The Upgrade of the M50 in the context of an integrated approach to transportation in Dublin

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Synopsis: This paper presents an overview of the development of the M50 upgrade scheme from inception through to statutory approval. It covers issues such as options considered, traffic modelling and assessment and EIS preparation. It also includes a description of project procurement.
Background

Introduction

Arup commenced a study on the M50 Upgrade Scheme in 2000 with a brief to “maximise the capacity of the built portion of the “C” ring (M1 to M81) by measures such as the provision throughout its length of an additional lane in each direction, the incorporation of noise and amelioration measures, the identification of necessary modifications to interchanges and the possible applications of telematics.” It also required Arup to “examine the capacity of the remaining section of the M50”, from N81 to N11, and “to recommend the measures necessary to balance and complement the identified and agreed development necessary to maximise the capacity of the built portion of the “C” ring”.

As the M50 traverses the local authority areas of Fingal, South Dublin and Dun Laoghaire Rathdown and Dublin City, a Steering Committee with a representative from each local authority was established to guide the Arup Study Team. The NRA and the DTO were also represented on the Steering Committee. Arup and the Steering Committee reviewed the brief, expanding the study to look at alternatives to widening.

The study took place in the period 2000 – 2004 with the scheme development being put on hold midway through the process, pending funding approval. Extensive optioneering, traffic analysis and public consultation were undertaken and an EIS prepared. An Oral Hearing took place in December 2004 / January 2005 and the construction of the upgrade scheme is being progressed under both Design and Build and PPP Contracts.

This paper describes the scheme development from initial brief through to completion of the Oral Hearing and briefly outlines how the construction is being procured.
History of M50

The existing M50 is a result of over three decades of planning and construction during the period in which Dublin and indeed Ireland have experienced unprecedented growth and change. The first section of the motorway to be constructed was the Western Parkway, which opened in 1990. The Northern Cross and Southern Cross followed in 1996 and 2001, respectively. The final section, the South Eastern Motorway opened in 2005, Figure 1.

Traffic and economic growth are generally highly correlated and the M50 is no exception. The M50 has experienced compound traffic growth rates of between 8% and 10% on most sections in the period between 1997 and 2003, Figure 2.

The M50 was originally conceived as an orbital route to carry longer distance strategic traffic around and away from the city centre. It is also the most significant crossing of the River Liffey and one of the few outside the urban centre of Dublin. The M50’s strategic function will increase in importance with the opening of the Dublin Port Tunnel and it will continue to provide access to strategic facilities such as Dublin Airport and Dublin Port. However, in addition to its strategic function and as a result of the growth in development along the corridor, the existing M50 now performs a more local function connecting residential and commercial centres on and adjacent to the corridor as well as catering for commuting traffic.

Although the implementation of the DTO “A Platform for Change Strategy” will provide more and better alternatives to the car for short distance local trips as well as commuters, the M50 is likely to maintain its multi-functional role even if, in the case of non-strategic traffic, this is reduced.

Existing M50

The M50 was designed as a dual 2-lane motorway with a wide median, facilitating a later upgrade to a dual 3-lane motorway. However statutory approval for the construction to dual 2-lane motorway standards only was received at that time. The design is typical of that of a rural motorway with a wide median and hard shoulders. The existing M50 generally has 2 x 3.75 m lanes in each direction with a hard shoulder up to 3.0m wide. The Northern Cross, Western Parkway and South Eastern Motorway sections have a design speed of 120 kph, while the Southern Cross section has a design speed of 100 kph.

The M50 crosses the River Liffey at the Westlink Bridge between the N3 and N4 interchanges. The original bridge was constructed as a 4 lane bridge (2 lanes in each direction). A second bridge was constructed in 2003 and the two bridges combined now provide 3 lanes in each direction. This section of the M50 was procured as a Public Private Partnership (PPP) project with the concessionaire, National Toll Roads (NTR) collecting direct tolls at the Westlink Toll Plaza.

The existing Westlink Toll Plaza is located immediately north of the Westlink Bridges and has seven lanes and toll booths in each direction. There are currently three payment methods available including manual collection (where change is given), automatic coin machines and a pre-pay electronic tag system (Eazy Pass).

The M50 has interchanges with most of the main radial routes leading into Dublin City Centre. The national primary and secondary interchanges consist of grade separated four-leg roundabouts, generally over the M50 except at the N2 where it is located under the M50. The other interchanges are similar or consist of grade separated four-leg dumbbell style interchanges.

The increase in traffic growth on the M50 and change in travel patterns over recent years have given rise to significant capacity challenges. The main issues are:

• Congestion on many interchanges and on the mainline;
• Difficulty for traffic merging onto the mainline;
• Queues on merge and diverge slip lanes;
• Congestion on the approaches to the Toll Plaza; particularly in peak periods.

<table>
<thead>
<tr>
<th>M50 Section</th>
<th>Location</th>
<th>Opening Year</th>
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</thead>
<tbody>
<tr>
<td>Western Parkway and Westlink Toll Plaza</td>
<td>N3 Interchange – N81 Interchange inclusive</td>
<td>1990</td>
</tr>
<tr>
<td>Northern Cross</td>
<td>M1 Interchange – N3 Interchange</td>
<td>1996</td>
</tr>
<tr>
<td>Southern Cross</td>
<td>N81 Interchange – Ballinteer Interchange</td>
<td>2001</td>
</tr>
<tr>
<td>Second Westlink Bridge</td>
<td>Between N3 and N4 Interchanges</td>
<td>2003</td>
</tr>
<tr>
<td>Southern Eastern Motorway</td>
<td>Ballinteer Interchange to M11 at Shankill</td>
<td>2005</td>
</tr>
</tbody>
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Figure 1 History of M50

Figure 2 AADT in PCUs
Policy and Planning Context

The M50 is part of the national road network of Ireland and traverses through the Local Authority areas of Fingal, South Dublin and Dun Laoghaire-Rathdown and Dublin City. The development of the M50 is therefore important in a national, regional and local planning context.

The M50 Motorway plays an important role at a national level due to its scale, function and location. Dublin is the capital city of Ireland and a third of the total population of Ireland reside in the Greater Dublin Area (GDA).

Considerable employment, shopping and community services for the country are also located in the Greater Dublin Area. Planning policy on a national level includes the National Development Plan (NDP), 2000-2006 and the National Special strategy. The NDP, under the Strategy for Transport in the Greater Dublin Area, includes provision for the widening of the C-ring (M50) to three lanes, together with improvements to the interchanges.

Policy and planning documentation was drawn up for the Greater Dublin Area to guide development, taking place as a result of the unprecedented growth in population, housing, traffic volumes, etc. The M50 Motorway plays a very important role in traffic flow between Dublin and adjacent Counties. Planning and policy documentation relevant at a regional level includes:

- Strategic Planning Guidelines for the Greater Dublin Area (SPGDA), 1999
- Regional Planning Guidelines Greater Dublin Area (RPGGDA) 2004

The Strategic Planning Guidelines for the GDA were prepared to provide a coherent strategic planning framework for the local authority Development Plans and for the provision of major transportation, sanitary services and other infrastructure.

In September 2000, the DTO published “A Platform for Change Strategy 2000-2016” (DTO Strategy) - outlining its transport strategy for the period 2000 – 2016. A final report was published in November 2001. This strategy supports and complements the strategic land use planning framework described in the SPGDA. The strategy comprises two interdependent elements, first infrastructure and service improvements and secondly demand management. Infrastructure and service improvements are proposed to “increase the supply of transport, including substantial expansion of the public transport network (including LUAS, Metro, DART and bus services), some strategic road construction and traffic management”. It includes “upgrading and completion of the orbital motorway around Dublin (M50, Dublin Port Tunnel and Eastern By-Pass)” and “upgrading the arterial national routes outside the orbital motorway”. It is included as Government Policy in the Transport 21 initiative.

