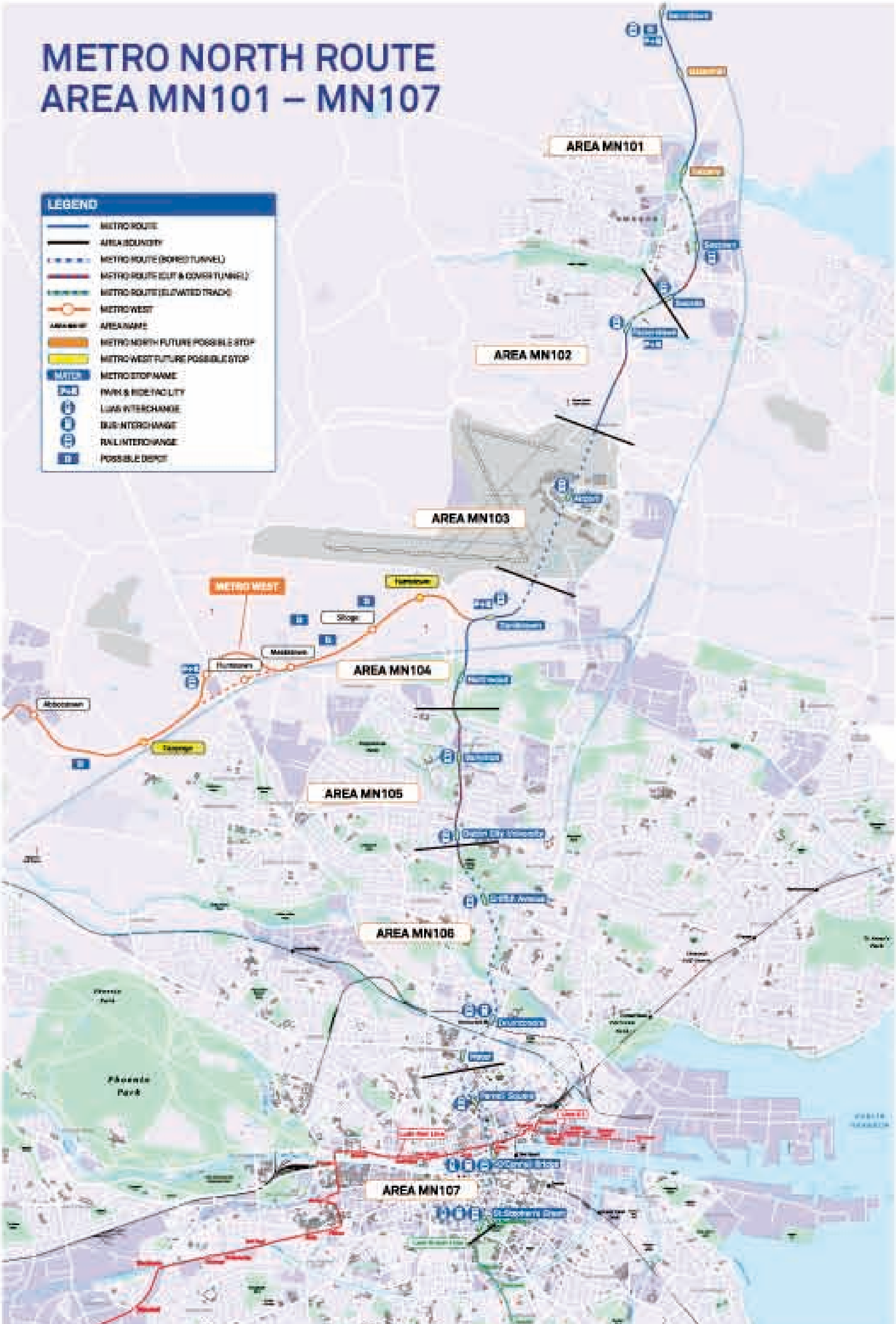
ENVIRONMENTAL IMPACT STATEMENT – METRO NORTH

DUBLIN AIRPORT

AREA MN103 (PART 1 – CHAPTER 1 to 5)

VOLUME 2 – BOOK 3 OF 7


METRO NORTH ROUTE
AREA MN101 – MN107
LEGEND
METRO ROUTE
AREA BOUNDARY
METRO ROUTE (BORED TUNNEL)
METRO ROUTE (CUT & COVER TUNNEL)
METRO ROUTE (ELEVATED TRACK)
METRO WEST
AREA NAME
METRO NORTH FUTURE POSSIBLE STOP
METRO WEST FUTURE POSSIBLE STOP
METRO STOP NAME
PARK & RIDE FACILITY
LUAS INTERCHANGE
BUS INTERCHANGE
RAIL INTERCHANGE
POSSIBLE DEPOT
AREA MN101
AREA MN102
AREA MN103
AREA MN104
AREA MN105
AREA MN106
AREA MN107
METRO WEST
Abbotstown
Phoenix Park

ENVIRONMENTAL IMPACT STATEMENT – METRO NORTH

DUBLIN AIRPORT

AREA MN103

VOLUME 2 – BOOK 3 OF 7

National Development Plan 2007 - 2013

Railway Procurement Agency

ENVIRONMENTAL IMPACT STATEMENT

For ease of local identification this Environmental Impact Statement (EIS) has been divided into seven areas. These areas are numbered Area MN101 to Area MN107 inclusive going from Belinstown in north County Dublin to St. Stephen's Green in the city centre.

The environmental impact of the proposed scheme in each of these areas is set out in individual books numbered MN101 to MN107 and which collectively make up Volume 2 of this EIS.

The Environmental Impact Statement (EIS) is being published in three separate Volumes as follows:

VOLUME 1

Introduction to the scheme and a description of the receiving environment

Volume 1 of the EIS is set out in 25 Chapters as follows:

Chapter 1 Introduction

Chapter 2 Need and Objectives

Chapter 3 Legislation

Chapter 4 Planning and Policy Context

Chapter 5 Alternatives

Chapter 6 Description of the Scheme

Chapter 7 Consultation

Chapter 8 Human Health

Chapter 9 Difficulties Encountered

Chapter 10 – 25
Description of the baseline environment

VOLUME 2

Environmental Impact – Area MN101

Environmental Impact – Area MN102

Environmental Impact – Area MN103

Environmental Impact – Area MN104

Environmental Impact – Area MN105

Environmental Impact – Area MN106

Environmental Impact – Area MN107

Volume 2 of the EIS is set out in 18 Chapters as follows:

Chapter 1 Introduction to Areas MN101 -107

Chapter 2 Human Beings: Landuse

Chapter 3 Human Beings: Socio-economics

Chapter 4 Human Beings: Noise

Chapter 5 Human Beings: Vibration

Chapter 6 Human Beings:
Radiation and Stray Current

Chapter 7 Human Beings: Traffic

Chapter 8 Flora and Fauna

Chapter 9 Soil and Geology

Chapter 10 Groundwater

Chapter 11 Surface Water

Chapter 12 Air and Climatic Factors

Chapter 13 Landscape and Visual

Chapter 14 Material Assets: Agronomy

Chapter 15 Material Assets: Archaeology,
Architectural Heritage and Cultural Heritage

Chapter 16 Material Assets:
Non Agricultural Property

Chapter 17 Material Assets: Utilities

Chapter 18 Interrelationships, Interactions
and Cumulative Impacts

VOLUME 3

Book 1 of 2
Specialist maps – baseline and impact

Book 2 of 2
Annexes to the EIS

Volume 3 of the EIS is set out in 2 books.

Book 1 of 2 contains all baseline and impact assessment maps and Book 2 of 2 contains annexes to the EIS e.g. technical reports.

EIS NON-TECHNICAL SUMMARY (NTS)

EIS METHODOLOGY

The methodology used in this EIS generally involves the following steps:

- Definition of the study area;
- Data collection and description;
- Baseline description and evaluation;
- Identification of potential environmental impacts and the potential areas to be affected;
- Description and evaluation of the impacts;
- Derivation of mitigation measures to minimise the impact;
- Description of the residual impacts of the scheme.

Further detail in relation to the EIS methodology is provided in Volume 1 of the EIS.

ENVIRONMENTAL IMPACT STATEMENT STUDY TEAM

The EIS was prepared on behalf of the Railway Procurement Agency (RPA) by a study team led by Environmental Resources Management (Ireland) Ltd, who were responsible for the overall assessment management and co-ordination as well as for the production of the Landuse, Socio-economics, Noise, Vibration (part), Radiation and Stray current, Flora and Fauna, Soil and Geology (part), Air and Climatic factors, Non Agricultural Property and Utilities chapters of this EIS. The other members of the study team are outlined in the table below.

AVAILABILITY OF THE EIS

This EIS is available to download for free through the RPA website at www.dublinmetronorth.ie

Copies of this EIS including the Non-Technical Summary may be purchased by any member of the public during normal office hours at the following location:

Railway Procurement Agency (RPA)
Parkgate Street
Dublin 8

The EIS may be purchased as a complete document for a sum of €170.00 (Volumes 1, 2 & 3)

The EIS can also be purchased as individual books e.g:

- Copies of Volume 1 may be purchased for €30.00 each;
- Copies of Volume 2 (individual book e.g. MN101) may be purchased for €15.00 each;
- Copies of Volume 3 (individual books e.g. Book 1 of 2) may be purchased for €15.00 each;
- Copies of the NTS of this EIS may be purchased for €5.00 each.

A DVD version of the whole EIS may be purchased for €15.00 which includes Volume 1; Volume 2 (Area MN101 – MN107); Volume 3 (Book 1 of 2 and Book 2 of 2) and the Non-Technical Summary.

Input	Contributor
Human Health	EHA Consulting Group
Human Beings: Vibration	Rupert Taylor F.I.O.A
Human Beings: Traffic	MVA Consulting
Soil and Geology	Jacobs Engineering Ireland Ltd.
Groundwater	AWN Consulting
Surface Water	AWN Consulting
Landscape and Visual (photomontages)	Digitech
Material Assets: Agronomy	Curtin Agricultural Consultants
Material Assets: Archaeology, Architectural Heritage and Cultural Heritage	CRDS Ltd.

CONTENTS

01 INTRODUCTION TO AREA MN103

Metro North is the next phase of Dublin's integrated light rail network. The proposed scheme will serve an 18km corridor from Belinstown in the north of County Dublin to St. Stephen's Green in the city centre via Dublin Airport.

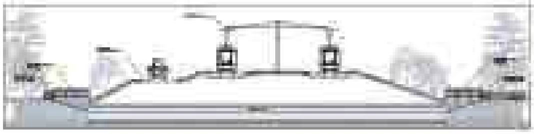
Metro North is the next phase of Dublin's integrated light rail network. The proposed scheme will serve an 18km corridor from Belinstown in the north of County Dublin to St. Stephen's Green in the city centre via Dublin Airport. Metro North is a light rail system running on a line of sight basis, at grade, in underpasses or on elevated sections between Belinstown and Fosterstown and under full signal control on a segregated alignment between Fosterstown and St. Stephen's Green. Metro North will run in a mix of bored and cut and cover tunnels beneath the city and beneath Dublin Airport.

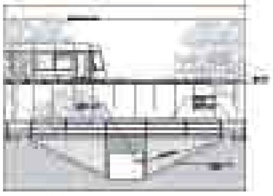
For ease of local identification, in this EIS the proposed scheme is divided into seven areas. These areas are numbered Area MN101 to Area MN107 inclusive going from Belinstown in north County Dublin to St Stephen's Green in the city centre. The environmental impact of the proposed scheme in each of these areas is set out in individual books numbered MN101 to MN107 and collectively make up Volume 2 of this EIS. This document relates to **Area MN103** Dublin Airport.

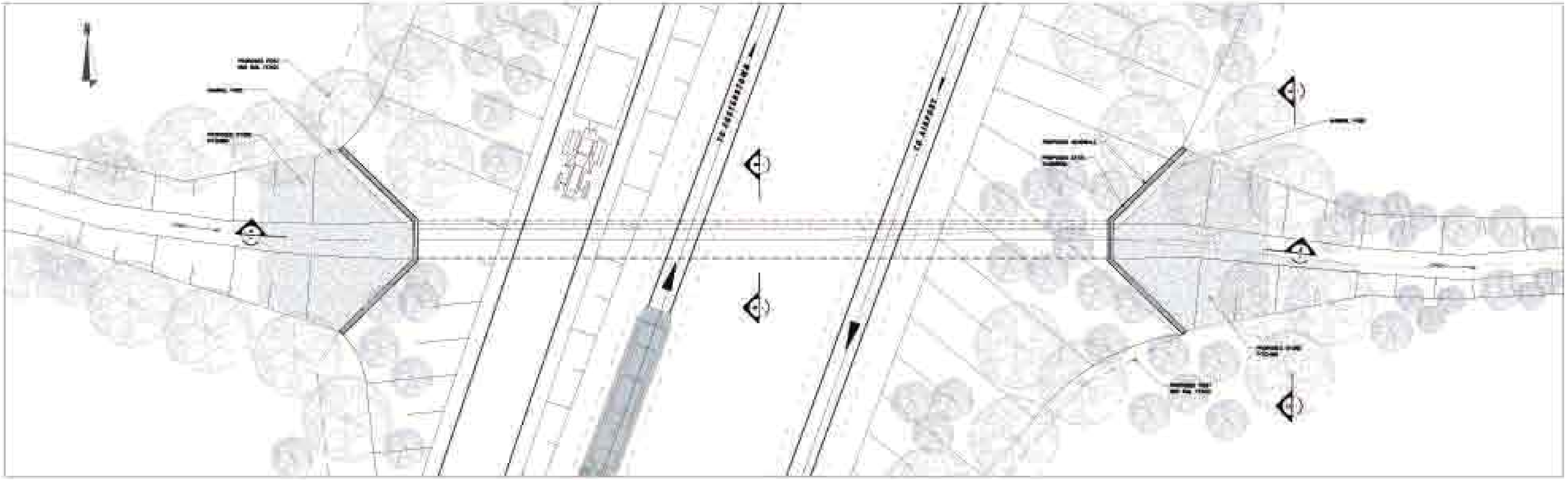
The route enters two bored tunnels (one for northbound services and one for southbound) to the north of Dublin Airport. A tunnel portal and ventilation building is located in this area. The route traverses the airport in a southerly direction passing under the Airport South Perimeter Road (Collinstown Lane) which marks the end of Area MN103. An underground stop, Airport, is located on this tunnelled section close to the existing airport terminal on the site of the proposed airport Ground Transportation Centre.

