

GLENAMUCK DISTRICT DISTRIBUTOR ROAD



Dún Laoghaire-Rathdown
County Council Comhairle Contae
Dhún Laoghaire-Ráth an Dúin

PRELIMINARY DESIGN REPORT

JULY 2007

RPS



Glenamuck District Distributor Road Scheme

Preliminary Design Report

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TABLE OF CONTENTS

1	INTRODUCTION.....	6
1.1	TERMS OF REFERENCE AND REPORT FORMAT	6
1.2	GLENAMUCK DISTRICT DISTRIBUTOR ROAD	6
1.3	NEED FOR AND BENEFITS OF THE SCHEME	7
1.4	THE NEXT STAGE	10
2	SCHEME DESCRIPTION	11
2.1	INTRODUCTION	11
2.2	GLENAMUCK DISTRICT DISTRIBUTOR ROAD	11
2.3	LINK ROAD	11
2.4	EXISTING GLENAMUCK ROAD	11
2.5	ENNISKERRY ROAD AND KILTERNAN VILLAGE	12
2.6	SCHEME LAYOUT DESCRIPTION	12
3	TRAFFIC.....	14
3.1	INTRODUCTION	14
3.2	EXISTING INFORMATION	14
3.3	PREFERRED ROUTE OPTION	16
3.4	METHODOLOGY	18
3.5	BASE YEAR TRAFFIC FLOWS 2004	19
3.6	FUTURE DESIGN YEAR TRAFFIC FLOWS	20
3.7	CROSS SECTION REQUIREMENT	21
3.8	LINK CAPACITY	23
3.9	JUNCTION STRATEGY	23
3.10	PUBLIC TRANSPORT PROVISION	31
3.11	MOBILITY MANAGEMENT PLANS.....	32
3.12	PEDESTRIAN AND CYCLIST INFRASTRUCTURE.....	32
3.13	CONCLUSIONS	32
4	GEOMETRIC DESIGN OF RECOMMENDED ROUTE.....	34
4.1	GENERAL	34
4.2	DESIGN CODES	34
4.3	JUNCTION STRATEGY	34
4.4	ROAD TYPES	36
4.5	GEOMETRIC DESIGN	36
4.6	GROUND CONDITIONS	38
4.7	PAVEMENT	39
4.8	DRAINAGE	40
4.9	ROAD SIGNAGE AND PUBLIC LIGHTING.....	46
4.10	SERVICE RELOCATIONS	48

4.11 BOUNDARY TREATMENT 49

4.12 SAFETY AUDIT 49

5 ENVIRONMENTAL ASSESSMENT 50

5.1 INTRODUCTION 50

5.2 ENVIRONMENTAL DISCIPLINE 50

6 COST ESTIMATE 60

6.1 INTRODUCTION 60

6.2 CONSTRUCTION ELEMENTS 60

6.3 COST OF PURCHASING LAND 61

6.4 SUMMARY 62

LIST OF FIGURES

Figure 1.1	Location Plan
Figure 1.2	Existing Local Road Network
Figure 1.3	Local Planning Objectives
Figure 2.1	Proposed Road Layout
Figure 3.1	Route Option A
Figure 3.2	Route Option B
Figure 3.3	Route Option C
Figure 3.4	Preferred GDDR Route Option C - Scheme and Junction Layout
Figure 3.5	Base Year 2004 – Calibrated and Validated AADT Flows
Figure 3.6	Not Used
Figure 3.7	Design Year 2016 ‘Do Minimum’ & ‘Do Something’ - Estimated AADT Flows
Figure 3.8	Design Year 2022 ‘Do Minimum’ & ‘Do Something’ - Estimated AADT Flows
Figure 3.9	Proposed GDDR Dual Carriageway Urban Cross Section A - A
Figure 3.10	Proposed GDDR and Link Road Single Carriageway Urban Cross Section B – B
Figure 3.11	Proposed Link Road Single Carriageway Urban Cross Section C – C
Figure 3.12	2022 ‘Do Something’ Scenario – AM Peak Traffic Flows, Key Junctions Only
Figure 3.13	Junction 1 - Indicative Geometric Layout – Roundabout Junction
Figure 3.14	Junction 3/9 - Indicative Geometric Layout – Signal Control
Figure 3.15	Junction 5 - Indicative Geometric Layout – Signal Control
Figure 3.16	Junction 11 - Indicative Geometric Layout – Priority Control
Figure 3.17	Junction 12 - Indicative Geometric Layout – Signal Control
Figure 4.1	Horizontal and Vertical Alignment of the proposed GDDR
Figure 4.2	Horizontal and Vertical Alignment of the proposed Link Road
Figure 4.3	Vertical Alignments at Glenamuck Road and Ballycorus Road
Figure 4.4a	Enniskerry Road
Figure 4.4b	Glenamuck Stream
Figure 4.5	Contributing Catchments to Proposed Crossings
Figure 4.6	Proposed Drainage Layout, Sheet 1 of 5

Figure 4.7	Proposed Drainage Layout, Sheet 2 of 5
Figure 4.8	Proposed Drainage Layout, Sheet 3 of 5
Figure 4.9	Proposed Drainage Layout, Sheet 4 of 5
Figure 4.10	Proposed Drainage Layout, Sheet 5 of 5
Figure 4.11	Typical Interceptor Ditch Arrangement
Figure 4.12	Existing Utilities – ESB, Eircom and Bord Gais
Figure 4.13	Existing Utilities – Watermains and Sewers

LIST OF TABLES

Table 3.1: Estimated AADT flows for the Base Year Road Network 2004.....	19
Table 3.2: Estimated AADT flows for the Local Road Network 2006.....	19
Table 3.3: Future Design Years - Estimated AADT Flows.....	20
Table 3.4: NRA DMRB Recommended Rural Road Cross-Sections.....	22
Table 3.5: Required Urban Cross-Sections.....	22
Table 3.6: Urban Link Capacity 'Do Something' Scenario 2022.....	23
Table 3.7: Junction 1 – ARCADY Capacity Analysis, Existing Geometry (2022 Design Year).....	26
Table 3.8: Junction 1 – Recommended Mitigation Measures Capacity Analysis.....	27
Table 3.9: Node 3/9 - LINSIG Capacity Analysis (2022 Design Year).....	28
Table 3.10: Junction 5 - LINSIG Capacity Analysis (2022 Design Year).....	29
Table 3.11: Junction 11 - Priority Junction Capacity Analysis (2022 Design Year).....	29
Table 3.12: Junction 12 - LINSIG Capacity Analysis (2022 Design Year).....	30
Table 4.1: Summary of Key Junction Types on the GDDR Scheme.....	35
Table 4.2: Road Name and Target Minimum Design Speed.....	36
Table 4.3 Proposed Road Closures.....	38
Table 4.4: Typical Attenuation Pond Details.....	43
Table 4.5: Watercourse Crossing Details.....	44
Table 5.1: Indicative Noise Barriers.....	53
Table 5.2: Visual Impacts on Residential Properties.....	54
Table 6.1: GDDR 'Route Option C' Scheme - Cost Estimate.....	61

1 INTRODUCTION

1.1 TERMS OF REFERENCE AND REPORT FORMAT

This Report describes the analysis carried out by RPS Consulting Engineers (RPS) in the selection and preliminary design of a preferred route option for the Glenamuck District Distributor Road (GDDR) Scheme on behalf of Dun Laoghaire–Rathdown County Council (DLRCC). It details the Preliminary Design of that option within the study area, in addition to highlighting the need for and benefits of the Scheme. The study area is shown in Figure 1.1.

This Preliminary Design Report contains:

- Need for, benefits and description of the Scheme
- The selection of a preferred scheme layout
- A review of existing and projected traffic conditions;
- The Preliminary Design of the Scheme:
- An assessment of the likely environmental impacts of the Scheme; and
- A cost estimate for the construction of the Scheme.

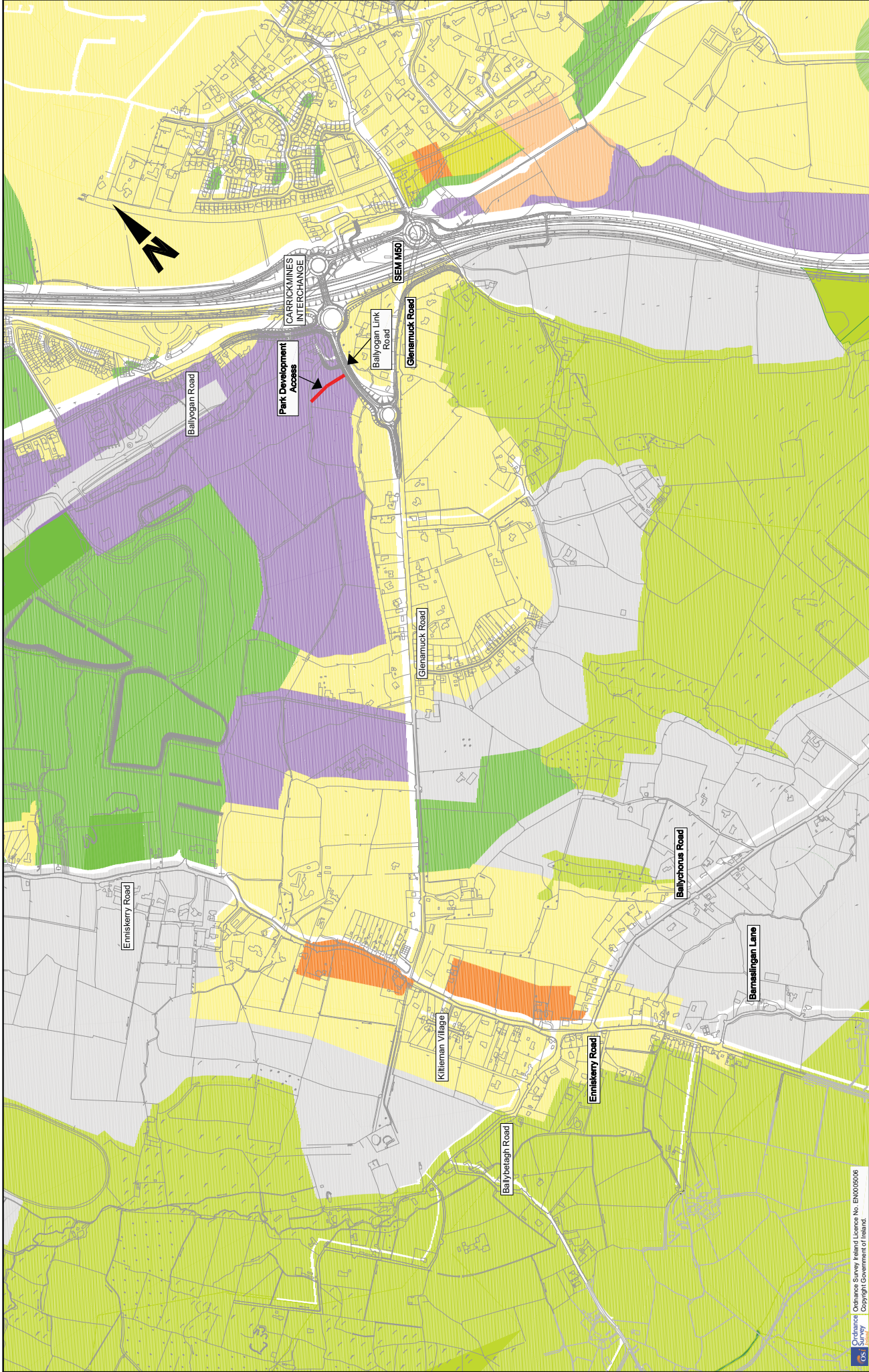
The Scheme description is discussed in Chapter 2. Chapter 3 evaluates the existing and future traffic conditions, in addition to the traffic assessments undertaken and conclusions reached. The engineering description of the preferred layout is given in Chapter 4 under the headings of:

- Road Design;
- Junction Strategy;
- Geometric Design;
- Ground Conditions;
- Pavement;
- Drainage;
- Road Signage and Public Lighting;
- Services Relocation;
- Boundary Treatment;
- Road Safety Audit.

A summary of the Environmental Assessment undertaken for the GDDR Scheme is described in Chapter 5. Chapter 6 outlines the estimated Construction Cost of the Scheme.

1.2 GLENAMUCK DISTRICT DISTRIBUTOR ROAD

Dun Laoghaire-Rathdown's County Council's Development Plan 2004-2010 contains a six-year road objective to upgrade the Glenamuck Road corridor between the Enniskerry Road and the Carrickmines Interchange Southern Roundabout. The area is rural in character, however the existing road is not considered capable of servicing the transportation needs arising from the extensive residential and commercial zoning set out in the County's Development Plan. With the completion of the South Eastern Motorway further demand will be placed on this corridor, as it will be a direct strategic link to the motorway off the already heavily trafficked Enniskerry Road. The existing local road network in the study area is shown in Figure 1.2.



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Project: GLENAMUCK DISTRICT DISTRIBUTOR ROAD

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Fig. 1.2
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The section of the Glenamuck Road currently under consideration lies between the Golden Ball junction where it meets the Enniskerry Road to the south and the Carrickmines Interchange Southern Roundabout to the north. This scheme (known as the Glenamuck District Distributor Road) represents approximately 1.5km of Distributor Road Realignment and associated works.

It is anticipated that this local road infrastructure needs to be upgraded to deal with the predicted increase in traffic associated with the opening of the South Eastern Motorway along with the increase in residential and commercial development within the Study Area. The proposed local infrastructure improvements will also provide better access to the road network in general, thus promoting development in the area of agriculture, industry, housing and tourism.

1.3 NEED FOR AND BENEFITS OF THE SCHEME

1.3.1 General

The need for the Scheme has been recognised as an objective in the 2004 Dun Laoghaire-Rathdown County Development Plan.

The need to provide a quality distributor road in the Glenamuck area is inevitable with the current zoning objectives in the development plan and the development aspirations of DLRCC in the Glenamuck area. The existing Glenamuck Road is considered to be of sub-standard quality to cater for significant traffic growth or development of surrounding lands in the future.

The existing Glenamuck Road has an average width of approximately 11m with a reasonable standard of horizontal and vertical alignment. There are, however, sections of the existing Glenamuck Road, which would not achieve the best standards of horizontal and vertical alignment such as the approach to the Enniskerry Road. The existing junction layout at the Golden Ball junction is also unsatisfactory for the current and predicted traffic volumes and does not comply with current design standards in relation to sight distance and therefore road safety. This junction is often congested and is a cause of delay for traffic turning onto the Enniskerry Road. The level of the traffic congestion frequently experienced can often hamper the use of the road by local people for commercial, community and amenity purposes. The Glenamuck District Distributor Road Scheme will be a major benefit in this area by either improving the junction or diverting traffic away from it. In the interests of safety, it would be recommended that the approach to the Enniskerry Road from Glenamuck Road and the junction be improved in consideration of the future planning and development of the area.

The Glenamuck Road is a distributor road to the Enniskerry Road from Carrickmines, Cabinteely and Cornelscourt and has to accommodate significant traffic volumes at peak commuter times. The Glenamuck Road has become even more important at a regional level as a distributor road from the Enniskerry Road to the M50, South Eastern Motorway. The Glenamuck District Distributor Road Scheme will prove a major benefit in coping with the predicted increase in traffic volumes.

There are currently a number of large-scale commercial and residential developments at both construction and planning phase within the study area. Many of these developments will be seeking access from the Glenamuck Road thereby placing further demand on the road. The Glenamuck District Distributor Road Scheme with its increased capacity will be of benefit in dealing with the increase in traffic generated by these developments.

The primary local objectives of the Glenamuck District Distributor Road Scheme are as follows:

- To operate successfully as a distributor road to the South Eastern Motorway
- To improve the capacity of the local road network at peak commuter times and accommodate the various modes of transport
- To improve access to public transport including LUAS and Quality Bus Corridors
- To improve road safety and reduce the number of accidents along the existing Glenamuck and Enniskerry Roads

- To improve provisions for cyclists, pedestrians and other vulnerable road users
- To promote the economic development within the area as identified in the Dun Laoghaire-Rathdown County Development Plan 2004-2010.

The proposed scheme will facilitate better access to existing tourist and leisure attractions in the area such as:

- Carrickmines Equestrian Centre
- Carrickmines Golf Course
- Stepside Golf Course
- Wayside Celtic Football Club
- Bective Rangers FC.

1.3.2 Dun Laoghaire-Rathdown County Development Plan (2004-2010)

The Development Plan (2004-2010) contains a six-year road objective to upgrade the Glenamuck Road corridor between the Enniskerry Road and the Carrickmines Interchange Southern Roundabout.

The land use proposed under the Dun Laoghaire-Rathdown County Development Plan (2004-2010) within the study area is mixed but consists predominantly of:

- 'economic development and employment';
- 'protect or improve residential amenity';
- 'protect and improve rural amenity and to provide for the development of agriculture'.

The land-use zoning objectives within the study area show a high proportion of land zoned for 'economic development and employment'. This would suggest that further demand will be placed on the Glenamuck Road with the development of these areas. The fact that a large proportion of the land within the study area is zoned 'protect and/or improve residential amenity' could result in further residential developments being built in the future, leading to further pressure being put on the Glenamuck Road.

Within the study area there are a number of specific local objectives of the council laid out in the Dun Laoghaire-Rathdown County Development Plan (2004-2010). The specific local objectives shown on Map 9 of the development plan include the following:

- Local Objective 5: To provide for a proposed LUAS stop, on race days only, adjacent to Leopardstown Racecourse.
- Local Objective 6: To provide for a proposed LUAS stop at Ballyogan Wood.
- Local Objective 7: To provide for a proposed LUAS stop at Carrickmines.
- Local Objective 9: To provide for the development of a neighbourhood centre at Park Developments, west of the Carrickmines Interchange Southern Roundabout.
- Local Objective 10: To provide for the future extension of the Stepside public golf course onto adjoining lands owned by the Council, to enlarge it into an 18 hole public golf course.
- Local Objective 12: To protect and enhance the community infrastructure of the Church of Ireland community in Kiltarnan.
- Local Objective 13: To provide for residential development as part of an enhanced Kiltarnan Village, which will include provision of playing pitches on the 8.5 hectares area zoned F "Open

Space”, located on the south side of Glenamuck Road. No residential or other development to take place until these pitches are in operation.

- Local Objective 14: To prepare a Local Area Plan for Kiltiernan/Glenamuck and that no development takes place until a Local Area Plan is approved.
- Local Objective 15: To encourage the provision of incubator units for craft industries in Kiltiernan.

The locations of these specific local objectives are shown in Figure 1.3. The above listed local objectives suggest a large amount of development potential within the study area. The introduction of the LUAS network in the area will potentially bring further development thereby putting a further demand for the LUAS in the area.

Many of the above listed specific local objectives are to be incorporated into the Kiltiernan/Glenamuck-Local Area Plan (see Section 1.3.3 below).

1.3.3 Kiltiernan/Glenamuck Local Area Plan

The Kiltiernan/Glenamuck-Local Area Plan is currently being prepared on foot of the Council objective to prepare a Local Village Plan for Kiltiernan.

The Local Area Plan (LAP) area for Kiltiernan/Glenamuck is approximately 174 hectares (ha) in extent. It is broadly bounded by the Stepside Golf Course to the north-west, the agricultural-zoned lands west of Enniskerry Road to the west, high amenity lands to the south, and the agricultural and high amenity zoned lands east of Glenamuck Road to the east.

Predominant issues to be contained in the plan include:

- The need to establish an obvious identity/sense of place for Kiltiernan.
- The need to establish a focal point/civic centre for Kiltiernan.
- The need to accommodate a significant level of residential and other ancillary development to ensure the wider strategic objectives of the 2004-2010 County Development Plan are realised.