The RPGGDA were adopted in July 2004 and supersede the SPGDA. This is the first regional policy document which is designed to implement the provisions of the National Spatial Strategy at a regional level. The M50 widening and interchange improvements are listed as a key strategic national road infrastructure project.

Outline Methodology

Development of the M50 Upgrade Scheme involved an initial assessment of the alternatives to upgrading the M50. The option of doing nothing was deemed unacceptable as the traffic congestion on the M50 is predicted to worsen in the future despite the implementation of public transport proposals (such as the Luas and Metro), road improvements and demand management strategies as proposed in the DTO Strategy for Dublin.

Alternative major road schemes were investigated including:
- provision of a new outer orbital route
- a new connection to the M50 between the existing N4 and N7 interchanges via a possible new M7.
- the provision of a new link road between the N2 and N3 as a possible measure to reduce traffic congestion at the N3 interchange and therefore minimise the need for improvements at this interchange.

In addition to the major alternative road schemes, a range of other alternative measures were examined. These included:
- the use of the third lane as a dedicated orbital facility for buses and taxis.
- A number of low cost traffic management measures, including partial use of the hard shoulder at specific locations and extension of some merging lanes, to alleviate problems at specific locations on the M50.
- Minor M50 interchange improvements such as improved signalisation, further segregated left turn lanes, traffic management and bridge widening to provide additional lane capacity, in conjunction with provision of a third lane in both directions.

After consideration of each alternative it was determined that none of these options would realistically provide a solution that would offer the same benefits and alleviate the need for upgrading the M50. Hence upgrading the existing M50 infrastructure was selected as the preferred option.

An incremental approach was taken to the design of each component of the M50 Upgrade Scheme. The approach involved examining at first minor upgrades, and then increasing in increments until one or more schemes met the design criteria of improving capacity, whilst taking account of the environmental, economic and physical site constraints. Dedicated pedestrian and cyclist facilities were also incorporated into the Scheme design.

DTO Transportation Model

The DTO Transportation Model was the principal traffic design and analysis tool used in the development of the DTO Strategy for Dublin. It has been and continues to be a consistent basis upon which to provide transport forecasts for use in the evaluation of major infrastructure proposals in the Greater Dublin Area. The model was used for the evaluation of both Luas and the Dublin Port Tunnel as well as for the development of a strategy for the proposed Eastern Bypass. The model has been used in developing the proposed M50 Upgrade Scheme. Since the original development of the model in the early 1990s, it has been extended, modified and upgraded many times to reflect the growth of Dublin along with new development and traffic trends.
The model has a number of strengths that make it well suited to carrying out this type of transportation analysis. Among these are:

- The model is multi-modal and as such is able to take into account the relative attractiveness of all motorised modes of surface transport (car, heavy goods vehicles, bus and rail) in trip making decisions.
- The highway assignment model takes full account of junction delays caused by congestion and the impacts of this congestion on bus travel. Recent improvements to the highway model have involved extending the model network to include parts of Kildare, Wicklow and Meath, as well as extension of the highway simulation model outside the M50.
- The model establishes a realistic mode choice based on the relative perceived ‘generalised’ costs of a given trip by the modes available to the trip maker. This cost is determined by applying a monetary value to both the time and distance elements associated with any trips. In performing this mode split, the cost of trips by car varies with the level of congestion on the road network.
- The model covers the entire Dublin Urban Area and takes into account trips to and from regions of the country outside this area.
- The DTO Transportation Model was used to predict both peak hour and inter peak hour flows for the forecast years 2008 and 2023.

The model incorporates all of the transport proposals, which comprise the integrated transportation strategy for the Dublin area as outlined in the DTO Strategy. In demographic terms, the transportation model forecasts incorporate population and household projections based on the development plans supplied by the seven Local Authorities in the Greater Dublin Area (Fingal, South Dublin, Dun Laoghaire Rathdown, Dublin City, Kildare, Meath and Wicklow), as well as estimates of population growth for the region from the Strategic Planning Guidelines. Projections of employment were based on land zoned for future development and other related information supplied by the local authorities and the DTO.

The DTO Transportation Model is regularly updated and refined to maintain its currency. Earlier iterations of this upgrade scheme for the M50 were developed between 2000 and 2002 using the version of the model available at that time. The proposals put forward in this scheme were reviewed as part of a design development exercise and a number of the interchange layouts were considered. In the intervening period the model was updated and further refined. The preferred Scheme was reassessed in 2003 and early 2004 using the new model.

General Approach to Transport Assessment

The purpose of the transportation assessment was to quantify the effect of the proposed Scheme particularly in terms of its operational performance, value for money and its effect on the transport network in Dublin. The transport network includes all motorised transport modes such as cars, buses and commercial vehicles and rail. The assessment also provides the necessary traffic data for use in the environmental assessment, particularly for the noise, air quality, climate and community assessment aspects.

With regard to operational performance, consideration was given to the proposed improvements for both interchange and mainline capacity and the resulting benefits in reduced traffic congestion that these would bring to the M50 corridor and the wider road network. Value for money was assessed by undertaking a cost benefit analysis which weighed the monetary value of savings in travel time, fuel consumption and accidents, etc. against the capital cost of the Scheme and its future maintenance costs.

Importantly, the transportation assessment also evaluated and quantified the impact of the Scheme on public transport modes both in the M50 corridor and the Greater Dublin Area. Demand management has not been incorporated as part of the current proposals. However it is anticipated that it will be implemented as required after opening of the Scheme.

The objective of the M50 Upgrade Scheme is to improve the capacity of the M50 within the context of an integrated transportation strategy for Dublin. In order to establish the infrastructure provision necessary to meet this objective a basic methodology was established. The steps in the methodology were:

Comprehensive traffic surveys were undertaken on the M50 and its interchanges to identify the location and scale of traffic congestion problems on the existing M50. Many of the problems were identified as being connected with capacity constraints at the interchanges and merging slip lanes as well as at the Toll Plaza.

The Dublin Transportation Office (DTO) Transportation Model was considered to be the most appropriate traffic forecasting tool and was used to quantify the scale of future traffic volumes on the M50 and its interchanges in the forecast years 2008 (year of opening) and 2023 (design year) if nothing was done (Do-Minimum Scenario).

Having quantified the scale of traffic growth in the Do-Minimum Scenario, strategic and off-line alternatives such as parallel routes, a new orbital route, as well as other measures such as a dedicated bus/ taxi lane were considered.

On concluding that these alternatives would not meet the project objectives, the transportation model was used to assess the benefits of on-line schemes specifically addressing the traffic issues identified in the Do-Minimum Scenario. These schemes, which included the widening of the main line to three lanes in both directions and interchange upgrades, formed the basis of the Scheme (Do-Something Scenario).

An iterative design process followed in which the proposals were continuously refined and evaluated to optimise the project objectives and to minimise the environmental impact within the physical constraints of the corridor. The Scheme that evolved was progressed to preliminary design stage, and is referred to as the Do-Something Scenario.

The process of identifying a solution to the M50 capacity problems was an iterative one, in which the performance of alternative designs for the interchanges and mainline were compared with the Do-Minimum Scenario in future years. The evaluation was conducted by making use of traffic performance criteria for the mainline and interchanges.

Do-Minimum Scenario

The Do-Minimum Scenario encapsulates all elements of the existing Dublin transportation network as well as the transport infrastructure commitments of...
the DTO Strategy, except for the M50 Upgrade Scheme. It provides a means of quantifying the extent of future traffic congestion on the existing M50 as well as a benchmark against which to evaluate and compare the possible upgrade options. Specifically the Do-Minimum Scenario comprised the following:

- Existing dual 2-lane carriageway on the M50.
- Existing M50 interchange configurations.
- Agreed improvements to the radial routes outside the M50.
- All other measures and proposals included in the DTO Strategy for the two forecast years 2008 and 2023.