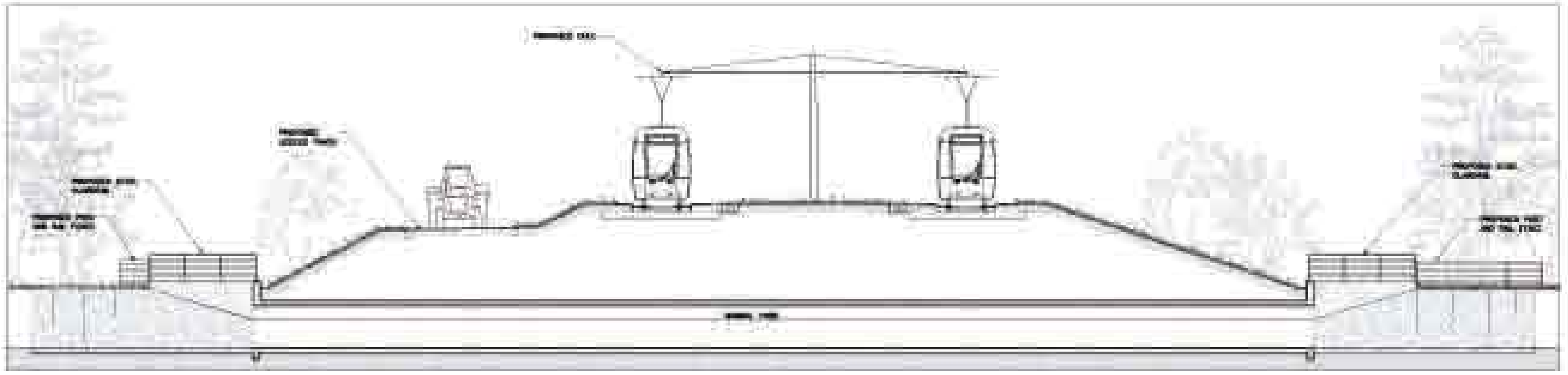
Structure drawings

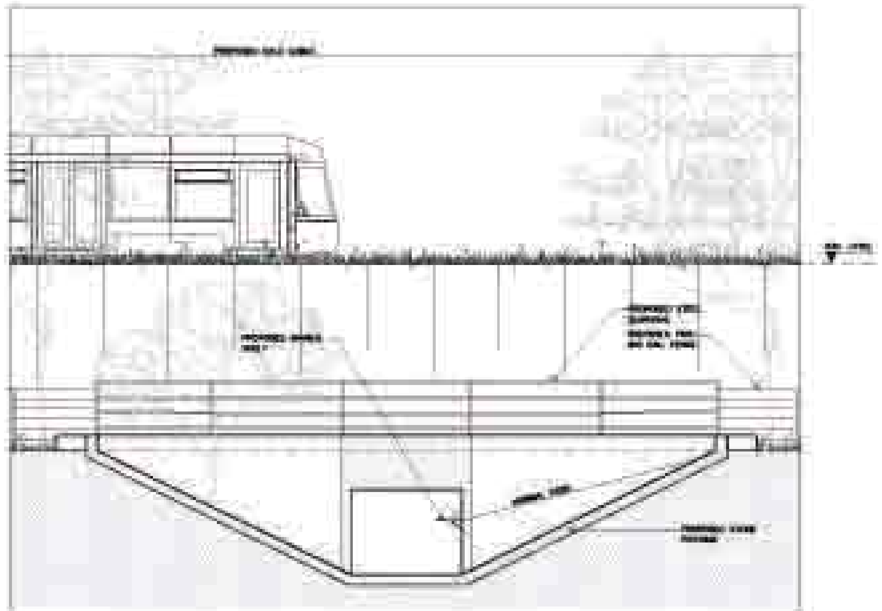
Structure drawings
Culvert in Area MN103











02 HUMAN BEINGS: LANDUSE

This chapter of the EIS describes the potential impacts on landuse which may arise due to activities associated with the construction and operation of the proposed scheme in Area MN103.

2.1 INTRODUCTION

This chapter describes the potential impacts on landuse which may arise due to activities associated with the construction and operation of the proposed scheme in Area MN103.

2.2 STUDY AREA

The study area for the assessment is set out in Table 2.1. In general the study area encompasses 500m either side of the alignment.

Table 2.1 Study area

Criteria	Width of study area (on both sides of the alignment)
Temporary and permanent land-take	All areas encompassed by the Compulsory Purchase Order (CPO) line for permanent and temporary land-take and construction compounds
Severance	

2.3 IMPACT ASSESSMENT METHODOLOGY

The source and type of all potential impacts are described in Section 2.4.1. Mitigation measures to be put in place are defined in Section 2.4.2. The extent to which mitigation is needed increases as the significance of the impact increases. Residual impacts are evaluated in Section 2.4.3 in terms of magnitude and significance.

2.3.1 Magnitude

The criteria used to assess the magnitude of impacts are shown in Table 2.2.

Table 2.2 Criteria for assessment of impact magnitude

Criteria	Impact magnitude
- Permanent land-take - Permanent severance	very high
- Temporary land-take for a period of more than 1 year or near/in residential areas - Temporary severance for a period of more than 1 year or near/in residential areas	high
- Temporary land-take for a period of less than 1 year - Temporary severance for a period of less than 1 year	medium
- Land-take in existing streetscapes	low
- N/A	very low

2.3.2 Significance

The significance of all impacts is assessed in consideration of the magnitude of the impact and the quality of the area (functional value) upon which the impact has an effect. The quantity of the land-take, relative to the affected landuse, is necessarily a factor of magnitude, and has therefore been taken into account in the assessment of an impact's significance.

2.4 IMPACT ASSESSMENT

2.4.1 Impact identification

The impact of the proposed scheme on the landuse along the alignment is assessed with reference to two categories: temporary and permanent impacts.

Temporary impacts
Temporary impacts typically occur during construction. These impacts are short to medium term in nature. Sources of temporary impact include construction compounds and construction activities.

Permanent impacts
Permanent impacts are long-term impacts associated with the structure and operation of the proposed scheme. Sources of permanent impacts include all permanent, above-ground, built structures associated with the scheme including stops, tracks, bridges, viaducts, substations, Park & Ride sites, ancillary roads, access ways, tunnel portals and areas affected by permanent changes to traffic routes.

The types and sources of impact considered in this chapter are summarised in Table 2.3. Table 2.3 also provides clarification as to whether the impact assessment of each impact type is carried out on a qualitative or quantitative basis.

Table 2.3 Impact identification

Potential impact type	Impact source	Assessment type: qualitative/quantitative*
Construction phase		
Temporary land-take	Temporary construction compounds, construction roads, tunnel launching sites, cut & cover locations, tunnel portals, storage areas, temporary land-take associated with the CPO etc.	Quantitative and qualitative
Temporary severance (only impacts that don't result in permanent land-take)		Qualitative
Permanent land-take	Road widening for construction roads, etc.	Quantitative and qualitative
Operational phase		
Permanent land-take	Scheme infrastructure: track; stop locations; access and egress locations; substations etc.	Quantitative and qualitative
Permanent severance		Qualitative

* Quantities are not calculated for land-takes in the existing streetscapes.

2.4.2 Mitigation measures

The amount of land taken for the proposed scheme has been minimised as much as possible and areas of land-take have been carefully chosen so as to try to minimise the level of impact that occurs.

In cases where land that has to be taken on a temporary basis, existing landuses will be maintained where possible and the land will be reinstated and returned to its original use as quickly as possible. Measures are to be taken where possible to ensure that open spaces remain easily accessible through the provision of, for example, adequate gating, redirected footpaths, pedestrian crossings and agricultural access routes.

Road diversions and other traffic management mechanisms are to be put in place before roads are closed to minimise severance impacts. Temporary road closures and diversions will be minimised, in number and duration, wherever possible.

In some locations, hoarding and other mechanisms will be used to ensure that the boundary of land-take is clearly demarcated so as to minimise the potential for 'drift' of the sites and impacts on adjacent landuses. Landscaping of areas will be designed so as to complement the surrounding landuses. A more detailed specific description of the mitigation measures to be put in place at each location is provided in Table 2.4 and Table 2.5.

2.4.3 Assessment of residual impacts

2.4.3.1 Project scenario: construction phase

Temporary land-take
Construction Compound 7, at the North Portal to the Dublin Airport Tunnel, will be approximately 1.2 ha in size and will be in place for more than 1 year. It will be located on lands that are classified as Agricultural and Rural Amenity and Dublin Airport Zone. The general area has a very high functional value. There is plenty of land classified as Agricultural and Rural Amenity land adjacent to the compound. With mitigation measures in place the significance of this impact is Low.

Also at the northern portal to the Dublin Airport Tunnel a small amount of land will be temporarily needed surrounding the permanent land-take. This temporary land-take, located in Agricultural and Rural Amenity lands and Dublin Airport Zone lands is of very high functional value and is only necessary for the construction of the northern portal. Due to the small size of temporary land-take it has been determined that the significance of the impact, post mitigation, is Low. The lands will be returned to their original use post construction.

The locations of the temporary land-take are illustrated in the maps included in (Landuse Impact) Volume 3, Book 1 of 2.

Temporary severance
There will be no temporary severance in Area MN103.

2.4.3.2 Project scenario: operational phase

Permanent land-take
Within Area MN103 the majority of the track travels beneath Dublin Airport and is constructed using Tunnel Boring Machines (TBM). At the northern portal there is some permanent land-take. This permanent land-take will accommodate the track in an open-cut section, an emergency access road and a parking area for emergency vehicles. The lands in which this land-take occurs are classified as Agricultural and Rural Amenity and Dublin Airport Zone and ascribed a very high functional value. Overall, the significance of the impact is Low with mitigation measures in place. The permanent land-take of lands within the Dublin Airport Zone will not affect the operations of the airport, nor will the land-take affect the use of the remaining land for agricultural purposes.

The locations of the permanent land-take are illustrated in the maps included in (Landuse Impact) Volume 3, Book 1 of 2.

Permanent severance
There will be no permanent severance in Area MN103.

Table 2.4 Summary of predicted impacts in Area MN103 occurring during the construction phase

						Post mitigation	
	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Magnitude	Significance
MN103/ CN-01	LA 10 North of Dublin Airport Zone on lands classified as Agricultural and Rural Amenity and Dublin Airport Zone	Local Construction Compound 7 surrounding Airport Tunnel North Portal	- Temporary land-take for a period of more than 1 year from Agricultural and Rural Amenity and Dublin Airport Zone lands. - This construction compound will be approximately 1.2ha in size and will also be the TBM extraction point. - It will be located adjacent to the Naul Road. - This construction compound will be located on agricultural lands which are mostly in Area MN102, total approximately 44 ha in size and are on Dublin Airport Zone lands. The Dublin Airport Zone land totals approximately 200ha in size.	very high	- As little land as possible will be temporarily taken. The majority of the land will ultimately form part of the permanent land-take, accommodating the access, road, parking area for emergency vehicles and the North Portal. - Its position adjacent to the Naul Road means that it is easily accessible. - The construction compound is located in a landuse upon which it will have minimal impact.	low	Low

	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation Magnitude	Post mitigation Significance
MN103/ CN-02	LA 10 North of Dublin Airport Zone on lands classified as Agricultural and Rural Amenity and Dublin Airport Zone	Land surrounding Construction Compound 7	- Temporary land-take for a period of more than 1 year from Agricultural and Rural Amenity and Dublin Airport Zone lands. - A narrow strip of land surrounding the permanent land-take will be temporarily used during the construction phase. - The total area of temporary land-take will be approximately 0.2ha in size and is taken from agricultural lands which are mostly in Area MN102, total approximately 44ha in size and Dublin Airport Zone lands. The Dublin Airport Zone land totals approximately 200ha in size.	very high	- As little land as possible will be temporarily taken. The land will be returned to its original use as quickly as possible. - The current landuse is to be maintained as much as possible. It will not be unnecessarily altered. This will facilitate a prompt return to its original use.	low	Low

Table 2.5 Summary of predicted impacts in Area MN103 occurring during the operational phase

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation Magnitude	Post mitigation Significance
MN103/ OP-01	LA 10 North of Dublin Airport Zone on lands classified as Agricultural and Rural Amenity and Dublin Airport Zone	Airport Tunnel North Portal, access road and parking area for emergency vehicles	- Permanent land-take from Agricultural and Rural Amenity and Dublin Airport Zone lands. - The permanent land-take will consist of land for access roads, open cut sections of track, the north portal and a parking area for emergency vehicles. - Approximately 0.7ha of this permanent land-take is from agricultural lands, the remaining 0.9ha of this permanent land-take is from the Dublin Airport Zone.	high	- As little land as possible will be taken.	low	Low

03 HUMAN BEINGS: SOCIO-ECONOMICS

This chapter of the EIS evaluates the potential socio-economics impacts arising from the construction and operation of the proposed scheme in Area MN103.

The socio-economic assessment will examine the potential impacts on:

- Demography;
- Unemployment;
- Employment classification;
- Travel to work data and commuting;
- Economic benefits and employment creation.

3.1 IMPACT ASSESSMENT METHODOLOGY

The impact assessment methodology in this section is set out in a number of steps:

- Impact identification;
- Impact assessment;
- Derivation of mitigation measures;
- Assessment of residual impacts.

3.1.1 Study area

The study area for this assessment is set out in Table 3.1.