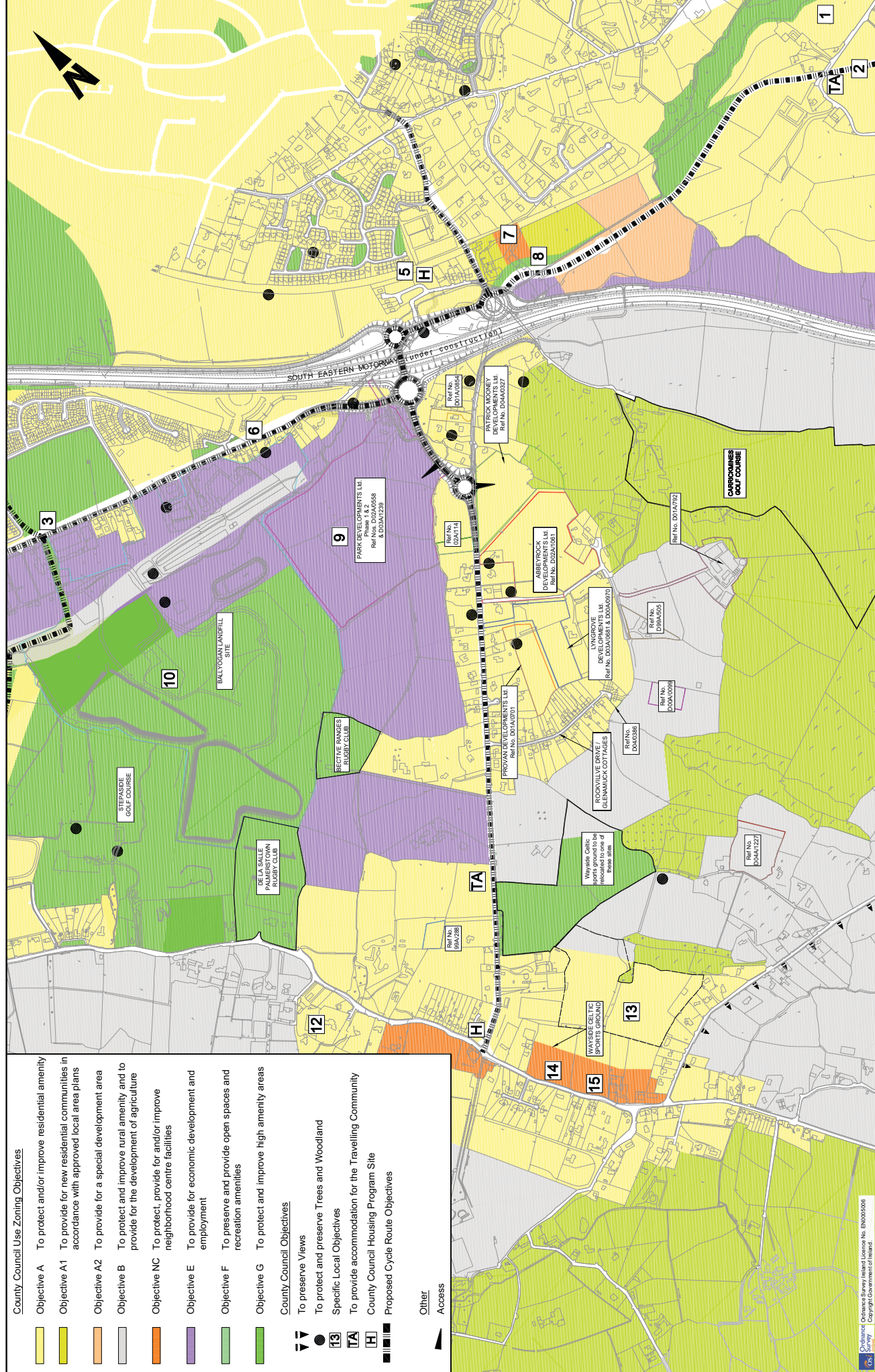
It will also have regard to the following principles, objectives and issues:

- Future Residential Development
- Development of a Neighbourhood Centre/Retailing
- Employment
- Transportation
- Architecture and Urban Design
- Open Space, Recreation and Amenities
- Community Facilities
- Environmental Issues
- Conservation of the Archaeological and Architectural Heritage

1.3.4 Accidents

The ‘Feasibility and Route Selection Report’ (discussed in Section 3.2.4) identifies the 1996-2002 NRA accident data in the Glenamuck Area and the local environs including the study area surrounding the proposed GDDR.

The construction of the GDDR will reduce accident rates due to the provision of high quality infrastructure and therefore have significant positive cost benefit, as well as personal beneficial implications for the residents of the Glenamuck Area.



- County Council Use Zoning Objectives**
- Objective A To protect and/or improve residential amenity
 - Objective A1 To provide for new residential communities in accordance with approved local area plans
 - Objective A2 To provide for a special development area
 - Objective B To protect and improve rural amenity and to provide for the development of agriculture
 - Objective NC To protect, provide for and/or improve neighbourhood centre facilities
 - Objective E To provide for economic development and employment
 - Objective F To preserve and provide open spaces and recreation amenities
 - Objective G To protect and improve high amenity areas
- County Council Objectives**
- To preserve Views
 - To protect and preserve Trees and Woodland
 - Specific Local Objectives
 - To provide accommodation for the Travelling Community
 - County Council Housing Program Site
 - Proposed Cycle Route Objectives
- Other**
- Access

<p>Client:</p> <p>Dún Laoghaire-Rathdown County Council/Comhairle Contae Dhún Laoghaire-Rath an Dúin</p> <p>Mr. John McDaid Senior Engineer - Transport Department DÚN LAOGHAIRE RATHDOWN COUNTY COUNCIL County Hall, Merrion Road, Dún Laoghaire, Co. Dublin Phone: 01 2045070 Fax: 01 2089890</p>	<p>Project:</p> <p>GLENAMUCK DISTRICT DISTRIBUTOR ROAD</p>	<p>Title:</p> <p>ZONING MAP WITH FUTURE DEVELOPMENTS & SPECIFIC LOCAL OBJECTIVES</p>
<p>Drawn by: AA</p> <p>Checked by: JD</p> <p>Approved by: MN</p> <p>Scale: 1:10,000 @ A3</p> <p>Date: Jan 05</p>	<p>Job No: MDT0205</p> <p>File No: MDT0205R0003.dwg</p> <p>Fig. No:</p> <p>Figure No. 1.3</p>	<p>Notes:</p> <ol style="list-style-type: none"> 1. This drawing is the property of RPS Consulting Engineers Ltd. It is a confidential document and must not be copied, used, or its content divulged without prior written consent. 2. All levels refer to Ordnance Survey Datum, Mullin Head. 3. DO NOT SCALE. Use figured dimensions only.

1.4 THE NEXT STAGE

The next stage of the GDDR scheme is to prepare the necessary documentation in order to fulfil the requirements of the planning process. Approval for the Scheme may be sought under Part 8 of the Planning and Development Regulations 2001 – 2002. If the Scheme is approved, DLRCC may seek to compulsorily acquire the land needed for the Scheme by way of a Compulsory Purchase Order (CPO). In this eventuality, an Oral Hearing by An Bord Pleanála may be held. Upon completion of the planning process a detailed design for the Scheme would be developed, and Contract Documents produced, in order to proceed to construction stage.

2 SCHEME DESCRIPTION

2.1 INTRODUCTION

A basic assessment of the study area and available traffic information illustrated that the major through traffic movement was to and from the M50. On closer inspection the origin and destination of the principal through traffic demands in the study area are as follows:-

- M50 to/from the northern section of the Enniskerry Road (Stepaside area)
- M50 to/from the southern section of the Enniskerry Road (south of Kiltiernan Village)

Also, future development trips to/from the study area were found to be from the M50 and to/from both the northern sections of the Enniskerry Road

In order to achieve a sustainable and beneficial road network in the study area it will be necessary to:

- Provide a distributor road network which can efficiently collect and distribute traffic in the study area, whilst minimising congestion and delay experienced by drivers
- Provide sufficient and efficient road infrastructure to cater for future design year traffic volumes in addition to traffic generated by the development of lands surrounding the network
- Provide a relief road network to remove through traffic from Kiltiernan Village
- Provide a road network, which can accommodate and provide quality infrastructure for public transport, pedestrians and cyclists.

An initial desk study was followed by a walk over survey, which included an inspection of the study area, examination of local records and discussions with DLRCC. This assessment included a thorough visual examination of the Glenamuck Area and made full use of available maps, plans, planning and heritage documents. It is proposed that the proposed road network be divided into two distinct sections as described below.

2.2 GLENAMUCK DISTRICT DISTRIBUTOR ROAD

The mainline of the scheme is known as the 'Glenamuck District Distributor Road' (GDDR) and is located north of the existing Glenamuck Road. This road would act as the main collector/distributor section of the overall network and directly connect the roundabout to the south of the Carrickmines interchange to the Enniskerry Road north of Kiltiernan Village.

2.3 LINK ROAD

It is also proposed that a further road link be part of the scheme known as the 'Link Road' which is located to the south of GDDR and runs in a north south direction connecting the GDDR to the Enniskerry Road south of Kiltiernan Village. This road would also act as a collector/distributor road for traffic to and from south of Kiltiernan Village.

The layout of the proposed network will essentially act as distributor roads for the distribution of traffic to/from the M50 and collector roads for the proposed developments in the Glenamuck Area and as a bypass of Kiltiernan Village.

2.4 EXISTING GLENAMUCK ROAD

The scheme proposes to 'Cul de sac' the northern end of the existing Glenamuck Road where it ties-in with the roundabout junction to the south of the Carrickmines Interchange. This measure will essentially create a traffic calming effect on the Glenamuck Road by removing the through route. It will act a measure to control traffic movements, provide a safer road environment and allow a more

controlled development of the area, which should benefit all existing residents and businesses utilising the existing road.

The proposed Link Road described above is to intersect the existing Glenamuck Road creating a new junction. This measure will mitigate any severance issues caused by the closing of the existing road.

2.5 ENNISKERRY ROAD AND KILTERNAN VILLAGE

The scheme provides for the GDDR and Link Road to tie in to the Enniskerry Road to the north and south of Kilternan Village respectively. This proposed layout will effectively create a bypass of Kilternan Village for traffic in the study area. This provision will remove the majority of unwanted through traffic from the village and create a naturally traffic calmed street.

2.6 SCHEME LAYOUT DESCRIPTION

The 'Feasibility and Route Selection Report' identified the general primary route options for the scheme, which appear to satisfy the scheme objectives. From this route option study, a general design philosophy was developed which takes into account a number of key objectives including constraints, traffic impact, traffic distribution, zoned development lands and alternative modes of transport.

The basic design philosophy adopted was the provision of roads that would allow traffic to/from the north and south of the Enniskerry Road to feed into one road (the GDDR) to facilitate access to/from the M50 and future development lands. The road hierarchy of this design would provide two single carriageway sections of road (the GDDR and the Link Road) feeding into a dual carriageway section of road (the mainline GDDR) closer to the Carrickmines Interchange.

The proposed scheme layout is shown in Fig. 2.1.

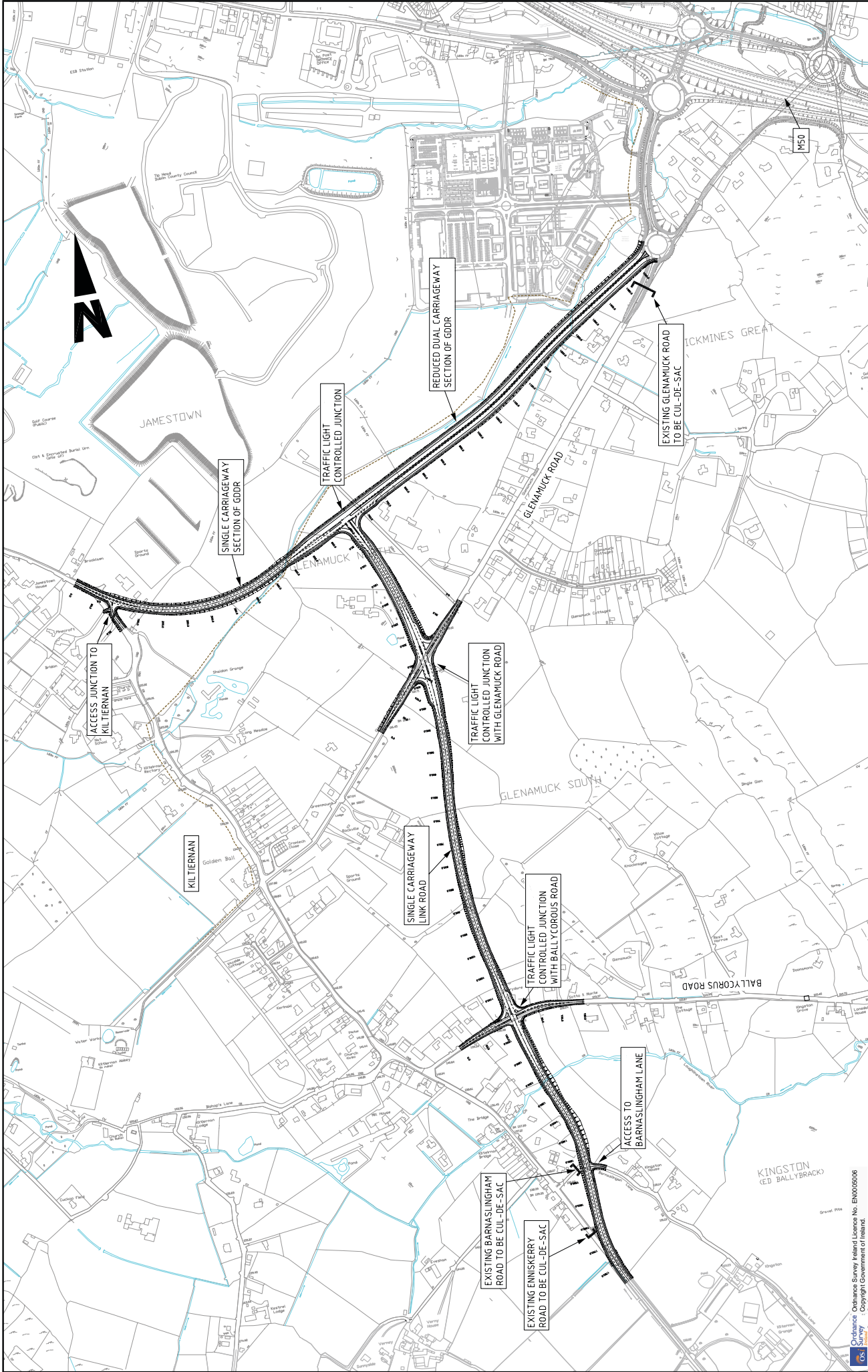
The GDDR scheme requires two distinct cross section types along its length. They are that of a Two-Lane Single Carriageway and that of a Reduced Dual Carriageway. These cross sections include specific modifications to accommodate the provision of bus and traffic lanes in the future if required. These sections are described and shown in detail in Section 3.7.

The junction strategy adopted in the design included four principal junctions between the GDDR scheme and the existing local road network with an additional key junction on the GDDR itself. The traffic impact and geometric requirements of each junction go together in the design process. The general traffic philosophy was the control of vehicles through the scheme. This was facilitated by the use of signal-controlled junctions throughout the scheme. The traffic needs assessment and capacity analysis of the scheme is contained in Chapter 3 with the geometric layout description contained in Chapter 4.

The proposed scheme option layout facilitates the development needs of the Glenamuck Road area allowing future development access to the distributor road at preferred access points, described in Section 3.9. The scheme is generally through undeveloped Greenfield sites and minimises impact on existing property.

The Scheme provides restricted access to Kilternan Village, thus removing the majority of unwanted through traffic and creating a naturally traffic calmed village. The scheme layout also requires a number of road closures ('Cul de sacs') on existing roads. These include:

- The existing Glenamuck Road is to be cul-de-saced south of the existing roundabout junction to the south of the Carrickmines Interchange. The existing Glenamuck Road southern arm of the roundabout is to be removed from the junction as part of this scheme.
- The existing Enniskerry Road will be cul-de-saced south of Kilternan Village adjacent to the proposed tie-in with the GDDR Link Road.



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- The existing Enniskerry Road at the northern tie-in to the GDDR single carriageway road. A new junction is to be provided for access to Kiltiernan Village.
- The existing Barnaslingan Lane will be cul-de-saced south of Kiltiernan Village in close proximity to the proposed 'cul-de-sac' on the Enniskerry Road and adjacent to the proposed tie-in with the GDDR scheme.

These cul-de-sac's are illustrated in Fig. 2.1.

The design has included for both pedestrian and cyclist infrastructure along the entire length of the GDDR scheme. Footpaths and cyclepath 2.0m wide have been provided at either side of the proposed roads. Each junction on the scheme will cater for the movements of both pedestrian and cyclists, with minimal delay (wait time) experienced by pedestrians at junctions.

The transportation policies and objectives used in this design reflect the central elements of both the DL RCC Development Plan 2004 and the Dublin Strategy contained in the 'Platform for Change, 2000-2016'. The design has provided facility for public transport infrastructure along the entire length of the GDDR scheme. Road space in the form of hard shoulders and/or additional verges has been set aside for the future provision of 3.0 to 3.5m bus lanes on the scheme. Each junction on the scheme has been carefully designed to enable a retro fit provision of bus lanes through each junction.

The scheme also considers future junction provision for development access and preferred points on the proposed road network are indicated. The scheme also proposed that space be set aside for the provision of bus stops/shelters along the route. Careful consideration is also to be given to the tie-in between the GDDR scheme and the existing road network to ensure a safe transition between both road types and standards at detailed design stage.

3 TRAFFIC

3.1 INTRODUCTION

This section of the Preliminary Design Report examines the traffic impacts for the proposed alignment of the GDDR and associated link roads. It will examine the existing and future traffic flows on the proposed GDDR and detail proposed junction types and configurations in addition to the GDDR carriageway cross section.

The preferred GDDR route option which will best serve the local and strategic transport needs of the area with regard to the future commercial, residential and recreational development set out in the document “Dun Laoghaire - Rathdown County Development Plan 2004 – 2010” is generally described in the ‘Feasibility and Route Selection Report’.

Numerous road layouts, junction strategies and road cross sections were examined in the Preliminary design to ensure that the optimal solution was achieved, whilst minimising adverse environmental impact and land-take. New pedestrian and cyclist facilities, where required, will improve the area recreationally, whilst providing for future development.

It was agreed with DLRCC at the outset of the commission that a traffic model would be produced by RPS Consulting Engineers in conjunction with the Dublin Transportation Office (DTO) with input from DLRCC Planning Department.

These traffic model outputs were interpreted in conjunction with the DTO to evaluate the traffic impact of proposed road layouts and junction strategies on both the existing and proposed road infrastructure.

This Chapter will deal with the following issues:

- Existing Information
- Preferred Route Option
- Modelling and Analysis Methodology;
- Existing traffic levels;
- Future traffic levels;
- Cross Sectional Requirements;
- Urban Link Capacity;
- Junction Strategy and Traffic Impact Analysis;
- Public Transport;
- Mobility Management Plans;
- Pedestrians and Cyclists;
- Conclusions.

3.2 EXISTING INFORMATION

A number of existing documents were utilised to inform the preliminary design process. They included the following:

3.2.1 Constraints Study Report

The Constraints Study focused on the physical, environmental, procedural, and legal constraints that exist affecting the design and choice of route for the scheme. These constraints, if not properly identified at an early stage could cause subsequent delay to the progress and influence the overall cost of the scheme. The Constraints Study was compiled from planning search reports, drawings and

mapping and took account of planning constraints, OS mapping showing proposed and existing development, landholdings, water features, geology and hydrogeology, topography, flora and fauna, archaeology and architecture, protected areas and utilities (Electricity, Communication, Gas, Water and Sewerage).

3.2.2 Traffic Appraisal Report - Existing Conditions

A 'Traffic Appraisal Report - Existing Conditions' for the Glenamuck area was produced between the Enniskerry Road at Kiltarnan and the South Eastern Motorway (SEM) M50 Carrickmines Interchange southern roundabout on the Glenamuck Road, prior to the production of this Report.

The Existing Conditions report examined the existing traffic conditions surrounding the Glenamuck Road and within the specified Study Area which encompasses the Glenamuck Road and the Enniskerry Road. The Study Area comprises the Carrickmines Interchange on the SEM to the northeast of the Glenamuck Road, the Carrickmines Interchange southern Roundabout and the priority junction formed by the Glenamuck Road and the Enniskerry Road. This Report provided a solid base on which all future traffic analysis and modelling work was undertaken. The existing traffic conditions were examined in terms of the overall Study Area, site location, road and junction geometry, existing traffic flows, junction capacity, public transport and pedestrian/cycle infrastructure, accident numbers, local planning policies and committed large scale developments in the area. All details contained in this report were used by the DTO to produce a fully calibrated and validated traffic model.

