
ENVIRONMENTAL IMPACT STATEMENT – METRO NORTH

ALBERT COLLEGE PARK TO MATER STOP

AREA MN106 (PART 1 – CHAPTERS 1 TO 5)
VOLUME 2 – BOOK 6 OF 7

Drumcondra

Mater

METRO NORTH ROUTE AREA MN101 – MN107

LEGEND

- METRO ROUTE
- AREA BOUNDARY
- METRO ROUTE BORROW TUNNEL
- METRO ROUTE CUT & COVER TUNNEL
- METRO ROUTE ELEVATED TRACK
- METRO FEED
- AREA FEED
- METRO FEED FUTURE POSSIBLE STOP
- METRO FEED FUTURE STATION & STOP
- METRO STOP NAME
- HIGH & BICYCLES
- LIGHT RAIL/STATION
- SUBWAY/STATION
- RAIL INTERCHANGE
- POSSIBLE DEPOT



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AREA MN106
VOLUME 2 – BOOK 6 OF 7

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.

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.

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.

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01

INTRODUCTION TO AREA MN106





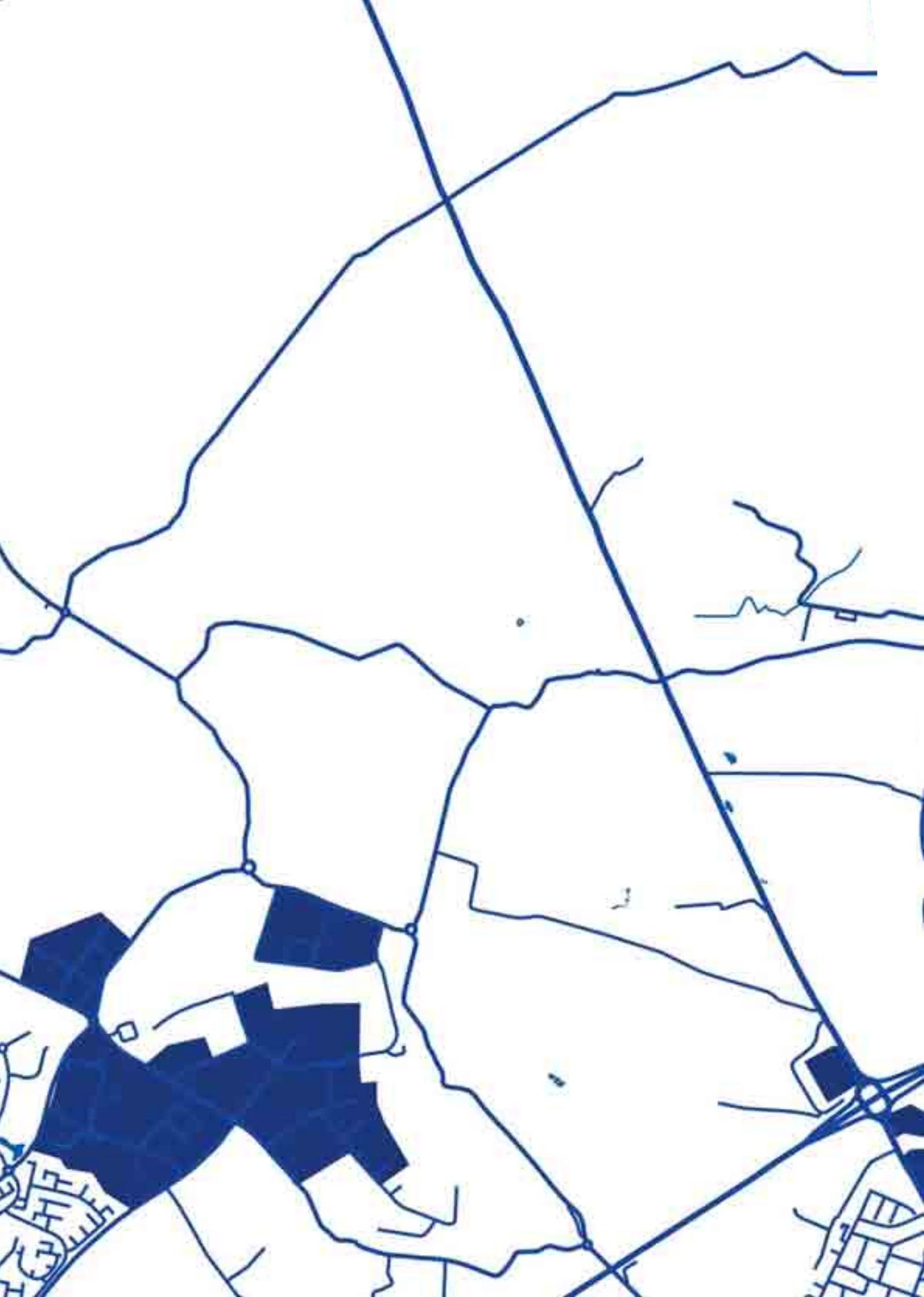
Metro North is the next phase of Dublin's integrated light rail network. The proposed scheme will serve an 18km corridor from Belinstown in the north of County Dublin to St. Stephen's Green in the city centre via Dublin Airport.

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 Stop and St. Stephen's Green. Metro North will run in a mix of bored and cut and cover tunnels beneath the city and 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 which collectively make up Volume 2 of this EIS. This document relates to **Area MN106** Albert College Park to Mater Stop.

The proposed scheme runs in a cut and cover tunnel across Albert College Park, entering bored tunnel near the southern boundary of the park. The route remains underground in the bored tunnel until its termination at St. Stephen's Green.

Continuing south in a bored tunnel from Albert College Park, the next stop is Griffith Avenue. This stop is located in the southwest corner of the agricultural lands on the north side of Griffith Avenue. Proceeding in a south-easterly direction, the route continues in tunnel under St. Patrick's College playing fields. An emergency access and ventilation shaft is located in the southwest corner of the college playing fields. The route continues in tunnel under the Tolka River to Drumcondra Stop. This stop is located to the west of Lower Drumcondra Road and adjacent to St. Joseph's Avenue. An interchange with Iarnród Éireann's suburban rail services to Maynooth is provided at this stop. The route turns in a south-westerly direction passing under a second mainline railway and the Royal Canal, to the Mater Stop, located under the Mater Hospital's existing surface car park. Area MN106 ends 100m further south where the tunnels pass under St. Joseph's Parade.



02

HUMAN BEINGS: LANDUSE

- 2.1 Introduction
- 2.2 Study area
- 2.3 Impact assessment methodology
 - 2.3.1 Magnitude
 - 2.3.2 Significance
- 2.4 Impact assessment
 - 2.4.1 Impact identification
 - 2.4.2 Mitigation measures
 - 2.4.3 Assessment of residual impacts





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 MN106.

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 MN106.

2.2 STUDY AREA

The study area for the assessment is set out in Table 2.1.

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)
Severance	line for permanent and temporary land-take and construction compounds

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	very high
Permanent severance	
Temporary land-take for a period of more than 1 year or near/in residential areas	high
Temporary severance for a period of more than 1 year or near/in residential areas	
Temporary land-take for a period of less than 1 year	medium
Temporary severance for a period of less than 1 year	
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 proposed 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 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. The hoarding will be used to provide public information about the proposed scheme and alternative access arrangements to local businesses and facilities. 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

Within Albert College Park, there are two Construction Compounds 12a and 12b which will total approximately 4.7ha in size and will be used for a period of more than 1 year. Albert College Park is Open Space and Recreational land in an area of very high functional value. Albert College Park is a valuable open space and is used regularly and intensively by local residents and sports clubs. The significance of this impact is High due to it being a temporary loss of a very important open space. Some of the park will be maintained as open space and will be accessible to the public. The temporary land-take will only use 4.7ha of the park. Approximately 9ha of the park will remain accessible and useable.

There will be a temporary construction compound (Compound 13) present for a period of more than 1 year, in order to facilitate the construction of Griffith Avenue Stop, in lands classified as Agricultural and Rural Amenity lands adjacent to Griffith Avenue. These lands are in an area of very high functional value. The significance of the impact of the temporary land-take will be Low.

It is rated Low significance due to the fact that the temporary land-take will not affect the overall viability of the remaining agricultural land.

In the southwest corner of St. Patrick's College, adjacent to St. Patrick's Boys National School there will be a construction compound (Compound 14) in place for a period of more than 1 year. An intervention shaft building will be constructed on this site. There will be a temporary land-take of the surrounding area while the intervention shaft building is being constructed. The land is classified as Educational/Institutional/Community/Civic and has a very high functional value. The significance of the impact will be Low. The land that will be temporarily taken is within the grounds of the national school. Land will be provided from St. Patrick's College to provide for an alternative playground for the school.

Surrounding the construction area of both the Drumcondra Stop and the Mater Stop (Construction Compound 15 and 16) there will be temporary land-takes to facilitate the construction phase. Both are located in areas of very high functional value. Both land-takes are in lands classified as Educational/Institutional/Community/Civic and Residential Areas. The temporary land-takes will be for a period of more than 1 year. Six buildings will be demolished at St. Alphonsus Avenue to allow for the construction of the Drumcondra Stop. The significance of the impacts of these temporary land-takes surrounding the Drumcondra Stop and the Mater Stop is determined to be Very high. This is due to the fact that it will be for a period of more than 1 year and is in a very high functional area.

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

Temporary severance

There will be no temporary severance within Area MN106. Alternative access is available at every location of construction above ground. Access to properties on St. Alphonsus Avenue and St. Joseph's Avenue will be hampered by the construction of the Drumcondra Stop. Alternative access to these properties will be made available. Similarly, access to Mater Hospital will be provided via alternative entrances.

2.4.3.2 Project scenario: operational phase

Permanent land-take

In Area MN106 the permanent land-take will occur at the locations of the stops and the intervention shaft building. There will be some permanent land-take to accommodate the Griffith Avenue Stop. With mitigation measures in place its impact significance is determined to be Low due to the fact that it does not impinge on the use of the remaining land for agricultural purposes and it will total approximately 0.5ha in an agricultural area approximately 11ha in total.

There will be a permanent land-take from the lands of St. Patrick's College and St. Patrick's National School in Drumcondra. These lands are classified as Educational/Institutional/Community/Civic and are in an area of very high functional value. The permanent land-take will accommodate an intervention shaft building and an associated parking area for emergency vehicles. The permanent land-take will cover some of the national school's playground. Alternative lands, currently part of St. Patrick's College will be provided to the national school to be used as a new playground. This impact is of Low significance due to the fact that an alternative site will be provided as a school playground.

At the Drumcondra Stop there will be permanent land-take of lands classified as Educational/Institutional/Community/Civic and Residential Areas. The area has a very high functional value. The permanent land-take is for the construction of the Drumcondra Stop. Currently there are buildings on the site which will have to be demolished, including St. Vincent's Centre for the Deaf. Overall, the significance of this impact is Very high.