The proposed Eastern Bypass, which will connect Sandyford to the Dublin Port Tunnel, is a longer-term proposal assumed to be completed after 2008, which would potentially have a significant impact on traffic flows on the Southern Cross Route and South Eastern Motorway sections of the M50.

In addition, it was anticipated that, at the time of opening of the upgraded M50 in 2008, legislation will be in place to allow the concessionaire to replace the existing toll plaza with a free-flow electronic toll collection system based on a combination of electronic tag readers sited on overhead gantries and number plate recognition.

Do-Something Scenario
The Do-Something Scenario for each of the design years 2008 and 2023 was based on the widening of the M50 to dual 3-lane motorway between the M1 and Sandyford together with auxiliary lanes between the M1 and Scholarstown and associated interchange upgrades. The public transport and other infrastructure proposals contained in the DTO Strategy, which are anticipated to be completed and operational by each forecast year, were also included in this Scenario.

Operational Performance Criteria
Operational criteria were established to assist the design process and as a means of quantifying the likely scale of traffic problems that would occur on the existing M50 if nothing were done, as well as the benefits that would arise from the proposed improvements. For the mainline carriageway use was made of the Congestion Reference Flow (CRF). The CRF of a link, as defined in the UK Design Manual for Roads and Bridges, is an estimate of the Annual Average Daily Traffic (AADT) flow at which the carriageway is likely to be ‘congested’ in the peak periods on an average day. For the purposes of calculating the CRF, ‘congestion’ is defined as the situation when the hourly traffic demand exceeds the maximum sustainable hourly throughput of the link. At this point the effect on traffic is likely to be one or more of the following:

- Traffic flow breaks down with speeds varying considerably;
- Average speeds drop significantly;
- The sustainable throughput is reduced and queues are likely to form.

The CRF, however, is a measure of the performance of a mainline link between junctions. The performance of junctions/interchanges will be considered separately.

Implications of Do-Minimum Scenario
Within the context of the DTO strategy, the Do-Minimum Scenario examines the consequences on the transport network if upgrading of the M50 does not occur.

Interchanges
It is clear that current congestion and the spreading of that congestion outside normal peak hours (peak spreading) will increase in the future if no improvements are implemented. This will be exacerbated by growth in traffic on the main radial corridors outside the M50 due, in part, to the major upgrading proposals currently planned for these routes. Based on an analysis of the forecast year morning peak, it is anticipated that two way traffic on the radial routes outside the M50 from 2004 will grow by approximately 12% by 2008 and 26% by 2023.

The forecast traffic conditions in 2023 at the M50 Interchanges in the Do-Minimum Scenario were assessed using peak hour traffic forecasts. The analysis identifies that the traffic demand at many of the existing interchanges will significantly exceed capacity. This will result in the deterioration of what are currently unacceptable conditions and will further exacerbate traffic congestion at these locations and on the wider road network. This will have serious implications on journey times and reliability for bus services using the interchanges as well as general vehicular traffic.
Mainline Carriageway

The development of the mainline widening and its extent was based on an assessment of future traffic conditions on the existing M50, i.e. the Do-Minimum Scenario and in the knowledge that sections of the mainline are frequently congested at present. The results of this analysis are illustrated in Figure 3 for the year of opening, 2008 using the Annual Average Daily Traffic Flow (AADT). The figure also incorporates the Congestion Reference Flow (CRF), which in the figure relates to a dual 2-lane carriageway.

There are a number of important factors which will affect the relative growth on individual sections of the M50 in the future:

- Sections currently operating at or around capacity are likely to experience lower levels of traffic growth due to these capacity constraints.
- The implementation of public transport infrastructure, particularly in the longer term, will have a dampening effect on traffic growth by encouraging modal shift.
- The implementation of major roads infrastructure, e.g. Eastern Bypass, will have an impact on the distribution of traffic on sections of the M50.

Taking the above into account, it can be seen from Figure 3 that many sections of the M50 will be operating around or above capacity by 2008.

Combined with the capacity limitations at the interchanges and at some of the merging and diverging motorway slip roads, the growth in traffic predicted in the Do-Minimum Scenario will further exacerbate the current traffic congestion problems on the motorway and its approach roads.

Using the CRF threshold as an initial guide in assessing the potential need for the widening of each section of the M50, the forecast traffic flows in Figure 3 show that in 2008 traffic flows on many of the existing sections of the M50 will be at or considerably in excess of the threshold.

Based on the 2008 traffic forecasts alone widening of the M50 to three lanes is justified between Ballymun and Sandyford. In terms of the strategic integrity of the M50, however, it would not be appropriate to exclude the short section between the M1 and Ballymun (and hence access to Dublin Port Tunnel and Dublin Airport) from the widening proposals.

Development of the Scheme

The development of the Scheme required the preparation of outline designs for the mainline and interchanges, incorporating facilities for Vulnerable Road Users (VRUs) such as pedestrians and cyclists.

The design process for increasing the capacity of the M50 within the context of an integrated transportation strategy for Dublin was an iterative one combining inputs from a diverse team of experts. Having established the objective of the study and formulated the transportation assessment methodology, the various team members then combined to develop a design which achieved the Scheme objectives while taking into account environmental, community, engineering and economic issues.

The design development for the M50 Upgrade Scheme occurred mainly over the period between 2000 and 2004 with the Scheme development being put on-hold mid-way through the process pending funding approval. As a result, a preliminary upgrade scheme for the M50 was developed between 2000 and 2002 using the DTO Traffic Model current at that time with forecast traffic design years of 2006 and 2016. The Scheme proposals were progressed between 2003 and 2004 and a number of the interchange layouts were re-considered. The proposed Scheme was then tested using the new DTO model with forecast traffic design years of 2008 and 2023. The opening year of 2008 was also considered to be a more achievable target opening year.

As before, the new DTO traffic model assumes that the proposals in the DTO Strategy will be delivered by 2016. The traffic volumes forecast in the 2023 DTO Traffic Model are generally higher than those predicted in the 2016 Traffic Model. Therefore the Do-Minimum and design iteration assessments were not repeated as part of the design development.

Mainline Widening

The development of the mainline widening and its extent was based on an assessment of future flows if the Scheme was not implemented, i.e. the Do-Minimum as described earlier. It is proposed that the M50 be widened to 3 lanes in each direction between the M1 and Sandyford.

Of significant benefit to the mainline widening of the M50 is the width of central median that generally allows for central widening. Therefore, it is possible to provide an additional third lane using mainly the existing median without a requirement for more land for additional lanes.

A detailed review of all bridges over and under the M50 followed to establish any constraints in terms of width and clearance available for widening. The main constraint identified during this review was the arched bridges at the N3, which have sufficient width to accommodate only three carriageway lanes and a sub standard hard shoulder. Other constraints that were considered in the process include existing drainage, utilities, noise and lighting.

A further influencing factor on the mainline cross section was the weaving movements from the proposed interchange schemes. The forecast increase in traffic flows and associated weaving movements generated a need to extend the length of on- and off-ramps at the interchanges. Given the close proximity of the M50 interchanges and to facilitate safe merging, it was concluded that these slip lanes should be extended to form auxiliary lanes between the M1 and Scholarstown Interchanges. It should be noted that the auxiliary lanes do not continue through the interchanges themselves. Auxiliary lanes are currently provided on the M50 between the N7 and Ballymount and between the N81 and Scholarstown interchanges.

