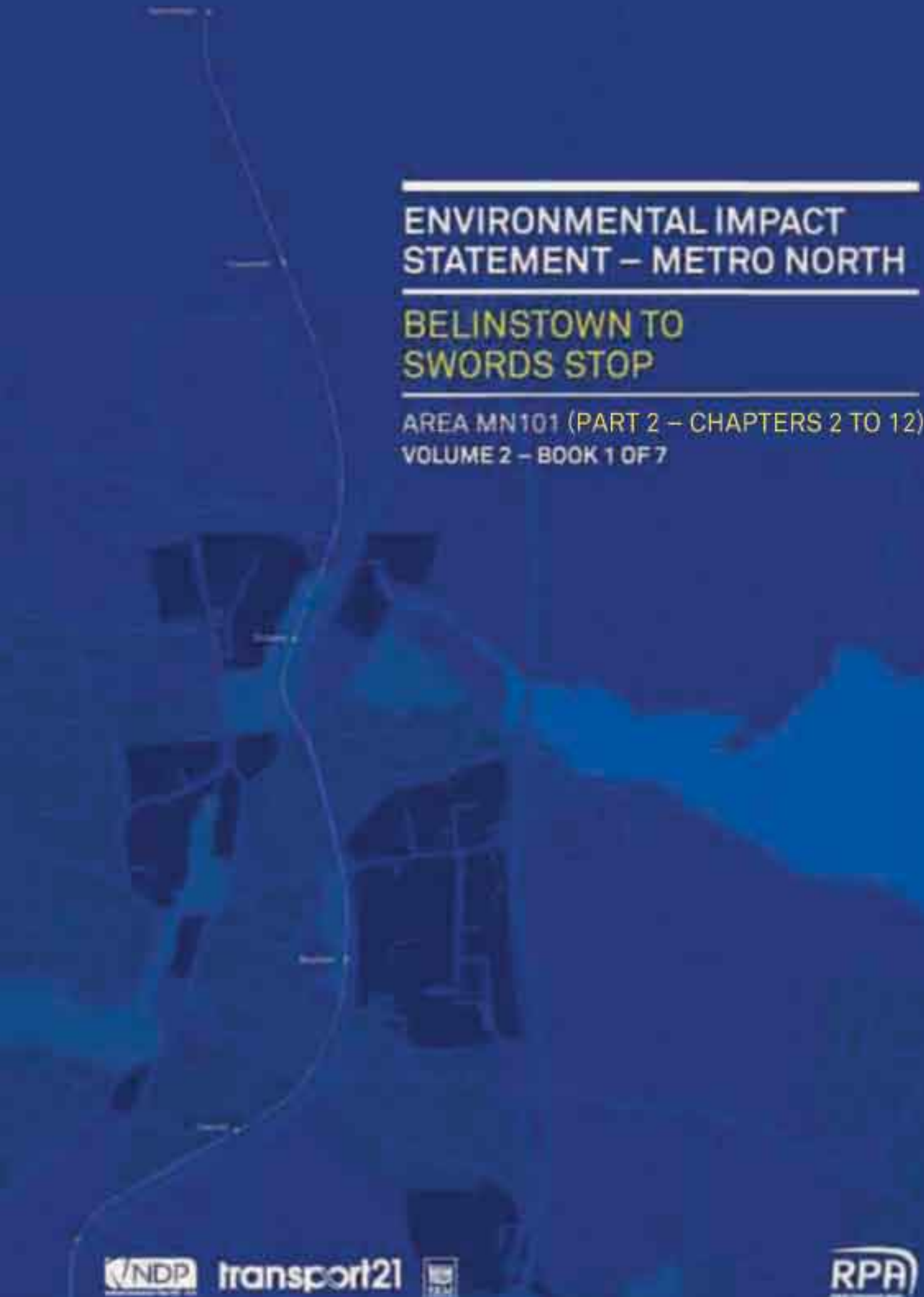
ENVIRONMENTAL IMPACT STATEMENT – METRO NORTH

BELINSTOWN TO SWORDS STOP

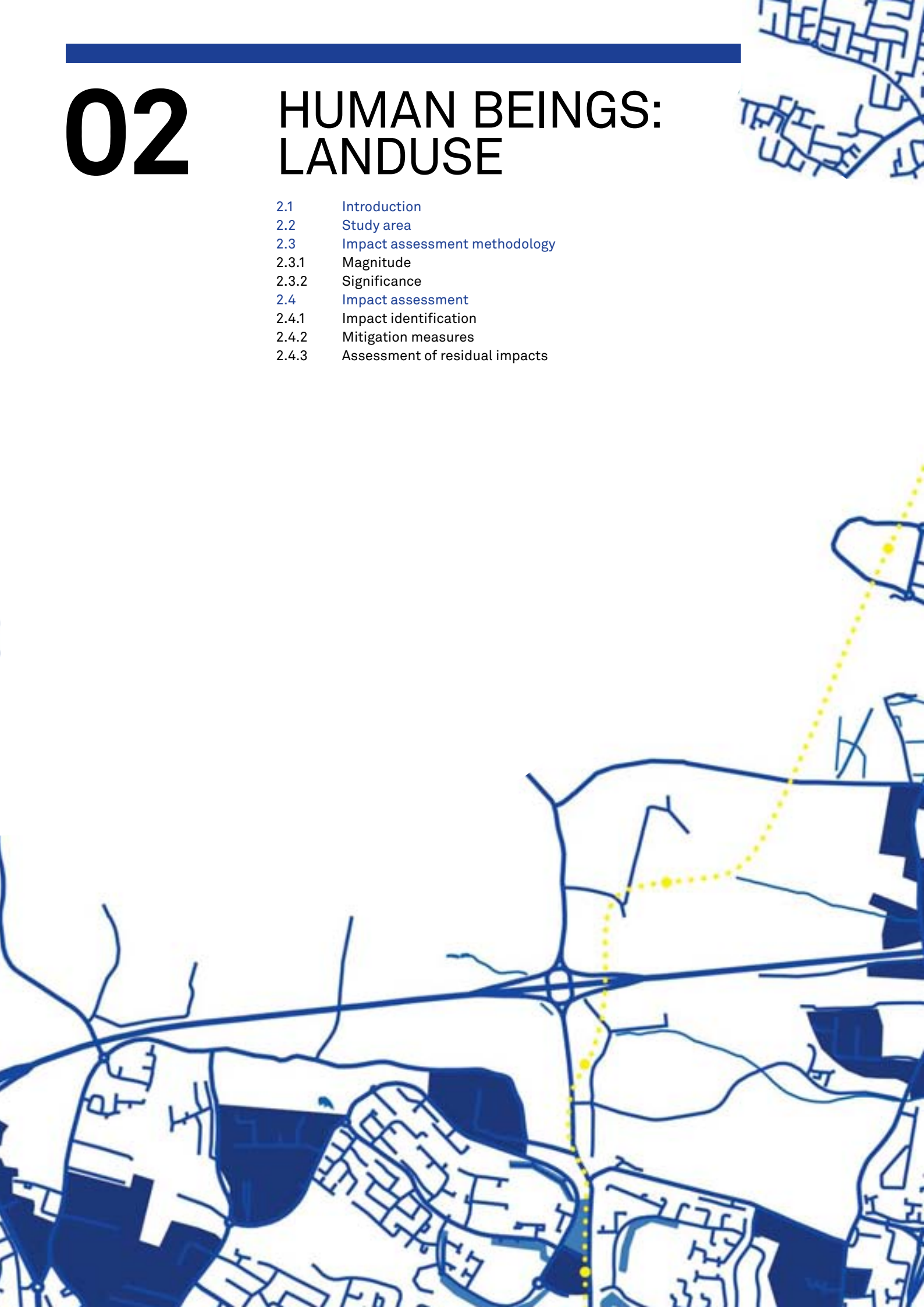
AREA MN101 (PART 2 – CHAPTERS 2 TO 12)

VOLUME 2 – BOOK 1 OF 7



NDP transport21 RPA

02 HUMAN BEINGS: LANDUSE



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 MN101.

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 MN101.

2.2 STUDY AREA

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

Table 2.1 Study area

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

2.3 IMPACT ASSESSMENT METHODOLOGY

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

2.3.1 Magnitude

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

Table 2.2 Criteria for assessment of impact magnitude

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

2.3.2 Significance

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

2.4 IMPACT ASSESSMENT

2.4.1 Impact identification

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

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

Permanent impacts
Permanent impacts are long-term impacts associated with the structure and operation of the proposed scheme. Sources of permanent impacts include all permanent, above-ground, built structures associated with the 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 that has to be taken on a temporary basis, existing landuses will be maintained where possible and the land will be reinstated and returned to its original use as quickly as possible. Measures are to be taken where possible to ensure that open spaces remain easily accessible through the provision of, for example, adequate gating, redirected footpaths, pedestrian crossings and agricultural access routes.
Road diversions and other traffic management mechanisms are to put in place before roads are closed to minimise severance impacts. Temporary road closures and diversions will be minimised, in number and duration, wherever possible.

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

2.4.3 Assessment of residual impacts

2.4.3.1 Project scenario: construction phase

Temporary land-take
A number of features for the proposed scheme will be constructed in Area MN101. These features will include the depot including the multi storey car park for the Park & Ride area at Belinstown, the track, electricity substations, bridges, viaducts, stops, the underpass at Malahide Roundabout, access roadways, and footpaths. In order to enable construction of the proposed scheme several construction compounds are located in Area MN101. The magnitude of the impact associated with the temporary land-take during construction is considered to be high if the construction activity and its associated activities extend beyond a 1 year period. Some of the compounds are located in areas with very high functional value, so the impacts have to be considered to be significant where no appropriate mitigation or substitution area is available or can be provided. This applies to all those areas where construction compounds are located in the direct neighbourhood of residential areas and which undergo intensive use for recreation. However, where sufficient additional amenity area is available to provide a reasonable temporary substitute the residual impact is rated as medium. While there will be a construction compound (Construction Compound 1) at the location of the depot for a period of approximately 4 years it will ultimately form part of the permanent land-take. The impacts on agriculture within Area MN101 are dealt with in Material Assets: Agronomy, Volume 2, Chapter 14.

The construction compounds adjacent to the Emmaus retreat centre, the Broad Meadow and the Ward Rivers (Compound 2, Option 1 and Option 2) will be present for more than 1 year, while the at-grade section in the western verge of the R132 will be reinstated in less than 1 year. These are areas of very high functional value and stringent mitigation management will be put in place in order to keep the temporary land-take to a minimum in order to maintain the use of the sports pitches and open spaces on the western side of the R132 and south of the rivers during construction. Construction Compound 2, Option 1, adjacent to the retreat centre, which will be approximately 2.4ha in size, is to be located on the fringe of the Swords urban fabric on agricultural lands. Due to the fact that there is abundant agricultural land in the region the temporary loss of this land is of medium impact magnitude and medium impact significance post mitigation. The Construction Compound 2, Option 2, adjacent to the Broad Meadow and the Ward Rivers, which will be approximately 0.6ha in size, and the at-grade section on the western verge of the R132 will be located on Brownfield/Vacant/Derelict lands and Open Space/Recreational lands. These sites will cover only a small proportion of the local open space. The construction works will not impact on the use of sports pitches within this open space and plenty of open space will remain accessible and useable during the construction phase of the scheme in Area MN101. Due to the fact that the majority of open space will remain useable and that the Construction Compound 2, Option 2, will be in use for more than 1 year the impact magnitude of this compound is also medium as is the impact significance post mitigation.

There will be three small construction compounds 3, 3a and 4 (0.4 Ha, 0.3ha and 0.2 Ha) associated with the reconstruction of the Chapel Lane footbridge, the Malahide south footbridge and construction of the Malahide Roundabout Underpass. The impact significance of their temporary land-take will be high because they are to be located in an area of high functional value, they will be present for more than 1 year and the open spaces which they will occupy are very valuable to the nearby residents. There is little alternative open space available in the immediate vicinity that is equally directly accessible from the homes of Ashley Avenue and Drive and Chapel Lane and Ashley Grove.

Adjacent to the Swords Stop there will be a small amount of temporary land-take in order to facilitate the construction of the stop. This land is currently used for agricultural purposes and is located in an area of high functional value. The temporary land-take will be for a period of less than one year. Due to the fact that there is plenty of agricultural land nearby, the residual impact is determined to be of low magnitude and Low significance.

There will be some temporary land-take in the existing streetscape at the Malahide Roundabout. This temporary land-take will facilitate the construction of the underpass using cut and cover techniques. The temporary land-take will be for a period of less than one year. Due to the fact that the impact magnitude of temporary land-takes in existing streetscapes is low the residual impact significance is also low.

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

Temporary severance

During the construction of the depot and the at grade sections of track in agricultural lands, there will be some severance between fields. This severance will be mitigated by the provision of access points for farmers to use in order to access their lands. The removal of the Estuary and Seatown Roundabouts to signalised junctions as well as the elevated sections of track in the median of the R132 will cause some temporary access disruption to the residential areas of Seatown Park, Estuary Court and Seatown Villas. These works are to be carried out in a period of less than 1 year and are therefore considered to be of Low significance, post mitigation.

2.4.3.2 Project scenario: operational phase

Permanent land-take

The main site of permanent land-take in area MN101 will be the depot (including Belinstown Stop and pPark & Ride) and the new access roads north of the Broad Meadow River. The total area of the future depot including landscaping will cover approximately 36.6ha of agricultural land of very high functional value. The residual impact of the land-take shows High significance due to its permanent change of land-use. Although agricultural land is widespread in the area, such a large amount of land-take is of high impact magnitude post mitigation. The impact of the track, Lissenhall Stop and the new access roads is determined to be medium post mitigation. This is due to the fact that it will be a permanent land-take of agricultural land in an area where there is abundant agricultural lands. It does not cause impacts on the adjacent landuses.

Through Area MN101, the median of the existing R132 will be utilised to reduce the impact it would otherwise have on other existing landuses. The permanent land-take for the track will be also kept to a minimum. To the east and south of the Lissenhall Bridge is an area that is currently classed as Open Space/Recreational. The usability of this land as open space will be compromised by the track (Medium significance) and two attenuation ponds. The existing footpath will be maintained via an at grade crossover connecting the residual open spaces (Medium significance). There will also be the loss of open space where the track and Estuary Stop are to be located. This impact is rated of Medium significance; even though valuable open space will be lost there will be a substantial amount of open space still available within the locality. Thus, the permanent land-take from these areas will not compromise the overall viability of these open spaces.

Along the R132 are lands that are to be permanently taken in order to accommodate substation and an attenuation pond. The significance of these impacts is low due to the fact that they are to be located on lands currently classed as Industrial/Warehouse/Storage. The change in landuse of these lands will not cause any significant impact as it involves a small portion of the land in Area MN101 that is classified as Industrial/Warehouse/Storage. The permanent land-take at the proposed location of the Seatown Stop will be in the existing streetscape. There will be no land taken from the Swords Business Park or the developments within. Therefore the residual impact significance of this impact is low. However, the entrance to the Seatown Business Park will be redesigned to better facilitate traffic.

There is to be a small amount of permanent land-take surrounding the bases of the Chapel Lane footbridge on the eastern and western sides of the R132 Swords Road. The significance of this land-take post mitigation will be low. The use of open space will not be impinged upon by this land-take. The open spaces will remain usable as open spaces.

Adjacent to the Swords Stop, in order to facilitate an at grade stop and track in the central median of the R132, it will be necessary to extend and widen the southbound lanes of the road. The land that will be permanently taken for the construction of the road and footpath is of high functional value and of Agricultural and Rural Amenity classification. The significance of this impact will be low due to the fact that it is only a narrow strip of land from agricultural lands and the adjacent land can continue to be used for agricultural purposes.

There will be permanent land-take in the existing streetscapes from three separate landuse character areas within Area MN101. This permanent land-take is to accommodate elevated and at grade sections of track. However, because the impact magnitude of permanent land-takes in the existing streetscapes is low, the residual impact significance is also low.

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 within Area MN101. Alternative access roads are provided for properties whose existing access roads are to be severed by the track. Where alternative access roads are provided the obsolete pre-existing road surfaces are removed and the land returned to agricultural and rural amenity uses.

All impacts in relation to traffic are described in Volume 2, Chapter 7.

Table 2.4 Summary of predicted impacts in Area MN101 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
MN101/ CN-01	LA 01 Belinstown South to Balheary Demesne townland on lands classified as Agricultural and Rural Amenity, Open Spaces/ Recreational and Brownfield/ Vacant/ Derelict	Temporary land-take along all track, Lissenhall Stop, new road section and access roads	Temporary land-take for a period of less than 1 year of lands classified as Agricultural and Rural Amenity Temporary land-take along the track, Lissenhall Stop, new road sections and access roads will only be used as long as those particular features are being constructed. These lands are narrow strips of land along all the track, Lissenhall Stop, new road sections and access roads. These lands will be used only temporarily during the construction phase. The temporary land-take along the at grade sections, Lissenhall Stop and new road sections and access roads will be approximately 0.6ha in total. The width of the strips of temporary land-take will be approximately 2m. There are approximately 240ha of agricultural and rural amenity lands in MN101. This temporary land-take will have no impact on the adjacent landuses.	very high	As little land as possible will be temporarily taken. The land will be returned to its original use as quickly as possible. Current landuses can be maintained in large parts of this temporary land-take, i.e. the temporary land-take in agricultural areas will still be usable by farmers for tractor and plant movements. This land will be reinstated as agricultural land.	low	Low

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/ CN-02	LA 01 Belinstown South to Balheary Demesne townland on land classified as Agricultural and Rural Amenity	Local Construction Compound 2 Option 1 to support construction of the surface works	Temporary land-take for a period of more than 1 year of approximately 2.4ha of Agricultural and Rural Amenity lands. The temporary construction compound will cover an access road and parts of three fields (suitable alternative access will be provided elsewhere). There will be a temporary loss of arable agriculture lands within the Greenbelt. This construction compound will facilitate the construction of the at grade track, the access road and the Lissenhall Stop. The construction compound borders lands classified as Open Space/Recreational uses and Residential with Mixed Uses (Commercial/Retail/Office), i.e. the property of Emmaus Retreat and Conference Centre. At the nearest point this construction compound will be approximately 50 m from the M1 motorway. This temporary land-take will be from Agricultural and Rural Amenity lands, of which there are approximately 240ha of in the vicinity, inside the study area. Approximately 0.7ha of this construction compound will ultimately form part of the permanent land-take, consisting of at grade track sections, earthworks and area inside the fence.	very high	As little land as possible will be temporarily taken. The land will be returned to its original use as quickly as possible. Road surfaces that are removed will not be restored as alternative access is provided elsewhere. They will be returned to Agricultural and Rural amenity. 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. The construction compound will be located in a landuse that it will impact as little as possible.	medium	Medium

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/ CN-03	LA 01 Belinstown South to Balheary Demesne townland on lands classified as Open Space Recreational and Brownfield/ Vacant/ Derelict	Construction Compound 2 Option 2 and temporary land-take beside Attenuation Pond and adjacent to R132	Temporary land-take for a period of more than 1 year of Open Spaces/Recreational and Brownfield/Vacant/ Derelict lands. The construction compound will be approximately 0.6ha in size. These lands will be temporarily taken in order to facilitate the construction of the attenuation pond and the Lissenhall Bridge and Estuary Stop. The land that will be temporarily taken is adjacent to the R132 and of low recreational value. Approximately 0.2ha of this construction compound will be located on Brownfield/ Vacant/Derelict land. The parcel of Brownfield/Vacant/Derelict land totals approximately 0.3ha. Post construction approximately 0.2ha will remain as permanent land-take for the attenuation pond, earthworks, at grade track sections and access points. The remaining 0.1ha of the Brownfield/Vacant/Derelict land will be landscaped as open space. The attenuation pond and associated works will be enclosed inside the fence. The construction compound will also temporarily use approximately 0.4ha of open space. The open space currently hosts a stand of trees. This open space is contiguous with approximately 26ha of open space inside the study area on the west side of the regional road R132. Within Area MN101 there are a total of approximately 52ha of open space.	very high	As little land as possible will be temporarily taken. The land will be returned to its original use as quickly as possible. Use of brownfield/ vacant/derelict land is maximised, while the use of open space and recreational lands is minimised. It will use the least attractive open space, i.e. the open space that is directly adjacent to the R132. Post construction the open space will be returned to a better condition than pre-construction. It will be used to buffer the Ward River and Broad Meadow River habitats.	medium	Medium

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/ CN-04	LA 03 Lissenhall & Seatown Residential areas on lands classified as Open Space/ Recreational	Along length of at grade and elevated track	Temporary land-take for a period of more than 1 year of Open Space/Recreational lands. A narrow strip of land will be temporarily needed for the construction of the track, at grade and elevated. The temporary land-take will total approximately 0.2ha of open space and ranges from approximately 2m to 5m in width, and is approximately 500 m in length. This land is a valuable open space used frequently by local residents and sports clubs. This open space is contiguous with approximately 26ha of open space inside the study area on the western side of the regional road R132. This open space is also valued because of the mature trees separating it from the motorway. The open space which this temporary land-take will be located on is linear, with the temporary land-take consuming the roadside length of the open space. There are currently football pitches located on this open space, whose use will be compromised by this temporary land-take.	very high	As little land as possible will be temporarily taken. The land will be returned to its original use as quickly as possible. It is necessary that the temporary land-take does not impact significantly on the usability of the football pitches in this open space. The pitches will be resized and reorganised so that they will remain useable during the construction phase. Measures will be taken to ensure that the open space remains easily accessible including the provision of adequate gating and redirected footpaths. The football pitches will be relocated as far away from the temporary land-take as possible to minimise the disruption that construction will have on their use.	medium	Medium

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/ CN-05	LA 08 Swords Business Park on lands classified as Industrial/ Warehouse/ Storage	Temporary land-take along eastern side of the Regional Road R132 between Seatown Road Roundabout and the Chapel Lane Footbridge	Temporary land-take for a period of less than 1 year of Industrial/ Warehouse/Storage lands. The temporary land-take will facilitate the construction of at grade track in the central median of the road and the relocating and widening of the southbound lanes. This will be a temporary land-take of approximately 0.1ha from a total area of Industrial/ Warehouse/Storage lands of total approximately 39 ha.	low	As little land as possible will be temporarily taken. The land will be returned to its original use as quickly as possible.	low	Low

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/ CN-06	LA 07 Swords Residential areas on lands classified as Open Space/ Recreational	Local Construction Compound 3 to support construction of the surface works and footbridge construction	Temporary land-take for a period of more than 1 year of Open Space/Recreational lands. The existing Chapel Lane footbridge is to be demolished and replaced with a new footbridge spanning the R132 Swords Road. At its base on the western side of the R132 will be a construction compound. This construction compound will be approximately 0.3ha in size. This construction compound will also facilitate the construction of Seatown Stop and the Malahide underpass. The open space that will be temporarily taken is regularly used by the residents of Seatown Walk and Chapel Lane. The open space allows for passive and active use in a supervised environment. This open space is contiguous with approximately 0.7ha of more open space. Overall, however, within MN101 there is a total of approximately 52ha of open space.	very high	As little land as possible will be temporarily taken. The land will be returned to its original use as quickly as possible. The construction compounds will maintain areas which can still be used as open space.	high	High

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/ CN-07	LA 07 Swords Residential areas on Broad Meadow lands classified as Open Space/ Recreational	Local Construction Compound 3A to support construction of the surface works and footbridge construction	Temporary land-take for a period of more than 1 year of Open Space/Recreational lands. The existing Chapel Lane footbridge is to be demolished and replaced with a new footbridge spanning the R132 Swords Road. At is base on the eastern side of the R132 will be a construction compound. This construction compound will be approximately 0.4ha in size. This construction compound will also facilitate the construction of Seatown Stop and the Malahide underpass. The open space that is temporarily taken is regularly used by the residents of Chapel Lane, Ashley Grove, Ashley Drive and Ashley Avenue. The open space allows for passive and active use in a supervised environment. This open space is contiguous with approximately 1ha of more open space. Overall, however, within MN101 there is a total of approximately 52ha open space. Within the residential area of Chapel Lane, Ashley Grove, Foxwood, Ashley Drive and Ashely Avenue, on the eastern side of the R132, there is a total of approximately 2.1ha of open space.	very high	As little land as possible will be temporarily taken. The land will be returned to its original use as quickly as possible. The construction compounds will maintain areas which can still be used as open space.	high	High

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/ CN-08	LA 07 Swords Residential areas on lands classified as Open Space/ Recreational	Local Construction Compound 4 to support construction of the surface works and footbridge construction	Temporary land-take for a period of more than 1 year of Open Space/Recreational lands. The existing Malahide footbridge is to be demolished and replaced with a new footbridge spanning the R132 Swords Road. Adjacent to the footbridge on the eastern side of the R132 will be a construction compound. This construction compound will be approximately 0.2ha in size. This construction compound will also facilitate the construction of the Malahide underpass. The open space that is to be temporarily taken is regularly used by the residents of Foxwood. The open space allows for passive and active use in a supervised environment. This open space is contiguous with no other open space. Within the residential area of Chapel Lane, Ashley Grove, Foxwood, Ashley Drive and Ashely Avenue, on the eastern side of the R132, there is a total of approximately 2.1ha of open space.	very high	As little land as possible will be temporarily taken. The land will be returned to its original use as quickly as possible. The construction compounds will maintain areas which can still be used as open space.	high	High

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/ CN-09	LA 05 Swords and Pavilions Shopping Centre and Nevinstown LAP on lands in the existing streetscape	Construction of Malahide underpass	Temporary land-take for a period of less than 1 year of lands in the existing streetscape. Cut and cover techniques will be used to construct the Malahide Underpass, where the track passes beneath the Malahide Roundabout	very high	As little land as possible will be temporarily taken. The land will be returned to its original use as quickly as possible.	low	Low
MN101/ CN-10	LA 05 Swords and Pavilions Shopping Centre and Nevinstown LAP on lands classified as Agricultural and Rural Amenity	Temporary land-take along southbound lanes of R132 beside Swords Stop	Temporary land-take for a period of less than 1 year of Agricultural and Rural Amenity lands. A narrow strip of land will be temporarily needed for the construction of the track, new road, footpath and substation. This narrow strip runs along the new footpath and around the substation on the eastern side of the R132. Temporary land-take along the southbound lanes of R132 beside Swords Stop will only be used as long as those particular features are being constructed. The temporary land-take will be approximately 2m wide along the southbound lanes of R132 and totals approximately 0.6 ha. The area of the Agricultural and Rural Amenity lands from which this temporary land-take is taken is approximately 21 ha.	high	As little land as possible will be temporarily taken. The land will be returned to its original use as quickly as possible. This temporary land-take will have no impact on the adjacent landuses. Current landuses can be maintained in large parts of this temporary land-take, i.e. the temporary land-take in agricultural areas will still be usable by farmers for tractor and plant movements. This land will be reinstated as agricultural land.	low	Low

Table 2.5 Summary of predicted impacts in Area MN101 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
MN101/ OP-01	LA 01 Belinstown South to Balheary Demesne townland on lands classified as Agricultural and Rural Amenity	Depot, including maintenance facility, Belinstown Stop, multi-storey car park, substations and landscaped areas	Permanent land-take of approximately 33.6ha of Agricultural and Rural Amenity lands. Construction Compound 1 will be located within these lands during the construction phase. Ultimately the entire construction compound will form part of the permanent land-take There will be a loss of arable agriculture lands within the Greenbelt, north of Belinstown Castle and east of Belinstown Farm. The depot will also cause a large degree of severance between the fields, i.e. fields previously easily accessible will now be more difficult to access. Located 100m from the M1 Motorway and outside lands proposed as a new development area by Fingal County Council. There is approximately 240ha of agricultural and rural amenity lands in the vicinity of the depot, within the study area of MN101.	very high	As little land as possible will be used for the depot and maintenance facilities. The landscaping areas will be in keeping with the surrounding landuses. The area of permanent land-take will be chosen so as the impact on landuse is minimised as much as possible. The depot will be located as close to the M1 as possible in order to minimise its impact on the Greenbelt. The location and design of the depot will minimise the number of individual fields impacted.	high	High

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/OP-02	LA 01 Belinstown South to Balheary Demesne townland on lands classified as Agricultural and Rural Amenity	Track, Lissenhall Stop and new road sections	Permanent land-take of Agricultural and Rural Amenity lands and a large degree of severance between fields, i.e. fields easily accessible will be more difficult to access. From the depot the track will traverse green field land, at grade. The access road (to be constructed parallel to the track) and the Lissenhall Stop will provide access from the R132 to the depot. The width of the track, road and earthworks will be approximately 35 – 40 m. Together with MN101/OP-03 approximately 6.2ha will be under permanent land-take. There is approximately 240ha of agricultural and rural amenity lands in the vicinity of this permanent land-take.	very high	As little land as possible will be used for the track, Lissenhall Stop and new road section. Farmers will be provided with track crossovers so that they can easily access severed parts of their landholdings.	medium	Medium
MN101/OP-03	LA 01 Belinstown South to Balheary Demesne townland on lands classified as Agricultural and Rural Amenity	New access roads	Permanent land-take of Agricultural and Rural Amenity lands and a large degree of severance between fields, i.e. fields easily accessible will be more difficult to access. These new access roads will provide access from the R132 to lands classified as Industrial/ Warehouses/Storage, Residential Areas, Open Spaces/Recreational, and Residential with Mixed Uses (Commercial/Retail/Office), i.e. the Emmaus Retreat and Conference Centre. They will also provide access to Agricultural and Rural Amenity lands severed by the track and new road section. Together with MN101/OP-02 approximately 6.2ha will be under permanent land-take.	very high	As little land as possible will be taken. Road surfaces that will be severed by the new access roads and made obsolete will be returned to Agricultural and Rural Amenity. Road diversions will be in place before roads are closed to minimise severance impacts. Temporary road closures and diversions will be minimised, in number and duration, wherever possible.	medium	Medium

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/ OP-04	LA 01 Belinstown South to Balheary Demesne townland on lands classified as Open Space/ Recreational	Footpath, Lissenhall Bridge strengthening and attenuation pond	Permanent land-take of Open Space/Recreational and Brownfield/Vacant/ Derelict lands. This permanent land-take will be for an attenuation pond to treat the rainwater runoff from the track and to prevent pollution of the river, an access footpath alongside the track and the strengthening of the Lissenhall Bridge. This permanent land-take will total approximately 0.5 ha. In Area MN101, within the study area, there is approximately 52ha of open space.	very high	As little land as possible will be taken. These permanent features will be located in lands that are capable of absorbing their impacts. The attenuation pond will be used to enhance the natural feel to this section of the open space. The footpath will provide improved access to the open space.	medium	Medium
MN101/ OP-05	LA 01 Lissenhall & Seatown Residential Areas and LA 03 Lissenhall & Seatown Residential Areas on lands classified as Open Space/ Recreational	Footpath, pedestrian crossing of track, attenuation pond and Balheary Bridge strengthening	Permanent land-take of Open Space/ Recreational lands This permanent land-take will be for an attenuation pond to treat the rainwater runoff from the track and to prevent pollution of the river, an access footpath, pedestrian crossing of the track and the strengthening of Balheary Bridge. Together with MN101/ OP-06 and MN101/OP-07 the permanent land-take will total approximately 1 ha. This open space is contiguous with approximately 26ha of open space inside the study area and on the western side of the R132.	very high	As little land as possible will be taken. These permanent features will be located in lands that are capable of absorbing their impacts. The attenuation pond will be used to enhance the natural feel to this section of the open space. The footpath will provide improved access to the open space.	medium	Medium

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/ OP-06	LA 03 Lissenhall & Seatown Residential Areas on lands classified as Open Space /Recreational	Track and Estuary Stop	Permanent land-take of Open Space/Recreational lands. This permanent land-take will be for the track and Estuary Stop. It will run the length of the open space adjacent to the R132. Together with MN101/ OP-05 and MN101/OP-06 the permanent land-take will total approximately 1 ha. This open space is contiguous with approximately 26ha of open space inside the study area and on the western side of the R132.	very high	As little land as possible will be taken. By running the track along the edge of the open space its impact will be reduced. It will act as a boundary between the open space and the road.	medium	Medium
MN101/ OP-07	LA 03 Lissenhall & Seatown Residential Areas on lands classified as Open Space and Recreational uses	Length of elevated track	Permanent land-take of Open Space and Recreational uses lands This permanent land-take will be for the track, at grade and as it becomes elevated. This length of track will run adjacent to the R132. Together with MN101/ OP-05 and MN101/OP-06 the permanent land-take will total approximately 1 ha. This open space is contiguous with approximately 26ha of open space inside the study area and on the western side of the R132.	very high	As little land as possible will be taken.	medium	Medium
MN101/ OP-08	LA 03 Lissenhall & Seatown Residential Areas on lands in the existing streetscapes	Length of elevated track	Permanent land-take of lands in the existing streetscapes. Demolition of the footbridge over the R132 north of Estuary Roundabout. Elevated track is to be located in the central median of the R132.	very high	As little land as possible will be taken. The elevated track will be located on land for which there are very few alternative uses. In the absence of footbridges, signalised pedestrian crossings will be installed to facilitate pedestrians.	low	Low

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/ OP-09	LA 07 Swords Residential areas on lands in the existing streetscapes	Redesign of roundabouts as junctions	Permanent land-take of lands in the existing streetscapes. Demolition of Seatown footbridges. Roundabouts are to be redesigned as signal controlled cross road junctions. Elevated track will pass overhead, in the central median of the R132.	very high	As little land as possible will be taken. In the absence of footbridges, signalised pedestrian crossings will be installed to facilitate pedestrians.	low	Low
MN101/ OP-10	LA 08 Swords Business Park on lands classified as Industrial/ Warehouse/ Storage	Attenuation pond, new footpath and new road section	Permanent land-take of Industrial/Warehouse/ Storage lands Road widening, provision of new footpath and the construction of an attenuation pond. This permanent land-take will be approximately 0.2ha from Industrial/Warehouse/ Storage area which totals approximately 39 ha. The permanent land-take will not adversely affect the neighbouring landuses.	low	As little land as possible will be taken.	low	Low
MN101/ OP-11	LA 07 Swords Residential areas on lands classified as Residential Areas and Open Spaces/ Recreational	Returning of elevated section to at grade, Seatown Stop and cut sections	Permanent land-take of land in the existing streetscape. Located in the central median of the R132 Swords Road. The entrance to the Swords Business Park will be redesigned and new footpaths constructed.	very high	As little land as possible will be taken. Adequate access will be provided for pedestrians to access the stop. There will be no land-take from the Swords Business Park and the developments within.	low	Low
MN101/ OP-12	LA 08 Swords Business Park on lands classified as Industrial/ Warehouse/ Storage	Substation, new footpath and new road section	Permanent land-take of Industrial/Warehouse/ Storage lands. Road widening, provision of new footpath and the construction of a substation. This permanent land-take will be approximately 0.3ha from Industrial/Warehouse area which totals approximately 39 ha. The permanent land-take will not adversely affect the neighbouring landuses.	low	As little land as possible will be taken.	low	Low

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/ OP-13	LA 07 Swords Residential areas on lands in the existing streetscapes	Length of elevated track and at grade track	Permanent land-take of lands in the existing streetscapes. Demolition of footbridge over the R132 north of Seatown Roundabout. Elevated track and at grade track will be located in the central median of the R132.	very high	As little land as possible will be taken. The elevated track and at grade track will be located on land for which there are very few alternative uses.	low	Low
MN101/ OP-14	LA 07 Swords Residential areas on lands classified as Open Space/ Recreational	Chapel Lane footbridge	Permanent land-take of Open Space/Recreational lands. Surrounding the base of the new Chapel Lane footbridge ridge on the eastern and western side of the R132 there will be some permanent land-take, consisting of earthworks. The total permanent land-take will total approximately 0.2 ha. In total, within Area MN101, there is approximately 52ha of open space.	very high	As little land as possible will be taken. While this land will be considered as permanent land-take it will remain within the public realm.	low	Low
MN101/ OP-15	LA 05 Swords and Pavilions Shopping Centre and Nevinstown LAP area on lands in the existing streetscapes	Return to at grade from Malahide Underpass cut sections, at grade section and Swords Stop	Permanent land-take of lands in the existing streetscapes. The track will return to at grade. It will travel along the median of the R132 Swords Road. The Swords Stop will also be located in the median. The stop at this location will have a positive impact on local businesses, through both ease of access for employees and ease of access for customers.	high	As little land as possible will be taken.	low	Low

Impact ID	Location	Source of impact	Impact description	Functional Value (FV) of affected area	Mitigation measure	Post mitigation	
						Magnitude	Significance
MN101/ OP-16	LA 05 Swords and Pavilions Shopping Centre and Nevinstown LAP area on lands classified as Agricultural and Rural Amenity	Substation	Permanent land-take of Agricultural and Rural Amenity lands. Substation to be constructed on the eastern side of the R132. This permanent land-take will be approximately 0.1ha in size and is from an agricultural land area which totals approximately 21ha in size.	high	As little land as possible will be taken.	low	Low
MN101/ OP-17	LA 05 Swords and Pavilions Shopping Centre and Nevinstown LAP area on lands classified as Agricultural and Rural Amenity	Construction of southbound lanes of R132 and footpath	Permanent land-take of Agricultural and Rural amenity lands. Agricultural lands will be permanently taken to facilitate road widening of the southbound lanes of the R132 and new footpaths. This permanent land-take will be approximately 0.4ha in size and will be from an agricultural land area which totals approximately 21ha in size. The new lanes will facilitate the operation of the proposed scheme and also accommodate road transport.	high	As little land as possible will be taken.	low	Low
MN101/ OP-18	LA 05 Swords and Pavilions Shopping Centre and Nevinstown LAP area on lands in the existing streetscapes	Length of at grade track and Swords Stop	Permanent land-take of lands in the existing streetscapes. Demolition and rebuilding of footbridge over the R132, south of Malahide Roundabout. At grade track will be located on the median of the R132.	high	As little land as possible will be taken.	low	Low

03 HUMAN BEINGS: SOCIO-ECONOMICS

This chapter of the EIS evaluates the potential socio-economics impacts arising from the construction and operation of the proposed scheme in Area MN101.

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 MN101 which are within 500m of the alignment

3.1.2 Impact identification

3.1.2.1 General/scheme-wide impacts

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

3.1.2.2 Localised (MN101) 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.

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.).

Typical Light Metro Vehicle (LMV)

Table 3.2 Criteria for assessment of impact magnitude

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

Table 3.3 Criteria for assessment of impact significance

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

3.1.4 Derivation of mitigation measures

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

3.1.5 Assessment of residual impacts

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

3.2 IMPACT ASSESSMENT

3.2.1 Project scenario: construction phase

3.2.1.1 General/scheme-wide impacts

Direct economic impacts

The expenditure of construction workers' wages will result in a considerable portion of this expenditure being spent in the regional economy of the Greater Dublin Area over the approximate 5 year construction period, thereby resulting in indirect/secondary economic benefits. The estimated level of average direct employment during the 5 year construction programme is approximately 3,100. 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 the direct employment is short-term (approximately 5 years), it is possible to equate this short-term employment to a level of permanent employment. The EIS for Crossrail (a major rail scheme in London which consists of a twin-bore tunnel on a west-east alignment under central London and the upgrading of existing National Rail lines to the east and west of central London) uses an employment multiplier of 10 employment years during construction as being the equivalent of one permanent/full-time job. Using this employment ratio, the equivalent level of permanent/full-time employment (FTE) is provided in Table 3.5. In total, the full time equivalent direct employment (FTE) generated by the construction phase is 1,550 jobs.

