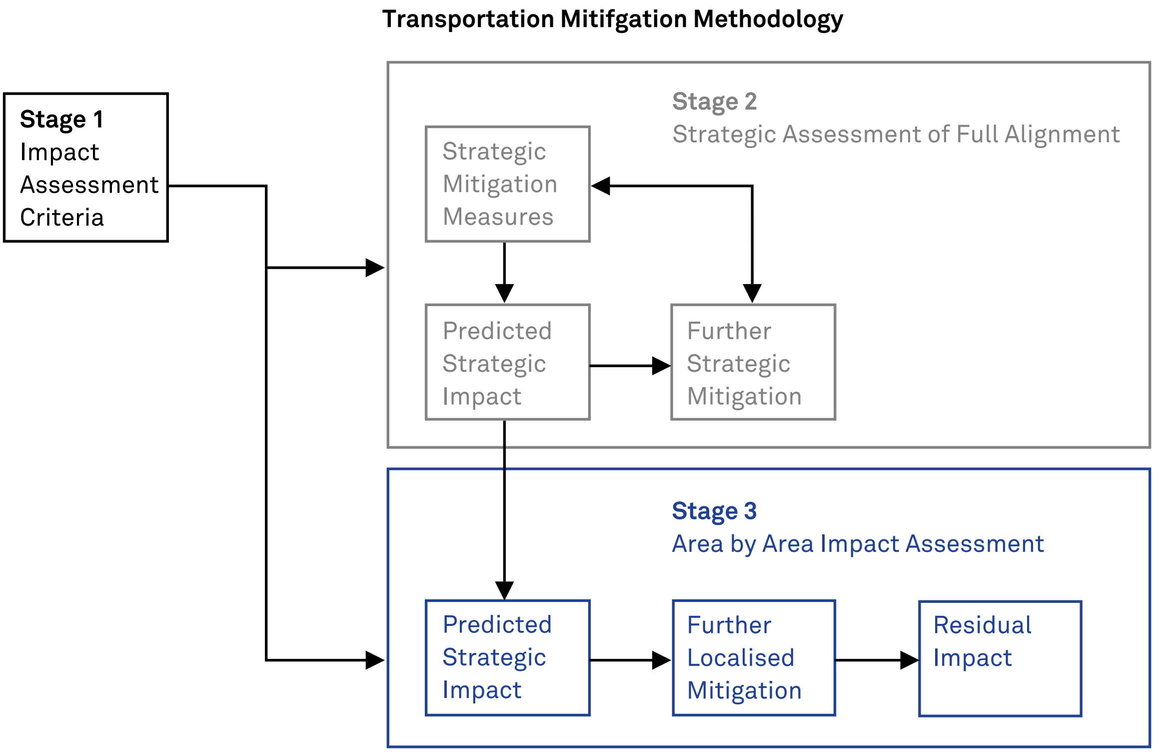
Stage 3 is the localised impact assessment on all road users which presents the predicted impact of the proposed scheme within each study area. A local area assessment is presented for each study area to identify the severity of the construction and operational impact. A detailed assessment is made on the impact on general traffic movements, access requirements, public transport services, the pedestrian and cycling environment and on the impact of construction and background HGV traffic on each area. Further area specific mitigation measures, not covered by the strategic mitigation methodology, are presented to address the impact on the local area. Finally, when all mitigation measures have been considered the residual impacts on a local area basis are identified.

7.1.2 Structure of transportation assessment section

The transportation assessment section is structured as follows:

- Impact Assessment Criteria;
- Strategic Mitigation Methodology;
- Predicted Strategic Impact;
- Strategic Further Mitigation;
- Predicted Local Area Impact;
- Local Further Mitigation Measures.

Figure 7.1 Transportation impact assessment process



7.2 IMPACT ASSESSSMENT CRITERIA

The Impact Assessment Criteria are based on advice contained in EIS guidance sources. Among the most important references are the Environmental Protection Agency's 'Guidelines on the information to be contained in Environmental Impact Statements (2002)', and the UK Department of Transport's 'Design Manual for Roads and Bridges' (DRMB Volume 11) which offers comprehensive advice for the staged assessment of major road schemes. Detailed information on the developing engineering design is used to 'scope' the potential key issues relating to vehicular and pedestrian traffic. The Impact Assessment Criteria are categorised as follows:

- Data sources used;
- General Assessment Criteria used for the Transport Assessment;
- Categorisation of Effects;
- Impact on Vehicular Traffic (Vehicular Traffic can be classified as all mechanised modes using the road network including: Car, Light Vehicles, Heavy Goods Vehicles, Buses and Taxis);
- Criteria for Driver Delay;
- Impact on Pedestrian and Cyclist Amenities;
- Impact of Severance on Pedestrians and Cyclists;
- Consideration of Impact on Vehicular, Pedestrian and Cyclist Traffic and Safety.

7.2.1 Data sources

The principal sources of data for pedestrian and vehicular traffic, for accidents, and for transportation modelling are as follows:

7.2.1.1 Traffic data (vehicle flows)

The principal source of traffic data for the assessment is the Metro North Traffic Model (MNTM), a traffic model developed specifically for the task of assessing the traffic related impact of the proposed scheme for both construction and operational years. This has been supplemented by individual traffic link and junction counts undertaken by the Railway Procurement Agency (RPA). Pedestrian and cycle counts have also been collected in sensitive areas in the city centre and Swords.

7.2.1.2 Accident data

An Garda Síochána has provided RPA with traffic accident data which in itself is derived from the National Roads Authority Accident database, for the period 2002-2006. This information, which relates to personal injury accidents, is derived from the national Garda reporting system which categorises accidents as fatal/serious/minor.

7.2.2 General assessment criteria used for the transport assessment

The criteria used for the assessment of the proposed scheme are based on EIS advice from industry standard best practice guidelines. Furthermore, the assessment is benchmarked against previous EIS assessments undertaken in Ireland and internationally to ensure that best practice has been maintained. The sources for this advice are as follows:

- The Environmental Protection Agency's 'Guidelines on the information to be contained in Environmental Impact Statements (2002)' and Advice Note on Current Practice;
- The US Highway Capacity Manual, 2000, providing advice on measuring pedestrian impact and level or service parameters for pedestrian movement;
- The UK Department of Transports 'Design Manual for Roads and Bridges' (DRMB Volume 11) which offers comprehensive advice for the staged assessment of major road schemes;
- The Institute of Environmental Management and Assessment (IEMA) – Guidelines for Traffic Impact Assessment (1994).

The advice contained within these documents forms the basis for the impact assessment of the proposed scheme.

Generally, the transport assessment for both construction and operational phases should have regard for the following:

- Data collection for vehicular, pedestrian and cyclist traffic;
- An understanding of the potential impacts generated by the proposed scheme;
- A development of mitigation measures to minimise the impact generated by the proposed scheme during both the construction and operational phases;
- An identification of predicted impacts for the construction and operational stages;
- A development of further mitigation measures (or remedial measures);
- An understanding of the additional mitigation residual impact.

Additionally, factors influencing the transport assessment during the construction phase include the:

- Sequence of construction activities and construction duration;
- Construction methodology;
- Construction compound locations.

7.2.3 Categorisation of effects

A transportation impact is determined significant by reference to the following criteria:

- The extent of the impact (the geographical area and size of population affected);
- The magnitude and complexity of the impact;
- The probability of the impact;
- The duration, frequency and reversibility of the impact.

The determination of significance rating for all road users is defined in the table below. They are categorised broadly into Slight, Moderate or Severe (see Table 7.1). Further additional significance ratings are provided for pedestrians and cyclists in Section 7.2.6.

Table 7.1 Categorisation of impact significance[1]

Level	Description
Slight	'Slight' impacts are those which, by and large, should be capable of being 'designed out' in the detailed design and construction planning. In particular, construction activity will generate many 'slight' effects that are typically of short duration and can be remedied with suitable traffic management measures and the provision of temporary bridges and footways.
Moderate	'Moderate' impacts are those which, depending on their intensity or the sensitivity of location to vehicular or pedestrian activity or the duration of the effect, should be recorded in an assessment, but which do not rank as severe themselves.
Severe	The 'Severe' level equates to impacts that are residual or of long duration, of a high magnitude and/or affecting a substantial population.

[1] Adapted from The Environmental Protection Agency's 'Guidelines on the information to be contained in Environmental Impact Statements (2002)' and Advice Note on Current Practice and The UK Department of Transports 'Design Manual for Roads and Bridges' (DRMB Volume 11) which offers comprehensive advice for the staged assessment of major road schemes.

7.2.4 Determination of impact significance on vehicular traffic

The significance of vehicular traffic impact is determined by changes to traffic flow, as follows:

- Highway links where traffic flows will increase by more than 30% (or the number of heavy goods vehicles will increase by more than 30%).
- Any other specifically sensitive areas where traffic flows will increase. (Specifically sensitive areas would include accident blackspots, conservation areas, hospitals, links with high pedestrian flows etc.).

The following table further outlines the criteria for classifying the impact of increases in traffic flows.

Table 7.2 Categorisation of impact significance for vehicular traffic[2]

Traffic Flow Increases	
<10%	Traffic flow increases directly attributable to the proposed scheme of less than 10% are not considered likely to give rise to any potential significant effects.
10% to 30%	Traffic flow increases of 10% to 30% are only considered to give rise to significant effects in specifically sensitive areas. For accidents, this is defined as any road link with more than 15 accidents in the last five year period for which data is available.
>30%	Traffic flow increases directly attributable to the proposed scheme of more than 30% are considered likely to give rise to potentially significant effects.

[2] Adapted from The Environmental Protection Agency's 'Guidelines on the information to be contained in Environmental Impact Statements (2002)' and Advice Note on Current Practice and The UK Department of Transports 'Design Manual for Roads and Bridges' (DRMB Volume 11) which offers comprehensive advice for the staged assessment of major road schemes.

7.2.5 Determination of impact significance on driver delay

A further determination of impact significance for vehicular traffic is the effect on driver delay which is deemed to exist where:

- there is predicted to be a decrease in link speeds of more than 5kph;
- there is predicted to be a increase in journey length of 500m.

7.2.6 Determination of impact significance on pedestrians and cyclists

The significance of pedestrian and cyclist movement impact is primarily determined by reference to the following criteria:

- There is predicted to be a increase in total traffic flow of more than 30% and the increase is more than 40 movements per day;
- There are 'material' levels of pedestrians;
- The sensitivity of the area is 'high' (e.g. conservation area, major community facility).

Severance can be defined as the sum of divisive effects that a project may impose on a community in terms of access to and movement between locations such as residences, workplaces, commercial/retail areas, schools, community facilities, etc. Catchment areas for community and religious facilities can be established by reference to parish boundaries. The significance of the severance impact is determined with regard to the following:

- The number of people who would be impacted;
- The presence of particularly vulnerable groups such as children, the aged or the disabled amongst those likely to be impacted.

The significance rating of pedestrian and cyclist impact is primarily determined by reference to the following table.

Table 7.3 Categorisation of impact significance for pedestrians and cyclists[3]

Extent of Impact	Description
Slight	In general the current journey pattern is likely to be maintained, but there will probably be some hindrance to movement, for example: - Pedestrian at-grade crossing of a road with <8000 Annual Average Daily Traffic – AADT); - A new bridge will need to be climbed or a subway traversed; - Increases in pedestrian journeys of at least 250m
Moderate	Some residents, particularly children and elderly people are likely to be dissuaded from making trips, for example: - Two of the impacts listed under 'slight'; - Pedestrian at-grade crossing of a road with between 8,000 and 16,000 AADT; - Journeys will be increased by 250m to 500m
Severe	People are likely to be deterred from making trips to an extent sufficient to induce a re-organisation of their habits, for example: - Pedestrian at-grade crossing of a road with >16,000 AADT; - An increase in length of journeys of over 500m; - Three or more of the hindrances listed under slight; - Two or more of the hindrances listed under moderate.

[3] Adapted from The UK Department of Transports 'Design Manual for Roads and Bridges' (DRMB Volume 11) which offers comprehensive advice for the staged assessment of major road schemes.

7.2.7 Consideration of impact on vehicular, pedestrian and cyclist traffic and safety

7.2.7.1 Baseline environment

The proposed scheme penetrates a large number of areas with very different environments. These environments vary in terms of the road network, the existing concentration of traffic movements and the existing make up of that traffic (i.e. cars, pedestrians, cyclists, buses).

The assessment of vehicular and pedestrian traffic and safety, for each of the seven areas, is carried out with regard to the following inputs:

- All day traffic flows at locations along the full alignment;
- Public transport infrastructure and services;
- Pedestrian counts in areas of high pedestrian concentrations;
- Cyclist counts;
- Accident history along the full length of the proposed alignment.

Construction phase
The construction phase will include utilities diversions and enabling works, which, by their nature are of short duration and will have localised impacts which will be mitigated. This phase also includes the main construction works for the proposed scheme, which are of longer duration and which have a potentially greater impact along the full length of the proposed scheme. The assessment therefore considers the main construction works.

The transport and traffic assumptions and modelling assessment undertaken represent a conservative view of the likely traffic conditions that will be experienced during the construction phase of the proposed scheme. The construction phase at each construction site (at a road junction or stop location) that is considered to have the most potentially significant impact on traffic was modelled. In reality the construction phases for each site that have the most significant impact on traffic movement are very unlikely to occur in tandem. However to ensure a robust traffic assessment and to ensure that mitigation requirements are not underestimated it was viewed as essential to examine worst case construction impact scenario. For the purposes of assessing the impact during construction, worst case scenarios are assumed. The construction assumptions are as follows:

- The phases of construction that will have the most Severe impact at key junctions occur concurrently;
- Network changes including infrastructure/road closures/ prohibited turning movements and other traffic restrictions are implemented;
- Construction Strategy – maximum length of time that specific areas will be affected;
- Construction vehicle routes and volumes – peak construction vehicle movements occur at each stop simultaneously.

The assessment of the impact on vehicular and pedestrian traffic and safety, for each of the seven areas, is carried out with regard to the following:

- Modelled traffic flows (AM Peak 08:00 to 09:00) extracted from the MNTM;
- Public transport infrastructure and services;
- Pedestrian and cyclists;
- Mobility Impaired / Disabled (MID);
- Access and servicing requirements.

Operational phase
The assessment of impact on vehicular and pedestrian traffic and safety during the opening year (2014) and forecast year (2029), for each of the seven areas, is carried out with regard to the following inputs:

- Modelled traffic flows (AM Peak 08:00 to 09:00) extracted from the MNTM;
- Modelled traffic flows (Off-Peak 14:00 to 15:00) extracted from the MNTM;
- Road network changes;
- Traffic management alterations;
- Public transport infrastructure;
- Details of pedestrian facilities – pedestrian bridges, crossing locations, etc;
- Details of cycle facilities – cycle lane provision and cycle parking;
- Mobility Impaired / Disabled (MID);
- Access and servicing requirements

7.3 STRATEGIC MITIGATION METHODOLOGY

7.3.1 Introduction

This Mitigation Methodology forms the basis for developing a comprehensive set of mitigation measures to minimise the impacts generated by the proposed scheme during both construction and operational phases. Mitigation measures are defined for any adverse impacts that are deemed to be of Moderate or greater significance prior to mitigation. The extent to which mitigation is needed increases as the severity of the impact increases.

7.3.1.1 Mitigation objectives

As it is anticipated that the construction phase of the proposed scheme will have a greater impact than the operational phase, a greater emphasis has been placed on construction mitigation objectives, although may are also applicable to the operational phase.

Light vehicles and HGV

- Minimise impact on current delivery arrangements for affected businesses;
- Minimise impact on current levels of on-street car parking provision;
- Maintain access to all off-street car parks;
- Minimise impact on quality of access/egress to off-street car parks;
- Minimise impact on current car journey times.

Buses

- Minimise impact on current bus service coverage;
- Minimise impact on current bus stop facilities;
- Minimise impact on current bus journey times;
- Minimise impact on routes between bus garages and termini;
- Minimise impact on current conditions on bus paths for turnaround of buses at the end of their routes.

Taxis

- Minimise impact on current taxi service coverage;
- Minimise impact on taxi passengers.

Pedestrians and cyclists

- Maintain a safe environment for pedestrian and cyclist movement in the vicinity of each construction site;
- Maintain pedestrian access to all buildings in the vicinity of construction works;
- Minimise impact to pedestrian and cycle networks.

Emergency vehicles

- Maintain emergency service access to all buildings in the vicinity of construction works;
- Minimise impact to current emergency services journey times.

Mobility impaired

- Ensure full mobility impaired/disabled (MID) compliance for all facilities.

7.3.1.2 Categorisation of mitigation measures

According to the EPA Guidelines, the central purpose of the Environmental Impact Assessment is to identify potentially significant adverse effects/impacts at the pre-consent stage and to propose measures to mitigate or ameliorate such impacts. There are two established strategies for impact mitigation which are used for this assessment, namely reduction and remedial measures. The difference between these two measures is highlighted by the examples given below:

- Strategic Reduction Measures – e.g. introduction of the Scheme Traffic Management Plan prior to construction of the proposed scheme;
- Strategic Remedial Measures – e.g. adjustment of traffic signals to improve traffic flow;
- Localised Reduction Measures – e.g. reduce the construction area in order to maintain a footpath;
- Localised Remedial Measures – e.g. when the construction area covers the footpath resulting in its closure, then the impact will be lessened by widening the opposite footpath.

In general, strategic reduction mitigation occurs before construction, while remedial measures are implemented during construction on an on-going basis. Mitigation is mainly achieved by remedial measures i.e. measures which can be put in place to negate the impacts of the proposed scheme on the environment.

Maintaining the safety of all road users is the primary objective during the construction of the proposed scheme; and is being considered in the preparation of recommendations for mitigation measures.

In order to successfully limit the impact of the construction period on the environment, a number of key mitigation measures are required, as outlined in the following sections.

7.3.2 Strategic construction mitigation measures

The mitigation required during the construction phase of the proposed scheme will be substantial. Due to the scale of the proposed scheme and its associated construction impact, it is important to develop an overarching Mitigation Methodology covering the full alignment of the proposed scheme. The aim of the methodology is to establish traffic management principles that will ensure that the construction impact of the proposed scheme will be minimised to the greatest extent possible. The principles of the Mitigation Methodology must be adhered to by the contractor. As part of the development of the Mitigation Methodology, international best practice guidelines were reviewed to produce a comprehensive list of mitigation objectives and an associated set of mitigation measures which can be applied to achieve them. These are outlined below.

7.3.2.1 Reduction measures (construction phase)

Reduction measures – general

- Construction of the proposed scheme will lead to some level of disruption throughout the study area. A number of mitigating measures have been proposed to address the impacts of the construction phase, which will minimise hindrance to general activity in the area while allowing the construction period to be progressed as fast as is feasible. Appropriate safety measures will be put in place to mitigate in general any safety risks to the general public. A scheme of traffic management measures will be adopted to manage traffic impacts. Development of this scheme will involve on-going consultation with all relevant stakeholders including Dublin City Council, Fingal County Council, Dublin Bus, the Dublin Transportation Office, An Garda Síochána, Dublin Chamber of Commerce, Dublin City Business Association, etc;
- Prior to the commencement of each construction phase, the necessary enabling works will be implemented. These will primarily take the form of additional road works and traffic signal changes;
- Co-ordination by RPA representatives of works by the utility companies and their contractors;
- Co-ordination by RPA representatives of the works of the infrastructure contractor;
- Prior to the commencement of the construction phase, a comprehensive publicity campaign will take place. This campaign will be launched through the local and national press and through radio, TV and the internet and will provide updates on the progress of the construction phases and on further mitigation measures that may be needed during the course of the construction programme. Overall, the public information campaign will inform the general public on:
    - The envisaged city centre traffic management plan (road closures, designated diversionary routes for general traffic, new bus routings and stop locations, new access arrangements, new taxi rank locations and pedestrian and cycling infrastructure);
    - The enabling works required before construction work commences and the associated timeframe;
    - The construction programme, including timeframe, construction vehicle routes, working hours and works areas;
    - The other general mitigation measures required to minimise the disruption;
    - To ensure a coordinated response to the construction activities, there will be frequent communication with, and information exchanged between interested parties (i.e. Local Councils, National Roads Authority, Local Chamber of Commerce, etc);
    - All traffic management implementation measures will be discussed and agreed with the relevant roads authorities, An Garda Síochána and other agencies such as the National Roads Authority as required.

Reduction measures – construction traffic

- Construction vehicles routes have been identified to direct construction traffic onto suitable roads, and to minimise the negative effects of increased HGV traffic on the environment;
- There will be strict controls and regulations at the entrance/exits of sites for construction vehicles in order to ensure the safety of other road users.

Reduction measures – general traffic

- Where practicable, construction work requiring short term disruption and road closures will be undertaken at times that minimise their impact, and will be agreed with the relevant planning and roads authority;
- Temporary ramps across trenches may be provided to facilitate the movements of diverted traffic.

Reduction measures – pedestrians and cyclists

- Pedestrian routes will be maintained throughout the construction period, either around or through the construction site, where safety risks to the general public will not increase as a result of construction activity;
- In very sensitive areas, such as the city centre, the designated access and pedestrian routes around the construction sites, particularly at and/or along the hording lines, must not be perceived as uninviting by pedestrians. The environment around the sites, therefore, will be designed to ensure that pedestrians and cyclists feel they are entering a safe and accessible environment. This will ensure that impact to businesses and shops adjacent to the works areas is minimised.

7.3.2.2 Remedial measures (construction phase)

Where significant adverse effects on the environment are identified, the impact will be limited by undertaking remedial works.

Remedial measures – general

- Alternative arrangements will be provided if road closures are unavoidable i.e. diversions, signage strategies for access traffic and through traffic;

- The Dublin City Council urban traffic signal control system will be used to optimise the flow of traffic along the diversion routes to mitigate queuing and delay which would otherwise be expected during peak periods. This may affect the level of green time afforded to pedestrians;
- Agreement will be sought from the relevant road authority and An Garda Síochána for the introduction of stricter speed limits on roads adjacent to construction sites to ensure the safety of all road users:
  - 50kph speed limit in the city centre will be reduced to 30kph;
  - 80kph on all other routes will be reduced to 50kph.
- The public will be provided with advanced warning of any proposed diversions and disruption through:
  - Signage on site;
  - Continuous updates on construction progress on the project website and external media.
- Temporary reinstatement of road surfaces to facilitate pedestrians, cyclists and MIDs will be provided;
- There will be safety procedures and fencing around trenches at all times in order to ensure the safety of road users.