Following an iterative process of examining a range of alignments, stopping sight distances and design speeds within the constraints identified, a scheme with a design speed of 100km/h was adopted.

Interchange Upgrades

An incremental approach was taken to the development of the interchange upgrade options for the scheme. The design process was based on an understanding of the physical and environmental constraints at the location and an understanding of the future traffic movements, which was based on the DTO model traffic forecasts and on existing traffic survey data.
The process, which involved examining at first minor upgrades, then increasing in scale of improvement until one or more schemes meets the design criteria. The initial minor upgrades identified possible improvements such as the revision of lane markings, the introduction of traffic signals or further segregated left turn lanes. If these did not achieve the design criteria objectives then more substantial measures were considered including bridge widening and in the case of the N2, N3, N4 and N7 Interchanges, the possible construction of radial flyovers across the interchanges. At the N7 Interchange the design proposals also had to optimise the performance of the interchange incorporating the operation of the Luas. At most of the major interchanges the provision of free-flow turning movements on some or all of the links was utilised to achieve the design objectives.

At an early stage, radial flyovers of the M50 were considered but were rejected as they did not accommodate the projected future traffic flows containing significant left and right turns on and off the M50. In addition, the radial flyovers were generally not considered to be environmentally acceptable as they added a third level to the interchanges.

Due to the urban location of the M50, the interchange sites are constrained by existing adjacent development. Traditional free flow interchange designs were, therefore, not appropriate. Alternative compact interchange designs were developed, based on experience from similar constrained interchanges in Australia and elsewhere.

All options were considered and compared in the context of the following:

- environmental effects
- cost
- future flexibility
- integration with public transport
- buildability
- construction disturbance
- land take

With all interchange upgrades the selected layout takes account of the existing interchange structures and seeks to provide the additional infrastructure necessary through the integration of new elements with the existing elements. This has the advantage of minimising the extent of new construction with the subsequent advantages of efficiency, speed of construction, minimisation of traffic disturbance and reduced construction impacts.

**Proposed Scheme**

**Do-Something Scenario**

The Do-Something transport Scenario for each of the forecast design years 2008 and 2023 was based on the widening of the M50 to dual 3-lane between the M1 and Sandyford (incorporating auxiliary lanes in each direction between the M1 and Scholarstown) together with the associated interchange improvements. All other transport schemes included in the Do-Minimum Scenario were included in the Do-Something Scenario for the appropriate forecast years.

The process of developing the detailed Scheme proposals took into account the capacity of the motorway and its interchanges, the physical and environmental constraints, the impact on the other modes of transport, as well as the economic return on the substantial investment, which would be required.

**Interchanges**

Significant improvements are proposed at the existing interchanges on the M50 to address existing and future traffic congestion and to balance the demand associated with the upgrade proposals.

The performance of the interchange improvements was compared with the Do-Minimum Scenario. The analysis clearly demonstrated a significant improvement in interchange performance compared to the Do-Minimum, the effect of which will be to relieve the unsatisfactory levels of traffic congestion which currently exist at the interchanges and which will deteriorate if nothing is done.

The proposed interchange improvements will also provide major benefits to other road users including bus passengers on radial services currently crossing the M50. By substantially reducing congestion at the interchanges, the proposed improvements will underpin the benefits delivered by the existing and proposed Quality Bus Corridors on the radial routes both inside and outside the M50.
The interchange improvements and the provision of high standard merges and diverges combined with the provision of an auxiliary lane in both directions between most of the interchanges will significantly improve accessibility to the motorway for general traffic and for bus services. The auxiliary lane, by providing a longer distance for merging with the main line carriageway, will improve safety by providing improved merging facilities.

**Mainline Carriageway**

The forecast daily traffic flows (AADT) on the Scheme in 2023 are provided in Figure 4.

Even with the higher traffic forecasts on the Scheme, the widened mainline carriageway will result in improved performance levels as measured by % CRF on the majority of sections of the M50 but particularly on the most heavily trafficked sections between the N3 and Ballinteer. This, combined with the reduction in traffic congestion resulting from the main interchange improvements is reflected in the major economic benefits discussed later.

The improved performance levels on the M50 are also reflected in increased journey speeds associated with the Scheme where on average, the Scheme improves peak hour traffic speeds on the M50 by 10 kph (19%) in 2008 and 6 kph (11%) in 2023.

The above performance analysis, however, is a conservative one based on the assumption that the auxiliary lanes on both carriageways between the M1 and Scholarstown do not contribute to the operational capacity of the mainline carriageway due to the relatively close proximity of the M50 interchanges. In practice, however, the proposed auxiliary lanes will have a positive effect on mainline capacity by improving the efficiency of merging and diverging traffic and by allowing some diverging traffic to exit earlier, thus reducing the traffic flow on the mainline.

Whilst wider demand management measures incorporated in the DTO Strategy have been taken into account in the production of the traffic forecasts using the model, specific measures related to the M50 have not. To ‘lock in’ the benefits arising from this major asset, it will, therefore, be necessary to implement more specific demand management measures to control the level of traffic growth on the radial routes travelling through the M50 junctions towards the city is however largely neutral. The M50 Upgrade Scheme will therefore improve access on to and off the motorway without significantly affecting journey times for traffic travelling into the city centre and is consistent with DTO policy, which seeks to discourage any increase in commuting by car to Dublin city centre and to encourage the use of alternative transport modes. In this situation the existing and proposed Quality Bus Corridors on the radial routes into Dublin City Centre will continue to provide a realistic and attractive alternative for many commuters.

**Other Roads**

The improved traffic conditions on the principal radial routes together with reduced congestion at the M50 junctions will substantially reduce traffic congestion on the radial routes approaching the motorway from outside the M50, hence improving access to the motorway, particularly during peak hour. This effect is illustrated clearly in Figure 5 which compare the average traffic speeds in the Do-Minimum and Do-Something Scenario in the morning peak hour for both 2008 and 2023. Similarly improved access will also be experienced by traffic travelling to the M50 from radial routes inside the motorway. The cumulative effect for traffic on radial routes travelling through the M50 junctions towards the city is however largely neutral. The M50 Upgrade Scheme will therefore improve access on to and off the motorway without significantly affecting journey times for traffic travelling into the city centre and is consistent with DTO policy, which seeks to discourage any increase in commuting by car to Dublin city centre and to encourage the use of alternative transport modes. In this situation the existing and proposed Quality Bus Corridors on the radial routes into Dublin City Centre will continue to provide a realistic and attractive alternative for many commuters.
interchanges and additional capacity on the M50 itself, are also expected to deliver a reduction in traffic volumes on the majority of other roads.

**Modal Shift**

An aim of the DTO Platform for Change Strategy is to produce a major change in modal shift away from use of the private car, in favour of public transport in the Greater Dublin Area. Upgrading of the M50 is an integral part of the DTO Strategy and as such it is recognised that it will have some effect on the demand for other modes, providing substantial increased capacity for vehicular traffic. However, assessment shows that this increased capacity will have minimal impact on modal split. Demand management on the M50, as proposed in the DTO Strategy would, likely have a positive impact on modal split.

**Quality Bus Network**

The DTO Strategy regards buses as the most flexible form of public transport, which can be implemented quickly and effectively. The Strategy therefore recommended a Quality Bus Network (QBN), which is made up of Quality Bus Corridors (QBCs) with the attributes of extensive bus priority measures, continuous high frequency throughout the day, new high quality vehicles and improved infrastructures (shelters etc.).