Table 3.5 Permanent equivalent level of construction employment

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

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

However, there has been a reduction in levels of activity in the construction sector since 2007 and the fall-off in construction activity has accelerated since late 2007 and is continuing. The Quarterly National Household Survey (CSO, 2008) notes that construction employment in Q4 (Sept. – Nov. '07) fell by 5,600 (-2.0%) and that the overall decrease in construction employment fell by 15,200 during 2007, and stood at 279,000 at the end of November 2007. Provisional 2008 data has indicated ongoing significant fall 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 job). The Crossrail EIS multiplier of 1.5 is based on multipliers used in other recent major rail schemes in the UK, such as:

- Thames link 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/full-time equivalent (FTE) level of construction employment

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

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

Impacts due to traffic congestion and diversion

This impact is addressed in the Traffic chapters of this EIS (Volume 2, Chapter 7). However, a brief summary is provided below.

Generally there is an increase in journey times on most of the roads/routes assessed during the five year construction programme. Traffic modelling data (MVA, 2007) indicates that some routes experience significant journey time deterioration, particularly the R132 through Swords, Ballymun Road, N2, Collins Avenue, Church Street and Baggot Street. Overall the impact on journey time can be classified as medium to severe on the routes assessed.

Traffic modelling results have shown that traffic speeds across the GDA will decrease by over 11%, or drop by 3kmh^{-1}. This represents a situation where traffic movement for all modes will be very difficult with significant delays at key areas. Drivers will travel further distances to avoid construction areas compounding the congestion levels on other parallel routes and affecting the operation of buses through the city. Other traffic modelling statistics such as impact on bus speeds and journey time on key routes further demonstrate the significance of the construction impact. Overall this will result in negative socio-economic impacts on the Greater Dublin Area's commuters and freight movements. These negative impacts are of medium to high magnitude and Medium to High significance, since the duration of these impacts ranges from temporary to short-term.

3.2.1.2 Localised socio-economic impacts

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

3.2.2 Project scenario: operational phase

3.2.2.1 General/scheme-wide impacts

Facilitating future development and employment creation

Overall the proposed scheme will facilitate a significant amount of future development along the whole alignment and across the wider northern part of the Greater Dublin Area. While the proposed scheme will not directly result in additional development in 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 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 the greater use of public transport (the proposed scheme in this case) with corresponding reductions in journey time and greater access to employment and other key destinations.

Fingal County Council commissioned a report titled 'Economic Development Strategy for the Metro North Economic Corridor (MNEC)' (Indecon International Economic Consultants, 2008) which outlines a long-term development strategy for a period up to 2025/2030. The Strategy has assumed that the MNEC is a 1km corridor on either side of the alignment 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 Electoral Districts of Swords-Lissenhall to the Fingal County Council-Dublin City Council administrative boundary at Santry Avenue.

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

The Strategy recommends that three specific locations within the MNEC will be the focus of the majority of overall new development and growth. These three areas are: Swords-Lissenhall, Dublin airport (Eastlands) and Metropark. The proposed scheme is a key piece of infrastructure which will facilitate the implementation of the Indecon Strategy. Without the proposed scheme many of the elements outlined in the Strategy will not arise. It should be noted that the various targets in the Strategy are acknowledged by Indecon as being ambitious and that they 'will be a major challenge and will require innovative policy initiatives' to ensure 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 in Dublin City Council's area, adjoining lands are predominantly already developed; whereas in Fingal, significant undeveloped sites exist, and it is these locations where the large quantum of future development (as envisaged in the MNEC) is likely to arise.

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

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

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

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

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

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

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

- Positive impact of the Luas on ease of travel around Dublin is widely acknowledged.
- The problem of staff punctuality as a result of inadequate public transport has been eased, in both the Red and Green line catchments.
- One in every four businesses overall, and three in every ten located in the Luas catchments, believe Luas has been advantageous for their business. Businesses in the Green Line catchment are the most positive. Green Line businesses noted that improved staff access to work was the main advantage while Red Line businesses noted easier and better access for customers and clients.
- Significant satisfaction with improved access to and from the city centre.

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

The proposed scheme will also go some way to reducing the wider costs of congestion and delays in commuting to work. The negative impacts of congestion to Dublin's (and thus, Ireland's) economy are significant: Dublin Chamber of Commerce estimates that 'the cost of congestion to the Greater Dublin Area in 2005 was €2.5bn' (Transport 21: Future for Dublin - A Policy Paper by 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, Metro North will result in the creation of new employment opportunities, although not to the same extent as the potential additional employment creation in Fingal County Council. Additional employment creation is likely to be focused at Ballymun (as part of the ongoing regeneration) and in the suburban retail and office concentrations, such as Drumcondra and Phibsborough.

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

Improving accessibility to community and social facilities

The proposed scheme will provide high-quality and frequent access to community and social facilities, such as typical city and town centre facilities (e.g. banking, post-offices, public sector services, retail, financial and professional services, medical and dental services and educational facilities). Examples of the key locations to which access will be provided include: Swords town centre, Airside Retail Park, Dublin Airport, Metropark, Ballymun Town Centre, Dublin City University, Mater Hospital, Drumcondra High Street, Trinity College, Dublin city centre and St. Stephens Green. Additionally, access will be provided to 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 to the scheme's alignment. The largest regeneration project is Ballymun and this is being managed by Ballymun Regeneration Ltd, a company set up by Dublin City Council to oversee the overall project. The proposed scheme will greatly assist with all of the regeneration and renewal objectives for this area of Dublin which has suffered socially challenging conditions for generations. The proposed scheme will provide the resident population (significant percentages of who are unemployed and with minimal educational qualifications) with direct, high-frequency and regular transport options to the key employment and other landuse areas of the Greater Dublin Area, thereby assisting with the regeneration objectives. The proposed scheme will also greatly assist the development of Ballymun Town Centre through providing direct, high-frequency and regular transport connectivity to the 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 Socio-economic 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 and 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 93,000 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 vehicles (45m). The proposed scheme has been specified to be capable of carrying 20,000 passengers per direction per hour, with LMV 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 2014 and around six times the current peak demand on the Luas Green line.

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

Regarding improvements to car-based journeys, Metro North 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 2kmh^{-1} and 3 kmh^{-1} 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 Avenue and Santry Avenue. There is a decrease in journey time of 19.8% on the R132 northbound from the city centre to the airport. There is a decrease in journey time of 17.2% using the Port Tunnel northbound. There is a decrease in journey time of 14.3% using the South Quays – George's Quay to O'Connell Bridge. There is a reduction in journey time on all routes on the M1 and on the N1 northbound and southbound from Dublin city centre to Swords and on the M50 in both directions. The most significant increase in journey time is anticipated to be 8.9% on the North Quays – from Heuston to O'Connell Bridge. However the majority of journey times are reduced along the routes. The journey time assessment for the operational years illustrates the significance of the positive impact that the proposed scheme will have on traffic movement particularly in the vicinity of the alignment.

The result of the proposed scheme is that it will provide a significant improvement 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, West Meath 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 commuters 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 (vehicle drivers, customer service staff, Park & Ride attendants, station staff, management etc.) and approximately 130 staff being employed in the maintenance of the system and infrastructure.

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

It is not possible to estimate where future employees will come from. However, it can be assumed that a portion will be from the proposed schemes 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 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 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 (MN101) socio-economic impacts

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

As previously noted in Section 3.2.2.1, Fingal County Council commissioned a report titled 'Economic Development Strategy for the Metro North Economic Corridor (MNEC)' which outlines a long-term development strategy for a period up to 2025/2030. In summary, this Strategy envisages an increase in the MNEC population of over 117%, over 2006 levels by 2025/2030. The basis for this proposed increase in MNEC population is that the attractiveness of the MNEC will be greatly enhanced by the transport advantages provided by the proposed scheme. Additionally, the Strategy is predicting the creation of an additional 37,000 within MNEC. Regarding MN101, the Strategy recommends that Swords-Lissenhall be one of three specific locations within the MNEC be the focus of the majority of overall new development and growth.

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

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

As described in the baseline Socio-economic chapter of this EIS (Volume 1, Chapter 11) Demographic Data for Area MN101 has had a population increase of almost 35% in the period 2002 to 2006. With the above economic and strategy policy being proposed by Fingal County Council in relation to Swords, the populations of three of the five EDs in MN101 (with the possible exceptions of Donabate and Lusk, due to a greater distance from Swords) although these will also undergo future growth) will significantly increase in future years, in accordance with Fingal County Council's policy.

The proposed scheme will facilitate future development and growth of the Metro North corridor through Fingal County Council in a planned and sustainable manner. This is a positive impact of very high magnitude and Very high significance.

Employment creation

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

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

The Strategy identifies the Swords-Lissenhall location as one of the three key growth areas and this has direct relevance for the population in MN101. It is likely that a significant amount of these additional jobs will be located with MN101, especially the EDs of Swords Village, Swords-Lissenhall and Swords Seatown.

Overall, the proposed scheme will, in the long-term, assist and facilitate the creation of a significant amount of the estimated 37,000 additional jobs to be created in the MNEC. This is a positive impact of very high magnitude and Very high significance.

Improving accessibility to and availability of employment opportunities

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

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

The proposed scheme will result in accessibility improvements through providing easier access to other employment locations (such as Dublin City centre and docklands). The current rate of employment in MN101 is high (61.4% to 72.3%) and generally above the average for Fingal County (64.6%), the average for the State (57.2%) and the Greater Dublin Area (59.9%). Correspondingly, unemployment rates are comparatively low. The slight exception is Swords Village, which has an unemployment rate of 6.6% against an average of 6.1% for Fingal and 7.0% for the Greater Dublin Area. Although the proposed scheme will improve access to employment opportunities across the Greater Dublin Area, it is not anticipated to result in significant reductions in unemployment for MN101, given the relatively high employment rates already found in the area. However, specific improvements in access to employment opportunities are anticipated in Swords village, which might reduce its' unemployment rate slightly.

In the longer-term (to the period 2025/2030 and beyond), the proposed scheme will result in substantially positive impacts regarding employment creation of very high magnitude and Very high significance for MN101 through the assistance in the creation of 37,000 additional jobs.

For residents who currently commute by public transport from Swords to Dublin City centre, the proposed scheme will bring about significant improvements in the daily access to employment. The proposed scheme will provide a regular and rapid mode of commuting to and from the city centre and other destinations along the alignment. It shall also provide easy access to Dublin's wider rail, Luas and bus network, thus providing easy access to the majority of the Greater Dublin Area. The information presented in Chapter 11 (Baseline Socio-economics) shows that MN101 has some of the lowest levels of non-car use for commuting to work, school or college. The proposed scheme is predicted to increase the portion of those who will travel to work by non-car modes of transport. The EDs which will especially benefit are Swords Village (although this ED already has in excess of 50% journey by non-car modes) Swords, Seatown, Swords Lissenhall and Lusk (many of whose residents will use the Park & Ride facility at the terminus of the alignment). Commuters in Donabate already have an Irish Rail service so a large transfer to the proposed scheme is not anticipated.

The proposed scheme will provide significant improvements regarding commuting times and journey quality for the residents of MN101. Currently, the average bus journey from Swords to the city centre (bus number 41) takes approximately 75.2 minutes, with four such services per hour. This is predicted to increase to 91.8 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 30 minutes approximately with approximately 15 services per hour during peak periods. In comparison to the current level of bus service, this represents a substantial improvement in the peak commuting journey times.

Regarding improving transport options for those with no access to a car, the proposed scheme will provide significant improvements to accessibility for all five EDs within MN101, especially Swords Village (28.6% of whom do not have access to a car), Swords Lissenhall (14.8% with no car access) and Donabate (12.6%) – all of which have above or close to the average for no car access in Fingal (13.9%).

In relation to improving the type of employment opportunities, the proposed scheme will result in greater access to professional and technical employment for the population of MN101, especially the following EDs (which have lower than average professional employment and higher than average unskilled employment): Swords Village, Swords Lissenhall and Donabate.

Overall, the proposed scheme will improve access to more and better employment opportunities for MN101 residents especially the EDs of Swords Village and Swords Lissenhall.

Improving accessibility to community and social facilities

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

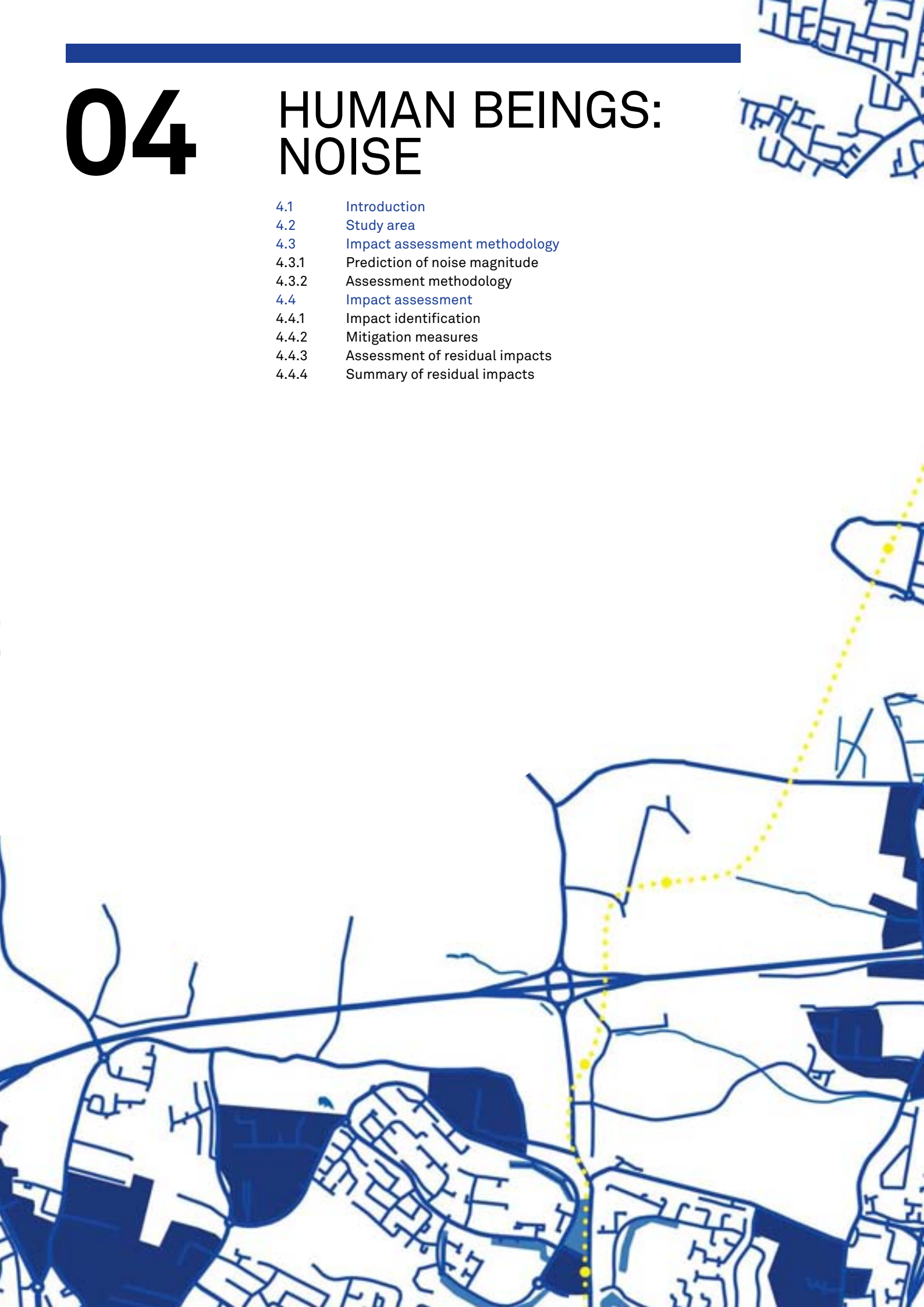
The proposed scheme will provide significantly faster and direct access to some key community and social facilities along the alignment, such as Swords town centre, Airside Retail Park, Dublin Airport, Metropark, Ballymun town centre, Dublin City University, Mater Hospital, Drumcondra high street, Trinity College, Dublin city centre and Dublin Docklands. 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.

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 (MN101) impacts: Construction phase			
Refer to respective Landuse and Traffic chapters			
Localised (MN101) impacts: Operational phase			
Facilitating future development	very high	very high	Very high
Employment creation	very high	very high	Very high
Improving accessibility to and availability of employment opportunities	very high	very high	Very high
Improving accessibility to community and social facilities	high	very high	High
Assisting regeneration and social-improvement activities	very high	very high	Very high

04 HUMAN BEINGS: NOISE



This chapter of the EIS evaluates the potential noise impacts arising from the construction and operation of the proposed scheme in Area MN101.

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 MN101. Groundborne noise and vibration impacts are reported the Vibration chapter of this EIS (Volume 2, Chapter 5).

4.2 STUDY AREA

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

4.3 IMPACT ASSESSMENT METHODOLOGY

The source and type of all potential impacts is described in Section 4.4.1. Mitigation measures to be put in place are defined in Section 4.4.2. The extent to which mitigation is needed increases as the magnitude of the impact increases. Unmitigated impacts and residual (mitigated) impacts are evaluated in Section 4.4.3. Annex C, Noise Assessment Details (Volume 3, Book 2 of 2), provides details of the noise modeling methods and results, including predicted levels of noise without mitigation for both the construction and operational phases.

4.3.1 Prediction of noise magnitude

4.3.1.1 Construction

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

4.3.1.2 Noise from the light metro vehicles (LMVs)

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

4.3.1.3 Noise from road traffic

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

4.3.2 Assessment methodology

4.3.2.1 Construction

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

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

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

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

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

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

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

Table 4.2 Definition of noise magnitude ratings

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

4.3.2.2 Operation

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

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

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

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

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

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

Table 4.4 Definition of noise magnitude ratings

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

Traffic noise impacts are assessed using the same methodology. Noise from fixed plant is considered in the same manner; however, it has been assumed insignificant if noise is less than NC25 inside neighboring buildings at night (to avoid sleep disturbance) or to not exceed the existing LA90 background noise. Noise Criteria (NC) curves are used to specify sound levels across a range of frequencies, and NC25 dB is an acceptable level for internal areas. Since all fixed plant is to be designed to meet these standards, it has not been necessary to define magnitudes of impact since no significant residual effects are expected.

4.4 IMPACT ASSESSMENT

4.4.1 Impact identification

4.4.1.1 Construction

The key noise sources during construction are likely to be the construction of the alignment including sections of elevated viaduct structures (the Estuary viaduct over Estuary and Seatown Roundabouts), at-grade sections and a cut-and-cover underpass at Malahide Roundabout. Structures are also required including bridges (a new bridge crossing the Ward River) and footbridges (Chapel Lane and Malahide South). The depot is also included in this route section. Above ground stops will be included at Belinstown, Lissenhall (provisional), Estuary (provisional), Seatown, and Swords.

4.4.1.2 Operation

During operation of the proposed scheme, noise sources will include LMVs using the above ground sections of the track and traveling through bends, switches and crossings, activities at the depot, traffic changes in the area of the alignment, Park & Ride sites, people at metro stops, and ancillary systems such as power supply facilities. There will also be occasional maintenance activities along the route.

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

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

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

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

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

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

The northbound service headways are:

- 4 minute (2014) and 3 minute (2029) service headways between 07.30 to 10.30 hours and 16.00 to 19.30 hours
- 7.5 minute (2014) and 6 minute (2029) service headways between 05.00 to 07.30 hours, 10.30 to 16.00 hours and 19.30 to 21.30 hours (with the exception of 05.00 and 07.30 hours in 2014 when 10 minute service headways will be operated)
- 10 minute service headways between 21.30 to 00.30 hours.

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

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

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

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

Noise impacts from traffic may result due to:

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

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

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

4.4.2 Mitigation measures

4.4.2.1 Construction

Mitigation will include the following measures:

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

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

- Construction compounds will be laid out so as to minimise noise impacts to neighboring noise sensitive receptors, by locating noisy operations well away from receptors and using on-site structures and materials to screen noise where practicable and necessary.

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

4.4.2.2 Operation

LMV Noise

Without mitigation, noise impacts have been predicted at several locations along the route. There are a number of mitigation measures available to reduce noise from new railways, but there is no statutory requirement to apply these measures nor guidance as to when to apply them.

On 1st May 2008, the Bord Pleanála Inspector's Report for the Luas Line A1 (Belgard to Saggart) Railway Order application was published. The report recommended granting the Order, and, in Schedule 12, attached a condition relating to noise, as follows:

> The Operational Noise Level criteria to be applied and the design goals adopted shall be those of the National Roads Authority as published in the document entitled "Guidelines for the Treatment of Noise and Vibration in National Road Schemes" (Revision 1, October 2004)

Reason: To achieve uniform noise criteria in an area where new road proposals are scheduled to be carried out in the same time period and adjacent to the light railway.

The application of the NRA design goal for railway noise from the Luas A1 scheme was linked to the fact that the scheme included road scheme proposals. It could be argued that this is not the case for the entirety of the proposed scheme. However, the majority of the proposed scheme above ground alignment follows road corridors, and it is considered appropriate to adopt the NRA design goal for designing mitigation for noise from the normal running of LMVs, in any case where that noise will be higher than the prevailing traffic noise level.

There are differences in the characteristics of road traffic and railway noise, and it has been shown that railway noise is less disturbing than road traffic noise, at a given level. This effect has been called a railway 'bonus' and is greater at higher noise levels. However, for the purposes of considering the NRA guidance for the proposed scheme the railway bonus has been ignored.

The NRA design goal is stated in the guidance as follows:

- Day-evening-night 60dB L_{den} (free-field residential facade criterion).

The guidance notes:

> Noise and vibration design goals are required in order to ensure that the current roads programme proceeds on a path of sustainable development. Achieving sustainable development in practice requires that economic growth supports social progress and respects the environment, that social policy underpins economic performance and that environmental policy is cost effective. In devising design goals for national roads the Authority has balanced environmental and economic considerations. With this in mind, the Authority acknowledges that it may be appropriate to adopt different design goals for diverse situations, e.g. design goals for existing situations may be different from new situations and there are different design goals for the construction phase of road schemes.
>
> This [operational phase] design goal has been shown to be significantly more onerous than the 68dB(A) L10(18 hour) value previously employed on national road schemes.
>
> This design goal is applicable to new road schemes only. In EIS terms, this means that it is to be applied to existing sensitive receptors in respect of both the year of opening and the design year (i.e. 15 years after projected year of opening).
>
> Following confirmation of the EIS, the issue of noise mitigation for new receptors is a matter for the Planning Authority within the planning legislation.
>
> The Authority accepts that it may not always be sustainable to provide adequate mitigation in order to achieve the design goal. Therefore, a structured approach should be taken in order to ameliorate as far as practicable road traffic noise through the consideration of measures such as alignment changes, barrier type (e.g. earth mounds), low noise road surfaces etc.

The guidance goes on to give conditions that must be satisfied for mitigation to be considered. In adopting this guidance for the proposed scheme, it is considered only appropriate where ambient noise levels are to be increased by noise from LMVs in operation. It is recognised that the 24 hour distribution of noise from the proposed scheme may be different from traffic noise in the adjacent roads, in particular it may be comparatively noisier at night. Hence, the condition for the design goal to be applied to railway noise shall be that railway noise must be above road traffic noise as measured in any hour of the day or night, in terms of $L_{Aeq\ 1\ hour}$. This is the adopted railway noise design goal. In such cases the resultant $L_{Aeq\ 1\ hour}$ noise level would increase by at least 3dB, and the railway noise L_{den} would be above 60dB.

The railway noise assessment has therefore computed L_{den} noise levels, as defined in Annex 1 of EC Directive 2002/49 Relating to the Assessment and Management of Environmental Noise, based on the metro service levels described above.

Above the railway noise design goal mitigation measures are considered to reduce noise impacts as follows.

The railway noise modelling is based on a series of conservative assumptions. These will be revisited at the final design stage (when the exact alignment, track and vehicle type are known), through a further detailed noise modelling study that will determine the exact form of noise mitigation. At this stage a number of measures are possible, as follows.

The noise modelling in this EIS has made a worst case assumption for the basic noise emission level of the LMVs. The metro rolling stock tenderers will be encouraged to provide a quieter LMV within the constraints of the competitive tendering process. It is quite possible the metro LMVs will be quieter than assumed.

Preferred operating speeds may be lower than assessed herein, which would reduce noise, as could other operational factors. Track design could reduce noise levels. Rail dampers can reduce rail generated noise, and absorptive materials within the trackbed can attenuate noise reflections.

On elevated sections it may be possible to modify the trackbed to include noise screening structures close in to the wheel rail interface, and between the tracks. Such structures would be barely visible from adjacent receptor locations. It is considered essential to minimise the visual impact of the railway viaducts, and in general will not construct highly visible noise barriers on viaducts.

Noise barriers may be considered at ground level but they have a number of dis-benefits that would need to be considered including potential conflicts with road traffic, concerns of track safety, driver sight lines, visual impact, security and crime considerations, and construction and maintenance issues. For these reasons noise barriers will not generally be suitable for built up areas near road traffic and pedestrians. It is likely that noise barriers will be appropriate to mitigate the noise impacts predicted in the area south of the Lissenhall Stop where the alignment is away from roads and pedestrians. Noise barriers incorporating suitable vegetation may be appropriate in this area, so that they appear similar to a hedge, minimising landscape and visual impacts.

Depot
The depot has potential to create noise impact at the residential property MN101-1. The landscape bunds and the Park & Ride building will provide noise screening, but some increase in ambient noise is expected. To address this further noise screening will be included on the site adjacent to tracks such as the track from the Stop heading north and to the southern stabling area.

There are a number of tight bends within the depot including one with a radius of 25m at the entrance to the depot which could potentially generate wheel squeal in certain conditions. The nearest receptor (receptor MN101-1) is approximately 160m from it and the entrance to the depot is screened by landscaping bunds and the multi-storey car park. However, the track geometry of this bend will be carefully designed to minimise the possibility of wheel squeal and if necessary track lubrication measures will be employed to prevent it.

4.4.3 Assessment of residual impacts

4.4.3.1 Project scenario: construction phase

Depot
Construction work at the depot (Construction compound No. 1) will take place over the whole of the compound. Key activities will include topsoil stripping, resolution of potential archaeological features, ground improvement and drainage, structures, track laying and general construction activities.

The predicted noise levels for these activities are shown in Tables 7.24 in Annex C Noise Assessment Details (Volume 3, Book 2 of 2). The works will be carried out during the day and activities will affect only isolated receptors to the west of the depot. Receptors to the north are screened from construction noise by existing agricultural buildings. Assuming that some plant is located at approximately 150m from the nearest receptor MN101-C2 (an individual propriety off of Balheary Road), and that plant is distributed around the site, noise levels of 64 to 66dB are predicted. These noise impacts are likely to increase existing noise levels, but are not expected to result in noise impacts.

Alignment
The route section contains at-grade track, viaduct and underpass sections. The key activities involved in enabling and constructing the at-grade sections are considered in this section and the viaduct and underpass sections are considered as structures since the work involved results in higher noise levels. The predicted noise levels for these activities are shown in Table 7.24 of Annex C Noise Assessment Details (Volume 3, Book 2 of 2).

Without mitigation noise impacts are predicted at 4 out of 6 representative receptors with noise levels exceeding impact assessment criteria by 2 to 13dB. Taking into account the degree of mitigation that may be available for alignment works, it is likely that noise levels could be reduced to below the impact assessment criterion and no significant residual noise impacts are expected except at an individual residential property south of the Lissenhall Stop (MN101_C4). At this location a residual impact of 3dB above the criterion is expected. This results in a Low to Medium impact for less than 10 months.

Structures
A new bridge will be constructed over the Ward River and bridge strengthening works will be undertaken at the existing Lissenhall and Balheary Bridges, however, these will involve relatively minor daytime works at existing bridges and these are located at approximately 160m and 270m from the nearest receptors, and significant noise impacts are not expected.

Chapel Lane and Malahide South footbridges are to be replaced as part of the proposed scheme. These will involve the majority of work during the day. Without mitigation noise impacts are predicted at the closest receptors of 6 to 16dB. With mitigation residual noise impacts 6dB above the assessment criterion are predicted at Ashley Grove (MN101-C26) during the closest works on the new bridge structure at Chapel Lane. This impact has been defined as a High daytime impact.

There will be limited night-time work associated with demolition of the existing bridge, and this is discussed in following section 'Works at night'. The predicted noise levels for these activities are shown in Table 7.24 of Annex C Noise Assessment Details (Volume 3, Book 2 of 2).

The alignment will pass along the proposed Estuary Viaduct and via the Malahide Underpass. Without mitigation the works on Estuary viaduct are expected to result in noise impacts up to 14dB above the assessment criterion. Residual noise impacts 1dB above the assessment criterion are predicted at Newcourt (MN101-C11) and Seatown West (MN101-C12), and 4dB at the closest properties in Mantau Park (MN101-C17). These result in Very low impacts and Medium impacts at these receptors. The total duration of works is approximately 12 months, and individual receptors are likely to experience significant residual impacts for less than this since they will tend to be affected by the installation of the piers and spans that are closest to them. Individual piers will take approximately 10 days to install and spans will take approximately 5 days to install.

Without mitigation the Malahide Underpass works would result in noise impacts up to 16dB above the assessment criterion. Residual noise impacts 6dB above the assessment criterion are predicted at Foxwood (MN101-C29). This is a High impact. The works on the Malahide underpass are likely to take place over approximately 11 months, with the highest noise levels expected for only part of this period.

Stops
For the purposes of this assessment it is assumed that the provisional stops at Estuary and Lissenhall are included in the proposed scheme since this represents a worst case assessment in terms of construction noise.

The predicted noise levels for these activities are shown in Table 7.24 of Annex C Noise Assessment Details (Volume 3, Book 2 of 2). Noise levels are below the 75dB criterion which applies to the majority of receptors and below the 70dB criterion that applies to the northern end of the proposed scheme. At MN101-C22 (Seatown School) the unmitigated noise level exceeded the 65dB criterion by 3dB. No residual impacts are expected with mitigation in place.

Construction compounds
Construction compounds 1, 2 (option 1 and 2), 3, 3A and 4 are located in Area MN101. Construction compound 1 relates to the depot and light work related to the storage of materials is insignificant compared to the main works on the site, which are discussed previous section 'Depot'. Compound 2 (both options) are related to the construction of the depot access road, estuary viaduct and strengthening works at the Broad Meadow and Ward River bridges and careful layout of these sites will be sufficient to ensure that noise levels do not exceed noise criteria. Construction compound 3 and 3A is related to the Chapel Lane footbridge and Malahide underpass construction. Construction compound 4 is associated with the construction of the Malahide South footbridge, which have been discussed in detail in previous section 'Structures'.

Works at night
Chapel Lane and Malahide South footbridges are to be replaced as part of the proposed scheme. These may include one or two nights of work potentially involving breaking out of existing concrete sections.

In the worst case this could require the use of excavator mounted breakers, which would result in residual impacts. If baseline noise levels in the hours of the night when this work is required are below L_{Aeq} 45dB, the magnitude of these impacts could be of 20 and 29dB at Ashley Grove (MN101-C26) and Seatown Walk South (MN101-C24) respectively, even with mitigation as a result of demolition of the existing Chapel Lane footbridge. Even if baseline noise levels are higher, Very high impacts are likely here.

Works on demolition of the Malahide South footbridge would result in residual impact of 15dB at Foxwood (MN101-C29), and the house east of the Tesco site (MN101-C30) at the Pavilions Shopping Centre.

A Very high residual impact is therefore predicted from the night-time works. Where bridge sections can be removed with lower noise demolition techniques such as concrete crushing, this will be used, which will reduce the effect of these works.

Construction traffic
Changes in traffic flows are expected to occur along the eastern access road from the R132 towards Balheary Road. Noise levels due to traffic are expected to increase the baseline noise levels at the nearest noise sensitive receptors (MN101-5, Emmaus Retreat Centre and NM101-6) by up to 2dB. This is considered to be a Low impact.

Traffic noise levels are expected to increase by 4dB along the Dublin Road and Main Street from the junction with Malahide Road to the junction with Chapel Lane, resulting in a Medium impact. Along this length of road (approximately 350m) lies a mixture of commercial and residential properties as well as a school. From there to the junction with Seatown Villas (along North Street), levels are expected to increase by 6dB which is a High impact. A mixture of commercial and residential properties and a school border this length of approximately 500m of road. Properties could experience Medium or High impacts for up to approximately 21 months.

Along St. Cronan's Avenue (from Brackenstown Road to Rathbeale Road), traffic noise levels are expected to increase by 3dB. Approximately 60 properties border these routes, and could experience Medium impacts for up to approximately 13 months.

4.4.3.2 Project scenario: operational phase

Introduction

The alignment runs at-grade in much of this section and is elevated on viaduct across the Estuary and Seatown Roundabouts. Stops are located at Belinstown, Seatown and Swords. Provisional stops are also located at Lissenhall and Estuary. The assessment has assumed that these provisional Stops would be built later so trains could run through the area around those Stops at full speed, ie a worst case. The Belinstown Depot is located at the northern end of Area MN101 and a Park & Ride facility with 2,000 parking spaces, designed as a multi-storey car park, is planned to serve this area.

The key noise sources are:

- the LMVs running on track, on curves, switches and crossings;
- LMVs using the depot;
- maintenance activities within the depot;
- road traffic noise changes including the Park & Ride;
- an ESB supply substation which will be provided at Belinstown and will supply power to the stop substations by means of a 22kV ring main routed along the track.

Railway Noise

The noise levels predicted at the 25 representative receptors in Area MN101 are reported in Tables 7.1 and 7.2 of Annex C Noise Assessment Details (Volume 3, Book 2 of 2). The mitigation measures proposed to address the predicted impacts are described above. Since night-time impacts have the highest magnitude, the residual impacts have been discussed in terms of night-time time only. No impacts are expected at the two sensitive receptors that are only sensitive to noise during the day (Estuary Road MN101-7 and Seatown School MN101-20). On the basis that the LMV is no quieter than modelled at this stage, the locations where mitigation may be needed and the resultant noise impacts expected after mitigation are summarised in Table 4.5.

Table 4.5 Residual operational noise impacts MN101

Representative Receptor	Possible Mitigation	Magnitude of Residual Impact
MN101-1	No further mitigation	Slight
MN101-2	No further mitigation	Slight
MN101-3	Landscaped noise barrier	Slight
MN101-4	Landscaped noise barrier	Slight
MN101-5 Emmaus Retreat Centre	Landscaped noise barrier	Slight
MN101-6 (NML 9)	Landscaped noise barrier	Slight
MN101-7 Estuary Road commercial (daytime only)	No further mitigation	No Impact
MN101-8 Newcourt North	No further mitigation	Slight
MN101-9 Newcourt	Modified trackform	Slight
MN101-10 Seatown West	Modified trackform	Slight
MN101-11 The Crescent	Modified trackform	Slight
NM101-12 The Crescent South	No further mitigation	Slight
NM101-13 Nethercross Court	No further mitigation	Slight
MN101-14 Estuary Court	Modified trackform	Slight
MN101-15 Mantua Park	Modified trackform	Slight
MN101-16 Mantua Park West	No further mitigation	Slight
MN101- 17 Mantua Park West	No further mitigation	Slight
MN101-18 Seatown Terrace North	No further mitigation	Slight
MN101-19 Seatown Terrace	No further mitigation	Moderate (3.4dB)
MN101-20 Seatown School	No further mitigation	No Impact
MN101-21 Seatown Walk	Modified Trackform	Slight
MN101-22 Seatown Walk South	No further mitigation	Slight
MN101- 23 Castle Park	Modified Trackform	Slight

Table 4.5 shows that the mitigation proposed where noise levels are above the L_{den} 60dB design goal will ensure that all impacts with magnitude greater than slight (up to 3dB) are addressed, with one exception; MN101-19 Seatown Terrace, where an impact magnitude of 3.4 dB is predicted to affect about 6 properties. This is not considered to be significant.

Where mitigation is expected (because the predicted noise level is above the L_{den} 60dB design goal) reducing noise to the design goal will generally ensure levels are reduced to within the slight impact magnitude band. The exception is at the four receptors between the Estuary Stop and the depot (MN101-3 to MN101-6). However, the noise barriers that are likely to be constructed to address this could provide 10-15dB attenuation which would be sufficient to mitigate to the slight residual impact level.

If the optional stops at Lissenhall and Estuary are built early in the life of the proposed scheme the speed reductions would reduce the noise levels in this area because the LMVs speed would be reduced even if the services did not stop.

Depot

Baseline noise levels at the nearest residential receptor (MN101-1) are low, and residual impacts are likely. The assessment presented represents and assessment of the plans that accompany the Railway Order application. Mitigation will be further refined by the Contractor through detailed noise modelling of screening effects from on site barriers, but it is likely that an impact of low or medium magnitude will remain.

Switches and crossings

A switch is located to the south of Belinstown Stop. The nearest receptor is MN101-1. A crossover is also located opposite a receptor on Estuary Road, MN101-7. The noise modelling and the assessment of impacts include the additional noise that is likely to be generated. The effect of the crossing and the switch on the overall noise level was found to be small (less than 1 dB(A)). So, no additional impacts are predicted.

Maintenance

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

Road Traffic Changes

Road traffic changes with the potential to cause greater than 3 dB changes in noise levels on the road network have been considered by analysis of traffic flow forecasts for roads along and adjacent to the route. Changes of this order have only been identified on the slip road coming from the R132 to the M1 (southbound) where an increase of 3 dB is expected in 2014, increasing to 5 dB by 2029. This change is considered to be an impact of Medium significance. This will affect the six houses to the east of junction.

Belinstown Park and Ride

Changes in traffic flow are expected to occur on the access road between the Park & Ride and the R132. Ambient noise levels in 2014 are expected to increase at the receptors outlined in Table 4.6.

Table 4.6 Noise level changes at noise sensitive receptors along the eastern access road from the R132 in 2014

Receptor	Noise Level Change Between 0700-0800, dB	Level of Impact	Noise Level Change Between 0800-0900, dB	Level of Impact
MN101-3	2	Low	1	Low
MN101-5	3	Low	2	Low
MN101-6	1	Low	1	Very low

Traffic flow changes in the peak hours are detailed in Table 4.7.

Table 4.7 Belinstown Park & Ride traffic flows in 2014

		Traffic Flows Between 0700-0800	Traffic Flows Between 0800-0900
Eastern Access Road between the Park & Ride from R132.	Do Min	0	0
	Do Metro	456	277
	% Change	N/A	N/A
Balheary Road from the North to Batter Lane	Do Min	238	272
	Do Metro	253	308
	% Change	6%	13%
Balheary Road from the South to Batter Lane	Do Min	444	719
	Do Metro	577	826
	% Change	30%	15%
Batter Lane from Balheary Road to the Park & Ride	Do Min	56	290
	Do Metro	95	299
	% Change	70%	3%
Northern Access Route, on Batter Lane to the North of the Park & Ride	Do Min	218	476
	Do Metro	211	627
	% Change	-3%	32%

Analysis of the traffic flows in Table 4.6 shows that properties along Batter Lane to the Park & Ride (represented by MN101-1), are likely to experience the greatest change in noise level (an increase of up to 2 dB) in the peak hour, producing an impact of Low significance. None of the above traffic related impacts will be significant.

Junction Realignments

The effects of junction realignments have been considered for road links that are being moved closer to receptors and which carry significant flows of traffic. It was found that the junction remodelling that is required for the proposed scheme involves relatively minor changes in kerb lines resulting in noise changes of less than 1 dB, which are of very low impact magnitude and are not considered significant.

An exception to this is the single property on Seatown West, adjacent to the junction realignment between Castlegrange Road and the R132, which may experience a noise level change of up to 1 dB. Although this increase is not large enough to result in an impact in its own right receptors in this area will also be exposed to noise from LMVs, so the change in traffic noise has been considered when calculating the overall noise level in the area with the vehicles.