Remedial measures – construction traffic
- Construction vehicles will be sheeted to ensure loss of material is minimised;
- Wheel wash facilities or road cleaning will be provided at work sites, as required;
- The numbers of employee vehicles travelling to and from construction sites on a daily basis will be limited through:
  - Car sharing;
  - Transporting workers to site via car pools and mini-buses from designated collection points (such as Luas and DART stations or other appropriate locations);
  - Offering subsidised travel via public transport.

Remedial measures – general traffic
- To maintain traffic flow and minimise delay, the introduction of traffic management measures will be implemented as agreed with the road authority and An Garda Síochána, including prohibitions of turning movements, loading and waiting restrictions, reconfiguration of traffic signals etc.

Remedial measures – public transport
- The requirement and potential for additional mitigation measures to facilitate enhanced public transport operations along the corridor to encourage a transfer from car to public transport will be examined;
- Bus stops affected by the construction of the proposed scheme, will be temporarily relocated in order to ensure the safety of passengers and the continued operation of services.

Remedial measures – pedestrians and cyclists
- Temporary pathways and cycle tracks will be installed where appropriate and provision will be made to ensure access for the mobility impaired is maintained;
- Where the existing level of service cannot be maintained in the vicinity of the construction sites, an alternative route will be designated, be clearly visible, be safe and be signed and have the level of service required to cater for the pedestrian demand.

7.3.3 Strategic operational mitigation measures

During its operational phase, the proposed scheme will have an overall beneficial impact on traffic. There may, however, be localised increases in traffic volumes around each stop associated with increased pedestrian activity, Park & Ride, and drop off facilities.

The aim of the Strategic Mitigation Methodology is to establish traffic management principles that will ensure that the operational impact of the proposed scheme will be minimised as much as possible.

7.3.3.1 Reduction measures (operational phase)

Reduction measures – pedestrians and cyclists
Subject to agreement of the relevant road authority and An Garda Síochána, where necessary, the following measures will be implemented:

- The number of pedestrian crossing facilities will be increased in the immediate vicinity of stops where appropriate;
- Sufficient pedestrian access between the drop-off points and the stops will be provided where appropriate;
- Suitable parking and storage facilities for bicycles will be provided in prominent locations at Stops and Park & Ride facilities for public use.

Reduction measures – public transport
- At designated stops, bus and car interchange facilities will be provided;
- Enhanced bus priority facilities will be introduced at selected locations, subject to agreement with the relevant roads authority.

Reduction measures – mobility impaired
- All proposed pedestrian crossing facilities installed will incorporate audio/tactile units to facilitate mobility and visual impaired persons;
- Adequate ramps / lifts will be provided at each stop platform to enable access for mobility impaired / disabled persons;
- Mobility impaired / disabled compliance will be ensured at stops and Park & Ride facilities.

7.3.3.2 Remedial measures (operational phase)

Remedial measures – general traffic

- Variable Message Signs will be located at appropriate locations to advise motorists on appropriate access routes to the Park & Ride sites, and on available car park capacity at the site;
- The Dublin City Council urban traffic signal control system will be used to optimise the flow of traffic along the routes, particularly during peak traffic times, to reduce the impact of queuing and delay during the operational phase.

Remedial measures – pedestrian and cyclists

- Appropriate signage will be installed to advise pedestrians of appropriate crossing locations and access routes to each stop.

7.4 PREDICTED STRATEGIC IMPACT

7.4.1 Introduction

The proposed scheme will have both a local and strategic impact on all road users. The scale of the proposed scheme, its anticipated construction impact footprint and the envisaged operational benefits means that there will be a significant predicted impact during both construction and operational phases. There will either be considerable vehicular re-assignment away from roads where construction is taking place or, during its operational phase, reductions in car numbers within the study area. The cumulative impact of the proposed scheme can only be understood through a strategic understanding of the impact.

7.4.2 Source of the predicted strategic impact

The proposed scheme will have two very distinct impact phases. The construction phase could have significant negative impacts on all road users, which will be limited through the introduction of mitigation measures. During the operational phase the proposed scheme will have very significant beneficial impacts. Understanding, managing and reducing the impact generated by the construction phase of the proposed scheme is of particular importance to ensure that general traffic can move at reasonable speeds and that vulnerable road users can move in a safe manner around the construction sites. In its operational phase, understanding the strategic traffic impact is of lesser importance as the proposed scheme will generally reduce the level of traffic.

7.4.2.1 Construction phase

The construction impact is largely created by the construction of the stops, particularly in the city centre at St. Stephen's Green, O'Connell Bridge and Parnell Square where road capacity will be reduced substantially. The construction of these stops requires large areas of road space to be removed for long periods of time (for example, at Westmoreland Street and Parnell Square East) which will severely reduce the operating capacity available for all road users. Other construction activity, such as cut and cover tunnelling, through Ballymun and construction activity through junctions along the R132 in Swords will create further capacity limitations for all modes to travel in these areas. In all areas along the alignment of the proposed scheme, appropriate mitigation measures are required.

Each of the proposed schemes construction sites will also generate substantial levels of spoil removal and construction vehicles which will impact on both the local and strategic road network. The cumulative impact of all the construction sites (and the associated number of construction vehicles generated) on traffic movement throughout the Dublin Area has been assessed. The routes proposed to facilitate construction vehicle activity are illustrated in Annex I, Volume 3, Book 2 of 2.

The combination of the construction site impact and the construction vehicle activity creates a situation were significant mitigation is required to create a workable transport environment within the vicinity of the proposed alignment and also in areas where vehicles re-distribute to completely avoid the construction sites.

7.4.2.2 Operational phase

The operational phase of the proposed scheme will have a substantial overall beneficial impact as it will allow people within its walking, cycling and bus interchange catchment (and those who can avail of the Park & Ride facilities at Belinstown, Dardistown and Fosterstown Stops) to use a high quality public transport service. Furthermore, during its operational phase, vehicular traffic on the surrounding road network will be reduced as some people who would otherwise have driven will use the service provided by the proposed scheme. It is estimated that the proposed scheme will remove in the region of up to 5,000 cars from the road network, in the morning peak period (07.00-09.00), during its operational phase as a result of mode shift from car to the proposed scheme.

During the proposed scheme's operational phase, some stops will generate additional pedestrian, cyclist, bus and car trips on the local surrounding road infrastructure when compared to the situation without the proposed scheme. Some level of mitigation is required to ensure that the local environment around each stop is configured to accommodate the additional demand and that complementary facilities are in place at and around each stop.

7.4.3 Assessment of the predicted strategic impact

Given the proposed scheme's length and catchment it will have a city wide impact on traffic movement during its construction and operational phases. The traffic modelling process adopted to assess the impact of the proposed scheme ensures that both local and strategic impacts are understood and mitigation measures tested. Furthermore, the impact of the proposed scheme during its operational phase will become more beneficial over time as other elements of the Transport 21 network are built which will connect with the proposed scheme thereby enhancing accessibility from within its catchment area. This will further increase its attractiveness to commuters and continue to reduce car use within the proposed scheme's catchment.

To assess the strategic impact of the proposed scheme for the construction and operational phases the following traffic modelling statistics, extracted from the MNTM, are presented:

- General traffic statistics for the full Greater Dublin Area for average network speed, queuing, distance travelled and time travelled;
- General traffic flow plots representing traffic changes between the do-minimum and do-something scenarios on strategic roads within the Dublin Area;
- Journey time and speed changes on a number of key routes that will be affected by the proposed scheme;
- Strategic Bus operation speeds and queuing statistics.

Pedestrian and cyclist impacts are considered under local predicted impact, described later.

7.4.3.1 Strategic traffic statistics for Greater Dublin Area

A number of summary traffic statistics were extracted from the MNTM traffic model. These statistics include the following:

For general vehicular traffic assessment:

- Queuing – This statistic relates to the time spent in congestion within the modelled period. The units of measurement are in Passenger Car Unit (pcu) hours.
- Travel Time – This statistic relates to the time spent travelling within the modelled period. The units of measurement are in pcu hours.
- Travel distance – This statistic relates to the distance travelled by vehicles across the GDA within the modelled period. The units of measurement are in pcu kilometres.
- Average Speed – This statistics represents the average speed across the road network. The units of measurement are in kilometres per hour (kph).

For bus movement assessment:

- Average Bus Speeds – This statistic represents the average bus speed across the road network. The units of measurement are in kilometres per hour (kph);
- Bus kilometres lost to queuing – This statistic provides information on the kilometres lost to congestion in the modelled hour for buses. The units of measurement are in kilometre hours.

These statistics provide good indicators to the overall performance of the road network and, therefore, are a very useful way of presenting and understanding the overall strategic predicted impact of the proposed scheme during both construction and operational phases. The statistics are presented for the AM Peak hour (08.00-09.00) only as this time period represents a heavily congested road network and negative or positive impacts generated by the proposed scheme can be clearly identified.

7.4.4 Predicted strategic construction impact

The predicted strategic impact has been determined based on the worst case scenario without mitigation measures, but with local diversionary measures in place.

Table 7.4 shows the strategic modelled impact of the proposed scheme during its construction phase. In general, queuing, time spent travelling and distance travelled would increase as a result of the construction activities. Queuing would increase by over 22% with time spent travelling increasing by over 15%. The time spent queuing as proportion of overall travel time would increase from 24% to 27% as a result of the construction phase.

The increase in travel time and travel distance indicates that without mitigation measures there would be considerable re-routing of vehicles through the network as drivers try to avoid construction areas. This would impact on parallel routes contributing to further delay and congestion.

The average speed for travel across the network would deteriorate by over 11%, a reduction of 3kph. Based on these statistics, the strategic impact on the city wide road network during the construction phase would be Severe without the proposed mitigation measures.

Table 7.4 Strategic construction impact 2011 (AM peak hour) – general traffic

Indicator	Do-Minimum	Do-Something	% Change
Queuing Statistic (pcu hours)	21,000	25,700	+22.4%
Travel Time (pcu hrs)	86,700	100,200	+15.6%
Travel Distance (pcu kilometres)	2,190,000	2,250,000	+2.8%
Average Speed (kph)	25	22	-11.1%

Table 7.5 presents the impact of the proposed scheme without public transport mitigation measures. This would have a city wide impact on bus movement during the construction phase. The average bus speed throughout the city is predicted to decrease by 27%, a drop of 4kph. Furthermore, the bus kilometres lost to queuing per hour is predicted to increase by over 250% as a result of construction.

Table 7.5 Strategic construction impact, 2011 (AM peak hour) – bus only

Indicator	Do-Minimum	Do-Something	% Change
Bus Speed (kph)	19	15	-27%
Bus kilometres lost to queuing per hour	1,900	4,800	+252%

The traffic modelling statistics shown above clearly show that the strategic, or city wide, predicted impact of the construction phase would be Severe on all vehicular modes of transport without the proposed mitigation measures.

7.4.5 Predicted strategic operational impact

The predicted strategic impact has been determined based on the assumed scenario and traffic management measures being restored to baseline arrangements.

Table 7.7 present the strategic impact of the proposed scheme during its operational phase for the assumed year of opening, 2014, and the forecast year, 2029. In 2014, the operational impact of the proposed scheme on the highway network would be very positive. The queuing, travel time and distance travelled statistics would all decrease substantially from the Do-minimum scenario. Queuing would decrease by over 21% with time spent travelling decreasing by over 9%. The time spent queuing as a proportion of overall travel time would decrease from 25% to 22% as a direct result of the proposed scheme. The average speed on the network would increase by 8% in 2014, or by 2kph.

In 2029, the statistics show a similar positive impact as 2014. In 2029, the proposed scheme forms part of a much bigger public transportation network than in 2014 (in 2029, the full Transport 21 public transportation network is assumed). Furthermore, in 2029, the demand for travel in the Dublin area is much higher than in 2014 and, therefore, the number of vehicles on the highway network is greater. This is particularly reflected in the growth in queuing between 2014 and 2029 (i.e. 23,400 to 66,500 in the do-minimum scenarios). The queuing, time spent travelling and distance travelled statistics would all decrease from the do-minimum scenario. Queuing would decrease by approximately 9% with time spent travelling decreasing by up to 32%. The average speed on the network would increase by 17% in 2029, or by 3kph.

Table 7.8 and Table 7.9 present the predicted impact the operational phases that the proposed scheme will have on bus. In 2014, the average speed of bus increases by 6%, or 1kph. The bus kilometres lost to queuing decreases by 21%. In 2029, there is predicted to be a 14% increase in average bus speed, or 2kph. Bus kilometres lost to queuing in 2029, decreases by 10%.

Table 7.6 Strategic operational impact 2014 (AM peak hour)

Criteria	Do-Minimum	Do-Something	% Change
Queuing Statistic (pcu hours)	23,400	19,400	-21%
Travel Time (pcu hrs)	95,200	86,900	-9.5%
Travel Distance (pcu kilometres)	2,320,600	2,250,300	-3%
Average Speed (kph)	24	26	+8%

Table 7.7 Strategic operational impact 2029 (AM peak hour)

Criteria	Do-Minimum	Do-Something	% Change
Queuing Statistic (pcu hours)	66,500	60,600	-9%
Travel Time (pcu hrs)	173,700	117,800	-32%
Travel Distance (pcu kilometres)	3,155,500	2,510,300	-20%
Average Speed (kph)	18	21	+17%

Table 7.8 Strategic operational impact 2014 (AM Peak Hour) – bus only

Criteria	Do-Minimum	Do-Something	% Change
Bus Speed (kph)	18	19	+6%
Bus kilometres lost to queuing per hour	2,300	1,900	-21%

Table 7.9 Strategic operational impact 2029 (AM Peak Hour) – bus only

Criteria	Do-Minimum	Do-Something	% Change
Bus Speed (kph)	14	16	+14%
Bus kilometres lost to queuing per hour	4,100	3,700	-10%

Overall, the predicted operational impact of the proposed scheme would be very positive. In both 2014 and 2029, significant beneficial impacts are demonstrated to the road network in terms of increasing average speed, decreasing congestion and reducing the distance and time spent travelled. There would also be a very beneficial impact to bus movement as the proposed scheme reduces the number of cars on the road network reducing congestion generally and thereby allowing buses to move more freely. The positive impact of the proposed scheme will also grow over time as more elements of the Transport 21 public transport network come on stream allowing better interchange and enhancing accessibility.

7.4.6 Strategic traffic flow changes and re-distribution

Another means of presenting the strategic impact of the proposed scheme is by comparing the traffic flow changes on the highway network and ascertaining where vehicles will redistribute during construction and operational phases.

Traffic flow plots have been extracted from the MNTM traffic model and are presented in Figure 7.2 to Figure 7.17. These plots illustrate the changes in traffic flow, for different areas in Dublin, between the do-minimum and the do-something scenarios for the construction year 2011 and the operational years 2014 and 2029 respectively. The flow changes are presented in terms of coloured bandwidths, green representing an increase in traffic flow and blue a decrease in traffic flow. The thickness of the bandwidth demonstrates the proportionate level of change (i.e, the thicker the greater the increase or decrease in traffic flow).

7.4.6.1 Changes in traffic flow during construction of the proposed scheme

Figure 7.2 and Figure 7.3 illustrate the traffic flow changes in Swords and its surrounding areas. Generally, traffic would try to avoid the construction works on the R132 and divert to the other roads such as the R108, R129 and the M1. Main Street in Swords would also experience an increase in traffic flow.

Figure 7.4 illustrates the traffic flow changes across the Dublin area within the vicinity of the M50. This plot shows that without the proposed mitigation measures there would be a substantial reduction in traffic using the Ballymun Road particularly in a southbound direction as drivers would try to avoid the construction activities. The Port Tunnel becomes an attractive diversionary route for some drivers accessing the city centre and the south east city areas. Furthermore, the upgraded M50, would allow some drivers to drive longer distances to avoid the congestion caused by construction activities.

Generally, as Figure 7.4 demonstrates, there would be some increase in traffic on all areas of the city as traffic would redistribute across the road network to avoid the construction sites and to minimise journey time.

Figure 7.5 provides a more detailed view of traffic distribution changes in the Ballymun, Finglas, Glasnevin and Drumcondra areas. Generally, traffic travelling Southbound along the Ballymun Road reduces and diverts to parallel routes such as the N2, Port Tunnel and Drumcondra Road.

Figure 7.6 and 7.6 provide a more detailed view of traffic distribution changes in the city centre. Without the proposed mitigation measures there would be substantial reductions in traffic volumes on Dame Street, College Green, O'Connell Bridge, O'Connell Street and Nassau Street. There would be increases in northbound traffic on Patrick Street, High Street, Bridge Street, Church Street and on Tara Street. Southbound traffic increases would occur on Amiens Street, Talbot Memorial Bridge, City Quay, and Lombard Street. East west traffic movements on the north and south quays would also increase particularly on Georges Quay, Burgh Quay, Eden Quay and Custom House Quay.

Other areas of the city experiencing increases in traffic flow include Bridgefoot Street and Queen Street to the west and East Wall Road to the east.

In summary the city wide predicted impact of the construction phase on vehicular routing would be extensive. Drivers would look for quicker alternative routes through the city, in all areas, avoiding the construction sites to complete their journey.

7.4.6.2 Changes in traffic flow during operation of the proposed scheme

During the operational phase of the proposed scheme the impact on traffic flow would be a general reduction in the levels of traffic within the areas served by the proposed scheme. This will be more pronounced in outlying areas such as Swords were the existing public transport service is poor and car use is high, particularly for commuting. In other areas further into the city served by the proposed scheme the impact on car use would be reduced as some users would transfer from other public transport modes such as bus.

Figure 7.8 presents the traffic flow distribution pattern for the Swords area for the opening year of the proposed scheme. Generally, the R132 experiences a reduction in traffic flow as a result of the proposed scheme. The increases in traffic flow on the M1 can be attributed to a redistribution of general traffic availing of increased road capacity which would be created by the modal shift from car to the proposed scheme.

Figure 7.9 provides a view of the traffic flow changes in the Ballymun, Glasnevin, Finglas and Drumcondra areas. There are general reductions in traffic flow on the M50, M1, Port Tunnel, Ballymun Road, Finglas Road and on many other roads within the catchment area of the proposed scheme corridor.

Figure 7.10 illustrates the traffic flow and distribution impact of the proposed scheme from a city wide perspective. There are reductions in traffic flow on the M50.

Figure 7.11 and 7.12 illustrate the impact on traffic flow and distribution in the city centre. Generally the impact of the proposed scheme within the city centre area in terms of reducing traffic flow would be positive. In 2029, the traffic flow changes and distribution results are similar to those of 2014. Figure 7.13 and Figure 7.14 illustrate these changes from Swords to the city centre. The impact of the proposed scheme in 2029 would be positive in terms of reducing traffic flow within the catchment area.