The permanent land-take at Mater Stop is to accommodate the permanent features which include the stop buildings, vents, emergency exhaust vent and maintenance access stairs. The permanent land-take for the Mater Stop will be of land that is classified as Educational/Institutional/Community/Civic and Residential Areas. Five private properties (No. 24 - 26 Leo Street and No. 398 and 400 North Circular Road) are to be demolished in order to accommodate the permanent features of the Mater Stop. The area in which Mater Stop is to be located is of very high functional value. Plans for the proposed scheme at this location have been devised in conjunction with existing plans for the redevelopment of the Mater Hospital. The significance of the impact of the permanent land-take is Very high.

Throughout Area MN106 there will be substratum permanent land-take to accommodate the tunnels beneath the surface. This land-take will have no impact on the existing surrounding landuses, but will limit the future landuses directly above it. The post mitigation impact significance of this impact is determined to be Low due to the fact that the substratum permanent land-take will have no impact on surface landuses.

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

Permanent severance

There will be no permanent severance in Area MN106 as a result of the operation of the proposed scheme.

Typical Light
Metro Vehicle



Table 2.4 Summary of predicted impacts in Area MN106 occurring during the construction phase

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN106/ CN-01	LA 16 Dublin City University (DCU), Albert College Park and Elmhurst Convalescent Home Areas on land classified as Open Spaces and Recreational	Local Construction Compound 12a to support construction	<p>Temporary land-take for a period of more than 1 year from Open Space and Recreational lands.</p> <p>This construction compound will be used to support the work done on the cut and cover sections along the Ballymun Road and to support the operations of the Tunnel Boring Machine (TBM).</p> <p>The total area of the Construction Compounds 12a and 12b will be approximately 4.7ha.</p> <p>This open space is frequently used by local residents and sports clubs.</p> <p>The park contains numerous sports pitches.</p> <p>This construction compound will be reinstated as open space once the cut and cover operations are completed.</p> <p>The total area of open space and recreational land at Albert College Park is approximately 14ha.</p>	very high	<p>The park will be reinstated on completion.</p> <p>The majority of the area within the park will be maintained as open space.</p> <p>Information will be provided to local residents on alternative open spaces that they may use.</p>	high	High

Impact ID	Location	Source of impact	Impact description	Functional Value (FY) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN106/ CN-02	LA 16 Dublin City University (DCU), Albert College Park and Elmhurst Convalescent Home Areas on land classified as Open Spaces and Recreational	Construction Compound 12b TBM launch site	<p>Temporary land-take for a period of more than 1 year from Open Spaces and Recreational lands.</p> <p>This construction compound will be used for launching the TBM.</p> <p>The total area of the Construction Compounds 12a and 12b will be approximately 4.7ha.</p> <p>This open space is frequently used by local residents and sports clubs.</p> <p>The park contains numerous sports pitches.</p> <p>This construction compound will be reinstated as open space once the tunnel operations are completed.</p> <p>The total area of open space and recreational land at Albert College Park is approximately 14ha.</p>	very high	<p>The park will be reinstated on completion.</p> <p>Areas within the park will be maintained as open space.</p> <p>Information will be provided to local residents on alternative open spaces that they may use.</p>	high	High

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN106/ CN-03	LA 16 Dublin City University (DCU), Albert College Park and Elmhurst Convalescent Home Areas on land classified as Agricultural and Rural Amenity	Stop box Construction Compound 13	<p>Temporary land-take for a period of more than 1 year from Agricultural and Rural Amenity lands.</p> <p>This construction compound will be used for the construction of the Griffith Avenue Stop.</p> <p>The temporary land-take will be as close as possible to Griffith Avenue.</p> <p>This construction compound will be approximately 1.6ha in size, of which 0.5ha will form part of the permanent land-take.</p> <p>This temporary land-take is from agricultural lands which are approximately 11ha in area.</p>	very high	<p>As little land as possible will be temporarily taken. The majority of the temporary land-take will be returned to its original use as quickly as possible.</p> <p>A full programme of agricultural reinstatement will be designed to ensure that agricultural land is reinstated to productive use; soil profiles will be stored and reused where possible.</p> <p>This temporary land-take will be kept separated from the surrounding existing landuses of residential and agricultural areas.</p> <p>The location and design of the compound minimises the number of fields impacted.</p>	low	Low

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN106/ CN-04	LA 18 St. Patrick's College on lands classified as Educational/ Institutional/ Community/ Civic	Land surrounding intervention shaft and Construction Compound 14	<p>Temporary land-take for a period of more than 1 year from Educational/ Institutional/Community/ Civic lands.</p> <p>The area of this construction compound will be approximately 0.25ha.</p> <p>There will be a strip of land surrounding the permanent land-take for the Intervention Shaft that will be temporarily used during its construction.</p> <p>There will be some temporary land-take from the school playground of St. Patrick's National School and from the sports pitches of St. Patrick's College.</p> <p>The total area of St. Patrick's College and St. Patrick's National School is approximately 11ha in area.</p>	very high	<p>As little land as possible will be temporarily taken. The land will be returned to its original use as quickly as possible.</p> <p>St. Patrick's National School will be provided with suitable land as an alternative school playground.</p> <p>The temporary land-take will not threaten the character of the adjacent landuses. It will be maintained and kept clean.</p>	low	Low
MN106/ CN-05	LA 21 Drumcondra, Phibsborough and Mountjoy Residential areas on lands classified as Residential Areas and Educational/ Institutional/ Community/ Civic	Land surrounding Drumcondra Stop and stop box Compound 15	<p>Temporary land-take for a period of more than 1 year from Educational/ Institutional/Community / Civic and Residential Areas lands.</p> <p>The area of this construction compound will be approximately 0.6ha.</p> <p>Lands surrounding the Drumcondra Stop will be temporarily used during the construction of the stop. Six buildings will be demolished in order to facilitate the temporary land-take for the construction of the Drumcondra Stop.</p>	very high	<p>As little land as possible will be temporarily taken.</p> <p>In order to facilitate construction the minimum amount of buildings will be demolished.</p> <p>Alternative access to residential areas will be provided through the surrounding road network.</p> <p>The temporary land-take will not threaten the character of the surrounding residential areas.</p>	very high	Very high

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN106/ CN-06	LA 25 Phibsborough and Mountjoy residential areas, Mater Hospital and Parnell Street on lands classified as Educational/ Institutional/ Community/ Civic and Residential Areas	Land surrounding Mater Stop and stop box Compound 16	<p>Temporary land-take for a period of more than 1 year from Educational/ Institutional/Community/ Civic and Residential Areas lands.</p> <p>The area of this construction compound will be approximately 0.5ha.</p> <p>Land surrounding the Mater Stop will be temporarily used during the construction of the stop. The demolition of two residential buildings on Leo Street and two residential buildings (which have been converted to office use) on North Circular Road will be required and they will not be rebuilt post construction.</p>	very high	<p>As little land as possible will be temporarily taken.</p> <p>In order to facilitate construction the minimum amount of buildings will be demolished.</p> <p>The temporary land-take will not threaten the character of the surrounding areas.</p> <p>Alternative access to the Mater Hospital will be provided.</p>	very high	Very high

Table 2.5 Summary of predicted impacts in Area MN106 occurring during the operational phase

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN106/OP-01	LA 16 Dublin City University (DCU), Albert College Park and Elmhurst Convalescent Home Areas on land classified as Open Space and Recreational and Educational/Institutional/Community/Civic	Tunnel constructed by TBM	Permanent land-take from Open Space and Recreational and Educational/Institutional/Community/Civic lands. There will be substratum permanent land-take beneath the surface. This will have no impact on the existing surrounding land-uses, but limits the future landuses above it.	very high	As little land as possible will be taken. The tunnel will be constructed at such a depth so that it will not impact on the current surface level landuses.	low	Low
MN106/OP-02	LA 16 Dublin City University (DCU), Albert College Park and Elmhurst Convalescent Home Areas on land classified as Agricultural and Rural amenity	Griffith Avenue Stop buildings, vents and exhaust vents	Permanent land-take from Agricultural and Rural Amenity lands. The above ground features of the Griffith Avenue Stop building, vents and exhaust vents will occupy space previously occupied by Agricultural and Rural Amenity lands. Permanent land-take of approximately 0.5ha from an agricultural area that totals approximately 11ha in size.	very high	As little land as possible will be taken. The above ground stop features will be finished to a high quality and will be designed to fit in with the existing built environment. The surrounding lands will be maintained as agricultural lands.	low	Low
MN106/OP-03	LA 17 Griffith Avenue south as far as Tolka River Valley on lands classified as Residential Areas and Educational/Institutional/Community/Civic	Tunnel constructed by TBM	Permanent land-take from Residential Areas and Educational/Institutional/Community/Civic lands. There will be substratum permanent land-take beneath the surface. This will have no impact on the existing surrounding land-uses, but limits the future landuses above it.	very high	As little land as possible will be taken. The tunnel will be constructed at such a depth so that it will not impact on the current surface level landuses.	low	Low

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN106/ OP-04	LA 18 St. Patrick's College on lands classified as Educational/ Institutional/ Community/ Civic	Tunnel constructed by TBM	<p>Permanent land-take from Educational/Institutional/ Community/Civic lands.</p> <p>There will be substratum permanent land-take beneath the surface. This will have no impact on the existing surrounding land-uses, but limits the future landuses above it.</p>	very high	<p>As little land as possible will be taken.</p> <p>The tunnel will be constructed at such a depth so that it will not impact on the current surface level landuses.</p>	low	Low
MN106/ OP-05	LA 18 St. Patrick's College on lands classified as Educational/ Institutional/ Community/ Civic	Intervention Shaft	<p>Permanent land-take from Educational/Institutional/ Community/Civic lands.</p> <p>A large intervention shaft with a parking area for emergency vehicles will be constructed adjacent to St. Patrick's Boys National School. It will take some hard-surfaced lands and a garden from the National School. The majority of the land it will occupy is currently open space occupied by St. Patrick's National School.</p> <p>Permanent land-take of approximately 0.1ha from and Educational/ Institutional/Community and Civic landuse that is approximately 11ha in size.</p>	very high	<p>As little land as possible will be taken.</p> <p>St. Patrick's National School will be provided with additional lands from St. Patrick's College for a school playground in place of the lands that they lose as a result of the permanent land-take.</p> <p>The intervention shaft building will be maintained and kept clean.</p>	low	Low
MN106/ OP-06	LA 19 Tolka River Valley on lands classified as Open Space and Recreational and Water Bodies	Tunnel constructed by TBM	<p>Permanent land-take from Open Space and Recreational and Water Bodies lands.</p> <p>There will be substratum permanent land-take beneath the surface. This will have no impact on the existing surrounding land-uses, but limits the future landuses above it.</p>	very high	<p>As little land as possible will be taken.</p> <p>The tunnel will be constructed at such a depth so that it will not impact on the current surface level landuses.</p>	low	Low