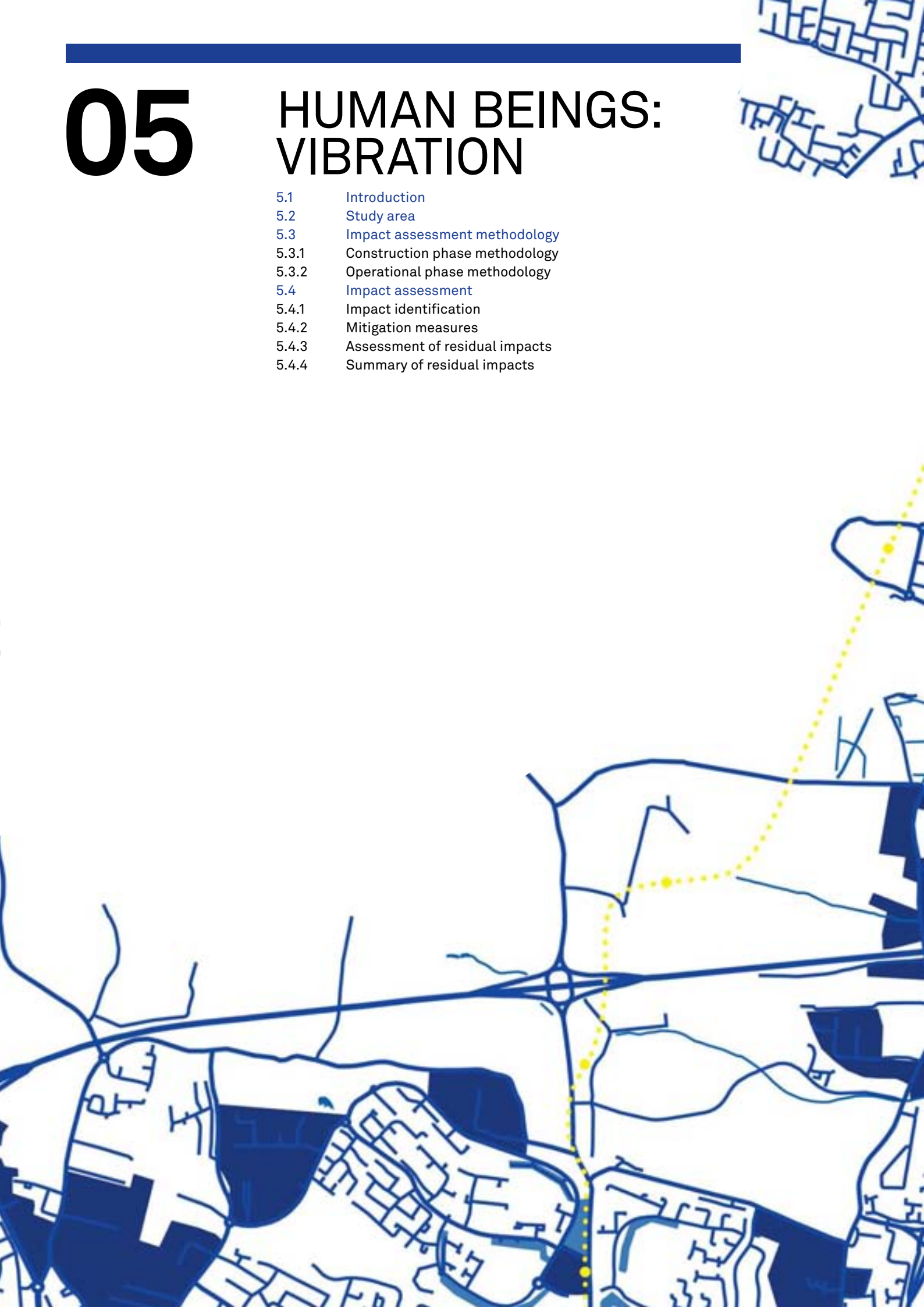
4.4.4 Summary of residual impacts

A summary of the residual impacts associated with this section of the proposed scheme is provided in Table 4.8.

Table 4.8 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	High at Ashley Grove (MN101-C26) and Foxwood (MN101-C29)	very high	Significant
	Medium at Mantau Park (MN101-C17)		Significant
	Low to medium at a property south of Lissenhall Stop (MN101-C4)		Significant
	High road traffic noise affecting properties on North Road from Chapel Road to Seatown Villas.		Significant
	Medium road traffic noise affecting properties on Dublin Road and Main Street (from Malahide Road to Chapel Lane). Medium road traffic noise affecting properties on St. Cronan's Avenue (from Brackenstown Road to Rathbeale Road).		Significant
	Other impacts are not significant.		
Construction Noise During Night	Very high over 1 to 2 nights at Ashley Grove (MN101-C26), Seatown Walk South (MN101-C24), Foxwood (MN101-C29) and the house east of the Tesco site (MN101-C30).	very high	Significant
Operational phase			
Airborne Noise from LMVs	Low except medium at Seatown Terrace (NM101-19) affecting approximately 6 properties.	very high	Not Significant
Depot Operations	Low or medium.	very high	Potentially significant
Effect of traffic changes on network	Medium at 6 houses to the east of the R132/M1 junction.	very high	Significant
Effect of Park & Ride	Low at 1 house represented by MN101-1 (NML 3) on the access road from the Balheary Road.	very high	Not significant

05 HUMAN BEINGS: VIBRATION



This chapter of the EIS evaluates the potential vibration impacts arising from the construction and operation of the proposed scheme within Area MN101.

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 MN101.

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 Vibration – building damage	50m
Construction Vibration – human perception	80m
Operational Vibration – human perception	50m
Operational Groundborne Noise – human perception	50m

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.

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 human response, a relationship between peak particle velocity (PPV) and KB_{Fmax} is required. The relationship depends on the frequency. Based on measured PPV levels for the relevant plant, a ratio of 2:1 was used.

Table 5.2 Criteria for assessment of impact magnitude during construction

Criteria		Impact magnitude
Vibration effect on people	Night $A_u > 0.2$, $A_o > 0.4$, $A_r > 0.1$ Day $A_u > 1.6$, $A_o > 5$, $A_r > 1.2$	very high
	Night $A_u \leq 0.2$, $A_o \leq 0.4$, $A_r \leq 0.1$ Day $A_u \leq 1.6$, $A_o \leq 5$, $A_r \leq 1.2$	high
	Night $A_u \leq 0.15$, $A_o \leq 0.3$, $A_r \leq 0.07$ Day $A_u \leq 1.2$, $A_o \leq 5$, $A_r \leq 0.8$	medium
	Night $A_u \leq 0.1$, $A_o \leq 0.2$, $A_r \leq 0.05$ Day $A_u \leq 0.8$, $A_o \leq 5$, $A_r \leq 0.4$	low
	Night $A_u \leq 0.1$, $A_o \leq 0.15$, $A_r \leq 0.05$ Day $A_u \leq 0.4$, $A_o \leq 3$, $A_r \leq 0.2$	very low
Vibration – building damage	>50mm/s ppv	very high
	≤50mm/s ppv	high
	≤12mm/s ppv	medium
	≤5mm/s ppv	low
	≤3mm/s ppv	very low

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.

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.

Table 5.3 Criteria for assessment of impact magnitude during operation

Criteria		Impact magnitude
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	

5.4 IMPACT ASSESSMENT

5.4.1 Impact identification

5.4.1.1 Construction Phase

For this part of the proposed scheme, vibration sources during the construction phase will be limited to construction plant operating on worksites. 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.

5.4.1.2 Operational Phase

The main source of vibration and groundborne noise during the operation of the scheme is the wheel/rail interaction during the movement of light metro vehicles.

5.4.2 Mitigation measures

5.4.2.1 Construction

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. Similarly where vibratory rollers are required lower vibration techniques may not be available, but their use will be minimised where possible.

5.4.2.2 Operation

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.

The Environmental Impact 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.

It is assumed that the following specification will be imposed:

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

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

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

5.4.3 Assessment of residual impacts

5.4.3.1 Project scenario: construction phase

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 vibration levels typically associated with bored piling and the use of vibratory rollers 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.

Baseline monitoring at Seatown Road, Swords indicates that existing vibration levels already exceed the levels at which very high magnitude impacts are expected to occur, based on the worst-case assumption that traffic is constant (ERM, 2008). In the residential sections, the alignment is in the central reservation of the existing road. The alignment is either at grade, on viaduct or in a short cut-and-cover underpass. Demolition and other construction works could produce some perceptible vibration, but no construction techniques that create high levels of vibration are expected sufficiently near to receptors to cause significant disturbance. Low vibration impacts are likely in this section.

5.4.3.2 Project scenario: operational phase

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 vehicles will take place after the writing of this Environmental Impact Statement, it is not possible to model the performance of the actual track and vehicles. However, based on the measured vibration performance of track with standard resilient rail support, Very Low vibration or groundborne noise impacts are expected.

5.4.4 Summary of residual impacts

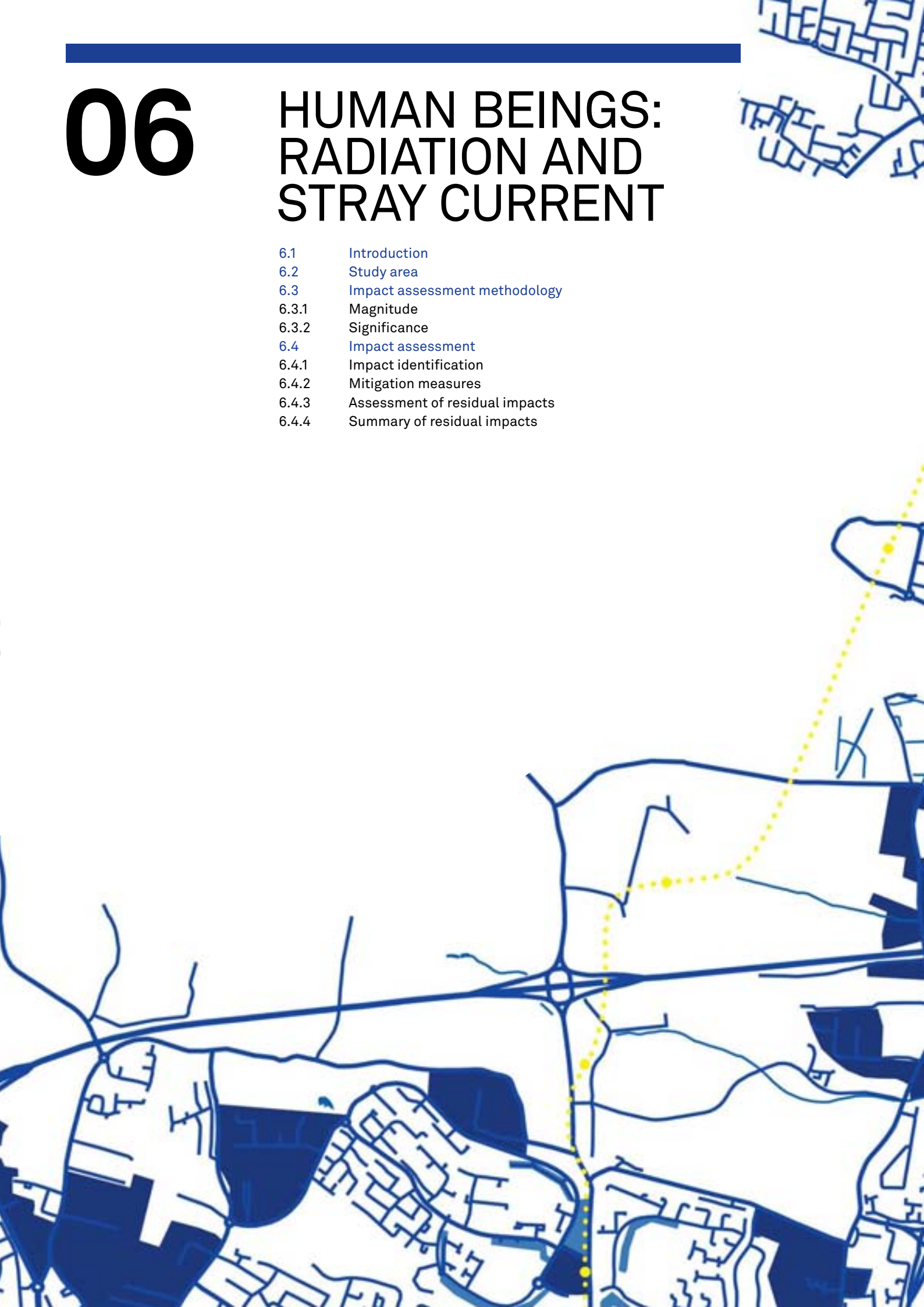
The potential noise and vibration effects from construction and operation of the proposed scheme have been assessed. An assessment of the requirements for mitigation has been undertaken. A summary of the residual impacts associated with the proposed scheme is provided in Table 5.4.

Table 5.4 Summary of residual impacts

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

Belinstown Stop and Park & Ride

06 HUMAN BEINGS: RADIATION AND STRAY CURRENT



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

6.1 INTRODUCTION

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

6.2 STUDY AREA

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

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

Table 6.1 Study area

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

6.3 IMPACT ASSESSMENT METHODOLOGY

The potential for EMI impacts has been assessed by:

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

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

6.3.1 Magnitude

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

Table 6.2: Criteria for assessment of impact magnitude.

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

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

6.3.2 Significance

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

6.4 IMPACT ASSESSMENT

6.4.1 Impact identification

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

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

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

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

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

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

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

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

6.4.2 Mitigation measures

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

6.4.3 Assessment of residual impacts

6.4.3.1 Project scenario: construction phase

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

6.4.3.2 Project scenario: operational phase

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

Table 6.3 Reference standards, regulations and other relevant documents

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

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

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

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

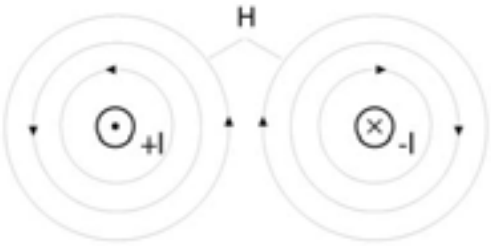


Figure 6.1 Electric conductors with magnetic field streamlines

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

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

Where:

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

I: traction current (Amps A): and

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

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

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

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

Where:

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

μ0: absolute permeability (physical constant);

μr: relative permeability (coefficient of materials).

Selection of representative locations

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

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

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

Identification of representative scenarios

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

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

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

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

Predicting the magnetic fields for the chosen scenarios and locations

The electromagnetic calculations carried out were based upon the key assumptions set out in Table 6.4 and 6.6. The results are set out in Table 6.7 to 6.11.

Table 6.4 LMV Performance

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

Table 6.5 Power Supply Performance

Maximum short circuit current	20000A

Table 6.6 Track and OCS Parameters

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

Table 6.7 EMI at Seatown – Normal Operation

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

Table 6.8 EMI at Seatown – Fault Operation

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

Table 6.9 EMI at Albert College – Normal Operation

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

Table 6.10 EMI at Mater Hospital – Normal Operation

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

Table 6.11 EMI at Rotunda Hospital – Normal Operation

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

Extrapolating of the obtained results to assess the potential risk along the entire alignment

The results presented in the tables above show that during normal operations, the electromagnetic impact of the proposed scheme is low and medium, which results in a small increase in the electromagnetic environment in the vicinity of the proposed scheme.

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

6.4.4 Summary of residual impacts

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

07 HUMAN BEINGS: TRAFFIC

This chapter of the EIS examines the transportation impact of the proposed scheme. The impacts on vehicular, pedestrian and cycling traffic and safety arising out of the construction and operation of the proposed scheme are described for Area MN101.

7.1 INTRODUCTION

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

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

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

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

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

7.1.1 Transport assessment methodology

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

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

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

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

7.1.2 Structure of transportation assessment section

The transportation assessment section is structured as follows:

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

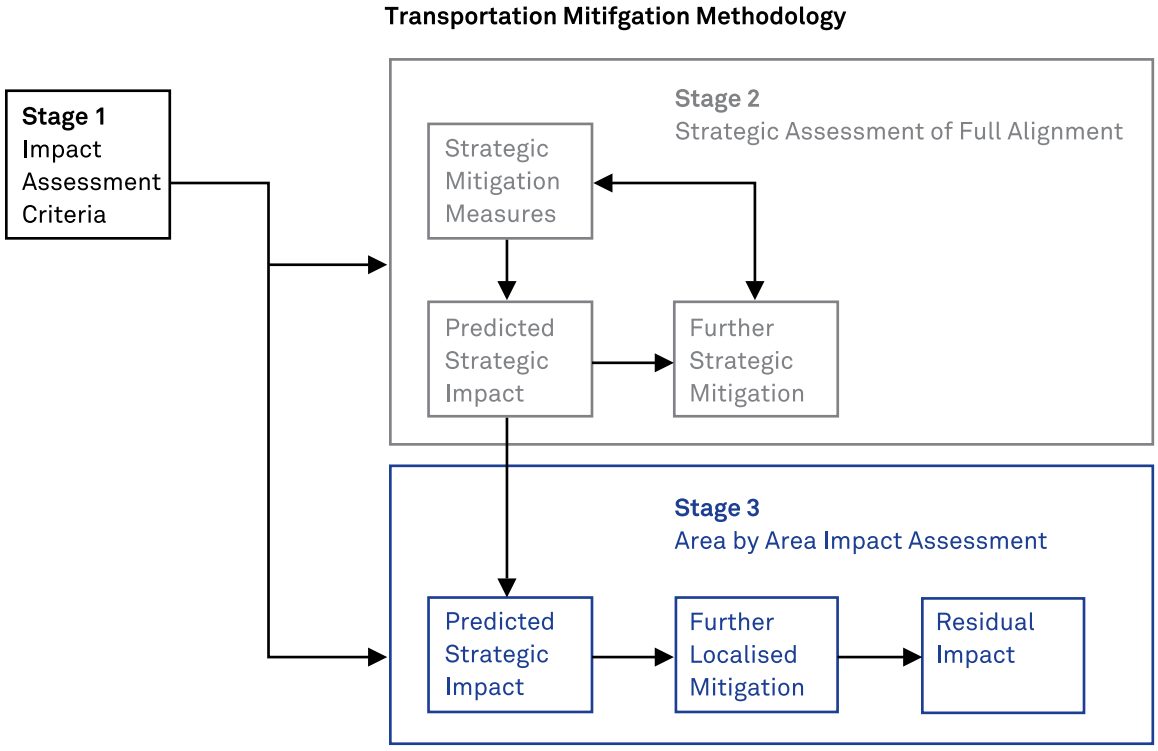


Figure 7.1 Transportation impact assessment process

7.2 IMPACT ASSESSSMENT CRITERIA

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

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

7.2.1 Data sources

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

7.2.1.1 Traffic data (vehicle flows)

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

7.2.1.2 Accident data

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

7.2.2 General assessment criteria used for the transport assessment

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

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

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

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

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

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

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

7.2.3 Categorisation of effects

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

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

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

Table 7.1 Categorisation of impact significance[1]

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

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

7.2.4 Determination of impact significance on vehicular traffic

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

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

Table 7.2 further outlines the criteria for classifying the impact of increases in traffic flows.

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

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

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

7.2.5 Determination of impact significance on driver delay

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

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

7.2.6 Determination of impact significance on pedestrians and cyclists

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

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

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

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

The significance rating of pedestrian and cyclist impact is primarily determined by reference to Table 7.3.

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

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

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

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

7.2.7.1 Baseline environment

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

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

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

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

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

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

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

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

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

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

7.3 STRATEGIC MITIGATION METHODOLOGY

7.3.1 Introduction

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

7.3.1.1 Mitigation objectives

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

Light Metro Vehicles (LMVs) and HGV

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

Buses

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

Taxis

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

Pedestrians and cyclists

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

Emergency vehicles

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

Mobility impaired

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

7.3.1.2 Categorisation of mitigation measures

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

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

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

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

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

7.3.2 Strategic construction mitigation measures

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

7.3.2.1 Reduction measures (construction phase)

Reduction measures – general

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

Reduction measures – construction traffic

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

Reduction measures – general traffic

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

Reduction measures – pedestrians and cyclists

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

7.3.2.2 Remedial measures (construction phase)

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

Remedial measures – general

- Alternative arrangements will be provided if road closures are unavoidable i.e. diversions, signage strategies for access traffic and through traffic;
- The Dublin City Council urban traffic signal control system will be used to optimise the flow of traffic along the diversion routes to mitigate queuing and delay which would otherwise be expected during peak periods. This may affect the level of green time afforded to pedestrians;

- Agreement will be sought from the relevant road authority and An Garda Síochána for the introduction of stricter speed limits on roads adjacent to construction sites to ensure the safety of all road users:
    - 50kph speed limit in the city centre will be reduced to 30kph;
    - 80kph on all other routes will be reduced to 50kph.
- The public will be provided with advanced warning of any proposed diversions and disruption through:
    - Signage on site;
    - Continuous updates on construction progress on the project website and external media.
- Temporary reinstatement of road surfaces to facilitate pedestrians, cyclists and MIDs will be provided;
- There will be safety procedures and fencing around trenches at all times in order to ensure the safety of road users.

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

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

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

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

7.3.3 Strategic operational mitigation measures

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

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

7.3.3.1 Reduction measures (operational phase)

Reduction measures – pedestrians and cyclists
Subject to agreement of the relevant road authority and An Garda Síochána, where necessary, the following measures will be implemented:
- The number of pedestrian crossing facilities will be increased in the immediate vicinity of stops where appropriate;
- Sufficient pedestrian access between the drop-off points and the stops will be provided where appropriate;
- Suitable parking and storage facilities for bicycles will be provided in prominent locations at Stops and Park & Ride facilities for public use.

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

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

7.3.3.2 Remedial measures (operational phase)

Remedial measures – general traffic

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

Remedial measures – pedestrian and cyclists

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

7.4 PREDICTED STRATEGIC IMPACT

7.4.1 Introduction

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

7.4.2 Source of the predicted strategic impact

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

7.4.2.1 Construction phase

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

Each of the proposed scheme's construction sites will also generate substantial levels of spoil removal and construction vehicles which will impact on both the local and strategic road network. The cumulative impact of all the construction sites (and the associated number of construction vehicles generated) on traffic movement throughout the Dublin Area has been assessed. The routes proposed to facilitate construction vehicle activity are illustrated in Annex I of this EIS (Volume 3, Book 2 of 2). The proposed scheme Traffic Management Plan will examine the appropriate mitigation measures required to minimise their impact.

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

7.4.2.2 Operational phase

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

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

7.4.3 Assessment of the predicted strategic impact

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

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

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

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

7.4.3.1 Strategic traffic statistics for Greater Dublin Area

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

For general vehicular traffic assessment:

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

For bus movement assessment:

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

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

7.4.4 Predicted strategic construction impact

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

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

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

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

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

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

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

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

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

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

7.4.5 Predicted strategic operational impact

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

Tables 7.6 and 7.7 present the strategic impact of the proposed scheme during its operational phase for the assumed year of opening, 2014, and the forecast year, 2029. In 2014, the operational impact of the proposed scheme on the highway network would be very positive. The queuing, travel time and distance travelled statistics would all decrease substantially from the Do-minimum scenario. Queuing would decrease by over 21% with time spent travelling decreasing by over 9%. The time spent queuing as a proportion of overall travel time would decrease from 25% to 22% as a direct result of the proposed scheme. The average speed on the network would increase by 8% in 2014, or by 2kph.

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

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

Table 7.6 Strategic operational impact 2014 (AM peak hour)

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

Table 7.7 Strategic operational impact 2029 (AM peak hour)

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

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

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

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

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

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

7.4.6 Strategic traffic flow changes and re-distribution

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

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

7.4.6.1 Changes in traffic flow during construction of the proposed scheme

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

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

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

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

Figures 7.6 and 7.7 provide a more detailed view of traffic distribution changes in the city centre. Without the proposed mitigation measures there would be substantial reductions in traffic volumes on Dame Street, College Green, O'Connell Bridge, O'Connell Street and Nassau Street. There would be increases in northbound traffic on Patrick Street, High Street, Bridge Street, Church Street and on Tara Street. Southbound traffic increases would occur on Amiens Street, Talbot Memorial Bridge, City Quay, and Lombard Street. East west traffic movements on the north and south quays would also increase particularly on Georges Quay, Burgh Quay, Eden Quay and Custom House Quay.

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

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

7.4.6.2 Changes in traffic flow during operation of the proposed scheme

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

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

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

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

Figure 7.11 and 7.12 illustrate the impact on traffic flow and distribution in the city centre. Generally the impact of the proposed scheme within the city centre area in terms of reducing traffic flow would be positive. In 2029, the traffic flow changes and distribution results are similar to those of 2014. Figures 7.13 to 7.17 illustrate these changes from Swords to the city centre. The impact of the proposed scheme in 2029 would be positive in terms of reducing traffic flow within the catchment area.

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

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

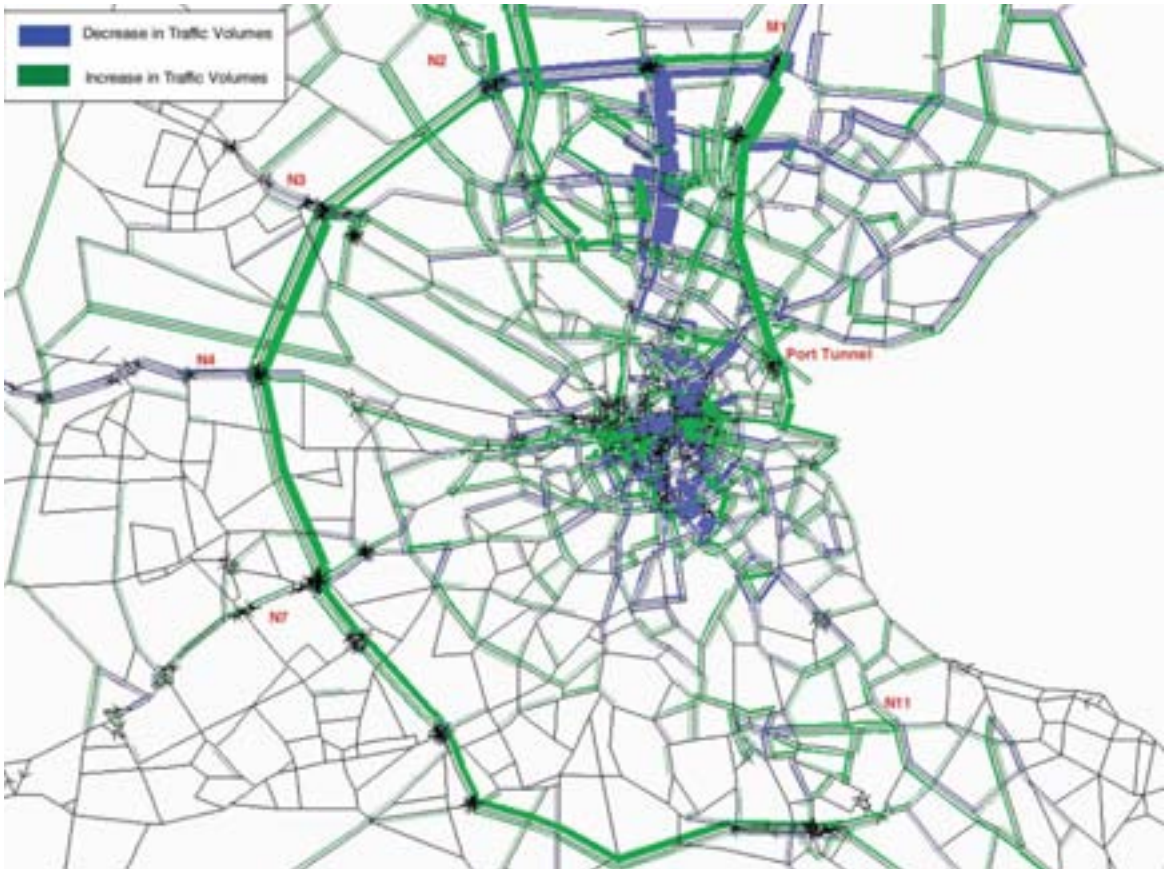


Figure 7.4
Traffic flow changes – do-minimum vs. do-something 2011 (city wide area)

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

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

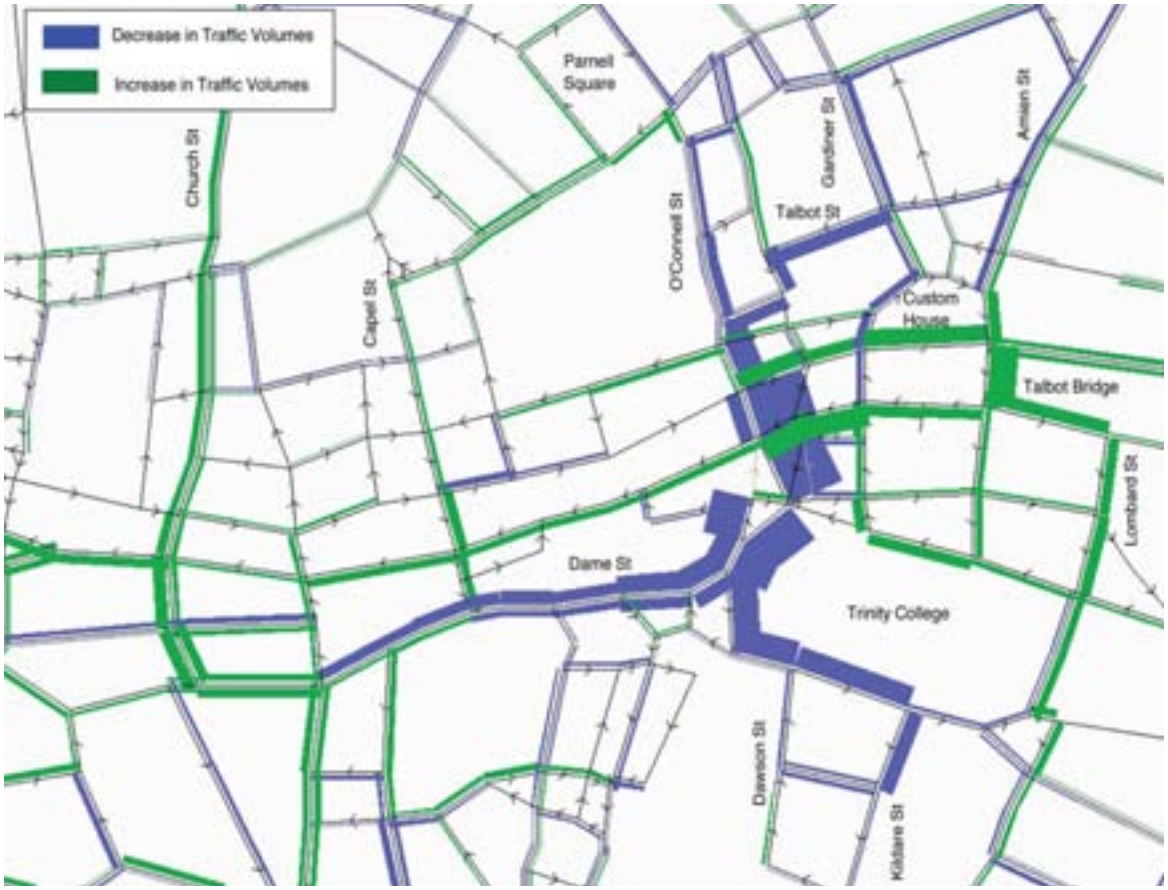


Figure 7.7
Traffic flow changes – do-minimum vs. do-something 2011 (core city area)

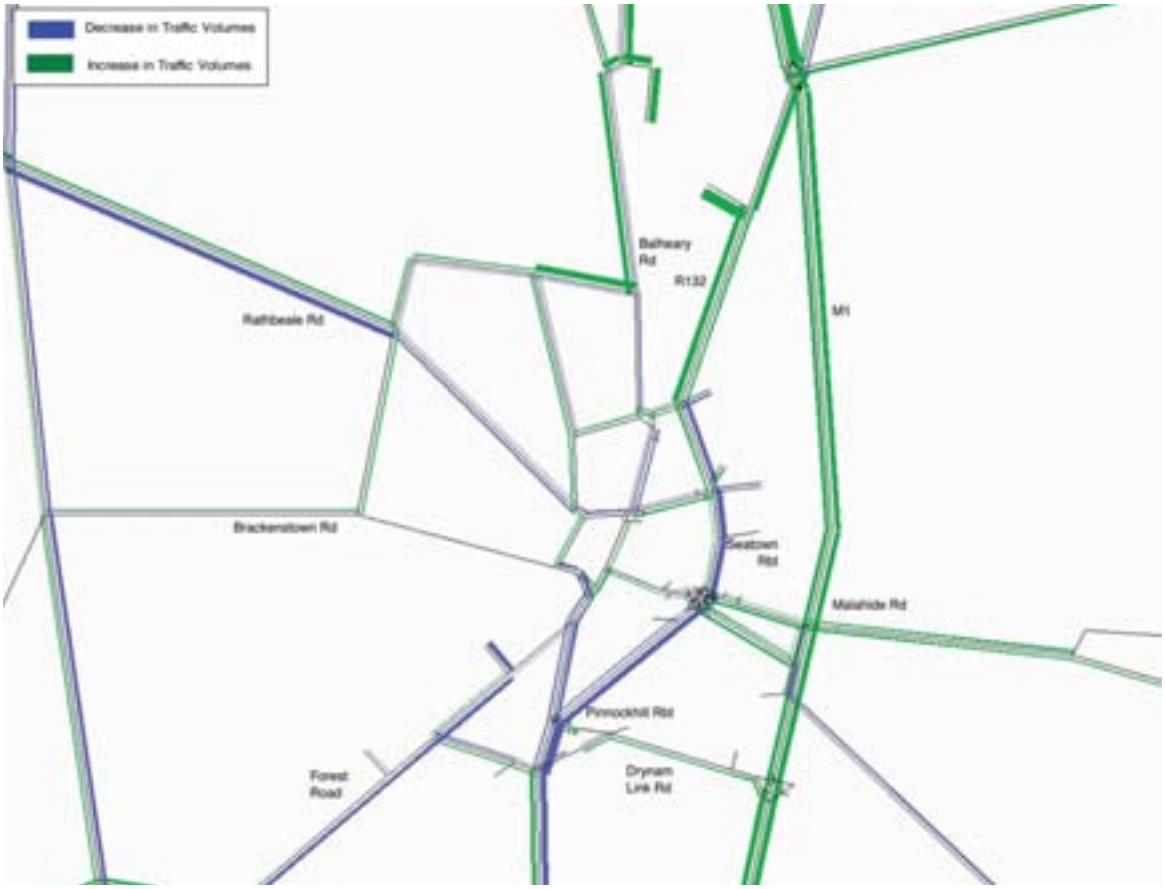


Figure 7.8 Traffic flow changes – do-minimum vs. do-something 2014 (Swords area)

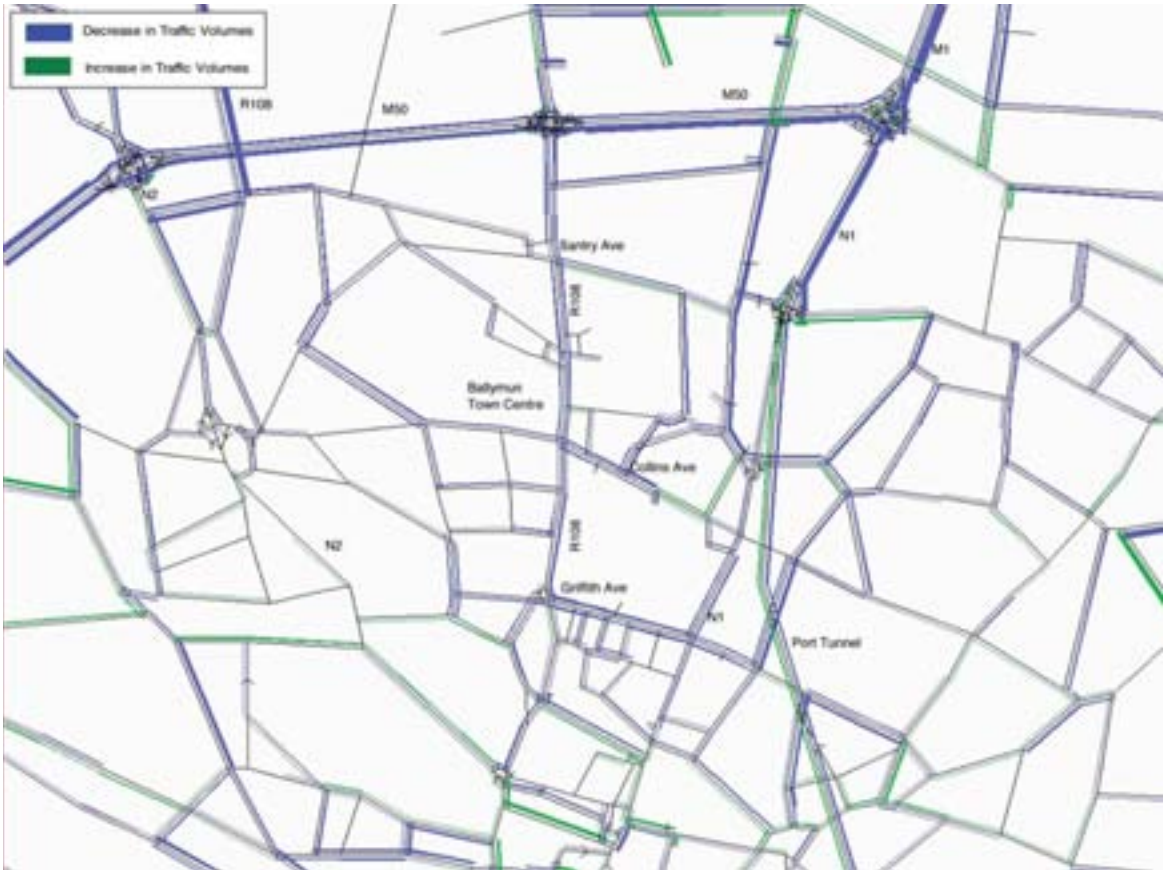


Figure 7.9 Traffic flow changes – do-minimum vs. do-something 2014 (Ballymun/ Glasnevin/ Finglas/ Drumcondra area)

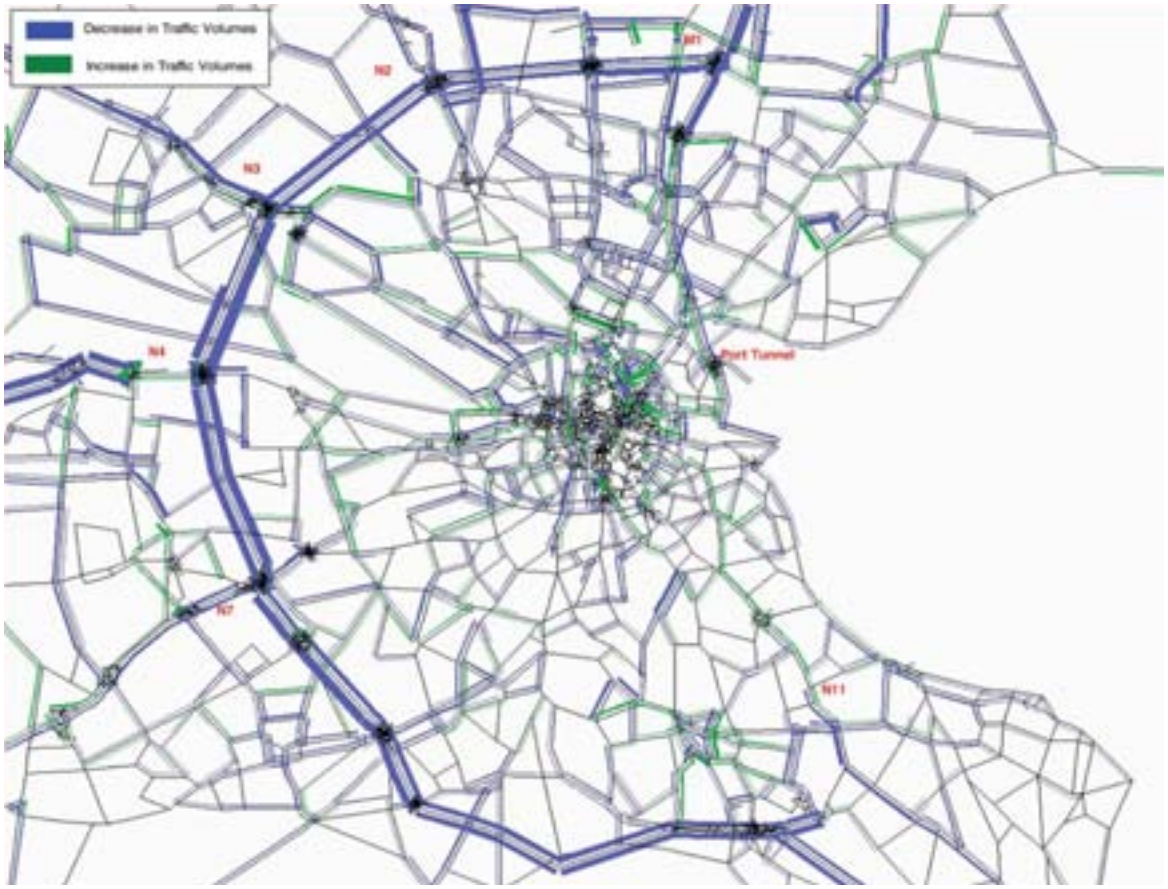


Figure 7.10
Traffic flow changes – do-minimum vs. do-something 2014 (city wide area)