3.2.3 DTO SATURN Modelling Report

The DTO was commissioned by RPS Consulting Engineers on behalf of DLRCC to develop a Local Area Model (LAM) to aid the assessment of the GDDR Scheme. The DTO tested a number of Route Options and alternatives as specified in order to identify the most favourable layouts in terms of traffic impact. The DTO then provided detailed traffic analysis of the preferred route option and tested six future scenarios:

- 2007 Year of Opening AM Peak – 'Do Minimum' and 'Do Something'
- 2016 Intermediate Year AM Peak – 'Do Minimum' and 'Do Something'
- 2022 Design Year AM Peak – 'Do Minimum' and 'Do Something'

A modelling report was produced by the DTO, which included a detailed assessment and analysis of the preferred route option in terms of road and junction performance. The report also describes the modelling methodology, scenario testing and model outputs and results.

3.2.3.1 Validation Report

The DTO produced a "Validation Report" for the LAM at the outset of the project, which demonstrated that the SATURN model developed would replicate observed existing traffic conditions and was therefore suitable for use as a traffic appraisal tool to test and analyse selected route options.

3.2.4 Feasibility and Route Selection Report

The 'Feasibility and Route Selection Report' for the GDDR scheme contains a detailed examination of various route options and a preferred route option was identified prior to the preliminary design described in this report.

The Feasibility and Route Selection Report consists of an assessment of various route options, a review of existing and projected traffic conditions, a summary of the various environmental, political, social and planning constraints on the scheme, a framework assessment of the route options and preparation of a cost estimate for the construction of the scheme. The traffic element of this Feasibility

Study examined three identified route options in terms of maximum hourly and daily traffic flows, junction impact, journey times and alignment.

3.2.5 Dun Laoghaire - Rathdown County Development Plan 2004 – 2010

The Dun Laoghaire-Rathdown County Development Plan 2004-2010 was reviewed, consulted and utilised at a number of stages in the project. This development plan has been discussed in greater detail in Section 1.3.2.

3.3 PREFERRED ROUTE OPTION

Following the identification and analysis of the constraints to the scheme, three primary routes were identified in the 'Feasibility and Route Selection Report' that appear to satisfy the scheme objectives. These routes were identified taking account of the engineering considerations and having regard to the issues and constraints identified in the Constraints Report. Due to the length of the scheme (approximately 1.5km), there are a limited number of viable route options available for consideration.

3.3.1 Preferred Route Option 1 from the Feasibility and Route Selection Report

The three initial route options identified in the Feasibility Route Selection Report, commenced at the Carrickmines Interchange Southern Roundabout and extended to meet the Enniskerry Road at a number of locations. Route 1 was to the northwest of the existing Glenamuck Road, Route 2 ran along the majority of the existing Glenamuck Road and Route 3 was to the southeast of the existing Glenamuck Road. All three-route options are described in more detail in the Feasibility and Route Selection Report.

At this stage of the scheme two possible cross routes Link A or Link B were also identified as part of the route selection process, which would compliment the Glenamuck District Distributor Road. These link routes would be capable of serving the future development objectives, provide a possible bypass of Kiltiernan Village and a possible future link to Ballycorus Road, all within the study area.

From the route selection analysis, it was concluded that Option 1 is the preferred Route. This route will reduce traffic in both Kiltiernan Village and on the existing Glenamuck Road, whilst providing quality road infrastructure to link with the M50 and for the future development of local lands. A number of additional links and junctions will provide for an increase in the overall road network capacity, thus providing for future traffic needs.

3.3.2 Layout Alternatives for Route Option 1

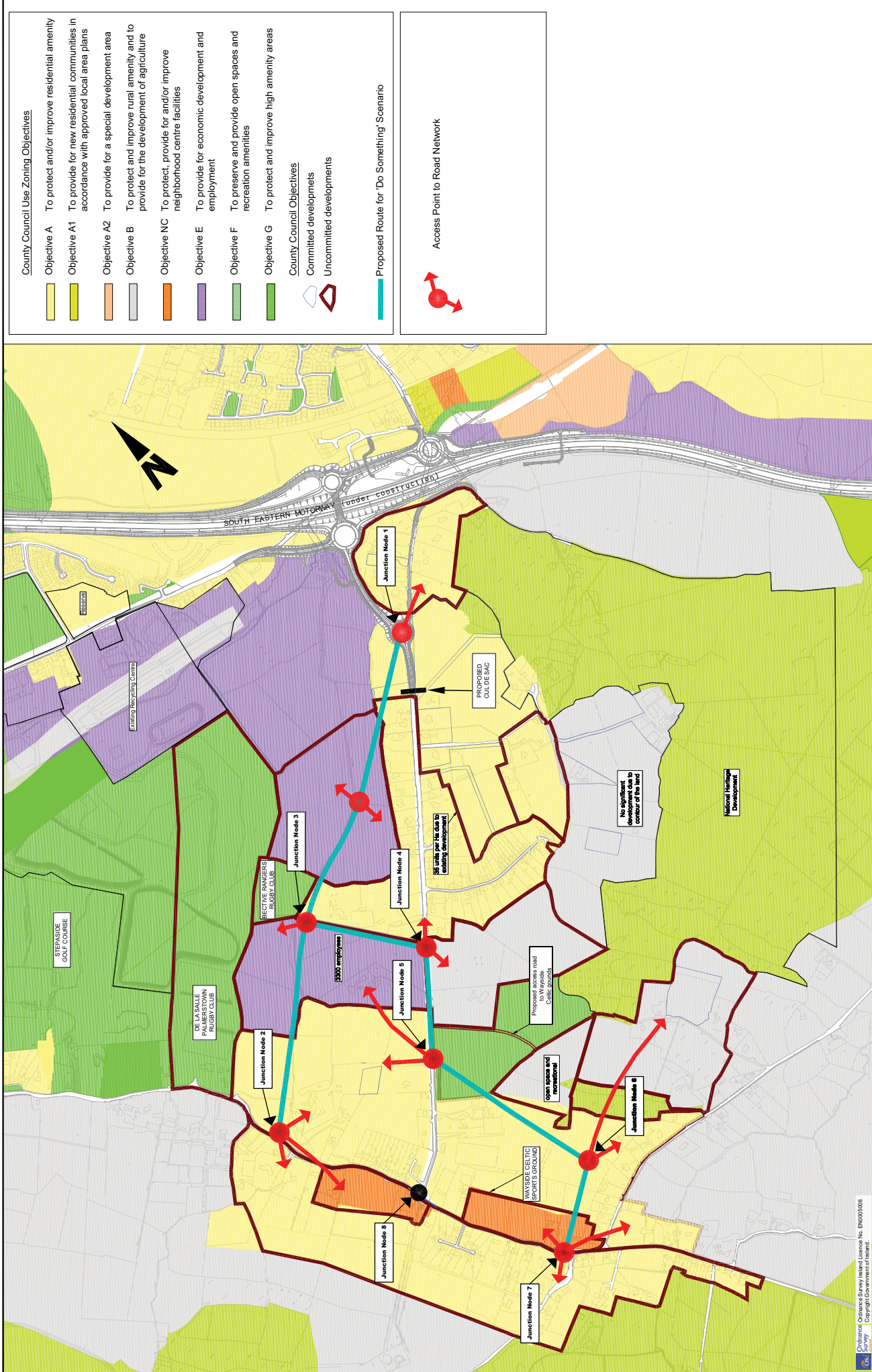
The Preliminary design stage of the scheme further developed potential options for the proposed Route Option 1 GDDR scheme. Three alternative schematic layouts were examined, summarised below:

3.3.2.1 Route Option Layout A

Route Option Layout A is the preferred route option identified in the Feasibility Report. The alignment of this route option is shown schematically in Figure 3.1.

3.3.2.2 Route Option Layout B

Route Option Layout B is a modified version of Route Option A with the provision a link road which forms a complete bypass of Kiltiernan Village with the GDDR meeting this bypass at a 'T' junction (Junction node 9). The alignment of this route option is shown schematically in Figure 3.2.



- County Council Use Zoning Objectives**
- Objective A To protect and/or improve residential amenity
 - Objective A1 To provide for new residential communities in accordance with approved local area plans
 - Objective A2 To provide for a special development area
 - Objective B To protect and improve rural amenity and to provide for the development of agriculture
 - Objective NC To protect, provide for and/or improve neighborhood centre facilities
 - Objective E To provide for economic development and employment
 - Objective F To preserve and provide open spaces and recreation amenities
 - Objective G To protect and improve high amenity areas
- County Council Objectives**
- Committed developments
 - Uncommitted developments

Proposed Route for 'Do Something' Scenario

Access Point to Road Network

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Project: GLENAMUCK DISTRICT DISTRIBUTOR ROAD

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Approved by: MN Fig No:

Scale: 1:10,000 @ A2

Date: Mar/08

Fig. 3.1

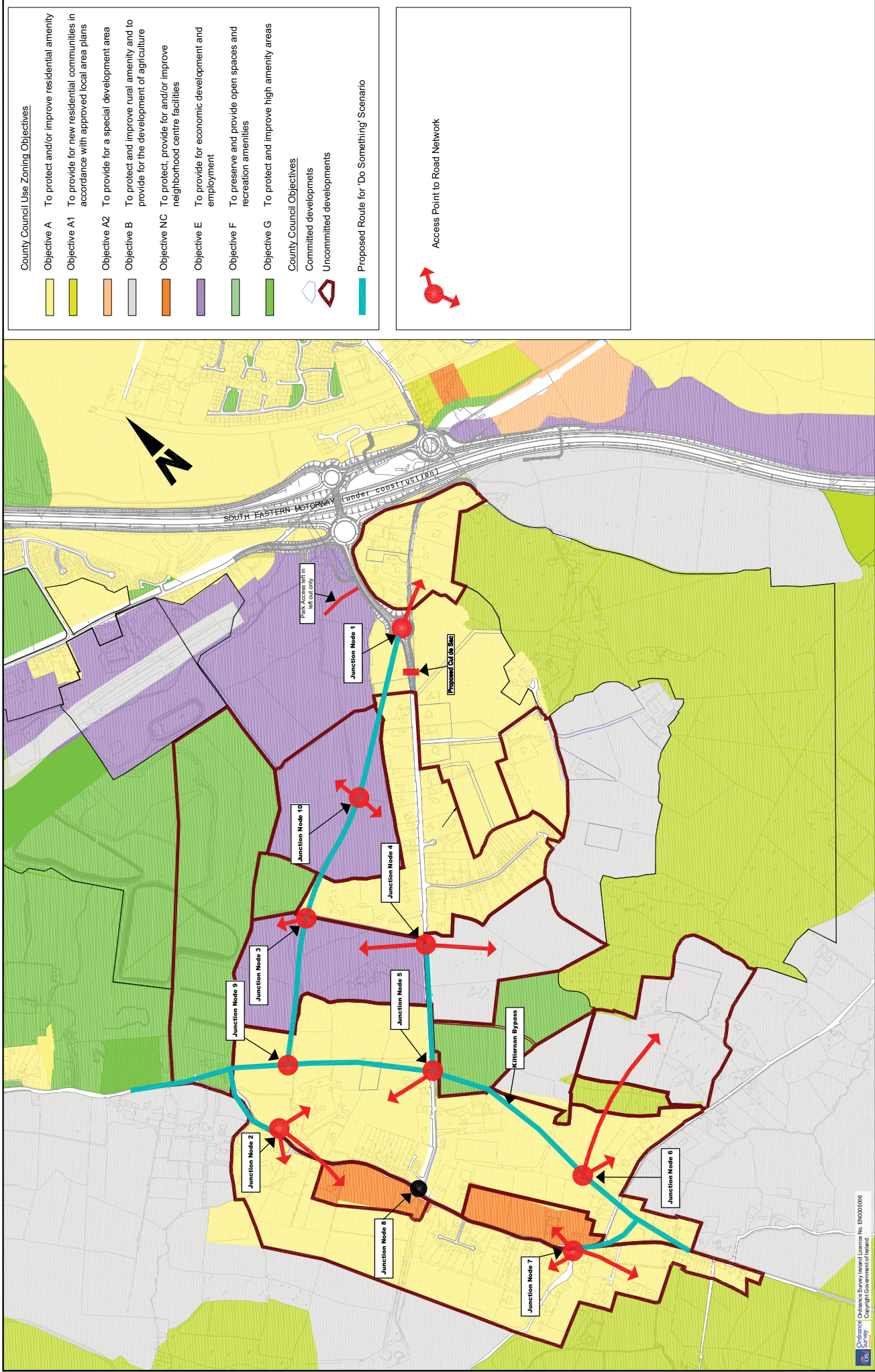
Proposed Route Option 'A' For 'Do Something' Scenario

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Dún Laoghaire-Rathdown
County Council/Comhairle Contae Dún Laoghaire-Rath an Dúin



County Council Use Zoning Objectives

- Objective A To protect and/or improve residential amenity
- Objective A1 To provide for new residential communities in accordance with approved local area plans
- Objective A2 To provide for a special development area
- Objective B To protect and improve rural amenity and to provide for the development of agriculture
- Objective NC To protect, provide for and/or improve neighborhood centre facilities
- Objective E To provide for economic development and employment
- Objective F To preserve and provide open spaces and recreation amenities
- Objective G To protect and improve high amenity areas

County Council Objectives
 Committed developments
 Uncommitted developments

Proposed Route for 'Do Something' Scenario



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**Proposed Route Option 'B'
 For 'Do Something' Scenario**

**GLENAMUCK DISTRICT
 DISTRIBUTOR ROAD**

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3.3.2.3 Route Option Layout C

Route Option C is a modified version of Route Option B with the provision of a link road which forms a partial bypass of Kiltiernan Village and with the GDDR forming the remainder of the bypass and meeting at a 'T' junction. This route option also provides for Enniskerry Road traffic to be directed to a key junction on the GDDR for distribution to and from the M50/development lands. The alignment of this route option is shown schematically in Figure 3.3.

3.3.3 Preferred Route Option

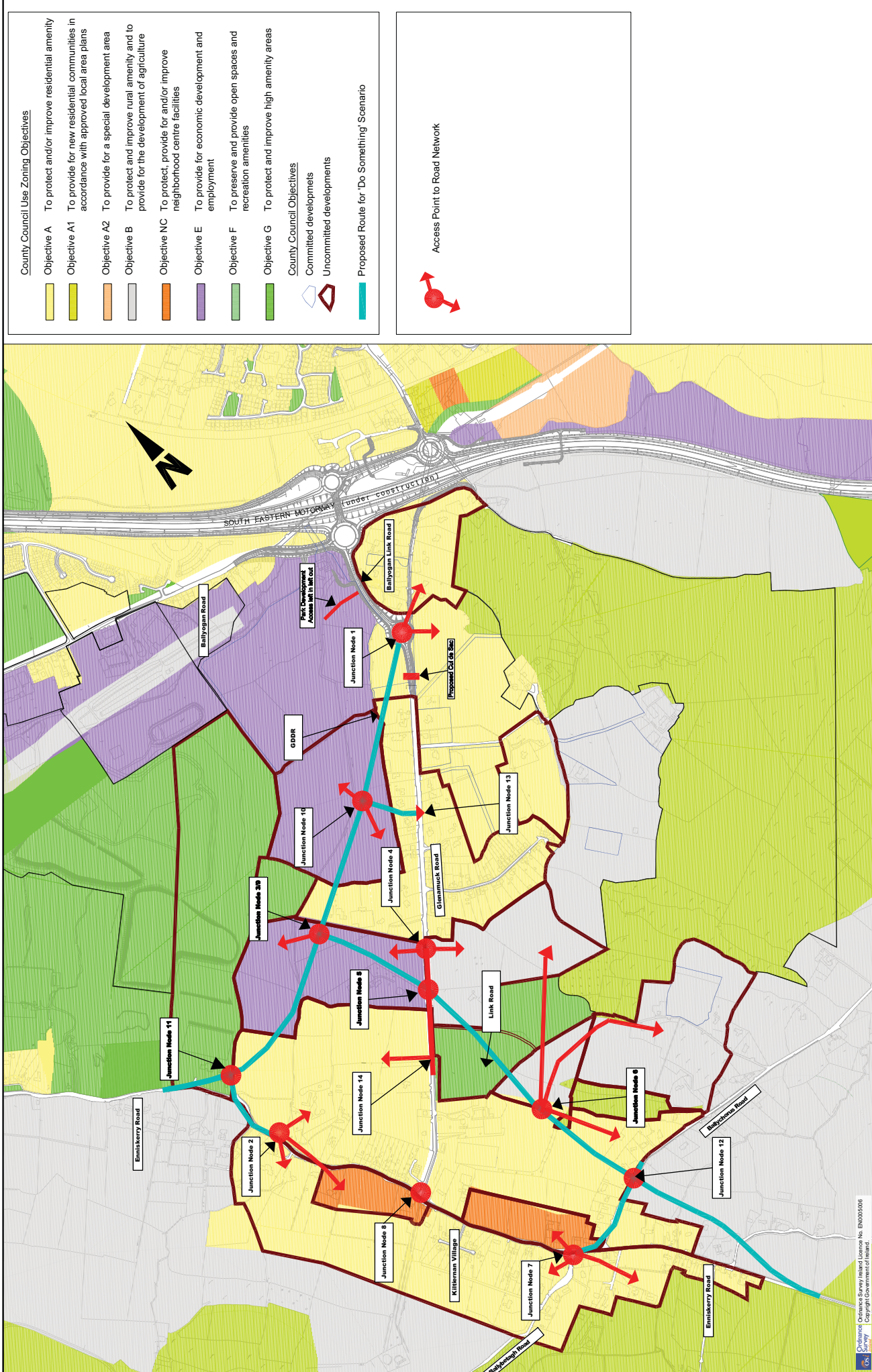
All three route options were evaluated taking into account both their advantages and disadvantages to the scheme as a whole. The assessment studied how each route catered for both strategic and local traffic assignment through the network whilst also accommodating future traffic volumes and patterns. It considered the routes and compared them in terms of link flow, junction impact, traffic dispersal, congestion, delays and impact on Kiltiernan Village.

The DTO SATURN model output results were studied to compare each route option for the 'Do Something' Scenario in the design year 2022. The comparison took into account the parameters detailed above. The DTO SATURN model is ideal for comparing alternative route options of the scheme as it compares each at a strategic level. The SATURN model generates average queue lengths and overall levels of congestion and delay at junctions and on the local road network.

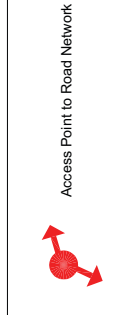
In order to assess the network in detail, static models of each key junction on the network were produced and the results were input back into the SATURN model to produce a more comprehensive, effective model. The static model analyses took into account parameters such as geometry, traffic flows and movements, pedestrian crossings, detailed phases and stages, lane usage and optimisation of cycle times and green times. This process ensures the proposed road network and preferred route option would cater for these future traffic levels. The following are a number of key advantages, disadvantages and comparisons of each Route Option:

- DTO SATURN model design year 2022 output results for Route Option A were studied and revealed that severe congestion and delay was predicted on the proposed road network due to the number and location of the scheme junctions in relation to the traffic assignment. This severity of congestion and delay was not predicted on Route Options B and C. For this key reason among others, Route Option A was discounted.
- A comparative assessment of Route Options B and C revealed that although Route Option B provided for a better quality, complete Bypass of Kiltiernan Village, it predicted severe congestion and delay at Junction Node 9 due to the inappropriate junction priority given to traffic on Enniskerry Road (major road). The junction priority is required from the Enniskerry Road to the GDDR/M50 and visa versa due to the predicted heavy traffic flows to and from the M50. For this key reason among others, Route Option B was discounted.
- A comparative assessment of Route Options B and C above also revealed that Route Option C had a superior junction layout (Junction Node 3/9) providing junction priority to traffic from the Enniskerry Road to the GDDR/M50 and visa versa. For this key reason among others, Route Option C was superior to Route Option B.
- Route Option C required less road upgrade to the existing Glenamuck Road to cater for future traffic compared to Route Option B. Option C preserved more of the existing Glenamuck Road for local use.
- The alignment of Route Option C was superior to that of Route Option B in that it allowed for both a bypass of Kiltiernan Village whilst also significantly reducing congestion and delay on the proposed road network by giving priority to the major traffic demand flows.