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN106/ OP-07	LA 21 Drumcondra, Phibsborough and Mountjoy Residential areas on lands classified as Residential Areas, Residential with Mixed Uses (Commercial/Retail/Office) and Educational/Institutional/Community/Civic	Tunnel constructed by TBM	Permanent land-take from Residential Areas, Residential with Mixed Uses (Commercial/Retail/Office) and Educational/Institutional/Community/Civic lands. There will be substratum permanent land-take beneath the surface. This will have no impact on the existing surrounding land-uses, but limits the future landuses above it.	very high	As little land as possible will be taken. The tunnel will be constructed at such a depth so that it will not impact on the current surface level landuses.	low	Low
MN106/ OP-08	LA 21 Drumcondra, Phibsborough and Mountjoy Residential areas on lands classified as Educational/Institutional/Community/Civic and Residential Areas	Drumcondra Stop buildings, vents, emergency exhaust vents and maintenance access stairs	Permanent land-take of Educational/Institutional/Community/Civic and Residential Area lands. The land taken for the Drumcondra Stop is currently built on. It will be necessary to demolish six buildings, including the St. Vincent's Centre for the Deaf as well as residential buildings, in order to allow for the construction and operation of the Drumcondra Stop. These buildings will be permanently removed and replaced with the Drumcondra Stop buildings, vents, emergency exhaust vents and maintenance access stairs.	very High	As little land as possible will be taken. Only the minimum amount of properties necessary will be demolished. The above ground stop features will be finished to a high quality and will be designed to fit in with the existing built environment. Compensation will be made to those whose homes will be demolished	very high	Very high
MN106/ OP-09	LA 23 Royal canal on lands classified as Open Space and Recreational and Water Body	Tunnel constructed by TBM	Permanent land-take from Open Space and Recreational and Water Body lands. There will be substratum permanent land-take beneath the surface. This will have no impact on the existing surrounding land-uses, but limits the future landuses above it.	very high	As little land as possible will be taken. The tunnel will be constructed at such a depth so that it will not impact on the current surface level landuses.	low	Low

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN106/ OP-10	LA 25 Phibsborough and Mountjoy residential areas, Mater Hospital and Parnell Square on lands classified as Educational/ Institutional/ Community/ Civic and Residential Areas	Tunnel constructed by TBM	Permanent land-take from Educational/Institutional/ Community/Civic and Residential Areas lands. There will be substratum permanent land-take beneath the surface. This will have no impact on the existing surrounding land-uses, but limits the future landuses above it.	very high	As little land as possible will be taken. The tunnel will be constructed at such a depth so that it will not impact on the current surface level landuses.	low	Low
MN106/ OP-11	LA 25 Phibsborough and Mountjoy residential areas, Mater Hospital and Parnell Square on lands classified as Educational/ Institutional/ Community/ Civic and Residential Areas	Mater Stop buildings, vents, emergency exhaust vents and maintenance access stairs	Permanent land-take of Educational/Institutional/ Community/Civic and Residential Area lands. In order to accommodate the Mater Stop buildings and access the demolition of three residential buildings on Leo Street and two residential buildings (which have been converted to office use) on North Circular Road is necessary. These buildings will be permanently removed and replaced with the Mater Stop buildings, vents, emergency exhaust vents and maintenance access stairs.	very high	As little land as possible will be taken and there will be minimum amount of disruption to residents. Only the minimum amount of properties necessary will be demolished. The above ground stop features will be finished to a high quality and will be designed to fit in with the existing built environment. Compensation will be made to those whose homes will be demolished.	very high	Very high



03

HUMAN BEINGS: SOCIO-ECONOMICS

- 3.1 [Impact assessment methodology](#)
 - 3.1.1 Study area
 - 3.1.2 Impact identification
 - 3.1.3 Impact assessment
 - 3.1.4 Derivation of mitigation measures
 - 3.1.5 Assessment of residual impacts
- 3.2 [Impact assessment](#)
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- 3.3 [Derivation of mitigation measures](#)
 - 3.3.1 Construction phase
 - 3.3.2 Operational phase
- 3.4 [Assessment of residual impacts](#)



This chapter of the EIS evaluates the potential socio-economics impacts arising from the construction and operation of the proposed scheme in Area MN106.

This chapter of the EIS evaluates the potential socio-economics impacts arising from the construction and operation of the proposed scheme in Area MN106.

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 MN106 and 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. Thus, there is no specific element of the proposed scheme which will be focused upon in the assessment of these particular types of impacts. Instead, the focus will be on the concept and overall operational performance of the proposed scheme, which include the cumulative impacts of relevant localised impacts.

3.1.2.2 Localised (MN106) impacts

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

Localised impacts will also focus on the potential impacts which may arise from the operation of the proposed scheme.

EDs 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).	very high
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.	
Long-term and significant change in population levels, employment, employment classification or mode of travel to work.	high
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.	
Long-term and moderate change in population levels, employment, employment classification or mode of travel to work.	medium
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.	
Long-term and minor change in population levels, employment, employment classification or mode of travel to work.	low
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.	
Long-term and insignificant change in population levels, employment, employment classification or mode of travel to work.	very low

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

3.1.3.2 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.).

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. Table 3.4 provides a breakdown of this estimated level of employment during construction.

Table 3.4 Estimated average 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 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 job. Using this employment ratio, the equivalent level of permanent employment 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 years employment equivalent
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 and the fall-off in construction activity has accelerated since late 2007 and is continuing. The Quarterly National Household Survey (CSO, 5th March 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 and 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 from the proposed scheme such as 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 jobs (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 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- equivalent 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 development 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 chapters of this EIS (Volume 2, Chapter 7). However, a brief summary is provided in this section.

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 Medium to significant 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 (MN101 to MN107) and are addressed in the Landuse chapters of this EIS (Volume 2, Chapter 2). Similarly localised traffic disruption during construction is addressed in the 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 the proximity of 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 great use of public transport (the proposed development 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 of the proposed scheme (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 which 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 its 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, the area served by the proposed scheme which is in Dublin City Council's administrative area is different to the areas served in Fingal. 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 ('What Light Rail Can Do For Cities - A review of the evidence, prepared by Steer Davies Gleave, February 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 ('LUAS 'After' Study: Employers & Retailers, Dublin Transportation Office: prepared by Millward Brown IMS, 2006) November 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, 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 of the proposed 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 planning 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 on to Dublin Airport beyond Swords. The journey time from Dublin Airport to the city centre (St. Stephen's Green) is estimated at approximately 20 minutes and the journey from city centre to the terminus north of Swords is estimated to be approximately 30 - 35 minutes. Annual patronage (total journeys) is estimate to be 34 million, in excess of an average of 94,000 journeys per day. The initial peak service (broadly 0700 - 1000 and 1530 - 1930) is expected to be a 90m 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 LMVs (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 seven 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 the proposed scheme journey time savings exist along the whole scheme.

Regarding improvements to car-based journeys, the proposed scheme will positively impact on these, thus providing these 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 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 Ave 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 N2 north bound 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 to 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 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 proposed scheme 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 (MN106) socio-economic impacts

Facilitating future development

While the proposed scheme will not directly result in increased population levels proximate of the proposed scheme it will, indirectly, allow the relevant planning authorities to plan for and grant consent for higher residential densities of development due to the greater public transport capacities provided by the proposed scheme.

MN106 is comparatively developed in comparison to Areas MN101 to MN105. However, there are some planning documents prepared by Dublin City Council, the implementation of which will be assisted and promoted by the proposed scheme.

Phibsborough/Mountjoy Draft Local Area Plan (LAP) was published by Dublin City Council for public consultation in March 2008. The draft LAP makes reference to potential redevelopment of key sites and these include:

- Mountjoy Prison (once closed);
- Bohemians Football Club at Dalymount Park (once they relocate to the north of the city);
- Former Shandon bakery site at Cross Guns Bridge;
- Smurfit printworks on Botanic Road;
- Proposed develop of the Grangegorman campus (relocation of Dublin Institute of Technology (DIT)).

It should be noted that the closest stop (Drumcondra and Mater) and the alignment of the proposed scheme are not within the boundary of the draft LAP, however, the proposed scheme is seen as being an important element of the implementation of the Phibsborough/Mountjoy area in future years. The draft LAP notes (p.40) that:

‘The delivery of new commercial and employment floorspace as part of an integrated mixed-use development strategy in the Phibsborough/ Mountjoy LAP area will help drive the economic development of the area; reinforce the viability of Metro North; support investment in new retail development, community and social infrastructure; and deliver local employment which is in accordance with the best principles of sustainable development.’

It also notes that:

‘The redeveloped Mountjoy Prison site also presents an opportunity for the development of associated ancillary medical, service industry, commercial and office employment floorspace and to create an important economic and employment cluster in the vicinity of the planned Metro North station.’

Thus, the proposed scheme is an important piece of infrastructure for the future planning and development of this part of north Dublin.

The Richmond Road Area Action Plan (AAP), (published by Dublin City Council in April 2007), is applicable to the east of the proposed scheme. However, this makes no specific mention of the proposed scheme assisting with the AAP’s overall development objectives.

The proposed scheme will also permit Dublin City Council to grant higher density planning permissions in the vicinity of the alignment. Although much of the existing residential densities are already high in Area MN106 (and are typically high across much of inner-city Dublin), the proposed scheme is still expected to result in a considerable increase in future development patterns, and thus, future populations levels (although this increase will not be as significant as Areas MN101 and MN102).

MN106 consists of a predominately developed part of north Dublin. It is made up of eleven EDs, which are:

- Drumcondra South C;
- Botanic A;
- Drumcondra South A;
- Botanic B;
- Drumcondra South B;
- Botanic C;
- Ballybough B;
- Inns Quay A;
- Cabra East A;
- Mountjoy B (also partially within MN107);
- Inns Quay B (also partially within MN107).

Parts of Mountjoy B and Inns Quay B are located within Area MN107 but they are described in this section because the majority of the area of these EDs is in Area MN106. There has been a slight change (+3.3%) in the population of Area MN106 over the period 2002-2006. In total the population has grown from 34,752 in 2002 to 35,895 in 2006. Some EDs experienced a reduction in population: Drumcondra South C (-5.2%), Botanic B (-6.8%), Botanic C (-4.4%), Drumcondra South B and Cabra East A (both -0.6%). In future years, the proposed scheme will assist with higher levels of population growth and development, primarily through assisting with the implementation of the Phibsborough/Mountjoy Local Area Plan.

Overall the proposed scheme is anticipated to have a positive impact on the future development patterns of MN106 of medium magnitude and Medium significance.

Employment creation

As with the future planning of economic development in Fingal, the proposed scheme will permit Dublin City Council to plan for a significantly greater level of employment along the corridor defined by the proposed scheme. However, the segment of the proposed scheme in the administrative area of Dublin City Council is more developed than the corresponding corridor in Fingal, which currently has large undeveloped areas (which, as noted in the Socio-economics chapters of this EIS (Volume 2, Chapter 3) for Areas MN101 to MN104 inclusive, will be subject to future development as part of the Metro North Economic Corridor (MNEC) Strategy). Thus, the quantum of future employment creation to be indirectly created and assisted by the proposed scheme will be much lower than the corresponding employment creation in Fingal.