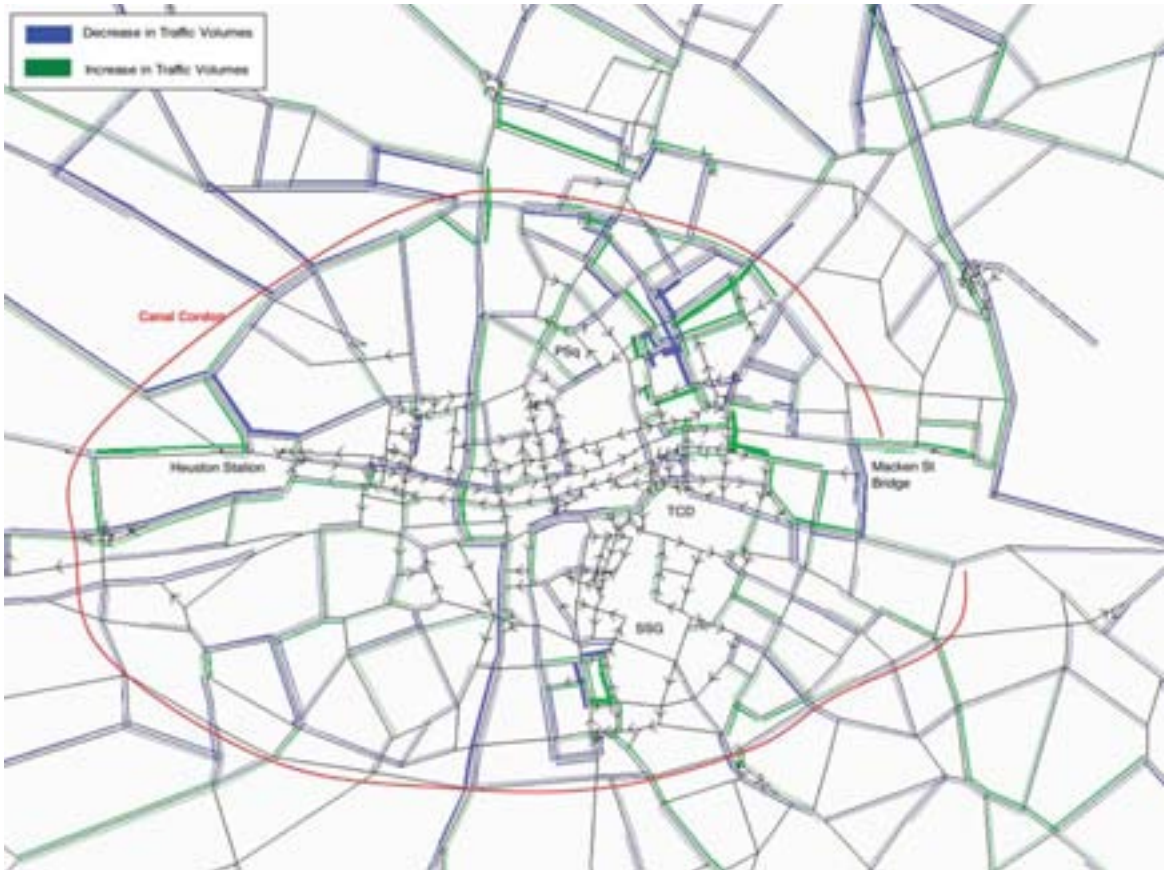


Figure 7.11
Traffic flow changes – do-minimum vs. do-something 2014 (city centre area)

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

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

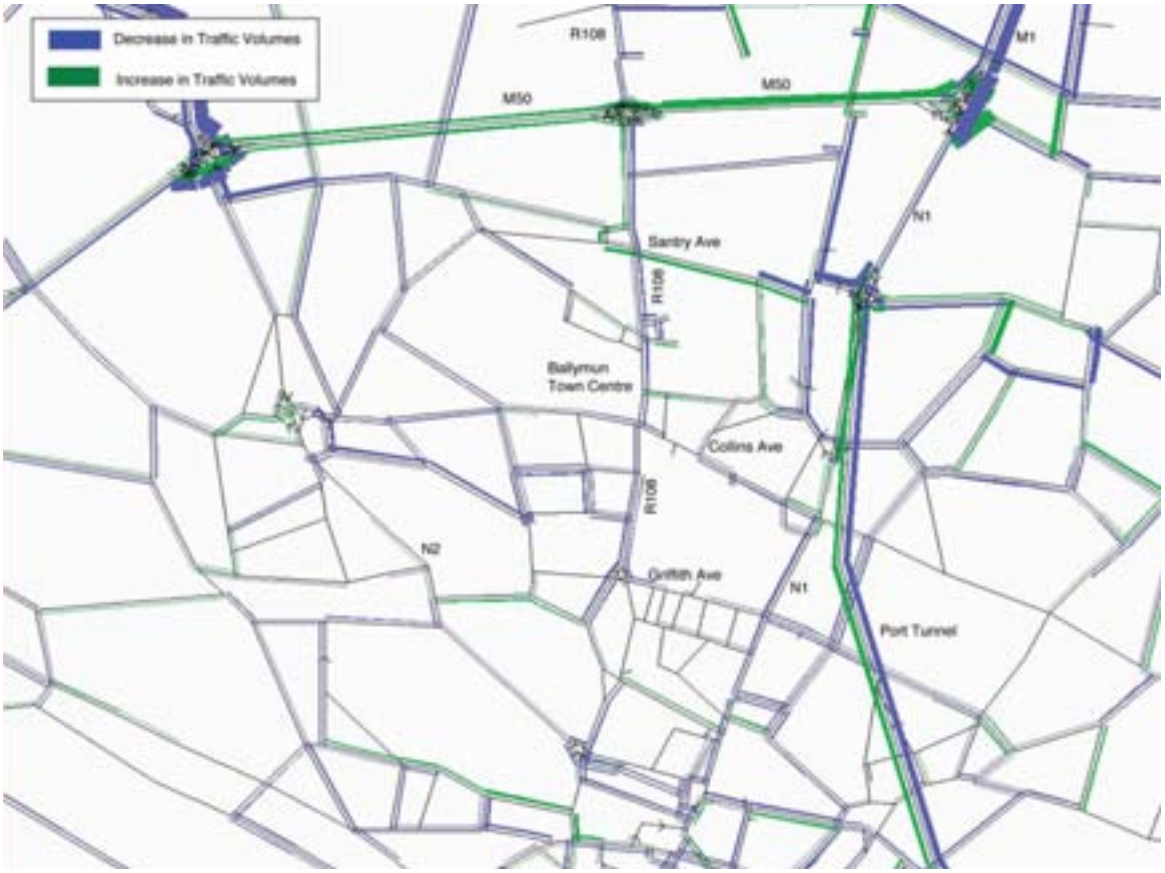


Figure 7.14
Traffic flow changes – do-minimum vs. do-something 2029 (Ballymun/ Glasnevin/ Finglas/ Drumcondra area)

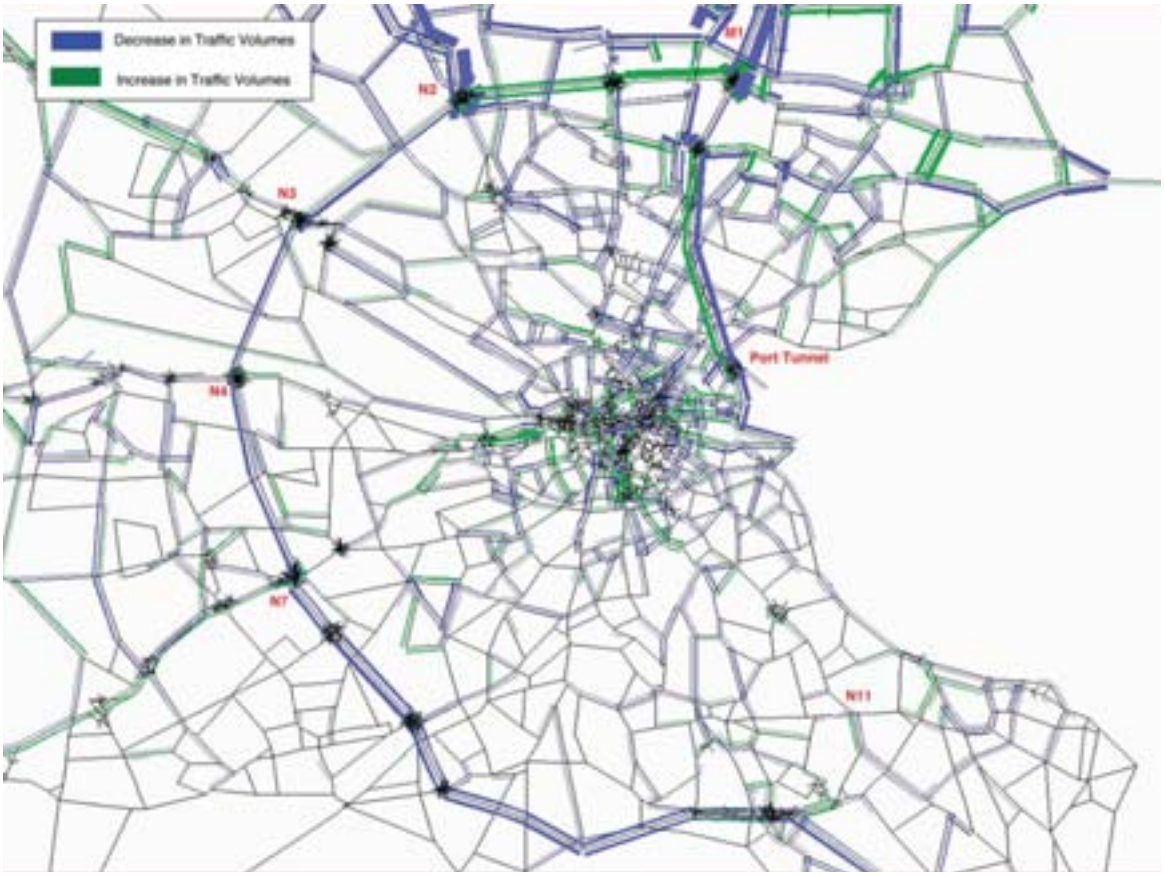


Figure 7.15
Traffic flow changes – do-minimum vs. do-something 2029 (city wide area)

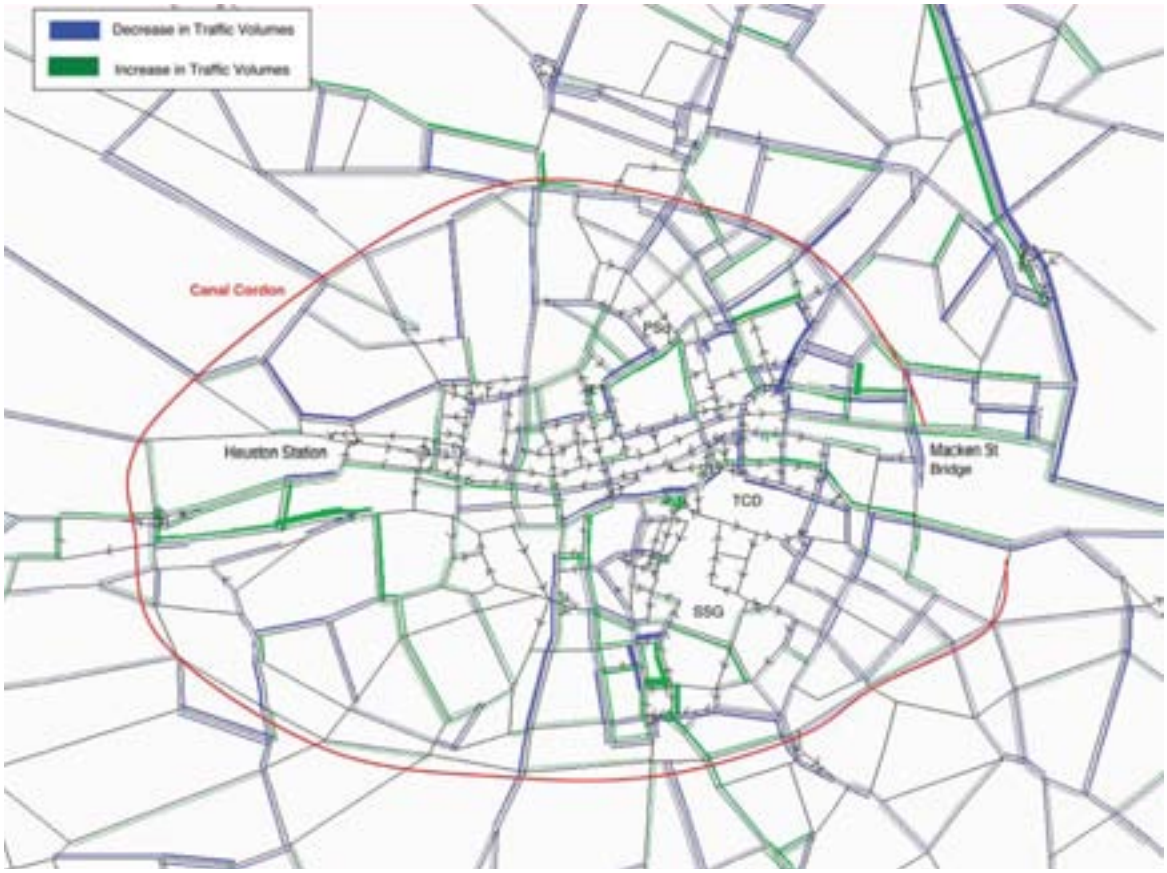


Figure 7.16 Traffic flow changes – do-minimum vs. do-something 2029 (city centre area)

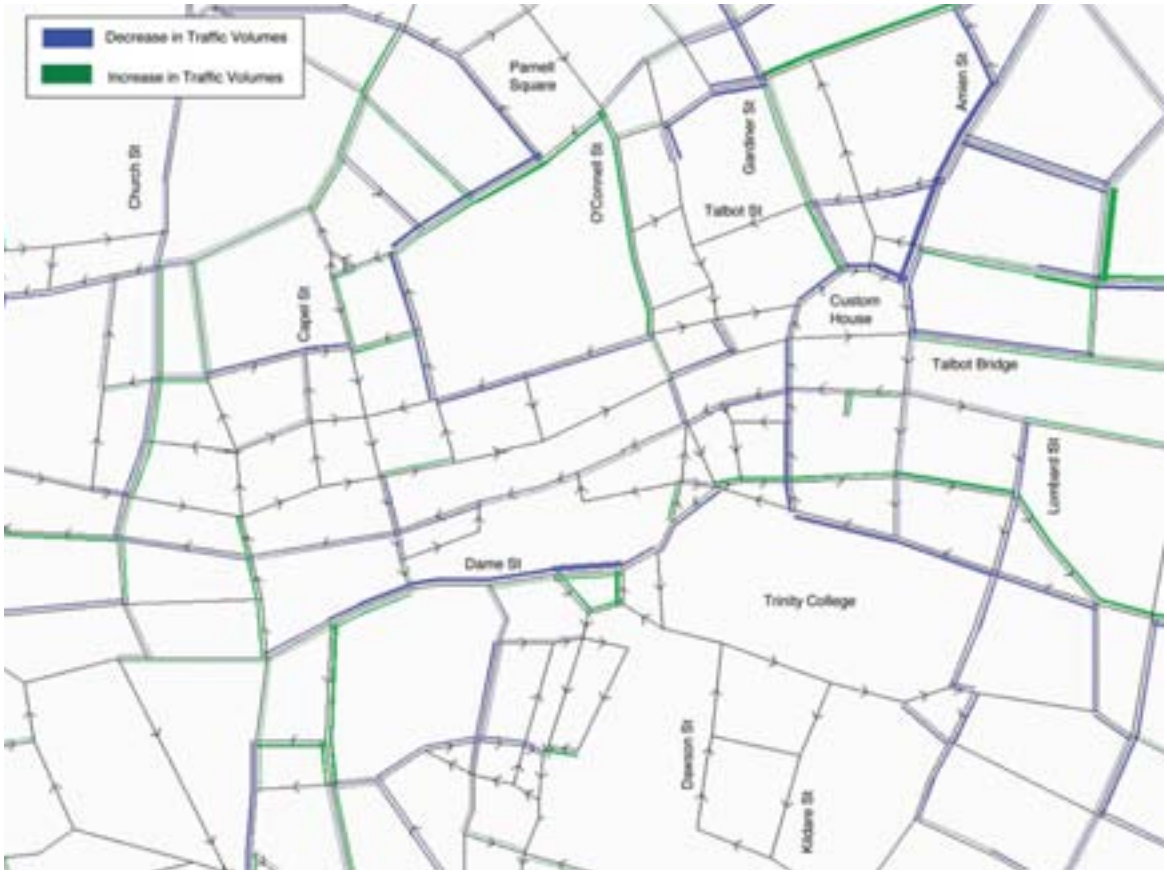


Figure 7.17 Traffic flow changes – do-minimum vs. do-something 2029 (core city area)

7.4.6.3 Journey time and speed changes along key routes

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

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

7.4.6.4 Predicted construction impact on traffic flow

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

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

7.4.6.5 Predicted operational impact on traffic flow

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

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

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

Route	2011 AM Peak Do-minimum (Minutes)	2011 AM Peak Do-Something (Minutes)	% Change
Port Tunnel Northbound	09m 11s	08m 29s	-7.7%
Gardiner Street/ Baggott Street Southbound	16m 32s	17m 11s	3.9%
Baggott Street/ Gardiner Street Northbound	34m 04s	40m 54s	20.0%
Church Street/ Clanbrassil Street Southbound	30m 57s	36m 46s	18.8%
Clanbrassil Street/ Church Street Northbound	21m 40s	31m 40s	46.1%
North Quays – Heuston to O'Connell Bridge	15m 33s	17m 02s	9.5%
South Quays - O'Connell Bridge to Heuston	06m 42s	07m 54s	17.9%
South Quays – Georges Quay to O'Connell Bridge	14m 02s	08m 58s	-36.1%
North Quays – Heuston to North Wall Quay	22m 38s	24m 26s	8.0%
South Quays – Georges Quay to Heuston	22m 40s	17m 19s	-23.6%

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

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

Route	2014 AM Peak Do-minimum (Minutes)	2014 AM Peak Do-Something (Minutes)	% Change
Clanbrassil Street/ Church Street Northbound	18m 38s	17m 21s	-6.9%
North Quays – Heuston to O'Connell Bridge	18m 04s	17m 07s	-5.2%
South Quays - O'Connell Bridge to Heuston	06m 32s	06m 38s	1.5%
South Quays – Georges Quay to O'Connell Bridge	13m 23s	12m 44s	-4.8%
North Quays – Heuston to North Wall Quay	24m 56s	24m 08s	-3.2%
South Quays – Georges Quay to Heuston	21m 46s	21m 03s	-3.3%

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

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

7.4.7 Conclusions drawn from the strategic predicted impact assessment

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

7.4.7.1 Summary of the predicted construction impact

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

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

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

7.4.7.2 Summary of the predicted operational impact

The strategic impact of the proposed scheme during its operational phases would be very positive. The modal shift from car to the proposed scheme improves the average speed across the GDA by 2kph and 3kph in 2014 and 2029 respectively. Time spent queuing decreases, distance travelled decreases and also time spent travelling decreases. There are also improvements to bus speeds across the GDA. Journey time assessments on key routes further demonstrate the positive nature of the impact as the majority in both 2014 and 2029 show decreases.

7.5 STRATEGIC FURTHER MITIGATION

7.5.1 Introduction

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

7.5.2 Scheme Traffic Management Plan

Measures necessary to mitigate the negative effects of construction of the proposed scheme will be developed as the proposed scheme evolves to construction in consultation with key stakeholders such as the relevant roads authorities. These will be detailed in a Scheme Traffic Management Plan. This plan will prioritise pedestrian, cyclist, public transport and local access needs (for example, multi storey car parks, residential and commercial properties). Such an approach will minimise the impact of the construction phase on transport and business activities. To facilitate this, it will be important for the plan to divert through traffic away from key construction areas.

This plan is a framework document within which the necessary mitigation measures will be developed through the various stages of design and construction. This will detail the proposed programme of works, how appropriate access can be retained throughout the works and how the potential negative traffic impacts (including pedestrian and cyclist impacts) associated with operating a number of urban construction sites concurrently can be managed. Initially, this plan will be developed by RPA in consultation with the roads authority and other key stakeholders until the PPP contractor is appointed. Then the PPP contractor will continue to develop and implement the strategy throughout the construction phase. This plan will be reviewed on a regular basis during its implementation for its relevance and effectiveness.

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

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

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

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

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

7.5.3 Public transport operations

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

7.5.4 Corridor management strategies

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

7.5.5 Pedestrian management strategies

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

7.6 PREDICTED LOCAL CONSTRUCTION IMPACT – AREA MN101

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

7.6.1 Construction impact area

Three stops will be constructed within Area MN101 at Belinstown, Seatown and Swords. Preparatory works will also be undertaken for two additional stops at Lissenhall and Estuary which will be completed in the future as development in the area progresses. The most northerly stop will be located at Belinstown and provision will be made for a 2000 space multi-storey Park & Ride facility. All the stops within Area MN101 will be constructed at-grade.

The northern terminus of the proposed scheme will be located at Belinstown to the west of the M1. North of the Estuary Roundabout, the construction of the proposed scheme within Area MN101 will largely take place in green field areas. The most substantial impact in terms of transportation north of Estuary Roundabout will result from additional traffic generated by construction vehicle movements. Construction traffic will be confined to the new Depot Access Road, directly from a new signalised junction on the R132, just north of Estuary Roundabout. In addition, there will be localised impacts where new junctions are provided to connect Batter Lane to the Park & Ride site at Belinstown. There will be further local impacts associated with the widening of Batter Lane north of the depot, which is required to accommodate Park & Ride access traffic.

South of Estuary Roundabout, the alignment follows the route of the R132 within Area MN101. Various methods of construction will be employed depending on the alignment through Area MN101. Between and across the Estuary and Seatown Roundabouts, the proposed scheme will be on a viaduct. Many of the sections will be pre-cast so as to minimise construction duration and hence reduce construction impact on the local area.

The construction works at Estuary and Seatown Roundabouts will be complex requiring many different phases of traffic diversions. Night-time closures of carriageways at these junctions will be required to complete connections between phases. During some of the night-time closures, traffic will be diverted in temporary contra-flow lanes onto the opposite side of the road.

Without mitigation measures the construction of the proposed scheme will have a significant impact on traffic conditions within this Area, particularly along the R132 corridor. During the construction phase, the number of traffic lanes on the R132 will remain unaltered, i.e. two general traffic lanes in each direction. However, the existing hard shoulder will be removed. The existing bus lanes south of the Malahide Roundabout will be closed for the duration of construction in the area. In addition, major alterations will be made to the layout, configuration and operation of a number of junctions along the R132 within Area MN101.

The construction of the proposed scheme along the R132 will take place in a phased manner. From the current construction proposals, the critical phase for each junction and link along the alignment has been identified. This phase represents the worst case construction scenario for each junction. In this way, the most substantial impacts on traffic movement within the area can be assessed. The other construction phases assumed for each of the junctions will have less of an impact as more options for traffic movement are available.

The alterations that are likely to be made to the configuration of major junctions within Area MN101, during the construction phase, are described below.

7.6.1.1 Estuary Roundabout

The existing Estuary Roundabout will be re-configured as a four-arm signalised junction. The number and allocation of traffic lanes on approaches to the signalised crossing will vary during the construction period. The construction phase representing the largest impact in terms of lane restrictions for the revised junction is shown in Table 7.15.

Table 7.15 Construction changes to the road network at Estuary Roundabout

Traffic flow into junction	Existing number of approach lanes at junction	Remaining number of approach lanes at junction	Proposed lane configuration during construction
R132 – southbound	2	3	- One right-turn lane - One straight ahead lane - One shared straight ahead and left-turn lane
R132 – northbound	2	2 plus flare	- One right-turn flare lane - One straight ahead lane - One shared straight ahead and left-turn lane
Seatown West	2	1 plus flare plus slip lane	- One right-turn flare lane - One straight ahead lane - One left–turn slip lane
Estuary Road	2	1 plus flare plus slip lane	- One right-turn flare lane - One straight ahead lane - One left–turn slip lane

7.6.1.2 Seatown Roundabout

The existing Seatown Roundabout will be re-configured as a four-arm signalised junction. The number and allocation of traffic lanes on approaches to the signalised crossing will vary during the construction period. The construction phase representing the largest impact in terms of lane restrictions for the revised junction is shown in Table 7.16.

Table 7.16 Construction changes to the road network at Seatown Roundabout

Traffic flow into junction	Existing number of approach lanes at junction	Remaining number of approach lanes at junction	Proposed lane configuration during construction
R132 – southbound	2	3 plus slip lane	- One right-turn lane - Two straight ahead lanes - One left-turn slip lane
R132 – northbound	2	3 plus slip lane	- One right-turn lane - Two straight ahead lanes - One left-turn slip lane
Seatown Road	2	2	- One right-turn lane - One shared straight ahead and left-turn lane
Estuary Road	2	1 plus flare	- One right-turn flare lane - One shared straight ahead and left-turn lane

7.6.1.3 Malahide Roundabout

Throughout the construction period, the Malahide Roundabout will continue to operate as a signalised roundabout. The road links to and from the roundabout will be maintained and all existing traffic movements will be permitted. During particular phases, to facilitate the connection of construction works, there will be a need to alter the geometry of the roundabout by reducing the central radius. This may result in a relatively small reduction in the junction capacity. However, given that the construction of the proposed scheme at other locations is likely to result in a decrease in traffic flow along the R132, the alterations to the Malahide Roundabout will not have a noticeable impact.

7.6.2 Construction vehicle traffic and background HGV traffic flows

The modelled scenario is based on a worst case assumption of excavation and concreting operations taking place simultaneously at every work site throughout the proposed scheme. In practice, it is improbable that this scenario will materialise due to constraints on vehicle/ plant/ staff resources etc. Therefore the full impacts predicted below are very unlikely to materialise, in particular on routes serving multiple sites such as the M1 and R132.

Table 7.17 details the predicted construction traffic volumes within Area MN101 based on this worst case scenario without mitigation. In addition, the modelled results allow for the impact of the redistribution of background HGV traffic as a result of the overall traffic impact of the construction of the proposed scheme.

Table 7.17 Comparison of 2011 modelled heavy goods vehicle and construction vehicle traffic flows with and without the construction of the proposed scheme (AM peak hour flows 08:00 to 09:00)

Link	Direction	2011 Do-Minimum	2011 Do-Something	% Change
R132, north of Estuary Roundabout	North	45	80	78%
	South	40	85	113%
Seatown West	East	40	5	-88%
	West	10	20	100%
Estuary Road at Estuary Roundabout	East	10	10	0%
	West	10	10	0%
R132, between Estuary and Seatown Roundabouts	North	50	90	80%
	South	80	80	0%
Seatown Road	East	20	20	0%
	West	5	5	0%
Estuary Road at Seatown Roundabout	East	45	45	0%
	West	50	50	0%
R132, between Seatown and Malahide Roundabouts	North	60	90	50%
	South	110	100	-9%
Malahide Road, west of Malahide Roundabout	East	15	15	0%
	West	5	5	0%
Malahide Road, east of Malahide Roundabout	East	40	30	-25%
	West	15	20	33%
Drynam Road	East	35	35	0%
	West	15	30	100%
R132, between Malahide and Pinnock Hill Roundabouts	North	100	120	20%
	South	110	120	9%
M1, between Lissenhall and Drynam interchanges	North	260	450	73%
	South	250	420	68%

The construction of the Belinstown Depot will require a large volume of fill material. It is proposed that a large proportion of the spoil generated by the construction of the tunnel and underground works will be used as the fill material. This operation will generate additional traffic in the area as the spoil removal vehicles transport the fill material to Belinstown. The level of construction traffic will vary throughout the construction period, with the highest volumes of construction vehicle movements coinciding with the period of maximum impact of the R132 works. The primary access route for construction vehicles to and from Belinstown within Area MN101 is along the M1 and via the Lissenhall interchange, onto the R132 and into the depot site via the new Depot Access Road.

Table 7.17 shows that the volume of traffic on the M1 would increase substantially in both directions as a result of construction activity. With the modelled scenario, there would be a 71% increase in HGV and construction traffic on the M1 between the Lissenhall and Drynam interchanges arising from approximately 190 additional construction vehicle movements in each direction. The construction traffic associated with the construction works will be assigned to routes to and from the construction sites along the alignment. These routes were chosen to mitigate the impact of increases in HGV traffic in other areas. Consequently, construction related traffic from north of the Airport amounting to approximately 40 vehicles per hour will travel to the depot via the R132. It is assumed that all other construction related traffic from south of the Airport will be routed along the M1 and via the Lissenhall interchange. Without the mitigation measures the impact during the construction phase of additional traffic would be significant during peak hours, and measures to reduce this impact shall be identified in the Scheme Traffic Management Plan. The modelled results comprise peak construction vehicle movements and this high level of construction related traffic is very unlikely to materialise, in particular on routes serving multiple sites such as the M1 and R132.

Access to the Belinstown Depot requires a right-turn movement from the R132 south of the Lissenhall interchange, at a new signal controlled junction.

Traffic modelling indicates that, during the worst case scenario, there would be a general reduction in the level of background HGV traffic on the R132 as some existing non-construction traffic diverts onto alternative routes to avoid congestion. In particular, there would be a reduction in southbound background HGV movements on the R132 during the AM peak hour. The background HGV traffic would redistribute in a similar manner to general traffic patterns. Model results for this worst case scenario indicate increases of more than 30% in HGV traffic on the R129, Naul Road (the R108), Rathbeale Road, Brakenstown Road and a small number of other local roads. Although these increases are high in percentage terms, the increases would be small in real terms and represent an increase of the order of 15 HGVs an hour. One notable exception is the Rathbeale Road west of the junction with the Naul Road (R108) where two flows combine to result in approximately 40 additional HGV movements per hour westbound along the road.

Even with the worst case scenario modelled, the M1 within Area MN101, is a high capacity route, which will, in general, have sufficient capacity to cater for the high levels of construction traffic predicted. Consideration of the operation of individual junctions, and appropriate mitigation, such as limiting the numbers of construction vehicle movements on certain roads at certain times, shall be included in the Scheme Traffic Management Plan.

Given the conservative assumptions underpinning traffic modelling and the limited duration of construction works on the R132, it is considered that the likely impact on the area as a whole will be slight.

7.6.3 Construction phase impact on general traffic

As stated above, the modelled scenario is based on a worst case prediction of the impact of construction traffic movements within Area MN101. Table 7.18 illustrates the modelled traffic flows within Area MN101 for the construction year 2011, based on this assumption.

Table 7.18 Comparison of 2011 modelled car and light goods vehicle traffic flows with and without the construction of the proposed scheme (AM peak hour flows 08:00 to 09:00)

Link	Direction	2011 Do-Minimum	2011 Do-Something	% Change
R132, north of Estuary Roundabout	North	500	425	-15%
	South	1,340	1,450	8%
Seatown West	East	680	190	-72%
	West	570	400	-30%
Estuary Road at Estuary Roundabout	East	200	190	-5%
	West	150	110	-27%
R132, between Estuary and Seatown Roundabouts	North	880	610	-31%
	South	1,690	1,230	-27%
Seatown Road	East	370	360	-3%
	West	250	140	-44%
Estuary Road at Seatown Roundabout	East	470	460	-2%
	West	380	380	0%
R132, between Seatown and Malahide Roundabouts	North	1,020	690	-32%
	South	2,100	1,460	-30%
Malahide Road, west of Malahide Roundabout	East	300	400	33%
	West	150	170	13%
Malahide Road, east of Malahide Roundabout	East	1,020	1,040	2%
	West	230	370	61%
Drynam Road	East	570	570	0%
	West	260	350	35%
R132, between Malahide and Pinnock Hill Roundabouts	North	1,549	1,269	-18%
	South	1,356	1,098	-19%
M1, between Lissenhall and Drynam interchanges	North	1,538	1,255	-18%
	South	3,214	2,959	-8%

Without mitigation measures the volume of general traffic on the R132 would be reduced during construction of the proposed scheme. Traffic model results indicate that there is a considerable decrease in through traffic along the R132, accumulating a reduction of over 600 cars per hour heading southbound between the Seatown and Malahide Roundabout. The majority of this traffic originates in the towns north of Swords such as Donabate, Rush and Lusk. Analysis of the model results show that much of this traffic is destined for areas within the boundaries of the M50.

In the absence of the proposed scheme construction, this traffic generally uses Ballymun Road to access the city. Due to the reduction in traffic capacity on the Ballymun Road during the construction of the proposed scheme, the attractiveness of this route is substantially reduced. To the east, the Drumcondra Road is heavily trafficked both with and without construction impacts and does not represent a desirable alternative. Therefore, traffic redistributes westerly following a number of local roads in order to access the N2 corridor. Overall there is an increase in traffic on local roads to the west and south-west of Swords. During the AM peak period, model results indicate an increase in traffic volumes on Rathbeale Road and the R108, Naul Road due to the redistribution of through traffic.

Without mitigation, overall car speeds within Area MN101 would decrease from an average of 32kph in the do-minimum scenario to 27kph during construction of the proposed scheme. This represents a 14% decrease in car traffic speeds during the AM peak hour period. Given the duration of the construction works within Area MN101 as a result of the proposed scheme and the trip redistribution impacts and journey speed reduction the impact of construction on car traffic movement in the area is considered medium to severe.

Similarly, during off-peak hours average car speeds within Area MN101 would decrease from 58kph to 51kph. This equates to a decrease of 12% in car traffic speeds during the representative off-peak hour (14:00 to 15:00). Off-peak traffic speeds would be reduced by 7kph and the impact would be moderate. However, the residual speed would remain relatively high and the impact of reduced speed on journey time and driver stress would be moderate.

7.6.4 Construction phase impact on public transport

Bus is the main form of public transport currently available within Area MN101. There are relatively low volumes of bus services operating on the R132 north of the Malahide Roundabout, as the majority of bus services are routed to Swords village. Therefore the direct impact of the proposed scheme construction on bus services along this section of the R132 will be limited.

The closure of the existing bus lanes on the R132 to the south of the Malahide Roundabout will negatively impact on bus services along this section of the R132. This is likely to result in an increase in bus journey times.

Existing bus stops will be relocated to accommodate works in specific areas, however there will be no overall reduction in the number of bus stops along the R132.

Overall, the impact on bus in Area MN101 during the construction phase of the proposed scheme is classified as moderate.

7.6.5 Construction phase impact on pedestrians and cyclists

North of the Estuary Roundabout, there are very low levels of pedestrian crossing activity and little or no pedestrian infrastructure. Pedestrian movements north of the Estuary Roundabout will therefore experience only a slight impact as a result of the construction of the proposed scheme.

As part of the construction of the proposed scheme, the pedestrian bridges at Estuary Roundabout, Seatown Roundabout, Chapel Lane and Malahide Roundabout will be replaced by temporary at-grade signalised crossings. The location of the temporary crossings will vary as construction works progress and the different phases of construction are undertaken. The Chapel Lane and Malahide Roundabout bridges will be reconstructed while Estuary Roundabout and Seatown Roundabout will be ultimately be replaced by at-grade crossings.

The construction works will include the widening of the R132 south of Estuary Roundabout within Area MN101. During these works, it will be necessary to close existing footpaths in the vicinity of the works, and alternative routes will be provided. Enhanced pedestrian facilities will be provided as part of these works.

Measures will be implemented to maintain adequate levels of pedestrian safety through the construction period. Before removal of existing pedestrian bridges, at-grade signalised pedestrian crossings will be provided. Pedestrian diversions in all instances will be no greater than approximately 100m resulting in a slight negative impact on pedestrians.

Pedestrian access to and from existing or relocated bus stops will be maintained at all times during the hours of bus operation.

Overall the impact of the construction phase on pedestrians will be moderate.

There are very low volumes of cyclists within Area MN101 and therefore the impact on cyclists is unlikely to be significant. Cyclists will be affected by the same turning restrictions and junction reconfigurations as general traffic. To a certain extent, the reconfiguration of Estuary and Seatown Roundabout as signal controlled crossings will be beneficial to cyclists. However, cyclists will have to share a general traffic lane, which is not of sufficient width to accommodate the provision of a cycle track. Temporary road surfaces will be provided to meet required standards. Overall the impact on cyclists will be moderate.

7.7 PREDICTED LOCAL OPERATIONAL IMPACT - AREA MN101

7.7.1 Operational impact area

7.7.1.1 Network changes over the do-minimum scenario

During construction of the proposed scheme, improvements to the transport infrastructure and local road network in Area MN101 will be performed, as listed below:

- The R132/Swords Bypass will be realigned to provide 2 general traffic lanes and a continuous bus lane from the Malahide Roundabout to Estuary Roundabout;
- Estuary and Seatown Roundabouts will become four-arm signalised junctions;
- Traffic to and from the Belinstown Park & Ride site will be signed along two routes. The access route from the north, Batter Lane, will be improved. The route from the south will comprise a new road (referred to as the Depot Access Road) which will intersect with the R132 at a signalised junction.

It is intended that by 2029, the Swords Western Ring Road will be completed, and operational. It will be built to dual-carriageway standard, and will run along the southern border of the Park & Ride site. It is envisaged that a direct connection to the Park & Ride site will be provided so as to form a direct link to the R132 and the M1 motorway.

7.7.2 Operational phase impact on general traffic

The operation of the Park & Ride site will act as a localised trip attractor within the region north of Swords. It is anticipated that there will be approximately 1,400 vehicles accessing the Park & Ride site between 07:00 and 09:00 hours in 2014. This figure will rise to approximately 1,700 vehicles in 2029 as travel by public transport within Dublin City becomes more accessible through the provision of the Transport 21 public transport network.

Traffic generated by the Park & Ride facility will come mainly from three sources:

- Vehicles from towns and villages to the immediate east and north-east are likely to use the northern access route (Batter Lane) to access the Park & Ride site;
- Vehicles from further north will travel south on the M1, exit at the Lissenhall Interchange, continue south on the R132, and access the Park & Ride site via the Depot Access Road;
- Vehicles arriving from the south (Swords and its environs) will be signed to use the Depot Access Road.

By 2029, vehicles approaching from any direction may also avail of the Swords Western Ring Road to access the Park & Ride site.