Figure 7.2
Traffic flow changes – do-minimum vs. do-something 2011 (Swords area)

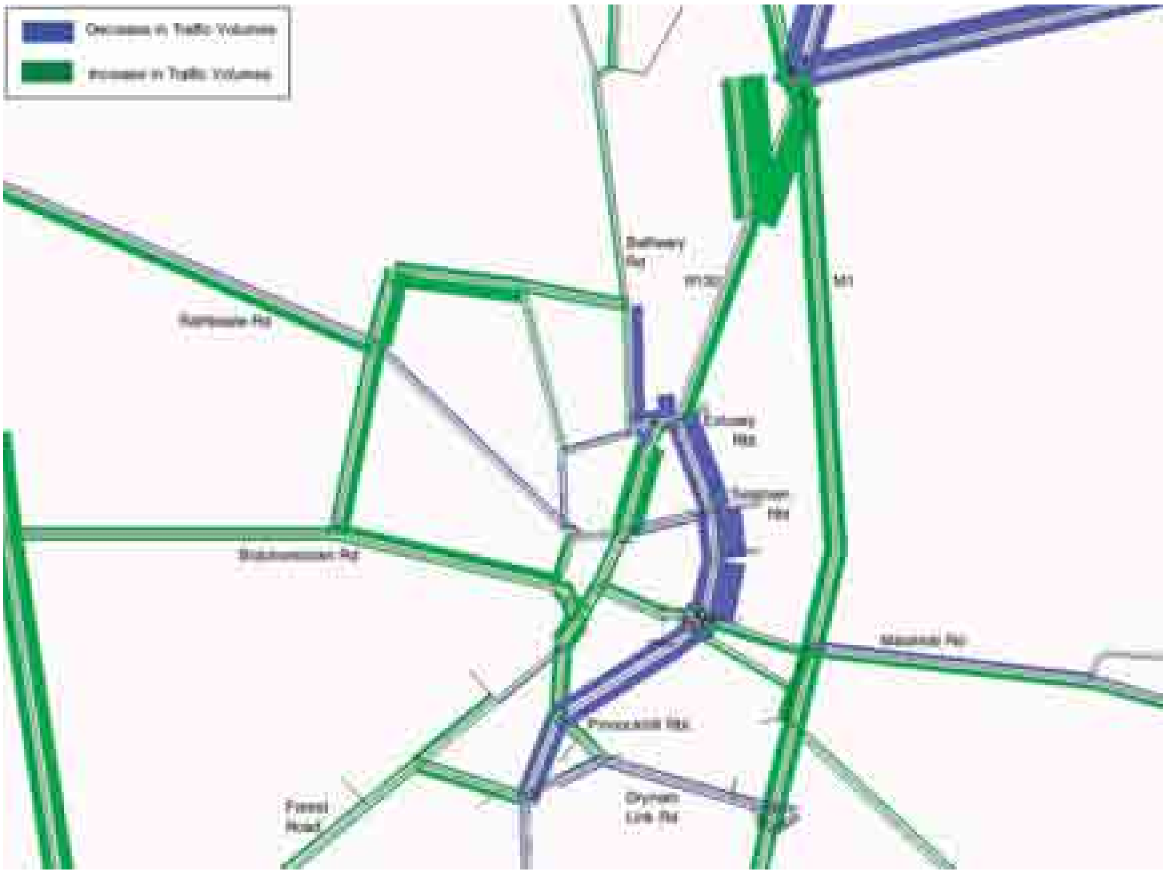


Figure 7.3
Traffic flow changes – do-minimum vs. do-something 2011 (Swords area)

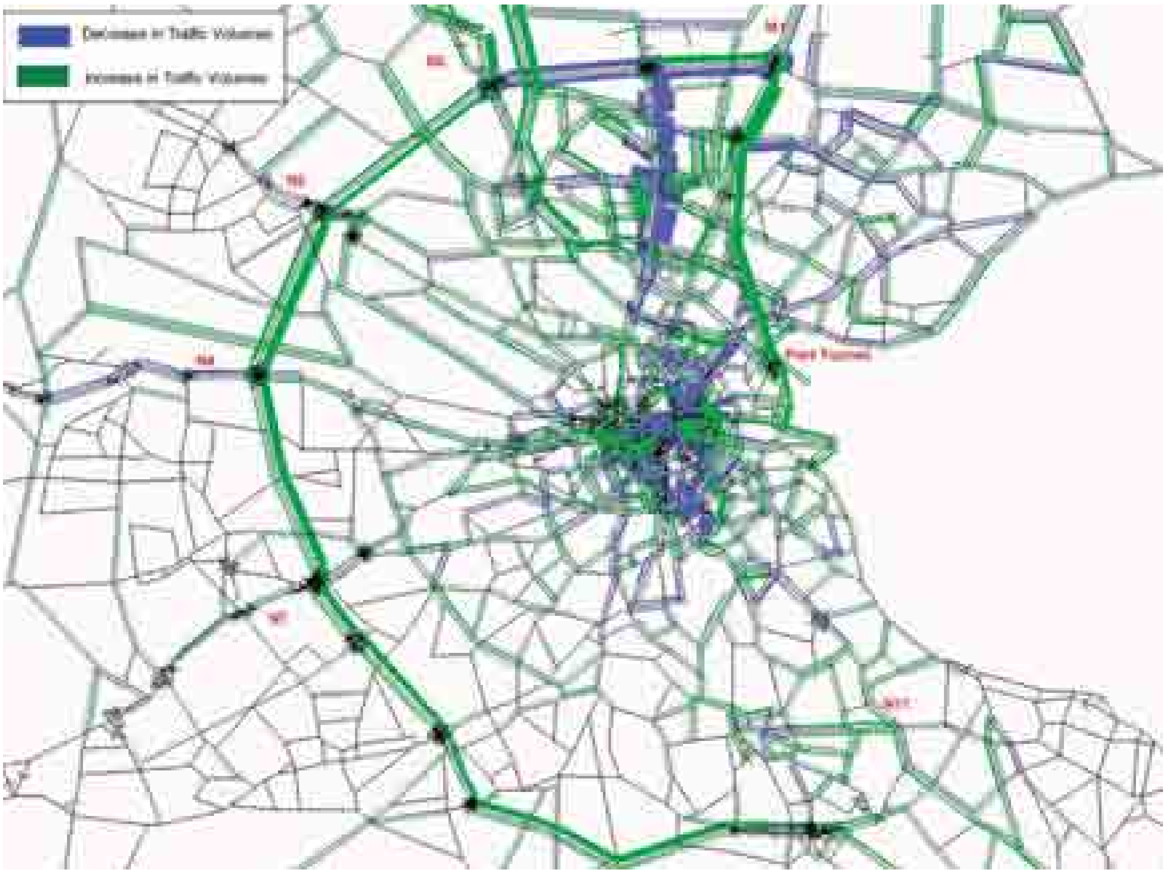


Figure 7.4
Traffic flow changes – do-minimum vs. do-something 2011 (city wide area)

Figure 7.5
Traffic flow changes – do-minimum vs. do-something 2011 (Ballymun/ Glasnevin/ Finglas/ Drumcondra areas)

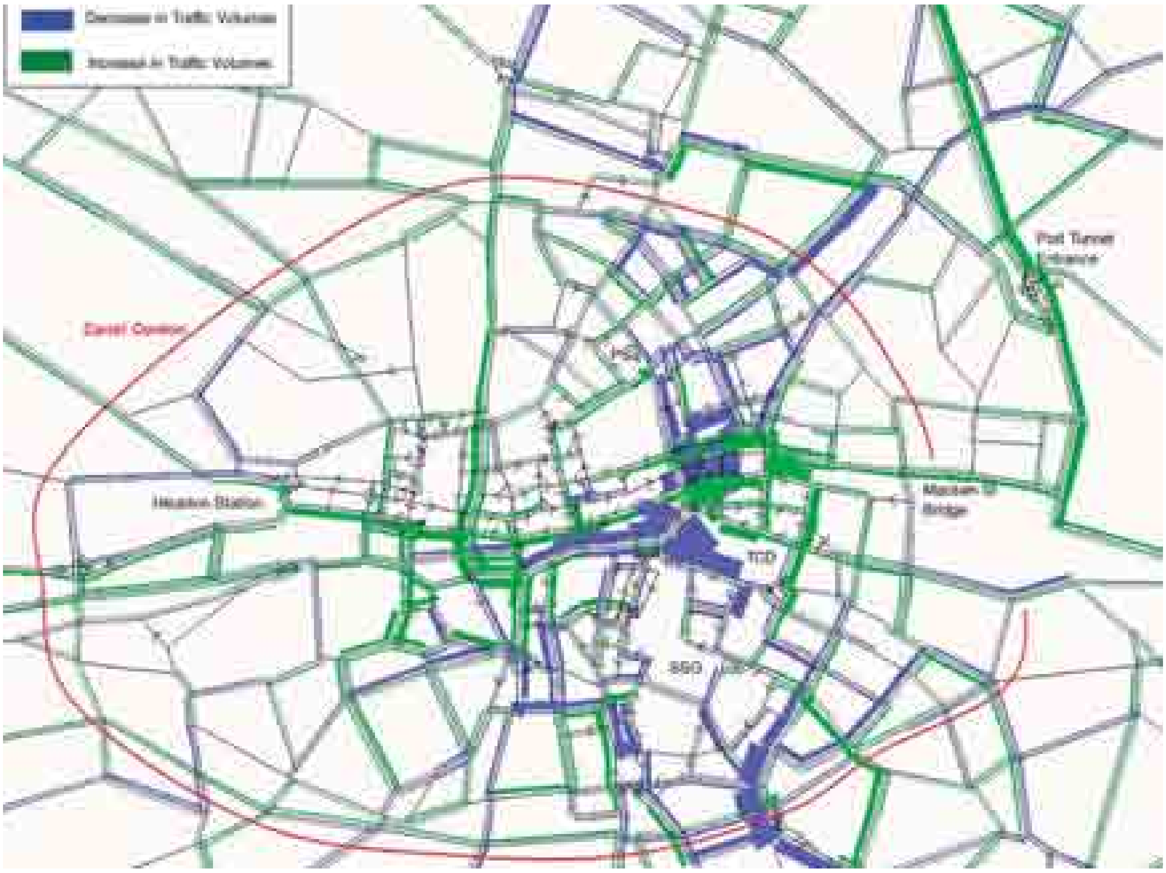


Figure 7.6
Traffic flow changes – do-minimum vs. do-something 2011 (city centre area)

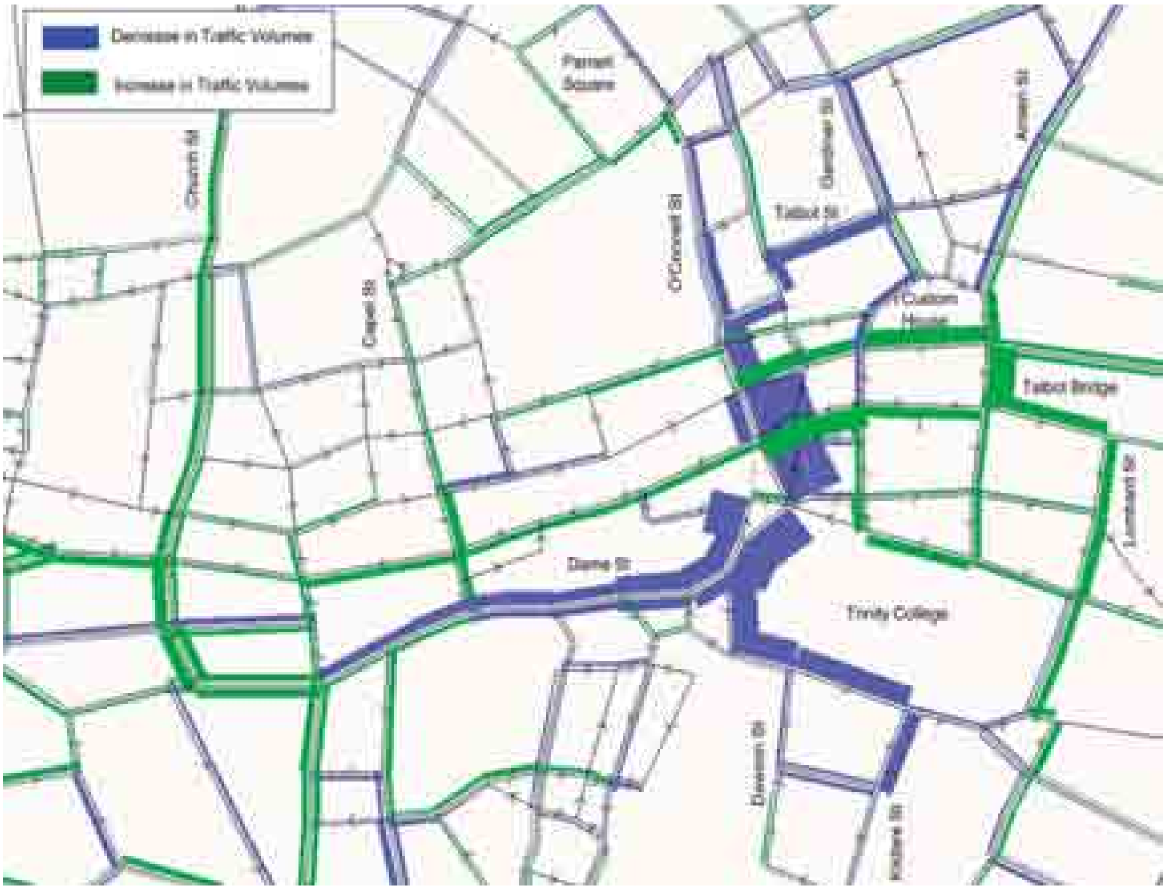


Figure 7.7
Traffic flow changes – do-minimum vs. do-something 2011 (core city area)

Figure 7.8
Traffic flow changes – do-minimum vs. do-something 2014 (Swords area)

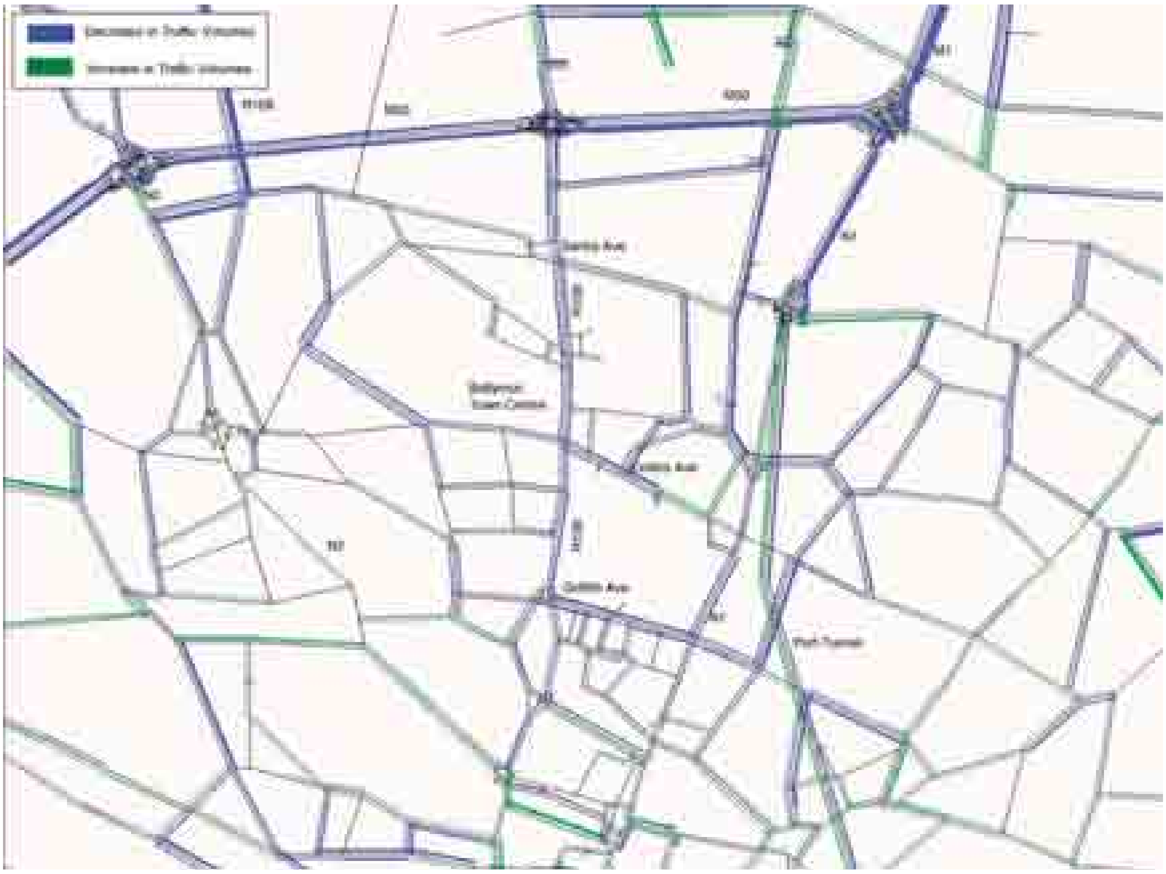


Figure 7.9
Traffic flow changes – do-minimum vs. do-something 2014 (Ballymun/ Glasnevin/ Finglas/ Drumcondra area)

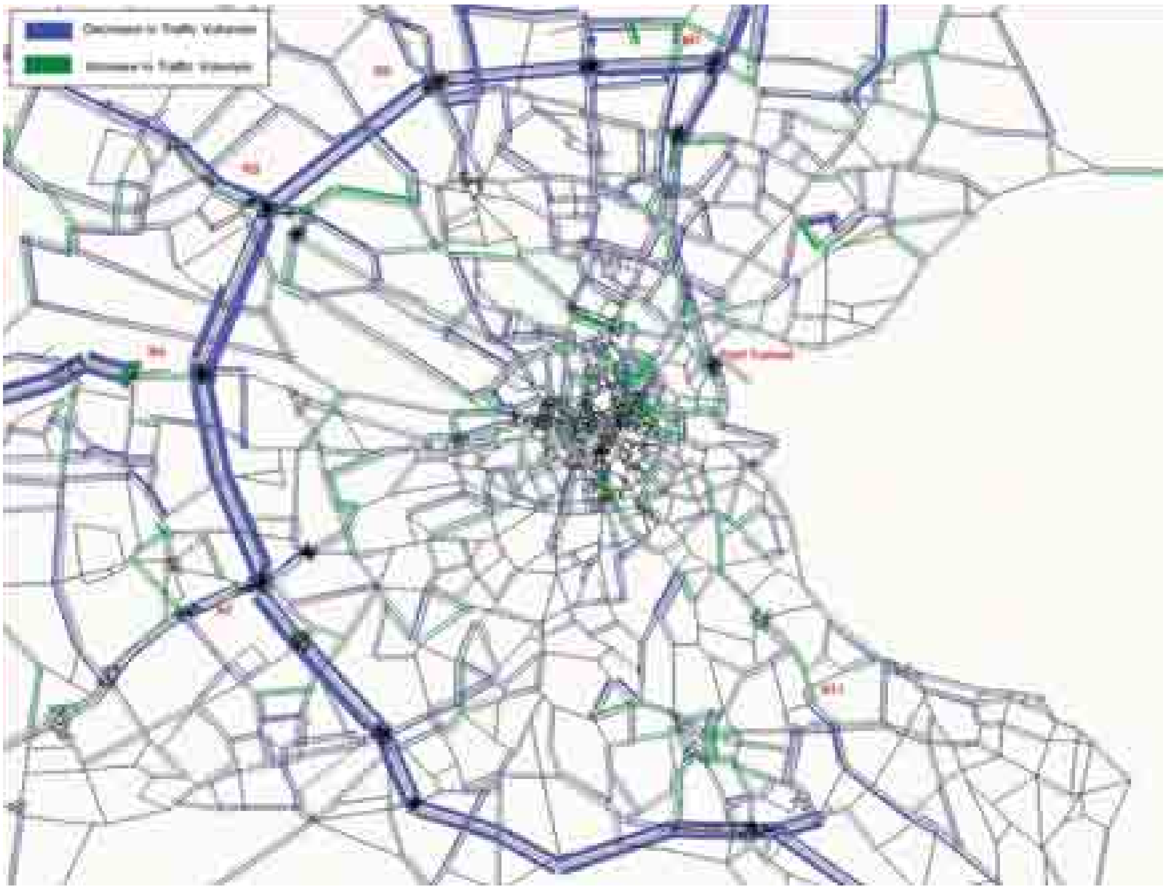


Figure 7.10
Traffic flow changes – do-minimum vs. do-something 2014 (city wide area)

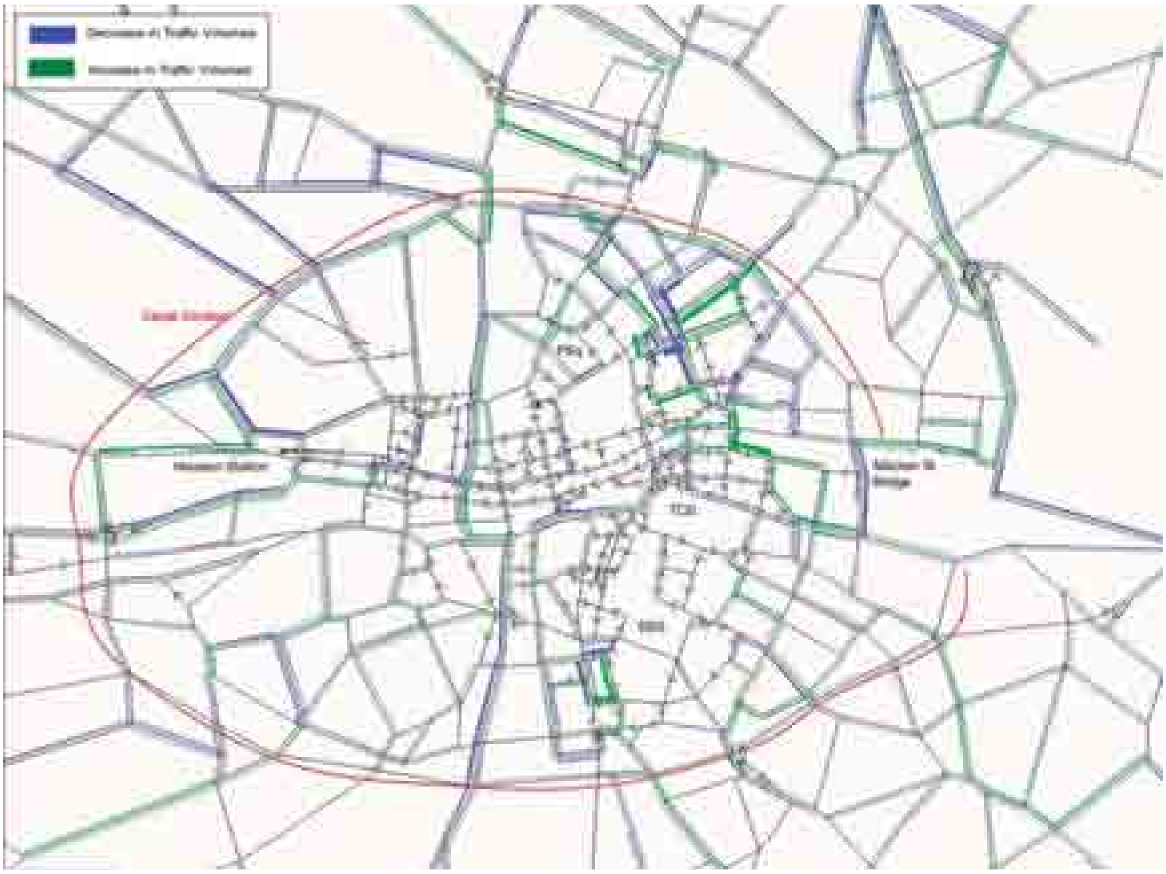


Figure 7.11
Traffic flow changes – do-minimum vs. do-something 2014 (city centre area)

Figure 7.12
Traffic flow changes – do-minimum vs. do-something 2014 (core city area)

Figure 7.13
Traffic flow changes – do-minimum vs. do-something 2029 (Swords area)

Figure 7.14
Traffic flow changes – do-minimum vs. do-something 2029 (Ballymun/ Glasnevin/ Finglas/ Drumcondra area)