In the design of the M50 Upgrade Scheme, specific allowance for dedicated (physical) bus lanes has not been provided within the main interchanges. The principal reason for this design assumption is that once constructed, there will be greatly improved capacity at the interchanges reducing congestion. This will significantly improve journey times and reliability for all traffic including bus services. The Scheme therefore will reinforce the benefits of the existing and proposed QBCs on radial routes into Dublin City Centre ensuring that they provide a realistic, reliable and attractive alternative for many commuters.

**Luas: Connolly to Tallaght Line**

In the upgraded N7 interchange scheme the Luas line crosses the road layout at approximately the current locations. The crossings will be at grade, as before, and will be signal controlled. The signal timings will be designed to provide similar Luas tram crossing frequency as for the existing road. The scheme will, therefore, support the benefits of the Luas line providing a realistic, reliable and attractive alternative for many commuters.

**The Wider Effects on Congestion**

The implementation of the Scheme will have far reaching benefits and will significantly reduce traffic congestion on the whole of the Dublin road network.

As forecast by the DTO Model, traffic speeds on the city-wide network in the morning peak hour in 2008 are predicted to increase from 21.7kph in the Do-Minimum to 23.7kph with the Scheme, an increase of 9%. An increase of 12% is also forecast in off-peak traffic speeds in 2008. These are very significant improvements in the context of the overall Dublin road network and will benefit all road based transport including buses.

**Proposed Scheme**

The M50 Upgrade Scheme comprises the upgrade of 31km of the M50 mainline to dual 3-lane motorway standards between the M1 and the Sandyford Interchanges together with the upgrade of 10 interchanges along this length as described below. Pedestrian and cyclist facilities have been provided at all interchanges, except the M1 Interchange, as part of the M50 Upgrade Scheme.

It is proposed to widen the M50 mainline through the addition of a third lane in each direction. This will generally be carried out within the existing central median. In order to facilitate merging interchange traffic, an auxiliary weaving lane will be provided between interchanges on the section between the M1 and Scholarstown Interchanges. There are currently auxiliary lanes on the M50 between the N7 and Ballymount and the N81 and Scholarstown Interchanges.

To facilitate access on and off the motorway seven interchanges will receive major upgrades involving the reconfiguration of the interchanges to include full or partial free flow lanes.

**M1 Interchange**

- The M1 Interchange will provide free flow lanes for all M50/M1 traffic movements. The interchange is grade separated with the M1 mainline passing underneath the M50. The existing roundabout will be maintained as a signalised roundabout to accommodate N32 traffic. Three new bridges will be constructed. This is a motorway-to-motorway interchange so facilities for pedestrians and cyclists are not provided at this location.

**N2 Interchange**

- The interchange will be upgraded to a partially free flowing interchange. The interchange is grade separated with the M50 mainline passing over the N2. The existing bridges over the roundabout will be re-used and a further four new road bridges and one new pedestrian/cyclist bridge will be constructed.

**N3 Interchange**

- The interchange will be upgraded to a partially free flowing interchange. The interchange is grade separated with the M50 mainline passing underneath. The bridges on
the existing roundabout will be re-used and a further fifteen new road bridges and two new pedestrian/cyclist bridges will be constructed. The Interchange layout will generally separate national and local traffic and will upgrade access to Blanchardstown.

**N4 Interchange** - The interchange will be upgraded to a completely free flowing interchange. The interchange is grade separated with the M50 mainline passing underneath. The two existing bridges will be re-used and a further four new road bridges and one new pedestrian/cyclist bridge will be constructed. In addition one existing pedestrian bridge will be reconstructed as a pedestrian/cyclist bridge.

**N7 Interchange** - The interchange will be upgraded to a partial free flowing interchange. The interchange is grade separated with the M50 mainline passing underneath. The existing two bridges from the roundabout will be used and a further three new road bridges and two new pedestrian/cyclist bridges will be constructed.

**Ballymount Interchange** - The interchange will be a fully signalised interchange with the existing roundabouts removed. Free flow slip lanes will be provided for left turning traffic. The existing bridge will be upgraded to three lanes and one additional two lane road bridge will be constructed to the north of the existing road bridge. One pedestrian/cyclist bridge will be constructed on the south side of the existing bridge.

**Scholarstown Interchange**: The upgrade involves reconfiguring the existing bridge to three lanes and providing an additional three-lane bridge with one-way pedestrian/cyclist facilities to the south and a new one-way pedestrian/cyclist bridge to the north. The interchange will be fully signalised.

Less extensive upgrades such as the addition of left slip lanes and/or traffic signals to the existing roundabouts are proposed at the Ballymun, N81 and Sandyford Interchanges.

**Westlink Toll Facility** - It was proposed to upgrade the Westlink Toll Plaza on a phased basis to a fully free flow electronic toll collection system. However, this proposal is now being reconsidered by the NRA.

**Design Standards**

**Mainline Design**

The Northern Cross, Western Parkway and South Eastern Motorway were originally designed to a 120 Kph design speed. The Southern Cross is designed to a 100 Kph design speed. However, since the motorway opened, traffic volumes have grown significantly and few places remain where daytime operating speeds of 120 Kph are attainable. A major contributing factor is the turbulent flow at interchange merges and diverges and associated weaving between interchanges.

There are a number of locations on the Western Parkway where the full 120 Kph design speed sight line is not achieved. This deficiency would be increased when the proposed scheme is constructed by reducing the width of the median and installing safety barriers. Suitable sight distance with relaxations can be maintained for 100 kph design speed. The M50 mainline widening has, therefore, been designed for a 100 kph design speed.

The existing horizontal and vertical alignment and superelevation of the M50 mainline will generally remain unchanged. Widening in the median will be undertaken by extending the existing crossfalls to the edge of the new road pavement. Any differences in level across the median will be taken out by using batters or by the provision of retaining walls.

By widening the M50 in the central median there are instances where the
design standards need the application of a relaxation. These generally relate to reductions in stopping sight distance resulting from the inclusion of a safety barrier in the central median.

From the M1 to Scholarstown an additional auxiliary lane in each direction will be provided between interchanges, to improve the weaving opportunities and provide a better level of service at merges and diverges. Variations from this cross section are required in some sections of the mainline.

Interchange Design
The interchange concepts have been developed using the Design Manual for Roads and Bridges (DMRB) as published by the NRA. Specifically the following documents have been used:

- TD 22/92 - Layout of Grade Separated Junctions
- TD 39/94 - Layout of Major Interchanges
- TD 40/94 - Layout of Compact Grade Separated Junctions
- TD 42/95 - Geometric Design of Major/Minor Priority Junctions
- TD 50/99 - The Geometric Layout of Signal Controlled Junctions and Signalled Roundabouts
- TD 9/03 - Road Link Design
- TA 43/03 - Guidance on Road Link Design
- TD 27/00 - Cross Sections and Headroom
- Other international standards and documents have also been consulted.

These include:
- CALTRANS Highway Design Manual (Californian standards - USA),
- TACATC – Geometric Design Guide for Canadian Roads,
- Department of Main Roads (Queensland Australia), and
- Determination of Interchange Types on Freeway Facilities – Paper by Joel Leisch.

These standards have also been used in assessing road safety and determining suitable design parameters such as design speeds and stopping sight distances.

At the main radial routes, the need to minimise the land take has resulted in a more compact form of junction than would be used for a new build motorway. It has been the objective of the design to maintain an appropriate design speed for each of the alignments within the junction layouts. The design, therefore, has tried to achieve a balance between maintaining appropriate combination of horizontal geometry, design speed and superelevation. Where changes in speed environment have been identified, the design aims to provide, where possible, a progressive increase/decrease in speed through the junction.

Design speeds have been selected after an assessment of the existing constraints and the anticipated speed environment. Drivers are currently required to stop or travel at low speeds within the existing interchanges due to high traffic volumes causing congestion.