The Phibsborough/Mountjoy Draft Local Area Plan does identify some specific area of future employment creation. The key sites include:

- National Children's Hospital on the Mater Hospital site – 'new employment opportunities';
- Mountjoy Prison – 'development of associated ancillary medical, service industry, commercial and office employment floorspace';
- The planned Mater Stop – 'important economic and employment cluster';
- The Phibsborough Shopping Centre/Dalymount Park site – 'a suitable location for office/commercial floorspace given the current existence of a large office block on the site and its potential to enhance the economic vitality and viability of Phibsborough Village'.

While it is difficult to estimate the level of potential employment to be indirectly created within MN106, it is still likely that the positive impact of indirect employment creation will be of medium magnitude and Medium significance in the long-term for MN106.

Improving accessibility to and availability of employment opportunities

The rate of employment in the eleven EDs of MN106 is broadly average when compared to the averages for Dublin City, Greater Dublin Area, and the State. They range from 53.4% to 64.5%, as against an average in Dublin City Council's functional area of 56.9%, a Greater Dublin Area average of 59.9% and a State average of 57.2%. Unemployment rates are relatively low to average in MN106, ranging from 3.5% (Drumcondra South C: please note that this ED has very low labour workforce participation rate, which may explain the very low unemployment rate) to 15.0% (Mountjoy B). Some EDs in Area MN106 (Ballybough B, Mountjoy B and Inns Quay A and B) have very challenging social conditions, similar to those currently being experienced in Ballymun in Area MN105.

The proposed scheme will improve access to employment opportunities across the Greater Dublin Area (especially the disadvantaged EDs of Mountjoy B, Inns Quays A and B, and Ballybough B) and it will also result in significantly positive employment impacts for MN106, through providing a high-quality, rapid and frequent mode of transport to the major employment areas of Dublin, especially for those commuting northwards (to current and future employment locations such as Dublin Airport, Ballymun, Metropark and Swords).

Regarding improving transport options for those with no access to a car, the proposed scheme will provide significant improvements to accessibility for EDs within MN106, especially Mountjoy B (76.2% of whom do not have access to a car), Inns Quay B (70.3% of whom do not have access to a car) Inns Quay A (59.8%) and Ballybough B (63.2%); all of which have significantly higher levels of no car ownership in comparison to the average for Dublin City Council (40.5%), Greater Dublin Area (22%) and the State (19.7%). However, it should also be noted that these high density areas of Dublin typically have higher percentages than normal level of no car ownership – a reflection of the fact that car parking availability can be limited coupled with the relatively good public transport options and proximity to Dublin City centre.

The proposed scheme will provide significant improvements regarding commuting times and journey quality for the residential population of MN106. This is evident in comparing a comparable bus journey to that of the route for the proposed scheme. A relevant example re MN106 is the bus journey from Ballymun to the city centre (bus number 13). This currently takes approximately 56.2 minutes, with four such services per hour. This is predicted to decrease to 54.8 minutes in 2014, however increase to 73.2 minutes in 2029, all without the proposed scheme. When operational in 2014, the proposed scheme will provide an average journey time of approximately 15-18 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, which is an impact of very high magnitude and Very high significance.

In relation to improving the type of employment opportunities, the proposed scheme will result in considerably greater access to professional and technical employment for the population of MN106, especially the following two (of eleven) EDs (which have significantly lower than average professional employment and higher than average unskilled employment): Mountjoy B (13.5% professional occupations), Inns Quay B (24.4%) and Inns Quay A (24.9%) against a Dublin City average of professional occupations of 30.4% and a State average of 32.9%.

Overall, the proposed scheme will increase access to more and better employment opportunities for MN106, a positive impact of very high magnitude and Very high significance.

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, 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.

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

Mountjoy B is included in Dublin City North East Inner City RAPID Area. There are no Urban Renewal Schemes located within Area MN106. Within 500m of the proposed scheme, there is one primary school included in the Delivering Equality of Opportunity in Schools (DEIS) programme. The proposed scheme will greatly assist with these regeneration and social improvement programmes, as well as greatly assisting Dublin City Council in its long term objective of the regeneration of the inner city areas with considerable social issues and disadvantages.

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 project. 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.

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 proposed scheme is provided in Table 3.7.

Table 3.7 Summary of residual impacts

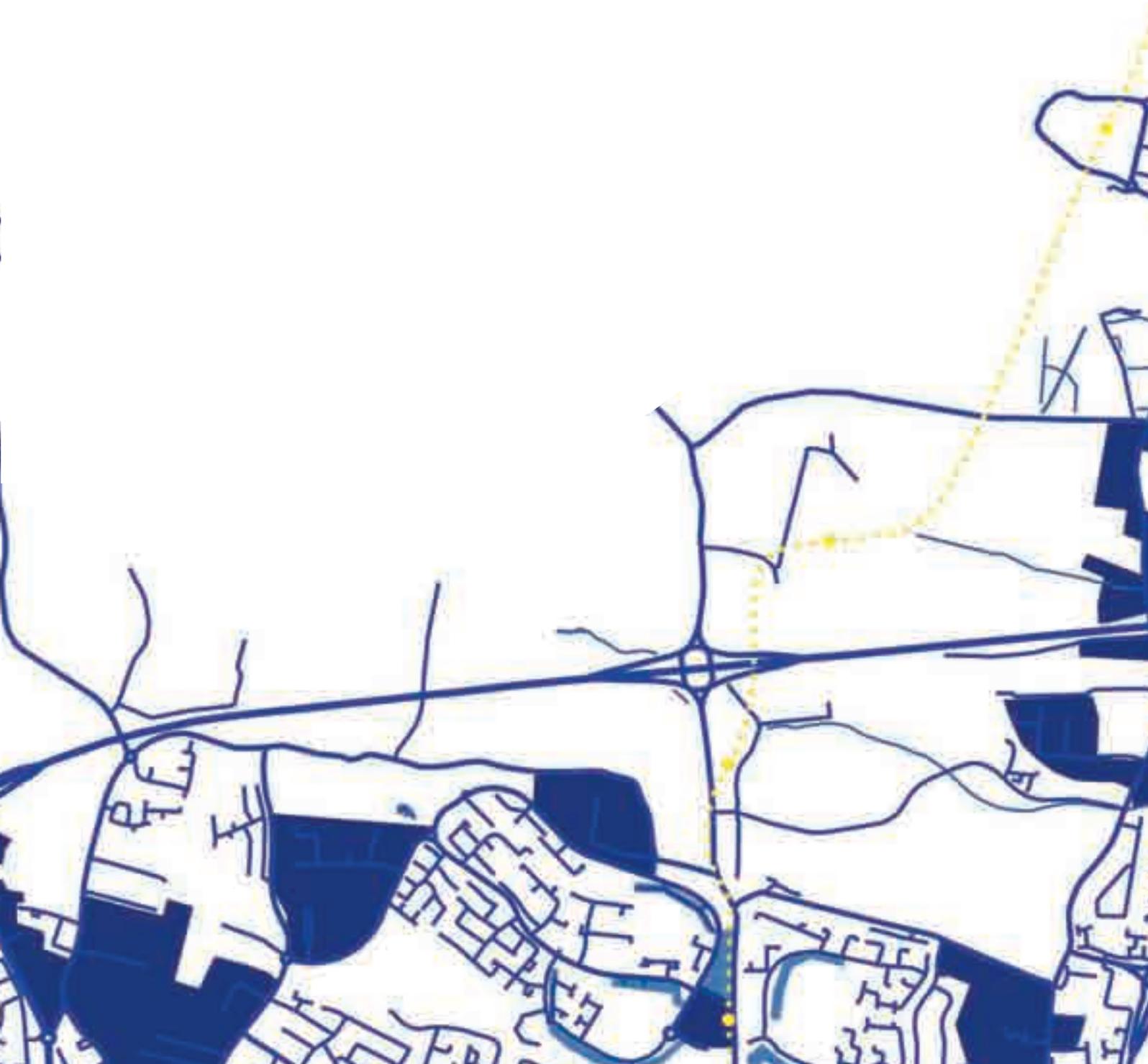
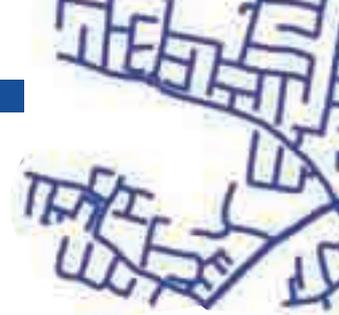
	Magnitude of impact taking into account mitigation	Functional value of area affected	Significance of impact
General/scheme-wide impacts: construction phase			
Direct economic impacts	very low	very high	Very low
Indirect economic impacts	low	very high	Low
Impacts due to traffic congestion and diversion	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	High	very high	High
Improved access to employment through commuting improvements	very high	very high	Very high
Improved commuting journeys for long-distance commuters	high	very high	High
Direct employment creation	very low	very high	Very low
Localised (MN106) impacts: construction phase			
Refer to respective Landuse and Traffic chapters of this EIS (Volume 2, Chapters 2 and 7 respectively)			
Localised (MN106) impacts: operational phase			
Facilitating future development	medium	very high	Medium
Employment creation	medium	very high	Medium
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

- 4.1 Introduction
- 4.2 Study area
- 4.3 Impact assessment methodology
 - 4.3.1 Prediction of noise magnitude
 - 4.3.2 Assessment methodology
- 4.4 Impact assessment
 - 4.4.1 Impact identification
 - 4.4.2 Mitigation measures
 - 4.4.4 Summary of residual impacts





This chapter of the EIS evaluates the potential noise impacts arising from the construction and operation of the proposed scheme in Area MN106.

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 MN106. Groundborne noise and vibration impacts are reported in 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 Section 4.4.3. Annex C, Noise Assessment Details, as provided in Volume 3, Book 2 of 2, provides details of the noise modelling 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 5 of Annex C Noise Assessment Details as provided in 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.

Noise from road traffic

For road traffic noise on the surrounding roads a similar approach to that described for Light Metro Vehicles (LMVs) is used. Significant changes in road traffic noise have been identified by analysis of the available road traffic modelling 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 (operation 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 \geq medium. Areas with a functional value of $<$ medium are not considered to be sensitive to noise.

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 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	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. Areas with a functional value of \geq medium have been considered. Areas with a functional value of $<$ medium have not been assessed because they are not considered to be sensitive to noise. For road traffic the significance of noise impact has been assessed with reference to the change in noise. The magnitude ratings used in the assessment are summarised in Table 4.3. 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 4.3 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	low
<1dB	No Impact	very low

Traffic noise impacts are assessed using this methodology. Noise from fixed plant is considered in the same manner; however, it has been assumed insignificant if noise is less than NC25 inside neighbouring 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 airborne noise sources during construction are likely to be from the construction of the underground stops at Griffith, Drumcondra and Mater, which will be constructed by cut-and-cover techniques. Tunnelling surface support works will be carried out at the Albert College Park compounds. Construction of an emergency access and intervention shaft will also take place between Griffith Avenue and Drumcondra in the grounds of St. Patrick's College.