The MNTM traffic model predicts that several hundred vehicles will exit the M1 at the Lissenhall Interchange to access the Park & Ride site, as described above. This will lead to minor increases in delay at the Interchange compared to the do-minimum scenario, however this will be offset by transfer from car to public transport due to the proposed scheme. In 2014, there will be a minimal increase in the delay, so the impact of the proposed scheme on the operation of Lissenhall Interchange will be slight. By 2029, however, the increase in background traffic volumes is predicted to have a substantial impact on the operating efficiency of the Lissenhall Interchange. By this time, the Swords Western Ring Road will substantially reduce the impact of Park & Ride traffic on the interchange.

The local road network providing access to the Belinstown Park & Ride site will experience an increase in traffic volumes. This leads to a slight drop in average speed in this area due to the additional vehicles. Overall, the additional traffic will likely have a moderate impact on the local road network during the operation of the proposed scheme.

By 2029, it is anticipated that approximately 50% of the traffic from the north and east will arrive at the Park & Ride via the Swords Western Ring Road. This will ease congestion on the local access roads, providing a positive impact on the locality.

Table 7.19 presents the traffic flows extracted from the MNTM for cars and light goods vehicles during the operational phase of the proposed scheme for 2014 and 2029. South of Estuary junction, within the environs of Swords town centre, there will be a noticeable decrease in traffic volumes along the R132. This is a direct result of the modal shift from car to the proposed scheme.

Westbound movements through Seatown junction and Malahide Roundabout show slight increases in traffic volumes as drivers access Swords town centre. This may be primarily composed of car drop-offs from the eastern residential developments to the Estuary and Swords Stops. This movement is more pronounced in 2029 than in 2014 due to general background growth in the intervening period.

There will be car drop-off/ pick-up spaces located on each side of the road, in close proximity to a pedestrian crossing that will provide access to the stops. There will be provision for approximately two cars to park on each side of the road.

There may be some localised increases in traffic volumes around each stop associated with car drop offs and bus interchange. Given the transfer from car to public transport, the predicted impact is assumed to be neutral.

Comparison between the AM peak do-minimum and do-something scenarios reveals only marginal changes in traffic speed, and thus journey times, through Area MN101. In 2014, the do-minimum average speed is 35kph, which increases to 36kph with the proposed scheme in place. However, in 2029, there is a slight decrease of 1kph from the do-minimum speed of 31kph, to 30kph with the proposed scheme in place. The predicted impact in the AM peak period, therefore, is assumed to be neutral.

Comparison between the off-peak do-minimum and do-something scenarios reveals marginal increases in the average network car speed within Area MN101. In 2014, the do-minimum average speed is 57kph, which increases to 58kph with the proposed scheme in place. Similarly, in 2029, the do-minimum speed is 42kph, which increases to 43kph with the proposed scheme in place. Thus, the presence of the proposed scheme will also have a slight positive impact on off-peak journey times.

With respect to Batter Lane, the existing two-way peak hour (08:00 to 09:00hrs) traffic flow has been observed to be 250 vehicles per hour. It is anticipated that this will increase to approximately 500 vehicles per hour in 2014, post completion of the proposed scheme, as a result of traffic accessing the Park & Ride at Belinstown. Batter Lane will be improved to accommodate this additional traffic flow. The completion of the Swords Western Ring Road will improve traffic conditions generally in Swords, and also on Batter Lane.

Table 7.20 presents the traffic flows extracted from the MNTM for heavy goods vehicles during the operational phase of the proposed scheme for 2014 and 2029. The predominant change in HGV movements will be a redistribution of westbound vehicles from Estuary and Seatown junctions to the Malahide Roundabout. However, all modelled changes in HGV volumes are less than ten vehicles per hour, and the predicted impact, therefore, is assumed to be slight.

Table 7.19 Changes in car and light goods vehicle traffic volumes due to the operation of the proposed scheme, as modelled for the years 2014 and 2029 (AM peak hour flows 08:00 to 09:00).

		2014 Cars and LGVs			2029 Cars and LGVs		
Link	Direction of traffic flow	Do-Minimum	Do-Something	% Change	Do-Minimum	Do-Something	% Change
R132, north of Estuary Roundabout	Northbound	850	980	15%	870	1,130	30%
	Southbound	1,280	1,310	2%	1,170	1,330	14%
Seatown West	Eastbound	820	830	1%	840	910	8%
	Westbound	600	610	2%	750	620	-17%
Estuary Road at Estuary Roundabout	Eastbound	200	200	0%	210	210	0%
	Westbound	150	100	-33%	250	130	-48%
R132, between Estuary and Seatown Roundabouts	Northbound	1,130	1,160	3%	1,210	1,220	1%
	Southbound	1,640	1,530	-7%	1,600	1,570	-2%
Seatown Road	Eastbound	380	360	-5%	590	560	-5%
	Westbound	210	260	24%	140	230	64%
Estuary Road at Seatown Roundabout	Eastbound	510	490	-4%	590	600	2%
	Westbound	390	390	0%	390	390	0%
R132, between Seatown and Malahide Roundabouts	Northbound	1,300	1,300	0%	1,240	1,230	-1%
	Southbound	2,090	1,940	-7%	2,130	1,960	-8%
Malahide Road, west of Malahide Roundabout	Eastbound	300	290	-3%	370	340	-8%
	Westbound	200	210	5%	210	270	29%
Malahide Road, east of Malahide Roundabout	Eastbound	830	850	2%	920	970	5%
	Westbound	200	250	25%	200	270	35%
Drynam Road	Eastbound	320	370	16%	320	420	31%
	Westbound	180	270	50%	160	250	56%
R132, between Malahide and Pinnock Hill Roundabouts	Northbound	1,650	1,600	-3%	1,610	1,560	-3%
	Southbound	1,480	1,350	-9%	1,470	1,200	-18%
M1, between Lissenhall and Drynam interchanges	Northbound	1,520	1,560	3%	1,250	1,210	-3%
	Southbound	3,130	3,240	4%	2,820	2,770	-2%

Table 7.20 Changes in heavy goods vehicle traffic volumes due to the operation of the proposed scheme, as modelled for the years 2014 and 2029 (AM peak hour flows 08:00 to 09:00).

		2014 Cars and LGVs			2029 Cars and LGVs		
Link	Direction of traffic flow	Do-Minimum	Do-Something	% Change	Do-Minimum	Do-Something	% Change
R132, north of Estuary Roundabout	Northbound	55	60	9%	75	70	-7%
	Southbound	55	60	9%	20	35	75%
Seatown West	Eastbound	50	50	0%	90	65	-28%
	Westbound	10	15	50%	20	20	0%
Estuary Road at Estuary Roundabout	Eastbound	10	10	0%	15	15	0%
	Westbound	10	5	-50%	15	10	-33%
R132, between Estuary and Seatown Roundabouts	Northbound	60	70	17%	85	85	0%
	Southbound	90	90	0%	95	80	-16%
Seatown Road	Eastbound	10	10	0%	10	10	0%
	Westbound	0	0	N/A	0	0	N/A
Estuary Road at Seatown Roundabout	Eastbound	50	50	0%	70	70	0%
	Westbound	60	60	0%	85	85	0%
R132, between Seatown and Malahide Roundabouts	Northbound	65	70	8%	80	80	0%
	Southbound	130	130	0%	125	115	-8%
Malahide Road, west of Malahide Roundabout	Eastbound	20	10	-50%	20	25	25%
	Westbound	10	15	50%	10	15	50%
Malahide Road, east of Malahide Roundabout	Eastbound	30	30	0%	45	40	-11%
	Westbound	15	20	33%	15	20	33%
Drynam Road	Eastbound	25	20	-20%	25	35	40%
	Westbound	15	15	0%	15	20	33%
R132, between Malahide and Pinnock Hill Roundabouts	Northbound	85	90	6%	100	100	0%
	Southbound	125	125	0%	115	105	-9%
M1, between Lissenhall oand Drynam interchanges	Northbound	270	285	6%	310	320	3%
	Southbound	245	250	2%	315	340	8%

7.7.3 Operational impact on public transport

The proposed scheme will have a substantial positive impact on the level of bus priority in Area MN101, where the bus lanes will be extended from the Malahide Roundabout to Estuary Roundabout.

Bus Interchange facilities will also be provided to accommodate feeder bus services. The bus stops will be located in close proximity to the pedestrian crossings at the above stops to facilitate interchange. Pedestrian access to these bus stops will be markedly improved over the current situation, as new footpaths will be provided during road realignment.

7.7.4 Operational impact on pedestrians and cyclists

The Seatown Stop will be located in the central median of the R132/Swords Bypass, and will serve residential areas to the north and south of this Stop, the Swords Business Park immediately to the east, local schools and churches. Swords Main Street is also located within a ten minute walk of this stop, via Chapel Lane.

The Swords Stop will be located in the central median of the R132/Swords Bypass opposite the Pavilions Shopping Centre and will serve local residential areas and the proposed development lands within the area.

The presence of the proposed scheme will have a positive impact on pedestrians in Area MN101, where the pedestrian network will be improved by:

- The extension of footpaths from Pinnock Hill Roundabout to Estuary Roundabout, along the full length of both sides of the R132;
- The widening of the Chapel Lane and Malahide footbridges across the realigned R132;
- The replacement of the footbridge at Seatown and Estuary Roundabouts, by pedestrian facilities at the signalised junctions;
- The creation of at-grade signalised pedestrian crossings of the R132 at either end of the platforms to provide access to the Seatown and Swords Stops;
- The creation of a footpath along the Depot Access Road;
- The creation of a footpath along Batter Lane.

The extension of footpaths along the R132 provides significantly improved ease of movement in a north-south direction. Similarly, the increased number of pedestrian crossings at the junctions and Stop platforms reduces severance in an east-west direction.

These improvements aid pedestrian movement to and from Swords Town Centre and the Pavilions Shopping Centre to the west, and the residential areas and local Business Parks to the east of the R132. The platforms are also readily accessible to pedestrians, by use of the adjoining signalised pedestrian crossings at either end of the platform.

Pedestrian security on the platforms will be enhanced by good lighting facilities and CCTV surveillance. Those with reduced mobility are provided for by compliance with the DETR Guidelines and the Disability Act 2005. The following infrastructure at all at-grade stops:

- Tactile paving at the controlled crossings;
- Ramps for access to the platform;
- All stop furniture being aligned against the rear of the platform or as a centre island on the platform, maximising the effective platform width;
- Public address system;
- Electronic passenger information display boards.

The reduction in traffic volumes and the provision of new controlled pedestrian crossings will make it easier for pedestrians to cross the R132, thus reducing severance in Swords. These features, in conjunction with the reduced speed limit will also create a safer pedestrian environment. Overall, the presence of the proposed scheme will have a positive impact on pedestrians in Area MN101.

The proposed scheme will deliver some improvement of cycle facilities along the R132 in Area MN101, both in terms of continuous bus/cycle lanes and of junction layout. The Seatown and Estuary Roundabouts will be replaced by signalised junctions that are easier for cyclists to navigate. These improvements will encourage increased cycle usage along the route and covered cycle storage will be provided at all the stops.

7.8 RESIDUAL LOCAL IMPACT – AREA MN101

The predicted local impact of the proposed scheme during both the construction and operational phases is detailed in the previous sections. These impacts can be mitigated by introducing further mitigation measures at the local level, as detailed below. Finally, the residual local impacts which remain after the introduction of these measures are shown in Table 7.21.

7.8.1 Further local mitigation measures

7.8.1.1 General traffic and HGV mitigation measures

- The realignment and widening of the R132 will take place at an early stage in the construction programme so that traffic can be diverted onto the new carriageway during the remainder of the construction period;
- The new Depot Access Road and its traffic signal controlled junction with the R132 will be constructed at an early stage in the construction programme to facilitate the movement of construction traffic;
- A reduced speed limit of 50kph will be imposed on the R132 in order to ensure the safety of all road users during the construction phase;
- Where appropriate, construction work requiring short term disruption and road closures, will be carried out when traffic volumes are lower, such as:
  - at night;
  - at weekends;
  - during school holidays.
- The hours of operation of construction vehicles accessing/egressing the sites will be controlled in Area MN101. This will mitigate against the impact of construction vehicle traffic on local residential areas;
- On contract award the Contractor will further develop construction vehicle routing arrangements in line with project programme and the evolving construction methodology. The Scheme Traffic Management Plan will be updated to reflect this.

7.8.1.2 Pedestrian and cyclist mitigation measures

- Temporary pedestrian crossings will be installed, where appropriate, in order to reduce severance of pedestrian movements during construction;
- Temporary pathways will be installed where appropriate to replicate existing pedestrian infrastructure and to facilitate pedestrian movements to and from relocated bus stops.

7.8.2 Residual local construction impact

The localised impacts resulting from the proposed scheme construction in Area MN101 have been described above. By applying the further local mitigation measures, the severity of these impacts will be significantly reduced, as outlined in the Table 7.21 below.

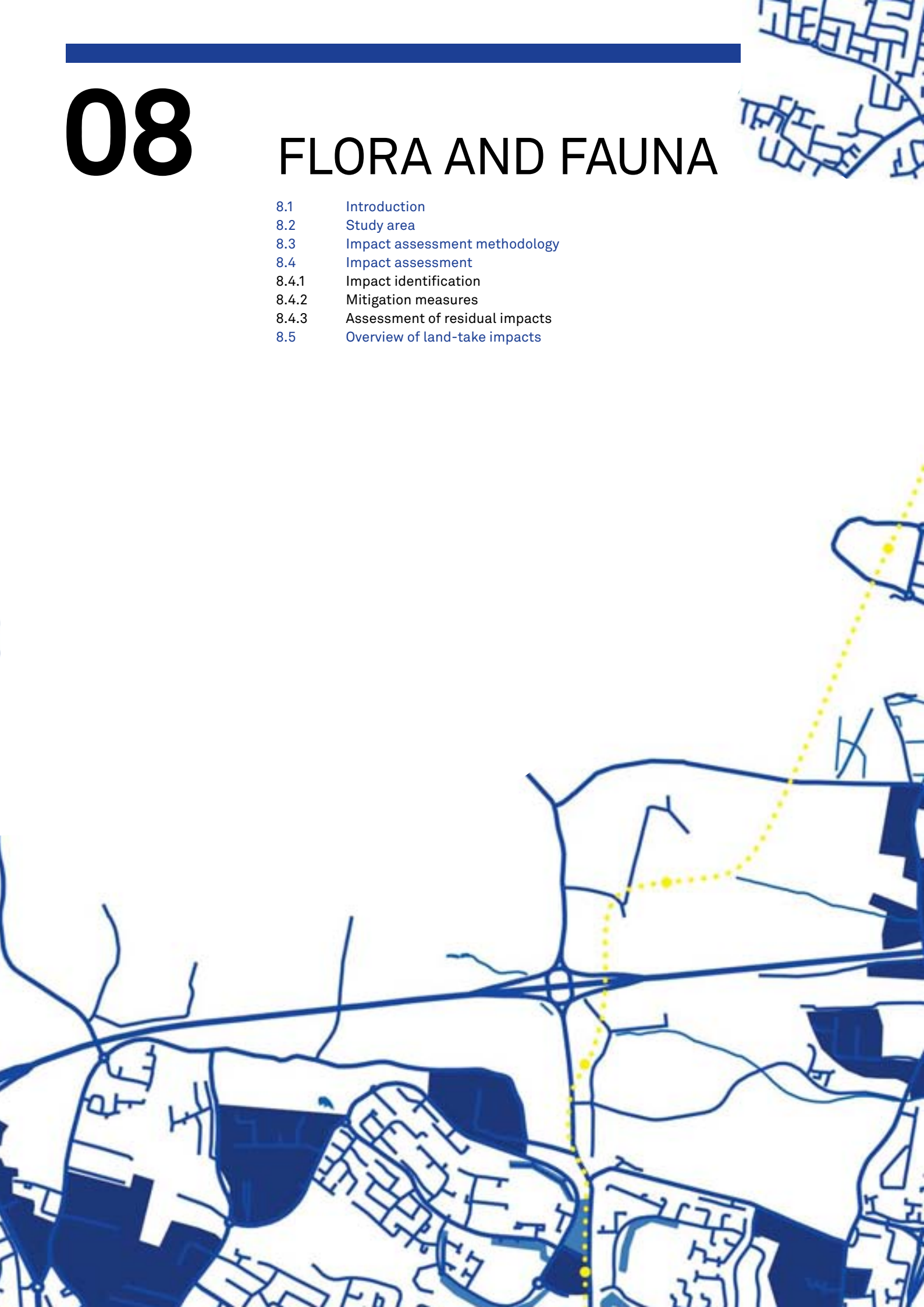
7.8.3 Residual local operational impact

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

Table 7.21 Construction impact, further mitigation, and residual local impacts

Impact ID	Location	Source of impact	Description of local impact	Strategic mitigation measures	Possible further local mitigation	Residual local impact
MN101/T01	Access to Belinstown Depot	Congestion due to construction vehicles accessing depot.	The new southern access road to the Belinstown Park & Ride requires a right-turn movement from the R132 south of the Lissenhall interchange. Without signals, this would negatively impact on the efficient and safe operation of this junction.	Phasing and sequencing of construction works.	Introduction of traffic signal control at this junction early in the construction programme will optimise traffic flow through the junction.	The residual impact will be slight and will be minimised by optimisation of the signal operation.
MN101/T02	R132 and M1	Additional construction vehicle traffic on the network.	There will be substantial levels of construction vehicle traffic on the R132 and the M1 as a result of the construction of the proposed scheme.	Phasing and sequencing of construction works.	The Scheme Traffic Management Plan will address or identify an appropriate phasing schedule for construction vehicle activities and construction works areas.	The residual impact will be moderate post introduction of mitigation.
MN101/T03	Throughout Area MN101	Reduction in traffic capacity due to lane closures and restrictions.	Without further mitigation there would be a decrease from 32kph in the do-minimum scenario to 27kph during the construction of the proposed scheme within Area MN101. This represents a 14% decrease in car traffic speeds during the AM peak hour period and a relative change of 5kph.	Phasing and sequencing of construction works.	The Scheme Traffic Management Plan will detail a comprehensive construction phasing plan to ensure that all critical phases do not coincide and that the impact is minimised.	The residual impact will be moderate post introduction of mitigation.

08 FLORA AND FAUNA



This chapter of the EIS describes the potential impacts on flora and fauna, which may arise due to activities associated with the construction and operation of the proposed scheme in Area MN101.

8.1 INTRODUCTION

This chapter of the EIS describes the potential impacts on flora and fauna, which may arise due to activities associated with the construction and operation of the proposed scheme in Area MN101.

8.2 STUDY AREA

The study area comprises any area within 500m of the centre line of the proposed alignment. This study area extends to up to 1km from the proposed alignment if species or habitats of particular interest are found to occur. The study area for designated sites comprises all areas within 10km of the centre line of the proposed alignment. Within this study area, a number of individual detailed faunal surveys have been carried out and the extent of the study area for each of these detailed faunal surveys is primarily influenced by faunal mobility. The study area for individual aspects of this environmental topic as set out in Table 8.1.

Table 8.1 Study area

Environmental aspect	Habitats to be surveyed	Width of study area (on both sides of the alignment)
Designated Sites*	Special Areas of Conservation (SAC), Special Protection Areas (SPA), Natural Heritage Areas (NHA), Nature Reserves, Ramsar Sites, National Parks, Refuge for Fauna	10km
Badger	Woodland habitats and hedgerows	500m
Otter	Rivers and streams in the area of above ground sections of the alignment	500m
Bats	Man-made structures (buildings, bridges and culverts) and aquatic habitats including rivers, streams and still water habitats associated with hedgerows, scrub woodlands etc.	500m
Birds	Suitable habitats for birds as identified during the Phase 1 Habitat Survey. Specific survey to record flight heights of wintering birds in the area of the Broad Meadow Swords SPA	500m
Amphibians	Specific aquatic habitats identified during the Phase I Habitat Survey as having a high potential to provide amphibian habitat e.g. lakes, ponds, rivers	500m
Habitats Phase I	All accessible habitats	500m

* Designated sites comprise those designated under national legislation, EU directives and other international conventions.

The majority of habitat complexes in Area MN101 are of low to moderate local value to Functional Value (very low to low functional value). The main habitat complexes of importance crossed by the route are the Broad Meadow and Ward Rivers which flow into the Broad Meadow/Swords/Malahide Estuary, an area of international importance which lies to the east of the proposed scheme.

8.3 IMPACT ASSESSMENT METHODOLOGY

The impact assessment methodology is described in Section 8.3 and the potential impacts are described in Section 8.4.1. Mitigation measures to be implemented are listed in Section 8.4.2. These measures are designed to reduce the adverse impacts that are deemed to be significant at a given geographical level. The residual impacts are reported in Section 8.4.3.

The potential for ecological and nature conservation impacts has been assessed in the light of the habitats and species that are likely to be affected by the proposed scheme taking into account the latest 'Guidelines for Ecological Impact Assessment in the United Kingdom' published by the Institute of Ecology and Environmental Management (IEEM, 2006), the 'Guidelines for the Assessment of Ecological Impacts of National Road Schemes' (National Roads Authority, 2006) and the relevant EPA guidance and advice with respect to EISs (EPA, 2002, 2003).

As part of the assessment the significance of potential ecological impacts has been evaluated taking into account the following factors:

- The magnitude of both positive and negative effects, as determined by intensity, frequency and by the effect extent in space and time;
- The vulnerability of the habitat or species to the changes likely to arise from the proposed scheme;
- The ability of the habitat, species or ecosystem to recover, considering both fragility and resilience;
- The viability of component ecological elements and the integrity of ecosystem function, processes and favourable condition;
- Value within a defined geographic frame of reference (national, regional or district);
- The biodiversity value of affected species, populations, communities, habitats and ecosystems, considering aspects such as rarity, distinct sub-populations of a species, habitat diversity and connectivity, species-rich assemblages, and species distribution and extent;
- Designated site and protected species status, and Priority Biodiversity Action Plan (BAP) or Habitat Action Plan (HAP) status.

Significance is determined through consideration of these criteria. The value of the affected feature is used to determine the geographical scale at which the impact is significant (e.g. international, national, regional and local levels). The determination of significance is based on whether the impact will affect the integrity or conservation status of the species, habitat, site or ecosystem within a given geographical frame of reference. Residual impacts are considered to be either significant or insignificant (and negative or positive), after taking into account the zone of influence, mitigation measures and the confidence in predictions associated with the assessment.

8.4 IMPACT ASSESSMENT

8.4.1 Impact identification

Potential sources and types of impact are set out in Table 8.2.

Table 8.2 Sources and types of impact

Impact source	Impact type
Construction phase	
Temporary land-take Construction compounds Working areas along track bed Cut and cover tunnels	- Permanent loss of habitat or species - Temporary loss of habitat or species - Fragmentation of habitat or severance of wildlife corridors between isolated habitats of ecological importance - Creation of barriers to the movements of animals, especially mammals, amphibians and plants with limited powers of dispersal - Impacts on designated sites
Construction activities (e.g. runoff and other pollution, increase of suspended solids, alteration of hydraulic conditions, noise and dust emissions, lighting, movement of vehicles, presence of construction personnel)	- Damage or alteration to adjacent habitats - Disturbance to species in the vicinity of the proposed scheme - Impacts on designated sites - Introduction of invasive species
Operational phase	
Permanent land-take (e.g. stops, track bed, substations, ventilation shafts, ancillary roads, tunnel portals, watercourse crossings (bridges and culverts), overhead wires, catenary system and supporting structures and elevated structures,	- Permanent loss of habitat or species - Permanent alterations to existing habitats - Fragmentation of habitat or severance of wildlife corridors between isolated habitats of ecological importance - Creation of barriers to the movements of animals, especially mammals, amphibians and plants with limited powers of dispersal - Impacts on designated sites - Creation of new habitats as a result of reinstatement works, habitat enhancement proposals and landscaping
Operation of rolling stock and maintenance of the track (e.g. runoff and other pollution, increase of suspended solids, noise and dust emissions, lighting, movement of vehicles, presence of maintenance personnel)	- Disturbance to species in the vicinity of the proposed scheme - Animal collisions - Impacts on designated sites

8.4.2 Mitigation measures

The mitigation measures necessary to avoid or reduce the significance of any adverse impacts on flora and fauna are outlined in this section. Detailed information regarding mitigation measures specific to this area are outlined in Section 8.4.3. These measures are over and above those already incorporated into the scheme design, which has for example sought to avoid sensitive habitats by using existing bridges over watercourses (e.g. across the Broad Meadow River).

- Habitat loss will be limited to the minimum needed for safe implementation of the works. Implementation of best practices will ensure that the risk of disturbance or damage to adjacent habitats is minimised.
- The 'Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub prior to, during and post Construction of National Road Schemes' (NRA) will be followed in areas where these habitats will be impacted upon or are in close proximity to the proposed scheme. Where possible, linear habitats such as hedgerows and tree lines will be crossed at right angles, utilising any existing gaps, to reduce the extent of habitat loss.
- Where new access roads are required, they will be situated in a position that utilises existing gaps in hedgerows/trees wherever possible to minimise tree loss and hedgerow removal.
- Where ditches are to be affected by works, measures will be implemented to ensure a regular water flow is maintained.
- Prior to excavation work, topsoil will be stripped and stored separately from subsoil and reinstated in the same order on completion of the works. Topsoil from any habitats of nature conservation value will be stored separately from topsoil removed from other areas.
- Stockpiled sand, gravel and soil will be placed in areas of low conservation value, kept to minimum size, situated well away from all watercourses and covered or seeded where appropriate.
- Sustainable Urban Drainage Solutions (SUDs) are to be incorporated into the design of all storm control areas, using best practice standards as detailed in the surface water chapter of this EIS (see Volume 2, Chapter 11).
- Best site management practices will be adopted during construction to minimise the risk of secondary impacts on adjacent habitats. Such practices include fencing to clearly mark boundaries and prevent accidental entrance into adjacent habitats, drainage systems designed to prevent water pollution and dust suppression to avoid dust dispersion. Further information is provided as detailed in the Surface Water and Air and Climatic Factor chapters of this EIS (Volume 2, Chapters 11 and Chapter 12 respectively).
- Measures will be put in place to avoid the pollution of waters during the construction and operation of the scheme, including following CIRIA guidance (Masters et al., 2001) on the control of water pollution from construction sites as described in the Surface Water chapter of this EIS (Volume 2, Chapter 11).
- Measures will be taken to avoid the spread of invasive species (including Japanese knotweed (*Fallopia japonica*), and giant hogweed (*Heracleum mantegazzianum*) during construction work (e.g. using appropriate control methods if species are noted), managing plant movement (e.g. wheel washing) and managing the use of imported soil (e.g. not using soil from areas where invasive species are known to be present).
- Where habitats are directly lost as a result of the proposed scheme, new alternative habitats will be created where feasible. Temporary works areas will be restored as soon as is reasonably practicable. Progressive restoration will occur along the route. Where areas of land become isolated due to severance and fragmentation, opportunities will be taken to create new habitat as part of the landscape strategy.
- Mitigation planting will be undertaken using predominantly native species typical of the area, obtained from local sources wherever possible and planted in order to emulate the surrounding natural vegetation. The details of tree planting, species mixes and habitat creation will be established by a professional landscape architect with the project ecologist at the detailed design stage of the project, in consultation with NPWS.
- Tree loss during construction and operation of the proposed scheme will be compensated for by tree planting along the alignment as described in the Landscape and Visual chapter of this EIS (Volume 2, Chapter 13).
- Where attenuation ponds are created, their restoration upon completion of the construction works will include features to enhance biodiversity in the longer term (e.g. scalloped edges, variation in water depths, marginal habitats and aquatic plant species).
- Mitigation which will be implemented will take account of relevant guidance including for badgers (NRA, 2006), bats (NRA, 2006) and otters (NRA, 2006) and will be agreed with National Parks and Wildlife Services (NPWS). It will ensure that appropriate pre-construction surveys are undertaken for protected species, that works are undertaken at appropriate times of the year, pathways and foraging routes are maintained including through the use of tall trees for bats, breeding sites protected and animals are not disturbed or excluded/ translocated (unless under licence). Alternative breeding sites (e.g. bat boxes, bird boxes) will be provided in areas where nest and roost sites are lost.

- Vegetation clearance will take place outside the breeding bird season (1 March to 31 August inclusive) in order to avoid the risk of disturbing breeding birds (which is an offence under the Wildlife Act, 1976 (as amended). If work has to be undertaken within the breeding bird season, buildings and trees, scrub and other vegetation will be checked for nesting birds before removal using methods agreed with NPWS.
- Measures will be taken to ensure that all construction areas are made safe and do not pose a threat to mobile and inquisitive species such as otters and badgers (e.g. planks will be placed across any identified pathways in excavated areas and in trenches to allow escape for any animals which may fall in, and exposed pipe systems will be covered).
- The contractor will develop best practice construction procedures and method statements in consultation with the Eastern Regional Fisheries Board (ERFB) prior to the commencement of in-stream construction activities. In-stream works will be undertaken in accordance with the advice set out in the guidelines of the NRA, ERFB and/or Department of Communications, Marine and Natural Resources. No works will be undertaken in salmonid rivers during the annual closed season of 1st October to 30th April inclusive or where amphibians are present in waterbodies during their breeding season. Any requirements specified by the Office of Public Works (OPW), ERFB or NPWS will be adhered to by the contractor.
- Culverts will be designed to allow the safe passage of wildlife, including fish and otter, in accordance with the NRA and ERFB best practice guidance referenced previously.
- Construction/security/scheme lighting will be kept to a minimum and directed away from sensitive receptors (e.g. badger setts, otter holts, bat foraging habitats). All light will be directed downwards and the height of the light columns will be as low as possible, taking safety and visibility requirements into account. Low pressure sodium lighting will be used where possible as these lights have been shown to attract the lowest numbers of prey insects which attract feeding bats. Construction compounds will not be illuminated at night when working has ceased to avoid impacts to bats.
- Night time lighting at construction compounds will be restricted to the minimum necessary for safety purposes, to reduce the risk of disturbance impacts on bats and otters.
- 'Safe-hop-over' features will be incorporated into the design of new bridges where flight paths of important bird species could potentially be affected. Tall trees will also be included in the landscaping planting to encourage important bird species to fly over the light metro vehicles.
- Works associated with the strengthening of the existing bridges and the construction of new bridges will commence after sunrise and finish before sunset in order to avoid disturbance impacts on otters.
- The methods used for applying herbicides to control plant growth on the tracks will ensure that it does not result in adverse impacts on adjacent habitats. The type of herbicides used will also be ones which do not have adverse effects on wildlife in the surrounding areas. The types and methods of application will be agreed with OPW, NPWS and ERFB.
- Best construction practices will be implemented to ensure that noise and air pollution (such as dust) is kept to a minimum to reduce impacts on adjacent flora and fauna. Further information in this regard is provided in Volume 2, Chapter 4 and Chapter 12.
- Trees that are lost will be replaced where possible using a mixture of native species, of local provenance and typical of the local area and ornamental species.
- Monitoring will be undertaken to confirm the effectiveness of mitigation measures during construction.

8.4.3 Assessment of residual impacts

This section describes the residual impacts resulting from construction and operation of the proposed scheme assuming that all the mitigation measures are successfully implemented.

8.4.3.1 Project scenario: construction phase

Construction impacts on designated sites

The proposed scheme will not result in significant impacts on the designated sites identified within the 10km of the proposed scheme as described in the Flora and Fauna baseline chapter (Volume 1, Chapter 16). The Broad Meadow and Ward Rivers flow into the Broad Meadow/Swords Estuary SPA, Malahide Estuary cSAC, pNHA and Ramsar site. The proposed scheme will use the existing bridges and a new bridge crossing of the Ward River is to be developed, approximately 250m upstream of the designated site. However, there will be no in-stream works and appropriate mitigation will be implemented during construction works to reduce the risk of pollution of the watercourse (as detailed in Section 8.4.2 and the Surface Water chapters (Volume 2, Chapter 11). A full assessment of the potential impact on designated sites has been carried out and the resulting report is included as Annex D (Appropriate assessment) and has been taken into consideration in this chapter.

Construction impacts on habitats
The construction of the proposed scheme results in the temporary loss of the following habitat types:

- Freshwater habitats
- Depositing/lowland river (FW2);
- Drainage ditches (FW4);
- Woodland habitats
- Hedgerows (WL1);
- (Mixed) broadleaved woodland (WD1);
- Scattered trees and parkland (WD5);
- Grassland and cultivated land
- Improved agricultural grassland (GA1);
- Amenity grassland (improved) (GA2);
- Dry meadows and grassy verges (GS2);
- Cultivated land (BC1 – arable crops);
- Built land (BL3 – Buildings and artificial surfaces);

The overall loss of habitat is shown in Table 8.3.

Freshwater habitats
The proposed alignment crosses the two major watercourses in Area MN101; the Broad Meadow and Ward Rivers. The crossing of the Broad Meadow River will be on an existing bridge and will not require any loss of in stream or bank side habitats. A small area of woodland will be lost. This is described further in the Woodland habitat section of this chapter. The Ward River will be crossed in two places. One track will cross the river using the existing Balheary Bridge; the other track will cross the river using the new Ward River Bridge which will be constructed as part of the proposed scheme. The new bridge will not require any loss of in-stream habitat. Three trees (two over mature beech (*Fagus sylvatica*) and one over-mature sycamore (*Acer pseudoplatanus*) will be lost to allow for the installation of supporting abutments.

Method statements for the construction of the abutments for the Ward River Bridge on the banks of the river will be agreed with relevant authorities prior to works commencing. The statements will for example include measures to reduce the risk of suspended solids entering the river during the works.

Construction impacts on freshwater habitats are predominantly associated with the temporary loss of drainage ditches. This occurs in the area of the depot and directly adjacent to the alignment. Mitigation measures (as detailed in Section 8.4.2 and the Surface Water chapter of this EIS (Volume 2, Chapter 11) are to be implemented to ensure continued water flow and avoid pollution of the watercourse during the construction works. Habitats subject to temporary land-take will be re-instated on completion of the works. The loss of such habitat will be short-term and re-instatement will be undertaken progressively to minimise the length of time that habitat is affected.

Given the small areas affected, the short timescale of effect and the mitigation measures implemented, significant effects are not predicted.

Woodland habitat
The proposed scheme will result in the temporary loss of approximately 900m of hedgerow habitat which form the dominant field boundary type in this area. These hedgerows act as an important ecological feature within an area of semi-natural grassland, intensive agricultural grassland and arable fields to the north of Lissenhall.

Temporary land-take of approximately 0.4ha of scattered trees and parkland (WD5) will result in a temporarily loss of habitat during construction of Construction Compound 2 - Option 2 to the east of the existing Lissenhall and Balheary Bridges. The construction compound will be in use over a period of approximately two years. The trees that will be lost comprise semi-mature ash (*Fraxinus excelsior*), sycamore (*Acer pseudoplatanus*) and beech (*Fagus sylvatica*) and a small number of over-mature holly oak (*Quercus ilex*) and beech. These trees will be replaced with new native trees in the same area once construction is completed. Substantial areas of scattered trees and parkland are present at a number of locations both within Area MN101 and in other areas along the proposed alignment. Within Area MN101 scattered trees and parkland covers an area of approximately 9.5ha. In light of the small area affected, the fact that the areas will be replaced on completion of the works, and the fact that much larger areas of mature scattered trees and parkland habitat exist in the local area, significant impacts on woodland during construction are not predicted.

Trees will be protected against damage in areas where construction activities occurs in close vicinity to this habitat. Trees and hedgerows will be protected following general mitigation measure as described in Section 8.4.2. The loss of trees will, where possible, be kept to a minimum.

Grassland and Cultivated Land
Habitat loss at the depot is largely permanent and described in Section 8.4.3.2. Small areas of agricultural arable fields (BC1), semi-natural grassland (GS2) and improved agricultural grassland (GA1) are required to construct the construction compounds in this area and for the temporary land-take along the at-grade sections between Swords and the proposed depot. These areas will be re-instated on completion of the work.

These habitat types are common and widespread in the local area north of Swords and in Ireland. Areas of semi-natural grassland to the south of the depot are species poor dominated by common grassland species with Yorkshire fog (*Holcus lanatus*) being the dominant species. The temporary loss comprises a small percentage of the overall amount of these habitat types within both the study area and surrounding areas, and will not adversely affect the abundance or distribution of these habitat types. No significant impacts are predicted.

Temporary land-take of approximately 0.9ha of amenity grassland (GA2) is required to construct Construction Compound 3 (Chapel Lane), 3A (Ashley Avenue) and Compound 4 (Malahide South Footbridge). Amenity grassland occurs in a number of locations within Area MN101 predominantly associated with public and private open space such as private gardens, recreational areas and sports grounds. Only a minor proportion of approximately 1.3ha of this habitat type within the survey area of Area MN101 will be lost for a period of approximately two years. Amenity grassland is of low ecological value, typically species poor, heavily modified and managed providing limited potential for supporting wildlife. Once the construction phase of the proposed scheme has been completed, the land that has been temporarily taken in these areas is to be reinstated. No significant impacts results from the temporary loss of this habitat type.

Built land

The temporary removal of areas of built land and hard-standing areas will not result in significant impacts on ecological resources.

Construction impacts on species

Bats

The surveys did not record any bat roosts in areas which will be directly affected by the proposed scheme. A large proportion of the route alignment in Area MN101 is either on road or across arable/tilled fields, and will have little or no effect on bats.

Although no roost sites were recorded in this area, a number of bat species such as Leisler's bat, Daubenton's bat, soprano pipistrelle and common pipistrelle were recorded in the northern part of Area MN101. The temporary loss of hedgerow habitat mainly to the north of the Broad Meadow River will result in the short-term severance of some bat commuting and foraging routes. Other foraging and commuting routes in the surrounding area will remain unaffected, and hence the works will not result in a barrier to bat movement. Hedgerows lost will largely be replaced by new hedgerows around the depot site, thereby replacing lost foraging and commuting routes. Mitigation measures described in Section 8.4.2 will also be implemented to reduce the risk of disturbance impacts on bats from temporary lighting at the construction compound.

The Ward and Broad Meadow Rivers are known to act as important commuting and foraging habitats for a variety of bat species such as Daubenton's, soprano pipistrelle and common pipistrelle. Construction activities in these locations are unlikely to affect bat species for the following reasons:

- Areas of foraging habitat temporarily affected will be small and very localised;
- All trees to be removed will be surveyed prior to construction commencing to confirm whether they are being used as roosts, and if so any removal of trees will be undertaken in the period September/October under licence from NPWS, with construction undertaken over the winter months, at a time when bats are hibernating and will not be affected by the proposals;
- The work at the river crossing locations will occur throughout the daylight hours wherever possible to reduce the risk of disturbance to otters, but this will also benefit bats.

All these bat species are common and widespread in Ireland. Construction impacts on these species will be short-term and will not affect the distribution or abundance, and are not predicted to be significant as the favourable conservation status of these species will not be affected.

Badgers

No evidence of recent badger activity was recorded within Area MN101 during the surveys, with only one inactive sett recorded. Further surveys will be undertaken prior to work commencing to determine whether any changes in the status of badgers have occurred as described in Section 8.4.2.

Otters

Otters are not known to breed in Area MN101, but spraints have been recorded along the Broad Meadow and Ward Rivers indicating that the species use this habitat for foraging and commuting as described in the Flora and Fauna baseline chapter of this EIS (Volume 1, Chapter 16).

The construction works will not require any in-river work along these watercourses and hence there will be no barriers to the movement of otters along the rivers. Measures will be implemented during the construction works to avoid impacts on otters. Such measures are described in the Surface Water chapters of this EIS (Volume 2, Chapter 11) and include the use of directional lighting to avoid disturbance and avoidance of night time work whenever possible to avoid the main periods of the day when otters are active. Best practice measures will be also be implemented to reduce the risk of pollution of the watercourses as described in the Surface Water chapters of this EIS (Volume 2, Chapter 11). Measures will be taken to ensure that all construction areas to the north of Lissenhall will be made safe to ensure that they do not pose a threat to otter (i.e. planks placed in ditches to allow any animals which fall in to escape).

The favourable conservation status of the otter will not be affected. Otters occur on most watercourses throughout Ireland which hold the densest population of otter in Western Europe (Hayden et al., 2000). Construction impacts will be short-term. The abundance and distribution of otters will not be affected by the works and significant impacts on otters are therefore not predicted.