As there will be the introduction of low speed geometry (loops) suitable acceleration and deceleration lengths will be provided to and from the mainline. Gantry signs will also be provided to give drivers’ advance warning of approaching geometry and advice on appropriate operating speeds.

The design speeds generally being adopted are shown in Table 1.

<table>
<thead>
<tr>
<th>Location</th>
<th>Design Speed (Kph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mainline</td>
<td>100</td>
</tr>
<tr>
<td>Slip-Roads</td>
<td>70</td>
</tr>
<tr>
<td>Interchange Links</td>
<td>50</td>
</tr>
<tr>
<td>Loops</td>
<td>30 (min)</td>
</tr>
</tbody>
</table>

Table 1 Desirable Design Speeds

The majority of interchanges along the M50 present particular difficulties for the provision of desirable minimum horizontal standards. The design approach was to provide maximum feasible horizontal curves as part of a coordinated design approach, and where required, relaxations and departures requested.

The interchanges were also designed taking account of advice contained in TA43/03, particularly, driver comfort and gross lateral acceleration. Where loop geometry has been applied, it is in accordance with TD22/92 and TD40/94.

The interchange links have generally been designed for a speed of 50 kph. However, there are some locations where the constraints have necessitated the inclusion of tighter horizontal geometry and in these cases a lower design speed has been adopted.

The following standards have been adopted for superelevation:

<table>
<thead>
<tr>
<th>Type</th>
<th>Superelevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>3%</td>
</tr>
<tr>
<td>Desirable Maximum</td>
<td>5%</td>
</tr>
</tbody>
</table>

Table 2 Superelevation Standards

A maximum superelevation of 5% has generally been adopted to reduce the risk of large slow vehicles slipping during icy conditions.

The rollover between different superelevations is traditionally provided over the length of a transition curve. However TD 40/94 does not require the inclusion of transition curves within a compact interchange. For this project, straight curves have generally been incorporated within interchanges to provide geometry over which the rollover can take place.

Lane widths have generally been designed as Table 3.

With the introduction of low radii geometry, the lanes have been widened as necessary to provide adequate sweep paths for large vehicles in accordance with Table 7/2 of TD42/95.

In an attempt to standardise the outer shoulder and hard strip widths within the interchanges, they have generally been designed with widths of 1.5 m and 0.5 m respectively. Radial roads have generally been designed to either match existing or with a 2.5 m nearside shoulder and a 1 m hard strip.

Verge widths have generally been maintained at 3 m on both sides of the roadway. However, in constrained locations and on slip roads the verge has been reduced to 1.5 m. Where it is necessary to achieve the required sight stopping distances, widening of

<table>
<thead>
<tr>
<th>Location</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Line</td>
<td>3.50m desirable: 3.25m minimum</td>
</tr>
<tr>
<td>Connecting Radial</td>
<td>3.65m</td>
</tr>
<tr>
<td>Interchange Links 1 lane</td>
<td>4.00m</td>
</tr>
<tr>
<td>Interchange Links 2 lanes</td>
<td>3.65m desirable: 3.50m minimum</td>
</tr>
</tbody>
</table>

Table 3 Lane Widths
the verges and outer shoulders / hard strips has been undertaken.

Vertical geometry has been designed to conform to the requirements of TD9/03 Table 3. Where grades are above the maximum grades as documented in the standards, a departure has been requested. Diverges and merges have been designed for a mainline design speed of 100 kph and in accordance with the requirements of TD22/92.

Cost Benefit Analysis

A cost benefit analysis, using variable matrix techniques appropriate to the evaluation on an urban scheme was undertaken to assess the economic worthiness of the Scheme as a stand-alone project when compared with the Do-Minimum Scenario. In reality, however, the principle of the M50 upgrading proposal is an integral part of a much larger package of transport measures being promoted for the Dublin area which, it is generally accepted, are essential to the continued economic well being of the city and its environs.

The benefits incorporated in the cost benefit analysis include travel time savings to road based transport (including buses and taxis) as a result of the reduction in traffic congestion on the M50 corridor and on the associated road network, as well as changes in vehicle operating costs and accidents. The costs take account of both the initial capital costs of providing the infrastructure as well as the ongoing maintenance. The estimated cost of the Scheme at 2004 prices is €807 million exclusive of VAT.

An evaluation period of 30 years was adopted with the costs and benefits discounted over that period to a base year of 2004 using a 5% discount rate as recommended by the Department of Finance for capital projects.

The cost benefit analysis for the M50 upgrade proposals demonstrate clearly that significant economic benefits would accrue from the proposed Scheme, by far the largest element of the benefits being the value of the time savings resulting from the reduction in traffic congestion on the network.

In this instance the combined monetary benefit of time savings, vehicle operating costs and accident savings amount to a Present Value of Benefits of €4,919 million. Allowing for capital and maintenance costs, this results in a Net Present Value of €4,142 million and a benefit cost ratio of 6.33.

The above analysis did not take into account the effects of specific Scheme demand management measures were they to be introduced. The implementation of such measures would be likely to reduce the economic benefits arising from the Scheme. Nevertheless, the Benefit Cost Ratio demonstrates a sufficiently robust economic outcome to suggest that even with Scheme demand management in place the Scheme’s value as a stand alone project, as well as its contribution to and inclusion in the DTO Platform for Change Transport Strategy, would be very significant.

Project Procurement

The project is being progressed in three separate phases:

Contract 1
Design and build contract for the construction of the N4, N7 and Ballymount interchanges, the associated mainline widening and the Monastery Road overbridge. Following competitive tender, this contract has been awarded to SIAC Ferrovial JV, with completion due in 2008.

Contract 2
A PPP Contract for the construction of the M1 to N3 interchanges and associated mainline widening and the N81 to Sandyford interchanges and the widening from Ballymount to Sandyford. A prequalification process for PPP Tenderers is currently (March 06) underway.

Construction of widening the mainline between the N3 and N4 interchanges and removal of the Westlink Toll Plaza will be undertaken under separate contracts.

Statutory Procedures

Public Consultation

Non-statutory public consultations were undertaken during development of the Scheme, in particular during the preliminary design development and the EIS preparation phase of this project. The issues and concerns identified during this period were incorporated into the design of the Scheme where possible and addressed in the EIS.

The first public consultation sessions were held in July and August 2001. The developing scheme was presented and explained to the community using design drawings, photographs, artistic impression sketches, physical models and videos. Members of the Design and the EIS team and representatives from the Local Authorities were available at specified sessions to provide further detailed information.

Questionnaires and pre-paid reply envelopes were distributed at the con-
sultation sessions to enable individuals to readily make written submissions on the proposed scheme and the issues to be addressed in the EIS. Over 400 written submissions were received after the consultation. A database of all submissions was maintained to record and analyse the opinions expressed in the submissions and also to record the corresponding actions undertaken by the project team. The community raised many issues and concerns both verbally and as part of the written submissions. These concerns were addressed where possible as part of the design development and the environmental impact assessment process.

As the design development process progressed, taking the public comments into consideration, significant changes to the design of several aspects of the scheme were adopted. The most significant of these changes was at the N3/M50 interchange. Feedback on the initial scheme presented indicated that the proposed rearrangement of Scott’s roundabout in Blanchardstown provided reduced access/egress at the revised junction. Concerns were also expressed about the difficulty of getting to and from Blanchardstown Village and the surrounding areas, the potential effects on business, the lack of capacity at Snugborough interchange and the likely increase in travel times.

As a result of this feedback, the Scheme was amended to generally separate longer distance traffic from local traffic, particularly at Scott’s roundabout. The revised scheme provides access to Blanchardstown Village, the James Connolly Memorial Hospital and a fitness centre, while generally providing free-flow conditions for national traffic. All existing road, rail and canal bridges are used within the improved interchange. The provision of the additional traffic movements in this revised option required additional infrastructure and thus has associated additional costs. A portion of these additional costs was set against the need to upgrade Snugborough Interchange in the earlier scheme. The Scheme was adopted as the benefits in terms of access to the local community and improved capacity on the N3 were significant.