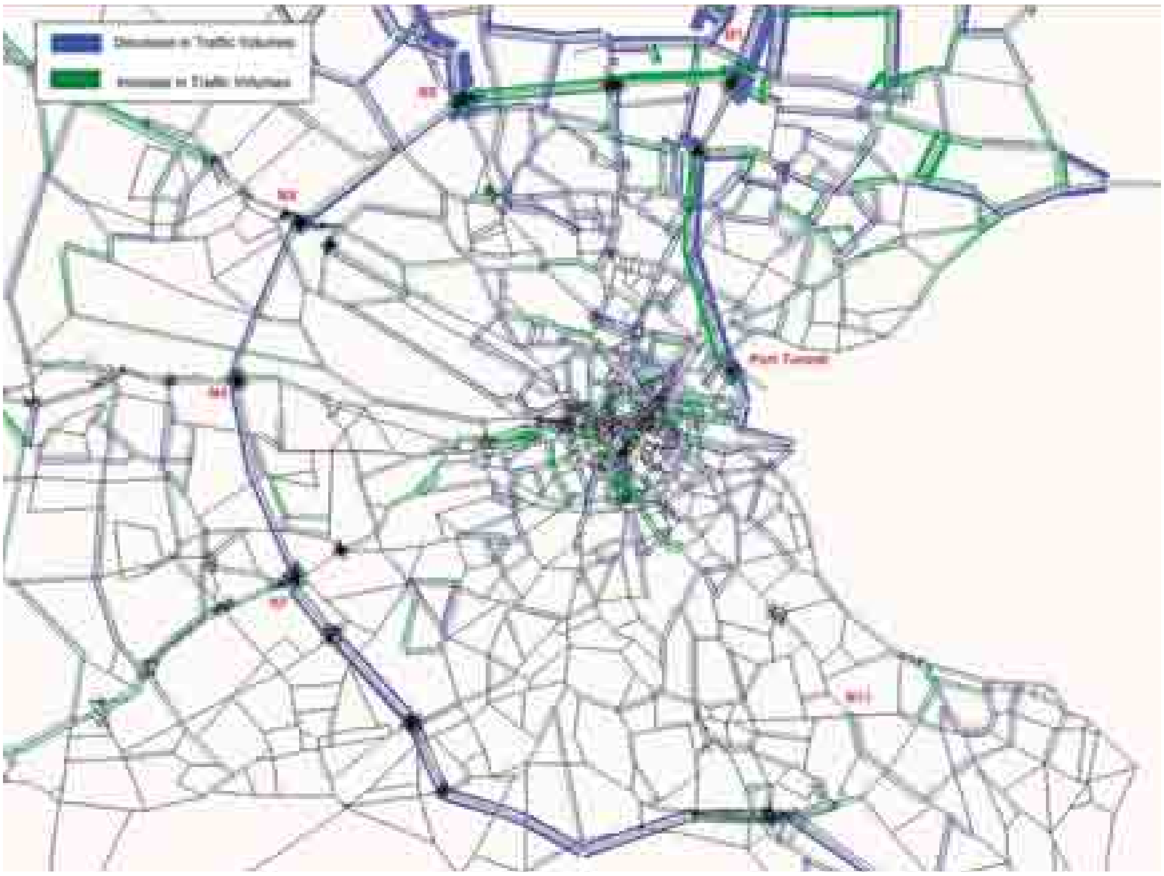


Figure 7.15
Traffic flow changes – do-minimum vs. do-something 2029 (city wide area)

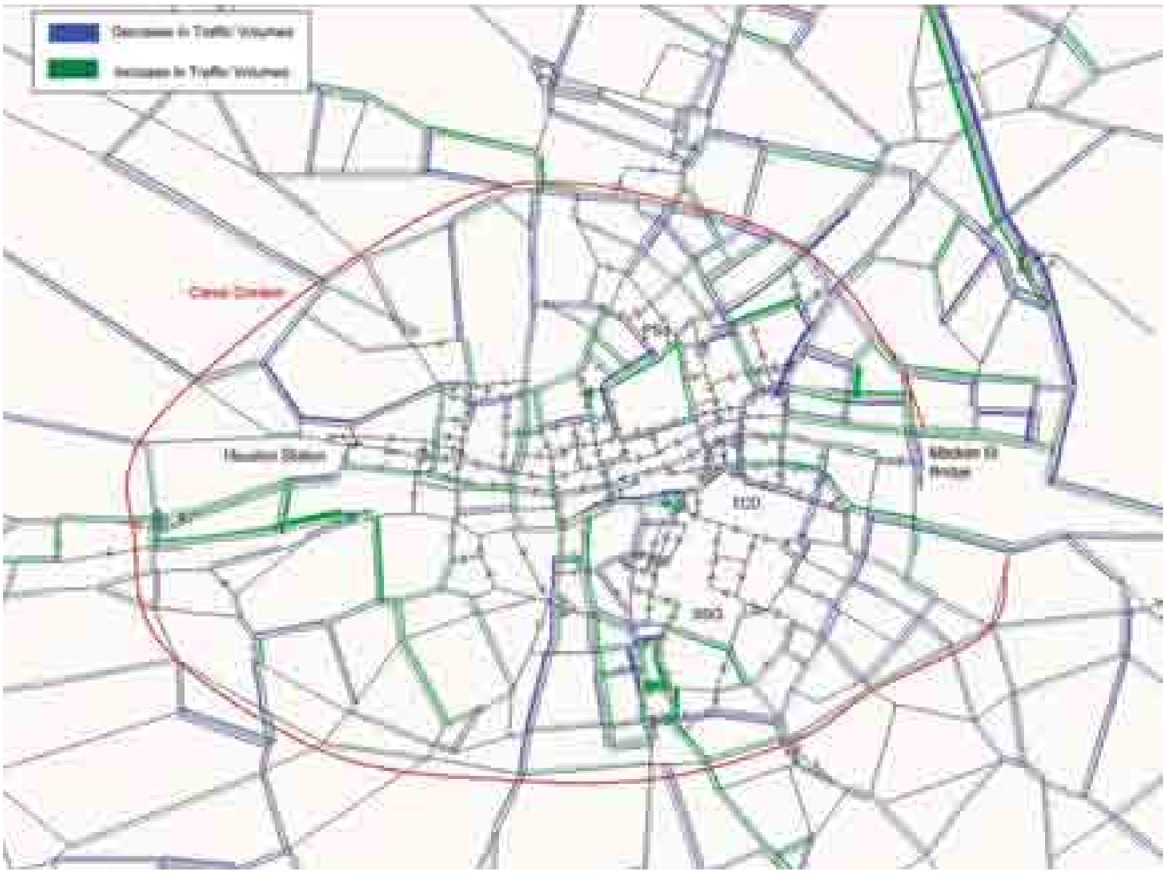


Figure 7.16
Traffic flow changes – do-minimum vs. do-something 2029 (city centre area)

Figure 7.17
Traffic flow changes – do-minimum vs. do-something 2029 (core city area)

7.4.6.3 Journey time and speed changes along key routes

A further method of demonstrating the predicted impact of the proposed scheme is through the assessment of journey times along key radial and orbital routes. Journey time statistics for a number of key radial and orbital routes in the vicinity of the proposed scheme have been extracted from the MNTM traffic model for the do-minimum and do-something scenarios.

Annex I of this EIS (Volume 3, Book 2 of 2) illustrates the routes for which these statistics are presented.

7.4.6.4 Predicted construction impact on traffic flow

Table 7.10 presents and compares the journey time statistics for 2011 for the do-minimum and do-something scenarios. Generally there is an increase in journey times on most of the routes assessed. Without the mitigation measures some routes would experience considerable journey time deterioration, particularly the R132 through Swords, Ballymun Road, N2, Collins Avenue, Church Street and Baggot Street.

Overall the impact on journey time can be classified as Moderate to Severe on the routes assessed in the absence of the proposed mitigation measures.

7.4.6.5 Predicted operational impact on traffic flow

Table 7.11 and Table 7.12 present and compare the journey time statistics for the do-minimum and do-something for 2014 and 2029 respectively. In both operational years there is a general reduction in journey times on most of the routes assessed. Journey time reductions of note include on the R132, Ballymun Road, M1, N2, Collins Ave and Santry Avenue. The journey time assessment for the operational years illustrates the magnitude of the positive impact that the proposed scheme would have on traffic movement particularly in the vicinity of the alignment.

Table 7.10 Journey times – 2011 do-minimum vs. do-something

Route	2011 AM Peak Do-minimum (Minutes)	2011 AM Peak Do-Something (Minutes)	% Change
R132 Southbound	21m 28s	26m 33s	23.6%
R132 Northbound	35m 15s	45m 09s	28.1%
M1/N1 Southbound	42m 57s	44m 25s	3.4%
M1/N1 Northbound	20m 55s	23m 42s	13.3%
N2 Southbound	25m 39s	27m 19s	6.5%
N2 Northbound	15m 40s	16m 23s	4.6%
Ballymun Road Southbound	34m 07s	34m 22s	0.7%
Ballymun Road Northbound	18m 40s	21m 52s	17.1%
M50 Southbound	26m 01s	26m 53s	3.3%
M50 Northbound	24m 47s	24m 17s	-2.0%
Santry Ave Southbound	23m 55s	23m 14s	-2.8%
Santry Ave Northbound	18m 33s	19m 29s	5.0%
Collins Ave Eastbound	22m 02s	24m 40s	11.9%
Collins Ave Westbound	13m 04s	15m 41s	20.1%
Griffith Ave Eastbound	13m 07s	12m 13s	-6.9%
Griffith Ave Westbound	10m 57s	11m 25s	4.2%
Port Tunnel Southbound	07m 44s	09m 02s	16.8%
Port Tunnel Northbound	09m 11s	08m 29s	-7.7%

Route	2011 AM Peak Do-minimum (Minutes)	2011 AM Peak Do-Something (Minutes)	% Change
Gardiner Street/Baggott Street Southbound	16m 32s	17m 11s	3.9%
Baggott Street/Gardiner Street Northbound	34m 04s	40m 54s	20.0%
Church Street/Clanbrassil Street Southbound	30m 57s	36m 46s	18.8%
Clanbrassil Street/Church Street Northbound	21m 40s	31m 40s	46.1%
North Quays – Heuston to O'Connell Bridge	15m 33s	17m 02s	9.5%
South Quays - O'Connell Bridge to Heuston	06m 42s	07m 54s	17.9%
South Quays – Georges Quay to O'Connell Bridge	14m 02s	08m 58s	-36.1%
North Quays – Heuston to North Wall Quay	22m 38s	24m 26s	8.0%
South Quays – Georges Quay to Heuston	22m 40s	17m 19s	-23.6%

Table 7.11 Journey times – 2014 do-minimum vs. do-something

Route	2014 AM Peak Do-minimum (Minutes)	2014 AM Peak Do-Something (Minutes)	% Change
R132 Southbound	22m 13s	21m 26s	-3.6%
R132 Northbound	37m 20s	32m 42s	-12.4%
M1/N1 Southbound	53m 13s	41m 34s	-21.9%
M1/N1 Northbound	21m 28s	21m 07s	-1.7%
N2 Southbound	26m 60s	26m 06s	-3.3%
N2 Northbound	14m 52s	15m 06s	1.6%
Ballymun Road Southbound	38m 45s	32m 18s	-16.7%
Ballymun Road Northbound	17m 28s	17m 37s	0.9%
M50 Southbound	27m 49s	26m 29s	-4.8%
M50 Northbound	25m 29s	27m 25s	7.6%
Santry Ave Southbound	14m 42s	13m 32s	-7.9%
Santry Ave Northbound	19m 53s	17m 31s	-11.9%
Collins Ave Eastbound	20m 07s	18m 19s	-9.0%
Collins Ave Westbound	13m 04s	13m 26s	2.9%
Griffith Ave Eastbound	11m 05s	10m 54s	-1.6%
Griffith Ave Westbound	11m 13s	10m 53s	-3.0%
Port Tunnel Southbound	07m 58s	07m 52s	-1.4%
Port Tunnel Northbound	08m 34s	08m 37s	0.6%
Gardiner Street/Baggott Street Southbound	15m 59s	15m 35s	-2.5%
Baggott Street/Gardiner Street Northbound	35m 11s	35m 35s	1.1%
Church Street/Clanbrassil Street Southbound	32m 07s	30m 07s	-6.2%
Clanbrassil Street/Church Street Northbound	18m 38s	17m 21s	-6.9%

Route	2014 AM Peak Do-minimum (Minutes)	2014 AM Peak Do-Something (Minutes)	% Change
North Quays – Heuston to O'Connell Bridge	18m 04s	17m 07s	-5.2%
South Quays - O'Connell Bridge to Heuston	06m 32s	06m 38s	1.5%
South Quays – Georges Quay to O'Connell Bridge	13m 23s	12m 44s	-4.8%
North Quays – Heuston to North Wall Quay	24m 56s	24m 08s	-3.2%
South Quays – Georges Quay to Heuston	21m 46s	21m 03s	-3.3%

Table 7.12 Journey times – 2029 do-minimum vs. do-something

Route	2029 AM Peak Do-minimum (Minutes)	2029 AM Peak Do-Something (Minutes)	% Change
R132 Southbound	26m 52s	27m 02s	0.6%
R132 Northbound	40m 06s	32m 09s	-19.8%
M1/N1 Southbound	64m 32s	54m 05s	-16.2%
M1/N1 Northbound	24m 56s	24m 38s	-1.2%
N2 Southbound	37m 29s	34m 12s	-8.8%
N2 Northbound	18m 24s	18m 15s	-0.9%
Ballymun Road Southbound	49m 55s	45m 04s	-9.7%
Ballymun Road Northbound	21m 09s	21m 24s	1.2%
M50 Southbound	40m 04s	37m 42s	-5.9%
M50 Northbound	39m 23s	38m 52s	-1.3%
Santry Ave Southbound	17m 01s	16m 11s	-4.9%
Santry Ave Northbound	30m 04s	25m 11s	-16.2%
Collins Ave Eastbound	28m 06s	25m 30s	-9.3%
Collins Ave Westbound	17m 41s	16m 25s	-7.1%
Griffith Ave Eastbound	11m 35s	11m 21s	-1.9%
Griffith Ave Westbound	13m 39s	13m 18s	-2.5%
Port Tunnel Southbound	10m 33s	09m 56s	-5.9%
Port Tunnel Northbound	12m 02s	09m 57s	-17.2%
Gardiner Street/Baggott Street Southbound	17m 04s	16m 05s	-5.7%
Baggott Street/Gardiner Street Northbound	35m 38s	36m 27s	2.3%
Church Street/Clanbrassil Street Southbound	35m 06s	35m 45s	1.9%
Clanbrassil Street/Church Street Northbound	20m 24s	19m 30s	-4.4%
North Quays – Heuston to O'Connell Bridge	16m 58s	18m 28s	8.9%
South Quays - O'Connell Bridge to Heuston	07m 05s	07m 25s	4.9%
South Quays – Georges Quay to O'Connell Bridge	14m 18s	12m 15s	-14.3%
North Quays – Heuston to North Wall Quay	24m 29s	26m 05s	6.5%
South Quays – Georges Quay to Heuston	22m 51s	21m 01s	-8.0%

7.4.7 Conclusions drawn from the strategic predicted impact assessment

The traffic modelling results have shown that the strategic predicted impact of the proposed scheme would be Severe during the construction phase in the absence of further mitigation to offset these predicted impacts. The predicted impact of the operational phase of the proposed scheme on traffic movement is very positive and further mitigation measures are not required.

7.4.7.1 Summary of the predicted construction impact

The assumptions underpinning the traffic modelling undertaken to assess the construction impact of the proposed scheme are very conservative and represent an absolute worst case construction scenario. Limited mitigation measures have been assumed in this assessment. The assessment, therefore, must be viewed in the context of this conservatism in that the modelled impact will be further mitigated to ensure that this impact would not come to fruition. A Scheme Traffic Management Plan which will be developed (see below) will provide further mitigation measures that are required to alleviate the severity of the modelled impact.

Based on the traffic modelling construction assumptions and results, the predicted strategic impact on traffic accruing from construction activities would be Severe without implementing further mitigation measures. Modelling results indicate that traffic speeds across the GDA would decrease by over 11%, a reduction of 3kph. Drivers would travel further distances to avoid construction areas compounding the congestion levels on other parallel routes and affecting the operation of buses through the city. Other traffic modelling statistics such as impact on bus speeds and journey time on key routes further demonstrate the significance of the construction impact in the absence of mitigation measures.

Substantial further traffic management mitigation measures, described below, are required along the full alignment to reduce this impact and to develop intervention policies that will clearly demonstrate how traffic will operate in conjunction with the construction phase.

7.4.7.2 Summary of the predicted operational impact

The strategic impact of the proposed scheme during its operational phases would be very positive. The modal shift from car to the proposed scheme improves the average speed across the GDA by 2kph and 3kph in 2014 and 2029 respectively. Time spent queuing decreases, distance travelled decreases and also time spent travelling decreases.

There are also improvements to bus speeds across the GDA. Journey time assessments on key routes further demonstrate the positive nature of the impact as the majority in both 2014 and 2029 show decreases.

7.5 STRATEGIC FURTHER MITIGATION

7.5.1 Introduction

The strategic predicted impact assessment has shown that the city wide construction impact of the proposed scheme, without mitigation measures, would be Severe with average speeds across the city falling 3kph. The following are mitigation measures that are required to reduce the severity of the construction impact.

7.5.2 Scheme Traffic Management Plan

Measures necessary to mitigate the negative effects of construction of the proposed scheme will be developed as the proposed scheme evolves to construction in consultation with key stakeholders such as the relevant roads authorities. These will be detailed in a Scheme Traffic Management Plan. This plan will prioritise pedestrian, cyclist, public transport and local access needs (for example, multi storey car parks, residential and commercial properties). Such an approach will minimise the impact of the construction phase on transport and business activities. To facilitate this, it will be important for the plan to divert through traffic away from key construction This plan is a framework document within which the necessary mitigation measures will be developed through the various stages of design and construction. This will detail the proposed programme of works, how appropriate access can be retained throughout the works and how the potential negative traffic impacts (including pedestrian and cyclist impacts) associated with operating a number of urban construction sites concurrently can be managed. Initially, this plan will be developed by RPA in consultation with the roads authority and other key stakeholders until the PPP contractor is appointed. Then the PPP contractor will continue to develop and implement the strategy throughout the construction phase. This plan will be reviewed on a regular basis during its implementation for its relevance and effectiveness.

The MNTM traffic model has been used to assess the impact of Dublin City Council's SCATS system. Within the MNTM there is a facility to optimise signal green times for the whole Dublin region. This signal optimisation programme was run through the MNTM for 2011 with scheme construction assumed. The results of this test are shown below in Table 7.13 and Table 7.14 compared to the do-minimum and do-something scenarios. The results indicate that by reconfiguring the signal green time within the city there will be potential to minimise the traffic disruption generated by the construction activities to achieve congestion levels and network speeds that exist in the do-minimum scenario.

Table 7.13 Strategic construction impact 2011 (AM Peak Hour) – general traffic

Criteria	Do-Minimum	Do-Something	Do-Something with Signal Optimisation
Queuing Statistic (pcu hours)	21,000	25,700	19,400
Travel Time (pcu hrs)	86,700	100,200	87,000
Travel Distance (pcu kilometres)	2,190,000	2,250,000	2,220,300
Average Speed (kph)	25	22	25

Table 7.14 Strategic construction impact 2011 (AM peak hour) – bus only

Criteria	Do-Minimum	Do-Something	Do-Something with Signal Optimisation
Bus Speed (kph)	19	15	19
Bus kilometres lost to queuing per hour	1,900	4,800	2,100

7.5.3 Public transport operations

The Scheme Traffic Management Plan considers public transport operating needs along the alignment of the proposed scheme. Discussions will be held with relevant public transport operators, and roads and planning authorities to mitigate the proposed scheme's impacts.

7.5.4 Corridor management strategies

The Scheme Traffic Management Plan includes corridor management strategies as required for areas and roads directly affected by construction activities. These strategies are required for routes that without mitigation measures would experience substantial increases in traffic flow from displaced vehicle trips avoiding construction areas. The corridor management strategies will take the form of additional signal priority for certain movements, reconfiguration of key junctions, re-signing of routes (including utilisation of VMS).

7.5.5 Pedestrian management strategies

The Scheme Traffic Management Plan includes pedestrian management strategies around each work site to ensure that pedestrian circulation and safety requirements take priority in all instances where construction works interface with pedestrians. This is critical in the context of the large number of construction phases envisaged at and between discrete site locations. Furthermore, the city centre stops are located in very sensitive urban areas with high pedestrian volumes and substantial volumes of general traffic. The additional construction activity (site areas and construction vehicles) in these areas will impede pedestrian circulation and access unless properly managed.

7.6 PREDICTED LOCAL CONSTRUCTION IMPACT - AREA MN107

The construction phase will include utilities diversions and enabling works, which, by their nature are of short duration and will have localised impacts which will be mitigated. This phase also includes the main construction works for the proposed scheme, which are of longer duration and which have a potentially greater impact along the full length of the scheme. The following assessment therefore considers the main construction works. The combined impact of both HGV and general traffic has been assessed in the preceding Strategic Impact Assessment section.

7.6.1 Construction impact area

The alignment of the proposed scheme, in Area MN107, extends from St. Josephs Parade south of the Mater Stop to St. Stephen's Green South and this will be wholly underground. Three stops will be located within the area at Parnell Square, O'Connell Bridge and St. Stephen's Green. Construction works associated with the three stops will require substantial works areas at ground level.

The construction of each stop will require ground excavation from street level down. This will require the use of areas of the street surface above the station footprint. As a consequence sections of the road and footpath space around each station site will be unavailable to road users during construction.

Construction works at the three stop locations will be carried out concurrently for a considerable length of time during the overall construction programme. The period coinciding with the maximum ground level works activities is termed the critical construction phase, as the impact on transportation in the city will be most Severe during this time.

General traffic speeds across the city centre, within Area MN107, will decrease during the construction phase. This decrease in speeds will result from a combination of the proposed scheme works areas, their associated proposed traffic management requirements and increases in HGV flows arising from construction vehicles in the vicinity of the alignment of the proposed scheme.

Construction vehicles in operation in the city centre will only be permitted to use designated routes during the construction of the proposed scheme. All construction related traffic management arrangements in the city centre will be set out in a Scheme Traffic Management Plan

The relative proximity of the city centre stops and the complexity of the construction programme and traffic management arrangements requires that a combined assessment of their impact.

7.6.1.1 Construction site traffic management measures

The area of Dublin City within Area MN107 comprises a number of strategic routes that provide for both movement through the city for high volumes of cars, buses, and HGVs and for local access to businesses and residential areas. The junctions around O'Connell Bridge, in particular, are critical points in the road network for both general traffic and bus movements.

The traffic management arrangements described in the following sections will have an impact on traffic movement through and around the city centre area and which have consequences for the wider Dublin road network.