Taking all of the above into account, 'Route Option C' was identified as the preferred route layout. The preferred GDDR Route Option C layout and proposed junction locations is shown in more detail in Figure 3.4. This figure identifies the recommended key junctions and the preferred development



- County Council Use Zoning Objectives**
- Objective A To protect and/or improve residential amenity
 - Objective A1 To provide for new residential communities in accordance with approved local area plans
 - Objective A2 To provide for a special development area
 - Objective B To protect and improve rural amenity and to provide for the development of agriculture
 - Objective NC To protect, provide for and/or improve neighborhood centre facilities
 - Objective E To provide for economic development and employment
 - Objective F To preserve and provide open spaces and recreation amenities
 - Objective G To protect and improve high amenity areas
- County Council Objectives**
- Committed developments
 - Uncommitted developments
- Proposed Route for 'Do Something' Scenario**



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Date: Nov/08

Project: GLENAMUCK DISTRICT DISTRIBUTOR ROAD

Title: Proposed Route Option 'C' For 'Do Something' Scenario

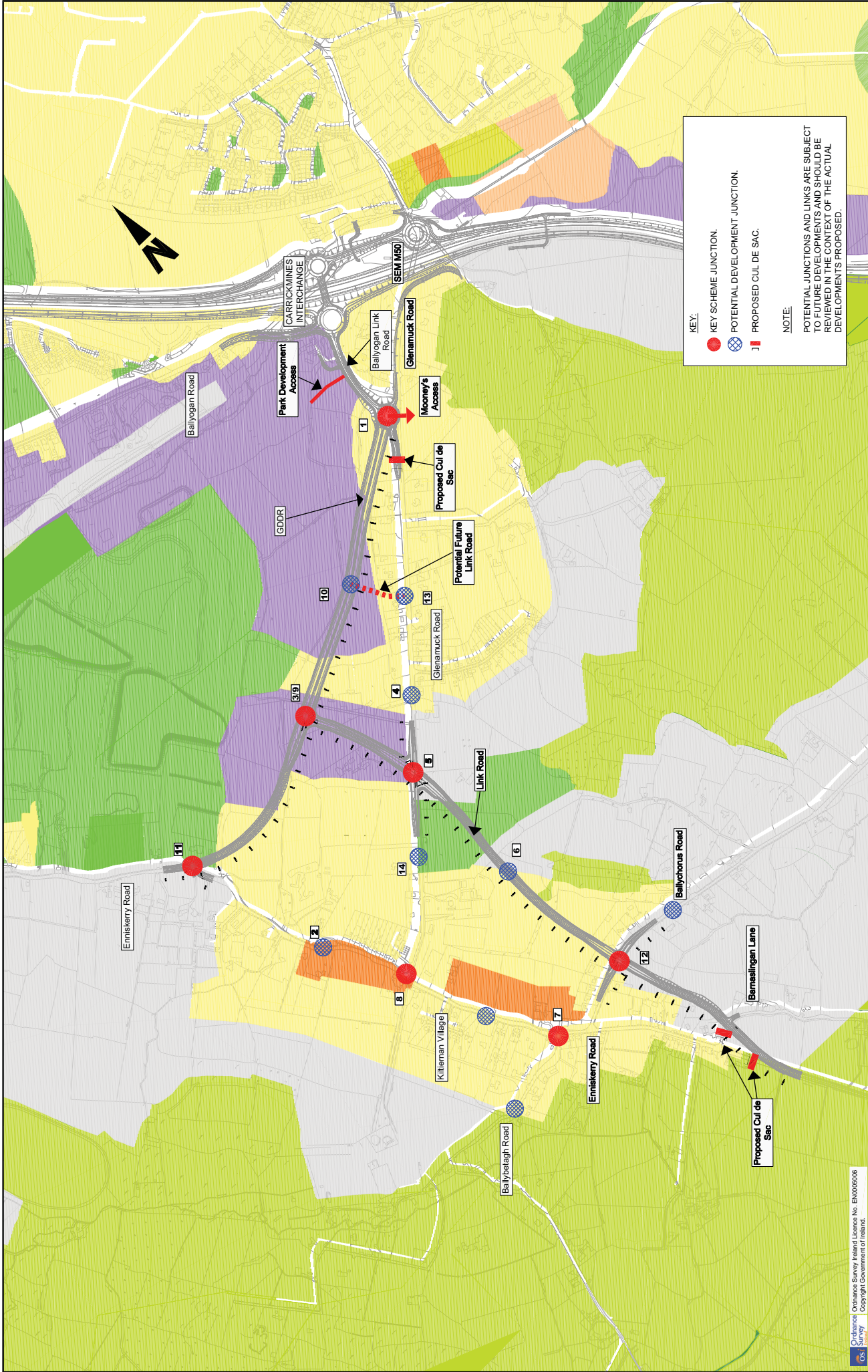
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KEY:

- KEY SCHEME JUNCTION.
- ⊗ POTENTIAL DEVELOPMENT JUNCTION.
- ➔ PROPOSED CUI DE SAC.

NOTE:

POTENTIAL JUNCTIONS AND LINKS ARE SUBJECT TO FUTURE DEVELOPMENTS AND SHOULD BE REVIEWED IN THE CONTEXT OF THE ACTUAL DEVELOPMENTS PROPOSED.

<p>Client: Dún Laoghaire-Rathdown County Council Mr. John McElduff Senior Planning Officer Dún Laoghaire-Rathdown County Council County Hall, Marine Road, Dun Laoghaire, Co. Dublin Phone: 01 20454700 Fax: 01 2060869</p>		<p>Drawn by: NL Checked by: BC Approved by: MN Scale: 1:10,000 @ A3 Date: Jan '06</p>									
<p>Project: GLENAMUCK DISTRICT DISTRIBUTOR ROAD</p>		<p>Title: Preferred GDDR Route Option 1C Scheme and Junction Layout</p>									
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<p>Approval/Issue:</p> <table border="1"> <tr> <th>No.</th> <th>Date</th> <th>Issue/Amendment</th> <th>Appr.</th> </tr> <tr> <td>A01</td> <td>Jan'06</td> <td>ISSUE FOR APPROVAL</td> <td>OK</td> </tr> </table>		No.	Date	Issue/Amendment	Appr.	A01	Jan'06	ISSUE FOR APPROVAL	OK	<p>Job No: MDT0205</p>	
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access junctions to the proposed GDDR Scheme and surrounding road network. It is recommended, in terms of efficient traffic management of the proposed road network that this number of proposed junctions not be exceeded. It is recognised, however that future access proposals for development will be subject to the Planning Process.

A detailed assessment of this route option has been carried out and is outlined in the following sections.

3.4 METHODOLOGY

The DTO Route Option C SATURN model outputs were used to assess AADT flows and turning movement flows at critical roads and junctions in the study area. These were studied in both the ‘Do Nothing’ and ‘Do Something’ scenarios for each design year. The ‘Do Nothing’ scenario is an assessment of the existing road infrastructure and conditions and ‘Do Something’ scenario is an assessment of the proposed road infrastructure and conditions.

The DTO included other infrastructural schemes such as, LUAS, METRO and Quality Bus Corridors in accordance with DTO policies and anticipated timeframes. Information regarding other significant traffic generators, for example, the Cherrywood development lands was input directly to the model by the DTO. There were six scenarios tested:

- 2007 Year of Opening AM Peak – ‘Do Minimum’ and ‘Do Something’
- 2016 Intermediate Year AM Peak – ‘Do Minimum’ and ‘Do Something’
- 2022 Design Year AM Peak – ‘Do Minimum’ and ‘Do Something’

The 2022 Design Year complies with paragraph 4.34 of TD37/93 of the DMRB, which states the need to assess a scheme 15 years beyond the Year of Opening. It includes all infrastructural and public transport improvement measures as identified in the DTO’s document “Platform for Change”. The 2016 Intermediate Year was chosen on the basis that the proposed METRO is not likely to be in place by this time.

The DTO SATURN model provided the following outputs

- Modal Split by car for each test year
- Internal Generated Traffic in the Study Area
- Assumptions on Highway and Public Transport Infrastructure in the Study Area
- Link flows and turning movements for each test year
- Heavy Goods Vehicle (HGV) flows for each test year
- Junction queues and delays for each test year

The AM peak hour outputs from the Saturn Model were used to estimate the Annual Average Daily Traffic (AADT) on the proposed and existing local road network for each test year. Using these peak hour and AADT flows, the carriageway cross section needs could be assessed for the GDDR, associated Link Road and subsequently a junction design strategy could be formulated to accommodate these predicted traffic flows. The estimation of AADT flows is based on the assumption (discussed in detail in the Feasibility and Route Selection Report) that the AM peak hour flow from the SATURN model typically represents approximately 8% of the AADT. This assumption is a conservative worst case approach to AADT flow estimation which ensures the design will be robust in respect to future traffic flows demands. However, traffic counts taken in 2006 showed that the AM peak on Ballybetagh Road represented approximately 16.5% of the AADT. This is not typical and considering the low standard form of the Ballybetagh Road, this factor was used to predict the future AADT flows on Ballybetagh Road in lieu of the more typical 8%.

It is estimated that the prediction of AADT flows in this analysis would be accurate with a range of +/- 20% approximately. This range is based on published statistics by An Foras Forbartha Teoranta, previous experience and existing traffic flow patterns in the study area.

3.5 BASE YEAR TRAFFIC FLOWS 2004

Base year traffic flows were estimated from both the 2004 traffic counts and the 2004 Base Year SATURN model run, which was fully calibrated and validated. Table 3.1 below shows the estimated AADT flows for the existing year 2004 where no new road infrastructure is in place. The 2004 Base Year road network AADT flows are shown graphically in Figure 3.5.

Table 3.1: Estimated AADT flows for the Base Year Road Network 2004.

Road	2004 AADT (range +/- 21%)		
	AADT	Range (+/-)	
Glenamuck Road North of the roundabout (Junction 1)	11,088	8,760	13,416
Glenamuck Road South of the roundabout (Junction 1)	6,306	4,982	7,630
Ballyogan Link Road	8,675	6,853	10,497
Kiltiernan Village (North of existing Glenamuck Road)	17,108	13,515	20,701
Kiltiernan Village (South of existing Glenamuck Road)	19,200	15,168	23,232

It must be noted that the base year analysis precedes the opening of the SEM M50 (June 2005).

3.5.1 Existing 2006 Traffic Flows

'Count On Us Ltd.' conducted a 12-hour AM and PM peak manual classified traffic count on behalf of RPS in March 2006 for three junctions on the Enniskerry Road. These included:

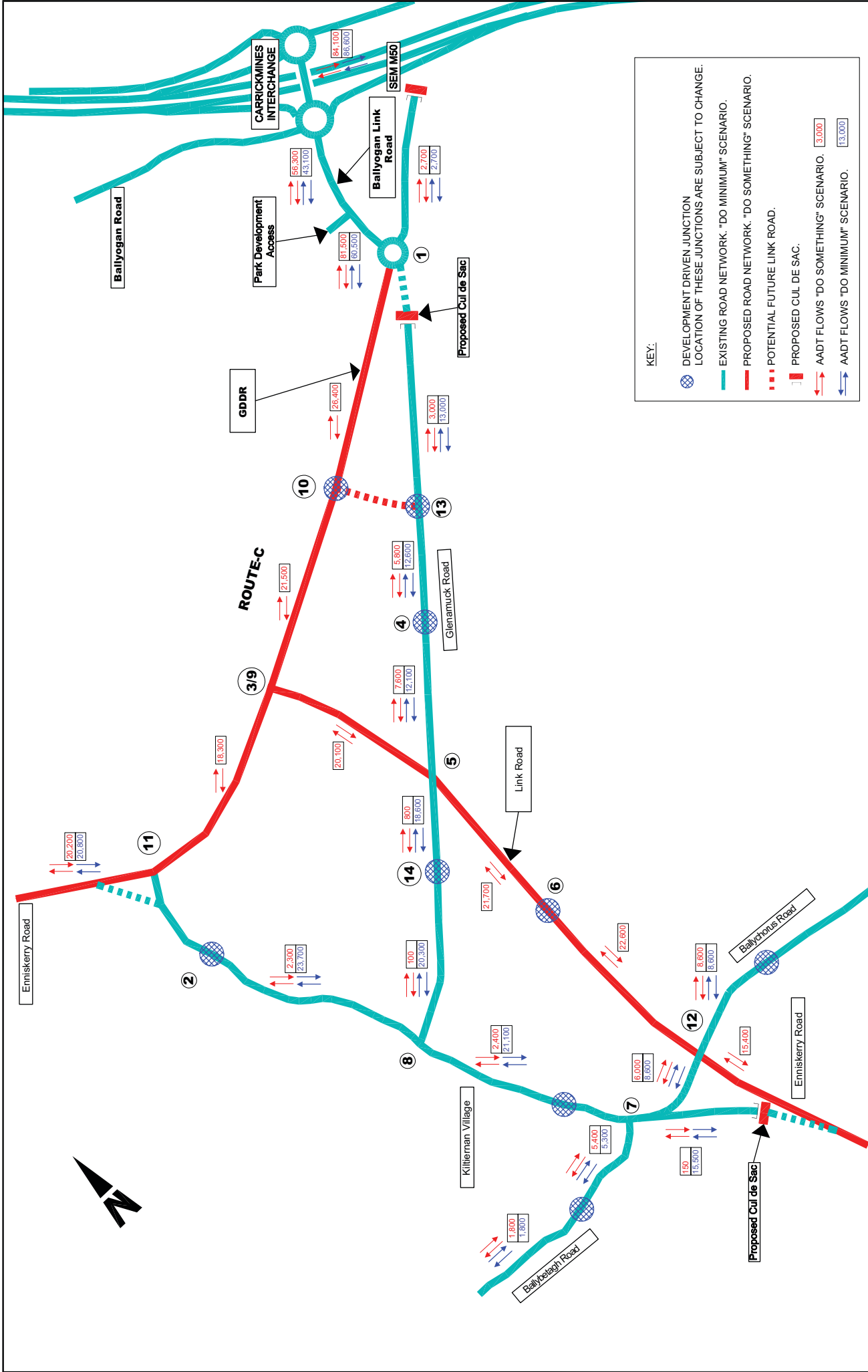
- 1.) Enniskerry Road / Glenamuck Road
- 2.) Enniskerry Road / Ballybetagh Road
- 3.) Enniskerry Road / Ballycorus Road

The count was conducted on Tuesdays 28th March 2006 between 07:00 and 19:00. The 2006 AADT flows were estimated from the above 12-hour counts using the An Foras Forbatha Teoranta document 'Expansion Factors for Short period Traffic Counts, RT201', Devlin, 1978. The 2006 estimated AADT flows include the following:

Table 3.2: Estimated AADT flows for the Local Road Network 2006.

Road	2006 AADT (range +/- 11%)		
	AADT	Range (+/-)	
Enniskerry Road north of Glenamuck Road	7,500	6,700	8,200
Enniskerry Road south of Glenamuck Road)	8,800	7,800	9,800
Glenamuck Road	4,400	3,900	4,900
Enniskerry Road south of Ballybetagh Road	6,800	6,100	7,500
Ballybetagh Road	2,500	2,200	2,800
Enniskerry Road south of Ballycorus Road	5,000	4,400	5,600
Ballycorus Road	2,600	2,300	2,900

The change in AADT flows between 2004 and 2006 are primarily due to the opening of the SEM section of the M50.



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Project: GLENAMUCK DISTRICT DISTRIBUTOR ROAD

Title: Opening Year 2007 Estimated AADT Flows

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Checked by: BC File No: MDT0205TR10201001001001001001
Approved by: MN Drg No:
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 Rev: A02 Fig. 3.6

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Revision Table:

No.	Date	By	Description
A02	Jun'06	BC	Traffic Counts Amended
A01	Jun'06	MN	ISSUE FOR APPROVAL
			Amendment / Issue

3.6 FUTURE DESIGN YEAR TRAFFIC FLOWS

Future traffic flows have been estimated for the Design Years 2016 and 2022 for both the 'Do Minimum' and 'Do Something' scenarios.

The AADT flows for all future design years for the proposed road network as illustrated on Figures 4.1 to 4.3 were estimated from the SATURN model AM peak hour traffic flows using the methodology described in Section 3.4.1 and are shown below in Table 3.3.

Comparisons of the 2016 and 2022 'Do Minimum' and 'Do Something' scenario AADT flows are shown in Table 3.3. This table should also be read in conjunction with Figure 3.4. The impact on the road network at a local level is also detailed where appropriate. The 2016 and 2022 'Do Minimum' and 'Do Something' scenario estimated AADT flows are shown graphically in Figures 3.7 and 3.8 respectively.

Table 3.3: Future Design Years - Estimated AADT Flows

Road Link	Estimated AADT Flows (veh/day) (Mean Flows Shown, note: +/- 20% predicted accuracy)					
	2016			2022		
	Do Min.	Do Some.	Local Network Impact (%)	Do Min.	Do Some.	Local Network Impact (%)
Ballyogan Link Road North of Park Dev.	45,200	62,500	+38%	48,400	66,300	+37%
Ballyogan Link Road North of Junction 1	58,300	77,000	+32%	58,100	78,000	+34%
GDDR South of Junction 1		44,900	N/a		49,400	N/a
GDDR South of Junction 10		38,600	N/a		46,000	N/a
GDDR South of Junction 3/9		21,700	N/a		22,200	N/a
GDDR/Enniskerry Road North of Junction 11	24,400	22,000	-10%	17,500	25,900	+48%
Glenamuck Road North of Junction 1	3,100	3,100	0%	3,600	3,700	+1%
Glenamuck Road North of Junction 13	19,900	2,400	-88%	20,800	2,200	-89%
Glenamuck Road North of Junction 4	17,000	11,000	-36%	18,200	13,200	-28%
Glenamuck Road North of Junction 5	18,200	12,200	-33%	19,900	12,400	-38%
Glenamuck Road North of Junction 14	16,400	3,200	-80%	15,200	4,800	-68%
Glenamuck Road North of Junction 8	21,900	1,600	-93%	21,500	3,300	-85%
Link Road South of Junction 3/9		27,200	N/a		31,700	N/a
Link Road South of Junction 5		24,600	N/a		26,100	N/a
Link Road South of Junction 6		28,400	N/a		23,600	N/a
Link Road South of Junction 12		19,000	N/a		17,600	N/a
Enniskerry Road Proposed Cul de Sac South of Junction 7	18,400	150	-99%	15,300	150	-99%
Ballycorus Road East of Junction 12	15,100	13,200	-12%	14,600	16,000	+10%
Ballycorus Road West of Junction 12	15,100	14,300	-5%	14,600	14,800	+1%
Kilternan Village North of Junction 8	28,800	5,000	-83%	26,100	7,100	-73%
Kilternan Village South of Junction 8	22,300	5,800	-74%	16,200	8,600	-47%
Ballybetagh Road West of Junction 7	10,500	12,500	+19%	10,300	10,700	+4%

Road Link	Estimated AADT Flows (veh/day) (Mean Flows Shown, note: approx. +/- 20% predicted accuracy)					
	2016			2022		
	Do Min.	Do Some.	Local Network Impact (%)	Do Min.	Do Some.	Local Network Impact (%)
Ballybetagh Road West of Dev. Access	2,250	2,250	0%	2,500	2,500	0%
M50 - SEM North of Carrickmines	107,900	113,100	+5%	103,900	110,800	+7%
M50 - SEM Southbound off ramp	18,000	23,800	+32%	18,000	23,800	+32%
M50 - SEM Northbound on ramp	13,700	22,100	+61%	14,700	25,400	+73%
M50 - SEM South of Carrickmines	90,300	88,300	-2%	83,600	79,600	-5%
M50 - SEM Northbound off ramp	12,500	12,900	+3%	13,000	13,200	+2%
M50 - SEM Southbound on ramp	3,300	5,200	+58%	2,900	4,000	+38%
M50 - SEM Overbridge	28,200	35,600	+26%	27,600	35,200	+27%
Ballyogan Road West of Interchange	25,200	29,900	+19%	21,600	27,000	+25%