An additional public display of these changes to the N3, and other changes to the N7 and the West-Link Toll Plaza was presented in January 2002.

Formal Scoping was undertaken in November 2001 as provided for under Section 50 of the Roads Act 1993 as amended. This allows for An Bord Pleanála to provide a written opinion on the information to be contained in the EIS. This opinion was taken into consideration in the preparation of the EIS.

In addition to the formal scoping, a number of government and non-government bodies were also consulted with regard to the scheme including amongst others:
- Eastern Regional Fisheries Board
- Córas Iompair Éireann
- Dublin Bus
- Waterways Ireland
- Dublin Transportation Office
- Department of Environment, Heritage and Local Government (Formerly Dúchas – The Heritage Service)
- An Taisce
- An Chomhairle Oidhreachta – The Heritage Council
- An Chomhairle Ealaíon – The Arts Council
- An Bord Pleanála
- Various local authority departments.

Environmental Impact Statement

The EIS published in September 2004 is a statement of the likely effects on the environment of the proposed M50 Upgrade Scheme. The impact assessment methodology assessed the likely effects of the Scheme on the environment for the Scheme opening year (2008) and/or design year (2023) and compared them with the scenario without the proposed Scheme. The assessment methodology for the EIS also incorporated any significant interaction of impacts.

A noise and vibration assessment was undertaken for the construction and operation of the proposed Scheme. The assessment was undertaken with regard to the guidance set out in the National Roads Authority (NRA) Draft Guidelines for the Treatment of Noise and Vibration in National Road Schemes 2004.

Construction noise levels were predicted to be generally lower than the recommended maximum permissible construction noise levels at most properties in the vicinity of the proposed Scheme, although greater levels may also occur. Because of the nature of the works and the necessity to keep these very busy interchanges operational, there may be occasions when the NRA draft noise guidance limits will be exceeded. Mitigation measures have been incorporated into the Contract documents to reduce the impact of construction noise at sensitive receptors. The application of the Noise and Vibration Management Plan will ensure that noise impact is kept to a minimum consistent with efficient construction practices.
Construction of the proposed road scheme is not expected to give rise to vibration that is either significantly intrusive or capable of giving rise to structural or even cosmetic damage.

The NRA guidelines specify noise design goals for new national road developments in Ireland during operation as follows:

- day-evening-night
  60dB $L_{den}$ (free field)
- night (23:00hrs to 07:00hrs)
  50dB $L_{night}$ (free field)

A noise model was also prepared to predict the future noise levels at noise sensitive locations both with and without the Scheme in 2008 and 2023.

In accordance with the criteria outlined in the NRA guidelines, noise mitigation measures were required as part of the Scheme at numerous locations along the M50 mainline and interchanges. Noise mitigation measures in the form of both low noise road surfacing and noise barriers are included as part of the Scheme. Approximately 16km of new noise barriers will be constructed. In addition, it is required to increase the height of approximately 7 km of existing barriers/walls for noise mitigation purposes. The proposed noise barriers are generally between 2.0 m and 4.0 m in height though some are up to 6.0 m in height.

With mitigation in place, all receiver locations comply with the NRA design goals, except at four locations. However, at these four locations, measures have been taken to reduce road traffic noise as far as is practicable.

The level of noise residual impact has been assessed by consideration of predicted changes in noise level due to the proposed Scheme. This was done for the Scheme opening (2008) and design (2023) years by calculating the change in noise day-evening-night levels ($L_{den}$) and night levels ($L_{night}$).

With the incorporation of the mitigation measures, the residual impacts are as follows:

- For $L_{den}$ in the Opening Year (2008) – the impact is not significant at 170 locations, minor positive at 9 locations and moderate positive at 6 locations
- For $L_{night}$ in the Opening Year (2008) – the impact is not significant at 166 locations, minor positive at 14 locations and moderate positive at 5 location
- For $L_{den}$ in the Design Year (2023) – the impact is not significant at 178 locations and minor positive at 7 locations
- For $L_{night}$ in the Design Year (2023) – the impact is not significant at 177 locations, minor positive at 7 locations and moderate positive at 1 location.

In summary, the proposed Scheme will be either not significant or positive at all of the noise sensitive locations in the immediate vicinity.

No vibration impacts are predicted during the operation phase of the Scheme.

An air quality assessment was undertaken for the construction and operation of the Scheme in accordance with the guidelines provided in the United Kingdom Design Manual for Roads and Bridges. It involved an assessment of the existing air quality and prediction and assessment of future air quality using modelling techniques. Mitigation measures have been proposed where appropriate to reduce, remedy or avoid significant adverse impacts.

Detailed dust modelling techniques were used to predict dust deposition rates and dust concentrations during construction of the Scheme. The construction activities at the N3 and N4 Interchanges were assessed as they have the greatest potential to result in adverse impacts due to the magnitude and length of construction and the close proximity of residential properties.

Based on monthly daily mean dust deposition rates, the construction activities were predicted to have a minor adverse impact on air quality at the N3 and N4 Interchanges. It should be noted however that at limited times during the works, some exceedance of the generally accepted deposition level of 250 mg/m²/day may occur.

A construction methodology will be devised by the contractor that will reduce the potential for adverse environmental impacts on local receptors. Dust control measures incorporated into a construction methodology include vehicle wheel-washing; appropriate storage, handling and transport of dusty materials; provision of hoard-

Visual Impact Studies at Coldcut Road
M50 Upgrade

...ing/barriers to prevent dust breakout; and appropriate site dust monitoring included within the site management practices to inform site management of the success of dust control measures used.

An air quality model was prepared to predict the future air quality at sensitive locations both with and without the Scheme in 2008 and 2023. In general, the pollutant concentrations at the receptors modelled are predicted to increase with the proposed Scheme in place.

This would be expected due to the increased traffic flows associated with the Scheme and, in some cases, the closer proximity of the realigned interchanges to the receptors. Overall the proposed Scheme is determined to have a minor adverse impact on air quality in terms of local air quality, when compared with predicted air quality without the Scheme in place.

An assessment of the impacts of the operation of the proposed Scheme on regional air quality associated with vehicle emissions was undertaken. Overall it is predicted that operation of the proposed M50 Upgrade Scheme will result in small changes in the pollutants assessed, with the maximum increase of 0.62% for NOx in 2023.

With regard to landscape and visual impacts, along the mainline of the M50 corridor, adverse impacts during construction will generally be minor as the changes relate primarily to the central median and portions of the outside grass verge, thus retaining most of the existing screen planting along the M50. There will, however, be some severe impacts and several major impacts at sections along the Scheme, including the M1, N3, N4 and N7 Interchanges, and sections of mainline between the N3 and the River Liffey and between Edmonstown Road Underbridge and Ballinteer Interchange. This is predominately due to the intensity of works in these areas and the likelihood that all of the existing screen vegetation will be removed during construction, combined with the number of residential and other property types adjacent to the Scheme at these locations. Impacts at the interchanges where less extensive works are proposed will range from minor to moderate adverse impacts, as existing vegetation will be maintained wherever practicable.

Two assessments of the level of landscape and visual impact were undertaken for the operational phase of the Scheme. These include:

- Impact of the completed Scheme on a winter’s day in the year the Scheme would open (2008), when planting mitigation measures are least effective.
- Impact in the winter of the design year for the Scheme (2023), taking account of the proposed mitigation measures and planting.