Birds

The temporary removal of habitat in Area MN101, especially in the northern part for Construction Compound 1, will result in the loss of some nesting and foraging habitat for a range of common bird species including wren, house martin, robin and dunnock. Yellowhammer, a species of Conservation Concern in Ireland (Lynas et al., 2007) was recorded within this area. Significant impacts on this species are not predicted to occur and the species is common throughout the wider Dublin area. The proposed scheme causes the loss of only minor proportions of suitable nesting and foraging habitat and construction impacts are not predicted to result in significant impacts on the abundance and long-term distribution of birds. The clearance of vegetation will be carried out outside the birds breeding season from 1st of March until 31st of August to avoid impacts on nesting birds. Construction activities throughout Area MN101, including the creation of the depot bunds, will result in some increased disturbance during the construction period, due to increased noise and the presence of the construction workforce and vehicles. The impacts are, however, short-term and localised and will not result in significant impacts on the long-term abundance and distribution of common bird species. The favourable conservation status of birds will not therefore be affected.

The Broad Meadow River supports species listed on Annex I of the EC Birds Directive (79/409/EEC) such as little egret (*Egretta garzetta*) and kingfisher (*Alcedo atthis*). Works in this area are largely to existing bridge structures with no in-river works. Some short-term disturbance is possible from noise and the presence of construction workers, which may result in the kingfisher altering its flight path slightly and little egret flying higher or further upstream of the bridges under construction. However, significant effects on the movement of these species along the river are not predicted. The numbers of little egret are increasing in Ireland and the species are present in most estuarine habitats within the wider Dublin area (ERM, 2008). The proposed scheme will not result in any significant negative impacts on the conservation status of this species.

A number of common bird species including long-tailed tit (*Aegithalos caudatus*) and chaffinch (*Fringilla coelebs*) were recorded during the field surveys in the vicinity of Construction Compound 2 - Option 2. This construction compound lies within an area of scattered trees and parkland enclosed by hedgerows of moderate quality. These habitats provide suitable nesting habitats for species typically associated with woodland and hedgerow habitats, and some disturbance is likely to occur during the construction period of the proposed scheme. The impacts are, however, short-term and localised and will not result in significant impacts on the long-term abundance and distribution of these species and hence their favourable conservation status will not be affected.

Extensive areas of amenity grassland are known to be used by feeding bird species such as oystercatchers. Whilst feeding oystercatchers were recorded within areas of recreational amenity grassland to the west of the Ward River, they were not recorded within the areas where the construction compounds are located, and will not be affected by the proposed scheme.

Small numbers of light-bellied brent geese and lapwings were observed during the site surveys flying across the R132 in a westerly direction at a height of approximately 50m. None were observed in the areas of the proposed scheme, and hence impacts on these species are not predicted

Aquatic fauna

The proposed scheme will require the permanent realignment of a stream and losses of stretches of drainage ditches to facilitate Construction Compound 1 (depot) and the new depot. During the works, measures will be taken to maintain the flow of water in the stream, minimise the effects of sediment dispersal and reduce the risk of pollution (for further information, please refer to the Surface Water chapters of this EIS (Volume 2, Chapter 11). Further surveys will be undertaken prior to construction commencing to determine the use of the stream and ditches in the depot area by amphibians such as common frog and smooth newt. If necessary, a licence will be sought from NPWS to allow works to proceed whilst ensuring the protection of any amphibians present. Given the above and that the works will be localised and short-term, and that enhancements are proposed as part of the landscaping strategy, no significant impacts are predicted.

The construction works in the area of Lissenhall and Ward River will not entail any in-river works. Both the Broad Meadow and Ward Rivers support salmonid species, and measures will be implemented during the construction period (approximately 15 weeks excluding track laying) to reduce the risk of significant impacts on the watercourse (and the aquatic fauna it supports). The measures to be taken are set out in Section 8.4.2. No significant impacts on aquatic fauna are predicted during construction.

8.4.3.2 Project scenario: operational phase

Operational impacts on designated sites

The designated sites potentially affected by the proposed scheme are described previously. Provided that the mitigation measures to prevent pollution and avoid changes to natural drainage conditions are adopted, successfully implemented and monitored on-the-ground, the proposed scheme will not adversely affect the integrity of the Broad Meadow/Swords Estuary SPA. This matter is discussed further in Volume 3, Book 2 of 2, Annex D.

Operational impacts on habitats

The operation of the proposed scheme results in the permanent loss of the following habitat types:

- Freshwater habitats
  - Drainage ditches (FW4);
- Woodland habitat
  - Linear woodland (WL1);
  - Mixed/Broadleaved woodland (WD1);
  - Scattered trees and parkland (WD5);
- Grassland
  - Improved agricultural grassland (GA1);
  - Amenity grassland (GA2);
  - Semi-natural grassland (GS2);
- Built and cultivated land
  - Cultivated land (BC1 – arable crops, BC3 – tilled land); and
  - Built land (BC3 – Buildings artificial surfaces).

Freshwater Habitat

The proposed alignment crosses two major watercourses (Broad Meadow and Ward Rivers) and one drainage ditch in the western part of the Area.

The crossing of the Broad Meadow River will be on an existing bridge and will not require any loss of in stream or bank side habitats, although a small area of woodland will be lost (see Woodland habitat section). The Ward River will be crossed in two places, with part of the alignment using the existing Balheary Bridge and the other part using the new Ward River Bridge which will be constructed across the river. The new bridge will not require any permanent loss of in-stream habitat, and only three trees (two over mature beech (*Fagus sylvatica*) and one over mature sycamore (*Acer pseudoplatanus*) will be lost to allow for the installation of supporting abutments.

The alignment will affect drainage ditches and a small unnamed stream, resulting in the permanent loss of approximately 1,800m of habitat. The main effect will be from the culverting of a stretch of the unnamed stream (approximately 450m) at the depot building and a further realignment of the same stream along the southern edge of the depot site. The water quality of this stream is poor due to high levels of pollutants as described in the Surface Water chapters of this EIS (Volume 2, Chapter 11). A second ditch which currently runs across the eastern part of the proposed depot site will be realigned, to run along the northern edge of the new depot ultimately joining the stream which will be culverted under the depot site. Many of the remaining ditches which will be affected are only seasonally filled with water.

Ditches are common in Area MN101 and the habitat which will be lost is in poor condition and is cut back to the edge of the watercourse due to agricultural maintenance. A range of common species such as bramble (*Rubus fruticosus agg.*) and hawthorn (*Crataegus monogyna*) were recorded here as described in the Flora and Fauna baseline chapter of this EIS (Volume 1, Chapter 16). Where the ditches and streams are re-aligned in open channels, the new channels will be designed to enhance the habitat and wildlife value of the area. For example, the design will include meanders and the development of marginal and bankside vegetation. In addition two attenuation ponds which will be used in the construction compound at the depot site will be retained on completion of the construction works, and enhanced to provide new freshwater habitat. The loss of habitat will not adversely affect the distribution and abundance of this habitat type in the local area, and losses will be offset by the creation of the two new ponds. The loss will not affect the favourable conservation status of this habitat type and significant impacts are not predicted.

The operating scheme will have no significant other impact on freshwater habitats, as appropriate drainage systems will be in place to ensure that run-off from the track does not affect freshwater habitats. These measures are described in more detail in the Surface water chapters of the EIS (Volume 2, Chapter 11).

Woodland habitat

In Area MN101 the proposed scheme crosses 5 hedgerows (WL1), resulting in the permanent loss of 40m of hedgerows of low value and 200m of hedgerow of moderate value within the area north of the Broad Meadow River. Impact on hedgerows in this area is primarily due to the development of the depot site at the northern end of the route (which affects 8 hedgerows of moderate value hedgerow) and due to the creation of a maintenance road which runs parallel to the R132 to the east between Estuary Roundabout and Malahide Estuary. The remaining losses comprise very short sections of hedgerow which are crossed by the at-grade sections of the proposed alignment in the northern part of Area MN101, and an access road west of the Broad Meadow River.

The hedgerows of moderate value are dominated by hawthorn (*Crataegus monogyna*) with some semi-mature ash (*Fraxinus excelsior*). These hedgerows are often associated with seasonally water filled drainage ditches. The hedgerows of low value are dominated by Bramble (*Rubus fruticosus agg*). The hedgerow to the east of the R132 between Estuary Roundabout and Malahide Roundabout is a mature/semi-mature hedgerow and is dominated by birch (*Betula pendula*) and ash (*Fraxinus excelsior*) with frequent ivy (*Hedera helix*).

The northern part of Area MN101 is dominated by agricultural fields. The hedgerows in this area increase the biodiversity value of the area and provide wildlife corridors but none of the specific hedgerows that are impacted upon are of high value. Hedgerows are common and widespread in the local area. The overall loss of hedgerow will not affect the favourable conservation status of this habitat type and no significant impacts are predicted.

The construction of the at-grade section of the proposed scheme will result in the permanent removal of approximately 0.85ha semi-mature linear woodland (WD1) to the west of the R132. This area of woodland is dominated by semi-mature poplar (*Populus spp.*), with occasional lime (*Tilia cordata*), beech (*Fagus sylvatica*) and some ivy (*Hedera helix*). This habitat will be replaced by woodland planting parallel to the at-grade section of the proposed scheme. Mixed/broadleaved woodland is the dominant woodland type within the study area, covering an area of approximately 11ha.

A small area of roadside screen planting will be permanently lost for the installation of the footbridge to the south of Malahide Roundabout. Typical species include sycamore (*Acer pseudoplatanus*) whilst significant ivy cover is present to the west of the roundabout.

Existing semi-mature roadside screen-planting is present in a number of locations throughout Area MN101. These trees will be replaced by new planting adjacent to the new scheme as part of the landscaping strategy. For more information in this regard, please refer to the Landscape and Visual chapters of this EIS (Volume 2, Chapter 13).

The construction of the track across the new bridge crossing of the Ward River will result in the permanent removal of a very small area of mixed/broadleaved woodland (WD1) in Habitat Complex 04. This area is too small to be shown effectively on the Flora and Fauna maps (Habitat Types), and is included within an area marked as scattered trees and parkland. The woodland is characterised by over-mature sycamore (*Acer pseudoplatanus*) and beech (*Fagus sylvatia*). Mixed broadleaved woodland was recorded at a number of locations within the survey area of the proposed scheme covering an area of approximately 11ha in total. The proportion lost in Area MN101 is small (approximately 1ha), and all the species affected are common locally. These trees will be replaced by new planting as part of the landscaping strategy described in Volume 2, Chapter 13 (Landscape and Visual). The distribution and abundance of these habitat types will not be greatly affected nor will the favourable conservation status. This impact is not therefore considered to be significant.

Grassland

The proposed scheme will result in a permanent loss of approximately 7.1ha of grassland habitats including 1ha of amenity grassland (GA2), 4.3ha of agricultural grassland (GA1) and 1.8ha semi-natural grassland (GS2). Agricultural and amenity grassland habitats are of relatively low botanical value, although they do provide foraging and roosting habitat for some bird and mammal species. They are common and widespread habitat types both in the local area and the wider region. Semi-natural grassland within this area is dominated by common grassland species with *Holcus lanatus* being the dominant species.

The area of these habitat types which is lost is small, but some severance and fragmentation of the agricultural grassland fields will result in the northern part of Area MN101. The distribution and abundance of these habitat types will not be greatly affected nor will the favourable conservation status. This impact is not therefore considered to be significant.

Built and cultivated land

The proposals will result in the permanent loss of 12.1ha of arable land and 25.7ha tilled crops from the western extremity of the alignment and the depot. Such land is common and widespread in the local area, and of relatively low ecological value. Such losses will not affect its abundance and distribution. This impact is not therefore considered to be significant.

South of Estuary Roundabout the alignment passes along the existing R132 corridor. This will result in the loss of tarmac road and occasional areas of amenity grassland and heavily managed hedgerow from the central reservation. This impact of this loss is not considered to be significant.

Operational impacts on species

Bats

The surveys did not record any bat roosts in areas which will be directly affected by the proposed scheme, and a large proportion of the route alignment in Area MN101 is either on road or across arable/tilled fields, and will have little or no effect on bats.

There will be permanent loss and severance of existing hedgerows, and loss of small areas of scattered trees and woodland all of which provide foraging and commuting corridors for bats. The baseline survey on bats identified a number of species commuting/foraging along hedgerows throughout the farmland areas in the northern part of Area MN101 in Habitat Complex 01. Species include common pipistrelles (*Pipistrellus pipistrellus*) soprano pipistrelles (*Pipistrellus pygmaeus*) (which typically use linear habitats as foraging habitats), Leisler's bats (*Nyctalus leisleri*) (which are less dependant on these linear habitats) and Daubenton's bats (*Myotis daubentoni*) which were only recorded along the Broad Meadow River east of the R132. The lengths of hedgerow loss will be for the most part small (approximately 2km), especially in the western part of Area MN101.

Substantial foraging habitat will remain. The width of the hedgerow crossing points will be kept to a necessary minimum to reduce the risk of severance of the foraging/commuting corridors. Longer lengths of hedgerow will be lost along the southern edge of the R132. However these hedgerows are located close to residential properties with gardens and hence foraging/commuting corridors will remain unaffected in these areas. Tree loss along Batter Lane to the north of the depot will be kept to a minimum. Substantial number of trees along this road corridor, which may support roosting bats due to a dense ivy cover, will not be affected. Small areas of woodland and treelines will be lost close to the R132. Areas of amenity grassland near the Broad Meadow and Ward Rivers will also be lost. In both areas other corridors will remain including the watercourses. The alignment will cross the Broad Meadow River using existing infrastructure and consequently no additional severance will occur. The new bridge that crosses the Ward River will result in the loss of a very small area of bankside habitat.

New planting as part of the landscaping strategy will provide new corridors for foraging and commuting bats in the longer term. Trees will also be planted in locations where severance of a corridor occurs, to act as 'hop-overs' in the long-term which will reduce the risk of bats colliding with the operating vehicles. Where the alignment runs on existing road, the majority of hedgerows and trees, and hence bat foraging routes, lie parallel to the alignment. Collisions are therefore unlikely to occur even in sections where the route is elevated.

Lighting is required at the depot and the stops along the alignment. as described in Section 8.4.2, this lighting will be directed to avoid dispersion into surrounding habitats, and will be of a type which reduces the attraction of invertebrates and hence bats.

Leisler's bat, common and soprano pipistrelles, and Daubenton's bats are all widespread species in Ireland. The pipistrelle species are the two most common species in Ireland and the Irish population of Leisler's bats is the largest in Europe (Hayden et al., 2000).

The abundance and distribution of these bat species are not predicted to be affected by the proposed scheme because only a small number of hedgerows and other habitats used by bats are affected. Measures to be implemented to reduce the risk of impacts on bats are described in Section 8.4.2. The species that are affected are all common and widespread in Ireland. No impact on the favourable conservation status of these species is therefore predicted and no significant impacts will result.

Badgers

No evidence of recent badger activity was recorded within Area MN101 during the surveys. Further surveys will be undertaken prior to work commencing to determine whether any changes in the status of badgers have occurred since the most recent surveys.

Otter

Otters are known to be present along the Broad Meadow and Ward Rivers but no holts or couches (above ground shelters) were found in or near areas which are to be affected by the proposed scheme. Only one new river crossing is required in Area MN101 to cross the Ward River. Other crossings will use the existing Lissenhall and Balheary Bridges. The mitigation measures to be put in place to minimise the potential for impact on otters are described in Section 8.4.2. These measures include the inclusion of mammal ledges in the bridge design to ensure that otters can continue to move along the river. Lighting at the crossing points of the rivers will be reduced to the minimum necessary for safety purposes and directed away from the watercourse to reduce the risk of any disturbance to otters. Pre-construction otter surveys will be undertaken to confirm whether any changes in the status of otter populations along these watercourses have occurred.

The proposed scheme is not predicted to affect the abundance and distribution of otters. The favourable conservation status of otters in this area will not be adversely affected as a result and no significant impacts are predicted.

Birds

A large part of the route in Area MN101 is within the existing R132 road corridor. The scheme will therefore have little or no effect on birds because it impacts either tarmac road, amenity grassland or, in some cases, highly managed hedgerows along the central reservation. The main habitats available for birds are in the northern part of the route across the agricultural land.

The grassland fields in the Lissenhall area are used by roosting/foraging black-headed gulls. Yellowhammers, a declining breeder and therefore a species of Conservation concern in Ireland (Lynas et al., 2007), were also recorded within the area of the depot and surrounds. However, the area of breeding and feeding habitat loss is small. Large areas of suitable habitat will remain unaffected and can support this species. Much of the land lost on and close to the depot site is arable and tilled land. This is a very common habitat type in the area. Small areas of nesting and foraging habitat for a range of common bird species including meadow pipit, house martin, dunnock and robin will be lost. This loss will occur where the alignment crosses semi-natural grassland, hedgerows and treelines, areas of scattered trees and parkland and woodland. The crossing of the Broad Meadow and Ward Rivers will not result in significant habitat loss for birds.

Overall the area of permanent habitat loss is small and affects common habitat types supporting predominantly common bird species which are widespread in Ireland. Considerable areas of new nesting and foraging habitat for birds is also to be created as part of the landscaping scheme described in the Landscape Insertion Plans (see page 226 to page 327) in the Landscape and Visual chapter of this EIS (Volume 2, Chapter 13). Black-headed gull is a red list species in Ireland and numbers have been declining. Changes in the long-term distribution and abundance of this and other bird species are not predicted to occur due to the extent of grassland habitat available within the study area (approximately 25ha). Effects on the favourable conservation status of bird species are not predicted. No significant impacts on birds from permanent habitat loss are predicted.

The operating vehicles will result in permanent increases in noise levels in parts of the study area. These areas include agricultural fields in the northern part of Area MN101 which currently experience lower noise levels as described in the noise chapter of this EIS (Volume 2, Chapter 4). This will increase the level of disturbance to a range of predominantly common bird species. However, this impact only affects localised areas in the immediate surrounds of the proposed alignment. Black-headed gulls also occur here but this species often occurs in urban areas and demonstrates a degree of tolerance to disturbance such as noise. Significant impacts from increased noise levels are not predicted to occur and will not affect the favourable conservation status of bird species encountered.

There is a risk of collisions to bird species from the operating vehicles and overhead wires where the route crosses or severs existing habitat corridors. Two heron species were recorded along the river corridors; grey heron (*Ardea cinerea*) and little egret (*Egretta garzetta*), a species listed on Annex I of the EC Birds Directive. The birds were recorded flying from the eastern side of the R132 over large HGVs across to the Broad Meadow River. Overhead wires with bird deflectors attached will be installed at the Lissenhall, Balheary and Ward River bridges to encourage little egret to fly sufficiently high along the river corridor to avoid any collisions with the operating vehicles. The final design will be agreed with NPWS.

Further species such as lapwing (*Vanellus vanellus*), black-headed gull (*Larus ridibundus*) and light-bellied brent geese (*Branta bernicla hrota*). Light-bellied brent geese are a species which occurs in internationally important numbers within Broad Meadow/Swords Estuary SPA. The species were recorded flying west across the northern part of the proposed alignment. All flight paths of these species were observed at heights well above those of the proposed light metro vehicles. The species are not therefore at risk of collision with the vehicles. No significant impacts on bird flights are predicted as a result of the new bunds around the depot site.

Aquatic species

The loss of stream and drainage ditch habitats in the northern part of the alignment will result in a reduction in the area of habitat available for amphibians such as common frog and smooth newt. In the majority of locations where ditches are crossed, only very short stretches of the habitat are lost, and the water quality of the stream is poor which means that its potential to support amphibians is limited. One drainage ditch known to support amphibian will be severed to the south of the depot. Where the alignment severs these ditches the waterflow will be maintained by the installation of culverts as described in the Surface Water chapter of this EIS (Volume 2, Chapter 11). As a consequence, considerable habitat for amphibians will remain unaffected and the passage of amphibians can continue to occur along the ditches. Both common frog and smooth newt are common and widespread in Ireland (NPWS, 2008) and given the small areas of drainage ditch lost, and the poor water quality of the stream, effects on the abundance and distribution of these species and hence their conservation status are not likely to occur. Impacts from the proposed scheme on amphibians are not predicted to be significant.

As part of the landscaping strategy for the proposed scheme, additional wetland habitat will be created in Area MN101 through retention and enhancement of four attenuation ponds (two near the Lissenhall bridges and two at the depot). The enhancement of these ponds will include measures to encourage their use by amphibian species. These measures are described in Section 8.4.2.

The crossing of the Broad Meadow and Ward Rivers will not require any in-stream works. Measures will be implemented to ensure that run-off and other sources of pollution from the operation and maintenance of the route do not enter rivers in the Surface Water chapters of this EIS (Volume 2, Chapter 11). Given the above there will be no significant effects on fish or other aquatic fauna.

8.5 OVERVIEW OF LAND-TAKE IMPACTS

Table 8.3 shows the permanent and temporary land-take within the different habitat types within Area MN101 in comparison to the total area of those habitat types occurring within the study area of the proposed scheme.

Table 8.3 Permanent/temporary habitat loss in area MN101

Habitat Type	Area of habitat lost in Area MN101 [ha]	Total existing area of habitat within Area MN101 [ha]	Total area of habitat in study area [ha]
Temporary land-take			
BC1	0.1	98.5	219.3
BL3	1.1	155.4	1054.6
GA1	2.6	83.0	159.7
GA2	1.3	72.9	255.2
GS2	0.4	21.2	80.6
WD1	0.3	11.0	27.0
WD5	0.4	9.5	63.9
Permanent land-take			
BC1	12.1	98.5	219.3
BC3	25.7	35.2	36.8
BL3	2.8	155.4	1054.6
ED2	0.1	1.4	25.3
GA1	4.3	83.0	159.7
GA2	1.0	72.9	255.2
GS2	1.8	21.2	80.6
WD1	1.0	11.0	27.0
WD5	0.3	9.5	63.9

* The total area of habitat within the study area could not be calculated due to the absence of information for St. Stephen's Green.

09 SOIL AND GEOLOGY

This chapter of the EIS describes the potential impacts on soils and geology, which may arise due to activities associated with the construction and operation of the proposed scheme in Area MN101.

9.1 INTRODUCTION

This chapter of the EIS describes the potential impacts on soils and geology, which may arise due to activities associated with the construction and operation of the proposed scheme in Area MN101.

9.2 STUDY AREA

The study area for this assessment is set out in Table 9.1. The assessment area has been defined with reference to the potential for impact from the proposed scheme and the availability of relevant information.

Table 9.1 Study area

Criteria	Width of study area (on both sides of the alignment)
Geology	50m
Landuse	50m
Subsoils	50m
Ecology	50m
Preliminary Ground Investigation	1km approx.
Construction compounds	All areas within 50m of construction site boundary

9.3 IMPACT ASSESSMENT METHODOLOGY

The source and type of all potential impacts is described in Section 9.4.1. Mitigation measures to be put in place are defined in Section 9.4.2. Mitigation measures are defined 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 of each impact is then evaluated in Section 9.4.3 in terms of magnitude and significance.

9.3.1 Magnitude

The criteria used to assess the different impacts associated with the proposed scheme are shown in Table 9.2.

9.3.2 Significance

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

Table 9.2 Criteria for assessment of impact magnitude

Criteria	Impact magnitude
Creation of impermeable areas that do not allow the percolation of water through soils e.g. paving, construction of impermeable tunnels through areas of soil Creation of areas with very high levels of contamination	very high
Permanent substantial impacts to soils including compaction, excavation and contamination Temporary major impacts to soils during construction e.g. temporary creation of impermeable areas Creation of areas with high levels of contamination	high
Temporary moderate impacts to soils including compaction and excavation. Creation of areas with medium levels of contamination	medium
Permanent low magnitude impacts such as implementation of drainage schemes, landscaping and maintenance work Creation of areas with low levels of contamination	low
Temporary immaterial impacts such as minor ground disturbance or use of unpaved, non-compacted areas for and impacts associated with activities such as track cleaning etc. Creation of areas with very low levels of contamination	very low

9.4 IMPACT ASSESSMENT

9.4.1 Impact identification

The following components of the proposed scheme may cause impacts on soils and geology.

- All areas where elements of the proposed scheme intersect soils or geology e.g. stops, track, tunnels, depot, substations, ventilation shafts, landscaping bunds, ancillary roads and access ways and tunnel portals;
- Earthworks, cuttings and embankments;
- Spoil storage areas and disposal sites;
- Construction compounds;
- Track maintenance and drainage operations which may lead to contamination of soil.

The only underground structure in Area MN101 is the Malahide Roundabout underpass. No significant settlement impacts are anticipated.

Two types of impact are recognised to occur: temporary and permanent.

9.4.1.1 Temporary Impacts

Temporary impacts are typically associated with the construction phase of the proposed scheme. These impacts are typically short-term in nature and are required to facilitate the construction of the proposed scheme. The impacts will not continue after the construction phase has been completed. Impacts of this type include those associated with activities such as the movement, excavation and disposal of soils, contaminated materials and bedrock, temporary paving or compaction of soils, temporary construction of roads, traffic management procedures and dewatering works.

In some cases, only minor disturbance of soils occurs. An example of this is areas on construction compounds used for temporary administration structures or ground disturbed during construction but not subject to compaction.

9.4.1.2 Permanent Impacts

Permanent impacts are longer term impacts which are expected to persist for the lifetime of the proposed scheme and its operation. Permanent structural impacts occur where the soil or geology has been permanently altered to allow for the construction of the parts of the proposed scheme e.g. sealing of surfaces by paving and also impacts associated with the installation of the railway, new traffic systems or roadways, drainage and conduit channels, car park facilities, ancillary buildings and ground settlement.

Permanent operational impacts occur where the general day to day operation of the proposed scheme impacts on soil and geology. Potential impacts of this type arise due to activities such as maintenance works (including track cleaning) and activities which could potentially lead to contamination.

9.4.2 Mitigation measures

Paving
Paving of areas will be avoided where possible. Paved areas that are not required after the construction of the project (e.g. paved temporary road diversion routes) will be removed and reinstated with landscaping to compliment the surrounding landuse. The areas that are to be reinstated are illustrated on the Landscape Insertion Plans included in the Landscape and Visual chapter of this EIS (Volume 2, Chapter 13).

Compaction
Compaction of areas will be avoided where possible. Hoarding and signposting will be used in this regard to clearly demarcate haulage routes and other areas being used during construction. Landscaping and restoration will be undertaken with areas reinstated to their original condition, where possible. The areas that are to be reinstated are illustrated on the Landscape Insertion Plans in the Landscape and Visual chapter of this EIS (Volume 2, Chapter 13).

Excavation
Excavation of areas will be avoided where possible. Areas of potential contamination may be encountered during the construction phase. Uncontaminated spoil will be reused where possible within the proposed scheme to construct areas such as the depot, embankments, bunds and landscaping structures. Uncontaminated spoil will be loaded directly onto trucks so that intermediate storage will not usually be required. Any contaminated spoil will be treated in accordance with all relevant legislation and best practice guidelines at the point of origin or at an alternative suitable site prior to disposal. Spoil will be dewatered, as part of treatment, if required, in order to reduce the volume of spoil generated. Once the spoil has been loaded onto the trucks, the trucks will then travel directly to the area in which the spoil is to be reused, recycled or disposed. All trucks will be covered during transport.

Spoil that cannot be reused or recycled will be disposed of in a manner that is in accordance with all relevant legislation and best practice guidelines.

Any mitigation measures associated with potential human health impacts are addressed in Volume 1, Chapter 8. Measures taken to reduce the potential for environmental pollution and dispersion of contaminated soil comprise capping of contaminated areas and dust suppression if necessary. The disturbance of contaminated soils will be minimised and an appropriate risk assessment will be undertaken to mitigate against environmental risks.

Waste, spoil and contamination
A waste management plan is to be developed in accordance with the Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects (DoEHLG, 2006) as part of the construction environmental management plan to ensure that all construction waste is stored, managed, moved, reused or disposed of in an appropriate manner by appropriate contractors in accordance with all relevant waste legislation. A spoil strategy is to be developed as part of the Waste Management Plan to ensure that spoil to ensure that spoil and any potential contamination is dealt with in an appropriate manner in accordance with all relevant legislation.

Maintenance of the metro vehicles will only occur in hardstanding areas of the depot. All maintenance/repair work of metro vehicles or track will be undertaken using non-polluting substances where possible. Any hazardous materials required for the proposed schemes maintenance will be stored in bunded areas.

Ground gases including radon
It is noted the RPII assessment does not take into consideration exposure pathways that may be created due to any underground works such as the construction of tunnels or underpasses. In recognition of this fact, an occupational monitoring programme will be implemented to ensure that no adverse impacts occur as a result of the tunnel construction process due to the migration of ground gases (including carbon dioxide, methane and radon) which may be mobilised due to the tunnel construction technique or associated dewatering activities. The Radiological Protection Institute of Ireland (RPII) has issued separate guidance in respect underground working entitled 'Radon in Underground Workplaces - Guidance Notes for Employers' (2007) and in this guidance an occupational exposure standard of 400 Bq/m^3 has been set. If radon levels in the underground sections of the proposed scheme exceed this threshold during construction, appropriate remedial measures (as prescribed by the RPII) will be undertaken to ensure that no negative impact on the surrounding environmental occurs.

9.4.3 Assessment of residual impacts

9.4.3.1 Project scenario: construction phase

Paving
A number of paved areas will be constructed in Area MN101. These paved areas will include parts of the depot, parts of the track, electricity substations, bridges, viaducts, the stops, the Park & Ride facility, the underpass at Malahide Roundabout, access roadways, roads, footpaths and the construction compounds. The magnitude of the impact associated with paving of any area is considered to be very high because the soil cannot continue to perform its natural functions. The paved areas will be constructed predominantly in areas of medium functional value so the impacts will have moderate significance. However, areas of made-ground and existing paved areas such as those along the R132 have lower functional value and the significance of impact is reduced to Low and Very low respectively. When the mitigation measures are taken into consideration, the magnitude and significance of this impact remains the same but the footprint of the area impacted upon decreases.

The locations of paved areas are illustrated on the Landscape Insertion Plans in the Landscape and Visual chapter of this EIS (Volume 2, Chapter 13) and in Table 9.3.

Compaction
Compacted areas will occur during the construction phase in Area MN101. These will include the construction of the depot, the track line, bridges, viaducts, the stops, the Park & Ride facility, the underpass at Malahide Roundabout, access roadways, roads and construction compounds. The magnitude of the impact associated with the compacting of an area during construction is high as the soil is compressed and disturbed. The compacted areas are all to be constructed in areas of medium functional value so the impacts will have moderate significance. When the mitigation measures are taken into consideration, the magnitude and significance of this impact remains the same but the footprint of the area impacted upon decreases.

Areas of made-ground and existing paving such as those along the R132 have lower functional value and the significance of impact is reduced to Low and Very low respectively.

The locations of paved areas are illustrated on the Landscape Insertion Plans in the Landscape and Visual chapter of this EIS (Volume 2, Chapter 13) and in Table 9.3.

Excavation
Excavation of soil will occur along the track line in Area MN101 and for the underpass at Malahide Roundabout. The magnitude of the impact associated with this activity (i.e. excavating an area during construction) is high as soil disturbance has a high impact on soil function. The majority of the excavated areas are located in areas of medium functional value so the impacts will have moderate significance. However, areas of made-ground and existing paving such as those along the R132 and the Malahide Roundabout have lower functional value and the significance of impact is reduced to Low and Very low respectively.

The locations of paved areas are illustrated on the Landscape Insertion Plans in the Landscape and Visual chapter of this EIS (Volume 2, Chapter 13) and in Table 9.3.

Waste, spoil and contamination
Soil from a number of sampling locations along the route has been sampled and tested for contamination. In all cases, the current information indicates that there will not be any impact on commercial landuses in which the samples all occur because contamination levels are all below the screening criteria for a commercial end landuse. However, soil sampling was undertaken at discrete representative locations based on historical activities and an assessment of the potential for contamination to be encountered. Areas of soil contamination could potentially be encountered in other areas outside the areas where analysis was undertaken.

If contamination is encountered in other areas during construction, the magnitude of this impact will range from low to high depending on the type and amount of contamination encountered. Areas of contamination may be encountered in Area MN101 in areas of medium functional value so the impacts would be of moderate significance if mitigation measures were not put in place. The mitigation measures to be put in place are specified in Section 9.4.2. When these mitigation measures are taken into consideration, the magnitude of the impact will be reduced to Low or Very low.

However, areas of made ground and existing paved areas such as those along the R132 have lower functional value and the significance of impact is reduced to Low and Very low respectively.

A total of approximately 2.9 million cubic metres of spoil is to be generated across the entire proposed scheme. Approximately 2 million cubic metres of this spoil is to be reused in the proposed scheme for a number of purposes such as construction of embankments, levelling of topography, landscaping and other mitigation measures. Where reuse is not possible, spoil will be recycled and where this is not possible, spoil will be disposed of in a manner that is in accordance with all relevant legislation. Impacts associated with the transport of spoil are assessed in the Traffic chapter of this EIS (Volume 2, Chapter 7). A waste management plan is to be developed as part of the construction environmental management plan to ensure that all construction waste is managed, stored and disposed of in an appropriate manner by appropriate contractors in accordance with all relevant waste legislation.

Ground gases including radon

Radon gas comes from the radioactive decay of minute quantities of uranium present in all rocks and soils. The RPII has produced a 'Radon Map of County Dublin' which was compiled based on monitoring results from a number of sample houses within the county. The map illustrates 10km grid squares within the county and provides an estimate of the percentage of dwellings within each 10km area which are predicted to exceed the domestic radon standard of 200 Bq/m³ of radiation.

The geology of the study area is described in the Soil and Geology chapter of this EIS (Volume 1, Chapter 17). As detailed in this chapter, the study area is dominated by limestones and shales which would allow the transmission of radon to occur if a significant source of radon existed. However, the RPII database indicates that within the study area, the percentage of dwellings predicted to exceed the domestic radon standard is low (1- 5%) and the area is not defined as a 'high radon area'. This provides an indication that the area as a whole is not likely to be associated with a significant radon problem.

It is noted that the RPII assessment does not take into consideration exposure pathways that may be created due to any underground works such as the construction of tunnels or underpasses. In recognition of this fact, the mitigation measures detailed in Section 9.4.2 are to be put in place to ensure that no significant adverse impact occurs.

9.4.3.2 Project scenario: operational phase

Contamination

Maintenance work is likely to be undertaken in the depot area and along the track. There is the potential for contaminating materials (such as oils and lubricants) to impact on the soil outside of paved areas. The magnitude of impact associated with a spill of hazardous materials during maintenance/repair work is high because of the potential for soil contamination to occur. However, when the mitigation measures set out in Section 9.2.2 are taken into account, the significance of an impact is Low to Very low.

Ground gases including radon

In the operational phase it is assumed that the construction of the tunnel lining itself and the ventilation systems are sufficient to mitigate any potential accumulation of radon or other ground gases. This will be appraised during the detail design. This appraisal will include consideration of not just the main tunnel structure but also any side tunnels, refuges or other confined spaces where ventilation rates may not be the same as in the main tunnel.

During the operational phase Metro North infrastructure will not generate further ground movement. The underground structures are designed as undrained (watertight) and therefore long-term ground movements beyond the construction phase are not expected to occur.

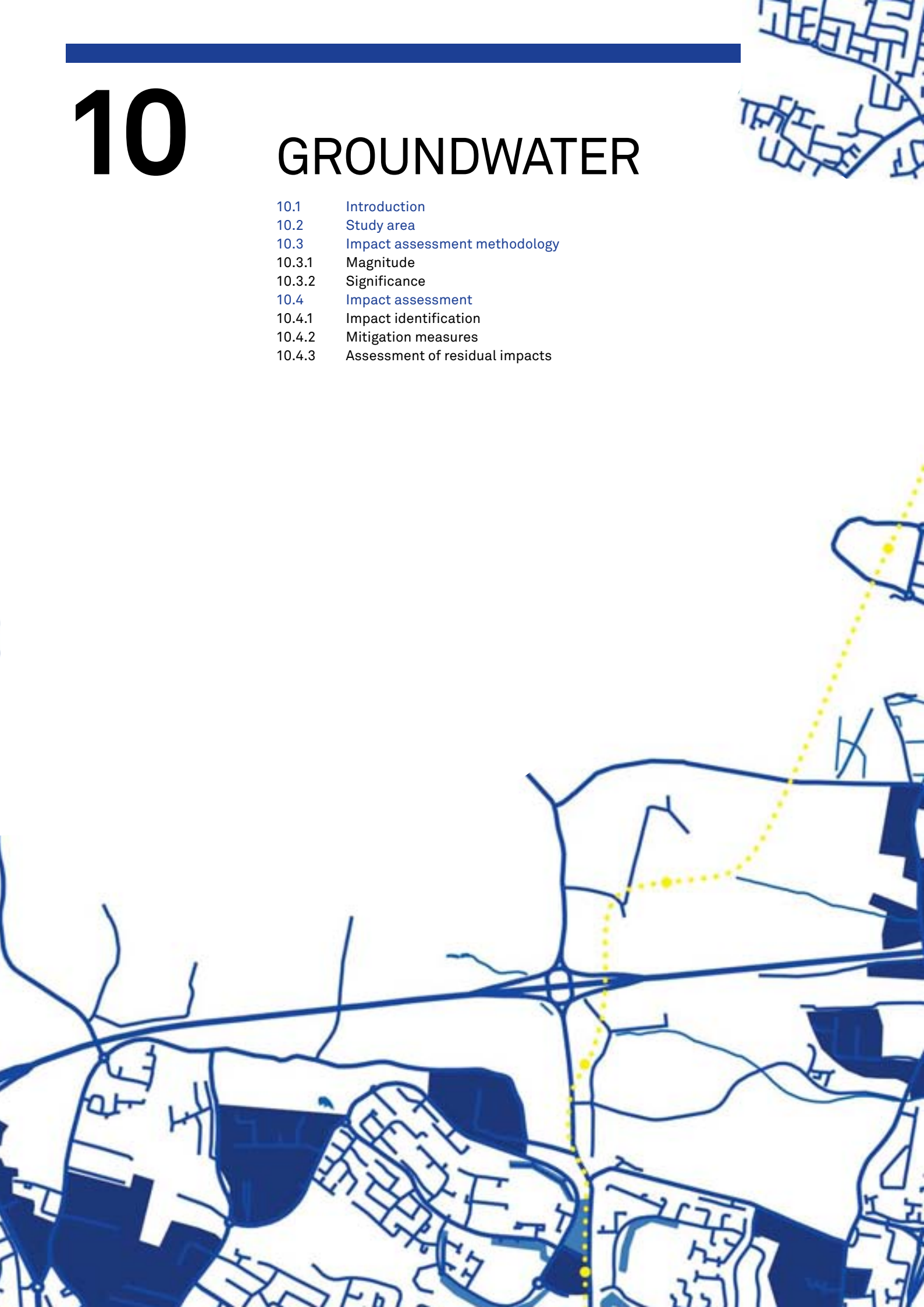
9.4.4 Summary of residual impacts

A summary of the residual impacts associated with the scheme and affecting this area is provided in Table 9.3.

Table 9.3 Summary of residual impacts

Location	Area of land-take (m²)	Type of impact	Significance of Impact
Depot	126,000	Paved	Medium to Very low
Depot	254,000	Potentially Disturbed Ground	Medium to Very low
MN101	58,000	Paved	Medium to Very low
MN101	64,000	Potentially Disturbed Ground	Medium to Very low

10 GROUNDWATER



This chapter of the EIS describes the potential impacts on groundwater, which may arise due to activities associated with the construction and operation of the proposed scheme in Area MN101.

10.1 INTRODUCTION

This chapter of the EIS describes the potential impacts on groundwater, which may arise due to activities associated with the construction and operation of the proposed scheme in Area MN101.