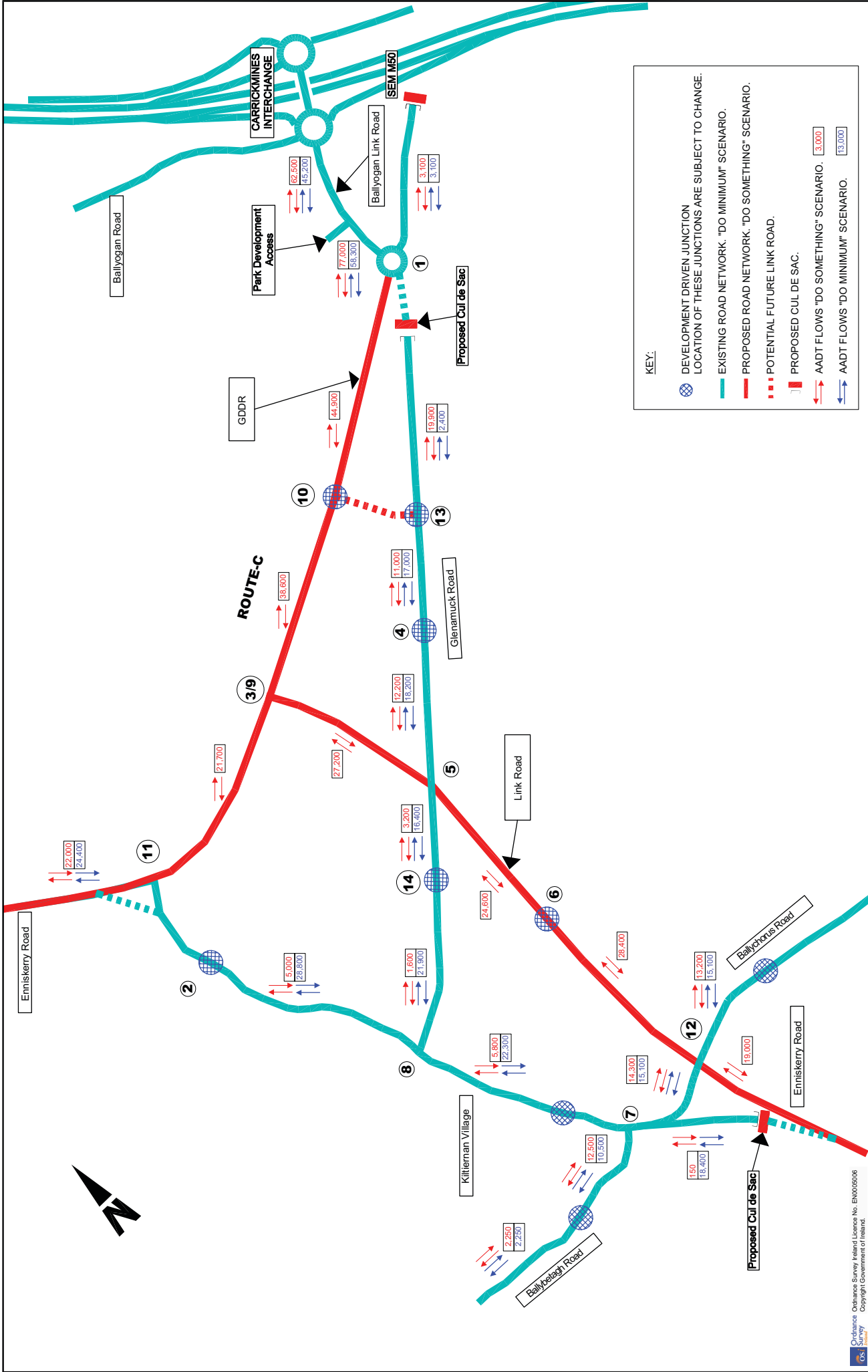
Table 3.3 shows the overall flows on the existing Glenamuck Road in 2016 and 2022 reduce by an average of 54% and a maximum of 99% by transferring up to 49,400 vehicles per day to the GDDR. The overall flows on the Enniskerry Road (Kiltiernan Village) in 2016 and 2022 reduces by an average of 76% by transferring up to 22,200 vehicles per day to the GDDR and up to 23,600 vehicles per day to the Link Road. These changes in AADT flows on the local existing road network are as a direct result of the proposed GDDR scheme. The combined impact of the proposed GDDR and the associated Link Road in the study area will change the travel patterns considerably since there will be numerous alternative routes for the commuter. The above results in Table 3.3 show the overall impact between the 'Do Minimum' and 'Do Something' scenario is a positive one in the local area and will result in significant benefits to the study area as a whole.

3.7 CROSS SECTION REQUIREMENT

As discussed previously in the 'Feasibility and Route Selection Report', the Advice Note TA 79/99 'Traffic Capacity of Urban Roads' contained in the UK DMRB (Chapter 2 Part 3) details the process by which one can estimate both the capacity and cross section of an urban road. This Advice Note gives the maximum hourly vehicle capacity for various types of urban road. These capacities may be used as starting points in the design and assessment of new urban road links and are intended to help designers make a judgement as to which carriageway standard is likely to provide an acceptable level of service within an urban context when operating close to capacity. These capacities apply to links and take no account of the effects of junctions. Unlike the data for rural roads, the urban road design flows are given in vehicles per hour rather than in terms of AADTs.

The Design Manual for Roads and Bridges as published by the National Roads Authority (NRA) provides design standards for the development and design of new non-urban roads. It determines the appropriate type of roadway to cater for predicted AADT flows.

The required cross section of the proposed GDDR and associated link roads was established using a combination of Table 5.1 from the NRA DMRB, UK DMRB TA 79/99 and the DTO document 'Traffic Management Guidelines'. The recommended road cross-sections considered suitable for Irish conditions are summarised in Table 3.4 (NRA DMRB TD9/03 Table 4 and TD27/00 Figure 6A).



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Design Year 2016
Estimated AADT Flows

GLENAMUCK DISTRICT
DISTRIBUTOR ROAD

Drawn by: NL Job No: MDT0205
Checked by: BC File No: MDT0205TR1010.rwg
Approved by: MN Dwg No:
Scale: N.T.S. Date: Jan'06
Rev: A02 Fig. 3.7

Table 3.4: NRA DMRB Recommended Rural Road Cross-Sections Road Type	Lane Width (m)	Hard Shoulders / Hard Strips (m)	Median Width (m)	Verge Width (m)	Total Width (m)
Reduced Two-Lane	2 x 3.5	2 x 0.5 (H. Strips)	-	2 x 2.5	13.0
Standard Two-Lane	2 x 3.75	2 x 3.0 (H. Shoulders)	-	2 x 3.0	19.5
Wide Two-Lane	2 x 5.0	2 x 2.5 (H. Shoulders)	-	2 x 3.0	21.0
Reduced Dual Carriageway	4 x 3.75	4 x 1.0 (H. Strips)	2.5	2 x 3.0	27.5
Standard Dual Carriageway	4 x 3.75	2 x 3.0 (H. Shoulders) 2 x 1.0 (H. Strips)	7.0	2 x 3.0	36.0
Dual Carriageway Motorway	4 x 3.75	2 x 3.0 (H. Shoulders) 2 x 1.0 (H. Strips)	7.0 / 14.0	2 x 3.0	43.0

The GDDR requires two distinct cross sections along its length. They are that of a Reduced Dual Carriageway (Section A-A) and that of a Standard Two-Lane Carriageway (Section B-B) as described above in Table 3.4 and shown in Figures 3.9 and 3.10 respectively. The above cross sections will require specific modifications to accommodate the provision of future bus lanes.

The Link Road also requires two cross sections along its length. That of two Standard Single Carriageways, Section B-B and Section C-C shown in Figures 3.10 and 3.11 respectively. The section of Link Road adjacent to the GDDR requires Section C-C and the section of Link Road to the south requires the Section B-B identical to that described above. These cross sections will require specific modifications to accommodate the provision of additional traffic and bus lanes in the future.

The required urban cross sections and total effective carriageway width are shown below in Table 3.5.

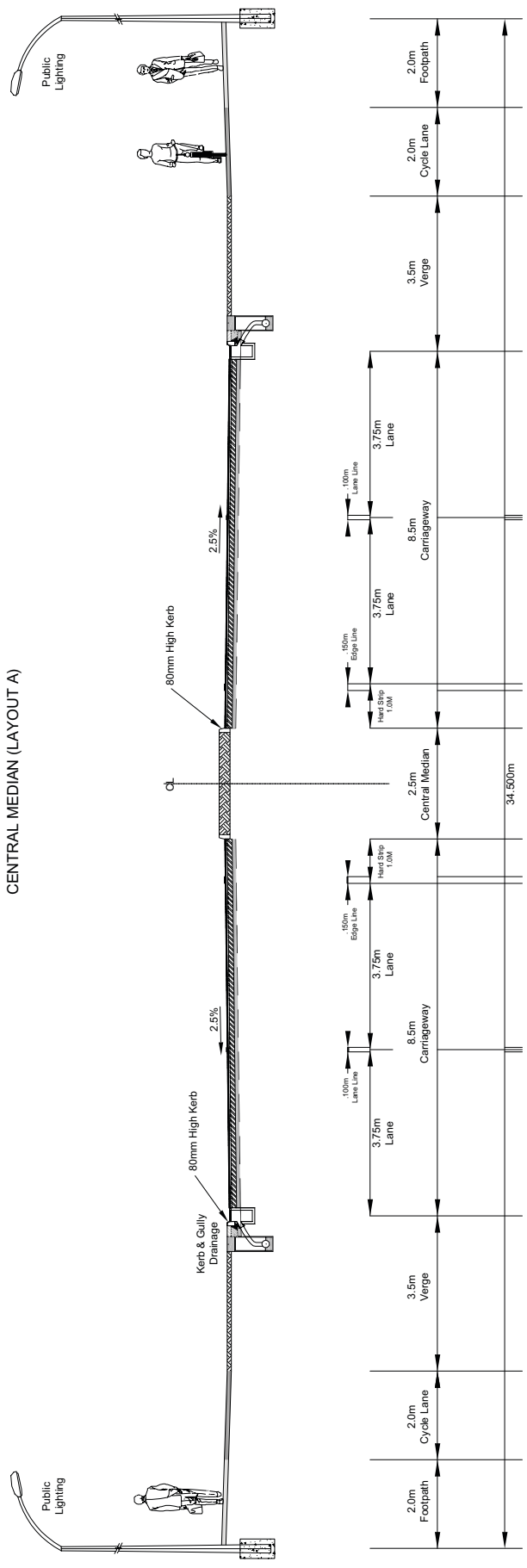
Table 3.5: Required Urban Cross-Sections

Road	Road Type	Lane Width (m)	Hard Strips (m)	Minimum Median Width (m)	Footpath Width (m)	Cyclepath Width (m)	Verge Width (m)	Total Width (m)
GDDR Section A-A	Reduced Dual Carriageway	4 x 3.75	2 x 1.0 (H. Strips)	2.5	2 x 2.0	2 x 2.0	2 x 3.5	34.5
GDDR Section B-B	Standard Two-Lane	2 x 3.65	2 x 3.0 (H. Shoulder)	-	2 x 2.0	2 x 2.0	-	21.3
Link Road Section C-C	Standard Two-Lane	2 x 3.65	2 x 3.0 (H. Shoulder)	-	2 x 2.0	2 x 2.0	2 x 3.5	28.3
Link Road Section B-B	Standard Two-Lane	2 x 3.65	2 x 3.0 (H. Shoulder)	-	2 x 2.0	2 x 2.0	-	21.3

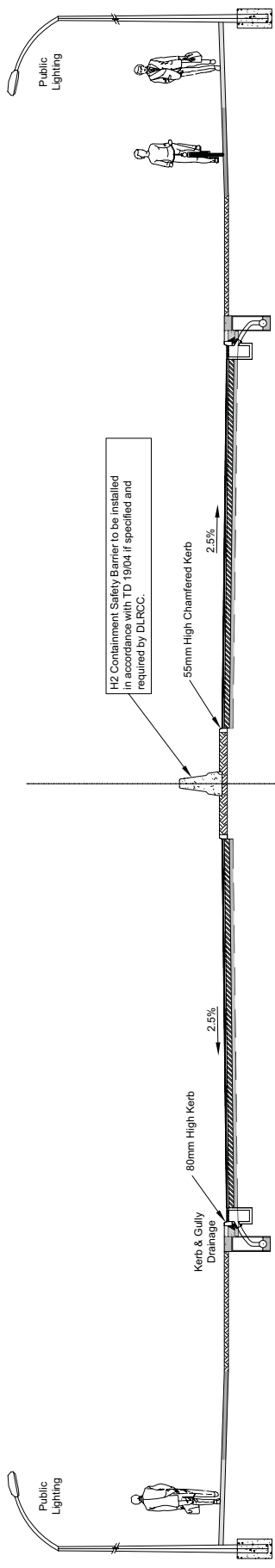
The central median of cross Section A-A on the dual carriageway section of the GDDR has been proposed as a raised central median with the provision of 80mm to 125mm high kerbs on either side. The central median would be suitably landscaped in the detailed design stage subject to the requirements of DLRCC. This 'Layout A' is shown in Figure 3.9.

In accordance with DMRB TD 19/04, there would be a requirement for the inclusion of a Safety Barrier on an at-grade or raised central median with the provision of up to 80mm high precast chamfered kerbs at either side if a raised central median is used. This DMRB standard states that Safety Barrier

TYPICAL CROSS SECTION A - A
CENTRAL MEDIAN (LAYOUT A)



TYPICAL CROSS SECTION A - A
CENTRAL MEDIAN (LAYOUT B)



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A01	Jan'04	ISSUE FOR APPROVAL	OK
			App.

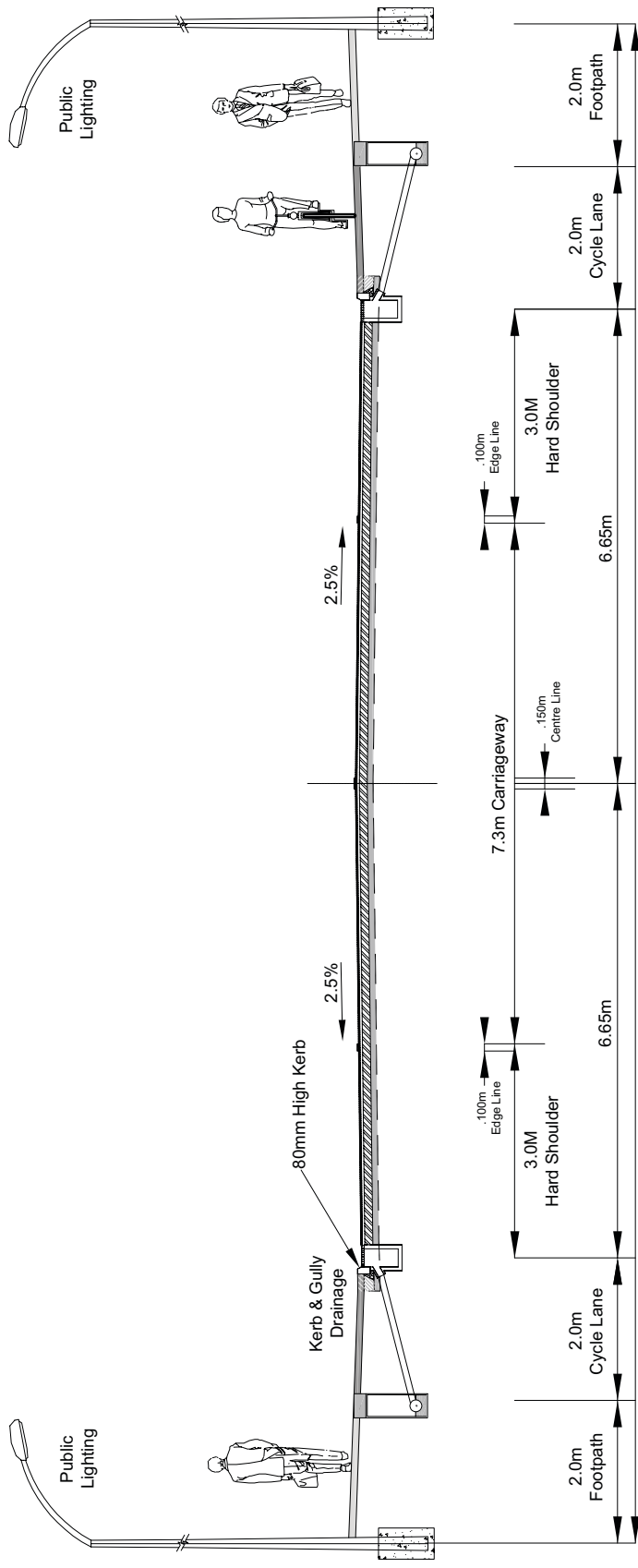
Project: **GLENAMUCK DISTRICT DISTRIBUTOR ROAD**

Title: **PROPOSED GDDR URBAN CROSS SECTIONS A - A**

Drawn by: NL
 Checked by: BC
 Approved by: OK
 Scale: N.T.S.
 Date: Jan'06

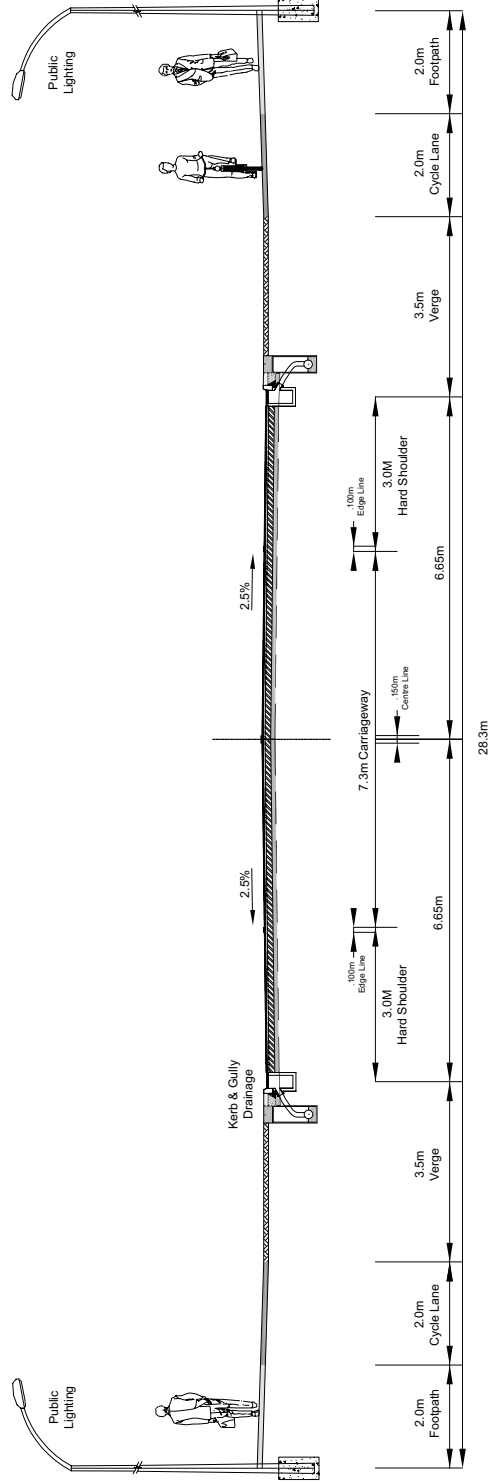
Job No: MDT/0205
 File No: MDT/0205TR/102.dwg
 Dwg No: Fig 3.9
 Rev: A02

By: RPS CONSULTING ENGINEERS 13.11.04 11:38:11 AM



GDDR AND LINK ROAD
TYPICAL CROSS SECTION B - B

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	No.	Date					Amendment / Issue	App.														
A01	Jan/08	ISSUE FOR APPROVAL	OK																			
A02	May/08	Safety audit comments incorporated	OK																			
Job No: MDT/0205 File No: MDT/0205TR/1013.dwg Dwg No: Rev: A02 Fig 3.10																						



LINK ROAD TYPICAL
CROSS SECTION C - C

Client:	<p>Dún Laoghaire-Rathdown County Council Comhairle Contae Dhúil Laoghaire-Ráth an Dúin</p>	<p>RPS Consulting Engineers RPS Consulting Engineers Ltd., West Pier Business Campus, Dún Laoghaire, Co. Dublin, Ireland. W: www.rpsgroup.com/ireland</p>	<p>NOTES</p> <ol style="list-style-type: none"> This drawing is the property of RPS Consulting Engineers. It is a confidential document and must not be copied, used, or its content divulged without prior written consent. All Levels refer to Ordnance Survey Datum, Mean High. DO NOT SCALE. Use figured dimensions only. If in doubt ask. 	<table border="1"> <tr> <th>No.</th> <th>Date</th> <th>Amendment / Issue</th> </tr> <tr> <td>A01</td> <td>Jan 08</td> <td>ISSUE FOR APPROVAL</td> </tr> <tr> <td></td> <td></td> <td>App</td> </tr> </table>	No.	Date	Amendment / Issue	A01	Jan 08	ISSUE FOR APPROVAL			App	<p>Project: GLENAMUCK DISTRICT DISTRIBUTOR ROAD</p>	<p>Title: PROPOSED LINK ROAD URBAN CROSS SECTIONS</p>	<p>Drawn by: NL</p>	<p>Job No: MDT0205</p>
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A01	Jan 08	ISSUE FOR APPROVAL															
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						<p>Scale: 1:1.5</p>	<p>Fig No: Fig 3.11</p>										
						<p>Date: Jan 08</p>	<p>Rev: A01</p>										

should be used for ‘all schemes for the construction and /or improvement of National Roads’ on ‘roads with a design speed of 85km/h or above’. TD 19/04 however, also states that ‘If this standard is to be used for the design of local road schemes (non-national roads), the designer should agree with the relevant Road Authority (DLRCC) the extent to which this document is appropriate in any particular instance’. The use of this standard TD19/04 is subject to the approval and agreement by the Employer (DLRCC). The inclusion of a safety barrier is shown in Figure 3.9 ‘Layout B’. The safety barrier shown in this figure is the required H2 Containment Barrier.