The Outer and Inner Orbital Routes, as shown in Figure 7.8 and Figure 7.9, remain unchanged by the construction of the three city centre stops, and traffic with access to the Inner Orbital Route from within its boundary may access any of the strategic routes in and out of the city centre. Thus, for Area MN107, reference is made only to the maintenance of access to the Inner Orbital Route when discussing the routing effect of traffic management alterations to the city centre.

Figure 7.8
Inner and Outer Orbital Routes

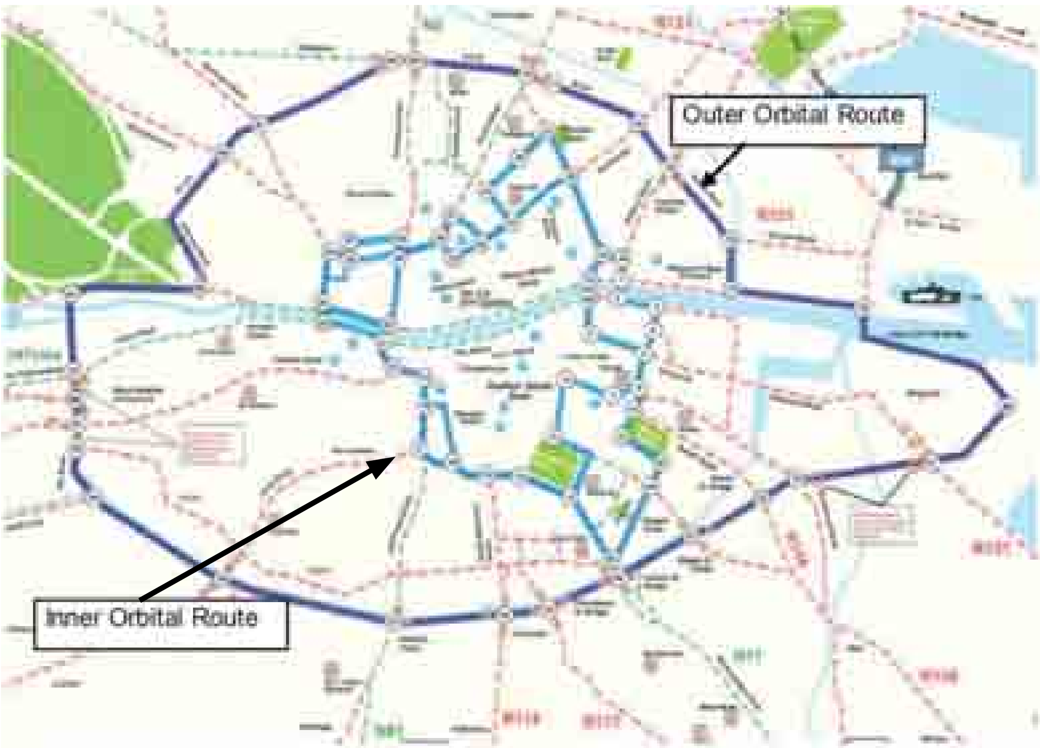


Figure 7.9
Inner Orbital
Route

Parnell Square Stop
Construction of the Parnell Square Stop will be primarily accommodated on Parnell Square East between the junctions of Denmark Street Great /Gardiner Row and Rutland Place. However works of shorter duration will be required on the other three sides of the Square. There will be substantial loss of street space for general traffic, bus, taxi and pedestrian movement. One lane of traffic will be available during the construction phase on Parnell Square East. To accommodate the large number of buses that use Parnell Square East, and generally within the city centre area, this lane will operate as a bus lane in the southbound direction. A portion of the existing footpath will also be maintained on eastern side of the street to facilitate pedestrian movement and local access requirements.

The movement from Parnell Square North to Denmark Street Great /Gardiner Row will be permitted. The right turn from Denmark Street Great /Gardiner Row to Frederick Street North will be permitted; the left turn from Denmark Street Great /Gardiner Row onto Parnell Square East will be available for construction vehicles.

At present, the right turn from Parnell Square North to Parnell Square East provides for a relatively small number of general traffic movements, most of which is accessing the local area. Alternative routes are available via Denmark Street Great /Gardiner Row and Gardiner Street to cater for the affected traffic. The restriction on general traffic on Parnell Square East will not have a significant traffic impact.

The reduction of Parnell Square East to one lane will require the relocation of all the bus stops on Parnell Square East, as a single lane cannot accommodate high volumes of stopping buses without undue impact on bus and taxi movements.

Details of the junctions affected by traffic restrictions in and around Parnell Square East are provided in Table 7.15 and Table 7.16.

Table 7.15 Construction changes to the road network at the junction of Parnell Square North/Parnell Square East/Denmark Street Great/Gardiner Row

Approach Name	Existing Number of Approach Lanes	Remaining Number of Approach Lanes	Proposed Lane Configuration During Construction
Frederick Street North	1	1	Shared lane – left for general traffic and straight ahead for buses.
Denmark Street Great / Gardiner Row	1	1	One shared lane: General traffic can right turn onto Fredrick Street North. Buses can left turn onto the bus lane on Parnell Square East. Construction vehicles can left turn into the works site.
Parnell Square East	N/A	N/A	One southbound bus lane heading away from the junction
Parnell Square North	2	1	One shared lane: General traffic can go left and straight ahead. Buses only can right turn onto Parnell Square East.

Table7.16 Construction changes to the road network at the junction of Parnell Street / Parnell Square East / O'Connell Street

Approach Name	Existing Number of Approach Lanes	Remaining Number of Approach Lanes	Proposed Lane Configuration During Construction
Parnell Square East	4	1	Shared left and straight ahead.
Parnell Street from East	2	2	One straight ahead lane.
O'Connell Street	2	2	2 right turn lanes.
Parnell Street from West	N/A	N/A	2 lanes westbound heading away from the junction.

O'Connell Bridge Stop

The stop at O'Connell Bridge requires separate works areas located in O'Connell Street Lower, O'Connell Bridge and Westmoreland Street. Under current proposals, construction works at the O'Connell Bridge Stop will be undertaken in approximately 15 construction phases, with a number of sub-phases likely. Shorter term construction works will also be required on other streets in the area including D'Olier Street, Abbey Street and the Quays.

Construction works on O'Connell Street Lower will require the reduction in the number of lanes on O'Connell Street Lower (Abbey Street to Eden Quay) and O'Connell Bridge to three lanes. Therefore it is proposed to provide a new bridge linking Marlborough Street with Hawkins Street to replace the lost southbound traffic lanes. It is proposed that the remaining traffic lanes on O'Connell Street Lower and O'Connell Bridge will be allocated as follows:

- Two northbound general traffic lanes;
- One southbound contra-flow bus lane.

General traffic travelling southbound from the north inner city area will no longer be able to avail of access via O'Connell Street Lower and O'Connell Bridge. It is likely that this traffic will divert onto existing bridges east and west of O'Connell Street, such as Talbot Memorial Bridge and Grattan Bridge. The Inner Orbital Route passes over Talbot Memorial Bridge and traffic circulation will be maintained.

The current left turn from Bachelors Walk onto O'Connell Street will be retained to permit the existing movements and access. The current right turn movement from Bachelors Walk onto O'Connell Bridge will be prohibited during construction. This will substantially reduce southbound general traffic volumes on D'Olier Street. Eastbound traffic (with the exception of buses and taxis) on Eden Quay will also be prohibited from turning right onto the new bridge at Marlborough Street. The west to east movement will remain unchanged on the North Quays and traffic wishing to access the south side of the city will have to avail of existing bridge crossings east and west of O'Connell Bridge which includes Father Mathew Bridge, Grattan Bridge and Talbot Memorial Bridge.

The contra-flow bus lane on Eden Quay will be shortened to terminate at the new bridge at Marlborough Street.

General traffic, including taxis, will be unable to travel southbound over O'Connell Bridge. The northbound right turn movement from O'Connell Bridge to Eden Quay will also be prohibited.

To the south of the bridge the main construction works will be confined to Westmoreland Street. This street will be fully closed for the duration of these works, with the loss of three northbound lanes for general traffic, bus and taxi movements between Fleet Street and the junction of Westmoreland Street / D'Olier Street / Aston Quay. The loss of capacity for general traffic proceeding northbound via Westmoreland Street will not be replaced. Buses which currently use Westmoreland Street will, however, be given replacement priority on a new two-way configuration on College Street and D'Olier Street.

A restriction of general traffic will be introduced on College Green and D'Olier Street northbound. These restrictions will only allow two-way bus and taxi movements through College Green. Provision for local access to areas within Westmoreland Street, D'Olier Street, College Street and Fleet Street will be available from the South Quays.

Buses travelling northbound through College Green may proceed eastbound along College Street by using a bus lane and continuing north along D'Olier Street to reach O'Connell Bridge. Buses may also continue to travel northbound on Westmoreland Street and turn right into Fleet Street.

D'Olier Street will operate as a two-way street, with two lanes southbound for general traffic, taxi and bus movements and one lane northbound. At the junction with Fleet Street and Townsend Street there will be two lanes southbound to accommodate left turning traffic onto Townsend Street and traffic movements onto College Street. There will be one lane northbound on D'Olier Street immediately to the north of this junction. The right turn movement from Fleet Street onto College Street will be prohibited during the construction works. Local access traffic will be permitted on Fleet Street between Westmoreland Street and D'Olier Street to provide for servicing the immediate area.

The College Street approach towards Westmoreland Street will be three lanes. Two lanes will accommodate traffic travelling towards College Green and one lane will function as a right turn lane into Westmoreland Street. The right turn will allow access to properties within the area.

During the construction phases, access to Fleet Street west of Westmoreland Street towards Temple Bar will be prohibited. Access to Fleet Street between Westmoreland Street and Price's Lane will be prohibited for all traffic. Alternative access will be provided via Dame Street or Aston Quay and Anglesea Street. This will facilitate necessary access to the area including the Fleet Street multi-storey car park. Fleet Street between Anglesea Street and Price's Lane will become two-way.

Due to the loss of southbound lanes on O'Connell Street Lower and O'Connell Bridge, it is proposed to build a new bridge over the River Liffey, which will be located in the area of the Marlborough Street / Hawkins Street north-south axis. The bridge will have two lanes southbound. Use of the bridge will be restricted to buses, taxis, pedestrians and cyclists. The principal function of the bridge will be to accommodate southbound buses displaced from O'Connell Bridge, and southbound taxis.

The loss in capacity on D'Olier Street, Westmoreland Street, O'Connell Street and O'Connell Bridge will result in the displacement of considerable volumes of general traffic from the core city centre road network around O'Connell Bridge. Traffic will redistribute away from the proposed scheme construction sites and the associated restrictions and traffic management arrangements. The routes most likely to absorb the redistributed traffic are Tara Street and Church Street northbound and Grattan Bridge and Talbot Memorial Bridge southbound.

Details of the junctions affected by traffic restrictions in and around the O'Connell Bridge Stop are provided in Table 7.17, Table 7.18, Table 7.19, Table 7.20 and Table 7.21.

Table 7.17 Construction changes to the road network at the junction of O'Connell Street/North Quays/O'Connell Bridge

Approach Name	Existing Number of Approach Lanes	Remaining Number of Approach Lanes	Proposed Lane Configuration During Construction
O'Connell Street Lower, Southbound	2	1	One straight ahead, contra-flow bus lane.
Eden Quay	1	0	Two lanes eastbound heading away from the junction.
O'Connell Bridge, Northbound	4	2	Two straight ahead lanes.
Bachelors Walk	3	3	One left turn lane. Two straight ahead lanes.

Table 7.18 Construction changes to the road network at the junction of O'Connell Bridge/South Quays/D'Olier Street/Westmoreland Street

Approach Name	Existing Number of Approach Lanes	Remaining Number of Approach Lanes	Proposed Lane Configuration During Construction
O'Connell Bridge, Southbound	4	1	One straight ahead contra-flow bus lane
Burgh Quay	4	4	One right turn lane. Two straight ahead lanes. One left turn lane.
D'Olier Street	0	2	Two lanes straight ahead.
Westmoreland Street	4	0	Closed.
Aston Quay	N/A	N/A	Two lanes westbound heading away from the junction.

Table 7.19 Construction changes to the road network at the junction of O'Connell Street/Abbey Street

Approach Name	Existing Number of Approach Lanes	Remaining Number of Approach Lanes	Proposed Lane Configuration During Construction
O'Connell Street from North	2	1	One shared lane: General traffic can left turn. Busses only can go straight ahead.
Abbey Street Lower	N/A	N/A	One lane eastbound heading away from the junction.
O'Connell Street from South	2	2	One shared straight ahead and left turn lane. One straight ahead only lane.
Abbey Street Middle	N/A	N/A	One lane westbound heading away from the junction.

Table 7.20 Construction changes to the road network at the junction of D'Olier Street/Fleet Street/Townsend Street/Hawkins Street/Pearse Street/College Street

Approach Name	Existing Number of Approach Lanes	Remaining Number of Approach Lanes	Proposed Lane Configuration During Construction
D'Olier Street	3	2	One left turn lane for general traffic. One straight ahead bus only lane to College Street.
Hawkins Street	1	1	One shared left turn and straight ahead lane.
Townsend Street	N/A	N/A	One straight ahead eastbound lane heading away from the junction.
Pearse Street	1	1	One lane straight ahead.
College Street	0	1	One lane north into D'Olier Street.
Fleet Street	1	1	One straight ahead lane.

Table 7.21 Construction changes to the road network at the junction of College Street/College Green/Westmoreland Street

Approach Name	Existing Number of Approach Lanes	Remaining Number of Approach Lanes	Proposed Lane Configuration During Construction
Westmoreland Street	N/A	0	Closed.
College Street	4	3	One right turn lane. Two bus only lanes straight through to College Green.
College Green	2	2	One straight ahead lane. One right turn bus only lane

St. Stephen's Green Stop
The main area of construction of the St. Stephen's Green Stop will include some of the northwest section of St. Stephen's Green park, St. Stephen's Green North between Dawson Street and Grafton Street, and St. Stephens Green West between Grafton Street and Glovers Alley.

During construction the current one-way road which runs along St. Stephen's Green North, West and into Glovers Alley will be closed. This is due to the available width between the buildings and the site hoarding line on St. Stephens Green West and North. In effect, all traffic accessing St. Stephen's Green/College of Surgeons car parks and the Fitzwilliam Hotel loading/servicing area and car park will occur via Mercer Street.

There will therefore be loss of street space for access traffic, taxi and servicing vehicles during construction of St. Stephen's Green Stop.

7.6.1.2 Accommodation of city centre traffic movements during construction

To accommodate the displacement of general traffic movements resulting from the construction of the proposed scheme traffic will be encouraged to use the Inner Orbital Route. Figure 7.9 shows the current Inner Orbital Route.

East-West movements
East-West movements along the North and South Quays will be maintained during the construction phase of the proposed scheme. Additional traffic volumes are likely to occur along the quays however as traffic redistributes away from the proposed scheme's construction sites.

Southbound movements
As a result of the construction works areas on O'Connell Street and O'Connell Bridge, and the banned right turn from Bachelors Walk onto O'Connell Bridge, traffic that currently crosses the River Liffey southbound via O'Connell Bridge will be diverted onto alternative routes. Additionally, southbound access to Dame Street and Nassau Street from Burgh Quay will be prohibited through the introduction of the traffic management arrangements in College Green, Westmoreland Street and D'Olier Street. The loss in capacity as a result of the proposed scheme and the traffic management arrangements will result in the displacement of considerable volumes of general traffic away from the core city centre road network which will redistribute onto alternative routes. These are as follows:

- South-eastern movement - Traffic travelling southbound from Dorset Street will turn onto Gardiner Street and travel south along its whole extent, turning left around Beresford Place and across Talbot Memorial Bridge. Traffic at this point can then turn right onto Georges Quay or left onto City Quay. This route remains unaltered during the construction of the proposed scheme. However, it is likely that congestion will increase on this link, although some extra capacity will be provided by the Macken Street Bridge;
- South central movement - Southbound traffic wishing to use O'Connell Street during the proposed construction phase will only be permitted as far as Abbey Street where they will be required to turn left, travelling around Beresford Place and southbound via Talbot Memorial Bridge. This will result in additional vehicles accessing Beresford Place and Talbot Memorial Bridge;
- South-western movement - Traffic travelling southwest from Dorset Street will travel south down Bolton Street, North King Street and Church Street and across the River Liffey via Father Mathew Bridge.

Northbound movements
The closure of Westmoreland Street represents a significant barrier to northbound traffic movements. Alternative routes are as follows:

- North-western movement - Traffic travelling north from the Dublin Castle area will be required to travel westbound along Dame Street, High Street Bridge Street and over the Father Mathew Bridge towards Church Street;
- North-eastern movements – Traffic from Dawson Street will turn right onto Nassau Street, left onto Westland Row, left onto Pearse Street, right onto Tara Street and across the Liffey via Butt Bridge. Traffic coming from the southeast of the city centre will not experience changes to their routing, though as is the case with other routes outlined above, it is likely that additional traffic volumes will be experienced as a result of traffic displacement.

7.6.2 Construction vehicle traffic and background HGV traffic flows

The Dublin City Council HGV Management Strategy was introduced in 2005 after the opening of the Port Tunnel. At present, 5-axle HGV traffic within the city centre is restricted from 07:00 to 19:00hrs. The HGV Management Strategy has been highly successful in controlling the volume of large HGVs within the city centre. A permit system is in operation to allow HGV access for vehicles that are destined for the city centre. Those construction vehicles that will be affected by the restriction serving the proposed scheme will require permits to access the city centre worksites.

Existing HGV traffic within the city centre will be affected by the general traffic restrictions outlined in the traffic management arrangements, described above. Analysis of the traffic model results indicates that displaced HGV traffic will use alternative routes such as the Quays, the Port Tunnel and Church Street. Along these roads, HGV traffic flows are predicted to increase by approximately 30 vehicles per hour during the AM peak period. The impact of this level of increase of HGV traffic on these routes will be Moderate.

In addition to the redistribution of background HGV traffic, impacts will arise as a result of additional construction vehicles servicing the proposed scheme's city centre worksites at Parnell Square, O'Connell Bridge and St. Stephen's Green. During the critical phase there will be approximately 12 construction vehicles accessing each worksite per hour with a similar volume of construction vehicles leaving the sites.

Specific access routes for each of the city centre worksites will be detailed in the Scheme Traffic Management Plan. The most suitable routes have been chosen for each worksite and construction vehicles will be restricted to their designated route. Construction vehicle access to the Parnell Square worksite will be via the M1, Swords Road and Dorset Street. Construction vehicles will access the O'Connell Bridge worksites via the M1, Port Tunnel and the North and South Quays. The St. Stephen's Green worksite will be accessed via the M1, Port Tunnel, North Quays, South Quays, Westland Row and Merrion Square. Construction vehicles leaving the St. Stephen's Green worksite will do so via Dawson Street, Lombard Street, Pearse Street and the North Quays heading towards the Port Tunnel Figure 7.10 below, illustrates the designated routes to be taken by the construction vehicles accessing and egressing each site.

The peak volume of construction vehicle traffic flows are relatively low and the overall impact of construction related traffic on general traffic movement is likely to be Moderate. In particularly sensitive areas, where streets are narrower and there are high levels of pedestrian activity, such as Dawson Street, the impact will be Severe. Construction vehicles will need to be managed appropriately to mitigate this impact. Construction vehicles will be wheel washed, cleaned and covered prior to leaving the worksite so as to minimise dust and particulates being shed.

Figure 7.10 Construction vehicle routes within the city centre

7.6.2.1 Construction phase impact on servicing and deliveries

The construction works in the city centre will require the relocation of a number of loading bays in the city centre. It will be necessary to accommodate servicing and deliveries in suitable alternative locations in order to satisfy the specific needs of local businesses in the affected areas.

Parnell Square Stop
There are no designated loading bays on Parnell Square East. The existing parking on the western side of Parnell Square East will be removed. The premises on Parnell Square East have access to the rear from Rutland Place. This access will be retained to provide for the needs of the local area.

O'Connell Bridge Stop
The location of loading bays and vehicular access to them remains largely unchanged in the vicinity of O'Connell Street Lower. Loading will continue to operate to the rear of properties on streets such as Earl Place and Thomas Lane and on Price's Street North. Access for loading will be affected by the changes to the general traffic movements.

Servicing and delivery arrangements to premises in the vicinity of the construction work sites will be agreed in consultation with key stakeholders in advance of construction.

The loading areas on the western side of Fleet Street (between Westmoreland Street and D'Olier Street) will become a Clearway during peak periods. The bus stop at the corner of Fleet Street with D'Olier Street will be maintained.

A small amount of loading will be retained on the eastern side of D'Olier Street at the northern end.

St. Stephen's Green Stop
During the construction phase, loading on Grafton Street and South King Street will be maintained at present levels, with all vehicles exiting via South King Street. Properties in St. Stephen's Green North will be serviced either from the west from Grafton Street and from the east from Dawson Street. Loading from the west will be subject to the restriction of loading times as currently exists in Grafton Street.

While current levels of servicing and deliveries will be affected during the construction, the relocation to suitable locations and the extension of operating hours will mitigate these impacts. As such, the overall impact on servicing and deliveries in Area MN107 is Moderate.

7.6.3 Construction phase impact on general traffic

A number of summary traffic statistics were extracted from the Metro North Traffic Model (MNTM) for Area MN107 to demonstrate the predicted impact. These statistics include the following:

For general vehicular traffic assessment:

- Queuing – This statistic relates to the time spent in congestion within the modelled period (8am to 9am). The units of measurement are in Passenger Car Units (pcu) hours.
- Travel Time – This statistic relates to the time spent travelling within the modelled period. The units of measurement are in pcu hours.
- Travel distance – This statistic relates to the distance travelled by vehicles across the GDA within the modelled period. The units of measurement are in pcu kilometres.
- Average Speed – This statistics represents the average speed across the road network. The units of measurement are in kilometres per hour (kph).
- Car trips accessing the area – This statistic informs on the number of cars entering the area. This is a useful measure of the congestion levels within the area as fewer cars will enter the area if congestion worsens.