Table 3.1 Study area

Criteria	Width of study area (on both sides of the alignment)
General/scheme-wide impacts	Greater Dublin Area and the Irish State
Localised impacts	Electoral Districts (EDs) in Area MN103 which are within 500m of the alignment

3.1.2 Impact identification

3.1.2.1 General/scheme-wide impacts

These impacts address the overall or 'global' socio-economic impacts of the proposed scheme and will focus on the scheme as a piece of transport infrastructure. This section will examine the scheme-wide positive and negative impacts associated with the construction and operation of the proposed scheme, which include the cumulative impacts of relevant localised impacts.

3.1.2.2 Localised (MN103) impacts

These impacts will occur at the location of key construction activities along the alignment. The construction methodology will also be of direct interest.

Localised impacts may arise due to the operation of the proposed scheme.

Electoral Districts of particular interest (e.g. those with higher than average unemployment rate or those with a higher than average car ownership rate) will also be highlighted.

3.1.3 Impact assessment

3.1.3.1 Magnitude

The criteria used to assess the different impacts associated with this scheme are shown in Table 3.2.

Table 3.2 Criteria for assessment of impact magnitude

Criteria	Impact magnitude
- Long-term (15+ years) and/or substantial change in population levels, employment, employment classification or mode of travel to work (i.e. reduced congestion and commuting delays). - Long-term economic disruption to residents, businesses and commuters from construction activities. - Substantial improvements in quality of life due to significantly reduced commuting times, improved commuting experience and reliability of service.	very high
- Long-term and significant change in population levels, employment, employment classification or mode of travel to work. - Short-term (1 - 5 years) economic disruption to residents, businesses and commuters from surface-construction activities. - Significant improvements in quality of life due to reduced commuting times, improved commuting experience and reliability of service.	high
- Long-term and moderate change in population levels, employment, employment classification or mode of travel to work. - Short-term and substantial change in population levels, employment, employment classification or mode of travel to work. - Temporary (less than 1 year) economic disruption to residents, businesses and commuters from surface-construction activities. - Moderate improvements in quality of life due to reduced commuting times, improved commuting experience and reliability of service.	medium
- Long-term and minor change in population levels, employment, employment classification or mode of travel to work. - Short-term and significant change in population levels, employment, employment classification or mode of travel to work. - Minor improvements in quality of life due to reduced commuting times, improved commuting experience and reliability of service.	low
- Long-term and insignificant change in population levels, employment, employment classification or mode of travel to work.	very low

3.1.3.2 Significance

The matrix used to define the significance of impacts is shown in Table 3.3.

All socio-economic receptors along the alignment have been classified as having a very high functional value. Socio-economic receptors in this case refer to the key socio-economic factors and data sets (employment level, demographics etc.).

Table 3.3 Criteria for assessment of impact significance

		Magnitude of impact				
		very low	low	medium	high	very high
Functional value of affected receptor	very high	Not significant	Low significance	Medium significance	High significance	Very high significance

3.1.4 Derivation of mitigation measures

Mitigation measures are only defined for any impacts that are deemed to be of Medium significance, and greater, in Table 3.3. The extent to which mitigation is needed increases as the significance of the impact increases. The logical basis for providing mitigation for impacts of Medium significance and above is that such measures should only be focused on significant environmental effects of the proposed scheme.

3.1.5 Assessment of residual impacts

Residual impacts that will persist after mitigation measures have been put in place are summarised in Table 3.7.

3.2 IMPACT ASSESSMENT

3.2.1 Project scenario: construction phase

3.2.1.1 General/scheme-wide impacts

Direct economic impacts

The expenditure of construction workers' wages will result in a considerable portion of this expenditure being spent in the regional economy of the Greater Dublin Area over the approximate 5 year construction period, thereby resulting in indirect/ secondary economic benefits. The estimated level of average direct employment during the 5 year construction programme is approximately 3,100 individuals per year. Table 3.4 provides a breakdown of this estimated level of employment during construction.

Table 3.4 Estimated construction employment for the proposed scheme

Construction Year	Average direct construction employment
1	4,000
2	4,000
3	3,500
4	2,500
5	1,500
Annual average	3,100

Although the direct employment is short-term (approximately 5 years), it is possible to equate this short-term employment to a level of permanent employment. The EIS for Crossrail (a major rail scheme in London which consists of a twin-bore tunnel on a west-east alignment under central London and the upgrading of existing National Rail lines to the east and west of central London) uses an employment multiplier of 10 employment years during construction as being the equivalent of one permanent/full-time job. Using this employment ratio, the equivalent level of permanent/full-time employment (FTE) is provided in Table 3.5. In total, the full time equivalent direct employment (FTE) generated by the construction phase is 1,550 jobs.

Table 3.5 Permanent equivalent level of construction employment

Construction Year	Person years equivalent	Permanent/full-time years employment equivalent (FTE)
1	4,000	400
2	4,000	400
3	3,500	350
4	2,500	250
5	1,500	150

It is likely that the majority of the construction workforce will be resident in the Greater Dublin Area, given the fact that this is where the majority of construction workers resided during the recent period of high-levels of construction activity in Greater Dublin.

However, there has been a reduction in levels of activity in the construction sector since 2007. The fall-off in construction activity has accelerated since late 2007 and is continuing. The Quarterly National Household Survey (CSO, 2008) notes that construction employment in Q4 (Sept. – Nov. '07) fell by 5,600 (-2.0%) and that the overall decrease in construction employment fell by 15,200 during 2007, and stood at 279,000 at the end of November 2007. Provisional 2008 data has indicated ongoing significant falls in construction-related employment in Ireland and a rise in overall unemployment. In the context of the significant fall in construction-related employment (and rising overall unemployment), and given the fact that the Greater Dublin Area is the largest urbanised area of Ireland, it is likely that the majority of construction workers will be sourced from the Greater Dublin Area.

Overall it is likely that there will be more than sufficient capacity in the construction sector of the Greater Dublin Area to build the proposed scheme and construction will not result in displacement of construction employees away from other large-scale infrastructural projects. Thus, the proposed scheme will not delay or impede the development of other strategic infrastructure projects in the Greater Dublin Area.

Overall, the proposed scheme will result in positive impacts due to direct employment creation. This is a positive impact of very low magnitude and Very low significance.

Indirect socio-economic impacts

Particular sectors of the regional economy (i.e. the economy of the GDA of Dublin, Wicklow, Kildare and Louth) are also likely to benefit are those in construction (and related industries) and the material supplying industry (steel, concrete etc.). There will also be secondary/spin off impacts due to expenditure of wages and salaries in the local economy by the construction workforce. These sectors are likely to include accommodation (e.g. B&Bs) and daily subsistence (e.g. lunch and evening meals) providers. The assessment of socio-economic effects in the Crossrail EIS assumed an employment multiplier of 1.5 (i.e. each permanent job (or equivalent) will generate an additional 0.5 permanent jobs). The Crossrail EIS multiplier of 1.5 is based on multipliers used in other recent major rail schemes in the UK, such as:

- Thameslink 2000:1.5;
- Channel Tunnel Rail Link: 1.4.

Other construction-related employment multipliers used in recent studies for the Scottish Executive were:

- Manufacture of structural metal products:1.52;
- Manufacture of other general purpose machinery:1.51;
- Manufacture of special purpose machinery:1.63;
- Manufacture of other transport equipment:1.33;
- Construction: 1.86.

Following a consideration of all these comparable multipliers it was decided that a multiplier of 1.5 was appropriate for the proposed scheme. Table 3.6 contains information regarding indirect employment creation due to the construction of the proposed scheme.

Table 3.6 Permanent/full-time equivalent (FTE) level of construction employment

Construction Year	Permanent years employment equivalent	Indirect employment creation	Total direct and indirect FTE
1	400	200	600
2	400	200	600
3	350	175	525
4	250	125	375
5	150	75	225

Overall, the construction of the proposed scheme will provide an annual average direct employment of 3,100 for the 5-year construction programme. This equates to 1,550 full-time equivalents, with a further 775 FTE arising as indirect impacts. Overall, the proposed scheme will result in positive impacts due to overall employment creation and this is a positive impact of low magnitude and Low significance.

Impacts due to traffic congestion and diversion
This impact is addressed in the Traffic chapter of this EIS (Volume 2, Chapter 7). However, a brief summary is provided below.

Generally there is an increase in journey times on most of the roads/routes assessed during the five year construction programme. Traffic modelling data (MVA, 2007) indicates that some routes experience significant 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.

Traffic modelling results have shown that traffic speeds across the GDA will decrease by over 11%, or drop by 3kph. This represents a situation where traffic movement for all modes will be very difficult with significant delays at key areas. Drivers will 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. Overall, this will result in negative socio-economic impacts on the Greater Dublin Area's commuters and freight movements. These negative impacts are of medium to high magnitude and Medium to High significance, since the duration of these impacts ranges from temporary to short-term.

3.2.1.2 Localised socio-economic impacts

The localised socio-economic impacts will be a consequence of the landuse impacts and are addressed in the Landuse chapter of this EIS (Volume 2, Chapter 2). Similarly localised traffic disruption during construction is addressed in the respective Traffic chapters of this EIS (Volume 2, Chapter 7).

3.2.2 Project scenario: operational phase

3.2.2.1 General/scheme-wide impacts

Facilitating future development and employment creation
Overall the proposed scheme will facilitate a significant amount of future development along the whole alignment and across the wider northern part of the Greater Dublin Area. While the proposed scheme will not directly result in additional development in proximity to the alignment the proposed scheme will, indirectly, allow the relevant planning authorities to plan for and grant consent for additional development at key locations.

Essentially, the proposed scheme will permit higher-residential densities (planning policy in Dublin City and Fingal County Councils envisage higher-density development along key transport corridors and close to key transport nodes) thereby maximising the transport and socio-economic benefits of the proposed scheme (Department of the Environment, Heritage and Local Government, 2008). The basis for higher-density zoning adjacent to key transport corridors is that this will provide a realistic and attractive alternative to private-car based commuting, thereby resulting in greater use of public transport (the proposed scheme in this case) with corresponding reductions in journey time and greater access to employment and other key destinations.

Fingal County Council commissioned a report titled 'Economic Development Strategy for the Metro North Economic Corridor (MNEC)' (Indecon International Economic Consultants, 2008) which outlines a long-term development strategy for a period up to 2025/2030. The Strategy has assumed that the MNEC is a 1km corridor on either side of the alignment (which corresponds to the width of Fingal County Council's Metro North Development Contributions Scheme) and extends from the terminus of the proposed scheme in the townland of Belinstown to the Fingal County Council-Dublin City Council administrative boundary at Santry Avenue.

In summary, this Strategy envisages an increase in the MNEC population from 59,000 (2006 data) to 128,100 by the period 2025/2030. This represents an increase in residents within this 2km-wide corridor of 69,100, an increase of over 117% over 2006 levels. The basis for this proposed increase in MNEC population is that the attractiveness of the MNEC will be greatly enhanced by the transport advantages provided by the proposed scheme.

The Strategy recommends that three specific locations within the MNEC will be the focus of the majority of overall new development and growth. These three areas are: Swords-Lissenhall, Dublin Airport (Eastlands) and Metropark. The proposed scheme is a key piece of infrastructure which will facilitate the implementation of the Indecon Strategy. Without the proposed scheme many of the elements outlined in the Strategy will not arise. It should be noted that the various targets in the Strategy are acknowledged by Indecon as being ambitious and that they 'will be a major challenge and will require innovative policy initiatives' to ensure their implementation.

The overall objectives of the MNEC Strategy have been adopted by Fingal County Council and it is their intention to prepare a number of variations to the Fingal County Development Plan to facilitate implementing the MNEC Strategy. In May 2008, Fingal County Council published a document titled 'Your Swords: An Emerging City – Strategic Vision 2035'. This states (p.15) that 'the identification and promotion of Metro Economic Corridor(s) will be of strategic importance to the economy and well-being of the county's residential and business/ employment population'. Fingal County Council also intends to prepare additional planning policy documentation to support the implementation of the MNEC Strategy as required in future years.

Dublin City Council also sees the proposed scheme as facilitating future development activity in their administrative area. However, in Dublin City Council's area, adjoining lands are predominantly already developed; whereas in Fingal, significant undeveloped sites existing, and it is these locations where the large quantum of future development (as envisaged in the MNEC) is likely to arise.

The proposed scheme will assist Dublin City Council with its development aspirations and objectives at key locations such as Ballymun (currently the focus of one of Europe's largest regeneration projects) and the north inner city. It will also assist with the implementation of the Phibsborough/Mountjoy Local Area Plan – which specifically refers to the proposed scheme and the role it will play on future development patterns and landuses.

In conclusion, the proposed scheme is essential to the planning and development aspiration of both Dublin City Council and Fingal County Council and this is strongly reflected in both of their respective development and planning policies. The proposed scheme will facilitate and greatly assist a more sustainable development pattern in future years and this is a positive impact of high magnitude and High significance.

The proposed scheme will also result in positive development and economic impacts for the Greater Dublin Area and beyond, through creating a positive image of the city – both for national and international markets – and result in wider economic benefits through assisting people move through and around the Greater Dublin Area. A report (Steer Davies Gleave, 2005) for pteg (Passenger Transport Executive Group, based in the UK) noted that:

'there is real evidence that UK light rail schemes have provided business with better access for customers; giving better access to labour markets, supporting business expansion and providing the confidence to make investment decisions based on the evident commitment to improved public transport. Increased development activity has brought a 'buzz' to areas served by the tram schemes.'

Dublin Transport Office (DTO) commissioned a study which surveyed household's attitudes to the Luas service (Millward Brown IMS, 2006). The survey was published in November 2006, over two years after the Luas service was introduced. The key findings of the survey were:

- Luas has contributed to people's overall satisfaction within their local area, with higher satisfaction levels in both Luas catchments;
- Luas is widely seen as a quicker way to travel than the car and, in particular, the bus. Many Luas users who have cars still opt for the Luas as the service offers speed and reliability (although the survey did highlight that there was a portion of car-users who were not willing to 'give-up' car-based travel in favour of the Luas);
- Luas has contributed to increased shopping and employment opportunities. Luas also generated incremental shopping trips (i.e. shopping-related trips that would not normally have been made in the absence of Luas). This finding is also reported in another economic paper (Graham, 2003).