To assess the construction noise impacts in this section of route, noise predictions have been carried out at 16 noise sensitive receptors around these works areas. 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.

Groundborne noise and vibration from construction and operation of the railway tunnels is reported in the Noise chapters of this EIS (Volume 2, Chapter 5).

4.4.1.2 Operation

During operation of the proposed scheme, noise sources will include testing of emergency ventilation fans and changes in traffic noise.

Noise impacts from traffic may result due to modal shift from the private car may help to reduce the number of vehicles on the highway network. It is noted that substantial changes in road traffic flow, speed, and/or composition are required to produce noise changes greater than 3dB.

People accessing the underground metro stops may cause additional noise, but in general stops 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 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 neighbouring 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

The alignment is in bored tunnel in this area. No airborne noise impacts will occur. No noise mitigation measures are required to mitigate airborne noise from the LMVs in Area MN106.

Emergency tunnel exhaust vents

The emergency tunnel exhaust vent fans will be fitted with exhaust silencers. The following sound power limits for the ventilation shaft fans and the minimum performance for their silencers will be:

- (a) Sound Requirements
- (i) in relation to emergency ventilation axial fans the total sound power generated by the fan shall not exceed the following decibel ratings at source when operating in the normal mode at rated speed
 - (ii) it is proposed that attenuation shall be included after the fans in the form of a silencer with the appropriate fire/heat rating. The sound attenuation shall be able to achieve a minimum noise reduction of NR 20 decibel reduction compared with the ratings in Table 4.4 in the nearest openable window of any habitable space.

Table 4.4 – Sound at Source – axial fans

Hz	63	125	250	500	1000	2000	4000	8000
Sound Power Level at fan (dBA) (referred to 10-12 watts)								
dB(A)	96	102	103	98	97	95	91	87

This indicates that the fan noise levels immediately outside the discharge opening of the emergency tunnel exhaust vents will be no higher than 70-75dB(A)

In addition RPA has committed to the following noise limit inside buildings near emergency tunnel exhaust vents:

‘The fans will be attenuated to ensure that the noise levels in adjacent buildings will not exceed Noise Criteria level NC25’.

This will preferably be achieved by increasing the fan silencer performance, but if necessary other measures including providing noise insulation to affected buildings if necessary (see below) will be applied.

4.4.3 Assessment of residual impacts

4.4.3.1 Project scenario: construction phase

Structures

The only structure to be constructed in Area MN106 is the St. Patrick’s Intervention and Emergency Ventilation Shaft at St. Patrick’s College. The predicted noise levels during construction are shown in Table 7.29 of Annex C Noise Assessment Details as provided in Volume 3, Book 2 of 2. Predicted noise levels were (22 to 26dB) above the 65dB criterion which applies to the college buildings that are close to the proposed construction site location.

A residual daytime impact during construction of the St. Patrick’s Intervention and Emergency Ventilation Shaft of 12dB is expected at St. Patrick’s College/Ferguson Road (MN106-C9), 14dB at St. Patrick’s College/Millbourne Road (MN106-C10) and 16dB at St. Patrick’s College (MN106-C11). These are all Very high daytime impacts. Since residential buildings are less sensitive to daytime noise and they are further from the construction works than the college buildings, Impacts at residential properties will be lower than those listed above.

Stops

Without mitigation predicted noise levels are (1 to 17dB) above the 75dB criterion which applies to six residential receptors (MN106-C5, C6, C7, C8, C13, and C17) and 17 to 30dB above the 65dB criterion that applies to five buildings with educational uses (MN106-C12, C14, C15, C16 and C18) that are close to the Drumcondra and Mater Stops.

Residual impacts of 6dB (High) are expected at residential areas in St. Joseph's Avenue (MN106-C13) and 7dB (High) at 1 to 23 Leo Street (MN106-C17). Impacts are also expected at receptors that are used in part for educational purposes including 20dB (Very high) at St. Alphonsus Road (Lower) (MN106-C12), 14dB at St. Alphonsus Avenue (MN106-C14), 14 to 18dB at Mater Misericordiae Hospital (MN106-C15 and C16) and 7dB (High) at Mater Private Hospital (MN106-C18).

Construction compounds

Construction Compounds 12, 12a (Albert College Tunnel Portal), 13 (Griffith Avenue Stop), 14 (St. Patricks), 15 (Drumcondra), and 16 (Mater) are located in Area MN106. The compounds at 12 and at 12a relate to tunnelling support and tunnel portal construction and will provide surface support activities to bored tunnelling activities that are being undertaken. Predicted noise levels without mitigation are between 70 and 75dB which is not likely to result in significant noise impacts during the day. Lower noise levels, typically 60 to 65dB would be predicted with further noise mitigation at the nearest receptors. Noise impacts are not expected during the evening. The results of working at night are discussed in the following section. Work on Sundays and Bank Holidays from 08.00 to 16.30 would be subject to a criterion which is more stringent than for other times (60 dB) and a Medium to High impact of 5 dB is predicted. Some temporary effects will also be experienced in the part of Albert College Park that remains open during construction. However, the effect on users of the park will be temporary and is not thought to be significant.

Other compounds in the area (13, 14, 15 and 16) provide for offices and storage, and are therefore not expected to result in significant noise impacts.

Works at night

Concrete pours outside of core hours may be required for the underground stops. It may be necessary to carry these out at night. This activity is not likely to be standard practice and the assessment therefore represents a worst case scenario. However, where required there will be liaison with the local community and agreement with the relevant local authority in advance of this works proceeding.

At residential locations Very high residual noise impacts of 14dB are predicted at The Rise (MN106-C5), 16dB at Griffith Avenue (MN106-C6), 12dB at Griffith Avenue (MN106-C7), 27dB at St. Joseph's Avenue (MN106-C13) and 28dB at Leo Street (MN106-C17). High residual impacts are predicted 6dB above the criterion at Walnut Lawn/Walnut Rise (MN106-C8).

Other buildings are also expected to experience residual noise impacts during construction. Very high noise impacts of 25dB are predicted at St. Alphonsus Avenue (MN106-C14), 25dB at Mater Misericordiae Hospital (MN106-C15), 29dB at Mater Misericordiae Hospital / Leo Street (MN106-C16) and 18dB at Mater Private Hospital (MN106-C18).

If tunnelling is carried out at night, work will also be carried out in support of this on the surface at Construction Compounds 12 and 12a. The work will result in mitigated noise levels of 60 to 65dB at nearest receptors along Ballymun Road and Hampstead Avenue (MN106-C1 to MN106-C4), which would result in a Very high impact of 15 to 20dB above the assessment criterion of 45dB.

The level of impact will depend on the baseline noise levels at specific receptors at the time that work will be carried out, but Very high residual impacts are likely.

4.4.3.2 Project scenario: operational phase

Introduction

The route runs in tunnel through this area, and no airborne noise impacts from the LMVs are predicted.

Emergency tunnel exhaust vents

Noise from testing of ventilation fans may be at levels of up to 70-75dB immediately next to the shaft. Testing will take place for about 30 minutes once every two weeks. In general where the shafts are located on busy streets the noise will be audible above ambient noise, but given its short duration will not constitute a significant noise impact. The noise impacts at three stops and the intervention shaft are discussed below.

At the Griffiths Avenue Stop the nearest residential receptors are on Griffiths Avenue and The Rise at least 40m from the shaft. Noise from fan testing during the day should be below ambient noise at these receptors. If testing is required at night additional noise attenuation may be necessary to achieve the NC25 standard within buildings. It is expected that additional fan silencers and design measures at source could achieve this.

At the Drumcondra and Mater Stops ventilation shaft discharges are to be located within 10m of residential receptors on St. Alphonsus Avenue and Leo Street. It is likely that additional attenuation will be needed to achieve the NC25 level inside these receptors. If additional fan silencers cannot achieve this, it will be possible to restrict testing to day. This will ensure disturbance and hence significant impacts are avoided.

At St. Patrick's college the Intervention and Emergency Ventilation shaft discharge will be within the college grounds near the sports fields and within about 20m of the nearest college building. Noise levels close to the discharge may cause some local disturbance during testing, although the impact of this will be Low. It is likely that additional attenuation will be needed to achieve the NC25 level inside the buildings. If additional fan silencers cannot achieve this, it will be possible to restrict testing to day, outside of school hours. This will ensure disturbance is avoided and there are no significant impacts.

4.4.4 Summary of residual impacts

A summary of the residual impacts associated with this section of the proposed 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 at parts of buildings that are used for educational purposes at St. Alphonsus Road (Lower) (MN106-C12), St. Alphonsus Avenue (MN106-C14), Mater Misericordiae Hospital (MN106-C15 and C16), St. Patrick's College/ Ferguson Road (MN106-C9), St. Patrick's College/Millbourne Road (MN106-C10) and St. Patrick's College (MN106-C11) High at St. Joseph's Avenue (MN106-C13), Leo Street (MN106-C17) and Mater Private Hospital (MN106-C18) Other impacts are not significant.	Very high for residential buildings High for educational buildings Medium for offices	Significant
Construction Noise During Night	Very high over periods when concrete pours cannot be completed during the day at The Rise (MN106_C5), Griffith Avenue (MN106_C6 and C7), St. Joseph's Avenue (MN106_C13), Leo Street (MN106_C17), St. Alphonsus Avenue (MN106_C14), Mater Misericordiae Hospital (MN106_C15), Mater Misericordiae Hospital / Leo Street (MN106_C16) and Mater Private Hospital(MN106-C18) High at Walnut Lawn/Walnut Rise (MN106_C8) This activity is not likely to be standard practice and the assessment therefore represents a worst case scenario.	Very high	Significant
Operational phase			
Airborne Noise from LMVs	Very low	Not Applicable	Not significant
Emergency Ventilation Fans	Very low	Very high	Not significant



05

HUMAN BEINGS: VIBRATION

- 5.1 Introduction
- 5.2 Study area
- 5.3 Impact assessment methodology
 - 5.3.1 Construction phase methodology
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 - 5.4.4 Summary of residual impacts





This chapter of the EIS evaluates the potential vibration impacts arising from the construction and operation of the proposed scheme within Area MN106.

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 MN106.

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 faculties	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 this 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 5 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 proposed scheme 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.

For assessment of vibration from blasting, the metric conventionally used is peak particle velocity (PPV). The Irish EPA recommends that to avoid any risk of damage to properties in the vicinity of a quarry, the vibration levels from blasting should not exceed a peak particle velocity of 12mm/s as measured at a receiving location when blasting occurs at a frequency of once per week or less. In the rare event of more frequent blasting, the peak particle velocity should not exceed 8mm/s.

DIN 4150-2 uses $KB_{F_{max}}$ for the assessment of human exposure to vibration from blasting, using only the A_o values from the set of limits (A_o , A_u and A_r) used for general vibration assessment.