These statistics provide good indicators to the overall performance of the road network during construction of the proposed scheme. Statistics are presented for the AM Peak hour (08.00-09.00) only as this time period represents a heavily congested road network and negative or positive impacts generated by the proposed scheme can be clearly identified.

Table 7.22 includes output statistics for Area MN107. In general, queuing, time spent travelling and distance travelled all increase considerably as a result of the proposed scheme construction, without further mitigation measures. Queuing will increase substantially up to 50%, with time spent travelling increasing by over 22%. The time spent queuing as proportion of overall travel time increases from an already high 38% to 47% as a result of the construction phase. The average speed in Area MN107 will decrease by 20%, or drop by 1kph. These statistics reveal that the impact within Area MN107 will be Severe and requires further mitigation.

The number of cars entering the Area MN107 will drop by approximately 5%, or by 800 vehicles. This suggests that drivers are diverting to routes outside of Area MN107 to avoid the construction activity.

Table 7.22 Area MN107 construction impact 2011 (AM Peak Hour) – general traffic

Criteria	Do-Minimum	Do-Something	% Change
Queuing Statistic (pcu hours)	3,000	4,500	+50%
Travel Time (pcu hrs)	7,800	9,500	+22%
Travel Distance (pcu kilometres)	37,200	37,800	+2%
Average Speed (kph)	5.0	4.0	-20%
Cars entering Area MN107	18,300	17,500	-5%

Figure 7.11 illustrates the change in traffic flow resulting from the proposed scheme's construction. This is a plot extracted from the MNTM traffic model and compares the do-minimum with the do-something scenario, without mitigation measures. The blue bandwidth represents a reduction in traffic volumes and the green bandwidth represents an increase in traffic volumes. The thicker the bandwidth the greater the traffic volume represented. There are substantial decreases in traffic flow on College Green, Dame Street, Nassau Street and O'Connell Street. This can be attributed to the closure of Westmoreland Street and part of O'Connell Street Lower. The traffic displaced from these roads will divert to other roads that provide north-south and south-north access. Traffic will increase on a number of roads. The following represents a summary of conditions on the main routes providing for all movements for vehicles, without mitigation measures:

- Considerable northbound increases over the Father Mathew Bridge at Bridge Street with increases in both approaches from Bridge Street and Cook Street. Bridge Street will experience a 50% increase in traffic flows (250 cars) and Cook Street will increase by 100 cars (300%). The impact around this area will be Severe on Bridge Street with queuing predicted to more than double from High Street to the bridge (Severe impact);
- Delay on Cook St westbound will roughly double to over 85 seconds per car per hour (Moderate impact);
- Southbound increases on Capel Street and over Grattan Bridge and down Parliament Street of 20-25% or about 150 cars (Moderate impact);
- Substantial southbound increases in car volumes over Talbot Memorial Bridge due to southbound traffic diverting away from O'Connell Bridge. There will be a Severe impact from Eden Quay at Marlborough Street and over Talbot Memorial Bridge to either Moss Street or Lombard Street. Traffic volumes generally increase by about 350 on the quays and 650 over Talbot Memorial Bridge. Due to capacity limitations in the network the increase in volume is largely manifested as increases in queue lengths and much slower moving traffic (Severe impact).
- Westbound increases on Dame Street from west of Parliament Street of 180 cars or 30% (Moderate impact);
- Westbound increases on Pearse Street from Shaw Street to Tara Street. There will be just over 200 additional cars on this road section; however the predicted impact will be Slight to Moderate for cars with speeds only slightly affected through the right turn to Tara Street.

There will be a number of positive impacts due to the effect of the traffic management plan in place during construction:

- There will be a very substantial reduction in car traffic on Dame Street eastbound. The reduction is predicted to be in the order of 350 to 400 cars per hour in the AM peak period;
- There will be virtually no general traffic on College Green. General traffic must turn around at the eastern end of Dame Street due to the traffic management arrangements for the proposed scheme. Other general traffic travelling eastbound on Dame Street will turn right onto Trinity Street.
- There will be a reduction of about 150 cars eastbound on Townsend Street. This is a decrease of about 60%.
- O'Connell Street southbound is predicted to have almost 200 fewer cars travelling southbound which equates to about 40% reduction in car numbers.
- Kildare Street Southbound is predicted to be utilised by about 250 fewer vehicles, a drop of 65%.

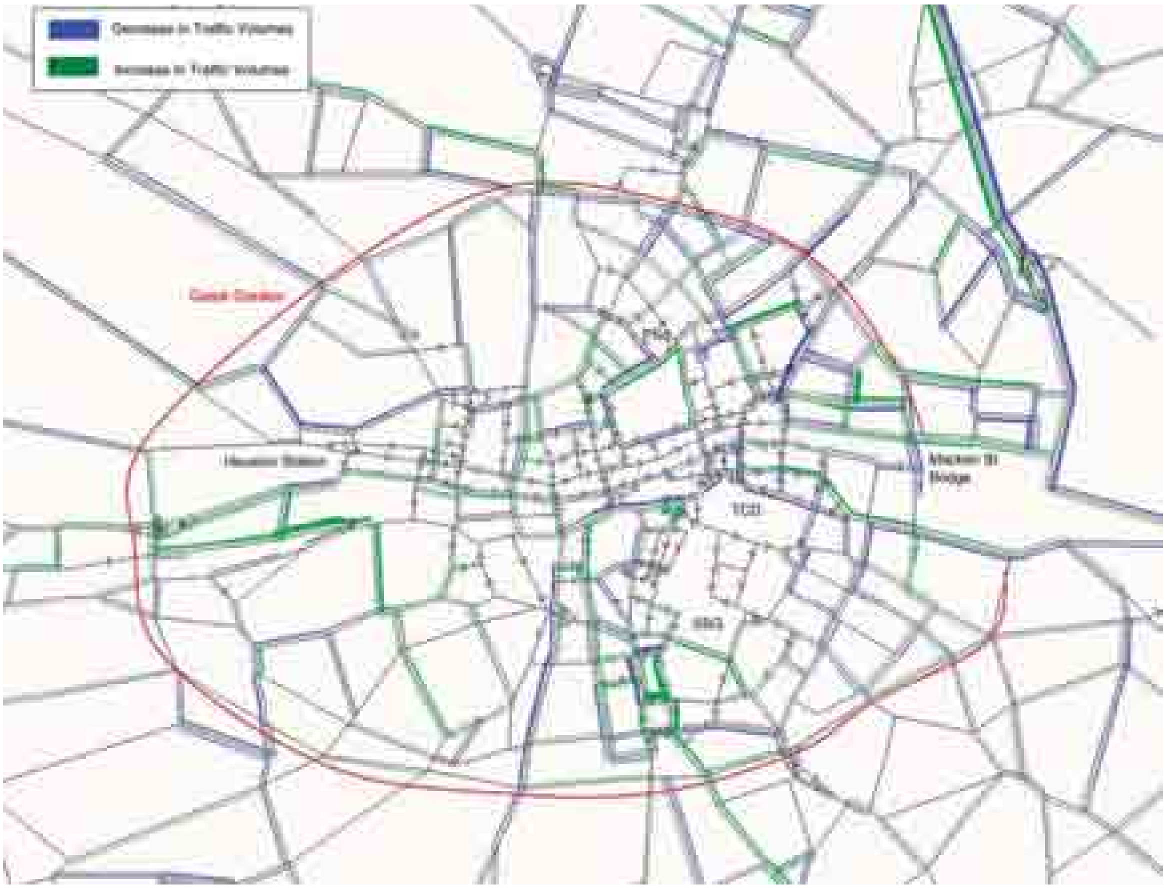


Figure 7.11
Traffic flow changes – comparison of the do-minimum and do-something 2011 construction scenarios (core city area)

7.6.3.1 Car park access arrangements

Within Area MN107, there are approximately 13 multi-story car parks with in excess of 6,700 car parking spaces. The access arrangements for the majority of these car parks remain unchanged during the construction phase of the proposed scheme. Access to the various off street car parks off Abbey Street and O'Connell Street will be maintained via the Quays and O'Connell Street northbound. However, access to five city centre car parks - St. Stephen's Green Shopping Centre, Royal College of Surgeons, Fitzwilliam Hotel, Drury Street and Fleet St Car Park, will be affected during the construction phase of the proposed scheme. Figure 7.12 illustrates the access arrangements to the affected multi-storey car parks.

Fleet Street multi-storey car park
Fleet Street will be open only to the east of Westmoreland Street. Access to Fleet Street between Westmoreland Street and Price's Lane will be prohibited for all traffic. Access to Fleet Street, west of Westmoreland Street and the Fleet Street multi-storey car park will be maintained from Aston Quay and from Dame Street via Anglesea Street. Fleet Street between Anglesea Street and Price's Lane will become two-way.

Multi-storey car parks in the St. Stephen's Green Area
Construction works will require the closure of the North West corner of St. Stephen's Green to traffic. This section of road provides access to Glovers Alley from which four off street car parks are accessed - Royal College of Surgeons, St. Stephen's Green Shopping Centre, the Fitzwilliam Hotel and Drury Street Car Park. There are quite a high number of through movements served by this section of road and local movements will be affected. Car park access to the four multi-storey car parks will be maintained from Mercer Street via Stephen Street Lower or York Street and via the right hand turn off Aungier Street.

Overall, the impact on multi-storey car parks in Area MN107 is Slight as the majority of access arrangements remain in place. The car parks directly affected by construction are still accessible through a slight alteration to current routes.

7.6.3.2 Emergency vehicle access arrangements

At all locations in the city centre access will be maintained for emergency vehicles during the construction of the proposed scheme. Emergency vehicles will not be subject to general traffic restrictions imposed by the construction of the proposed scheme.

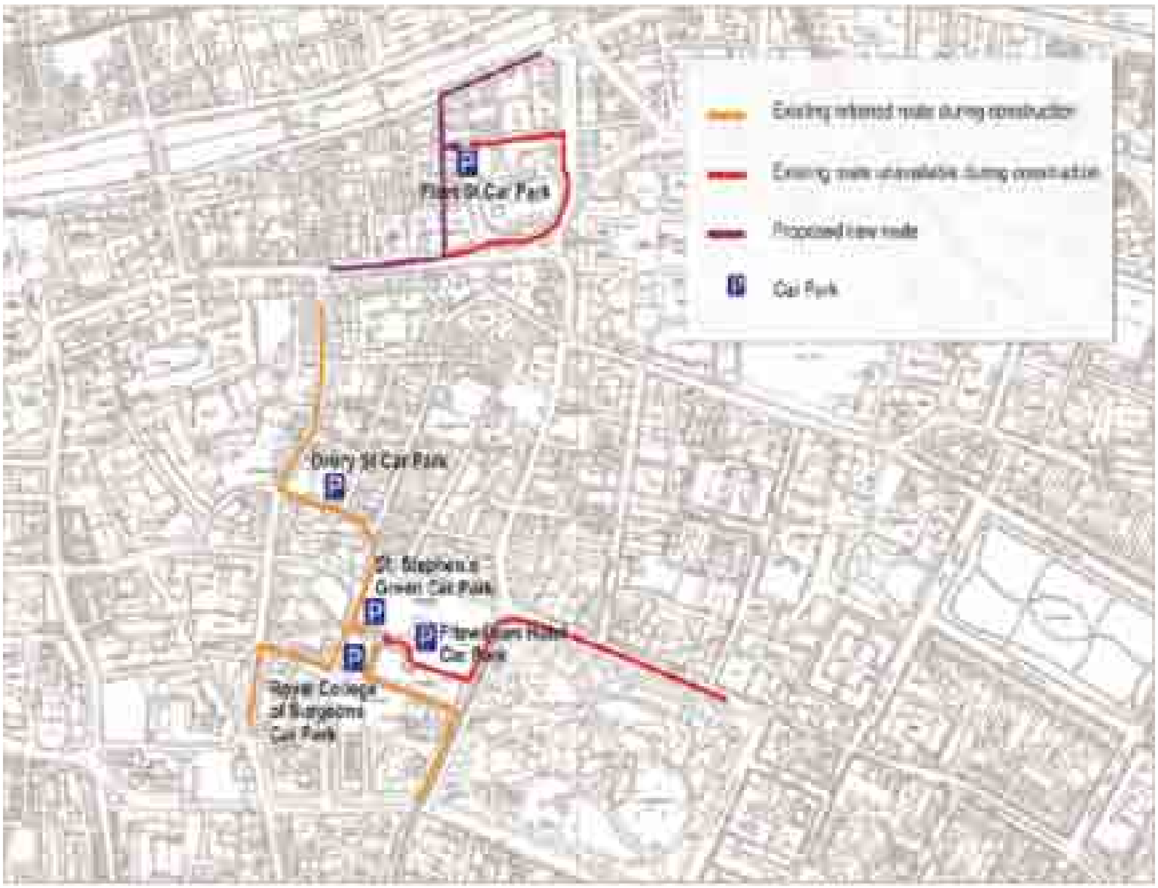


Figure 7.12
Car park access arrangements

Two major hospitals: Rotunda and Temple Street are located along the corridor of the proposed scheme in Area MN107. It has been recognised as important to minimise disruption to the operating environment for emergency service vehicles in and around these hospitals. They are in the North City Centre area and will be most affected by the works on Parnell Square East.

Some localised increases in congestion are predicted on Parnell Square South, West and North due to the closure of Parnell Square East to general traffic. This may have a Slight impact on access to the Rotunda Hospital. However, as emergency vehicles are permitted to use bus lanes, ambulances can route through Parnell Square East to minimise their journey time. On balance, the impact on emergency access to the Rotunda Hospital will be neutral.

There are no other road closures in the area, so access to Temple Street Hospital will be unaffected during the construction of the proposed scheme.

7.6.4 Construction phase impact on public transport

7.6.4.1 Bus

The impact of the construction of the proposed scheme on public transport will largely be experienced by bus services operating in the vicinity of the Parnell Square and O'Connell Bridge Stops. A number of summary traffic statistics were extracted from the MNTM traffic model for Area MN107 to demonstrate the predicted impact on bus services. These statistics include the following:

- Average Bus Speeds – This statistic represents the average bus speed across the road network in kilometres per hour (kph);
- Bus kilometres lost to queuing per hour – This statistic presents the number of kilometres lost to congestion in the modelled hour for buses.

Table 7.23 provides an indication of the impact the proposed scheme's construction will have on bus movement in Area MN107. Buses will be affected by a 6% reduction in average speed, and bus kilometres lost to queuing will increase by 21%. This represents a Severe impact on bus movement, without mitigation measures.

Table 7.23 Area MN107 Construction Impact 2011 (AM Peak Hour) – Bus Only

Year	Indicator	Do-Minimum	Do-Something	% Change
2011	Bus Speed (kph)	5.20	4.90	-6%
	Bus kilometres lost to queuing per hour	190	230	+21%

In addition to the general impacts on bus movements, in terms of average speed and delay, bus operations will be affected in a number of other ways including:

- The loss of space necessary for bus stops at various locations;
- The loss of turnaround routes due to the closure of Westmoreland Street;
- The loss of lay-over space at certain locations;
- Change to the routing available through the network which will have further impacts on access to existing bus stops.

These issues are outlined below in relation to the specific impacts at each of the worksites within the city centre. Mitigation measures will be developed as part of the Scheme Traffic Management Plan.

Parnell Square Stop

The construction of the stop at Parnell Square will necessitate the closure of most of the existing roadway on Parnell Square East although one bus lane will remain.

There are a number of bus stops and stands along Parnell Square East serving a variety of service groups including cross-city services such as the 10's, 11's, 16's and 19's. Many other services commence operation at Parnell Square and the bus stops on Parnell Square East are the first stop along the routes. Parnell Square is the terminus for the following Dublin Bus Services: 1, 2, 8, 14/A and 48A. Given the number of services, and the average dwell time, it will not be practical to maintain these stops during the construction period.

The impact on bus services of the construction of the stop at Parnell Square will largely be as a result of the relocation of the existing bus stops. There is likely to be a loss of bus stop coverage in the immediate locality and some passengers will need to walk further to access bus services. This will add to the overall door to door journey time by bus and will inconvenience passengers.

Overall the impact on bus services of the construction of the stop at Parnell Square will be Moderate.

O'Connell Bridge Stop

The closure of Westmoreland Street from Fleet Street to Aston Quay will have a significant impact on bus services. In all, over 150 bus routes will be altered as a result of the construction of the proposed scheme and the associated traffic management plan. As well as the necessary diversions, replacement bus stops will be required to replace the existing stops that are no longer accessed by the new routes e.g. the bus stop on O'Connell Bridge which services ten routes. The general traffic restriction on College Green will provide valuable mitigation for bus services.

The operation of two existing termini at Pearse Street and Hawkins Street will be revised. The buses allocated to the Pearse Street terminus will no longer be able to directly access the Quays as they do at present. Therefore it is proposed that this terminus is relocated. The second terminus affected will be Hawkins Street. There will be a considerable increase in traffic volumes on Hawkins Street and it will be preferable to relocate the existing terminus in order to use the road space more effectively.

Table 7.24 summarises the main diversions that are assumed and example services are listed for clarification.

Table 7.24 General bus route alterations during the construction of the proposed scheme

Description	Existing Route	Proposed Route	Example Services
Northbound Cross-City / Cross-Over Services	Suffolk Street or Dame Street – College Green – Westmoreland Street – O'Connell Bridge – O'Connell Street	Suffolk Street or Dame Street – College Green – College Street – D'Olier Street – O'Connell Bridge – O'Connell Street	10/A 11/A 16/A 19/A 46A/B/C/D/E 121, 122, 123 Aircoach
Pearse Street to O'Connell Street	Pearse Street – College Street – Westmoreland Street – O'Connell Bridge – O'Connell Street	Pearse Street – Tara Street – Burgh Quay – O'Connell Bridge – O'Connell Street	1, 2, 3 4/A 7/A
Pearse Street Terminus	Pearse Street – College Street – Westmoreland Street – O'Connell Bridge – O'Connell Street	Burgh Quay – O'Connell Bridge – O'Connell Street	25/25A 66/A/B 67/A
Hawkins Street Terminus outbound	Hawkins Street – College Street – Dame Street	Strand Street – Capel Street – the Quays	37 39/A
Aston Quay Terminus	Dame Street (last stop) –(Out of service access) College Green – Westmoreland Street – Aston Quay	Bachelor's Walk – New Marlborough Street Bridge – Burgh Quay – Aston Quay	68 69 78/A 79/A
Eden Quay (Contra Flow) Terminus	Eden Quay – O'Connell Bridge – D'Olier Street – College Street	Eden Quay (east of Marlborough Street) – New Marlborough Street Bridge – Hawkins Street – College Street	15/A/B/C/F 49/A 54A 65/B 45 84/X
Bachelors Walk to south city	Bachelors Walk – O'Connell Bridge – D'Olier Street – College Street	Bachelors Walk – Eden Quay – New Marlborough Street Bridge – Hawkins Street – College Street	Xpresso services 83 92
O'Connell Street to south city via Townsend Street	O'Connell Street – O'Connell Bridge – D'Olier Street – Townsend Street	O'Connell Street – Abbey Street – Marlborough Street – New Marlborough Street Bridge – Hawkins Street – Townsend Street	3 13/A
Westmoreland Street to north city via Eden Quay	Westmoreland Street – O'Connell Bridge – Eden Quay – Beresford Place	Westmoreland Street – Fleet Street – Townsend Street – Tara Street – Butt Bridge – Beresford Place	Xpresso services 20B

St. Stephen's Green Stop
The existing bus stops located on St. Stephen's Green North will be unaffected by the construction worksite and there will be no direct impact on bus services in the locality.

Summary of impacts on bus services
The construction of the proposed scheme will necessitate a considerable level of change to the bus network in the city centre. The area around O'Connell Bridge has the highest concentration of bus services in the city centre. The Scheme Traffic Management Plan will mitigate the negative impact on bus services. The proposed restriction on general traffic in College Green will also mitigate the impacts on bus services. Access to bus stops will be critical to the continued operation of buses in the locality and major reorganisation and relocation of bus stops will be required. The impact on bus services will be Severe, without mitigation measures.

The construction of the proposed scheme will have a Severe impact on bus movements along the routes that experience an increase in traffic flow unless public transport mitigation measures are introduced.

7.4.6.2 Luas

The Luas Red Line runs across O'Connell Street at the Abbey Street junction. There will be no direct impact on services in the locality.

Similarly, the construction of the underground stop at St. Stephen's Green will not have a direct impact on the operation of the Luas Green Line Stop, and Luas services to St. Stephen's Green will continue uninterrupted during the proposed scheme's construction phase.

7.4.6.3 Taxi

The city centre is a major destination for taxi trips and there is a large volume of taxis in Area MN107. Taxi operations in and around the City Centre will be significantly impacted by construction works associated with the proposed scheme. This impact will arise from the need to relocate taxi ranks and the proposed introduction of contra flow bus lanes, in which taxis are prohibited.

Parnell Square Stop
There are no existing taxi ranks in the immediate vicinity of the Parnell Square Stop.

The retained lane on Parnell Square East will operate as a bus/ taxi only lane in the southbound direction. The impact on taxis as a result of the construction of the Parnell Stop will be Slight.

O'Connell Bridge Stop
The construction of the O'Connell Bridge Stop will affect the existing taxi ranks on Westmoreland Street and College Street. The taxi ranks at the northern end of O'Connell Street, Sackville Place and on Cathedral Street will remain unchanged. The rank located on the eastern side of Westmoreland Street, in front of the Westin Hotel, will be temporarily relocated to the western side of the street. The College Street rank will be removed and taxi services will be incorporated in the new Westmoreland Street rank.

Under the traffic management arrangements that will be in place during the construction phase, taxis will not be permitted to use the proposed contra flow bus lane southbound on O'Connell Street and O'Connell Bridge. Taxis travelling southbound on O'Connell Street will turn left onto Abbey Street and cross the river by way of the new bridge at Marlborough Street or by the Talbot Memorial Bridge.

Taxis travelling northbound from Dame Street will no longer travel north on Westmoreland Street and onto O'Connell Bridge. During construction they will be travel eastbound along College Street, turn left onto D'Olier Street and over O'Connell Bridge.