10.2 STUDY AREA

The study area for this assessment is set out in Table 10.1.

Table 10.1 Study area

Criteria	Width of study area (on both sides of the alignment)
Groundwater	500m

10.3 IMPACT ASSESSMENT METHODOLOGY

The source and type of all potential impacts is described in Section 10.4.1. Mitigation measures to be put in place are defined in Section 10.4.2 Mitigation measures are defined 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 effect of each impact is then evaluated in Section 10.4.3 in terms of magnitude and significance.

10.3.1 Magnitude

The criteria used to assess the different impacts associated with this proposed scheme are shown in Table 10.2. The criteria have been defined in consideration of the 'Guidelines on Information to be Contained in Environmental Impact Statements' (EPA, 2002).

Table 10.2 Criteria for assessment of impact magnitude

Criteria	Impact magnitude
Permanent impact relating to the alteration of the direction of groundwater flow Long-term impact relating to the depletion of groundwater sources due to dewatering activities Long-term impact relating to the deterioration of groundwater quality (if left untreated) Permanent impact relating to the recharge of the underlying groundwater sources	very high
Long-term impact relating to the alteration of the direction of groundwater flow Medium-term impact relating to the depletion of groundwater sources due to dewatering activities Medium-term impact relating to the deterioration of groundwater quality (if left untreated) Long-term impact relating to the recharge of the underlying groundwater sources	high
Medium-term impact relating to the alteration of the direction of groundwater flow Medium-term impact relating to the depletion of groundwater sources due to dewatering activities Medium-term impact relating to the deterioration of groundwater quality (if left untreated) Medium-term impact relating to the recharge of the underlying groundwater sources	medium
Short-term impact relating to the alteration of the direction of groundwater flow Short-term impact relating to the depletion of groundwater sources due to dewatering activities Short-term impact relating to the deterioration of groundwater quality (if left untreated) Short-term impact relating to the recharge of the underlying groundwater sources	low
Temporary impact relating to the alteration of the direction of groundwater flow Temporary impact relating to the depletion of groundwater sources due to dewatering activities Temporary impact relating to the deterioration of groundwater quality (if left untreated) Temporary impact relating to the recharge of the underlying groundwater sources	very low

The duration of impacts (as detailed in Table 10.2 are defined as shown in Table 10.3 as per EPA Guidance (EPA, 2002).

Table 10.3 Definition of duration criteria

Impact Description	Definition
Permanent impact	Impact lasting over sixty years
Long-term impact	Impact lasting fifteen to sixty years
Medium-term impact	Impact lasting seven to fifteen years
Short-term impact	Impact lasting one to seven years
Temporary impact	Impact lasting for one year or less

10.3.2 Significance

The significance of all impacts is assessed in consideration of the magnitude of the impact and the functional value of the area upon which the impact has an effect. The functional value of all groundwater resources is set out in the Groundwater baseline chapter of the EIS (Volume 1, Chapter 18).

10.4 IMPACT ASSESSMENT

10.4.1 Impact identification

Various elements of both the construction and operational phases have the potential to impact on the groundwater environment.

10.4.1.1 Construction phase impacts

During the construction phase, certain activities have the potential to impact on the hydrogeological environment within the study area. Potential impacts can include localised alteration of the direction of groundwater flow due to tunnelling operations and the construction of cut and cover tunnels and stops. Developments that extend into underlying aquifers, for example during tunnelling operations, in addition to the construction of cut and cover tunnels and stops can potentially cause temporary lowering of the water table, if dewatering is required. This can result in the temporary depletion of groundwater in supply wells (where present) in the surrounding area, if prolonged or significant dewatering occurs.

There is the potential that the underlying groundwater quality may be impacted during the construction phase due to leakage of fuel from construction vehicles, oil spillages during refuelling or vehicle maintenance operations, leakage from chemical storage areas and inappropriate disposal of chemicals (paints, oils, glues etc.). Surface contaminants can migrate towards underlying groundwater sources. Contaminants arising from similar activities during subsurface operations can be released directly into the surrounding aquifer. It should be noted that the construction of the proposed scheme may result in a localised improvement in groundwater quality along some sections of the route due to the removal of overlying contaminated material.

10.4.1.2 Operational phase impacts

Potential impacts on the groundwater environment during the operational phase would be expected to include localised alteration of the groundwater flow along sections of the proposed route where tunnels exist. The replacement of greenfield areas along sections of the route with areas of hardstanding (stops, rail depots, in addition to Park & Ride facilities) can reduce to some extent the recharge rate into the underlying aquifer. The construction of a tunnel within an aquifer can result in a localised depression of the water table.

During the operational phase of the proposed scheme, there is the potential for the migration of surface contaminants (arising from chemical storage areas at depots, wastewater discharge and runoff from car parks, for example) towards the underlying groundwater sources. Due to the fact that the tunnelled sections of the route will comprise sealed structures and all underground pipework will include appropriate containment measures, the potential for contamination from underground sections of the route is considered to be low.

10.4.2 Mitigation measures

10.4.2.1 Construction phase

All of the impacts identified for the construction phase of the proposed scheme for this section of the route were found to be of Low significance. The following good housekeeping practices will be implemented in order to ensure protection of the surrounding groundwater sources.

Where possible groundwater will be recharged to the groundwater aquifer. Potentially contaminated groundwater generated by construction activities will be discharged to a nearby foul water sewer in accordance with the conditions set in the Trade Effluent Discharge Licence from the relevant Local Authority. Where required by the Local Authority, the treatment of groundwater will be carried out prior to discharge to the foul sewer in order to comply with the requirements of the discharge licence, which may contain limits for such parameters as, inter alia, pH, heavy metals, hydrocarbons, suspended solids and Biological Oxygen Demand (BOD). In the event that sufficient capacity is not available in the local foul sewer, the groundwater will be treated in accordance with the conditions in the Effluent

Discharge Licence from the relevant Local Authority prior to discharge to a nearby surface water body.

Groundwater, which is generated during the construction phase, will be collected on-site and tested prior to discharge to the surface water drain or foul sewer. The treatment of surface water runoff and groundwater will include the use of silt/sediment traps and oil interceptors prior to the release to surface water bodies, surface water drains or foul sewers.

Foul water generated by the welfare facilities at the construction compounds will be collected in portaloo facilities. At the larger compounds semi-permanent welfare facilities may be provided and the foul water generated will be treated at a local package treatment plant and the effluent will be discharged to local foul sewers.

Groundwater pollution will be minimised by the implementation of good construction practices as contained in the publication by the Construction Industry Research and Information Association (CIRIA) 'Control of Water Pollution from Construction-sites, Guidance from Consultants and Contractors' (Master et al. 2001). An emergency response protocol for pollution incidents will be established by the contractor and regularly updated. This protocol will include containment measures, a list of appropriate clean-up materials and equipment, details on staff responsibilities and trained personnel and contact details for pollution clean-up companies and relevant Local Authorities and emergency services.

In order to minimise any impact on the underlying subsurface strata and groundwater, all oils, solvents and paints used during construction will be stored within labelled, sealed containers in specially constructed dedicated, temporary, bunded areas or suitable bunded lockable storage containers within buildings or enclosures (hardstanding) in the construction compounds. Taking into account the 'Guidance Note for the Control of Pollution (Oil Storage) (England) Regulation 2001' (Department of Environment, Food and Rural Affairs in the UK (DEFRA), 2001), oil and fuel storage tanks are to be stored in designated bunded areas within the construction compounds. These areas are to be either double skinned or are to be bunded to a volume of 110% of the capacity of the largest tank/container present or 25% of the total tank capacity within the bund (plus an allowance of 30mm for rainwater ingress). Filling and draw-off points will be located entirely within the bunded area(s). Drainage from the bunded area(s) is to be diverted for collection and safe disposal off site by an appropriately licensed contractor. All storage tanks will have primary, secondary and tertiary containment. Their integrity will be regularly checked and maintained. Tank level gauges will be checked regularly in order to detect leakage at an early stage.

Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated bunded area of the construction compound site. The refuelling area will not be situated close to any surface water body or surface water drain. If it is not possible to bring a machine to the refuelling point, fuel will be delivered in a double skinned mobile fuel bowser. A drip tray will be used beneath the fill point during refuelling operations in order to contain any spillages that may occur. Spill-kits and hydrocarbon absorbent packs will be stored in this area and operators will be fully trained in the use of this equipment. Spill-kits and drip trays will be used to contain any spillages, which may occur.

Where concrete mixing is required this will only take place at a designated area at the construction compound, which will not be located next to a surface water drain or stream. The washing of concrete mixing vehicles will take place in a hardstanding bunded designated area. An emergency response protocol will be implemented in the event of concrete spillages during pouring operations.

All associated hazardous waste residuals, such as oil, solvent, material used in oil spill clean-ups, glue and solvent based paint containers will be stored within appropriately covered skips prior to removal by a suitable Local Authority or EPA licensed waste management contractor for off-site treatment/recycling/disposal. Any other construction waste will be disposed of to on-site skips for removal by an approved waste management contractor.Once hardstanding is removed, the underlying soil is exposed and it has the potential to be contaminated if Made Ground is present or industrial activities have taken place in the area in question. During wet weather, surface water that infiltrates through the exposed ground could leach contaminants, if present in the soil profile, downwards towards groundwater sources. In order to minimise the potential for the generation of this potentially contaminated leachate, all ground disturbances will be completed as quickly as possible and appropriately managed. The generation of potentially contaminated runoff from stockpiles of made ground will be prevented by the installation of temporary bunds around the stockpile, minimising the size of the stockpile and arranging for the removal of the material off-site as soon as possible.

10.4.2.2 Operational phase

All of the impacts identified for the operational phase of the proposed scheme for this section of the route were found to be of Low significance. The following good housekeeping practices will be implemented in order to ensure protection of the surrounding groundwater sources.

The potential for the release of chemical substances such as oils/lubricants/solvents used/ stored in the vehicle maintenance area in the Belinstown Depot into the underlying groundmass will be prevented by ensuring that:

- The substances are only used by suitably trained personnel;
- The substances are only used in small quantities, as required;
- The substances are always contained in appropriately labelled, sealed containers;
- The substances are placed back in the storage area (for example a locked cabinet or bunded area of hardstanding) on completion of their use;
- The availability of spill-kits for any clean-ups that may occur;
- A protocol is in place for the clean-up of any spillages that may occur.

With regards to fuel storage tanks and refuelling operations, the mitigation measures previously mentioned will be implemented.

Substations located at each stop and the Belinstown Depot will be regularly checked and maintained to minimise the potential for leakage of oil. The substations will be located on areas of hardstanding.

In accordance with the Waste Management Act 1996 (as amended) and associated Regulations, waste material generated at the Belinstown Depot and the stops along this section of the route will be stored in appropriate containers in a suitably designed waste storage area and collected on a regular basis by a suitably licensed waste collection contractor for disposal at an appropriately licensed waste facility. The waste storage area will be regularly and appropriately maintained.

There is the potential that surface water from the Park & Ride facility at the Belinstown Depot and Heavy Goods Vehicles (HGV) turning areas may be contaminated with hydrocarbons.

The release of potentially contaminated surface water into the groundmass can adversely impact on the underlying groundwater quality. Permeable paving overlying a modular geo-cellular storage tank is proposed at the Park & Ride facilities. Surface water drainage from the permeable pavement areas will pass through a Class I EN858 hydrocarbon interceptor before entering the track drainage system. This will ensure that hydrocarbons are removed from the surface water runoff prior to entering surrounding surface water bodies that may be hydraulically connected to the underlying groundwater.

Areas of hardstanding with low to medium risk of contamination (HGV parking and turning areas) will be contained and drained using a pipe and gully system. Runoff from these areas will pass through an approved Class 1 EN858 Light Liquid by-pass Separator before discharging to the on-site drainage system. Areas of high risk contamination such as fuel off-load and distribution areas, internal inspection pits, skip areas, waste compactor areas shall be fully protected and drained to a separate effluent drainage system which will be connected to an approved Class 1 EN858 full retention oil separator prior to removal to an approved treatment facility. Pollution control measures will be included in the drainage network to reduce the risk of pollution to receiving water bodies.

Both trade effluent and domestic sewage will be treated on site at Belinstown to comply with the requirements of Fingal County Council. The treatment system comprises oil separators, a package treatment plant (Klargester BioDisc BL or similar approved), a reed bed system and a balancing pond. The treated water from the Belinstown Depot Wastewater Treatment Plant will be discharged to nearby field drains.

The integrity of surface and foul sewers, including the oil interceptors, will be regularly checked and maintained.

10.4.3 Assessment of residual impacts

10.4.3.1 Project scenario: construction phase

The Groundwater Baseline Assessment indicates that groundwater along this section of the route is not considered to be heavily contaminated but does contain elevated concentrations of pesticide Malathion, zinc, lead, ammoniacal nitrogen, sulphate, nitrite and hydrocarbons (TPH). These contaminants would be considered typical for areas used for agricultural purposes and urban development. In general, the concentration of the contaminants in the groundwater is below the surface water quality limits in the EPA publication Parameters of Water Quality, Interpretation and Standards (2001). Therefore, there is the possibility that groundwater generated from construction along this section of the route can be discharged into a surface water body/drain but this would be subject to approval by the relevant Local Authority.

Groundwater encountered in excavations may be hydraulically connected to the underlying aquifer. Alternatively shallow groundwater encountered in excavations may indicate perched water, which is not hydraulically connected to the underlying aquifer but located instead above a low permeability clay layer. The accidental release at the surface of potential contaminants such as oils or solvents into groundwater encountered in excavations has the potential to contaminate the underlying aquifer, in the event that it is hydraulically connected to the aquifer. Provided that the mitigation measures detailed in Section 10.4.2 are put in place, the magnitude of this impact is low and the impact affects an area of medium functional value. Therefore, the impact is considered to be of Low significance.

There is the potential that the underlying groundwater quality may be impacted during the construction phase due to:

- leakage of fuel/lubricants/hydraulic oils from construction vehicles/equipment;
- oil spillages during refuelling or vehicle maintenance operations;
- leakage from chemical storage areas (including storage tanks) at the compounds and inappropriate disposal of chemicals (paints, oils, glues etc.);
- the generation of leachate/runoff from inappropriately managed waste storage areas at the construction compound;
- Spillage and/or inappropriate disposal of raw or uncured concrete or grout;
- The generation of potentially contaminated leachate from storage areas for construction materials at the construction compounds;
- Inappropriate disposal of domestic effluent from welfare facilities at the construction compound;
- Spillage and/or leakage if bitumen or sealants for waterproofing surfaces.

Surface contaminants can migrate towards underlying groundwater sources. Provided that the mitigation measures detailed in Section 10.4.2 are put in place, the magnitude of this impact is low and the impact affects an area of medium functional value. Therefore, the impact is considered to be of Low significance.

The potential for land contamination along this section of the route, is considered to be low. Limited amounts of made ground (to a maximum depth of 3m below ground level according to the Baseline Assessment) are present in localised areas along Area MN101 of the proposed scheme. There is the potential for the generation of contaminated leachate from the localised areas of made ground and its migrations downwards to groundwater sources during rainfall events. Similarly, the storage of stockpiles of excavated made ground, which has the potential to be contaminated, can result in the generation of contaminated leachate if suitable mitigation measures (such as the installation of bunds) are not implemented. Provided that the mitigation measures detailed in Section 10.4.2 are put in place, the magnitude of this impact is low and the impact affects an area of medium functional value. Therefore, the impact is considered to be of Low significance.

This section of the route is mainly at-grade but some excavations will extend to approximately 7m below ground level (bgl). The approximate depth of 7m bgl is based on information illustrated on Soil and Geology maps (Baseline Soil & Geology) in Volume 3, Book 1 of 2. According to the Groundwater Baseline Assessment, groundwater has been encountered within 1.0m bgl along this section of the route. Therefore, it is likely that discharge of groundwater will be required. Unless they are suitably controlled, such activities have the potential to temporarily cause minor reductions in the level of the water table. No significant long-term lowering of the water table is expected as a consequence of building the proposed scheme. Lowering of the water table will be limited to 1m depths during construction. Provided that the mitigation measures detailed in Section 10.4.2 are put in place, the magnitude of this impact is Low and the impact affects an area of Medium functional value. Therefore, the impact is considered to be of Low significance.

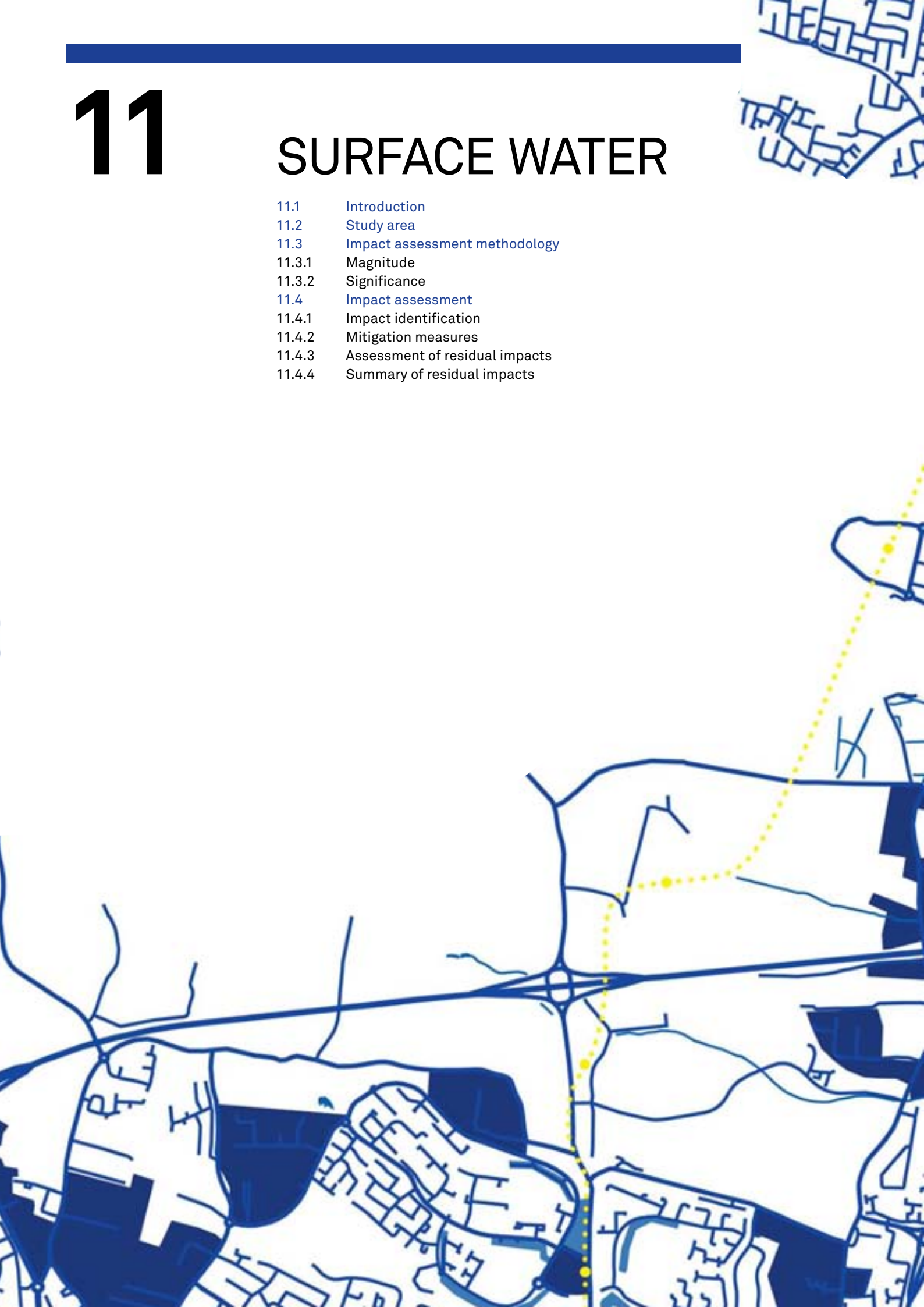
10.4.3.2 Project scenario: operational phase

During the operational phase of the proposed scheme, there is the potential for the migration of surface contaminants towards the underlying groundwater, which would result in the deterioration of the groundwater quality, from the following potential sources:

- Leakage or spillage of oils/lubricants/solvents used/stored in the vehicle maintenance area in the Belinstown Depot into the underlying ground;
- Spillage or leakage during refuelling operations and fuel distribution at the Belinstown Depot;
- Inappropriate waste disposal practices at the Belinstown Depot and stops;
- Inappropriate disposal of wash water from the vehicle washing facility at the Belinstown Depot;
- The infiltration of potentially contaminated surface water runoff from car parks, HGV turning areas and tracks into the surrounding ground;
- Inappropriate disposal of trade effluent and domestic effluent from the Belinstown Depot;
- Leakage from oils used in substations at each stop, including the main ESB supply substation at the Belinstown Depot;

With the mitigation measures set out in Section 10.4.2, the magnitude of this impact is low and the impact affects an area of medium functional value. Therefore, the impact is considered to be of Low significance.

11 SURFACE WATER



This chapter of the EIS evaluates the potential impacts on surface water, which may arise due to activities associated with the construction and operation of the proposed scheme Area MN101.

11.1 INTRODUCTION

This chapter of the EIS evaluates the potential impacts on surface water, which may arise due to activities associated with the construction and operation of the proposed scheme Area MN101.

11.2 STUDY AREA

The study area for this assessment is set out in Table 11.1. As shown in the table, this assessment focuses on all watercourses within 500m of the proposed alignment. Impacts that may affect the catchment of any watercourse within this study area are considered.

Table 11.1 Study area

Criteria	Width of study area (on both sides of the alignment)
Surface water quality and hydrodynamics (including flooding)	500m

11.3 IMPACT ASSESSMENT METHODOLOGY

The source and type of all potential impacts is described in Section 11.4.1. Mitigation measures to be put in place are defined in Section 11.4.2 Mitigation measures are defined 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 of each impact is then evaluated in Section 11.4.3 in terms of magnitude and significance.

11.3.1 Magnitude

The criteria used to assess the different impacts associated with this scheme are shown in Table 11.2. The criteria have been defined in consideration of the 'Guidelines on Information to be Contained in Environmental Impact Statements' (EPA, 2002).

Table 11.2 Criteria for assessment of impact magnitude

Criteria	Impact magnitude
Long-term to permanent change to a designated conservation site or designated salmonid river Medium-term to permanent contamination of surface water over entire surface water catchment Medium-term to permanent changes in drainage patterns over entire catchment	very high
Medium term change to a designated conservation site or a designated salmonid river Temporary to short-term contamination of surface water over entire surface water catchment Temporary to short-term changes in drainage patterns over entire catchment	high
Temporary to short-term change to a designated conservation site or a designated salmonid river Medium to long-term contamination of local surface water Medium to long-term changes in local drainage patterns	medium
Short-term contamination of local surface water Short term changes in local drainage patterns	low
Temporary contamination of local surface water Temporary changes in local drainage patterns	very low

The duration of impacts (as detailed in Table 11.2) are defined as shown in Table 11.3 as per EPA Guidance (EPA, 2002).

Table 11.3 Definition of duration criteria

Impact Description	Definition
Permanent impact	Impact lasting over sixty years
Long-term impact	Impact lasting fifteen to sixty years
Medium-term impact	Impact lasting seven to fifteen years
Short-term impact	Impact lasting one to seven years
Temporary impact	Impact lasting for one year or less

11.3.2 Significance

The significance of all impacts is determined in consideration of the magnitude of the impact and the functional value of the surface water resource.

11.4 IMPACT ASSESSMENT

11.4.1 Impact identification

Various elements of both the construction and operational phases have the potential to impact on surface water.

11.4.1.1 Construction impacts

Potential impacts on hydrodynamics and flooding
During the construction phase, various activities have the potential to result in increased surface water runoff which could potentially impact local drainage patterns and result in flooding. Other construction activities have the potential to alter the hydraulic flow regimes within watercourses and to lead to flooding. These include:

- The installation of surface water drainage discharge points to watercourses and surface water or foul drains also;
- The installation of hard standing for temporary construction compounds and access roads;
- The construction of surface and elevated structures on existing greenfield sites.

Works involving the diversion of ditches and the construction of culverts and bridges have the potential to impact flow regimes in existing watercourses and to lead to flooding of adjacent lands. If significant this may have the following impacts:

- Increased flood levels upstream of the culvert due to the creation of a restriction in the watercourse;
- Erosion of the watercourse and/or floodplain being initiated or accelerated due to the restriction increasing flow velocities and turbulence;
- Deposition of material in the watercourse or on the flood plain due to a change in flow velocities and turbulence;
- Interference with the passage or movement of fish.

Construction of the watercourse crossings has the potential to impact upon the hydraulic flow regime of the watercourses if the structure results in a reduction in channel dimensions (primarily width) or capacity. The span of the bridge and particularly the freeboard between water level and bridge soffit also has the potential to influence flow during periods of high-water. These factors could potentially lead to an increase in flooding upstream or downstream of the bridge and/or changes to sedimentation and erosion within the river system.

Potential impacts on water quality
There is the potential for contaminated surface water runoff to arise during the construction phase. If discharged to surface water courses this could negatively impact on surface water quality. Potentially contaminated runoff may arise in parking and turning areas, fuel off-load and distribution areas, materials storage areas, skip and waste compactor areas.

Works involving the diversion of ditches and the strengthening of bridges also have the potential to impact on surface water quality through deposition of material in the watercourse.

11.4.1.2 Operational impacts

Potential impacts on hydrodynamics and flooding
During the operational phase, increased surface water runoff will arise from drainage of hardstanding surface areas associated with permanent features (including the depot site and Park & Ride facilities), and from drainage of elevated structures.

The operation of features associated with drainage of the proposed scheme (including culverts and drainage discharge points to surface water bodies and surface water or foul drains) and the construction of new structures has the potential to impact flow regimes in existing watercourses and to lead to flooding of adjacent lands.

Potential impacts on water quality
During the operational phase, discharge of untreated wastewater to receiving waterbodies could potentially cause an impact if the wastewater does not receive adequate treatment in advance. Contaminated runoff may arise at the Park & Ride site and the depot car park, and from vehicle washing runoff at the depot site. Contaminated runoff has the potential to pollute receiving water bodies.

11.4.2 Mitigation measures

11.4.2.1 Construction phase

Measures to mitigate potential impacts on hydrodynamics and flooding
In relation to culverting and bridge strengthening works, the design will be in accordance with the requirements of the Office of Public Works (OPW) and Section 50 of the Arterial Drainage Act, 1945. As such, approval will be sought from the OPW for construction of the culvert, and the OPW's hydraulic design standards will be adhered to. The Eastern Regional Fisheries Board (ERFB) Guidelines 2006 will also be adhered to when selecting a culvert design, to ensure minimum negative impact on fish life. The culvert will be capable of passing a fluvial flood flow with a 1% annual exceedance probability or a 1 in 100 year flow without significantly changing the hydraulic characteristics of the watercourse. In addition, cognisance will be taken of the 'National Roads Authority (NRA) Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes' (NRA, 2007).

Measures to mitigate potential impacts on water quality

Any discharges arising from the construction phase of the proposed scheme entering the foul/storm sewer network will be in accordance with the requirements of a discharge licence granted by Fingal County Council. Similarly, any water discharge to surface water bodies will be treated in accordance with the requirements of a discharge licence (if required) granted by Fingal County Council.

All discharge points will be fitted with oil separators which will comply with current European Standard EN858. The oil separators will have silt chambers for the removal of silts and other settleable solids. Each separator will be fitted with an automatic alarm system which will relay information to a control unit to indicate the condition of the separator. The alarm probes will be set to coincide with the maximum oil storage volume for each separator. All full retention separators will be fitted with automatic closure devices which will be set to operate when the separated light liquid storage capacity reaches a volume equal to ten times the nominal size of the separator. By-pass separators will not be fitted with automatic closure devices.

Treatment of water produced during the construction phase will involve silt removal using a silt trap and hydrocarbon removal using a hydrocarbon interceptor.

Re-fuelling of construction equipment and the addition of hydraulic oil or lubricants to vehicles/ equipment will take place in designated bunded areas within the construction compounds, away from surface water gullies or drains. The vehicles and equipment will not be left unattended during refuelling. Spill kits and hydrocarbon adsorbent packs will be stored in this area and operators will be fully trained in the use of this equipment. As a precaution, a spill kit will also be stored in the cab of each vehicle in case of localised hydrocarbon loss of containment incidents, such as a machine 'blowing' a hydraulic hose.

Any hazardous waste residuals or potentially contaminated sludge from spill clean-up will be stored within appropriate metal or plastic containers in temporary bunded storage areas in the construction compounds prior to removal by an appropriate Local Authority or EPA approved waste management contractor for off-site treatment/ recycling/disposal.

Silt fences will be used during culvert construction and bridge strengthening works to prevent contamination of the watercourses with sediment. Washing of concrete trucks in the vicinity of the watercourses will be prohibited. All contractors will be required to make provision for removal of any concrete washwaters, no such washwaters will be permitted to be discharged to the stream under any circumstances.

The guidelines provided by the Department of the Marine and Natural Resources (1997) and guidelines provided by CIRIA (2001) and the ERFB (2006) on the prevention of water pollution from construction sites, will be adhered to, in order to ensure that the impact on the water environment during the construction phase of the proposed scheme is minimised. The ERFB document in particular provides much useful information about minimising the environmental risks associated with construction works, and will be referred to in the planning of any construction works in the vicinity of watercourses.

Regular monitoring of water will be conducted during the construction phase prior to discharge to ensure all relevant water quality parameters are within criteria specified by the relevant Local Authority

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11.4.2.2 Operational phase

Measures to mitigate potential impacts on hydrodynamics and flooding

At Belinstown Depot, storm water runoff will be managed on site using a combination of Sustainable Urban Drainage System (SUDS) techniques and conventional pipe drainage systems. The SUDS techniques will be used to help reduce the volume of runoff generated as well as the potential pollution load of runoff discharged from the site. The total discharge from the site will be restricted to the greenfield runoff rate of 2 l/s/ha or 6 l/s/ha for impermeable areas as recommended by Fingal County Council.

On-site attenuation at Belinstown Depot will be in the form of a geo-cellular underground tanks and balancing ponds, and will be sized to accommodate the 1 in 100 year storm with an additional 10% climate change allowance.

The design, installation and maintenance of the drainage system will comply with:

- The Greater Dublin Strategic Drainage Study, Technical Documents Volume 2 & 3;
- The Greater Dublin Regional Code of Practice for Drainage Works;
- Any specific requirements specified by Fingal County Council.

The performance of the drainage system will also be assessed for extreme rainfall events (in excess of the design rainfall) to identify areas at risk of flooding. Adequate measures will be put in place to safely manage the flood water and reduce the risk of damage to lives and properties.

In relation to ditch diversion at the Belinstown Depot site, all new pipes and culverts will be adequately sized to convey the existing peak flows with an additional 10% allowance for the effects of climate change. The diversion works will be carried out in a manner that will not adversely affect the field drainage of adjacent lands.

In relation to track and road drainage, all filter drains will be designed in accordance with CIRIA 697 and CIRIA 522 to accommodate a 1 in 30 year storm with a 10% climate change factor.

In relation to all stops in Area MN101 and the Park & Ride sites, all storage systems will be designed to accommodate the 100 year storm with a 10% allowance for climate change.

In relation to culverting and bridge strengthening works, mitigation measures will be implemented during the design stage as detailed in Section 11.4.2.

Measures to mitigate potential impacts on water quality

Any discharges arising from the operational phase of the proposed scheme entering the foul/storm sewer network will be in accordance with the requirements of a discharge licence granted by Fingal County Council. Similarly, any water discharge to surface water bodies will be treated in accordance with the requirements of a discharge licence (if required) granted by Fingal County Council.

At Belinstown Depot, areas of hardstanding with low to medium risk of contamination (HGV parking and turning areas) will be contained and drained using a pipe and gully system. Runoff from these areas will be passed through an approved Class 1 Light Liquid by-pass Separator before discharging to the on-site drainage system.

Areas of high risk of contamination such as fuel off-load and distribution areas, internal inspection pits, skip area, waste compactor areas shall be fully protected and drained to a separate effluent drainage system which shall be connected to an approved Class 1 full retention oil separation prior to discharge to the on-site package treatment plant.

A geo-cellular system and oil interceptor will be installed at the car Park & Ride at Belinstown Depot and at Fosterstown and will be regularly checked and maintained in full compliance with the manufacturers' requirements. An appropriately licensed contractor (holding an appropriate Local Authority Permit) will clean out the interceptor on a regular basis and dispose of the resulting material at an appropriately licensed facility.

All discharge points will be fitted with oil separators which will comply with current European Standard EN858. The oil separators will have silt chambers for the removal of silts and other settleable solids. Each separator will be fitted with an automatic alarm system which will relay information to a control unit to indicate the state of the separator. The alarm probes will be set to coincide with the maximum oil storage volume for each separator. All full retention separators will be fitted with automatic closure devices which will be set to operate when the separated light liquid storage capacity reaches a volume equal to ten times the nominal size of the separator. By-pass separators will not be fitted with automatic closure devices.

Herbicides used during operation will be applied sparingly and in compliance with suppliers' guidance, and will be suitable for use in an environment in which receiving watercourses are present.

11.4.3 Assessment of residual impacts

11.4.3.1 Project scenario: construction phase

Construction compounds will be installed at each of the stop locations. Construction compounds will also be installed at the depot site, in fields north of the Broad Meadow River, at the Chapel Lane footbridge site and at the Malahide underpass site. Where welfare facilities are provided at these compounds, temporary portaloo facilities will be used and foul water generated will be removed and treated off-site by an appropriately licensed contractor. Attenuation ponds will be installed north and south of the Ward River. These ponds will be part of the drainage system for the operational phase.

It is proposed to culvert a number of ditches/streams along the route of the proposed scheme within Area MN101. Several existing ditches at the Belinstown Depot site will be culverted to accommodate construction of the depot. In addition, three ditches between the Belinstown and Lissenhall Stops, one ditch at the Lissenhall Stop and one ditch south of the Lissenhall Stop will be culverted to accommodate construction of the tracks. Construction of these culverts will involve carrying out works to the stream/ditch beds and banks. There is the potential for sediment to contaminate the ditch/stream which could have a duration of impact of up to one year. This would therefore be a low magnitude impact if mitigation were not put in place. Provided that the mitigation measures specified in Section 11.4.2 are put in place, the magnitude of the residual impact is low to negligible. The significance of this impact is assessed as low to not significant.

Works will be carried out to strengthen the existing Lissenhall Bridge over the Broad Meadow River, strengthen the existing Balheary Bridge over the Ward River and construct a new bridge over the Ward River. These strengthening works have the potential to impact the hydraulic flow regime of the rivers and to contaminate the rivers with sediment and pollutants arising from construction materials.

Alterations to hydraulic flow regimes could potentially result in flooding upstream or downstream of the bridge locations. This would therefore be a medium magnitude impact if mitigation were not put in place. The Broad Meadow and Ward Rivers are of medium functional value. Therefore this potential impact would be of Medium significance if mitigation measures were not put in place. Provided that the mitigation measures specified in Section 11.4.2 are put in place, the magnitude of this impact is low to negligible and therefore the potential impact is

considered to be of Low significance. Measures will be put in place to ensure that channel widths are not reduced; residual impacts are therefore assessed as not significant.

During construction surface water runoff from areas of hardstanding will be collected and drained to the nearby storm water drainage system or treated and discharged to surface water bodies (if available). All waters collected in this manner will be treated in silt traps and hydrocarbon interceptors prior to discharge. These measures are subject to agreement with Fingal County Council and if necessary to obtaining an appropriate discharge licence.

Discharge of surface water runoff to storm water sewers or receiving surface water bodies could potentially impact the quality of receiving water bodies if the runoff does not receive adequate treatment in advance. The degree of contamination of the receiving water body depends on the volume and composition of the discharge. A pollution incident (for example a fuel spill) could potentially contaminate a receiving water body for a duration of up to one year. This would therefore be a low magnitude impact if mitigation were not put in place. Provided that the mitigation measures specified in Section 11.4.2 are put in place, the magnitude of the residual impact is low to negligible. The significance depends on the magnitude of the impact and the sensitivity of the receiving water body. Watercourses within Area MN101 were identified as having a medium functional value in the baseline study. Therefore the significance of this impact is assessed as Low to not significant.

11.4.3.2 Project scenario: operational phase

As outlined in Section 11.4.3.1, Area MN101 of the proposed scheme includes at-grade and elevated sections of track as well as an underpass. At the Belinstown Stop, an adjoining Park & Ride facility will be provided. Several streams north of the Broad Meadow River will be culverted to enable track construction and the attenuation pond installed at the construction compound adjacent to the Broad Meadow River will be retained during the operational phase.

Discharge of surface water runoff can potentially impact the quality of receiving water bodies however, the likelihood of contamination from surface water run off from a light rail system is considered low as the proposed system is electrically powered, and while it uses hydrocarbon lubricants within the rail vehicles, the lubricants are contained within sealed units, and the risk of leaks is therefore low. Herbicides may be used occasionally to control weed growth, but the quantities involved will be small and the herbicides used will comply with all applicable environmental codes.

Belinstown Depot

At Belinstown Depot, storm water runoff will be managed on site using a combination of Sustainable Urban Drainage System (SUDS) techniques and conventional pipe drainage systems. The SUDS techniques will be used to help reduce the volume of runoff generated as well as the potential pollution load of runoff discharged from the site. The total discharge from the site will be restricted to the greenfield runoff rate of 2 l/s/ha or 6 l/s/ha for impermeable areas as recommended by Fingal County Council.

Areas of hardstanding with low to medium risk of contamination (HGV parking and turning areas) will be contained and drained using a pipe and gully system. Runoff from these areas will pass through an approved Class 1 EN858 Light Liquid by-pass Separator before discharging to the on-site drainage system. Areas of high risk contamination such as fuel off-load and distribution areas, internal inspection pits, skip areas, waste compactor areas shall be fully protected and drained to a separate effluent drainage system which will be connected to an approved Class 1 EN858 full retention oil separator prior to removal to an approved treatment facility.

Pollution control measures will be included in the drainage network to reduce the risk of pollution to receiving water bodies. On-site attenuation will be in the form of geo-cellular underground storage tanks and balancing ponds, and will be sized to accommodate 1 in 100 year storm with an additional 10% climate change allowance.

The performance of the drainage system will be assessed for extreme rainfall events (in excess of the design rainfall) to identify areas at risk of flooding. Measures will be put in place to safely manage the flood water and reduce the risk of damage to lives and properties.

Both trade effluent and domestic sewage will be treated on site at Belinstown to comply with the requirements of Fingal County Council. The treatment system comprises oil separators, a package treatment plant (Klargester BioDisc BL or similar approved), a reed bed system and a balancing pond. The reed bed system will comprise horizontal modules constructed of Glass Reinforced Plastic (GRP), filled with granular material, which together with the reeds provide the hydraulic flow path and environment to achieve the improved effluent quality. The granular material will comprise clean, washed shingles or broken stones free of fines and dust and graded to 16 – 32mm. The reed plants will have an extensive root system and be native to the local environment.

As indicated on the Railway Order plans, effluent will discharge to an existing stream at the Belinstown Depot site. If the wastewater does not receive adequate treatment, effluent could potentially contaminate the stream. A pollution incident (for example a discharge of untreated sewage) could potentially contaminate a receiving water body for a duration of up to 1 year. The magnitude of this potential impact is assessed as low and the significance is assessed as low to not significant.

The proposed receiving water body to which effluent from the wastewater treatment plant will outfall was identified in the baseline study as having a high baseline concentration of orthophosphate that exceeds guideline levels set out in the Phosphorus Regulations 1998. In order to meet the requirements of the Phosphorus Regulations, the effluent must not have a negative impact on phosphorus concentrations. A detailed assimilative capacity study will be required as part of a discharge licence application. If this study indicates that a negative impact will result on phosphorus levels then the effluent will be discharged to sewer to ensure that overall there is no negative impact.