For human response, a relationship between PPV and $KB_{F_{max}}$ is required. The relationship depends on the frequency spectrum and the duration of the blast. The KB frequency weighting is almost flat between 16Hz and 63Hz, between which limits it is effectively an F-weighted exponential average of velocity in mm/s. While blasting vibration can occur significantly outside this range, often the dominant frequency is between 16Hz and 63Hz. The ratio of PPV to $KB_{F_{max}}$ in the example given in DIN 4150-2 is 2:1. Based on typical examples from blast monitoring of the Dublin Port Tunnel this would appear to be very conservative, and the ratio may be higher. However, the relationship $PPV = 2 \times KB_{F_{max}}$ is used in this assessment.

A daytime PPV of 12mm/s, taken as $A_o = 6$, is equated in this assessment to the threshold of 'High impact'. The threshold of 'Medium impact' is $A_o = 5$ and 'Low impact' is $A_o = 3$, being the daytime A_o value given in DIN 4150-2 for the two most sensitive classes, 'Buildings which are predominantly or purely residential' and 'Buildings in specially protected areas'.

Vibration from construction plant operating on above-ground worksites is assessed in the same way as vibration from the tunnelling, based on measured PPV levels for the relevant plant, converted to $KB_{F_{max}}$ using the same ratio of 2:1.

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 $L_{A_{max,S}} > 50\text{dB}$	very high
	Day $L_{A_{max,S}} > 55\text{dB}$	
	Night $45\text{dB} > L_{A_{max,S}} \leq 50\text{dB}$	high
	Day $50\text{dB} > L_{A_{max,S}} \leq 55\text{dB}$	
	Night $40\text{dB} > L_{A_{max,S}} \leq 45\text{dB}$	medium
	Day $45\text{dB} > L_{A_{max,S}} \leq 50\text{dB}$	
	Night $35\text{dB} > L_{A_{max,S}} \leq 40\text{dB}$	low
	Day $40\text{dB} > L_{A_{max,S}} \leq 45\text{dB}$	
Vibration effect on people (TBM and construction plant)	Night $A_u > 0.2, A_o > 0.4, A_r > 0.1$	very high
	Day $A_u > 1.6, A_o > 5, A_r > 1.2$	
	Night $A_u \leq 0.2, A_o \leq 0.4, A_r \leq 0.1$	high
	Day $A_u \leq 1.6, A_o \leq 5, A_r \leq 1.2$	
	Night $A_u \leq 0.15, A_o \leq 0.3, A_r \leq 0.07$	medium
	Day $A_u \leq 1.2, A_o \leq 5, A_r \leq 0.8$	
	Night $A_u \leq 0.1, A_o \leq 0.2, A_r \leq 0.05$	low
	Day $A_u \leq 0.8, A_o \leq 5, A_r \leq 0.4$	
Vibration effect on people (blasting)	Night $A_o > 0.4$	very high
	Day $A_o > 6$	
	Night $A_o \leq 0.4$	high
	Day $A_o \leq 6$	
	Night $A_o \leq 0.3$	medium
	Day $A_o \leq 5$	
	Night $A_o \leq 0.2$	low
	Day $A_o \leq 3$	
Vibration – building damage	$> 50\text{mm/s ppv}$	very high
	$\leq 50\text{mm/s ppv}$	high
	$\leq 12\text{mm/s ppv}$	medium
	$\leq 5\text{mm/s ppv}$	low
	$\leq 3\text{mm/s ppv}$	very low

Criteria		Impact magnitude
Places of meeting for religious worship, courts, lecture theatres, small auditoria – Sensitive During Daytime Only		
Groundborne noise (TBM)	$L_{Amax,S} > 55\text{dB}$	very high
	$50\text{dB} > L_{Amax,S} < 55\text{dB}$	high
	$45\text{dB} > L_{Amax,S} \leq 50\text{dB}$	medium
	$40\text{dB} > L_{Amax,S} \leq 45\text{dB}$	low
	$L_{Amax,S} \leq 40\text{dB}$	very low
Vibration effect on people (TBM)	$A_u > 1.6, A_o > 5, A_r > 1.2$	very high
	$A_u \leq 1.6, A_o \leq 5, A_r \leq 1.2$	high
	$A_u \leq 1.2, A_o \leq 5, A_r \leq 0.8$	medium
	$A_u \leq 0.8, A_o \leq 5, A_r \leq 0.4$	low
	$A_u \leq 0.4, A_o \leq 3, A_r \leq 0.2$	very low
Vibration effect on people (blasting)	$A_o > 6$	very high
	$A_o \leq 6$	high
	$A_o \leq 5$	medium
	$A_o \leq 3$	low
	$A_o \leq 2$	very low
Vibration – building damage	$> 50\text{mm/s ppv}$	very high
	$\leq 50\text{mm/s ppv}$	high
	$\leq 12\text{mm/s ppv}$	medium
	$\leq 5\text{mm/s ppv}$	low
	$\leq 3\text{mm/s ppv}$	very low
Sensitive Equipment		
Vibration	Computer equipment 0.25g peak acceleration	Must not exceed
	Mater Hospitals: agreed vibration limit at the centre span of any floor $12 \mu\text{m/s rms}$ in any third octave of frequency within the overall range 4 to 80Hz	Must not exceed
	Rotunda Hospital: Advised vibration limits $3 \mu\text{m}$ displacement at 5Hz, $6 \mu\text{m}$ displacement at 10Hz and 15Hz,	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	$L_{A_{max,S}} > 45\text{dB}$	very high
	$40\text{dB} > L_{A_{max,S}} \leq 45\text{dB}$	high
	$35\text{dB} > L_{A_{max,S}} \leq 40\text{dB}$	medium
	$30\text{dB} > L_{A_{max,S}} \leq 35\text{dB}$	low
	$L_{A_{max,S}} \leq 30\text{dB}$	very low
Vibration	Night $A_u = < 0.2, A_o = < 0.4, A_r = > 0.1$	very high
	Day $A_u = 0.4, A_o = 6, A_r = 0.2$	
	Night $A_u = 0.2, A_o = 0.4, A_r = 0.1$	high
	Day $A_u = 0.3, A_o = 6, A_r = 0.15$	
	Night $A_u = 0.15, A_o = 0.3, A_r = 0.07$	medium
	Day $A_u = 0.2, A_o = 5, A_r = 0.1$	
	Night $A_u = 0.15, A_o = 0.2, A_r = 0.05$	low
	Day $A_u = 0.15, A_o = 3, A_r = 0.07$	
	Night $A_u = 0.1, A_o = 0.15, A_r = 0.05$	very low
Day $A_u = 0.1, A_o = 3, A_r = 0.05$		
Places of meeting for religious worship, courts, lecture theatres, small auditoria – Sensitive During Daytime Only		
Groundborne noise	$L_{A_{max,S}} > 40\text{dB}$	very high
	$35\text{dB} > L_{A_{max,S}} \leq 40\text{dB}$	high
	$30\text{dB} > L_{A_{max,S}} \leq 35\text{dB}$	medium
	$25\text{dB} > L_{A_{max,S}} \leq 30\text{dB}$	low
	$L_{A_{max,S}} \leq 25\text{dB}$	very low
Vibration	$A_u = 0.3, A_o = 0.6, A_r = 0.15$	very high
	$A_u = 0.2, A_o = 0.4, A_r = 0.1$	high
	$A_u = 0.15, A_o = 0.3, A_r = 0.07$	medium
	$A_u = 0.15, A_o = 0.2, A_r = 0.05$	low
	$A_u = 0.1, A_o = 0.15, A_r = 0.05$	very low
Theatres, Large Auditoria and Concert Halls – Sensitive During Daytime Only		
Groundborne noise	$L_{A_{max,S}} > 30\text{dB}$	very high
	$25\text{dB} > L_{A_{max,S}} \leq 30\text{dB}$	high
	$20\text{dB} > L_{A_{max,S}} \leq 25\text{dB}$	medium
	$15\text{dB} > L_{A_{max,S}} \leq 20\text{dB}$	low
	$L_{A_{max,S}} \leq 15\text{dB}$	very low
Vibration	Day $A_u = 0.4, A_o = 6, A_r = 0.2$	very high
	Day $A_u = 0.3, A_o = 6, A_r = 0.15$	high
	Day $A_u = 0.2, A_o = 5, A_r = 0.1$	medium
	Day $A_u = 0.15, A_o = 3, A_r = 0.07$	low
	Day $A_u = 0.1, A_o = 3, A_r = 0.05$	very low
Sensitive Equipment		

Criteria		Impact magnitude
Vibration	Dublin Airport: The most sensitive equipment reported at the Airport is a ceilometer with a vibration criterion stated as a limit of ± 1 mm displacement in the range 5-13.2Hz, and ± 0.7 g in the range 13.2-100Hz.	Must not exceed
	Mater Hospitals: agreed vibration limit at the centre span of any floor $12 \mu\text{m/s}$ rms in any third octave of frequency within the overall range 4 to 80Hz	Must not exceed
	Rotunda Hospital: Advised vibration limits $3\mu\text{m}$ displacement at 5Hz, $6 \mu\text{m}$ displacement at 10Hz and 15Hz,	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 of three main kinds:

- Vibration due to the excavation of underground works, particularly cross-passages. It is likely that impact breakers will be used initially if the ground permits and then other methods may have to be used which could include chemical breaking, hydraulic splitting, Low VoD (velocity of detonation) pyrotechnics or drill and blast. The assessment has been based on the use of drill and blast, with other methods considered as mitigation through the use of alternatives causing lower vibration.
- Vibration due to the operation of the TBMs
- Vibration due to other construction work, including percussive breaking of rock and concrete, piling and diaphragm walling.

Drilling and Blasting

The principal source of vibration from drilling and blasting is the detonation of explosive charges underground. Vibration is a well known effect of blasting and the relationship

$$PPV = K W^a R^{-b}$$

is commonly used to predict peak particle velocity as a function of distance and charge weight per delay. In this expression K, is the Ground Transmission Constant, depending on the nature of the rock or soil and other parameters such as confinement. It will also be dependent on the blasting method, with specialist techniques used in tunnelling such as Penetrating Cone Fracture likely to give different results from conventional explosives. W is the charge weight per delay in kilogrammes, and R is the distance in metres, with d and b being empirical exponents. Blasting normally involves a sequence of detonations of small charges, separated by delays of 50 milliseconds or more. W relates to the mass of the explosive detonated after each delay. W and R are often combined in a parameter called scaled distance $S = R/\sqrt{W}$, in which case the express becomes

$$PPV = K S^{-b}$$

This effectively sets the value of d as 0.5b.

This relationship was originally derived for quarry blasting, and has been extended for use in drill and blast operations.

Values for K range from 200 to 1200 (for results in mm/s), the latter being for granitic and volcanic rocks, with soft rocks being in the range 500-600. A figure of 1.6 is commonly used for b.