3.8 LINK CAPACITY

Although link capacity and level of service (LOS) is a critical element of road design, it must be noted that in urban situations, where roads are often congested, it is the junctions that ultimately determine the capacity of the road network, not the links. In this respect, junction capacity analysis is seen as the critical element of the road network analysis and is contained in the next Section.

Based on the DMRB, Volume 5, TA 79/99, ‘Determination of Urban Road Capacity’ the capacity of the GDDR, Links Roads, existing Glenamuck Road and Kiltiernan Village were estimated for the 2022 ‘Do Something’ scenario where additional lanes when required have been provided for.

From TA 79/99, the GDDR and the Links Road are classed as ‘Urban All-Purpose Road’ (UAP1) and the existing Glenamuck Road and Kiltiernan Village (Enniskerry Road) are classed as ‘Urban All-Purpose Road’ (UAP3). The maximum traffic flows (link capacity) which can be accommodated on a road (link) are expressed in vehicles per hour (one-way flow on a single lane) for an average carriageway width. The degree of saturation on the road (link) is calculated by using a ratio of flow on the road versus the capacity of the road (RFC value). This Ratio of Flow to Capacity (RFC) is expressed as a percentage representing how saturated a link is, and consequently how much additional traffic the road could cater for.

The peak RFC value for each link is shown below in Table 3.6. The link capacity analysis in Table 3.5 below is a theoretical exercise to illustrate the general capacity of the road network provided between the proposed junctions on the scheme.

Table 3.6: Urban Link Capacity ‘Do Something’ Scenario 2022

	‘Do Something’ Scenario 2022		
	Capacity (one-way)	Max. One-way flow	RFC (%)
GDDR (dual - 34.5m wide)	3,600	2,300	64%
GDDR (single – 21.3m wide)	2,010	1,678	83%
Link Road (single - 28.3m wide)	2,800	1,768	63%
Link Road (single - 21.3m wide)	2,010	1,586	79%
Existing Glenamuck Road	1,110	699	63%
Kiltiernan Village	1,300	346	27%

The link capacity calculations show the proposed GDDR scheme will provide significant reserve capacity on the network in the 2022 ‘Do Something’ scenario. If traffic flows were to exceed their link capacities, it would necessitate the consideration of an upgrading of the road infrastructure.

3.9 JUNCTION STRATEGY

In accordance with the DMRB, the junction strategy to be adopted is a very important aspect of the design. Four principal junctions between the GDDR scheme and the existing local road network are to be provided with an additional key junction on the GDDR itself.

Junction assessments have been carried out for the ‘Do Something’ scenario AM peak flows for the Design Year 2022. For analysis purposes the AM peak (08:00-09:00) was identified as the critical period, which corresponds with the DTO SATURN model data, which produces AM peak outputs only. The locations of all junction nodes on the existing and proposed route option layout are shown in Figure 3.4.

The following key junctions in the GDDR scheme have been designed, assessed and analysed:

- Junction 1 – Roundabout junction with the GDDR, Ballyogan Link Road and Glenamuck Road
- Junction 3/9 – Signalised junction between the GDDR and the Link Roads
- Junction 5 – Signalised junction between the Link Road and the existing Glenamuck Road
- Junction 11 – Priority junction between the Link Road and the realigned Enniskerry Road
- Junction 12 – Signalised junction between the Link Road and Ballycorus Road

Other junctions in the scheme which are likely to be development driven (i.e. will be designed and constructed subject to future development and planning applications on zoned lands) will be commented on. These junctions include the following:

- Junction 2 - Signalised junction north of Kiltarnan Village
- Junction 6 - Signalised junction on the Link Road between Junction 5 and 12
- Junction 3/9 - Signalised junction between the GDDR and the Link Road (additional junction arm)
- Junction 7 - Signalised junction on the Enniskerry Road between Junction 8 and 12
- Junction 10 - Signalised junction on the GDDR between Junction 3/9 and 1
- Junction 13 - Signalised junction on the existing Glenamuck Road between Junction 4 and 1
- Junction 14 - Junction on the existing Glenamuck Road between Junction 5 and 8

3.9.1 Junction Design Philosophy

During the design process for each key junction, both the ‘Year of Opening’ design layout plus the provision for a ‘Design Year 2022’ layout were taken into account.

This complex approach allowed the design to provide for a worst-case scenario ‘Design Year 2022’ by introducing infrastructural measures to the interim ‘Year of Opening’ layout. These measures would enable the ‘Year of Opening’ layout to be converted to the ‘Design Year 2022’ layout in the most efficient manner. The ‘Design Year 2022’ layout can provide for additional traffic lanes and bus lanes in the scheme.

To facilitate the efficient future conversion of the road layouts the following key design parameters; Hard Shoulders, Verges, Traffic Islands, Pedestrian Crossings, Signal Pole Locations, Cycle Lanes, Left turn Lanes, Junction radii and Kerbs were taken into account.

3.9.2 Static Model Software used

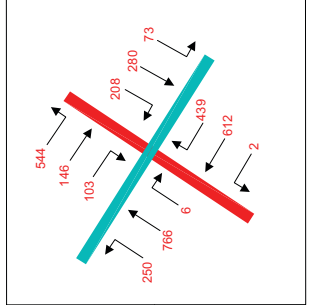
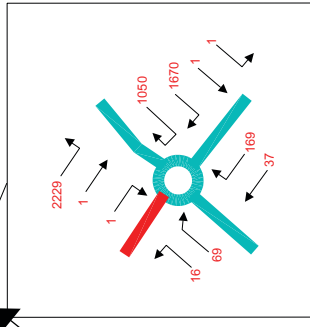
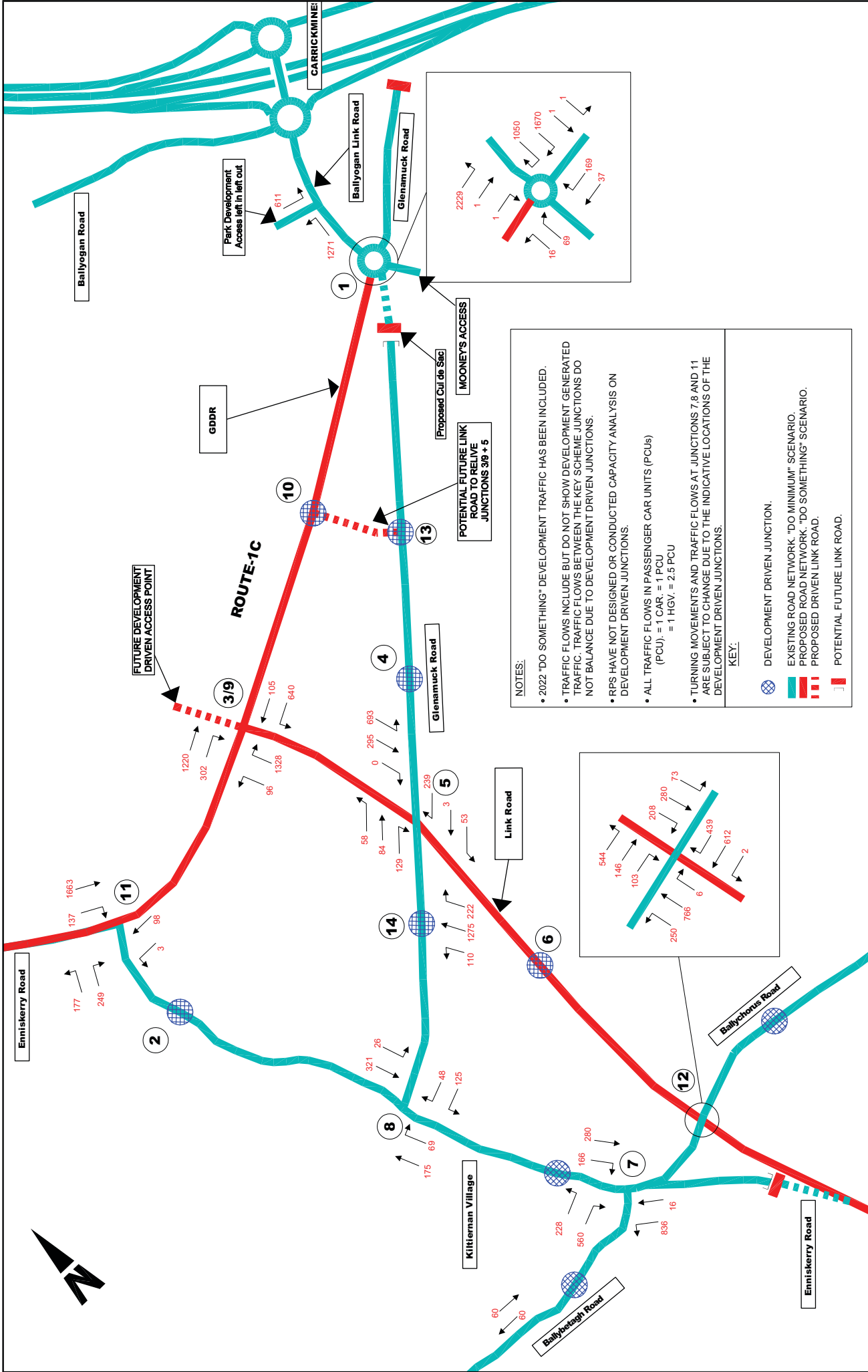
A number of static models were used to analyse the key junctions. They included the following:

- ARCADY which is used to model roundabout junctions
- PICADY which is used to model priority controlled junctions
- LINSIG which is used to model signal controlled junctions

The AM peak turning movements for the key junctions for the 2022 Design Year ‘Do Something’ scenario is shown in Figure 3.12. The turning movements were taken directly from the DTO SATURN model outputs, which are contained in the DTO “Glenamuck District Distributor Road Modelling Report, February 2006”.

Model outputs

- Degree of Saturation (Sat.) or Ratio of Flow to Capacity (RFC) is a statement of the degree of saturation of the link. The degree of saturation, ‘Sat/RFC’, is a measure of link flow to capacity quoted as a percentage, whereby 90% (or 0.90) for LINSIG and 85% (or 0.85) for ARCADY and PICADY is considered to be at capacity and anything over these values is considered over capacity.



NOTES:

- 2022 "DO SOMETHING" DEVELOPMENT TRAFFIC HAS BEEN INCLUDED.
- TRAFFIC FLOWS INCLUDE BUT DO NOT SHOW DEVELOPMENT GENERATED TRAFFIC. TRAFFIC FLOWS BETWEEN THE KEY SCHEME JUNCTIONS DO NOT BALANCE DUE TO DEVELOPMENT DRIVEN JUNCTIONS.
- RPS HAVE NOT DESIGNED OR CONDUCTED CAPACITY ANALYSIS ON DEVELOPMENT DRIVEN JUNCTIONS.
- ALL TRAFFIC FLOWS IN PASSENGER CAR UNITS (PCUs) (PCU) = 1 CAR = 1 PCU = 1 HVY. = 2.5 PCU
- TURNING MOVEMENTS AND TRAFFIC FLOWS AT JUNCTIONS 7, 8 AND 11 ARE SUBJECT TO CHANGE DUE TO THE INDICATIVE LOCATIONS OF THE DEVELOPMENT DRIVEN JUNCTIONS.

KEY:

- DEVELOPMENT DRIVEN JUNCTION.
- EXISTING ROAD NETWORK. "DO MINIMUM" SCENARIO.
- PROPOSED ROAD NETWORK. "DO SOMETHING" SCENARIO.
- PROPOSED DRIVEN LINK ROAD.
- POTENTIAL FUTURE LINK ROAD.

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Project: **GLENAMUCK DISTRICT DISTRIBUTOR ROAD**

Title: **DESIGN YEAR 2022 "DO SOMETHING" SCENARIO AM PEAK TRAFFIC FLOW KEY JUNCTIONS ONLY**

Drawn by: NL
Checked by: BC
Approved by: CK
Scale: N.T.S.
Date: Jan'08

Job No.: MDT/0205
File No.: MDT/0205TR/0105.dwg
Rev.:
Fig. No.: A01

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		Amendment / Issue	App.

A signalised junction is at its' most efficient when it operates as close to the maximum degree of saturation without going over it using the minimum cycle time available.

The lower the cycle time the more benefit pedestrians and cyclists encounter at a signalised junction, as the pedestrian crossings will be run once every cycle thus reducing the delay for crossing.

- PRC is the Practical Reserve Capacity measurement for the junction. The PRC is calculated from the maximum degree of saturation on a link and is a measure of how much additional traffic could pass through the junction while maintaining a maximum degree of saturation shown above
- If the PRC becomes negative, this indicates that the degree of saturation on the links is over 85% (ARCADY and PICADY) to 90% (LINSIG) and the junction is experiencing capacity problems.
- In LINSIG the 'Q (pcu)' represents the average queue in PCU's on the link at the beginning of the green period, which will occur in the modelling period.
- In ARCADY or PICADY the 'Max Q' represents the maximum predicted queue of vehicles that will occur during the analysed peak hour.
- Note: PCU = Passenger Car Units. Passenger car units allows for differences in the amount of interference to other traffic according to the type of vehicle. PCU's are used to represent the traffic flow in LINSIG analysis. For example, Car = 1 PCU, HGV's = 2.3 PCU, 1 PCU = 5.5-6.0m.

3.9.3 Junction 1 - GDDR / Ballyogan Link Road Roundabout Junction

At present this 3-arm roundabout junction has an ICD of 60m. This roundabout connects the existing Glenamuck Road (north and south of the junction) and the new Ballyogan Link Road. As part of proposals for 'The Park' development scheme, the Ballyogan Link Road was widened to a dual carriageway, which includes high standard pedestrian and cycling facilities. The new Ballyogan Link Road comprises of a 2 x 7.5m carriageway (plus 2 no. 1.0m hardstrips), 2 no. 2.0m wide cycleways and 2 no. 2.0m footpaths.

The current access to the 'The Park' development scheme is located on the new Ballyogan Link Road approximately 100m from Junction 1 and is a left in, left out priority junction. This access arrangement forces arrivals to the 'The Park' development to complete a u-turn manoeuvre at the roundabout Junction 1. Existing 2004 capacity analysis for this junction was conducted in the 'Traffic Appraisal Report - Existing Conditions' and the results showed that the junction currently operates significantly under capacity with minimal queue formation.

At present, this u-turning manoeuvre has minimal adverse impact on the performance of the roundabout junction due to the relatively low traffic flows. However, as traffic flows increase due to development in the study area, the performance and capacity of the roundabout decreases due to both increasing traffic volumes and critically the conflicting u-turning manoeuvre on the roundabout.

This junction was modelled using ARCADY for the design year 2022 'Do Something' scenario traffic flows illustrated in Figure 3.12 using the existing ICD of 60.0m. In this scenario, the development lands in the study area are attracting significant volumes of traffic. Also, 'The Park' development continues to attract significant volumes of traffic carrying out the u-turn manoeuvre. A roundabout junction with an RFC of 0.85 is considered to be at capacity while anything above 0.85 is considered to be over capacity¹, that is, will not have sufficient capacity to cater for the demand flows. The results are shown in Table 3.7. The junction arm notation is as follows:

- Arm A – Ballyogan Link Road to M50 (North)
- Arm B – GDDR (South)
- Arm C – Existing Glenamuck Road

¹ Paragraph 3 and 4, TD 42/95 (DMRB), Annex 1, Calculation of Capacity

Table 3.7: Junction 1 – ARCADY Capacity Analysis, Existing Geometry (2022 Design Year)

	Arm A – Ballyogan Link Road to M50 (North)		Arm B – GDDR (South)		Arm C – Existing Glenamuck Road (North)	
	Max RFC	Max Q	Max RFC	Max Q	Max RFC	Max Q
Weekday						
AM Peak						
2022	1.090	>100	1.511	54	1.381	>100

From the above results it is clear that the operation of the roundabout junction is very unsatisfactory for 2022 'Do Something' traffic flows. All junction arms are considerably over capacity with substantial queue formation and delays experienced. This substandard junction operation is primarily due to the conflicting u-turners but is also due to the existing restricted geometry.

As part of proposals for the residential development proposed by Mooney (D04A/0327), the ICD of the roundabout junction at Glenamuck Road and Ballyogan Link Road is to be increased to 65.2m from 60.0m to accommodate an additional circulatory lane. This infrastructural change has not yet been constructed. This development requires the addition of a fourth arm on the existing roundabout junction.

The existing roundabout junction layout with the inclusion of both the GDDR and Mooney's development access is shown in Figure 3.13.

A review of generated development traffic was undertaken to assess whether the estimated 2022 traffic flows predicted by the DTO model were over conservative. Discussions with DLRCC's Planning Department instigated this review of the trip generation from both committed and uncommitted developments within the Study Area. Proposed and actual GFA, development types, trip generation, employee numbers and development densities were all reviewed. The results have indicated that the estimated 2022 DTO traffic flows for employment and residential developments could be up to 25% and 15% respectively, greater than the more likely 2022 flows.

- Actual development in 'The Park' development was much lower in terms of trip generation than in the planning application and other employment zones in the area are expected to be of a similar nature. The actual development took on elements of retail warehousing which is approximately one employee per 70m² as opposed to the DTO level of retail/office, which is approximately one employee per 20m². An overall reduction of 25% in employment development traffic was identified as appropriate.
- The area of residential lands in hectares was also overestimated as it included sterilised and non-developable lands in the study area. A 15% reduction in residential development traffic was also identified as appropriate.

Taking into account this likely over estimation of development trips in the analysis of this junction, operational problems would continue to be experienced at this junction in the design year 2022 'Do Something' scenario using the existing geometry.

The following mitigation measures are proposed.

3.9.3.1 Recommended Mitigation Measure for Junction 1

It is recommended that the following measures be considered by DLRCC for the future 2022 operation of this junction:

1. The roundabout will operate as a four-arm junction (see Figure 3.13 and planning application D04A/0327).
2. The Internal Circulatory Diameter (ICD) of the roundabout be increased from 60m to 75m. The increased ICD of the roundabout from 60m to 65.2m has already been proposed and granted by DLRCC for the planning application D04A/0327.

3. Following the full construction of the GDDR and the possible construction of the above measures, DLRCC should continuously monitor the traffic flows at this junction to assess its performance.
4. If the junction exhibits signs of underperformance (i.e. queue formation and significant delays) it is recommended that DLRCC consider the signalisation of the junction. The increased ICD to 75m allows for limited storage of vehicles on the circulatory carriageway during the signal cycle. This may not be possible at an ICD of 60m or 65.2m as the required internal storage would not be available.
5. DLRCC in conjunction with 'The Park' Developments should also consider the removal or reduction in use of the left in access arrangement at the current access junction. The entrance access could be relocated as a right turn movement to the south on the proposed GDDR at Junction 10, which is proposed to be located approximately equidistant between Junction 1 and Junction 3/9 as part of future planning submissions. This measure will remove the u-turn movement on the roundabout and create a straight-ahead movement, which is less conflicting. However, 'The Park' is currently in operation and it is recognized there would be significant impact on the development if access were to be altered.

The 75m ICD roundabout junction was re-analysed using ARCADY using the reduced traffic demand. The junction arm notation is as follows:

- Arm A – Ballyogan Link Road to M50 (North)
- Arm B – Existing Glenamuck Road
- Arm C – Mooney's Access
- Arm D – GDDR

The capacity results for the recommended measures are shown in Table 3.8.