The on-site treatment system will be designed to treat wastewater to an acceptable standard and will comply with Fingal County Council's requirements and the Irish EPA Wastewater Treatment Manual Treatment Systems for Small Communities, Business, Leisure Centres and Hotels, which was published by the EPA in 1999. The calculation of peak wastewater flow rate will be prepared using the guidance, formulae and values specified in EN 12056 (1 to 5):2000. Providing these measures are adhered to the magnitude of the residual impact is assessed as low to very low (negligible).

Open Cut Sections

Runoff from the track and adjacent lands at the Lissenhall sections will be collected via a system of swales and filter drains and discharged to nearby field drains. The filter drains and swales will be designed in accordance with CIRIA guidelines to accommodate the 1 in 30 year storm event with an additional 10% capacity for the effects of climate change. Runoff from the tracks will be attenuated in ponds and within the filter trenches to restrict the discharge to a rate not exceeding the Greenfield Runoff rate of 2 l/s/ha or 6 l/s/ha for impermeable areas as specified by Fingal County Council.

Oil interceptors will be provided at outfalls to treat runoff to acceptable standards and hence reduce the risk of pollution to surface water bodies. Oil separators will be designed to comply with BS EN 858 and the Pollution Prevention Guidelines (PPG3) of the UK Environment Agency. Outfalls to the Broad Meadow and Ward rivers will be designed to be unobtrusive and protective measures will be put in place to prevent the erosion of the river bed and bank. A suitable non-return device will be fitted on all outfall pipes to the main water course as necessary. In addition, berms will be constructed on the ponds adjacent to the Broad Meadow River and Ward River to protect the ponds from the occasional flooding of the rivers.

The drainage strategy for open cut sections along roads during the operational phase involves the provision of cut-off drains at the top of cut-section to intercept runoff flowing towards the cut slope. Filter drains will be provided at the toe of the cut to collect runoff from the track as well as runoff from the cut slope. Runoff collected in filter drains will be discharged to watercourses by a gravity outfall. Where this cannot be achieved filter drains will be connected to the sump at the adjoining underground section from where runoff will be pumped up into a nearby surface drainage system, in both cases with appropriate treatment and subject to any licensing requirements of Fingal County Council.

Stops

During the operational phase, the stops along the route will be drained using a linear drainage system that will outfall to the filter drain serving the track.

Elevated Sections

Runoff from the Estuary viaduct will be collected through down pipes and discharged to the central reserve of the existing roadway. The runoff will be used to irrigate the grassed central reserve. Narrow filter drains will be provided along one end of the central reserve to collect any excess water for disposal. Using runoff from the elevated sections for watering the grassed central reserve will mimic the existing drainage regime and will help to offset the impact of the additional impervious area introduced by the elevated alignment.

Park & Ride Facility

Runoff from the multi storey car park will be collected through drainage pipes and discharged to a below ground drainage system into an attenuation tank. The attenuation tank will be designed to accommodate the 1 in 100 year storm with a 10% allowance for climate change.

Discharge of surface water runoff to storm water sewers or receiving surface water bodies could potentially impact the quality of receiving water bodies if the runoff does not receive adequate treatment in advance. The degree of contamination of the receiving water body depends on the volume and composition of the discharge. A pollution incident (for example a fuel spill) could potentially contaminate a receiving water body for a duration of up to one year. If mitigation measures were not put in place, the magnitude of this potential impact would be low. Provided that the mitigation measures specified in Section 11.5 are put in place, the magnitude of this residual impact is low to negligible.

Surface water discharge points within Area MN101 include four field drains at Lissenhall, the Broad Meadow and Ward Rivers, and an existing ditch at the Seatown Stop.

The baseline study identified that the functional value of the Broad Meadow and Ward River is medium. Therefore the impact of discharging surface water runoff (treated as described) is assessed as of low significance.

11.4.4 Summary of residual impacts

The main surface water features present in this area of the proposed scheme are the Broad Meadow and Ward Rivers with baseline medium functional values. Residual impacts due to the construction phase are assessed as of low magnitude and significance. Residual impacts due to the operational phase are of Low magnitude and significance.

Swords Stop

12 AIR AND CLIMATIC FACTORS

This chapter of the EIS evaluates the potential air and climatic impacts arising from the construction and operation of the proposed scheme in Area MN101.

12.1 INTRODUCTION

This chapter of the EIS evaluates the potential air and climatic impacts arising from the construction and operation of the proposed scheme in Area MN101.

12.2 STUDY AREA

The study area for this assessment comprises all areas within 175m of the central alignment or construction compounds and areas within 200m of road links where changes in air quality are predicted to occur.

12.3 IMPACT ASSESSMENT METHODOLOGY

12.3.1 Introduction

The source and type of all potential impacts is described in Section 12.4.1. Mitigation measures to be put in place are defined in Section 12.4.2. Mitigation measures are defined 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 effect of each impact is then evaluated in Section 12.4.3 in terms of magnitude and significance.

The impact that the scheme will have on air quality is assessed after the first year of construction 2011. The impact that the scheme will have on air quality during operation is assessed for 2029. Predicted changes in traffic flows for the do minimum and do metro years of 2011 and 2029 are described in Volume 1, Chapter 15 (Baseline Traffic) and Volume 2, Chapter 7 (Traffic impact assessments).

12.3.2 Assessment methodology for dust

For the purposes of this study, dust is taken to mean the particles released that have the capacity to cause annoyance to neighbours, through soiling of surfaces, such as windows and cars. There are no legal standards relating to acceptable levels of deposited dust, although monthly mean deposition rates in excess of 200 mg m^{-2} day^{-1} are considered likely to cause a nuisance (Schofield and Shillito, 1990). A risk-based approach has been developed for the purpose of the Environmental Impact Assessment (EIA) to identify significant potential impacts. This risk evaluation matrix has been devised and is presented in Table 12.1. The criteria detailed in the table have been devised in consideration of studies by the Building Research Establishment (BRE) which suggests that nuisance is unlikely to occur at distances greater than 50m from a construction site boundary (BRE, 2003). One particular study (Baughan, 1980) has also shown that at least half the people living within 50m of the site boundary of a road construction scheme were 'seriously bothered' by construction nuisance due to dust, but that beyond 100m less than 20% of the people were 'seriously bothered'. Construction sites are temporary in nature and some degree of nuisance is normally tolerable if the activity lasts for no more than a few months.

12.3.3 Assessment methodology for vehicle emissions

The Transport Analysis Guidance (TAG) of the UK's Department for Transport (2004) and the Design Manual for Roads and Bridges (DMRB) Air Quality Assessment (Highways Agency, 2003) have been used to assess the proposed scheme with respect to the pollutants that relate to road traffic i.e. nitrogen dioxide (NO_2) and particulate matter (PM_{10} or $PM_{2.5}$), and the greenhouse gas, carbon dioxide (CO_2). These tools have been selected because they are the best tools available in terms of allowing the user to assess impacts across many roads in a network, rather than simply considering individual roads in isolation.

In order to protect our health, vegetation and ecosystems, the EU has set down air quality standards in member states for a wide variety of pollutants. On the 14th April 2008 the European Commission adopted the Directive on Ambient Air Quality and Cleaner Air for Europe 2008. This directive merges four earlier directives and one Council decision into a single directive on air quality, all of which have been transposed into Irish law through the Environmental Protection Agency Act 1992 (Ambient Air Quality Assessment and Management) Regulations (S.I. No. 33 of 1999).

The new directive has not yet been transposed into Irish law, but does not introduce any new air quality limit values, except for the approach to particulate matter. Whereas the previous directive, and Irish law, have a limit value for PM_{10} to be achieved in 2010, the new directive calls for a limit value for $PM_{2.5}$ of 20 µg m^{-3} to be achieved by 2020, with an interim target value of 25 µg m^{-3} by 2015. This limit value will, at some point, be transposed into Irish law and has therefore been adopted as a criterion for this assessment.

A summary of the air quality standards relevant to the Dublin area is shown in Table 12.2.

Table 12.1 Evaluation of Potential Significant Effects of Dust Deposition, with control measures in place

Duration of on-site dust raising activity	Distance from Site Boundary to Sensitive (a) Receptors (m)		
	< 50 m	50 – 100 m	> 100 m
> 12 months	Significant	Significant	Potentially Significant
6 – 12 months	Significant	Potentially Significant	Not Significant
< 6 months	Potentially Significant	Not Significant	Not Significant

(a) Sensitive receptors defined as: residential, commercial office, hospital, surgery etc

Table 12.2 Irish Air Quality Standards

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg m-3)	Basis of Application of the Limit Value	Limit Value Attainment Date
NO_2	Protection of Human Health	Calendar year	40	Annual mean	1st January 2010
		1 hour	200	Not to be exceeded more than 18 times in a calendar year	1st January 2010
PM_{10} Stage 1[(a)]	Protection of Human Health	Calendar year	40	Annual mean	1st January 2005
		24 hours	50	Not to be exceeded more than 35 times in a calendar year	1st January 2005
PM_{10} Stage 2[(b)]	Protection of Human Health	Calendar year	(20)	Annual mean	1 January 2010
		24 hours	(50)	(Not to be exceeded more than 7 times in a calendar year)	1 January 2010

(a) Stage 1: 1 January 2005 to 1 January 2010

(b) Stage 2: From 1 January 2010 (no longer part of EU legislation)

12.3.4 Assessment methodology for microclimate

The significance of impacts associated with conversion of vegetated to unvegetated surfaces is assessed through consideration of the area of the land experiencing such a change and the area of vegetated land that continues to remain. If the area of land affected is marginal, then the effect on air temperature and microclimate is insignificant. The areas of land-take associated with the proposed scheme have been calculated on the basis of the following assumptions:

- Temporary land-take inside the Compulsory Purchase Order (CPO) line and within the construction compound is assumed to be reinstated back to its original state after construction operation;
- Permanent land-take associated with the proposed scheme is converted to permanent hardstanding concreted areas during operation. This is a worst-case scenario assumption because the some of this land may remain vegetated, depending on the limits of deviation associated with the scheme design.
- Cut and cover areas and embankments are assumed to be reinstated to their original status after construction.
- For the purpose of the calculations, all construction works are assumed to occur in tandem. The actual planned duration of individual construction work tasks is discussed in Section 12.4.3.1.
- Calculated figures are approximate figures with an estimated margin of error of approximately 10%.

All other potential microclimatic impacts are assessed on a case-by-case basis in consideration of the nature of the area affected and the specific design proposed in the area.

12.3.5 Assessment methodology for climate change

The impact of the proposed scheme with respect to climate change is assessed through consideration of the change in CO_2 emissions that will occur due to traffic changes in response to the proposed scheme.

12.3.6 Assessment criteria

The criteria used to assess the different magnitudes of impact associated with the proposed scheme are shown in Table 12.3. In the case of air quality, five classes of impact magnitude are used. In the case of microclimate and climate change, only four classes of magnitude are used because the precision of the assessment is such that only four classes are required.

Table 12.3 Criteria for assessment of impact magnitude

Criteria	Impact magnitude
Air quality Change of >35 µg m^{-3} in ambient NO_2 concentration Change of >17.5 µg m^{-3} in ambient PM_{10} concentration Change of >17.5 µg m^{-3} in ambient $PM_{2.5}$ concentration Any change with regards to compliance with any regulatory air quality limit specified in relevant legislation A substantial change in the area of green areas exerting an influence on the surface energy balance.	very high
Air quality Change of between 25 and 35 µg m^{-3} in ambient NO_2 concentration Change of between 12.5 and 17.5 µg m^{-3} in ambient PM_{10} concentration Change of between 12.5 and 17.5 µg m^{-3} in ambient $PM_{2.5}$ concentration Any change with regards to compliance with any regulatory air quality limit specified in relevant legislation **Microclimate** A substantial change in the area of green areas exerting an influence on the surface energy balance. **Climate Change** More than 25% change in CO_2 emissions	high
Air quality Change of between 5 and 25 µg m^{-3} in ambient NO_2 concentration Change of between 2.5 and 12.5 µg m^{-3} in ambient PM_{10} concentration Change of between 2.5 and 12.5 µg m^{-3} in ambient $PM_{2.5}$ concentration **Microclimate** Permanent structural impacts such as bridges, roadways, embankments, car park facilities and buildings where cold air 'ponding' and shading may take place. A moderate change in the area of green areas exerting an influence on the surface energy balance **Climate Change** 15- 25% change in CO_2 emissions	medium
Air quality Change of between 1 and 5 µg m^{-3} in ambient NO_2 concentration Change of between 0.5 and 2.5 µg m^{-3} in ambient PM_{10} concentration Change of between 0.5 and 2.5 µg m^{-3} in ambient $PM_{2.5}$ concentration **Microclimate** A minor change in the area of green areas exerting an influence on the surface energy balance Temporary stockpiling of soils during construction that may cause cold air ponding and shading to take place. **Climate Change** 5- 15% change in CO_2 emissions	low

Criteria	Impact magnitude
Air quality	very low
Change of between -1 and 1 µg m^{-3} in ambient NO_2 concentration	
Change of between -0.5 and 0.5 µg m^{-3} in ambient PM_{10} concentration	
Microclimate	
Permanent non-structural impacts such as minor landscaping and minor drainage.	
Air movement generated through movement of the light metro vehicles (LMVs)	
Immaterial temporary impacts such as minor ground disturbance or non-compacted areas of construction compounds.	
A very minor change in the area of green exerting an influence on the surface energy balance	
Climate Change	
0-5% change in CO_2 emissions	

The significance of impacts is assessed in consideration of the magnitude of the impact and the functional value of the receptor or nature of the receiving environment in which the impact has an effect.

12.4 IMPACT ASSESSMENT

12.4.1 Impact identification

12.4.1.1 Dust

Sources of dust include material stockpiles and other dusty surfaces, which may be disturbed by wind action. Dust of this type may also be thrown up by mechanical action, due to activities such as the movement of tyres on a dusty road, drilling or demolition. General construction works may cause occasional rather than continuous emissions of dust, as only certain activities (such as grinding and cutting) will result in dust emissions. Black smoke particles may also occur where hot bitumen is used to carry out tarmac laying. Ventilation shafts can also act as a minor source of dust above ground. Dust is generated underground through the action of train braking and friction wear on the tracks, together with a small biological component from the passengers themselves. Ventilation shafts transfer dust particles from underground tunnels and emit them to the open atmosphere.

The quantity of dust released during construction depends on a number of factors, including:

- the type of construction activities occurring (e.g. crushing and grinding);
- the volume of material being moved;
- the moisture and silt content of the materials;
- the distance travelled on unpaved roads;
- the area of exposed materials;
- the mitigation measures employed.

The effect of dust also depends on the wind direction and the distance between the dust source and receptor. Dust emissions arising from construction activities have the potential to cause nuisance both within the construction site and outside the site boundary. Accumulation and settling of particles on surfaces close to the point of release may occur leading to soiling of property, windows, cars or laundry. Such dust affects amenity, as the particles are mostly of sufficient size that they are visible. In industrial and commercial premises dust can cause soiling of goods, abrasion of moving parts in the plant and clogging of filters, if present in sufficient quantity. The generation of dust can also lead to increases in levels of particulate matter. It is also important to consider whether the dust has been generated through the disturbance of contaminated ground.

12.4.1.2 Vehicle emissions

Local emissions of NO_2, PM_{10} and $PM_{2.5}$ are typically emitted from vehicle exhausts and therefore are directly associated with the number of vehicles travelling on local road networks. The change in vehicles numbers as a result of the proposed scheme will therefore have an impact on the concentrations of these pollutants in areas where traffic levels change in response to the proposed scheme. The changes in traffic that will occur are described in the Traffic chapter of this EIS (Volume 2, Chapter 7). NO_2, PM_{10} and $PM_{2.5}$ emission can have a potential impact on human health as described in the Human Health chapter (Volume 1, Chapter 8).

12.4.1.3 Microclimate

The principal change to microclimate would occur through the replacement of a previously vegetated surface with paved surfaces. If this change occurred over a sufficiently large area, a change in the surface energy balance would occur, as moisture evaporation from the soil beneath the paved surfaces is eliminated and more of the available solar radiation is used to heat air rather than to evaporate water transpired by plants and trees. This could potentially have a discernible effect on air temperature, especially as a cooling effect in summer, and exacerbate the Urban Heat Island (UHI) effect, as described in the baseline Air and Climatic Factors chapter (Volume 1, Chapter 20).

During the construction phase, vegetated surfaces may be replaced with compacted or paved surfaces that are not vegetated. Examples include construction compounds, embankments, stockpiles and other temporary features that may lead to the disruption or destruction of existing vegetation. Vegetated surfaces may also be replaced permanently due to the above ground operational structures of the proposed scheme (e.g. track form, Park & Ride facilities, stops)

Alterations of the direction and speed of air flow may occur, due to large structures associated with the proposed scheme. The movement of LMVs on the track can potentially generate localised wind turbulence if the vehicles are moving at significant speeds. The construction of new elevated pedestrian crossings can expose pedestrians to wind turbulence.

Similarly, large structures can also lead to changes in lighting and shade. This impact is usually only significant if the barriers are solid and if sensitive areas are located in close proximity. Cold air can also accumulate behind physical barriers, such as buildings and embankments, thereby blocking nocturnal drainage flows and increasing the potential for incidence of 'frost hollows' and ice. These frost hollows and ice can impact on crops in an agricultural setting or create slip hazards on thoroughfares. These artificial frost hollows only typically occur if relatively solid barriers are created across valleys, where cold surface air would otherwise drain away during the night.

12.4.1.4 Climate change

Greenhouse gases are gases that exist in the earth's atmosphere and that contribute to global temperatures by reducing the loss of heat into space. This 'greenhouse effect' is a natural essential phenomenon in that without it, the planet would be cold and uninhabitable. However, the creation of excess greenhouse gases can lead to adverse impacts associated with excessive increases in global temperature. The major greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases. Significant sources of methane, nitrous oxide or fluorinated gases will not be associated with the proposed scheme. Traffic emissions are considered to be a significant source of carbon dioxide and this source of impact is considered in this assessment.

12.4.2 Mitigation measures

12.4.2.1 Dust

It is not possible to eliminate completely emissions of dust from construction sites. However, there are a number of good site practices that will be implemented to reduce the risk of dust effects arising during construction:

- All materials with the potential to cause dust will be covered during transport;
- Wheel washing facilities will be installed in all relevant construction sites and will be used by vehicles leaving the site;
- All material stockpiles with the potential to generate dust will be covered or dampened as necessary to minimise the potential for creation of dust. Particular precautionary measures will be undertaken if stockpiles comprise hazardous materials. Such measures will be agreed with the relevant authorities prior to commencement of the activity such that no adverse impact on the environment or human health is allowed to occur at any stage;
- Water suppression or dust extraction will be fitted where possible to construction equipment that has the potential to generate dust e.g. drilling, cutting and grinding equipment;
- On-site vehicle speeds on unhardened roads and surfaces will be limited to less than 15 kph;
- Drop heights for material transfer activities such as unloading materials will be minimised;
- Surfaces that are to be excavated or cleared will be dampened prior to clearing or excavation where there is potential for excessive dust to be created;
- Bowsers or similar equipment will be available for use in construction compounds to wash down surfaces and roads, particularly in periods of dry weather.

Tarmac laying and the associated use of hot bitumen can generate significant amounts of black smoke particles. This will be minimised by the application of the following measures suggested by the Building Research Establishment (BRE, 2000):

- bitumen will not be overheated and where possible, bitumen will not be heated with open flame burners;
- pots and tanks containing hot bitumen will be covered to minimise fume production;
- spillages will be minimised.

12.4.2.2 Vehicle emissions

The measures to be taken to minimise the potential for traffic generation and congestion, and associated emissions of PM_{10} and NO_2, are described in the Traffic chapter (Volume 2, Chapter 7).

12.4.2.3 Microclimate

A powerful method of off-setting the loss of vegetated surfaces is to plant trees, which have a large leaf area and transpire large quantities of water and thereby exert a significant cooling effect in summer. A summary of the key planting measures to be implemented at numerous locations across the proposed scheme is provided in this chapter. Details regarding the measures to be implemented are detailed further in the Landscape and Visual chapters (and Landscape Insertion Plans (see pages X to X)) of this EIS (Volume 2, Chapter 13).

- As much existing vegetation as possible is to be retained within and adjacent to the scheme. Trees that are to be retained will be protected in accordance with BS5837;
- Planting and/or hedgerow is to be introduced to compensate for vegetation loss;
- Planting is to be introduced on earthwork embankments and construction compounds to facilitate the reinstatement of these areas.

All bridges have been designed in accordance with appropriate safety design standards.

12.4.2.4 Climate change

The measures to be taken to minimise the potential for traffic generation and congestion, and associated emissions of CO_2, are described in "the Traffic chapter of the EIS (Volume 2, Chapter 7)

12.4.3 Assessment of residual impacts

12.4.3.1 Project scenario: construction phase

Dust

Sources

There are six construction compounds located within Area MN101. Most of these construction compounds are to be used for the delivery and storage of construction materials before distribution to relevant sections of the surface works. These compounds are also to be used for layout space for assembly of pre-fabrication material. Depending on volume, exposure and prevailing winds, there is potential for dust to be generated from the stored materials.

The activities in Area MN101 considered likely to give rise to construction dust are shown in Table 12.4.

Table 12.4 Construction activities having the potential to give rise to dust

Activity	Duration
Construction of Belinstown Depot	27 months
Construction of at grade stops.	Lissenhall Stop, 6 months Seatown Stop, 5 months Swords Stop, 5 months
Reinforcement of Lissenhall Bridge (with demolition occurring)	-
Construction of the Ward River bridge.	8 months
Construction of the Estuary Viaduct.	8-9 months
Demolition of footbridges at the Estuary and Seatown Roundabouts.	4 weeks
Construction of Malahide Underpass.	5 months
Construction of surface lines	
Depot to Lissenhall Stop	11-12 months
Lissenhall to Estuary Viaduct	12 months
Seatown Stop to Malahide Underpass	10 months

Sensitive Receptors

Maps (Air and Climatic Factors Baseline and Impact) included in Volume 3, Book 1 of 2 shows the boundaries of Area MN101 with dust buffers around construction compounds at 50m, 100m and 150m intervals. The alignment and construction compound boundaries have been used as the point from which to measure the distance contours, because it is not possible at this stage to pinpoint the actual locations of potential dust generating activities within specific construction compounds or along the route. In reality, the actual project worksites are likely to be more limited in their spatial extent than the boundary shown on the map would indicate.

Table 12.5 summarises the potential (non residential) receptors that are within 150m of the construction site.

It is expected that any potential effects of dust at St. Columbcilles School will be related to human health as the school is located within 50m of the construction compound and the Seatown Stop which will take up to 5 months.

Furthermore, there is one residential receptor located within 50m of Construction Compound 2 and the alignment. There are more expansive residential areas located either side of the alignment between the Estuary and Seatown Stop within 50m– 150m. Including Estuary Court, Neathercross Court and Seatown Villas. It is expected that the potential effects of dust deposition on the properties will be significant due to them being located within 50m of the alignment and construction of the Estuary Viaduct taking place over a period of approximately 9 months.

There are also a large number of residential receptors within 50m-150m of Construction Compound 4 near Swords Stop. Impacts on these properties will be potentially significant as construction of the stop at Swords will take 5 months. The significance of impacts, however, will depend on how close each residential receptor is to the construction compound.

Table 12.5 Summary of Potential Receptors to Construction Dust

Distance from Site Boundary (m)	Receptors
< 50m	St. Columbcilles Boys and Girls National School and retreat centre

Vehicle emissions

Changes in NO_2 and $PM_{2.5}$ across the proposed scheme in comparison to regulatory limits

Many of the changes described in the previous section do not lead to breaches of any regulatory limits. As described in the Baseline Air and Climatic Factors chapter of this EIS (Volume 1, Chapter 20), air quality along 3 road links of the traffic network of the proposed scheme is predicted to breach the NO_2 limit value of 40 µg m^{-3} in 2011 if the proposed scheme is not implemented. If the proposed scheme is implemented during construction, air quality at these 3 road links does not improve and breaches of the limit value persist. The breaches are not attributable to the proposed scheme however and are therefore not discussed any further.

The net result of the construction of the proposed scheme in 2011 is that the NO_2 concentration alongside a further 1 road link is predicted to exceed the NO_2 limit value of 40 µg m^{-3}. Table 12.6 shows the street link where a new marginal breach of the NO_2 limit value is predicted to occur in 2011, as a result of the construction phase of the alignment. This street link occurs within Area MN101.

The magnitude of change in NO_2 concentrations is 13.53 µg m^{-3}. This adverse impact would therefore normally be considered to be of medium magnitude because a change of between 5 and 25 µg m^{-3} in ambient NO_2 concentration occurs. However, this change leads to a breach of the 40 µg m^{-3} NO_2 limit value and therefore the impact is considered to be of high magnitude. As set out in the baseline Air and Climatic Factors chapter, (Volume 1, Chapter 20), any areas where a potential breach of any regulatory limit may occur are considered to be of very high functional value. This impact is therefore considered to be of High significance.

The proposed scheme does not have any impact in terms of changes in compliance or non-compliance with the limit values for PM_{10} or $PM_{2.5}$ in any area within MN101.

Changes in NO_2 and $PM_{2.5}$ across the proposed scheme

Changes in NO_2 and $PM_{10}/PM_{2.5}$ concentration (µg m^{-3}) for 2011 (the first year of construction) are presented in Table 12.7 for two scenarios: if the proposed scheme is not implemented and if it is implemented. The table shows the number of road links that will experience air quality improvements and degradations. The extent of change that will occur has been evaluated using the criteria detailed in Table 12.3 and the links on which changes will occur have been categorised into the relevant magnitude classes. It is assumed that vehicle exhaust is essentially all in the form of $PM_{2.5}$ and therefore may be thought of as contributing to PM_{10} or $PM_{2.5}$ concentrations equally.

Table 12.6 Street links where a new breach of the NO_2 limit value (40 µg m^{-3}) is predicted to occur in 2011

Road link	Street name	Magnitude of Change (µg m^{-3})	New Concentration (µg m^{-3})	Distance from Alignment
NO_2				
3562_3560	Link road from M1 Northbound to R127 north of Lissenhall	13.53	40.7	Between 500m and 1km

Source: Road names provided by MVA traffic consultants

Table 12.7 Road links with changes in NO_2 and $PM_{10}/PM_{2.5}$ Concentration (µg m^{-3}) from 2011 Do Minimum to 2011 With Metro

	Number of links with			
Impact Magnitude	Degradation in Air Quality with respect to NO_2 Concentration (µg m^{-3})	Improvement in Air Quality with respect to NO_2 Concentration (µg m^{-3})	Degradation in Air Quality with respect to $PM_{10}/PM_{2.5}$ Concentration (µg m^{-3}) (a)	Improvement in Air Quality with respect to $PM_{10}/PM_{2.5}$ Concentration (µg m^{-3}) (a)
high	0	0	0/0	0/0
medium	5	7	0/3	0/8
low	108	46	34/77	23/44
very low	12,318 (b)		12,427/12,352 (b)	

(a) Although the magnitude of the $PM_{2.5}$ and PM_{10} concentration changes are equal, the assessment criteria are not and so the impacts are distributed differently across the categories.

(b) This is the total number of changes as defined by a very low impact magnitude for both Degradation and Improvement combined

All of the changes in NO_2 and $PM_{10}/PM_{2.5}$ concentrations are of medium to very low magnitude. These changes are of Low significance.

Microclimate

During the construction phase, existing vegetated areas within Area MN101 will be temporarily converted to unvegetated areas due to the development of construction compounds, embankments and localised movement of plant and construction vehicles. The main sources of land-take are outlined in Table 12.8.

Area MN101 comprises approximately 5,125,000m² of land. Approximately 68% of this land currently comprises open green areas (3,510,000m²). The use of approximately 375,000m² of this area for the construction compounds is considered to be an impact of low magnitude and has no significance, in light of the fact that the land-take is short in duration (2-4 years approx.) and extensive green areas exist within the study area and further afield.

Table 12.8 Significant sources of temporary land-take within MN101

Land-take	Approximate area	Duration of land-take approximately
Compound 1	336,000m²	4 years
Compound 2 Option 1	24,000m²	2 years
Compound 2 Option 2	6,000m²	2 years
Compound 3 Chapel Lane Footbridge	3,000m²	2 years
Compound 3A	4,000m²	2 years
Compound 4 – Malahide South Footbridge	2,000m²	2 years
Total	375,000m²	

Climate change

Predicted CO_2 emissions in the do minimum year of 2011 are detailed in the Baseline Air and Climatic Factors chapter of this EIS (Volume 1, Chapter 20). The annual CO_2 emissions from vehicles during construction that will be produced in 2011 if the proposed scheme is implemented are detailed in Table 12.9 along with the percentage change relative to baseline emissions.

Table 12.9 CO_2 Emissions from Network in 2011 (tonnes annum^{-1})

Do Metro 2011 (tonnes annum^{-1})	Change relative to baseline (%)
2, 671,268 [a]	+0.6 %

(a) Estimated using DMRB methodology

The magnitude of change in CO_2 emissions in 2011 during construction if the proposed scheme goes ahead is very low and is, therefore, of no significance. The slight increase arises through a slight reduction in overall vehicle speeds on parts of the network and the additional traffic associated with construction activity.

12.4.3.2 Project scenario: operational phase

Modelling results for 2014, the first operational year of the scheme, showed less of an influence on air quality than for 2029; therefore, these results have not been discussed in detail in this section. They are however presented in the technical report included as Annex G. The 2029 results reflect the worst case scenario and are detailed in the following sections.

Dust

There are no ventilation shafts in Area MN101.

Vehicle emissions

Changes in NO_2 and $PM_{10}/PM_{2.5}$ across the proposed scheme in comparison to regulatory limits

As described in the Baseline Air and Climatic Factors Chapters in this EIS (Volume 1, Chapter 20), air quality along six road links of the proposed scheme within the 50m band alongside the road are predicted to breach the NO_2 limit value in 2029 if the scheme is not implemented. If the scheme is implemented, air quality at these six road links improves such that breaches of the limit value no longer occur. The six relevant links are shown in Figure 12.1.

The magnitude of improvement in NO_2 concentrations for the majority of the six links shown in Figure 12.1 is between -10 and -20 µg m^{-3}. This positive impact would normally therefore be considered to be of medium magnitude. However, the changes are such that breaches of relevant legislative limits no longer occur. The impacts are therefore considered to be of High magnitude and Medium significance.

Table 12.10 Street links where improvements in NO_2 concentrations result in compliance with the NO_2 limit value (40 µg m^{-3}) in 2029

Road link	Street name	Magnitude of Change (µg m^{-3})	New Concentration (µg m^{-3})	Distance from Alignment
NO_2				
5165_5144 [b]	Taney Road	-18.11	26.28	More than 5km
5014_5011 [b]	N11	-18.47	25.95	Between 3km and 4km
4250_4210 [b]	N7 Eastbound	-12.01	29.19	More than 5km
1833_1832	Oscar Traynor Road	-26.1	27.24	Between 2km and 3km
1415_1408	Berkeley Road	-17.51	24.99	Between 250m and 500m
2013_2012	Junction between College Green, Westmoreland Street and College Street.	-11.32	32.65	Less than 250m

(a) North of the alignment

(b) South of the alignment

Source: Road names provided by MVA traffic consultants

The result of the implementation of proposed scheme in 2029 is that there will only be one road link where NO_2 concentrations are predicted to exceed the NO_2 limit value (part of the Red Cow Roundabout). The link is shown in Figure 12.1 and Table 12.11. The magnitude of increase in the annual average NO_2 concentration for this link is approximately 13 µg m^{-3} and causes a marginal breach of the regulatory limit. This negative impact is therefore considered to be of high magnitude and of Medium significance.

Table 12.11 Street link where a new breach of the NO_2 limit value (of 40 µg m^{-3}) is predicted to occur in 2029

Road link (a)	Street name	Magnitude of Change (µg m^{-3})	New Concentration (µg m^{-3})	Distance from Alignment
NO_2				
4221_4220 (b)	Part of the Red Cow Roundabout, going from the East to the West (4221 to 4220), roundabout linking Western Parkway, R110 and Naas Road	12.98	41.41	More than 5km

(b) All links are South of the alignment

Source: Road names provided by MVA traffic consultants

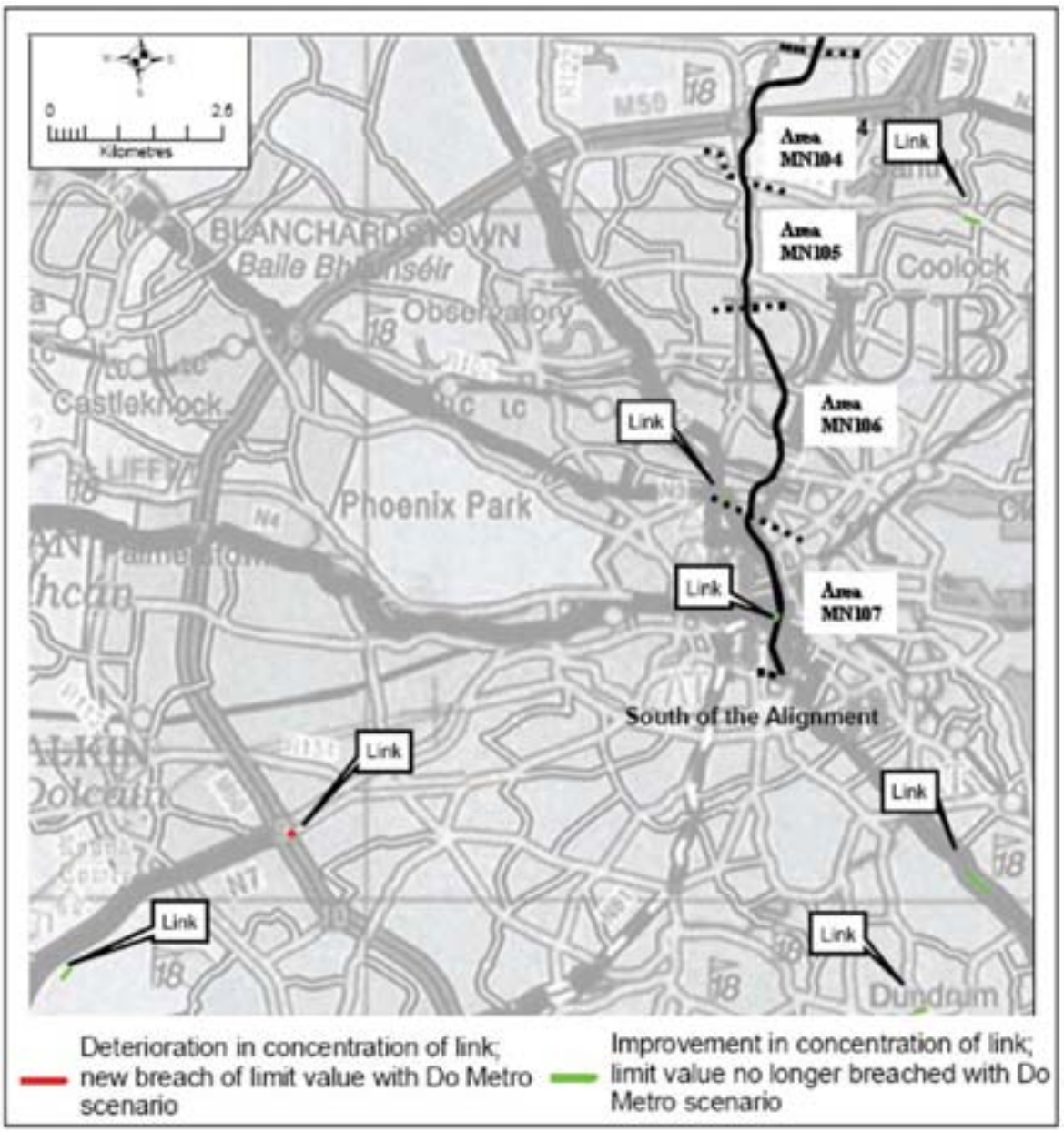

Figure 12.1 Road links where changes in compliance with regulatory NO_2 levels occur

If the proposed scheme is implemented, PM_{10}/$PM_{2.5}$ concentrations will decrease substantially alongside several road links. The proposed scheme does not have any implications in terms of compliance with PM_{10}/$PM_{2.5}$ limit values.

Changes in NO2 and PM10/PM2.5 across the entire scheme

Changes in NO_2 and PM_{10}/$PM_{2.5}$ concentration (µg m-3) for 2029 are presented in Table 12.12 for two scenarios: if the scheme is not implemented and if it is implemented. The table shows the number of road links with air quality improvements or degradation related to the magnitude of concentration changes for both NO_2 and PM_{10}/$PM_{2.5}$

Table 12.12 Road Links with changes in NO_2 and PM_{10}/$PM_{2.5}$ Concentration (µg m-3) from 2029 Do Minimum to 2029 With Metro

	Change in NO_2 Concentration (µg m-3)		Change in PM_{10}/$PM_{2.5}$ Concentration (µg m-3)	
Impact Magnitude	Number of links with Degradation in Air Quality	Number of links with Improvement in Air Quality	Number of links with Degradation in Air Quality	Number of links with Improvement in Air Quality
high	0	1	0/0	0/0
medium	47	45	0/7	3/14
low	595	536	68/184	63/198
very low	11,404 (a)		12,225 (a)	

(a) This is the total number of insignificant positive and negative changes as defined by a very low impact magnitude

All of the changes in NO_2 and PM_{10}/$PM_{2.5}$ concentrations are of medium to very low magnitude. These changes are of Low significance

Microclimate

Area MN101 comprises approximately 5,125,000m² of land. Approximately 68% of this land currently comprises open green areas (3,510,000m²). Permanent land-take will occur in this area due to features such as the Belinstown Depot and Park & Ride, the surface stops of Lissenhall, Seatown and Swords, and the at-grade sections of the alignment. This impact is not considered to be significant in light of the extensive landscaping measures to be carried out in Area MN101 (especially at the depot) and the fact that large vegetated areas will remain within the study area and extensive other green areas exist in the wider area.

The maximum speed of the LMVs in any area along the alignment is approximately 70km/h. This speed is not high enough to cause significant impacts on wind turbulence and thus microclimate. The topography of Area MN101 is relatively flat such that significant channelling of wind does not occur in any area. Large structures such as the depot are therefore unlikely to have a significant adverse impact on wind patterns in the local area The elevated structures to be constructed in this area (including the Ward River Bridge, Estuary Viaduct, Chapel Lane Footbridge and Malahide South Footbridge) are all relatively low in terms of elevation, or are span bridges with spaces through which air can travel. Impacts associated with cold air pooling and shading are therefore unlikely to occur and are not considered significant.

All of the bridges that are constructed are designed for an appropriate wind loadings and safety railing are eliminate any safety hazards arising from wind exposure.

Climate change

Predicted CO_2 emissions in the do minimum year of 2029 are detailed in the Baseline Air and Climatic Factors Chapter of this EIS (Volume 1, Chapter 20). The annual CO_2 emissions from vehicle emissions that will be produced in 2029 if the proposed scheme is implemented are shown in Table 12.13, along with the percentage change relative to baseline emissions.

Table 12.13 CO_2 Emissions from Network in 2029 (tonnes per annum)

Do Metro 2029 (tonnes annum-1)	Change relative to baseline (%)
3,096,110 (a)	- 0.6 %

(a) Estimated using DMRB methodology

The magnitude of change in CO_2 emissions in 2029 if the proposed scheme goes ahead is low and is, therefore, insignificant. The decrease is a result of a combination of traffic re-routing associated with the direct impacts of the proposed scheme on road capacity and the modal shift from car to the rail system. Emission factors are used to predict future emissions; these depend on fuel consumption and the carbon content of fuel. Emission factors decrease in the future as fuel consumption changes with improvements in vehicle efficiency and carbon content from 2008 to 2020 will reflect the introduction of bio-fuels.