Taxis using the rank on the southern end of Westmoreland Street will travel north by way of Fleet Street onto Townsend Street and left onto Tara Street and across Butt Bridge.

St. Stephen's Green Stop
The construction of the stop at St. Stephen's Green will affect the existing taxi rank either side of St. Stephen's Green North, west of Dawson Street. The rank on St. Stephen's Green North will be relocated to a suitable location to ensure that service coverage is maintained. This replacement location has been sought in association with Dublin City Council, the taxi regulator and the taxi regulative groups.

Taxi accessibility to local business on St. Stephen's Green West during the construction phase will be agreed in consultation with key stakeholders and detailed in the Scheme Traffic Management Plan.

While the relocation of taxi stands for the St. Stephen Green area will have implications on taxi services, overall, the impact on taxis in Area MN107 will be Moderate.

7.6.5 Construction phase impact on cyclists

Parnell Square Stop
The existing cycle infrastructure on Parnell Square East, including cycle lanes and parking stands, will be removed during construction. Suitable locations for bicycle parking will be identified in conjunction with Dublin City Council.

O'Connell Bridge Stop
The centre median on the southern section of O'Connell Street will be removed between Bachelors Walk and Abbey Street to allow for the construction site, and between Abbey Street and Price's Street to allow for the proposed northbound traffic management arrangements. The possibility of relocating cycle parking facilities nearby will be examined prior to the commencement of works.

Furthermore, the cycle lane on the eastern side of O'Connell Street Lower will be removed during construction to provide for continued two-way traffic movements between O'Connell Bridge and Abbey Street. The loss of the cycle lane will negatively impact on cyclists in the city centre.

St. Stephen's Green Stop
All bicycle parking on St. Stephen's Green North and West will be removed during the construction phase and supplementary bicycle parking will be provided on South King Street.

During all phases of construction, the area around St. Stephen's Green North and West will become fully pedestrianised, requiring cyclists to dismount before travelling through this area. This is particularly important during Phase 1, where there will only be 3.6m between the hoardings and buildings on St. Stephen's Green North.

Overall, the impact on cyclists in this area should be Slight.

7.6.6 Construction phase impact on pedestrians

Pedestrian volumes in the city centre in the vicinity of construction sites are very high. As a result of the works areas required to accommodate construction, pedestrians will be adversely impacted in the vicinity of city centre stop locations, without mitigation measures. In the case of the O'Connell Bridge Stop, the requirement to reduce footpath widths will likely result in a reduced pedestrian level of service. Furthermore, the proposed closure of key pedestrian crossing points across the northern end of Westmoreland Street, and the southern end of O'Connell Street during periods in the construction programme is likely to appreciably compromise pedestrian safety in these areas unless appropriate mitigation is implemented.

One of the main indicators used to assess the pedestrian conditions on routes are the widely accepted Fruin Levels of Service (LoS). This LOS indicator rates the level of congestion based on a combination of pedestrian flow and density measures.

Fruin classifies six levels of service (A-F). At the highest level of service (A), pedestrians are able to select freely their own walking speed and to pass others. At the lowest level of service (F), the density is such that walking speeds are extremely restricted and forward progress can only be made by shuffling.

The specific issues affecting pedestrians at each of the city centre worksites are described below.

Parnell Square Stop
In the case of Parnell Square a footpath width of 2.2 metres will be provided on the eastern side of Parnell Square East. The western footpath on Parnell Square East will be removed. The removal of bus stops along the pavement on Parnell Square East will reduce pedestrian activity on the remaining pavement for pedestrian movements. It is anticipated that the level of service available will be C. The works area will also be designed such that access will be maintained to the Rotunda Hospital and the Garden of Remembrance.

O'Connell Bridge Stop
Construction phasing, at the O'Connell Bridge Stop, will have 12 distinct phases and a number of sub-phases. The impact of each construction phase is discussed below.

Impact of Construction Phases
As mentioned above, the construction works at the O'Connell Bridge Stop will be broken into a number of phases and sub-phases. The area around O'Connell Bridge is highly sensitive in terms of pedestrian movement. The pedestrian impact during construction will vary considerably, depending on the construction phase and the time of day. The key pedestrian impacts at the O'Connell Bridge Stop are summarised below. In all phases, the loss of some pedestrian crossing points at the junctions of O'Connell Street/ Abbey Street, O'Connell Street/ Bachelors Walk and Westmoreland Street/ D'Olier Street/ South Quays will adversely impact on pedestrian safety in these areas, which currently carry very high pedestrian volumes.

During all phases involving works on the east side of O'Connell Street, the footpath on the eastern side of O'Connell Street will be reduced to approximately 3m. This will reduce the capacity of the footpath considerably and will have a significant impact on the existing pedestrian flows during peak periods. The edge effect associated with the site hoarding will further reduce the effective width of this footpath. A pedestrian path will be provided to the west of the construction site, and this will help mitigate the impact of the reduced footpath widths on the building side footpath.

The most critical impacts on pedestrians will be as follows:

- The reduction of the western footpath on Westmoreland Street, which carries the highest volumes of pedestrians, to approximately 3m will reduce the capacity to cater for existing large pedestrian flows during peak periods. The edge effect associated with the site hoarding will further reduce the effective width of this footpath;
- The risk to pedestrian safety at the location of the proposed pedestrian crossing point, between works areas on Westmoreland Street in an area with turning goods vehicles.

The extent of works on Westmoreland Street will vary during different phases. For a period of construction there will be a loss of physical space for pedestrians to cross the northern end of the Westmoreland Street site. Without mitigation this will have a significant adverse impact on pedestrian safety along the strong east-west and west-east pedestrian desire line and will result in substantial numbers of pedestrians continuing to cross the outside of the site area. The interaction of high traffic volumes, including considerable numbers of HGV and bus flows along Burgh Quay and Aston Quay, with pedestrians in this area represents a substantial accident risk. Appropriate mitigation measures will be implemented to minimise risks to pedestrian safety.

During the final phases there will be a loss of physical space for pedestrians to cross the northern end of the O'Connell Street site, at the Abbey Street junction. Appropriate mitigation measures will be implemented to minimise risks to pedestrian safety in this area, in particular due to the proximity of the site to Luas operations.

There will be a number of obstructions which will impede pedestrian flow during construction, which will have a significant adverse impact on pedestrians however they will be temporary in nature. The scheduling of the construction phases has been designed to minimise the impact of construction on pedestrians. The pedestrian management plan will also go some way to mitigate construction impact.

Footpaths on O'Connell Street and Westmoreland Street will be reduced in width during various phases of the construction works. The presence of temporary site hoarding around the worksites will further reduce the capacity of the footpaths on O'Connell Street and Westmoreland Street.

Bus traffic will be routed through the central median on O'Connell Bridge in construction phases 1 to 8. This will result in reduction to footpath space on O'Connell Bridge, however widths of the footpaths on the west and east side of the bridge will not be reduced during construction.

During phases 5, 6 and 11 (including phase 11 sub-phases) there will be a loss of physical space for pedestrians crossing at the northern end of Westmoreland Street. Without appropriate mitigation this could have a significant impact on pedestrian safety.

During the final phases (Phases 12 and 12A) there will be a loss of physical space for pedestrians crossing at the northern end of the O'Connell Street site, at the Abbey Street junction. Without appropriate mitigation this could have a significant adverse impact on pedestrian safety in this area, given the proximity of the site to Luas operations. A summary of each construction phase is provided below.

In phases 11, 11C, 12 and 12A construction works will take place at the southern end of O'Connell Street, which will have a significant impact on east-west and west-east crossings at the junction with the North Quays.

Once the Contractor is appointed and detailed design is progressed, the Contractor will aim to minimise the impact of the works upon the pedestrian environment. Each phase of construction is described below and a summary of the impact of construction works, for each phase, on the pedestrian environment is provided in Table 7.25.

Phase 1

Phase 1 of construction will involve works on the east side of O'Connell Street. During this phase the width of the eastern footpath will be reduced from 8 metres to just over 3 metres. This will reduce the capacity of the footpath considerably and will have a significant impact on the existing pedestrian flows during peak periods.

A temporary footpath will be provided to the west of the worksite (between Abbey Street and the North Quays), which will be just over 3 metres in width. This will help mitigate the impact of the reduced footpath widths on the building side footpath.

The footpath on the west side of O'Connell Street will provide more capacity for pedestrians for north-south movements.

The southern worksite will be located on the east side of Westmoreland Street during phase 1. The worksite will be approximately 41 metres in length. The width of eastern footpath will be just over 3 metres, but the edge effect associated with the hoarding will reduce the effective width of the footpath further. The footpath on the west side of Westmoreland Street will be approximately 5.5 metres in width.

Phase 2

In phase 2 the O'Connell Street worksite will remain on the east side of O'Connell Street and the Westmoreland Street worksite will be move to the west side of Westmoreland Street. The width of the western footpath will be reduced to just over 3 metres as a result (for a length of approximately 41 metres), which will have a significant impact on pedestrian flow along the footpath on the west side of Westmoreland Street.

Phase 3
Works at the O'Connell Street site will continue on the east side of O'Connell Street in phase 3. Westmoreland Street worksite will move to the southern end of the west side of Westmoreland Street, at the junction with Fleet Street. The footpath on the west side of Westmoreland Street, adjacent to the worksite will be reduced to just over three metres in width.

In phase 3 a temporary crossing will be provided to the north of the worksite in an area of turning goods vehicles, which will have an impact on pedestrian safety.

Phase 4
In phase 4 construction activity will continue on the east side of O'Connell Street.

Construction works at the Westmoreland Street worksite will move to the east side of Westmoreland Street, at the southern end at the junction with Fleet Street. The width of the footpath will be reduced to around three metres, which will impact on north-south and south-north pedestrian movements on the east side of Westmoreland Street. The temporary crossing between to the north of the works will remain in place in phase 4.

Phase 5
In phase 5 there will be a loss of physical space for pedestrians crossing the northern end of the Westmoreland Street site. This will have a significant adverse impact on pedestrian safety along the strong east-west and west-east pedestrian desire line and will result in substantial numbers of pedestrians continuing to cross the outside of the site area. A temporary pedestrian crossing to the south of the works will be provided in phase 5.

The O'Connell Street worksite will be located on the east side of the street in phase 5.

Phase 6
The Westmoreland Street worksite will move to the west side of the street in phase 6, at the junction with Aston Quay. Works will continue at the northern end of Westmoreland Street, which will also result in the loss of the northern crossing, which will have a significant adverse impact on the east-west and west-east pedestrian flows.

The O'Connell Street worksite will remain on the east side of O'Connell Street in phase 6, however the site will be moved slightly south, closer to the junction with Eden Quay. Additional physical space will be provided for pedestrians to the north of the site as a result of the change to the worksite location.

Phase 7
In phase 7 the northern worksite arrangements will be the same as in phase 6. The Westmoreland Street worksite will increase in size and will be located on both sides of Westmoreland Street, at the junction with Fleet Street. The site will have a significant impact on pedestrian flow on both sides of Westmoreland Street during phase 7.

Phase 8
During phase 8, the O'Connell Street worksite will move further south to the junction with the North Quays. This will have a significant adverse impact on pedestrian movement at the two east-west and west-east crossings at the southern end of the site. Additional physical space will be provided for pedestrians at the northern end of the site due to the movement of the worksite to the south.

The Westmoreland Street worksite will stay at the southern end of the street and the site boundary will extend further onto the footpath on the west side of Westmoreland Street. This will result in a further reduction in the capacity of the footpath in phase 8 and will result in a significant impact on pedestrians.

Phase 9
In phase 9, the O'Connell Street works will take place on the west side of O'Connell Street, at the junction with Middle Abbey Street. During this phase the footpath on the west side of the street will be reduced by about 7 metres (from 10.5 metres to about 3.5 metres). This will have a significant adverse impact on both the north-south and south-north pedestrian desire line on the west side of O'Connell Street, as well as on the east-west and west-east crossing at the northern end of the site.

During phase 9, the Westmoreland Street works will be located at the northern end of the street. In this phase the width of the footpath on the east side will be reduced to just over three metres. The capacity of the footpaths on both sides of the street will be reduced due to the edge effect associated with the hoarding surrounding the site.

Phase 10
The O'Connell Street worksite will move southwards, to the centre of the west side of the street in Phase 10. Pedestrian flow on the west side of O'Connell Street will still be affected in Phase 10 due to the northern worksite location.

In phase 10 the Westmoreland Street worksite location will be the same as in phase 9, however the western site boundary will extend further onto the footpath on the west side of the street which will further reduce the capacity of the western footpath.

Phase 11
During phase 11, construction of the stop will occur at the northern end of Westmoreland Street. Construction will also take place on the west side of O'Connell Street, between Bachelors Walk and Middle Abbey Street.

Construction phase 11 is expected to be the peak construction phase and therefore the 'worst case' scenario. Phase 11 also includes three sub-phases for archaeological works.

There will be a loss of physical space for pedestrians to cross the northern end of the Westmoreland Street site in phase 11. This will have a significant adverse impact on pedestrian safety along the strong east-west and west-east pedestrian desire line and will result in substantial numbers of pedestrians continuing to cross the outside of the site area. The location of the worksite at the northern end of Westmoreland Street will also have a significant adverse impact on the north-south and south-north pedestrian flow on both sides of the street.

Phase 12
During the final phase there will be a loss of physical space for pedestrians to cross the northern end of the O'Connell Street site, at the Abbey Street junction. Without appropriate mitigation, this could have a significant adverse impact on pedestrian safety in this area, given the proximity of the site to Luas operations.

In the final phase there will also be a significant impact on the pedestrian crossing at the northern end of the Westmoreland Street crossing.

The overall impact of the construction phase on the pedestrian environment around O'Connell Bridge Stop would be temporary in nature, albeit for a four year period, and be of varying magnitude for the duration of construction. It is expected that impact on the pedestrian environment would be low during the initial phases of construction. However, during the peak period of construction (phase 11) pedestrians could experience increased delays and congestion due to the temporary increase in construction activity and vehicles.

Table 7.25 Matrix of Construction Impact on Pedestrian Environment at the O'Connell Bridge Worksites

Construction Stage	Location of works	Reduction of footway width: O'Connell Street (eastern footway)	O'Connell Street (western footway)	Westmoreland Street (eastern footway)	Westmoreland Street (western footway)	Aston Quay (southern footway)	O'Connell Bridge (central median)
1	O'Connell Street – east side Westmoreland Street – east side	√		√			√
2	O'Connell Street – east side Westmoreland Street – west side	√			√		√
3	O'Connell Street – east side Westmoreland Street – west side	√			√		√
4	O'Connell Street – east side Westmoreland Street – east side	√		√			√
5	O'Connell Street – east side Westmoreland Street – east side	√		√			√
6	O'Connell Street – east side Westmoreland Street – west side	√			√		√

Construction Stage	Location of works	O'Connell Street (eastern footway)	O'Connell Street (western footway)	Westmoreland Street (eastern footway)	Westmoreland Street (western footway)	Aston Quay (southern footway)	O'Connell Bridge (central median)
		Reduction of footway width					
7	O'Connell Street – east side Westmoreland Street – east and west side	√		√	√		√
8	O'Connell Street – east side Westmoreland Street – east and west side	√		√	√		√
8A	O'Connell Street – east side Westmoreland Street – east and west side	√		√	√		√
8B	O'Connell Street – east side Westmoreland Street – east and west side	√		√	√		√
9	O'Connell Street – west side Westmoreland Street – east and west side		√	√	√		
10	O'Connell Street – west side Westmoreland Street – east and west side		√	√	√		
11	O'Connell Street – west side Westmoreland Street – east and west side		√	√	√	√	
11A	O'Connell Street – west side Westmoreland Street – east + west side		√	√	√	√	
11B	O'Connell Street – west side Westmoreland Street – east and west side		√	√	√	√	
11C	O'Connell Street – west side Westmoreland Street – east and west side		√	√	√	√	

Construction Stage	Location of works	O'Connell Street (eastern footway)	O'Connell Street (western footway)	Westmoreland Street (eastern footway)	Westmoreland Street (western footway)	Aston Quay (southern footway)	O'Connell Bridge (central median)
		Reduction of footway width					
12	O'Connell Street – west side Westmoreland Street – east side		√	√			
12A	O'Connell Street – west side Westmoreland Street – east side		√	√			

St. Stephen's Green Stop
The pedestrian analysis undertaken for the construction phase of the St. Stephen's Green Stop with two escalator banks, located on St. Stephen's Green North and St. Stephen's Green West has been undertaken.

The main area of construction will include some of the northwest section of St. Stephen's Green, the footpaths adjoining it on St. Stephens Green between Dawson Street and Grafton Street, and St. Stephens Green West between Grafton Street and Glovers Alley.

During the construction phase of the St. Stephens Green Stop the site hoarding line around the construction sites will restrict the areas currently available to pedestrians. During the construction phase the hoarding lines will include some of the footpaths along St. Stephen's Green North/West and therefore there will be a need to maintain at least existing levels of service in these areas with effectively half the footpaths. This will be achieved by removing vehicular traffic access between St. Stephen's Green and Glovers Alley. The Fusiliers' Arch entrance to the park will be closed through all phase of construction. However access will be maintained in the vicinity of York Street and Dawson Street on St. Stephen's Green West and North respectively.

Each phase of construction is described below and a summary of the impact of construction works, for each phase, on the pedestrian environment is provided in Table 7.26.

Phase 1
In phase 1 the works area will include a portion of St. Stephen's Green Park up to the existing park boundary on St. Stephen's Green North and West. There will also be two additional construction areas which will be located around both of the escalator banks. On St. Stephen's Green North there will be two pedestrian circulation areas located between the buildings and the site hoarding line (approximately 3.5 metres) and the site hoarding line and the park boundary (approximately 3 metres). On St. Stephen's Green West the pedestrian area between the buildings and the hoarding line will be approximately 2.5 metres wide and the site hoarding line and the park boundary will be approximately 2.8m wide. Construction areas outside the confines of St. Stephen's Green itself will be for approximately 100m on St. Stephen's Green North and 50m on St. Stephen's Green West.

Phase 2
In phase 2 the site hoarding line will continue to contain a portion of St. Stephen's Green Park and will extend from the park to include sections of the existing footpaths on St. Stephen's Green North and West (park side). It will also include an area representing the approximate location of the existing signalised pedestrian crossing linking Fusiliers' Arch and Grafton Street. The minimum distance between the site hoarding line and the buildings on St. Stephens Green North will be approximately 6 metres and St. Stephens Green West will be approximately 5 metres, however these widths represent localised narrowing at a single point only on St. Stephens Green North and West. In this construction phase the park side footpaths on St. Stephens Green North and West are closed.

Phase 3
In construction phase 3, construction will occur within the park boundary only. There will be no significant effect on pedestrians during this phase, although it is noted that pedestrian flows on St. Stephens Green North and West will increase as a result of the closure of the pedestrian route through the park, however these will not have a significant impact on these areas given that existing footpath widths on the park side are very generous at approximately 4.5 metres relative to existing pedestrian volumes (during the Saturday afternoon peak, these are a maximum of 2,100 = LOS B on St. Stephens Green North park side footpath). Construction Phase 3 will therefore not be critical in terms of pedestrian impact in the vicinity of the St. Stephens Green Stop.

In terms of the pedestrian impact, a pedestrian mid-LOS D will be experienced during Construction phases 1 and 2 during the critical time periods assessed, however it is during phase 1 where pedestrians will experience the greatest impact, as this will be experienced over a longer distance (approximately 100 meters on St. Stephen's Green North and approximately 50 meters on St. Stephen's Green West).

When compared to the existing pedestrian experience in the vicinity of the station, Grafton Street on a Saturday afternoon currently experiences a mid-LOS D. In no case is the level of service around the St. Stephen's Green construction site substantially worse than that which is currently experienced on Grafton Street during the Saturday afternoon peak. This is conservatively viewed as the maximum level of service that would be considered tolerable on each footpath during the construction period. On this basis, it is considered that the construction works will not represent an unacceptable pedestrian environment.

In summary, the results of the pedestrian assessment indicate that adequate space will be provided on St. Stephen's Green North and West to accommodate pedestrian circulation requirements during the critical time periods of the weekday morning and Saturday afternoon peaks. In no instances, will the pedestrian level of service exceed a D, which is the same level of service as that currently experienced on Grafton Street during the Saturday afternoon peak.

Pedestrians will, however experience some deterioration in their pedestrian environment as a combined result of reduced pedestrian areas and increased pedestrian volumes.

The table below summarises the impact of construction on the pedestrian environment around the St. Stephen's Green Stop.

Table 7.26 Matrix of Construction Impact on Pedestrian Environment at the St. Stephen's Green Worksites

		Reduction of footway width					
Construction Stage	Location of Works	St. Stephens Green West (western footpath)	St. Stephens Green West (eastern footpath)	St. Stephens Green North (northern footpath)	St. Stephens Green North (southern footpath)	St. Stephens Green (internal footpaths)	Grafton Street (southern end)
1	St. Stephen's Green North and West and Park	√	√	√	√	√	
2	St. Stephen's Green North and West and park		√	√	√	√	√
3	St. Stephen's Green Park					√	

7.6.7 Construction phase issues impacting safety and the mobility impaired

The specific issues in relation to the construction of the proposed scheme on mobility impaired persons at each of the city centre worksites are described below.

Parnell Square Stop
The presence of two hospitals – The Rotunda and Temple Street – in the immediate vicinity leads to higher than average numbers of mobility impaired people at the site. Consideration should also be given to the presence of a crèche on the eastern side of Parnell Square East. Consequently, adequate provision of facilities for those with reduced mobility is extremely important.

Under the current outline construction methodology, a 2.2m wide temporary footpath will be constructed on the eastern side of the worksite. The reduced footpath width of 2.2 metres may create a difficult environment for mobility impaired in this area. The impact, therefore, is considered to be Moderate to Severe, without mitigation. The removal of the bus stops along Parnell Square East will provide some level of mitigation.

O'Connell Bridge Stop
The accident data provided by An Garda Síochána has shown that between 2002-2006, there were 24 accidents involving pedestrians in the vicinity of O'Connell Bridge, of which 3 resulted in serious injury. This classifies O'Connell Bridge as a sensitive area with regards to pedestrian safety.