Vibration monitoring carried out at 27 locations in volcanic rock in San Diego county, California gave values for K for 95% confidence of 200-5000 with the mean lying on a line represented by $K=714$.

In limestone, the value of K can be expected to be less than in volcanic rock.

Monitoring of drilling and blasting for the Dublin Port Tunnel gave results from which parameters can be derived. The charge weights are not known, but a best fit for PPV in terms of KS^{-b} results from an assumption of 10kg per delay, and a value of K of 1,000 with a standard deviation of 9.6mm/s. The mean is used as the basis of this assessment, but it must be recognised that there will be a distribution of results about the mean. The Dublin Port Tunnel sample is too small, and the blasting took place too far from the proposed scheme blasting locations, to make a reliable estimate of confidence intervals (e.g. 95%), and it will be necessary to carry out trials of the proposed drill and blast method to evaluate more specific local values for K and to determine the associated confidence intervals.

Tunnel boring

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 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 the proposed scheme 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 be made.

Above ground works

Most construction plant is not likely to generate vibration that will be perceptible at off-site locations. Therefore, vibration impacts have been considered from the particular plant items that have the potential to generate perceptible levels of vibration. The activities that are most likely to fall into this category are bored piling and the use of vibratory rollers. These activities are unlikely to take place outside of daytime working hours.

The vibration levels typically decay rapidly from these activities and meet the DIN standards for construction within 10m from bored piling and 15m from vibratory rollers (resulting in Low or Very low impacts beyond this point). The standards that have been adopted apply to construction work carried out for up to 26 days. However, the operation of this plant is not likely to be sustained throughout the scheduled construction period and is likely to be limited to periods of less than this.

Effect of variations in geotechnical parameters

The ground conditions for the proposed scheme vary along the route. 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 the 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 phase

Drilling and Blasting

Blasting will not take place in residential areas at night and suitable advanced warning will be given to anyone who may experience noise or vibration. Additional mitigation measures assumed include monitoring of vibration from each blast to enable blasting parameters to be optimised and to ensure that damaging levels of vibration are not reached. For conventional explosives the parameters concerned are charge weight per delay, and length of delay. PPV is proportional to the charge weight to the power of 0.8, so halving the charge weight reduces the PPV by about 40%. However, the parameters in the scaled distance formula are all empirical, and have to be determined by experimental measurements on site.

Alternatives to conventional explosives are capable of achieving significantly lower PPV values, including penetrating cone fracture (PCF) methods, chemical breaking, hydraulic splitting and Low VoD pyrotechnics. Use of road headers (excavating equipment fitted with a boom-mounted rotating drum cutting head) also results in much lower vibration than blasting.

Tunnel boring machine

Two principal methods of mitigation are available. 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:

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) 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) 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.

Above Ground Works

Bored piling and vibratory rollers have been identified as the plant most likely to create vibration impacts in the form of disturbance to the occupiers of adjacent properties. Bored piling is a low vibration piling method, so where piling is necessary there may be limited scope to use alternative methods. Vibration will be monitored and advanced warning will be given of the relevant activities.

5.4.2.2 Operational phase

A particular feature of the operation of a newly designed railway 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 project description as described in 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 $40\text{dB } L_{A_{\text{max},S}}$ 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 $25\text{dB } L_{A_{\text{max},S}}$ 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 results of this assessment are as follows. For each group of receptors the potential impact with no mitigation has been predicted. The extent of committed mitigation is described and the resultant residual impact expected with that mitigation adopted is reported.

The depth of the tunnel may reduce somewhat due to the proposed limits of deviation. In each case, this is not expected to change the predicted impact categories.

Baseline monitoring at Griffith Avenue/Walnut rise junction was in the high category and in the very low category near the proposed stop on Drumcondra.

The bored tunnel begins at Albert College Park, and passes in the glacial till (boulder clay) above the limestone beneath the park entering the limestone at Hampstead Avenue. South of Griffith Avenue is a residential area and the Corpus Christi Girls National School (not occupied at night) having a basement directly above the tunnel with approximately 21m of ground cover to the school basement. During the passage of the TBM, the groundborne noise level is likely to be $46\text{dB } L_{A_{\text{max},S}}$ (slightly higher in the school basement).

This will cause a High impact in the residential area if tunnelling takes place at night and a Medium impact if tunnelling does not occur at night. Vibration is likely to be less than $0.08 \text{ KB}_{\text{FTR}}$. This will cause a High impact at night, and a Very low impact by day.

There is a proposed cross passage to the east of The Rise, which has approximately 15m of ground cover (78m slant distance to the nearest residential buildings). The likely PPV will be 6mm/s, $\text{KB}_{\text{Fmax}} = 3$, at the nearest residential building, in the Low impact category for people in the building.

There is a proposed cross passage near Bantry Road, which has approximately 19m of ground cover (33m slant distance to the nearest residential buildings). The likely PPV will be 24mm/s, $\text{KB}_{\text{Fmax}} = 12$, at the nearest residential building, in excess of the building damage threshold and in the Very high impact category for people in the building. The Low impact threshold of $\text{KB}_{\text{Fmax}} = 3$ will be exceeded within a radius of 75m and the building damage threshold of 12mm/s will be exceeded within a radius of 45m. With a dominant frequency of 25Hz, this would be equivalent to approximately 0.4g, in excess of the damage threshold for computer equipment. To limit the PPV to the Low impact category for daytime the charge weight per delay would have to be restricted to 1.4 to 1.8kg depending on the final tunnel alignment.

Rock breaking will be required for the construction of Griffith Avenue Stop, and assuming this is done using a hydraulic rock breaker, groundborne noise levels of approximately 44dB(A), assuming four breakers in simultaneous operation, are likely in buildings above the stop, with vibration less than $0.2 \text{ KB}_{\text{FTR}}$, resulting in Low impact by day, Medium impact by night.

There is a proposed cross passage at Home Farm Road, which has approximately 22m of ground cover (27m slant distance to Corpus Christi School and 23m slant distance to the nearest residential buildings). The likely PPV will be 32mm/s, $\text{KB}_{\text{Fmax}} = 16$, at the school and 42mm/s, $\text{KB}_{\text{Fmax}} = 21$, at the nearest residential building, in excess of the building damage threshold and in the Very high impact category for people in the building. The Low impact threshold of $\text{KB}_{\text{Fmax}} = 3$ will be exceeded within a radius of 74m and the building damage threshold of 12mm/s will be exceeded within a radius of 45m. With a dominant frequency of 25Hz, this would be equivalent to approximately 0.6g, in excess of the damage threshold for computer equipment. To limit the PPV to the Low impact category for daytime the charge weight per delay would have to be restricted to 0.7 to 0.9kg depending on the final tunnel alignment.

There is a proposed cross passage to the east of Ferguson Road, which has approximately 27m of ground cover (38 slant distance to the nearest residential buildings). The likely PPV will be 19mm/s, $\text{KB}_{\text{Fmax}} = 10$, in excess of the building damage threshold and in the Very high impact category for people in the building.

The Low impact threshold of $\text{KB}_{\text{Fmax}} = 3$ will be exceeded within a radius of 72m and the building damage threshold of 12mm/s will be exceeded within a radius of 42m. With a dominant frequency of 25Hz, this would be equivalent to approximately 0.3g, in excess of the damage threshold for computer equipment. To limit the PPV to the Low impact category for daytime the charge weight per delay would have to be restricted to 2.0 to 2.3kg depending on the final tunnel alignment.

Under the Sports Ground of St. Patrick's College there is a proposed crossover with 28m of ground cover, and the nearest house is 24m to the west. The crossover tunnel is proposed just to the south of the Ferguson Road cross passage, and similar PPVs and, KB_{Fmax} values will occur if the crossover tunnel is excavated by drill and blast. i.e. to limit the PPV to the Low impact category for daytime the charge weight per delay would have to be restricted to 1.0 to 1.7kg depending on the final tunnel alignment.

During the passage of the TBM, the groundborne noise level in this area is likely to be 44dB $L_{\text{Amax,S}}$, Medium impact if tunnelling takes place at night, Low impact if tunnelling does not occur at night.

The tunnels pass below the St. Patrick's Boys National School in Millbourne Avenue and Drumcondra Library, and to the east of Chapelgate. There is approximately 28m of ground cover above the tunnel at Drumcondra Stop. Rock breaking will be required for the construction of Drumcondra Stop, and assuming this is done using a hydraulic rock breaker, groundborne noise levels of approximately 45dB(A), assuming four breakers in simultaneous operation, are likely in buildings above the stop, with vibration less than $0.2 \text{ KB}_{\text{FTR}}$, resulting in Medium impact by day, High impact at night.

During the passage of the TBM, the groundborne noise level in this area is likely to be 49dB $L_{\text{Amax,S}}$, High impact if tunnelling takes place at night, Medium impact if tunnelling does not occur at night. Vibration is likely to be $0.1 \text{ KB}_{\text{FTR}}$, causing High impact at night, Very low impact by day.

There is a proposed cross passage near Woodvale Road directly below residential buildings, which has approximately 25m of ground cover. The likely PPV will be 37mm/s, $\text{KB}_{\text{Fmax}} = 19$, in excess of the building damage threshold and in the Very high impact category for people in the building. The Low impact threshold of $\text{KB}_{\text{Fmax}} = 3$ will be exceeded within a radius of 73m and the building damage threshold of 12mm/s will be exceeded within a radius of 47m. With a dominant frequency of 25Hz, this would be equivalent to approximately 0.6g, in excess of the damage threshold for computer equipment. To limit the PPV to the Low impact category for daytime the charge weight per delay would have to be restricted to to 0.8 to 1.0kg depending on the final tunnel alignment.

During the passage of the TBM in this area, the groundborne noise level is likely to be 47dB $L_{Amax,S}$. High impact if tunnelling takes place at night, Medium impact if tunnelling does not occur at night. Vibration is likely to be 0.08 KB_{FTr} . High impact at night, Very low impact by day.

There is a proposed cross passage near Carlingford Road directly below residential buildings, which has approximately 27m of ground cover. The likely PPV will be 32mm/s, $KB_{Fmax} = 16$, in excess of the building damage threshold and in the Very high impact category for people in the building. The Low impact threshold of $KB_{Fmax} = 3$ will be exceeded within a radius of 72m and the building damage threshold of 12mm/s will be exceeded within a radius of 47m. With a dominant frequency of 25Hz, this would be equivalent to approximately 0.5g, in excess of the damage threshold for computer equipment. To limit the PPV to the Low impact category for daytime the charge weight per delay would have to be restricted to 1.2kg.

South of Drumcondra Stop the tunnels pass beneath mixed uses including residential buildings, and rise out of the limestone into the glacial till some 140m north of Mater Stop.