In 2006, the DTO commissioned another study (Millward Brown IMS, 2006) which examined a range of public attitudes to the Luas light rail system. The study was undertaken from April to May 2006, approximately two years after the service was operational. The study had a number of key findings:

- Positive impact of the Luas on ease of travel around Dublin is widely acknowledged;
- The problem of staff punctuality as a result of inadequate public transport has been eased, in both the Red and Green line catchments;

- One in every four businesses, overall, and three in every ten located in the Luas catchments, believe Luas has been advantageous for their business. Businesses in the Green Line catchment are the most positive. Green Line businesses noted that improved staff access to work was the main advantage while Red Line businesses noted easier and better access for customers and clients;
- Significant satisfaction with improved access to and from the city centre.

Overall, the proposed scheme is likely to result in positive direct and indirect economic benefits for Dublin city, the Greater Dublin Area and the Irish economy through increasing accessibility to the city centre as well as induced/secondary/incremental economic and employment opportunities. It is noted by the pteg report that while it is difficult to quantify the wider economic impacts of rail schemes, 'there is clear empirical evidence of positive effects that light rail has had on the cities where it has been implemented in the UK'.

The proposed scheme will also go some way to reducing the wider costs of congestion and delays in commuting to work. The negative impacts of congestion to Dublin's (and thus, Ireland's) economy are significant: Dublin Chamber of Commerce estimates that 'the cost of congestion to the Greater Dublin Area in 2005 was €2.5bn' (Dublin Chamber of Commerce, 2005).

Overall, the proposed scheme will result in a positive impact to the wider economy in terms of development and reduced congestion of high magnitude, which is of High significance.

Improving accessibility to increased employment opportunities
Fingal County Council's MNEC Strategy will, through the Council's various planning policy documents, facilitate the creation of 37,000 additional jobs in the MNEC, up to the period 2025/2030. This represents an increase of 125% over the level of 2006 employment in the MNEC (which stands at 29,600 jobs). Additionally, the MNEC will have a resident population in excess of 128,000 and over 69% of these people will also work in the MNEC.

The Strategy envisages that most of these additional jobs will be within the services sector and target industries include corporate head offices, IT services, financial and business services, science and technology projects and environmental products and services. The strengths of MNEC, sourced from the MNEC Report, are:

- A high employment rate;
- A low dependency rate (i.e. retired, unable to work etc.);
- Large proportion of young population (25-44 age group);
- High educational attainment;
- Close proximity to Dublin Airport;
- Access to national and international markets via the national road network;
- Proximity to major seaports, including Dublin Port and the proposed Bremore Port;
- Existing base of foreign and indigenous firms;
- Access to major 3rd & 4th-level institutions in the Dublin area;
- A high quality of life.

The MNEC Strategy predicts that the majority of these jobs will be higher skilled and in the Market Services sector (76%: 28,200 additional jobs), followed by Non-Market Services (13%: 4,900) and Industrial jobs (11%: 3,900). Market Services jobs will entail financial and other international services, transport and communications services, and distribution. Industrial jobs comprise manufacturing, utilities and building. The principal future employment areas will be: Swords-Lissenhall, Dublin Airport (Eastlands) and Metropark.

In Dublin City Council, the proposed scheme will result in the creation of new employment opportunities, although not to the same extent as the potential additional employment creation in Fingal County Council. Additional employment creation is likely to be focused at Ballymun (as part of the ongoing regeneration) and in the suburban retail and office concentrations, such as Drumcondra and Phibsborough.

Overall, the proposed scheme will assist with the creation of major employment opportunities in the long-term and this is a positive impact of high magnitude and High significance.

Improving accessibility to community and social facilities
The proposed scheme will provide high-quality and frequent access to community and social facilities, such as typical city and town centre facilities (e.g. banking, post-offices, public sector services, retail, financial and professional services, medical and dental services and educational facilities). Examples of the key locations to which access will be provided include: Swords town centre, Airside Retail Park, Dublin Airport, Metropark, Ballymun Town Centre, Dublin City University, Mater Hospital, Drumcondra High Street, Trinity College, Dublin city centre and St. Stephen's Green. Additionally, access will be provided Dublin's wider rail and Luas network, thus opening up similar facilities all over the Greater Dublin Area, such as Dublin Docklands, Harcourt street business area, Dundrum Town Centre, Sandyford Industrial Estate, Heuston Station, Connolly Station and Tallaght Town Centre.

Overall, the proposed scheme will result in positive impacts with respect to access to the key social and community facilities in Dublin and this is a positive impact of high magnitude and High significance.

Assisting regeneration and social-improvement activities

The proposed scheme will greatly assist with the many ongoing regeneration initiatives in proximity the scheme's alignment. The largest regeneration project is Ballymun and this is being managed by Ballymun Regeneration Ltd, a company set up by Dublin City Council to oversee the overall project. The proposed scheme will greatly assist with all of the regeneration and renewal objectives for this area of Dublin which has suffered socially challenging conditions for generations. The proposed scheme will provide the resident population (significant percentages of who are unemployed and with minimal educational qualifications) with direct, high-frequency and regular transport options to the key employment and other landuse areas of the Greater Dublin Area, thereby assisting with the regeneration objectives. The proposed scheme will also greatly assist the development of Ballymun Town Centre through providing direct, high-frequency and regular transport connectivity to the planned and future employment opportunities and town centre landuses. Thus, Ballymun will become a key town centre, underpinning the future vitality and community of Ballymun.

The proposed scheme will also assist with other regeneration and social-improvement programmes. In total, there are five designated RAPID areas, four Integrated Action Plans (under the Urban Renewal Scheme), 16 primary schools and three post-primary schools in the Department of Education and Science's social inclusion programme, 'Delivering Equality of Opportunity in Schools' (DEIS). Many of these are located within the study area, as described in the baseline Socio-economics chapter of this EIS, (Volume 1, Chapter 11).

Overall, the proposed scheme will greatly assist with current and future regeneration programmes, a positive impact of high magnitude and High significance.

Improved access to employment through commuting improvements

The proposed scheme will deliver a fast, reliable, regular and efficient transport option through the north of Dublin city and onto Dublin Airport and beyond Swords. The journey time from Dublin Airport to the city centre (St. Stephens Green) is estimated at approximately 20 minutes and the journey from the city centre to the terminus north of Swords is estimated to be approximately 30 - 35 minutes. Annual patronage (total journeys) is estimated to be 34 million, in excess of an average of 93,000 journeys per day. The initial peak service (broadly 0700 – 1000 and 1530 – 1930) is expected to be a 90 metre LMV every four minutes, providing capacity for 10,000 passengers per direction per hour.

The off-peak service will be less frequent and possibly with shorter vehicles (45m). The proposed scheme has been specified to be capable of carrying 20,000 passengers per direction per hour, with LMVs up to 90m long running at frequencies up to every two minutes. The capacity specified is around four times the forecast peak demand on the line when it is expected to open in 2014, and around six times the current peak demand on the Luas Green line.

In comparison to the other public transport option, which is primarily bus along the alignment, the proposed scheme will provide substantial improvement in journey frequency and times. Currently, a sample bus journey from Swords to the city centre (bus number 41) takes approximately 75 minutes, with four such services per hour. This is predicted to increase to approximately 91 minutes in 2014 and 100 minutes in 2029, all without the proposed scheme. When operational in 2014, the proposed scheme will provide an average journey time of approximately 30 minutes with up to 15 services per hour during peak periods.
In comparison to the current level of bus service, this represents a substantial improvement in the peak commuting journey times. Such bus versus Metro North journey time savings exist along the whole scheme.

Regarding improvements to car-based journeys, the proposed scheme will provide car-based commuters with reduced journey times and improved quality of life (e.g. shorter and less-stressful commutes). The modal shift from car to Metro 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. Journey time assessments (MVA, 2007) on key routes further demonstrate the positive nature of the impact as the majority of journey times in both 2014 and 2029 show decreases. In both operational years 2014 and 2029 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 Avenue and Santry Avenue. There is a decrease in journey time of 19.8% on the R132 northbound from the city centre to the airport. There is a decrease in journey time of 17.2% using the Port Tunnel northbound. There is a decrease in journey time of 14.3% using the South Quays – Georges Quay to O'Connell Bridge. There is a reduction in journey time on all routes on the M1 and on the N2 northbound and southbound from Dublin city centre to Swords and on the M50 in both directions. The most significant increase in journey time is anticipated to be 8.9% on the North Quays – from Heuston to O'Connell Bridge. However the majority of journey times are reduced along the routes. The journey time assessment for the operational years illustrates the significance of the positive impact that the proposed scheme will have on traffic movement particularly in the vicinity of the alignment.

The result of the proposed scheme is that it will provide a significant improvement of transport options and accessibility to a large portion of the population along the alignment. The net result of the proposed scheme is that the quality of life for a large portion of the residents living along the commuting corridor of the proposed scheme will be significantly improved due to significantly reduced journey times, improved journey reliability, frequency, comfort and safety. This represents a positive impact of very high magnitude and Very high significance.

With the provision of three Park & Ride sites as part of the proposed scheme, improvements to the many commuters' quality of life will be extended to commuters living in the towns and villages of North County Dublin and Counties Louth, Meath, Cavan, Westmeath and Longford (i.e. long-distance commuters). The current prevalence of long-distance commuting in the 'outer' counties of the Greater Dublin Area (and beyond) can be seen in the average distances of journeys travelled to work data from the 2006 Census. For Dublin City, the greatest percentage of journeys travelled (25.03%) is in the 2-4km distance. For Dun-Laoghaire, the greatest journey to work travelled is in the 5-9km category (25.24%). However, significantly fewer percentages of similar (i.e. shorter) journeys are travelled in the outer counties and proportionally a greater volume of longer journeys (15km+) are undertaken instead. For example, in Kildare and Meath, 15.28% and 17.44% respectively of journeys travelled are 25 - 49km, as against an average for Leinster of 7.4% for the same distance of journey.

While the proposed scheme will not reduce the commuting distances, it will reduce the commuting time and provide a more regular and improved commuting journey, resulting in an overall improvement to many long-distance commuters' quality of life. Overall, the proposed scheme will result in a positive impact to the quality of life of the commuters along the proposed scheme, and to those from the wider region who will use the Park & Ride sites. This positive impact is of high magnitude and is of High significance.

Direct employment creation
The proposed scheme will generate direct employment opportunities. RPA estimate that a total of 350 people will be required to operate the service in the first nine years of operation, with approximately 220 staff being employed in the operation of the service (LMV drivers, customer service staff, Park & Ride attendants, station staff, management etc.) and approximately 130 staff being employed in the maintenance of the system and infrastructure.

The level of direct employment will increase in Year 10 due to the increased frequency of service and greater capacity on the system. It is estimated that 420 staff will be directly employed for the operation and maintenance of the proposed scheme after Year 10.

It is not possible to estimate where future employees will come from. However, it can be assumed that a portion will be from the proposed scheme catchment area. Given the higher unemployment levels in specific EDs (such as those in Ballymun and the north inner city of Dublin) within the study area, it is likely that employment of residents could be directly boosted in these EDs with some reduction of in unemployment rates.

The creation of this quantum of employment associated with the operation and management of the proposed scheme will also result in indirect socio-economic benefits, through expenditure of salaries by employees of the proposed scheme. Additional job creation will also result. This is difficult to quantify, but it will result in some further socio-economic benefits to the Greater Dublin Area.

It should be noted that these jobs will be new jobs and will not be as a result of displacement of employment from other sectors of public transport. Thus, there will be no impact on existing levels of employment in public transport.

Overall, direct employment from the proposed scheme will result in a positive impact of very low magnitude and, coupled with the very high functional value, this results in a positive impact of Very low significance.

3.2.2.2 Localised (MN103) socio-economic impacts

Facilitating future development
While the proposed scheme will not directly result in increased population levels proximate to the proposed scheme it will, indirectly, allow the relevant planning authorities to plan for and grant consent for higher residential and employment densities at key locations (in accordance with current and future planning policy), primarily due to the greater public transport capacities provided by the proposed scheme, but also due to some key characteristics of this part of Dublin.

As previously noted in Section 3.2.2.1, Fingal County Council commissioned a report titled 'Economic Development Strategy for the Metro North Economic Corridor (MNEC)' which outlines a long-term development strategy for a period up to 2025/2030. In summary, this Strategy envisages an increase in the MNEC population of over 117%, over 2006 levels by 2025/2030. The basis for this proposed increase in the MNEC population is that the attractiveness of the MNEC will be greatly enhanced by the transport advantages provided by the proposed scheme. Additionally, the Strategy is predicting the creation of an additional 37,000 jobs within the MNEC. Regarding MN103, the Strategy recommends that Dublin Airport Eastlands is one of three specific locations within the MNEC where the majority of the overall new development and growth should take place.

The proposed scheme is the key piece of infrastructure which will facilitate the implementation of the Strategy. Without the proposed scheme, many of the elements outlined in the Strategy will not arise.

As noted above, the overall objectives of the MNEC Strategy have been adopted by Fingal County Council, who intend to prepare a number of variations of the Fingal County Development Plan to facilitate implementing the MNEC Strategy. In May 2008, Fingal County Council published a document titled 'Your Swords: An Emerging City – Strategic Vision 2035'. In addition, there are also other Fingal County Council policy documents which accompany the Swords Vision document which support Fingal County Council's acceptance of the MNEC Strategy.

The information presented in Chapter 11 (Baseline Socio-economics) shows that Area MN103 has two EDs (Airport and Balgriffin, although parts of these two EDs are also within MN104 but they are reported in MN103) and these had a combined population increase of almost 145% in the period 2002 to 2006. This is, however, not as significant as it first appears as there is a relatively small population within MN103 (2,522 people in 2006), compared to all the other EDs along the alignment.

With the above economic and strategy policy being proposed by Fingal County Council in relation to Dublin Airport Eastlands, the populations of the two EDs within MN103 will increase in future years, in accordance with Fingal County Council's policy. However, this increase will not be as significant as it will be in other areas within the MNEC as Fingal County Council envisages that the Airport becomes an employment-led section (principally 'airport activities') of the MNEC, rather than a mixed-used section with a residential population.