The level of service on the footpaths in the area of the O'Connell Bridge worksites is generally good (levels A to C), and should not form any barrier to movement for those with reduced mobility. The greatest issue will be the levels of congestion experienced when crossing in a north-south direction at O'Connell Bridge. During the peak period of construction, these crossings will experience reduced levels of service of D, E, or F. The difficulty is compounded by the wide crossing distances (particularly on the south side. As a result of this reduced level of service it is likely that the impact on mobility impaired persons will be Moderate to Severe. Appropriate mitigation measures will be developed and implemented to minimise the impact.

St. Stephen's Green Stop
This area experiences very high levels of pedestrian movements due to the presence of Grafton Street and the Luas Green Line Terminus. During the construction phases pedestrians would be rerouted away from the park side of St. Stephen's Green North and West and onto the shop side of the same streets. However, modelling predicts that during both the weekday AM peak and the Saturday afternoon peak, the levels of congestion do not exceed those currently experienced (LOS B to D). Given the level of service available in the area for pedestrians during construction the impact on those with reduced mobility will be Slight.

7.7 PREDICTED LOCAL OPERATIONAL IMPACT – AREA MN107

7.7.1 Operational impact area

The strategic, or city wide, operational impact of the proposed scheme has demonstrated that there will be beneficial traffic impacts as a result of the mode shift from car to the proposed scheme. Generally in a confined area such as the city centre, where road space is at a premium and there are existing traffic management arrangements in place restricting traffic movement, the beneficial impact of the proposed scheme will be marginal as road space is taken up by other vehicles that cannot avail of the benefits of the proposed scheme.

The operational impact of the proposed scheme on traffic within Area MN107 will be mainly related to vehicle re-assignment across the road network. In other words, vehicles with different origins and destinations will utilise the road space freed up by the modal shift generated by the proposed scheme. There will, therefore, be an indirect benefit to those drivers who are outside the catchment area of the proposed scheme in that they will benefit from a freeing up of road space. An additional benefit is that there will be a contraction of the peak period as drivers will re-time their trip making.

There will also be some benefit to bus movement through this area (because bus operations do not suffer the same restrictions as general traffic).

The impact on HGV traffic is not included as HGV movements in the City Centre are controlled by Dublin City Council's HGV Traffic Management Strategy. The HGV ban is assumed to remain in place in future years. It is, therefore, assumed that the proposed scheme has very little impact on HGV traffic.

It is predicted that the three city centre stops will experience the highest volumes of passengers arriving and departing. The impact of the proposed scheme on pedestrian movements in the locality will be augmented by the pulse arrival pattern of passengers leaving the stops.

The proposed scheme, once operational, will not necessitate major changes to the current city centre traffic management arrangements. There are some traffic management arrangements which will remain in place during operation of the proposed scheme.

- Access to vehicular traffic from St. Stephen's Green North to Glovers Alley will remain closed. This arrangement will allow for the creation of a pedestrian plaza at the northwest corner of St. Stephen's Green which will facilitate the large numbers of pedestrians predicted in the locality of the stop. The access arrangements proposed in the construction phase of the proposed scheme will remain;

- Access to Fleet Street between Westmoreland Street and Price's Lane will also remain closed and vehicles will continue to access the area from the South Quays via Aston Place.

For the purposes of this assessment it has been assumed that traffic management within the city centre will revert to their arrangements prior to the construction of the proposed scheme. This will provide the clearest indication of the direct impact of the proposed scheme as the only changes to the transportation network will be as a result of the proposed scheme itself.

It should be noted however, that as the construction period will be of considerable duration and after such a period, it may not be appropriate to return the traffic management within Area MN107 to the current arrangements.

7.7.2 Operational phase impact on general traffic

7.7.2.1 General traffic flows

The presence of the proposed scheme will have only a Slight impact on general traffic patterns within the city centre. Traffic Model analysis indicates that there would be marginal differences in the order of 50 cars per hour along certain links between the do-minimum and the do-something scenarios in 2014, which increases to approximately 100 cars per hour by 2029. Minor decreases in traffic flows are predicted for Gardiner Street, Amiens Street, Bachelor's Walk, Dame Street and Clanbrassil Street.

Consequently, the operation of the city centre traffic network would alter, leading to minor increases in traffic along other links. A small number of roads in the north inner city would experience minor increases in traffic flow, the most notable of which would be increases of around 100 to 150 cars per hour on Summerhill.

Overall the impact of the operation of the proposed scheme on traffic flows within the City Centre is Slight.

7.7.2.2 Average general traffic speeds

Average general traffic speeds in the AM peak hour (08:00 to 09:00) would remain unchanged at 7.3kph between the 2014 do-minimum scenario and the do-something scenario. However, during off peak periods the model indicates that average car traffic speeds would decrease slightly by 3.4% in 2014 during the representative off-peak hour (14:00 to 15:00).

By 2029, average car speeds are predicted to increase from 4.9kph in the do-minimum scenario to 5.4kph when the proposed scheme is operational. This represents a 10.2% increase in average car speeds during the AM peak hour. The majority of this increase can be attributed to the influence of the proposed scheme on mode share and the overall reduction in the number of car trips within the whole network. During the off-peak traffic speeds are predicted to remain unchanged.

The levels of traffic in the city centre, and hence the average traffic speeds in the area, are influenced by traffic conditions in the surrounding areas and the Greater Dublin Area as a whole. The city centre is a very congested network and unless considerable changes are made to traffic management, it would continue to be heavily congested in 2014 and 2029. Relatively small changes in traffic volumes can result in substantial changes in average speeds because the network is operating near or over capacity in certain locations during the peak hours.

The impact of the operation of the proposed scheme on average traffic speeds in the city centre would be largely neutral, except in the AM peak hour for which there would be a Slight positive impact by 2029.

7.7.2.3 Deliveries, loading and unloading arrangements

The traffic management throughout the city centre will revert to its current configuration after the completion of the proposed scheme's construction. With the exception of the vehicular access on St. Stephen's Green North, west of Dawson Street, all roads and loading bays will be reinstated. Therefore the impact on deliveries, loading and unloading is generally neutral.

St. Stephen's Green Stop
At present, most of the deliveries/loading/unloading for the businesses in this locality occur on Grafton Street and South King Street between the hours of 06:00 and 11:00hrs. Vehicles are permitted to load and unload on these pedestrianised streets during this time. During the operational phase of the proposed scheme it is proposed that loading will occur on Grafton Street and South King Street as it does at present, with vehicles gaining access to properties on St. Stephen's Green North during permitted hours. The impact on deliveries and loading will be neutral.

7.7.2.4 Car park access arrangements

During the operational phase of the proposed scheme, car park access will generally return to current arrangements, except for the following:

- Access to Fleet Street Car park will continue to be provided from South Quays via Price's Lane;
- Access to St. Stephen's Green, College of Surgeons, Fitzwilliam Hotel and Drury Street car parks will continue to approach from the north via William Street South and from the south via York Street.

Overall, the impact on car park access within Area MN107 will be neutral.

7.7.2.5 Emergency vehicle access arrangements

Emergency vehicles will benefit from the reduced traffic in the city centre resulting from the mode shift from car to the proposed scheme. The predicted outcome of reduced journey times will positively impact on the provision of emergency services.

Emergency access to the city centre stops will be provided by dedicated fire-fighting lifts that provide direct connections between all levels and the surface. These will be located on the western footpath of Parnell Square East, on O'Connell Street Lower and Westmoreland Street, and within St. Stephen's Green Park.

7.7.3 Operational phase impact on public transport

7.7.3.1 Bus and Luas

Parnell Square Stop
For the purposes of this assessment, it is assumed that the existing bus services along Parnell Square East will be reinstated. The introduction of the services associated with the proposed scheme will greatly enhance public transport in the locality of the stop at Parnell Square. The proximity of the stop to a large number of bus services will allow for convenient transfer between the two public transport modes. Destinations around Parnell Square will benefit from the high quality public transport offered by the proposed scheme. Overall the impact on public transport will be very positive.

O'Connell Bridge Stop
The surface access to the O'Connell Bridge Stop on Westmoreland Street is likely to have an impact on existing bus stop arrangements. The location of the escalator banks along the roadside section of the footpath will necessitate the relocation of existing bus stops. However, for the purposes of this assessment, it is assumed that the existing bus service arrangements along Westmoreland Street will be reinstated.

The proximity of the stop to a large number of bus services will allow for convenient transfer between the two public transport modes. In addition, within a short walking distance, passengers will be able to interchange with the Luas Red line at Abbey Street and DART and outer suburban rail lines at Tara Street Station. The retail, employment and recreational facilities around the O'Connell Bridge Stop will benefit from the high quality public transport offered by the proposed scheme. Overall the impact on public transport will be very positive.

St. Stephen's Green Stop
The existing public transport infrastructure in the vicinity of the St. Stephen's Green Stop will be unaltered by the construction or operation of the proposed scheme. The proximity of the stop to a large number of bus services on St. Stephen's Green North and Dawson Street will allow for convenient transfer between the two public transport modes. In addition, western access to the stop will be adjacent to the Luas Green Line stop at St. Stephen's Green, enhancing the interconnectivity of the public transport modes. The retail, employment and recreational facilities in the locality will benefit from the high quality public transport offered by the proposed scheme.

In the 2029, it is assumed that the Interconnector and Luas Line BX will both be in operation with stops at St. Stephen's Green. St. Stephen's Green will function as a major public transport hub with excellent interchange facilities between many public transport facilities. The location of the stop in this locality will be highly beneficial to Dublin's transportation network.

7.7.3.2 Taxi

Parnell Square Stop
With the traffic management in the city returning to the current configuration, the impact on taxi services will be neutral.

O'Connell Bridge Stop
Once construction of the proposed scheme is completed and the city centre traffic management reverts to the current formation, these ranks can be reinstated. Therefore, the impact on taxi services in the locality is neutral.

St. Stephen's Green Stop
The rank on St. Stephen's Green North, will be relocated to a suitable location to ensure that service coverage is maintained in this area. This replacement location will be agreed with key stakeholders.

The eastbound only movement on Glover's Alley exiting southbound on St. Stephen's Green West towards York Street will remain in place to facilitate set down for the Fitzwilliam Hotel.

The impact on taxi services in the locality is likely to be Slight.

7.7.4 Operational phase cyclist impact

Parnell Square Stop
The existing cycle infrastructure on Parnell Square East, including cycle lanes and parking stands, will be reinstated prior to the commencement of operation of the proposed scheme. With the traffic management in the city returning to the existing situation, the impact on cyclists will be neutral.

O'Connell Bridge Stop
The existing cycle parking facilities will be reinstated prior to the commencement of operation of the proposed scheme. However, the existing cycle lanes on O'Connell Street Lower will not be reinstated during the operation of the proposed scheme. This cycle lane is currently well used, and its removal will result in a Moderate impact on cyclists.

St. Stephen's Green Stop
The existing cycle parking facilities will be reinstated prior to the commencement of operation of the proposed scheme. New and replacement cycle parking will also be provided in the proximity of the stop. The impact on cyclists will be neutral.

7.7.5 Operational phase pedestrian impact

Parnell Square Stop
The underground stop at Parnell Square will be served by two main access points, both of which will be located along the western side of Parnell Square East. Two sets of escalators will provide the principal means of access for passengers. Lifts will be provided in close proximity to the escalators to provide access for the mobility impaired.

The footpaths on the western side of Parnell Square East will be widened to accommodate the stop accesses and to provide adequate footpath space for the additional pedestrian movements generated by the proposed scheme's passengers. Therefore the impact of the proposed scheme on pedestrian movements in the locality of the Parnell Square Stop will be slightly positive.

O'Connell Bridge Stop
The underground stop at O'Connell Bridge will be one of the largest stops along the alignment of the proposed scheme and will be served by three main access points. Banks of escalators will provide the principal means of access for passengers. Lifts will be provided in close proximity to the escalators to provide access for the mobility impaired. One main access point will be located on the western side of Westmoreland Street between Fleet Street and Aston Quay; this will provide access from the south, southeast and southwest of the stop. The second main access will be located on the western side of O'Connell Street between Bachelors Walk and Abbey Street; this will provide access from the north and northwest. The final main access will be located on the opposite side of O'Connell Street between Eden Quay and Abbey Street; this will provide access to the north and north east. In addition, this access will be in close proximity to the Luas Red Line stop at Abbey Street and it will serve passengers transferring between the two lines.

The existing pedestrian crossings on Westmoreland Street, around O'Connell Bridge and on O'Connell Street will facilitate pedestrian movement to and from the stop. The traffic management will be reinstated after completion of the proposed scheme's construction and the existing junction layouts and signal configuration, including pedestrian phases, will be restored.

The O'Connell Bridge Stop is predicted to be one of the busiest along the alignment of the proposed scheme. There is a high concentration of destinations and trip generators within the catchment area of the station. In addition, there is a wealth of other public transport modes within easy walking distance including, the Luas Red Line stop on Abbey Street, Dart and outer suburban rail services at Tara Street and numerous bus services on Westmoreland Street, D'Olier Street, the Quays and O'Connell Street itself. It is predicted that the stop at O'Connell Bridge will generate a very high number of pedestrian movements as passengers arrive.

At present, there is a very high level of pedestrian activity in the locality. Although pedestrian volumes are consistently high throughout the day there are peak periods when pedestrian flows increase. There is considerable retail activity in the area and O'Connell Street / Westmoreland Street acts as a thoroughfare for pedestrian movements between the north and south shopping areas. As such, Saturday afternoons are particularly busy periods for pedestrian movements. In addition, during the evening weekday peak period there are very high volumes of pedestrians accessing bus stops in the locality, particularly along Westmoreland Street. The number of people waiting for bus services can increase pedestrian congestion to a large extent.

As part of the proposed scheme, the existing footpaths on the western side of Westmoreland Street will be widened to accommodate the stop accesses and to provide additional footpath space for the increase in pedestrian movements generated by the proposed scheme's passengers. The escalators on O'Connell Street will be positioned within the existing footpaths. The existing footpaths on O'Connell Street are very wide and the proposed escalators can be accommodated without undue negative impact on pedestrians.

Overall, the impact of the proposed scheme on pedestrian congestion is likely to be Moderate in the vicinity of the O'Connell Bridge Stop.

There will be three street entry/exits to O'Connell Bridge Stop, two at the northern end (on the east and west sides of O'Connell Street) and one at the southern end (on the west side of Westmoreland Street).

The footpaths on the east and west sides of O'Connell Street will be widened, which will be provide additional capacity for the pedestrian demand generated from the O'Connell Bridge Stop as well as background pedestrian flow.

The impact of increased pedestrian flows and patterns associated with the operational phase of the O'Connell Bridge Stop would typically not result in an impact greater than low other than in terms of pedestrian crossings close to the stop where there would be some occurrences of Moderate impact.

St. Stephen's Green 2014
The underground stop at St. Stephen's Green will be served by two main access points. Banks of escalators will provide the principal means of access for passengers. Lifts will be provided in close proximity to the escalators to provide access for the mobility impaired. One main access point will be located near the existing Luas Green Line platforms; this will facilitate passengers transferring between the two lines as well as providing access to the local area. The second main access will be located on St. Stephen's Green North near the junction with Dawson Street. The relative position of the main access points will provide for a high level of access from a variety of directions.

During the operational phase the requirements for pedestrian movement, in particular, will intensify from the current situation. The St. Stephen's Green Stop itself will bring new pedestrians into the area. The location of the stop at St. Stephen's Green will have some impact on pedestrians. Surveys indicate that pedestrian movements of up to 20,000 per hour (two-way total) can be experienced during the busiest peak time on a Saturday.

During the operational phase the requirements for pedestrian movement will intensify from the current situation. There will be peak periods of demand. Grafton Street has the highest level of retail activity of any street in Dublin and pedestrian volumes peak during peak shopping hours including Saturday afternoons and Thursday evenings.

A large proportion of passengers currently using the Luas Green Line will interchange with the proposed scheme (and vice versa).

The closure of the vehicular access between St. Stephen's Green and Glovers Alley will allow for the creation of a pedestrian plaza at the northwest corner of St. Stephen's Green. The area will become a pedestrian friendly environment where pedestrians are free to circulate between Grafton Street, South King Street, St. Stephen's Green North (west of Dawson Street) and St. Stephen's Green West (north of York Street). In addition to providing very high quality pedestrian infrastructure, the plaza will facilitate the safe and easy interchange between the proposed scheme, Luas and Interconnector services. Overall, with the plaza improvement the impact on pedestrians in this area will be neutral.

St. Stephen's Green 2029
In 2029, the Interconnector will be operation with a station at St. Stephen's Green. The Interconnector station will be fully integrated with the St. Stephen's Green Stop and there will be direct access for passengers to transfer between the two lines. As the Interconnector station and St. Stephen's Green Stop will be linked underground, non-transferring Interconnector passengers could use the proposed scheme's escalators. The additional demand generated by passengers interchanging between the proposed scheme and Interconnector will have a Slight to Moderate impact on pedestrians exiting the proposed scheme's accesses.

7.7.6 Operational issues impacting safety and the mobility impaired

7.7.6.1 Predicted operational impact on the mobility impaired

The specific issues in relation to the operation of the proposed scheme on mobility impaired persons at each of the city centre stops are described below.

Parnell Square Stop
The increased levels of pedestrian activity on Parnell Square East due to the operation of the proposed scheme are not sufficient to impact on the current levels of service. Consequently, ease of movement through the area for the mobility impaired will be maintained at the existing level. Access to the Stop for the mobility impaired will be provided for by means of two lifts on the western footpath.

O'Connell Bridge Stop
Pedestrian modeling predicts free-flowing pedestrian movement on the footpaths around the stop. Facilities will be provided to accommodate mobility impaired movement. The impact will be Slight.

St. Stephen's Green Stop
The main increase in pedestrian activity within the study area will be around Grafton Street/South King Street and its access to the St. Stephen's Green Stop. The level of service in this area during the operation of the proposed scheme will be similar to that currently experienced, except along St. Stephen's Green North, which experiences less congestion due to the increased effective footpath width. Access for the mobility impaired will be provided for by the provision of lifts on St. Stephen's Green West, close to the junction with Grafton Street.

7.8 RESIDUAL LOCAL IMPACT – AREA MN107

The predicted local impact of the proposed scheme during both the construction and operational phases is detailed in the previous sections. These impacts can be mitigated by introducing further mitigation measures at the local level, as detailed below. Finally, the residual local impacts which remain after the introduction of these measures are shown in Table 7.27.

7.8.1 Further local construction mitigation measures

General traffic mitigation measures

- The Scheme Traffic Management Plan will be implemented for the city centre to ensure that the construction impact of the proposed scheme is kept to a minimum. This plan will have from all relevant stakeholders including RPA, Dublin City Council, Dublin Bus, DCBA etc; The plan will address access to car parks, loading and unloading, bus stop infrastructure, taxi stands;
- A phasing plan will be prepared to ensure that all critical phases do not coincide. This would reduce the volume of construction traffic on the network at any one period in time;
- On contract award the Contractor will further develop construction vehicle routing arrangements in line with project programme and the evolving construction methodology. The Scheme Traffic Management Plan will be updated to reflect this.

Pedestrian/cyclist mitigation measures

- Pedestrian diversions will be in operation and the existing pedestrian infrastructure will be replaced by temporary routes that replicate the existing facilities as far as possible;
- Measures to minimise risk to pedestrian and cyclist safety will be developed and implemented through the construction phase.

7.8.2 Further local operational mitigation measures

General transport mitigation measures

- The Dublin City Council urban traffic signal control system will be used to optimise the flow of traffic along the routes, particularly during peak traffic times, to reduce the impact of queuing and delay during the operational phase;
- Bus stop facilities will be provided within close proximity of St. Stephens' Green, O'Connell Street and Parnell Square Stops;

Pedestrian/cyclist mitigation measures

- In general, the proposed scheme will lead to a greatly improved environment for pedestrians and cyclists. Following construction, pedestrian and cyclist safety will continue to be dealt with through an awareness campaign as is the approach with Luas and in other countries.

7.8.3 Residual local construction impacts

The localised impacts resulting from the proposed scheme construction in Area MN107 have been described above. By applying the further local mitigation measures, the severity of these impacts will be significantly reduced, as outlined in the Table 7.27 below.

Typical Light Metro Vehicle (LMV)

Table 7.27 Construction impact, further mitigation and residual local impacts

Impact ID	Location	Source of impact	Description of local impact	Strategic mitigation measures	Possible further local mitigation	Residual local impact
MN107/ T01	City Centre	Road capacity reduction as a result of the construction sites	Redistribution of general traffic away from construction sites and the impact of these routes.	Traffic management arrangements including Marlborough Street Bridge, College Green traffic plan and general re-routing of traffic away from sites to Inner and Outer Orbital Routes	The Scheme Traffic Management Plan identifies further traffic management measures to improve the movement of general traffic in the city centre area and on the orbital routes.	The residual impact will be Moderate post introduction of mitigation
MN107/ T02	Dawson Street	Additional construction vehicle traffic on the network.	Construction vehicles using Dawson Street and the sensitive nature of the environment	Phasing and sequencing of construction works	The Scheme Traffic Management Plan addresses an appropriate phasing schedule for construction vehicle activities and construction works areas.	The residual impact will be Moderate post introduction of mitigation
MN107/ T03	City Centre	Bus movement	The decrease in bus speeds through the city centre as a result of the construction sites.	Traffic management arrangements including public transport only bridge linking Marlborough Street to Hawkins Street, College Green traffic management plan facilitating bus movement and general re-routing of traffic away from sites to Inner and Outer Orbital Routes.	The Scheme Traffic Management Plan identifies further traffic management measures to improve the movement of buses through the affected areas.	The residual impact will be Moderate post introduction of mitigation

Appropriate measures to minimise risk to pedestrian and cyclist safety will be developed and implemented through the construction phase.

7.8.4 Residual local operational impacts

The proposed scheme has been designed to minimise the impact on all road users in its vicinity. The overall impact will be slightly positive, and therefore no operational mitigation measures are required.