Mitigation measures have been proposed so as to visually re-integrate the proposed development in its existing setting and to reduce the adverse nature of visual impacts wherever practicable. Mitigation measures include retention of existing planting where possible and extensive areas of new planting of dense vegetation / landscaping comprised of native species, to improve the character of the view.

The visual impact of the Scheme on a winter’s day in the year of opening was generally predicted to be minor to not significant, with some instances of moderate impact at the N4 and N7 Interchanges and along the mainline between the River Dodder and Edmonstown Road Underbridge. There will also be major impacts during the opening year at the M1 and N3 Interchanges. These impacts have been predicted to decrease over time as the landscaping matures. In overall terms, by the design year 2023, it is considered that upgrading of the mainline will have no significant residual impact while for the upgrading of the main interchanges, the M1, and N4 Interchanges will have minor residual impacts.
An Archaeological, Cultural Heritage and Architectural Heritage assessment was undertaken for the construction and operation of the proposed Scheme.

Two sites, Archaeological Site16 (area of potential), Archaeological Site 19 (habitation site) will be impacted directly by construction of the Scheme. No Architectural Sites will be directly impacted. Sixteen river crossings may be directly impacted during construction of the scheme to varying extents depending on the construction methodology employed.

Following the EIS publication, areas to be affected by the construction and identified by the NRA project archaeologist as being relatively undisturbed, were archaeologically tested. No archaeological features were identified.

Additional road lighting will be provided as part of the M50 Upgrade Scheme to ensure road lighting for the upgraded Scheme meets the road lighting standards. The potential impact of spill lighting from the proposed lighting design has been assessed for the construction and operation of the Scheme.

The spill lighting assessment indicated that average light spill along the mainline of the M50 would be in the order of 1.2Lux (on the horizontal plane) at 20m from the motorway boundary. This level is comparable to bright moonlight and considerably lower than the standard for residential street lighting and the effect is considered to be not significant.

Impacts from spill lighting at the interchanges were predicted to be not significant with the exception of two properties, which are predicted to experience minor and moderate impacts.

An assessment of the impacts of the proposed Scheme on community was undertaken with regard to the guidelines given in UK Design Manual for Road and Bridges. Communities are taken to constitute groups of people and the study does not assess the impact of the Scheme on particular persons / households/ businesses.

A major part of this assessment considered: (i) changes in journey length resulting from physical alterations to the road and increased traffic volumes, (ii) changes in journey amenity, (iii) the impact on community/recreational resources, and (iv) public transport.

The Contractor will be responsible for the preparation and implementation of the Community Liaison Plan during the construction phase with the aim of minimising the impact on the community as far as practicable.

Existing cyclist and pedestrian access will be maintained where feasible, and temporary alternative routes will be provided where necessary. Significant traffic delays, temporary diversions, speed restrictions, lane restrictions and contra-flows are likely adjacent to construction works. The contractor is required to liaise with bus operators to minimise the potential disruption to services. Some bus stops will require relocation during construction works and pedestrian access to these will be provided.

The upgrade of the N3 interchange will require temporary disruption of the Dublin-Maynooth/Sligo railway line. At the N7, the Luas line will be affected. Any temporary track closures/possessions and temporary train/tram speed restrictions will be agreed in advance with Iarnród Éireann/RPA and timed to minimise, in so far as is practicable, delays and disruption to railway operations and the travelling public.

The predicted impact of the proposed M50 Upgrade Scheme on private property and material assets to be fully or partly acquired by the scheme was assessed. The impact were assessed in terms of loss of buildings/facilities (including planning permissions), size of land holding, size of landtake, proximity to the route, loss of access, viability of the commercial, community or agricultural property and level of severance.

A total of nine (9) properties will be fully acquired and/or are predicted to experience a major adverse impact due to the proposed scheme, consisting of six (6) commercial properties, two (2) residential properties and one (1) undeveloped private landholding. These acquisitions will result in a major adverse impact.

The EIS also considered in some detail the affect of the scheme on climate, terrestrial ecology, surface water resources and soils and geology. While a level of protection of these resources is required during construction, no significant residual effects are anticipated.
Land and Property Issues

A key principle governing the design and construction of the Scheme was the minimisation of land take, and therefore, the impact on the local community. The method of widening the mainline will have limited impact on adjacent land. Where land has been acquired along the mainline this is predominantly required for the installation of walls/barriers and drainage works including emergency spill containment facilities. Similarly the design of the interchanges incorporates the use of compact loop geometrical interchanges primarily to reduce encroachment on surrounding land.

The acquisition of a total of 20 ha of private land and a further 35 ha of public (local authority and government owned) land was required for the construction and operation of the M50 Upgrade Scheme. Approximately 90 residential, commercial, agricultural, community and recreational properties, Local Authority land and Government land, were affected by the Compulsory Purchase Order (CPO).

The construction and operation of the M50 Upgrade Scheme requires the permanent acquisition of one private dwelling and one local authority owned dwelling.

Oral Hearing

The CPO and EIS for the Scheme were submitted to An Bord Pleanála in late September 2004. A total of 26 no submissions were made regarding the CPO and 226 regarding the EIS. A number of these were common to both.

The Board held a public oral hearing for the scheme over a two week period in December 2004/January 2005. Representations were made at the hearing by residents associations, landowners, homeowners, public representative and other interest groups.

Particular attention was focused on the following:

- Land take, disturbance and accommodation works at lands affected by the CPO
- Construction disturbance to local residents
- Strategic transportation issues, including the construction of the upgrade prior to the provision of public transport provision (metrol) and demand management measures
- Revision to the N3/M50 interchange to the east, and its interaction with the rail and canal, to improve access arrangements to adjacent lands

The Board gave approval to construct the scheme, subject to conditions in April 2005.

Comparison with Scheme Objective

As described earlier, the objective of the Scheme is to improve the capacity of the M50 within the context of an integrated transportation strategy for Dublin. The proposed Scheme will deliver this basic objective and supply further benefits to road users.

- The Scheme will result in an increase in the capacity of the M50 motorway, which will allow all road users including key public transport services, such as buses and taxis as well as commercial vehicles to benefit from significantly reduced traffic congestion. Given the multi-functional role that the M50 will continue to perform, these benefits will be shared by both local transport movements and those serving the strategic locations, such as the Airport and Dublin Port. The DTO Strategy recognises that these benefits of improved accessibility and reduction in congestion, particularly to the port and airport for passengers and goods, are required to support the regional economy and are also significant in a national and international context.
- The improvements proposed at the interchanges and on the mainline are consistent with providing a more balanced major road hierarchy. They complement, at strategic level, the improvements to the radial routes outside the M50 and other major infrastructure, such as the Dublin Port Tunnel. At the detailed level the Scheme will provide more efficient access to the M50 itself by reducing congestion on the approach routes and reducing the potential for traffic queues forming on the off ramps reducing the effectiveness of the motorway.
- The Scheme will be beneficial in delivering traffic reductions on a number of local roads in and around the M50 corridor.
- The Scheme will not create conditions which encourage additional commuting to the city centre by car.
- Neither will the Scheme generate any significant levels of induced traffic which have not already been incorporated in the transportation assessment.
- The monetary value of the significant benefits derived from the Scheme is encapsulated in the cost benefit analysis and a robust economic performance.
- To protect the benefits of the Scheme, it will be necessary in the future to implement specific Scheme demand management measures to control the level of traffic growth on the motorway. The precise nature of these measures will be established when the Scheme is operational.

Acknowledgement

The authors wish to acknowledge and thank the members of the M50 Steering Committee and their staff for their guidance and support during the development of the M50 Upgrade Scheme. They would also like to thank the many members of the Arup Team for their ongoing commitment to the project and the specialist sub-consultants who provided valuable support throughout.