Table 3.8: Junction 1 – Recommended Mitigation Measures Capacity Analysis

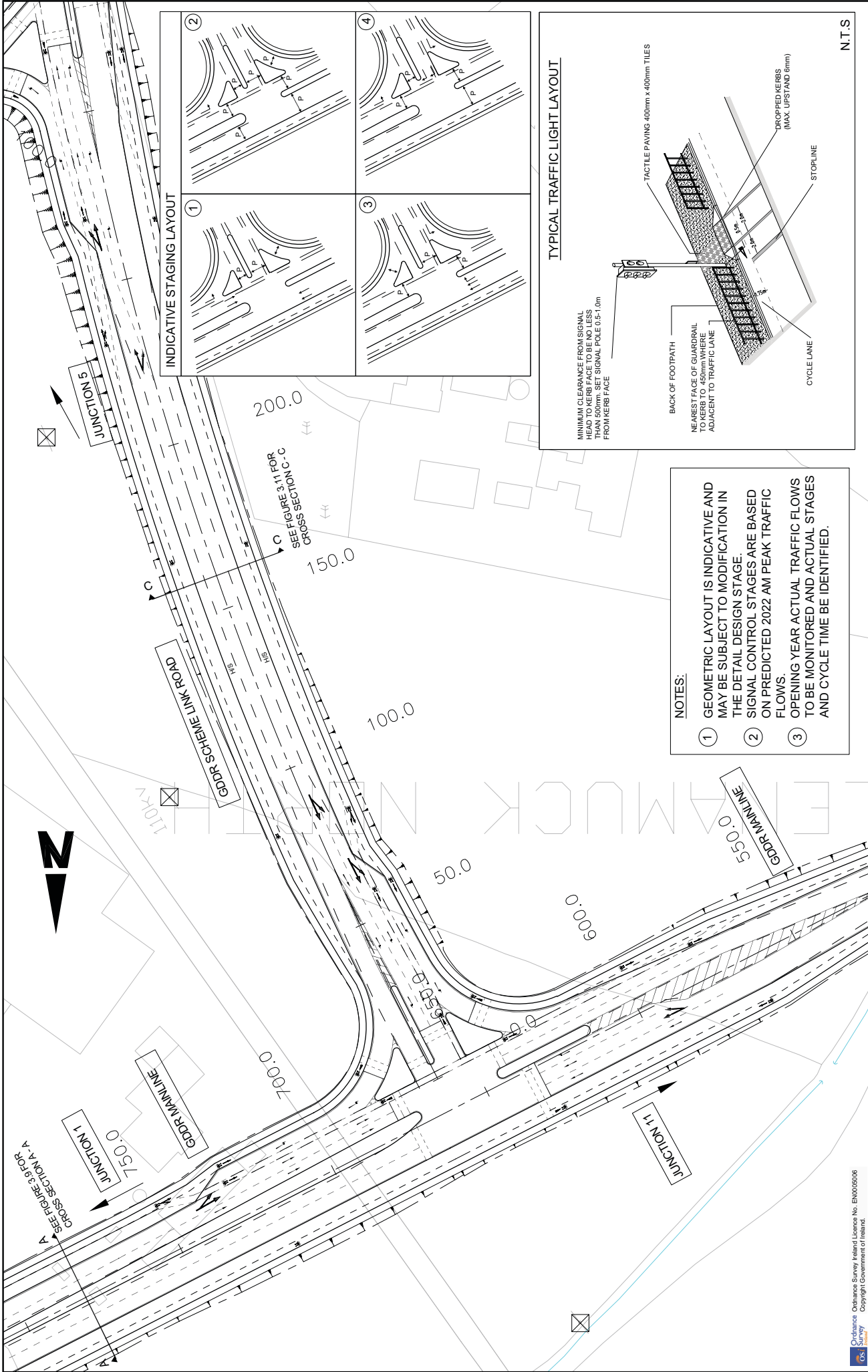
	Arm A – Link Road to M50 (North)		Arm B – Existing Glenamuck Road (North)		Arm C – Mooney's Access		Arm D – GDDR (South)	
	Max RFC	Max Q	Max RFC	Max Q	Max RFC	Max Q	Max RFC	Max Q
Weekday								
AM Peak								
Measure 1+2	0.926	11.1	0.422	0.7	0.225	0.3	0.931	11.4
Measure 1+2 +5	0.926	11.1	0.422	0.7	0.225	0.3	0.719	2.5

Taking into account the recommendations above, Table 3.8 above illustrates that a combination of measures 1, 2 and 5 produces the preferable performance of the junction in terms of capacity and queuing.

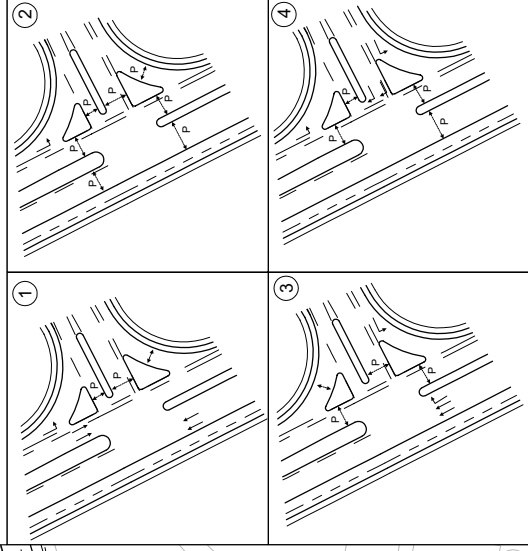
Although the junction itself will be performing over capacity, the combination of measures 1, 2 and 5 provides the best possible solution to the capacity problems encountered at Junction 1, a combination of measures 1 and 2 produces similar results without the required major infrastructural changes at 'Park' access. This change removes the left-in movement at the existing 'Park' access. The average inclusive queuing delay at the junction at the junction for measures 1 and 2 is approximately 9 seconds per vehicle, which is acceptable for the Design Year 2022 traffic flows.

Therefore, it is recommended that a combination of measures 1 and 2 be considered by DLRCC to cater for 2022 'Do Something' scenario traffic flows. These also include the introduction of an additional arm to cater for access to Mooney's development and the increased ICD from 60.0m to 75m.

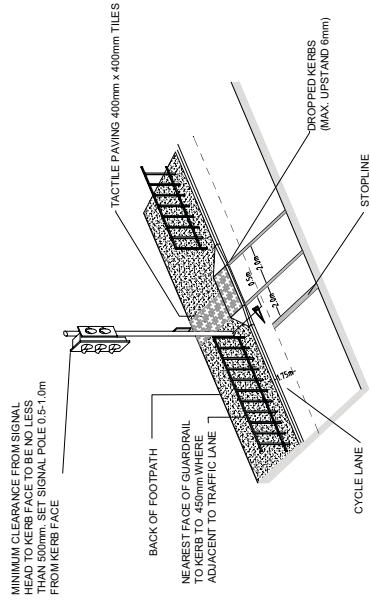
A further study and preliminary design may be necessary and should be considered by DLRCC to investigate these infrastructural recommendations further.



INDICATIVE STAGING LAYOUT



TYPICAL TRAFFIC LIGHT LAYOUT



NOTES:

- 1 GEOMETRIC LAYOUT IS INDICATIVE AND MAY BE SUBJECT TO MODIFICATION IN THE DETAIL DESIGN STAGE.
- 2 SIGNAL CONTROL STAGES ARE BASED ON PREDICTED 2022 AM PEAK TRAFFIC FLOWS.
- 3 OPENING YEAR ACTUAL TRAFFIC FLOWS TO BE MONITORED AND ACTUAL STAGES AND CYCLE TIME BE IDENTIFIED.

N.T.S

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<p>Client: Dún Laoghaire-Rathdown County Council Dún Laoghaire-Rath an Duin Phone: 01 2045770 Fax: 01 2010869</p>		<p>Approval: No. Date App A01 Jan'08 CK Amendment Issue</p>	

3.9.4 Junction 3/9 - GDDR / Link Road Signalised junction

It is proposed that the junction between the proposed GDDR and the Link Road will operate as a signalised tee junction (initially) to cater for all the predicted traffic movements. The junction was modelled for the AM peak hour period in the Design Year 2022 'Do Something' scenario, the traffic assignments of which are illustrated in Fig. 3.12.

This junction was modelled using LINSIG with an identified cycle time of 100 seconds. The pedestrian crossings are proposed to be operated by push buttons, and for modelling purposes, these were run once every cycle. The proposed junction layout and indicative staging sequence are illustrated in Figure 3.14. A summary of the results of the analysis are shown below in Tables 3.8.

Table 3.9: Node 3/9 - LINSIG Capacity Analysis (2022 Design Year)

		Design Year 2022		
		100 second signal cycle		
		AM peak traffic flows		
Link	Road & turning movement	Deg. Sat. (RFC)	Q (pcu)	Delay s/pcu
1/1	GDDR southbound, Left turn (Major road)	10.8	0.7	1.1
1/2	GDDR southbound, straight (Major road)	0.5	0.1	41.4
2/1	Link Road, Left turn (Minor road)	6.2	0.6	2.6
2/2	Link Road, Right turn (Minor road)	85.6	25.6	36.9
3/1	GDDR northbound, Right Turn (Major road)	55.2	6.3	36.7
3/2	GDDR northbound, Straight (Major road)	87.8	14.6	25.6
		PRC % = 2.5%		

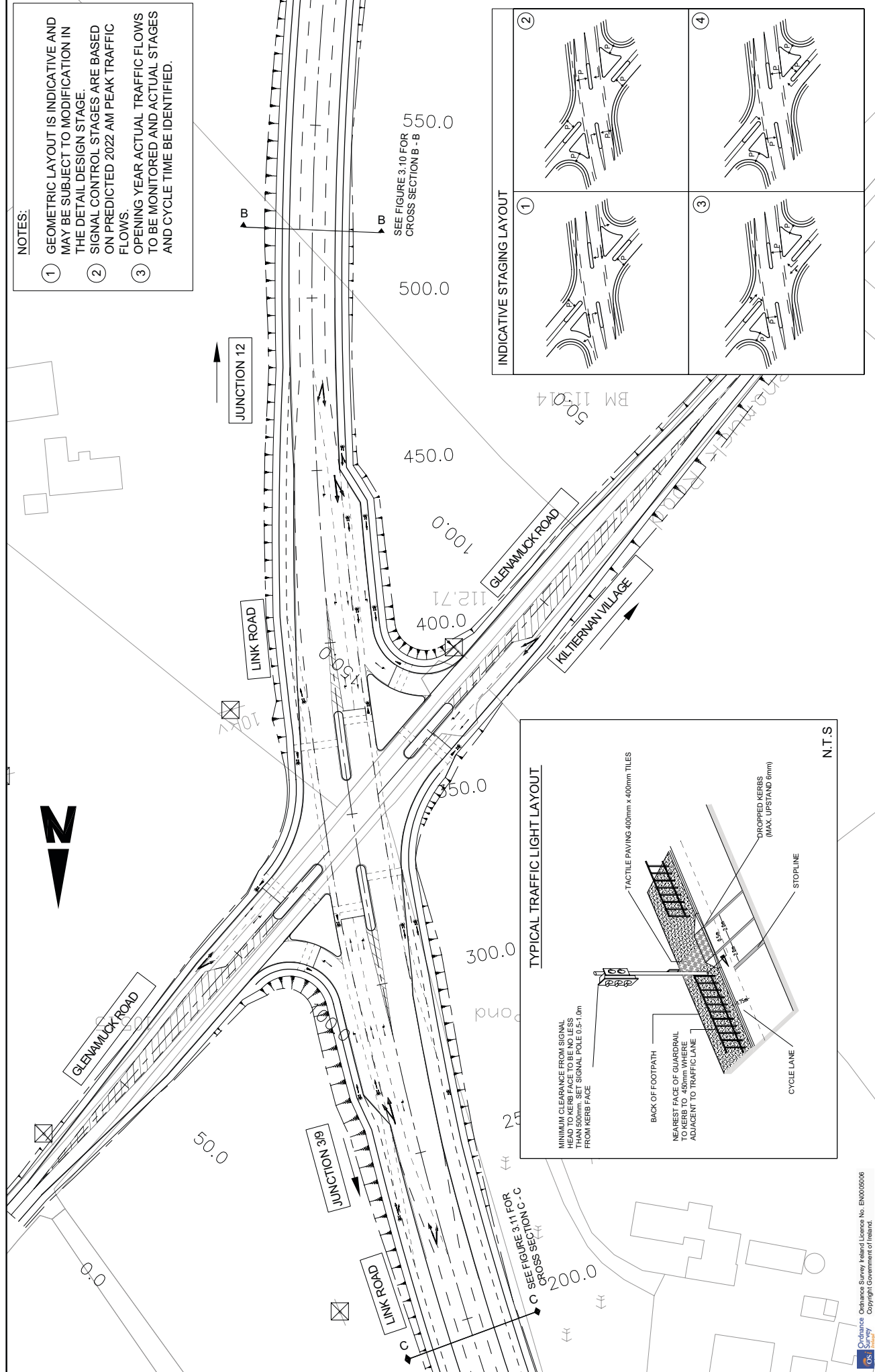
From Table 3.9 above, the junction operates within capacity up to 2022 and hence the junction operation is optimised and all vehicle and pedestrian movements are catered for within the modelled cycle time.

It is also recommended that this junction could be suitable for use as a future access point to development lands to the north. This would be achieved by the conversion of this three-arm junction into a signalised crossroads with the addition of a fourth arm. The current 'T' junction geometric layout has been designed to accommodate a future fourth arm (i.e. land/space is set aside for the accommodation of right turn lanes etc). The junction design layout complies with the required junction intervisibility and sightline/stopping sight distance standards set down in Figure 2/3 of TD 50/99 and Table 3 of TD 09/05 respectively.

3.9.5 Junction 5 – Link Road / Existing Glenamuck Road Signalised Junction

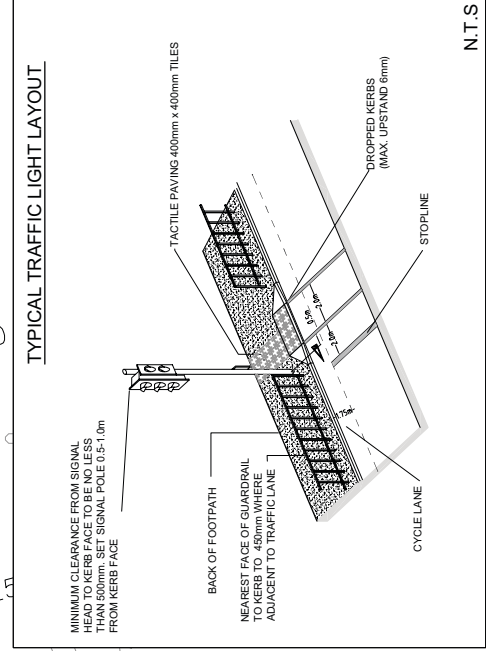
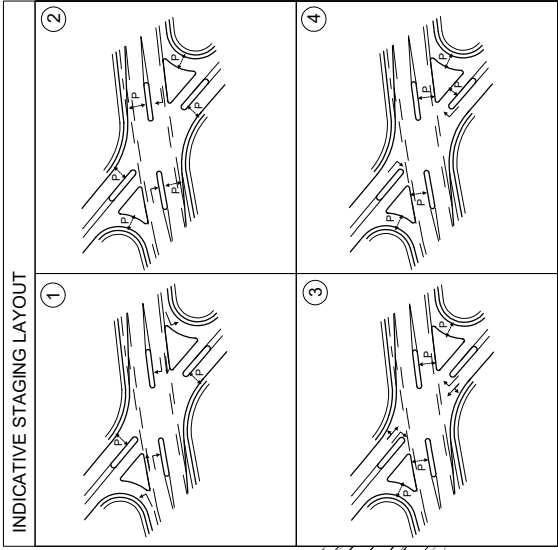
It is proposed that the junction between the proposed Link Road and the existing Glenamuck Road will operate as a signalised crossroad junction to cater for all the predicted traffic movements. The junction was modelled for the AM peak hour periods in the Design Year 2022 'Do Something' scenario, the traffic assignments of which are illustrated in Figure 3.12.

This junction was modelled using LINSIG with an identified minimum cycle time of 65 seconds to minimise delay to pedestrians crossing the junction. The pedestrian crossings will be operated by push buttons, and for modelling purposes, all crossings were run once every cycle. The proposed junction layout and indicative staging sequence are illustrated in Figure 3.15. A summary of the results of the analysis are shown in Table 3.10.



- NOTES:**
- ① GEOMETRIC LAYOUT IS INDICATIVE AND MAY BE SUBJECT TO MODIFICATION IN THE DETAIL DESIGN STAGE.
 - ② SIGNAL CONTROL STAGES ARE BASED ON PREDICTED 2022 AM PEAK TRAFFIC FLOWS.
 - ③ OPENING YEAR ACTUAL TRAFFIC FLOWS TO BE MONITORED AND ACTUAL STAGES AND CYCLE TIME BE IDENTIFIED.

SEE FIGURE 3.10 FOR CROSS SECTION B - B



SEE FIGURE 3.11 FOR CROSS SECTION C - C

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		App																

Table 3.10: Junction 5 - LINSIG Capacity Analysis (2022 Design Year)

		Design Year 2022		
		65 second signal cycle		
		AM peak traffic flows		
Link	Road & turning movement	Deg. Sat. (RFC)	Q (pcu)	Delay s/pcu
1/1	Link Road northbound, Right turn	33.0	1.9	9.7
1/2	Link Road northbound, Straight	87.5	9.8	33.7
1/3	Link Road northbound, Straight +Left turn	73.2	6.6	19.8
2/1	Glenamuck Road southbound, Right turn	38.6	2.7	16.9
2/2	Glenamuck Road southbound, Straight + Left turn	23.2	0.9	28.8
3/1	Glenamuck Road northbound, Right turn	36.3	1.9	24.5
3/2	Glenamuck Road northbound, Straight + Left turn	53.0	2.3	35.9
4/1	Link Road southbound, Right turn	0.0	0.0	9.4
4/2	Link Road southbound, Straight	49.4	3.9	23.3
4/3	Link Road southbound, Straight +Left turn	26.3	2.2	13.9
		PRC % = 5.1%		

From Table 3.10 above, the junction operates within capacity up to 2022 and hence the junction operation is optimised and all vehicle and pedestrian movements are catered for within the modelled cycle time. This junction design layout complies with the required junction intervisibility and sightline/stopping sight distance standards set down in Figure 2/3 of TD 50/99 and Table 3 of TD 09/05 respectively.

3.9.6 Junction 11 – GDDR / Realigned Enniskerry Road Priority Junction

The junction to be provided between the new GDDR and the realigned Enniskerry Road must cater for all movements in order to meet with the necessary local access requirements. Possible junctions include a Simple Tee Junction, Ghost Island Tee junction, Single Lane Dualling and a Signalised Junction.

An assessment of each junction type identified that the preferred junction solution would appear to be a Ghost Island Tee junction in accordance with TD 42/95 as it would provide access to Kiltiernan Village whilst not encouraging or promoting the village as a through route. The junction will operate as a priority junction to cater for all traffic movements. The junction was modelled using PICADY for the traffic assignments illustrated in Figure 3.12.

The proposed junction layout is illustrated in Figure 3.16. A summary of the results of the analysis are shown in Table 3.11.