Thus, the proposed scheme will facilitate future development and growth of the Metro North corridor through Fingal County Council in a planned and sustainable manner. This is a positive impact of very high magnitude and Very high significance, although these impacts will be more substantial in other areas of the alignment.

Employment creation

As noted in Section 3.2.2.1, the proposed scheme will facilitate the creation of 37,000 additional jobs in the MNEC, up to the period 2025/2030, representing an increase of 79% over the level of 2006 employment in the MNEC area. The Strategy predicts that the majority of these jobs will be in the Market Services sector (28,200 additional jobs), followed by Non-Market Services (4,900) and Industrial jobs (3,900).

As noted above, Fingal County Council has accepted the MNEC Strategy and intends to implement it over the coming years. This implementation process is already underway with the publication of the policy document 'Your Swords: An Emerging City – Strategic Vision 2035': published by Fingal County Council in May 2008.

The Strategy identifies the Airport Eastlands location as one of the three key growth areas and this has direct relevance for the population in MN103. It is likely that a significant amount of these additional jobs will be located within the two EDs of MN103.

Overall, the proposed scheme will assist in the creation of a significant amount of additional and skilled employment in the long-term, a positive impact of very high magnitude and Very high significance.

Improving accessibility to and availability of employment opportunities

In addition to being critical to the creation of jobs within the MNEC over the coming years, the proposed scheme will greatly increase the accessibility of residents to employment, both within the MNEC and also across the Greater Dublin Area.

Currently, only 27.6% of residents of MNEC actually work within the corridor. Of the remaining 72.4%, the majority (37%) work in Dublin City centre. However, the MNEC Strategy envisages that approximately 60% of future additional MNEC residents would also work within the MNEC. A key aspect of this is that the MNEC Strategy recommends the distribution of all types of landuses (residential, employment, recreational, etc) across all of the MNEC with a view to encouraging mixed-use development and lifestyles whilst minimising leakage of skills and out-commuting.

The proposed scheme will result in accessibility improvements through providing easier access to other employment locations (such as Dublin City centre and docklands), although there is not a larger proportion of populating living in the two EDs. The current rate of employment in MN103 is relatively high (59.2% to 74.3%) and generally at or above the average for Fingal County (64.6%), the average for the State (57.2%) and average for the Greater Dublin Area (59.9%). Correspondingly, unemployment rates are comparatively low. Although the proposed scheme will improve access to employment opportunities across the Greater Dublin Area, it is not anticipated to result in significantly reductions in employment for MN103, given the relatively high employment rates already found in the area.

In the longer-term (to the period 2025/2030 and beyond), The proposed scheme will result in substantially positive impacts regarding employment creation of very high magnitude and Very high significance for MN103 through the assistance in the creation of 37,000 additional jobs.

For residents who currently commute by public transport from Swords and Dublin City centre to Dublin Airport, the proposed scheme will bring about significant improvements in daily access to employment. The proposed scheme will provide a regular and rapid mode of commuting to and from the city centre and other destinations along the alignment. It shall also provide easy access to Dublin's wider rail, Luas and bus network, thus providing easy access to the majority of the Greater Dublin Area. It shall also provide significant improvements for those using the airport for air travel.

The information presented in the baseline Socio-economics chapter of the EIS (Volume 1, Chapter 11) shows that MN103 has some of the lowest levels of non-car modes of commuting to work, school or college. The proposed scheme is predicted to increase the portion of those who will travel to work by non-car modes of transport.

The proposed scheme will provide significant improvements regarding commuting times and journey quality for the residents of MN103. This positive impact can be seen by comparing a comparable bus journey to the proposed scheme, with Swords to the city centre, including calling at Dublin airport (bus number 41). Currently, the journey takes approximately 75.2 minutes, with four such services per hour. This is predicted to increase to 91.8 minutes in 2014 and 100.4 minutes in 2029, all without the proposed scheme. When operational in 2014, the proposed scheme will provide an average journey time of 30 - 35 minutes approximately with approximately 15 services per hour during peak periods. In comparison to the current level of bus service, this represents a substantial improvement in the peak commuting journey times.

Regarding improving transport options for those with no access to a car, the proposed scheme will provide significant improvements to the Airport Electoral Division (ED), (28.2% of whom do not have access to a car) but less of a benefit to Balgriffin (10.3% of whom do not have access to a car).

In relation to improving the type of employment opportunities, the proposed scheme will result in significantly greater access to professional and technical employment for the population of MN103, as both EDs show a higher than average level (23.4% and 30.7% against a Fingal average of 19.6% and a State average of 21.9%) of unskilled employment.

Overall, the proposed scheme will improve access to more and better employment opportunities for MN103 residents.

Improving accessibility to community and social facilities

This section is focusing on the benefits that the proposed scheme will provide in relation to access to community and social facilities, such as typical city and town centre facilities (e.g. banking, post-offices, public sector services, retail, financial and professional services, medical and dental services and educational facilities).

The proposed scheme will provide significantly faster and direct access to some key community and social facilities along the alignment, such as Swords town centre, Airside Retail Park, Dublin Airport, Metropark, Ballymun Town Centre, Dublin City University, Mater Hospital, Drumcondra high street, Trinity College and Dublin city centre. Additionally, access will be provided Dublin's wider rail and Luas network, thus opening up similar facilities all over the Greater Dublin Area.

The proposed scheme will also provide improved access for visitors and tourists to Dublin city centre and the wider transport network all over Ireland. Currently, the main transport options at Dublin Airport are private taxi and various bus operators (both locally and nationally). The proposed scheme will provide regular, rapid and reliable access and present an improvement on the current onward transport options at Dublin Airport. In 2007, Dublin Airport had 30.1 million passengers, an increase of 8% over 2006 levels.

Overall, the proposed scheme will improve access to community services, a positive impact of high magnitude and High significance.

Assisting regeneration and social-improvement activities

There are no RAPID, Urban Renewal Schemes or DEIS schools located within MN103. However, the proposed scheme will assist with short-term social-improvements in Swords village and Swords Lissenhall, two EDs which show some evidence of more challenging socio-economic conditions, such as lower than average percentages of the population with primary education and higher than average unskilled employment.

However, in the longer-term (up to 2025/2030 and beyond), the proposed scheme will facilitate the redevelopment and expansion of the various communities along the MNEC, including the provision of 37,000 additional jobs, the majority of which will be classed as skilled and well-paid employment.

Overall, the proposed scheme will greatly assist with current and future employment development objectives, a positive impact of very high magnitude and Very high significance.

3.3 DERIVATION OF MITIGATION MEASURES

3.3.1 Construction phase

All relevant construction mitigation measures for socio-economic impacts are linked to the general construction measures proposed within this EIS, which outlines a range of measures to minimise environmental impacts which might arise during the construction stage of the proposed scheme. Access to businesses and key retail, employment and commercial areas will be maintained during the construction phase and the public and local receptors will be fully aware of construction plans in advance. However there is likely to be traffic disruption associated with the construction phase.

Appropriate information and management procedures will be introduced before and during the construction phase for the resident, working and visitor populations. This will include traffic management and access measures. A Construction Team representative will be available during the construction phase for consultation with local residents and businesses.

3.3.2 Operational phase

All of the operational impacts are positive and, thus, no mitigation is proposed.

3.4 ASSESSMENT OF RESIDUAL IMPACTS

A summary of the residual impacts associated with the scheme is provided in Table 3.7.

Table 3.7 Summary of residual impacts

	Magnitude of impact taking into account mitigation	Functional value of area affected	Significance of impact
General/scheme-wide impacts: Construction phase			
Direct economic impacts	very low	very high	Very low
Indirect economic impacts	low	very high	Low
Impacts due to traffic congestion and diversion	high	very high	High
General/scheme-wide impacts: Operational phase			
Facilitating future development and employment creation	high	very high	High
Improving accessibility to employment opportunities	high	very high	High
Improving accessibility to community and social facilities	high	very high	High
Assisting regeneration and social-improvement activities	very high	very high	Very high
Improved access to employment through commuting improvements	high	very high	High
Improved commuting journeys for long-distance commuters	high	very high	High
Direct employment creation	very low	very high	Very low
Localised (MN103) impacts: Construction phase			
Refer to respective Landuse and Traffic chapters of this EIS (Volume 2, Chapters 2 and 7 respectively)			
Localised (MN103) impacts: Operational phase			
Facilitating future development	very high	very high	Very high
Employment creation	very high	very high	Very high
Improving accessibility to and availability of employment opportunities	very high	very high	Very high
Improving accessibility to community and social facilities	high	very high	High
Assisting regeneration and social-improvement activities	very high	very high	Very high

04 HUMAN BEINGS: NOISE

This chapter of the EIS evaluates the potential noise impacts arising from the construction and operation of the proposed scheme in Area MN103.

4.1 INTRODUCTION

This chapter of the EIS evaluates the potential noise impacts arising from the construction and operation of the proposed scheme in Area MN103. Groundborne noise and vibration impacts are reported in the Vibration chapter of this EIS (Volume 2, Chapter 5).

4.2 STUDY AREA

The study area for this assessment is defined in the baseline chapter and comprises the nearest noise sensitive receptors to the alignment corridor, construction compounds and adjacent roads where traffic flows may be changed up to 500m from the alignment.

4.3 IMPACT ASSESSMENT METHODOLOGY

The source and type of all potential impacts is described in Section 4.4.1. Mitigation measures to be put in place are defined in Section 4.4.2. The extent to which mitigation is needed increases as the magnitude of the impact increases. Unmitigated impacts and residual (mitigated) impacts are evaluated in Annex C, Noise Assessment Details (Volume 3, Book 2 of 2), provides details of the noise modeling methods and results, including predicted levels of noise without mitigation for both the construction and operational phases.

4.3.1 Prediction of noise magnitude

4.3.1.1 Construction

The magnitude of construction noise impacts is predicted by considering noise emissions data for typical construction equipment based on the expected methods of construction for each phase of work on each worksite. The plant teams used are listed in Section 6 of Annex C Noise Assessment Details (Volume 3, Book 2 of 2). The prediction method follows that recommended in BS 5228 Noise and vibration control on construction and open site, part 1, 2, 3, 1997.

4.3.1.2 Noise from the light metro vehicles (LMVs)

Noise levels associated with the operation of the proposed scheme have been modeled using a 3-dimensional noise model, Soundplan®. Baseline noise levels have been measured directly, as reported in the baseline Noise chapter of this EIS (Volume 1, Chapter 12). The predicted noise levels from the LMVs have been compared to the baseline noise levels to estimate likely changes in noise.

Noise from road traffic
For road traffic noise on the surrounding roads a similar approach to that described for LMVs is used. Significant changes in road traffic noise have been identified by analysis of the available road traffic modeling results. Changes in noise levels have been predicted using CRTN (Calculation of Road Traffic Noise, UK DoE, 1988) based on the traffic flows, speeds and percentage of the flow which is Heavy Goods Vehicles (HGVs) in the do minimum and do something scenarios for 2014 (year of opening) and 2029 (design year). These have then been compared. Also, where junction realignments take place that will bring road elements closer to receptors and will lead to increases in noise these have been calculated. Where an increase is expected, the functional value of the receptor is considered as described in the following section.

4.3.2 Assessment methodology

4.3.2.1 Construction

The predicted levels are compared to the assessment criteria given in Table 4.1. Any predicted noise levels exceeding the criteria given in Table 4.1 at a noise sensitive receptor are deemed to be an impact, unless they occur for very short periods of time. Where exceptions occur in this regard, they are discussed on a case by case basis.

The National Roads Authority (NRA) has published construction noise targets guidelines for L_{Aeq} in 'Guidelines for the Treatment of Noise and Vibration in National Roads Schemes'. The NRA guidelines are based on UK guidance which describes daytime noise levels for rural areas or areas away from major roads. These criteria are summarised in Table 4.1. As shown in Table 4.1, the evening targets are taken as 10 dB lower than the daytime levels based on guidance given in BS5228. The daytime criteria given in Table 4.1 may be appropriate for interurban road schemes undertaken by the NRA, but are not necessarily appropriate for the urban situation through which the majority of the proposed scheme is to be constructed. For the urban area, or near to main roads, the 75 dB value is used, taken directly from the UK guidance and common practice.

In addition, a level of 65 dB is used specifically for schools, again drawn from common practice in the UK for urban developments.

The criteria given in Table 4.1 have been applied to all areas with a functional value of ≥ medium. Areas with a functional value of < medium are not considered to be sensitive to noise.

Table 4.2 defines the impact ratings that are used in this assessment.

Table 4.1 Noise criteria during the construction phase (at 1m from the façade)

Period over which criterion applies	Noise Impact Criterion (L_{Aeq}, period)
- Monday to Friday:	
- Urban areas or near main roads; Day: 07.00 to 19.00	75 dB
- Rural areas away from main roads Day: 07.00 to 19.00	70 dB
- Monday to Friday: Evening: 19.00 to 22.00	65 dB
- Monday to Friday: Night: 22.00 to 07.00	The higher of 45 dB or the ambient level.
- Saturday: Day: 08.00 to 16.30 (work outside these hours will be subject to Monday to Friday night time noise levels i.e. the higher of 45dB or the ambient level)	65 dB
- Sundays and Bank Holidays: Day: 08.00 to 16.30 (work outside these hours will be subject to Monday to Friday night time noise levels i.e. the higher of 45dB or the ambient level)	60 dB

Table 4.2 Definition of noise magnitude ratings

Extent of Noise Impact (Exceedance of Assessment Criteria)	Noise Impact Magnitude	Magnitude Rating
>10dB	Severe	very high
5 to 10dB	Substantial	high
3 to 5dB	Moderate	medium
1 to 3dB	Slight	low
<1dB	No Impact	very low

4.3.2.2 Operation

When judging noise impact, the functional value of each receptor is considered. In terms of noise assessment, the functional value relates primarily to the noise sensitivity of the activity taking place in the building. Most receptors will fall into two groups: those that are sensitive at all times to noise and those that are only sensitive during the day. However, there are also receptors that have unique sensitivities.