There is a proposed cross passage under the Royal Canal, approximately 25m slant distance from the nearest residential buildings in St. Ignatius Road. The likely PPV will be 38mm/s, $KB_{Fmax} = 19$, in excess of the building damage threshold and in the Very high impact category for people in the building. The Low impact threshold of $KB_{Fmax} = 3$ will be exceeded within a radius of 73m and the building damage threshold of 12mm/s will be exceeded within a radius of 47m. With a dominant frequency of 25Hz, this would be equivalent to approximately 0.5g, in excess of the damage threshold for computer equipment. To limit the PPV to the Low impact category for daytime the charge weight per delay would have to be restricted to 0.7 to 1.0kg depending on the final tunnel alignment.

There is a proposed cross passage near Kenmare Parade directly below residential buildings, which has approximately 19m of ground cover. The likely PPV will be 58mm/s, $KB_{Fmax} = 29$, in excess of the building damage threshold and in the Very high impact category for people in the building. The Low impact threshold of $KB_{Fmax} = 3$ will be exceeded within a radius of 74m and the building damage threshold of 12mm/s will be exceeded within a radius of 45m. With a dominant frequency of 25Hz, this would be equivalent to approximately 0.75g, in excess of the damage threshold for computer equipment. To limit the PPV to the Low impact category for daytime the charge weight per delay would have to be restricted to 0.5 to 0.7kg depending on the final tunnel alignment.

During the passage of the TBM in this area, the groundborne noise level is likely to be 49dB $L_{Amax,S}$. High impact if tunnelling takes place at night, Medium impact if tunnelling does not occur at night. Vibration is likely to be 0.1 KB_{FTr} . High impact at night, Very low impact by day.

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 LMVs will take place after the writing of this EIS, 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 per metre 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 vehicle 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.

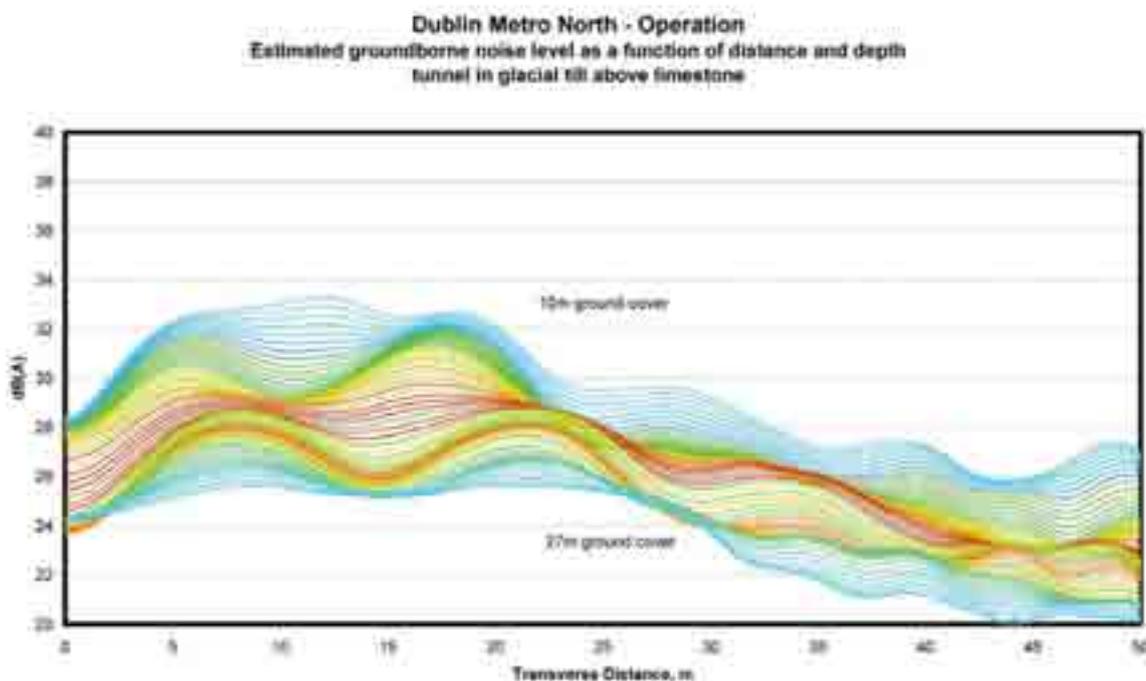


Figure 5.1
Groundborne noise from LMV in bored tunnel in glacial till above limestone

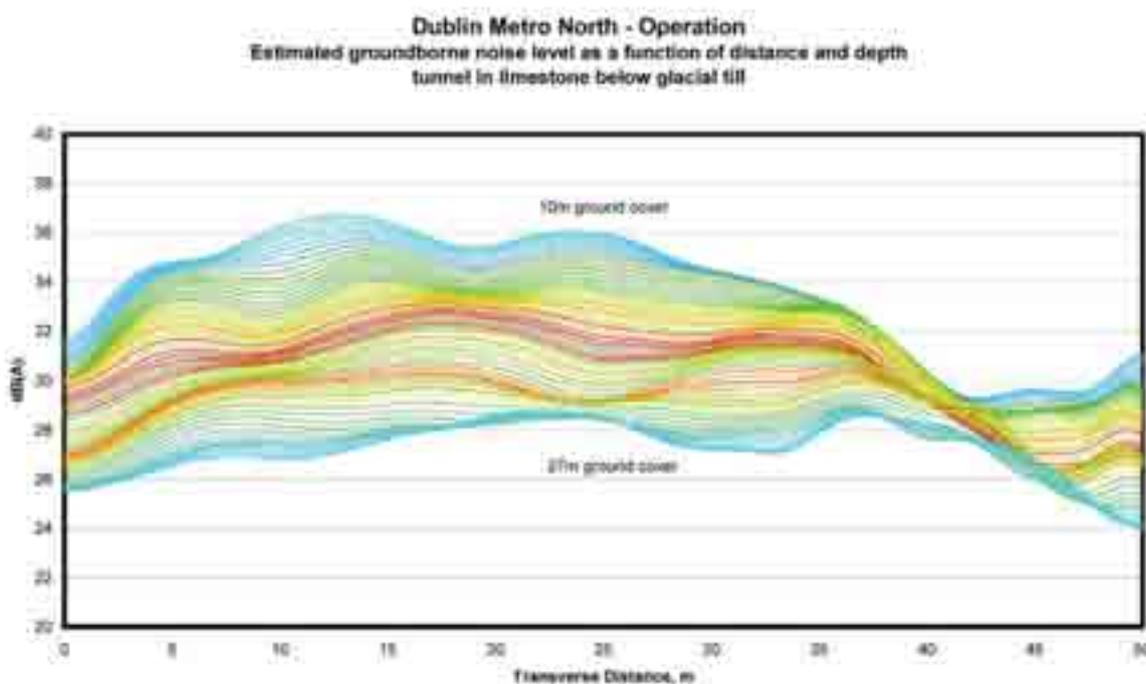
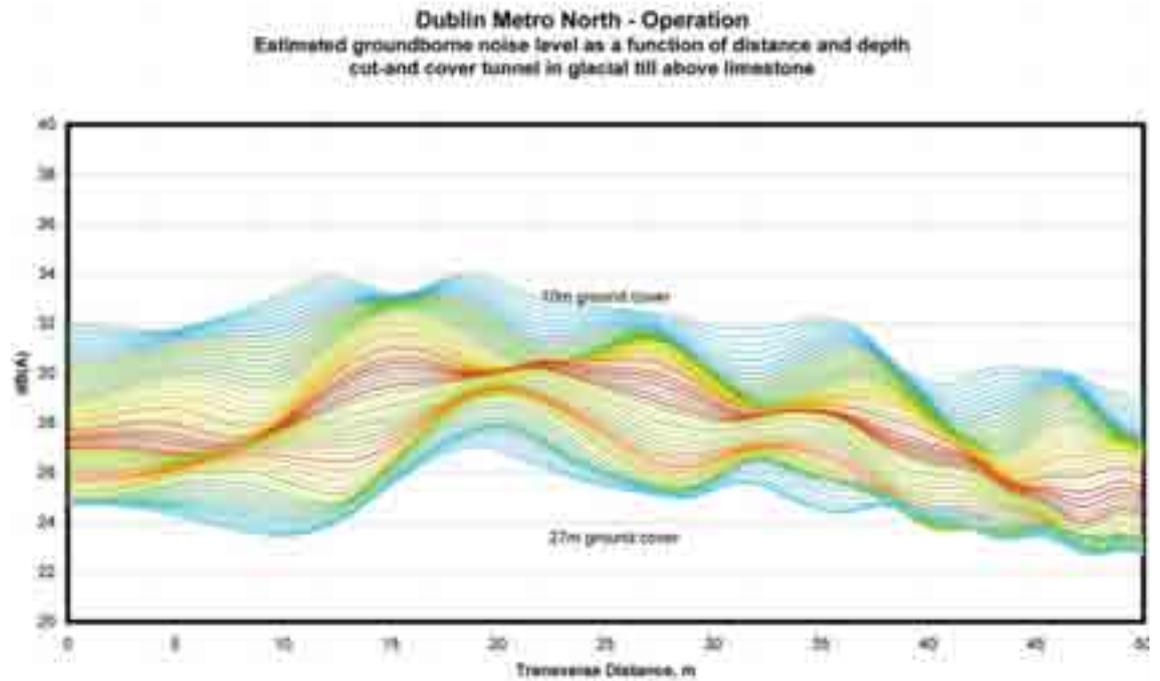


Figure 5.2
Groundborne noise from LMV in bored tunnel in limestone below glacial till

Figure 5.3
Groundborne
noise from 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 bored tunnel begins at Albert College Park, and passes in the glacial till (boulder clay) above the limestone beneath Albert College Park entering the limestone at Hampstead Avenue. South of Griffith Avenue is a residential area and the Corpus Christi Girls' National school directly above the tunnel with approximately 26m of ground cover. LMV speeds reach up to 70 km/h. With resiliently supported rail the $L_{Amax,S}$ would be approximately 30dB with two LMVs passing at Corpus Christi, which is not significant. Under the Sports Ground of St. Patrick's College there is a crossover, and the nearest house is 22m to the west with 32m of ground cover so that there will be no significant effect.

The tunnels pass below the St. Patrick's Boys' National School in Millbourne Avenue and Drumcondra Library, and to the east of Chapelgate. There is approximately 16m of ground cover above the tunnel at Drumcondra.

South of Drumcondra the tunnels pass beneath mixed uses including residential buildings, and rise out of the limestone into the glacial till some 140m north of Mater Stop.

Baseline monitoring at Griffith Avenue/Walnut Rise junction was in the high category and at Drumcondra was in the Very low category.

Very low vibration or groundborne noise impacts are likely with standard resilient rail support.

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 proposed 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			
Groundborne noise (TBM)	medium by day	very high	Significant
	high by night		Significant
Vibration affecting humans (TBM)	very low by day	very high	Not significant
	high by night		Significant
Vibration affecting buildings (TBM)	very low	very high	Not significant
Vibration affecting sensitive equipment (TBM)	low	very high	Not significant
Vibration affecting humans (drill and blast)	very High	very high	Significant
Vibration affecting buildings (drill and blast)	high	very high	Significant
Vibration affecting sensitive equipment (drill and blast)	high	very high	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