The criteria that are applied are summarised in Table 4.3 and Table 4.4. These criteria are applied to areas with a functional value of ≥ medium. Areas with a functional value of < medium have not been assessed because they are not considered to be sensitive to noise. The threshold criteria given in Table 4.3 are threshold noise levels below which environmental noise has insignificant effects. The noise levels in Table 4.3 are 'free-field' i.e. away from reflective surfaces. Changes in noise below these thresholds may be noticeable but would not result in significant environmental noise impacts.

Table 4.3 Threshold criteria for assessment of impacts during the operational phase

Area description	Functional value	Noise impact threshold during operation
Locations that are highly sensitive during both night and day: - Residential areas, medical facilities (hospitals, nursing homes etc)	very high	Daytime: 55 dB L_{Aeq} Night-time: 45 dB L_{Aeq}
Locations that are only sensitive during the day, where the activities that are carried out require an acceptable noise environment: - Educational/Institutional uses, theatres and religious buildings.	high	Daytime: 55 dB L_{Aeq} Night-time: Not applicable: Locations are not sensitive at night
Locations that are only sensitive during the day and where the activities that are carried out can be carried out in the presence of some noise, but not high levels of noise: - Outdoor recreational areas. - Cinemas. - Offices.	medium	Assessed on a case by case basis, depending on the sensitivity of the specific use and the level of protection that may be afforded by the building.

Where noise from the LMVs is above the threshold values, the impact depends directly on the change in noise levels or the extent to which the noise levels exceed the threshold values. For example, if the ambient noise level is currently high (well above the threshold), a small change in noise levels may be unnoticeable and a larger change may cause disturbance and be significant. In such cases the scale of the impact will depend on the degree of noise change. If the ambient noise level is currently low (below the thresholds) then the scale of the impact is dependent on the extent to which the predicted noise levels exceed the thresholds.

In this way the significance of noise impact has been assessed with reference to both the change in noise and the threshold values previously described. The magnitude ratings used in the assessment are summarised in Table 4.4. 3dB is generally the smallest change in environmental noise that would be noticeable under typical listening conditions. A change of 10dB is generally considered to be a doubling in loudness.

Table 4.4 Definition of noise magnitude ratings

Extent of Noise Impact (Exceedance of Threshold Criteria or Increase in Baseline Levels When Above Threshold)	Noise Impact Magnitude	Magnitude Rating
>10dB	Severe	very high
5 to 10dB	Substantial	high
3 to 5dB	Moderate	medium
1 to 3dB	Slight	medium
<1dB	No Impact	very low

Traffic noise impacts are assessed using the same methodology. Noise from fixed plant is considered in the same manner; however, it has been assumed insignificant if noise is less than NC25 inside neighboring buildings at night (to avoid sleep disturbance) or to not exceed the existing L_{A90} background noise. Noise Criteria (NC) curves are used to specify sound levels across a range of frequencies, and NC25 dB is an acceptable level for internal areas. Since all fixed plant is to be designed to meet these standards, it has not been necessary to define magnitudes of impact since no significant residual effects are expected.

4.4 IMPACT ASSESSMENT

4.4.1 Impact identification

4.4.1.1 Construction

The key noise sources during construction are likely to be the construction of the north Airport tunnel portal. DAA has already given permission for 24 hour working to take place within the airport, because noise impacts from construction of the cut and cover stop are not expected.

To assess the construction noise impacts in this route section, noise predictions have been carried out at 2 noise sensitive receptors around the northern portal worksite and construction compound. These receptors are illustrated on maps (Noise Impact) included in Volume 3, Book 1 of 2. Each receptor represents the group of properties most likely to be affected by the works nearby.

4.4.1.2 Operation

During operation of the proposed scheme, noise sources will include LMVs using the short above ground section of the track to the north of the airport tunnel portal, traffic changes in the area of the alignment, people at metro stops, and ancillary systems such as power supply facilities. There will also be occasional maintenance activities along the route.

The service levels of the LMVs are also important. For the purpose of this assessment, the following service levels are assumed to be planned:

- From Monday to Thursday, the service starts at 0500 hours and ends at 0030;
- On Fridays the service starts at 0500 hours and ends at 0230 hours;
- On Saturdays the service starts at 0600 hours and ends at 0230 hours;
- On Sunday the service starts at 0700 hours and ends at 2330 hours.

The most intense service frequency during the day occurs from Monday to Friday, and for the night occurs on Friday. These service periods have been assessed in order to consider the highest day and night noise levels and hence a worst case assessment. The noise assessment takes into account noise from all LMVs expected to operate during the full 16 hour daytime period from 0700 to 2300 hours and the full 8 hour night-time period from 2300 to 0700 hours.

At service commencement date train services will operate at 4 minute headways during peak hours. The tendering requirements also include an option to operate services at 3 minute headways during peak service hours. The assessment is based on the likely service patterns that can be foreseen within the period up to 2029 (3 minute headways).

The southbound service headways envisaged for the period up to the year 2029 are:

- 4 minute (2014) and 3 minute (2029) service headways between 07.00 to 10.00 hours and 15.30 to 19.00 hours
- 7.5 minute (2014) and 6 minute (2029) service headways between 05.00 to 07.00 hours, 10.00 to 15.30 hours and 19.00 to 21.00 hours (with the exception of 05.00 and 07.00 hours in 2014 when 10 minute service headways will be operated)
- 10 minute service headways between 21.00 to 00.00 hours.

The northbound service headways are:

- 4 minute (2014) and 3 minute (2029) service headways between 07.30 to 10.30 hours and 16.00 to 19.30 hours

- 7.5 minute (2014) and 6 minute (2029) service headways between 05.00 to 07.30 hours, 10.30 to 16.00 hours and 19.30 to 21.30 hours (with the exception of 05.00 and 07.30 hours in 2014 when 10 minute service headways will be operated)
- 10 minute service headways between 21.30 to 00.30 hours.

On Friday and Saturday nights, services will continue at 20 minute headways until 0200 hours southbound and 0230 hours northbound.

Some LMVs will need to run empty to St. Stephen's Green from the depot in the morning before the service starts (from approximately 0430 to 0500 hours), and back to the depot when the service ends (up to approximately 0300 hours on Friday and Saturday nights). Although out of service LMVs will be empty they will run at the same speed as in service vehicles.

Service levels may be varied on particular occasions, such as during major public events in the city or at Christmas. Noise impacts on these occasions have not been assessed because they will be very infrequent.

Levels of noise from LMV operations have been predicted at 25 locations in this route section. Detailed results are given in Table 4.1 and 4.2 of Annex C Noise Assessment Details (Volume 3, Book 2 of 2).

Noise impacts from traffic may result due to:

- the realignment of the road network thereby moving the road traffic closer to or further away from receptors;
- road closures or the remodeling of junctions to accommodate the LMVs;
- modal shift from the private car may help to reduce the number of vehicles on the highway network;
- traffic that diverts to other routes or accesses the Park & Ride at Belinstown.

It is noted that substantial changes in road traffic flow, speed, and/or composition are required to produce noise changes greater than 3dB.

People at metro stops may cause additional noise, but in general stops with nearby noise sensitive receptors are located in busy areas where ambient noise levels are relatively high, and any such affects will be small.

4.4.2 Mitigation measures

4.4.2.1 Construction

Mitigation will include the following measures:

Best practical means will be used to minimise construction noise through implementation of the recommendations set out in BS 5228. In particular, the following noise mitigation measures will be implemented:

- Proper use of plant with respect to minimising noise emissions and regular maintenance will be required. All vehicles and mechanical plant will be fitted with effective exhaust silencers and will be maintained in good efficient order.
- The use of inherently quiet plant where appropriate - all major compressors and generators will be 'sound reduced' models fitted with properly lined and sealed acoustic covers, which will be kept closed whenever the machines are in use, and all ancillary pneumatic percussive tools will be fitted with mufflers or silencers of the type recommended by the manufacturers.
- Machines in intermittent use will be shut down in the intervening periods between work or throttled down to a minimum.
- All ancillary plant such as generators and pumps will be positioned so as to cause minimum noise disturbance, and where necessary, acoustic enclosures will be provided.
- Where practicable the use of noisy plant will be limited to core daytime periods.
- Channels of communication will be established between the contractor/ developer, local authority and residents.
- A site representative will be appointed responsible for matters relating to noise.
- Typical levels of noise will be monitored during critical periods and at sensitive locations.
- A 2m high solid site hoarding along the site boundaries will be erected where practical and feasible.
- Localised noise barriers will be erected as necessary around items such as generators or high duty compressors.
- Construction compounds will be laid out so as to minimise noise impacts to neighboring noise sensitive receptors, by locating noisy operations well away from receptors and using on-site structures and materials to screen noise where practicable and necessary.

Additionally, all contractors will be required to comply with S.I. No 632 of 2001 European Communities (Noise Emission by Equipment for Use Outdoors) Regulations 2001, amended by S.I. No 241 of 2006.

4.4.2.2 Operation

LMV Noise

No noise impact are predicted in this route section, so no details of mitigation measures for the system in general or for this sections are reported in this chapter.

4.4.3 Assessment of residual impacts

4.4.3.1 Project scenario: construction phase

Alignment
The route section within Area MN103 contains a short section of at-grade track and bored tunnel beneath the airport. No receptors are located close to the at-grade section and noise impacts are not predicted.

Structures
Area MN103 includes the northern portal of the airport tunnel. The predicted noise levels for these activities are shown in Tables 7.26 in Annex C Noise Assessment Details (Volume 3, Book 2 of 2). Without mitigation the construction of the tunnel portal would result in noise impacts up to 16dB above the assessment criterion at the nearest parts of the halting site on the Naul Road to the east of compound 7 (MN103_C1). Residual noise impacts 6dB above the assessment criterion are predicted. This is a High impact. The works on the portal are likely to take place over approximately 6 months.

Stops
The Airport Stop is an underground stop constructed by cut-and-cover techniques. It is located close to the existing airport terminal and the planned second terminal on the site of the proposed airport Ground Transportation Centre. Buildings at the airport will be insulated to deal with high aircraft noise levels, and significant noise impacts from construction of the stop are not predicted.

Construction compounds
Construction compound 7 (the north Airport Tunnel portal) is located in Area MN103. The compound is only to be used for accommodation and welfare facilities in addition to the main portal works that are discussed in the structures section above. No significant noise impacts are predicted.

4.4.3.2 Project scenario: operational phase

Introduction
The alignment is in bored tunnel beneath the airport. No airborne noise predictions have been necessary for this section except for receptors close to northern tunnel portals. Noise levels were predicted at one representative receptor during operation of the proposed scheme; the Halting Site MN103-1, 200m from the portal alignment.

Railway Noise
The Noise levels predicted at the representative receptor in Area MN103 are reported in Tables 7.4 of Annex C Noise Assessment Details (Volume 3, Book 2 of 2). Noise levels below $L_{Aeq\ 1\ hr}$ 30dB were predicted and no impacts are expected. No mitigation is required.

Maintenance
Maintenance of the wheel and rail surfaces is an important means of avoiding train noise increasing over the years of operation. Much of the maintenance work on the track will be undertaken at night when the railway is not in use. Most maintenance activities are not particularly noisy, but rail grinding may cause some disturbance. Rail grinding in a given location is likely to be required at a frequency measured in years and will deliver long term noise and vibration benefits. Rail grinding in the vicinity of a particular receptor will take only a few hours and would generally be completed over a single night shift.

4.4.4 Summary of residual impacts

A summary of the residual impacts associated with this section of the scheme is provided in Table 4.5.

Table 4.5 Summary of residual impacts

	Magnitude of impact taking into account mitigation	Functional value of area affected	Significance of impact
Construction phase			
Construction Noise During Day	Very high impact nearest parts of the halting site on Naul Road to the east of the compound (MN103_C1) for 6 months. Other impacts are not significant	very high	Significant
Operation phase			
Airborne Noise from metro Vehicles	Very low	very high	Not significant

05 HUMAN BEINGS: VIBRATION

This chapter of the EIS evaluates the potential vibration impacts arising from the construction and operation of the proposed scheme within Area MN103.

5.1 INTRODUCTION

This chapter of the EIS evaluates the potential vibration impacts arising from the construction and operation of the proposed scheme within Area MN103.

5.2 STUDY AREA

The study area for this assessment is set out in Table 5.1.

Table 5.1 Study area

Criteria	Width of study area (on both sides of the alignment)
Construction Groundborne Noise – human perception	50m
Construction Groundborne Noise – effects on sensitive facilities	100m
Construction Vibration – building damage	50m
Construction Vibration – human perception	80m
Construction Vibration – effect on sensitive equipment	1,000m
Operational Vibration – human perception	50m
Operational Vibration – effect on sensitive equipment	100m
Operational Groundborne Noise – human perception	50m
Operational Groundborne Noise – effects on sensitive facilities	100m

5.3 IMPACT ASSESSMENT METHODOLOGY

5.3.1 Construction phase methodology

The source and type of all potential impacts is described in Section 5.4.1. Mitigation measures to be put in place are defined in Section 5.4.2 for any adverse impacts that are deemed to be of Medium or greater significance prior to mitigation. The extent to which mitigation is needed increases as the significance of the impact increases. The residual impact is then evaluated in Section 5.4.3 in terms of magnitude and significance.

5.3.1.1 Magnitude

The criteria used to assess the different impacts associated with the proposed scheme are discussed below and summarised in Table 5.2.

Groundborne Noise
The metric which is widely used for the assessment of groundborne noise is the maximum A-weighted sound level using 'slow' time response, $L_{Amax,S}$.

The symbol 'L' indicates a value expressed in decibels (abbreviated dB). The dB scale measures relative magnitudes of sound power or intensity (sound power per unit area) a property proportional to the mean squared value of the amplitudes of the air pressure oscillations that cause sound. Every doubling of intensity is a 3dB increase and every tenfold increase in intensity is a 10dB increase. A standard reference level (0dB = 20μPa of root mean square sound pressure) is used so that the dB scale can measure absolute levels as well as relative levels. The symbol 'A' signifies that the measured sound pressure has been subjected to frequency weighting using the standard 'A-weighting scale', to approximate the frequency response of the human ear - relatively insensitive at low frequencies and very high frequencies. Every 10dB increase in A-weighted sound level is perceived as approximately a doubling of loudness - slightly more than a doubling for sound of low frequency. The symbol 'S' specifies a method of averaging the oscillating sound pressure, by exponential averaging as defined in IEC 61672 (2002), using the standard 'slow' time constant of one second - the alternative being the 'F' or 'fast' time constant of 1/8 second. 'S' has a greater smoothing effect on sound that varies in level. The symbol 'max' means the highest averaged value reached during an event such as the passage of a train. The value of $L_{Amax,S}$ nearly equals the value of $L_{Amax,F}$ for a steady sound that lasts for one second or more, otherwise $L_{Amax,F}$ levels exceed $L_{Amax,S}$ levels by an amount dependent on the rapidity and magnitude of the variations. For groundborne noise from a modern underground railway, $L_{Amax,S}$ levels are typically 2dB lower than $L_{Amax,F}$ levels. $L_{Amax,S}$ can alternatively be written as L_{Asmax} and is defined in IEC 61672 (2002).

During the construction phase, vibration will relate principally to the passage of the tunnel boring machine (TBM) and will be experienced by humans as groundborne noise. The fact that the TBM will only be heard in each tunnel for the short period of its passage means that impact thresholds are higher than for the permanent effect of the operating scheme. In limestone, the TBM is likely to advance at the rate of about 75m per week, operating 6 days per week. In the case of the Dublin Port Tunnel noise from the TBM was sometimes audible for up to three weeks before, and three weeks after, reaching the closest point to a receiving location. The Dublin Port Tunnel is approximately 11m in diameter. The Metro North tunnels will be 6.7m in diameter so groundborne noise levels will be less than those for the Dublin Port Tunnel with consequently shorter durations. Passage through the overburden above the limestone is likely to be faster. In locations between the two tunnels, this experience will be repeated with a delay of the order of two months between the two tunnel drives.

Because of the finite duration of this effect, the night-time impact thresholds have been set 5dB higher than those for the operation of the proposed scheme. Separate day-time thresholds (not relevant to operation as there is no difference between $L_{Amax,S}$ for a passing LMV by day or night) have been used which are 5dB above the night-time thresholds (i.e. 10dB above the thresholds for operation).

Vibration
The metric which is used for the assessment of vibration is the KB value from DIN 4150-2, which is assessed using three different criteria, A_u, A_o and A_r. The KB value is a frequency weighted measure of vibration velocity in units of mm/s, using the 'F' time constant, obtained for each 30-second cycle in a sequence of contiguous 30-second cycles. Two types of parameters are defined based on the KB value:

- KB_{Fmax} the maximum value for the time varying KB value during the evaluation period;
- KB_{FTr} an evaluation parameter that is weighted according to the number of vibration events and the duration of these events during the evaluation period.

For daytime vibration other than blasting, if KB_{Fmax} is lower than or equal to A_u, DIN 4150-2 states that 'the requirements of the standard have been met'. If KB_{Fmax} is greater than A_o 'the requirements of the standard have not been met'. In other cases, where the KB_{Fmax} value is between A_u and A_o, KB_{FTr} is calculated as the root-mean square of the 30-second KB values, and if it does not exceed A_r the 'requirements of the standard have been met'.

For construction vibration three levels are defined by DIN 4150-2:

Level I: With vibration below this level, it can be assumed even without any previous knowledge, that there will be no considerable discomfort.

In this assessment daytime vibration impact above Level I and not above Level II is classed as 'low'.

Level II: Vibration below this level is also not likely to produce considerable discomfort, as long as the measures specified in items a) to e) (and if necessary, item f) of DIN 4150-2 are taken. As this level is exceeded, the probability increases that there will be considerable discomfort. According to DIN 4150-2 'If it is expected that Level II will be exceeded, an attempt shall be made to use construction methods that produce less vibration'.

In this assessment daytime vibration impact above Level II and not above Level III is classed as 'high'.

Level III: The effects produced by vibration above this level are unacceptable. In this case, special measures that go beyond those specified in items (a) to (f) of DIN 4150-2 shall be agreed upon.

In this assessment daytime vibration impact above Level III is classed as 'very high'

For construction vibration at night, the same guideline values used for operational vibration apply. In this context DIN 4150-2 defines criteria for five receptor types and the most stringent criteria have been used to define the 'very low' impact category. The criteria for less sensitive receptors defined in DIN 4150-2 have been used to define the higher impact magnitudes in the absence of other guidance. All impact magnitudes above 'very low' are defined as significant at night.

Table 5.2 Criteria for assessment of impact magnitude during construction

Criteria		Impact magnitude
Dwellings, Offices, Hotels, Schools, Colleges, Hospital Wards, Libraries		
Groundborne noise (TBM)	Night $L_{Amax,S}$ >50dB Day $L_{Amax,S}$ >55dB	very high
	Night 45dB >$L_{Amax,S} \leq$ 50dB Day 50dB >$L_{Amax,S} \leq$ 55dB	high
	Night 40dB >$L_{Amax,S} \leq$ 45dB Day 45dB >$L_{Amax,S} \leq$ 50dB	medium
	Night 35dB >$L_{Amax,S} \leq$ 40dB Day 40dB >$L_{Amax,S} \leq$ 45dB	low
	Night $L_{Amax,S} \leq$ 35dB Day $L_{Amax,S} \leq$ 40dB	very low
Vibration effect on people (TBM)	Night $A_u > 0.2$, $A_o > 0.4$, $A_r > 0.1$ Day $A_u > 1.6$, $A_o > 5$, $A_r > 1.2$	very high
	Night $A_u \leq 0.2$, $A_o \leq 0.4$, $A_r \leq 0.1$ Day $A_u \leq 1.6$, $A_o \leq 5$, $A_r \leq 1.2$	high
	Night $A_u \leq 0.15$, $A_o \leq 0.3$, $A_r \leq 0.07$ Day $A_u \leq 1.2$, $A_o \leq 5$, $A_r \leq 0.8$	medium
	Night $A_u \leq 0.1$, $A_o \leq 0.2$, $A_r \leq 0.05$ Day Au ≤ 0.8, $A_o \leq 5$, $A_r \leq 0.4$	low
	Night $A_u \leq 0.1$, $A_o \leq 0.15$, $A_r \leq 0.05$ Day $A_u \leq 0.4$, $A_o \leq 3$, $A_r \leq 0.2$	very low
Vibration – building damage	>50mm/s ppv	very high
	≤50mm/s ppv	high
	≤12mm/s ppv	medium
	≤5mm/s ppv	low
	≤3mm/s ppv	very low
Sensitive Equipment		
Vibration	Dublin Airport: The most sensitive equipment reported at the Airport is a ceilometer with a vibration criterion limit of ± 1mm displacement in the range 5-13.2Hz, and ± 0.7g in the range 13.2-100Hz.	Must not exceed
	Computer equipment 0.25g peak acceleration	Must not exceed

5.3.1.2 Significance

The significance of all impacts is assessed by considering the magnitude of the impact and the functional value of the area upon which the impact has an effect. The functional value of the receptor relates to its sensitivity which has been taken account of in the assessment criteria that have been adopted.

5.3.2 Operational phase methodology

5.3.2.1 Magnitude

The criteria used to assess the different impacts associated with the operation of the proposed scheme are shown in Table 5.3.

Table 5.3 Criteria for assessment of impact magnitude during operation

Criteria		Impact magnitude
Dwellings, Offices, Hotels, Schools, Colleges, Hospital Wards, Libraries		
Groundborne noise	$L_{Amax,S}$ >45dB	very high
	40dB > $L_{Amax,S} \leq$ 45dB	high
	35dB > $L_{Amax,S} \leq$ 40dB	medium
	30dB > $L_{Amax,S} \leq$ 35dB	low
	$L_{Amax,S} \leq$ 30dB	very low
Vibration	Night A_u = <0.2, A_o = <0.4, A_r = >0.1 Day A_u = 0.4, A_o = 6, A_r = 0.2	very high
	Night A_u = 0.2, A_o = 0.4, A_r = 0.1 Day A_u = 0.3, A_o = 6, A_r = 0.15	high
	Night A_u = 0.15, A_o = 0.3, A_r = 0.07 Day A_u = 0.2, A_o = 5, A_r = 0.1	medium
	Night A_u = 0.15, A_o = 0.2, A_r = 0.05 Day A_u = 0.15, A_o = 3, A_r = 0.07	low
	Night A_u = 0.1, A_o = 0.15, A_r = 0.05 Day A_u = 0.1, A_o = 3, A_r = 0.05	very low
Sensitive Equipment		
Vibration	Dublin Airport: The most sensitive equipment reported at the Airport is a ceilometer with a vibration criterion limit of ± 1mm displacement in the range 5-13.2Hz, and ± 0.7g in the range 13.2-100Hz.	Must not exceed

5.3.2.2 Significance

The significance of all impacts is assessed by considering the magnitude of the impact and the functional value of the area upon which the impact has an effect. The functional value of the receptor relates to its sensitivity which has been taken account of in the assessment criteria that have been adopted.

5.4 IMPACT ASSESSMENT

5.4.1 Impact identification

5.4.1.1 Construction phase

Vibration in the construction phase will be produced by the TBM. The principal sources of vibration from tunnel boring are probe drilling (if undertaken) and the cutting action of the TBM.

The Dublin Port Tunnel was bored through bedrock that is similar to that which is expected to be experienced by the TBMs involved in the proposed scheme. During the course of the construction of the Dublin Port Tunnel, the project carried out extensive monitoring of the groundborne noise and vibration that occurred at specific locations along the proposed scheme.

A numerical model of the Dublin Port Tunnel project has been created as part of the proposed scheme studies. The results of this model have been backfitted to the groundborne noise and vibration results that were measured when the port tunnel was being built in order to obtain a source term for the tunnel face. A comparative modelling exercise has then been carried out to create a model for the proposed scheme taking into account the fact that the tunnel will have a significantly smaller diameter (approximately 6.7m) than that of the Dublin Port Tunnel (approximately 11m). The output of the modelling exercise provides an indication of likely ground vibration and associated groundborne noise at various depths and geological conditions, as well as a prediction of the decay of vibration and groundborne noise with distance, both laterally and ahead and behind the TBM.

The predictions were carried out using the Rupert Taylor Finite Difference Time Domain model FINDWAVE®.

The model used for this study predicts, in the time domain, the three-dimensional vibration velocity of the tunnel face and surrounding lithology. The time-domain results are transformed into the frequency domain to give 1/3 octave frequency spectra, and overall sound levels in dB(A) and vibration units.

The approach has been to set up a generic model in an unbounded soil (i.e. with no ground surface in the model) and produce cross-sectional plots of vectored vibration velocity from which, subject to the application of transfer functions to buildings, ground surface predictions can been made.

Effect of variations in geotechnical parameters
The ground conditions for the proposed scheme vary along the alignment. These variations affect the predictions of groundborne noise and vibration from the TBM.

The effects are of three main kinds. The first is that the impedance of the rock in which the TBM is working affects the level of vibration generated. Impedance is the product of rock density and the speed of sound of compression waves in the rock. For constant face pressure, the power transmitted away from the face as vibration is inversely proportional to the rock impedance i.e. less vibration for harder rock. For constant TBM power, the power transmitted away from the face as vibration is independent of the rock impedance. If the power is increased to compensate for harder rock, then the power transmitted away from the face as vibration is proportional to the rock impedance. The last assumption has been made in this assessment, namely that the power transmitted away from the face as vibration is proportional to the rock impedance.

The second effect relates to the influence of the overburden layer of clay, sand or gravel between the rockhead and the foundations of buildings founded on the surface. The impedance of the overburden is less than that of limestone. There is a reduction in transmission of vibration out of the limestone into the overburden, but the nature of this effect depends not only on the impedance of the overburden relative to the limestone, but also on the thickness of the overburden. A reduction in the impedance of the overburden causes a broad reduction across the spectrum, but this can be less important than the fact that the peak frequency at which vibration is transmitted, shifts downwards, which in the region of the new peak causes an increase in vibration around that frequency.

The third effect is that lower impedance results in lower wave speed and shorter wavelength, and as loss due to material damping is inversely proportional to wavelength this results in greater material damping in the overburden layer.

The geotechnical properties continually change along the alignment, as does the depth of the tunnel, sometimes being in the overburden and sometimes in the limestone. The estimates of vibration and groundborne noise made in this assessment have been based on the numerical modelling results, adjusted according to the local geotechnical conditions in each location.

5.4.1.2 Operational phase

Vibration and groundborne noise are aspects of the same phenomenon, perceived differently or in different media. Vibration is movement of a surface or structure perceived by humans by the tactile sense or which directly affects the function of an item of equipment such as an electron microscope. Groundborne noise is vibration of a surface or structure perceived by humans by the sense of hearing, or by equipment such as microphones in, for example, recording studios, as a result of radiation of the vibration into air between the surface and the ear, causing sound.

Sources of vibration and groundborne noise in the operation of proposed scheme are:

- Wheel/rail interaction during the movement of LMVs
- over plain line
- over switches and crossings
- Operation of equipment such as escalators and mechanical services plant at stops

Escalators and mechanical services plant will be designed to ensure that they do not give rise to significant effects at offsite receptors. This will involve ensuring that mitigation will be incorporated to avoid exceeding significant impact levels as defined above. Mitigation measures will include well established techniques such as vibration isolating bearings to control vibration from this type of source if required. Therefore, it has not been necessary to consider these in detail in this assessment.

5.4.2 Mitigation measures

5.4.2.1 Construction

Two principal methods of mitigation are available for tunnel boring. The first is to limit hours of operation to avoid the more sensitive night period. The second method is optimisation of TBM characteristics including face pressure and selection of cutters and teeth.

The following incorporated mitigation measures have been assumed

Work may only be carried out between 07h00 and 23h00, Monday to Saturday but excluding bank holidays ('core permitted underground working hours') except that work may be carried out at times outside the core permitted underground working hours in the following cases:

i) groundborne noise levels are not in excess of 40dB $L_{Amax,s}$ (where $L_{Amax,s}$ is as defined in IEC 61672, 2002) as measured near the centre of any occupied sensitive room of an inhabited building.

or

ii) groundborne noise levels are in excess of 40dB $L_{Amax,s}$ (where $L_{Amax,s}$ is as defined in IEC 61672, 2002) as measured near the centre of any occupied sensitive room of an inhabited building provided that that work does not cause noise disturbance, where noise disturbance is defined as any complaint made by any person who is the occupant of a sensitive room in an inhabited building

or

iii) the full extent of the tunnel drives under the airport as well as for the Airport Stop where working hours of 24 hours per day seven days per week will be permitted without restriction.

5.4.2.2 Operation

A particular feature of the operation of a newly designed rail scheme is that the incorporation of resilient rail support and the use of welded rail have the result that significant effects due to vibration and groundborne noise are completely avoided provided that the appropriate form of track support is selected, and an adequate maintenance regime is followed. Resilient rail support has been established as the standard trackform for non-ballasted track on Luas and is the normal method of standard rail support for modern urban underground railways throughout the world. While resiliently embedded rail is used for street-running, resilient baseplates or other rail support systems, or booted blocks are typical modern designs.

The assessment of vibration and groundborne noise from a new railway therefore consists entirely of a consideration of the likely nature of incorporated mitigation in the design and operation (including maintenance) of the system. The Description of the Scheme chapter of this EIS (Volume 1, Chapter 6) states that a floating trackbed system will be provided in the twin bore running tunnels between St. Stephen's Green and Albert College Park.

It is assumed that the following specification will be imposed:

(a) To ensure that noise disturbance during operation of the proposed scheme is minimised, InfraCo shall ensure that the maximum permissible level of groundborne noise that may be generated during operation does not exceed 40dB $L_{Amax,S}$ determined near the centre of any occupied sensitive room of an inhabited building, except at the following locations:

   (i) Between Parnell Street and Albert College Park the maximum permissible groundborne noise that may be generated during operation does not exceed 25dB $L_{Amax,S}$ determined near the centre of any occupied sensitive room of an inhabited building.

(b) An inhabited building is a building which is in whole or in part lawfully used either temporarily or permanently as a dwelling, hospital, hostel or hotel. An occupied sensitive room is a room in an inhabited building that is a hospital ward, living room, or bedroom which is not a kitchen, bathroom, WC or circulation space that is in use as a living room or bedroom at the time the works are being carried out.

Mitigation measures primarily consist of the design of the track support system, and the choices available broadly fall into two categories, namely resilient rail support and floating slab track. Generally speaking, the parameter that controls the isolation performance of the system is the mass-spring natural frequency of the effective mass of the rail plus bogie unsprung mass on the spring provided by the resilience of the support system below the rail. Limitations on allowable dynamic rail deflection place a lower bound on the achievable dynamic stiffness of the support.

Resilient rail support means support of the rail from the second stage concrete by a system with a vertical dynamic stiffness below about 20MN/m (systems are available with vertical dynamic stiffnesses as low as 7MN/m). This may be in the form of a resilient baseplate supporting the rail foot, a resilient support for the rail web instead of the rail foot, or the provision of a resilient boot to a concrete block to which the rail is fastened.

Floating slab track (FST) means the support of the rail from a concrete slab which is mounted on resilient bearings. FST achieves greater isolation of vibration and groundborne noise largely because the mass of the concrete slab enables a lower natural frequency to be achieved without excessive dynamic deflection. Some of the vibration is also stored and dissipated in the slab and components above the slab.

5.4.3 Assessment of residual impacts

5.4.3.1 Project scenario: construction phase

The alignment is in bored tunnel beneath the airport. Vibration is likely to be 1.1mm/s and no additional mitigation is required to avoid exceeding the vibration limits for the most sensitive equipment reported at the airport including the ceilometer.

5.4.3.2 Project scenario: operational phase

For the purposes of this assessment the vibration performance of the track and LMVs have been assessed by numerical modelling, in two ways. For the most demanding cases, namely the achievement of the limits for sensitive equipment at the Mater hospitals, detailed numerical models of the stops, tunnels and the hospital buildings have been created, and the results have shown that with the use of floating slab track the vibration limits can be achieved. These vibration limits are equivalent to levels of groundborne noise below the most stringent 'very low' impact magnitudes in Table 5.2, and it follows that in any location where mitigation better than resiliently rail support is required, floating slab track will provide mitigation sufficient for the most demanding case.

For track laid without rail joints (except at switches and crossings) and with modern standards of rail alignment, groundborne noise is the determining impact, and tactile vibration is normally at levels below the threshold of human perception. Vibration only requires special consideration in the case of highly sensitive equipment as further explained below.

For the standard case of resilient rail support, three generic models have been created, one for the case of the tunnel in limestone with glacial till (boulder clay) above, one for the case of the tunnel in the clay above the limestone and one for cut-and-cover tunnel sections. The basic models are unbounded, and a further model was created including a ground surface to determine the effect of multiple reflections between the ground surface and the limestone rockhead. This was found to increase dB(A) levels by an average of 5dB(A), and this has been added to the unbounded results. The results are speed dependent at the rate of approximately 1dB per 8% change in speed. It is noted that the highest levels are not directly above the tunnel.

Because it will be for the appointed contractor to select the trackform at a future stage in the programme, and the procurement process for the light metro vehicles (LMVs) will take place after the writing of this Environmental Impact Statement, it is not possible to model the performance of the actual track and LMVs. The approach that has been taken is to model the rail support dynamic stiffnesses for resiliently supported rail as 13MN/m run of rail, to yield the likely significant effect of the proposed scheme The LMV characteristics used have been those for the vehicle with the highest unsprung mass among those likely to be offered by the contractor, and an allowance of 5dB(A) for LMV and rail support stiffness uncertainty has been added to the results.

The results of the modelling are shown in Figure 5.1 to Figure 5.3. These figures illustrate that generally the groundborne noise will reduce for higher depths of ground cover. They also show that the groundborne noise is dependent on transverse distance from the tunnel, and that it does not follow a simple linear decay.

Figure 5.1 Groundborne noise from LMV in bored tunnel in glacial till above limestone

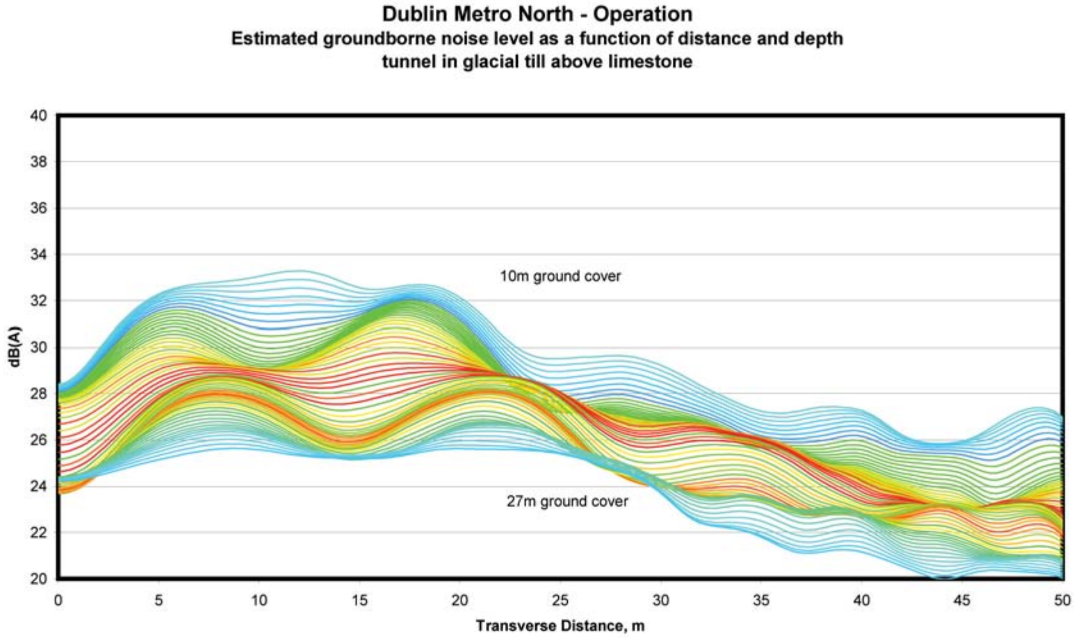


Figure 5.2 Groundborne noise from LMV in bored tunnel in limestone below glacial till

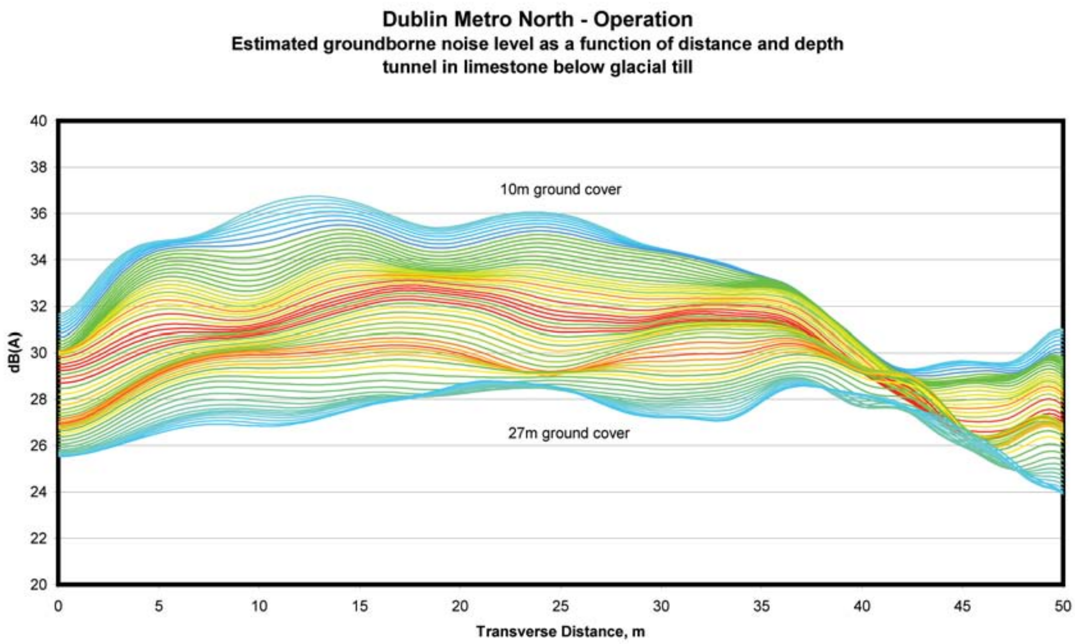
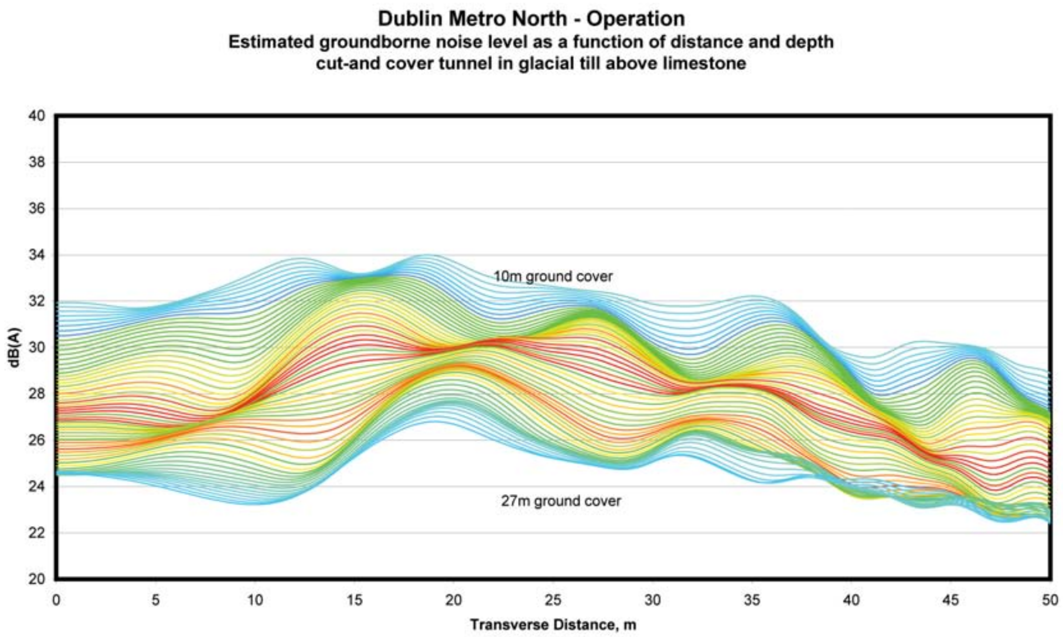


Figure 5.3 Groundborne noise from the LMV in cut-and-cover tunnel in glacial till above limestone



In any case where either a Medium, High or Very high significant impacts for groundborne noise are identified in this way, or where 'not to exceed' limits for sensitive equipment would be exceeded, incorporated mitigation in the form of floating slab track is assumed.

The results of this assessment are as follows:

The alignment is in bored tunnel beneath the airport. No additional mitigation is required to avoid exceeding the vibration limits for the most sensitive equipment reported at the airport.

5.4.4 Summary of residual impacts

The potential noise and vibration effects from construction and operation of the proposed scheme have been assessed. An assessment of the requirements for mitigation has been undertaken. A summary of the residual impacts associated with the scheme is provided in Table 5.4.

Table 5.4 Summary of residual impacts

	Magnitude of impact taking into account mitigation	Functional value of area affected	Significance of impact
Construction phase			
Goundborne noise	low	very high	Not significant
Vibration affecting humans	low	very high	Not Significant
Vibration affecting buildings	low	very high	Not significant
Vibration affecting sensitive equipment	low	very high	Not significant
Operational phase			
Groundborne noise	low or very low	very high	Not significant
Vibration affecting humans	very low	very high	Not significant
Vibration affecting sensitive equipment	very low	very high	Not significant