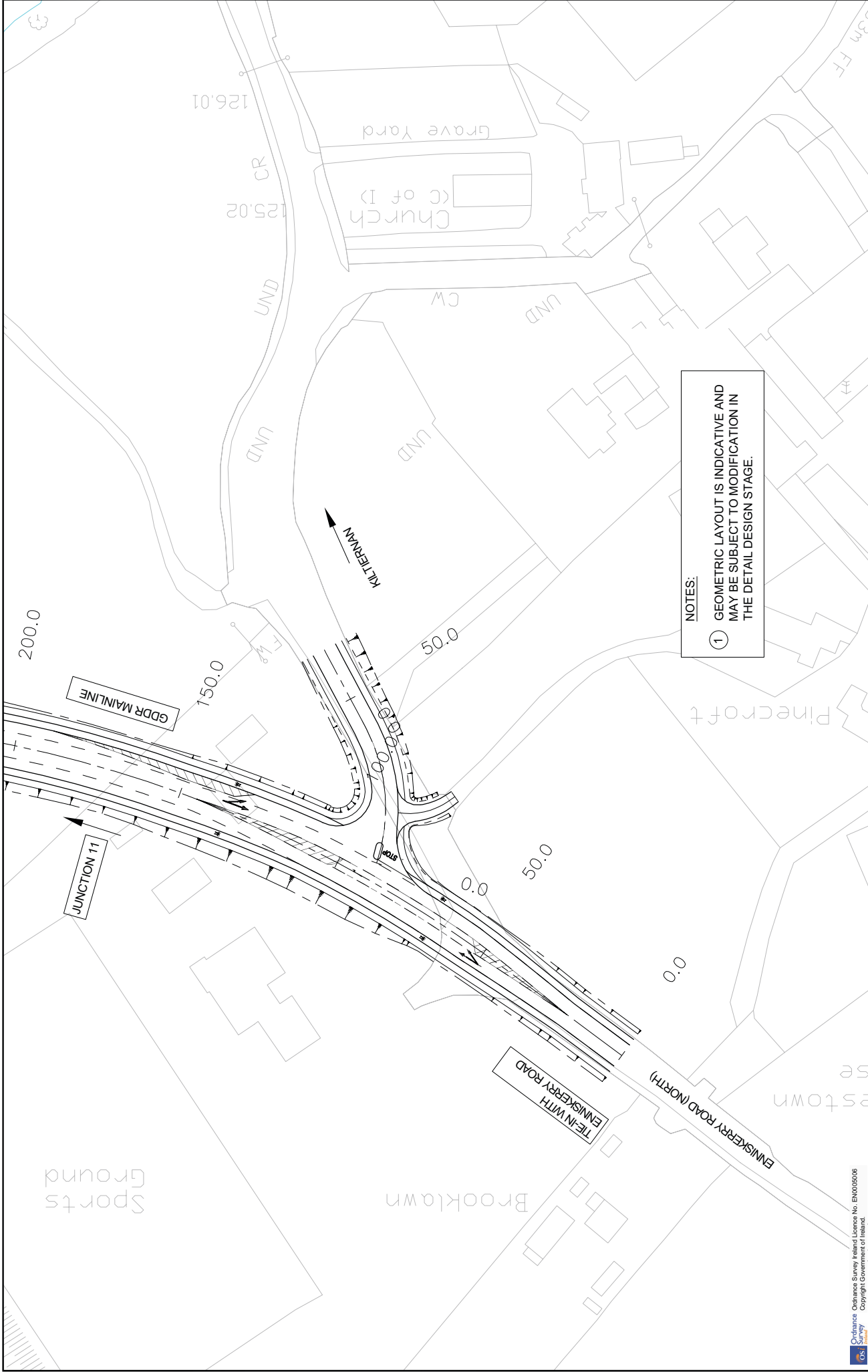
The junction arm notation is as follows:

- Arm A – GDDR (North)
- Arm B – Realigned Enniskerry Road (to Kiltiernan Village)
- Arm C – GDDR (South – realigned Enniskerry Road)

Table 3.11: Junction 11 - Priority Junction Capacity Analysis (2022 Design Year)

	Realigned Enniskerry Road, minor road				GDDR, major road	
	Arm B-A (right)		Arm B-C (left)		Arm C-B (Right)	
	Max RFC	Max Q	Max RFC	Max Q	Max RFC	Max Q
AM Peak						
2022	0.735	2.6 (3veh.)	0.332	0.5 (1veh.)	0.227	0.3 (1veh.)

The results above illustrates that the priority junction operates under capacity for the design year 2022 traffic flows and that no significant queue formation is predicted.



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3.9.7 Junction 12 – Link Road / Ballycorus Road Signalised Junction

It is proposed that the junction between the proposed Link Road and the existing Ballycorus road will operate as a signalised crossroad junction to cater for all predicted traffic movements. The junction was modelled for the AM peak hour periods in the Design Year 2022 'Do Something' scenario, the traffic assignments of which are illustrated in Figure 3.12.

This junction was modelled using LINSIG with an identified minimum cycle time of 60 seconds to minimise delay to pedestrians crossing the junction. The pedestrian crossings will be operated by push buttons, and for modelling purposes all crossings were run once every cycle. The proposed junction layout and staging sequence can be seen in Figure 3.17. A summary of the results of the analysis are shown in Table 3.12.

Table 3.12: Junction 12 - LINSIG Capacity Analysis (2022 Design Year)

		Design Year 2022		
		60 second signal cycle		
		AM peak traffic flows		
Link	Road & turning movement	Deg. Sat. (RFC)	Q (pcu)	Delay s/pcu
1/1	Link Road southbound, Straight	31.9	2.8	13.3
1/2	Link Road southbound, Right turn	73.6	2.7	30.7
1/3	Link Road southbound, Left turn	6.8	0.6	7.9
2/1	Ballycorus Road southbound, Straight + Left	85.2	8.7	31.8
2/2	Ballycorus Road southbound, Right turn	52.1	4.5	16.6
3/1	Link Road northbound, Right turn	1.0	0.1	10.3
3/2	Link Road northbound, Straight	87.3	10.2	30.0
3/3	Link Road northbound, Left turn	24.9	2.2	10.2
4/1	Enniskerry Road, Right turn	12.2	1.1	12.3
4/2	Enniskerry Road, Straight	18.1	1.5	13.4
4/3	Enniskerry Road, Left turn	58.3	4.9	14.4
		PRC % = 3.1%		

From Table 3.11 above, the junction operates within capacity up to 2022 and hence the junction operation is optimised and all vehicle and pedestrian movements are catered for within the modelled cycle time. This junction design layout complies with the required junction intervisibility and sightline/stopping sight distance standards set down in Figure 2/3 of TD 50/99 and Table 3 of TD 09/05 respectively.

3.9.8 Additional Development Junctions

In conjunction with the DTO the future development access needs in the study area have been assessed and a number of potential additional junctions to facilitate the development are proposed. These junctions, subject to planning permission, could serve to access development lands surrounding the existing and proposed road network.

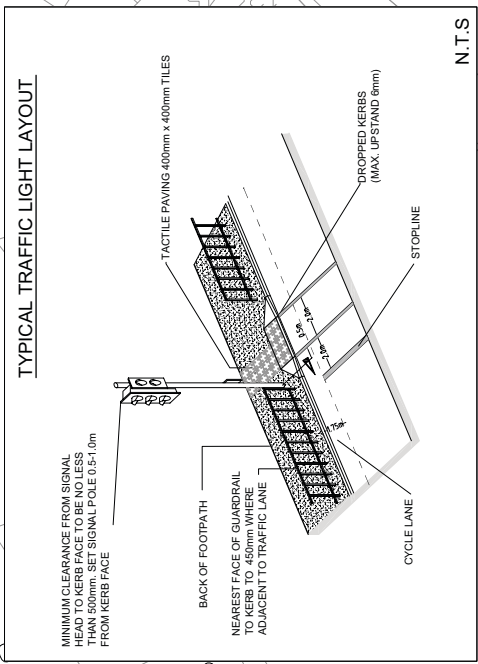
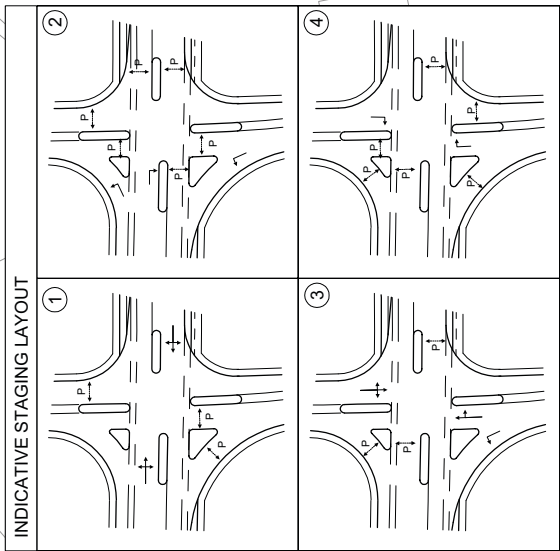
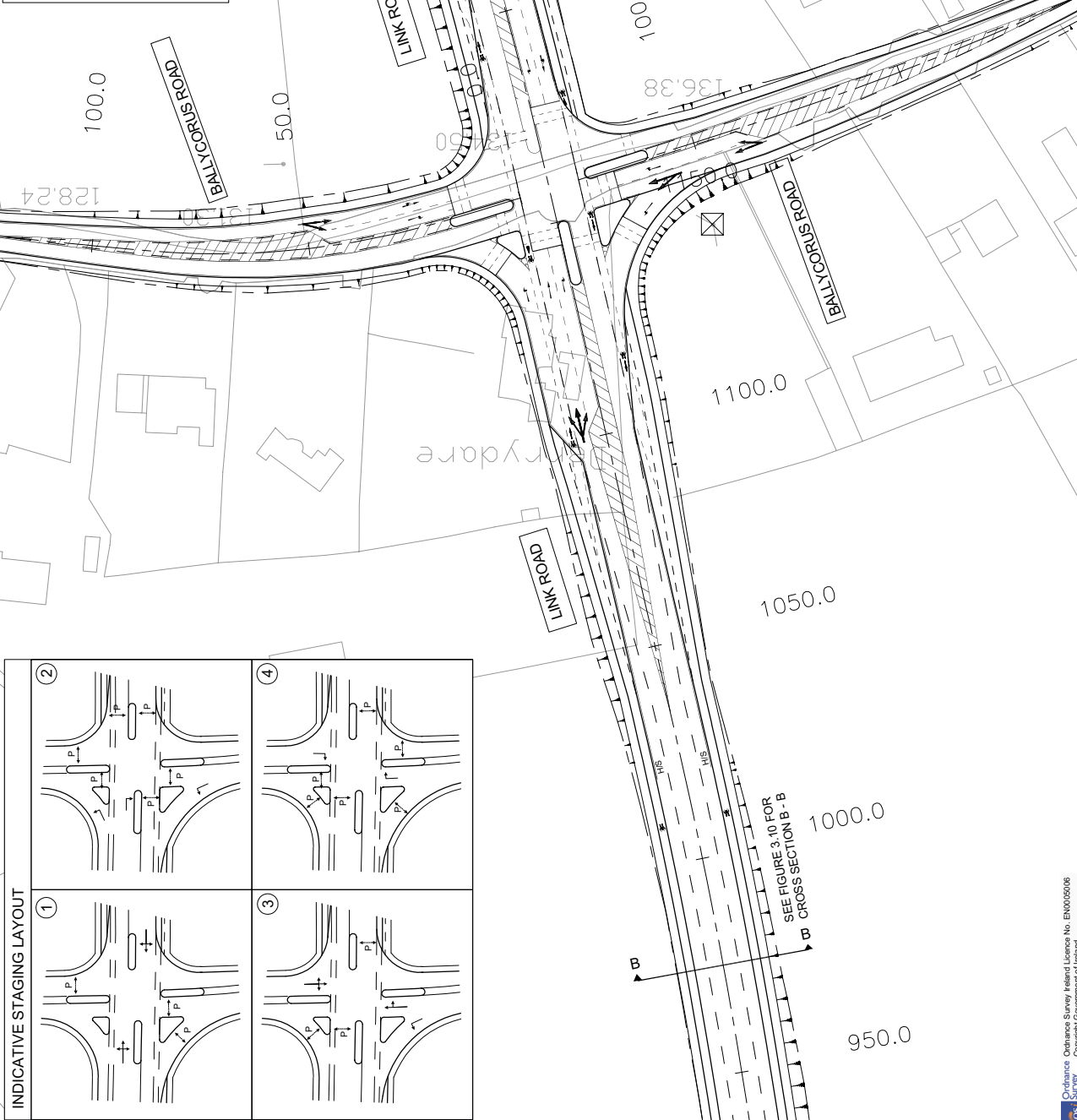
In order for the road network to perform efficiently, the number of additional junctions on the existing and proposed road network should be restricted and strategically located. The DTO SATURN model in conjunction with DLRCC zoning and planning information has been used to identify suitable/potential locations for these junctions. The locations of these junctions are shown in Figure 3.4.

These junctions will be subject to future development and planning applications to DLRCC on zoned lands. The following comments are made in relation to these junctions:



NOTES:

- ① GEOMETRIC LAYOUT IS INDICATIVE AND MAY BE SUBJECT TO MODIFICATION IN THE DETAIL DESIGN STAGE.
- ② SIGNAL CONTROL STAGES ARE BASED ON PREDICTED 2022 AM PEAK TRAFFIC FLOWS.
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Date:	Jan'08	Fig 3.17	

JUNCTION 12
INDICATIVE GEOMETRIC
LAYOUT
SIGNAL CONTROL

GLENAMUCK DISTRICT
DISTRIBUTOR ROAD

No.	Date	Amendment / Issue	App.
A02	May'08	ISSUE FOR APPROVAL	OK
A01	Jan'08	ISSUE FOR APPROVAL	OK

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Dun Laoghaire-Rathdown County Council
 County Council Comhairle Contae
 Dúin Laoghaire-Ráth an Dúin

3.9.8.1 Development Access in Kiltiernan Village (Junctions 2 and 7)

If significant development of Kiltiernan Village is to take place, suitable access junctions to development lands would be best located within the village itself. Lands to the east and west of the Enniskerry Road have been zoned for residential and mixed uses in the village. It is recommended that access Junction 2 be positioned at a suitable site between Junction 8 and Junction 11 and that a further access Junction 7 could be positioned at a suitable site between Junction 8 and Junction 12.

3.9.8.2 Development Access North of the GDDR (Junction 3/9)

It is recommended that this junction could be suitable to serve as a future access to development lands to the north of the junction 3/9. This would be achieved by the conversion of this proposed three-arm junction between the GDDR and Link Road into a signalised crossroads with the addition of a fourth arm. The current 'T' junction geometric layout has been designed to accommodate a future fourth arm (i.e. land/space has been set aside for right turn lanes, etc.). The final geometric design of this four-arm junction would be completed by a third party to suit proposed developments and will be subject to the planning process.

3.9.8.3 Development Access to Lands adjacent to Glenamuck Road (Junction 4)

It is considered that a junction could be provided on the existing Glenamuck Road between Junction 5 and 'Rockville Drive' to serve development lands on either side of the road. The location and design of this junction would be completed by a third party to suit proposed developments and will be subject to the planning process.

3.9.8.4 Development Access to Lands East of Glenamuck Road (Junction 6)

A junction could be provided on the proposed Link Road between Junction 5 and Junction 12 to serve development lands on either side of the Link Road. The location of this access should ideally be equidistant between these junctions. The final location, design and form of this junction are to be completed by a third party to suit proposed developments and will be subject to the planning process.

3.9.8.5 Development Access to Lands adjacent to GDDR (Junction 10)

To facilitate development south of 'The Park' development, it is proposed that a junction would be provided on the proposed GDDR between Junction 3/9 and Junction 1 to serve development lands on either side of the road. The location of this access should ideally be equidistant between these junctions. The final location, design and form of this junction are to be completed by a third party to suit proposed developments and will be subject to the planning process.

It is also considered that a link road between Junction 10 and the existing Glenamuck Road could be provided to serve future development of the area. This link would facilitate traffic distribution from development lands to the east of the existing Glenamuck Road and consequently ease the traffic demand at other junctions on the network as well as provide development access. This link road would ideally connect to the existing Glenamuck Road in the vicinity of Junction 13. An indicative location for this link is shown in Figure 3.4. The benefit of this link road and junction due to future development and traffic volumes is only evident in the design year 2016 and 2022 scenarios.

3.9.8.6 Development Access adjacent to Glenamuck Road (Junction 14)

To facilitate local developments adjacent to the existing Glenamuck Road close to Kiltiernan Village, consideration could be given to a local access junction (No.14), shown in Figure 3.4. The location of this junction should ideally be equidistant between the Enniskerry Road (Junction 8) and the Link Road (Junction 5). The final location, design and form of this junction are to be completed by a third party to suit proposed developments and will be subject to the planning process.

3.10 PUBLIC TRANSPORT PROVISION

A primary local objective of the GDDR Scheme is to improve access to existing and proposed future public transport infrastructure including Quality Bus Corridors, LUAS, Park and Ride sites and Metro. The design of the Scheme has taken into account this future public transport provision in the Glenamuck Area.

The junction requirements for the GDDR Scheme are complex. The complexities arise mainly from the need to provide strategically located junctions to meet traffic needs and the allocation road space and

infrastructure for future public transport provision (bus lanes and bus priority) and the provision of high quality pedestrian and cyclist infrastructure.

3.10.1 Bus Lanes

The entire GDDR Scheme has been design to accommodate future 3.0 to 3.5m wide bus lanes in both proposed hard shoulders and grass verges. Adequate space has been set aside to accommodate these facilities. The proposed junction and scheme layouts are shown in Figures 4.1 to 4.3.

3.11 MOBILITY MANAGEMENT PLANS

This study recommends and it is DLRCC policy to require Mobility Management Plans (MMP) for proposed developments in the study area. These would include centres of employment, or existing centres where expansion/development is proposed, mixed use, leisure and other developments, and which DLRCC considers will have significant trip generation and attraction rates at peak hours or throughout the day, and where the utilisation of existing or proposed public transport may be employed to good effect.

In addition to the DLRCC requirement for Mobility Management Plans at the planning stage, it is also recommended that DLRCC require that the MMP's be monitored following the development opening to ensure that the proposed targets and objectives are being met. Either the developer or DLRCC should complete this monitoring process on a yearly or semi-yearly basis. The monitoring process should be agreed prior to grant of planning permission. Consideration should also be given to the implementation of suitable penalties if targets are not met within an agreed timeframe.

3.12 PEDESTRIAN AND CYCLIST INFRASTRUCTURE

The proposed scheme provides for both pedestrian and cyclist infrastructure on both the GDDR and the Link Road. Each junction caters for the movements of both pedestrian and cyclists, with minimal delay (wait time) experienced by pedestrians at junctions.

Subject to the scale of development proposed in the study area, it is recommended that consideration be given to the promotion of grade separated pedestrian bridges along the dual carriageway section of the GDDR. This type of pedestrian infrastructure may be justified by the predicted future volumes of traffic, the level of development proposed on both sides of the dual carriageway section and also by the safe removal of the interaction of pedestrians and live traffic. This provision would also promote permeability of pedestrians and cyclists between developments either side of the dual carriageway.

3.13 CONCLUSIONS

The conclusions of the traffic analysis of this scheme can be summarised as follows:

- The GDDR Scheme is predicted to remove up to 89% of the predicted traffic from the existing Glenamuck Road in the design year 2022. The average reduction in traffic over the length of the road is estimated to be 50% transferring up to 49,400 vehicles per day to the GDDR.
- It is predicted that the overall flows on the Enniskerry Road (Kiltiernan Village) in 2016 and 2022 reduces by an average of 76% by transferring up to 22,200 vehicles per day to the GDDR and up to 23,600 vehicles per day to the Link Road by comparison of the future year "Do Something" scenario to the "Do Minimum" scenario.
- The AADT flows are reduced on the existing road network are as a direct result of the proposed GDDR scheme. The combined impact of the proposed GDDR and the Link Road between the 'Do Minimum' and 'Do Something' scenario is a positive one in the local area and results in significant benefits to the study area as a whole.
- The GDDR requires two cross sections along its length. That of a Reduced Dual Carriageway (Section A-A) and that of a Standard Single Carriageway (Section B-B). Cross section A-A will comprise of four 3.75m lanes, a 1.0m wide hardstrip adjacent to a 2.5m wide median, with

accompanying 2.0m wide footpaths and cycle lanes and a 3.5m wide verge on either side of the road. Cross section B - B will comprise of two 3.65m lanes, 3.0m wide hard shoulders, with accompanying 2.0m wide footpaths and cycle lanes on either side of the road;

- The Link Road also requires two single carriageway cross sections along its length. (Section B-B and Section C-C). The section of Link Road adjacent to the GDDR requires Section C – C and will comprise of two 3.65m lanes, 3.0m wide hard shoulders, with accompanying 2.0m wide footpaths and cycle lanes and 3.5m wide verges on either side of the road. The Link Road will also require a second cross section B – B identical to that described above.
- The GDDR Scheme provides for the future provision of public transport along the entire length by setting aside road space in the form of verges and hard shoulders for possible future conversion to bus lanes.
- The GDDR Scheme provides quality infrastructure for both pedestrians and cyclists;
- The proposed signalised junctions on the GDDR have been designed to cater for peak hour traffic flows and also the movement of non-motorised traffic across the junction;
- The analysis proposes a set number of key potential development junctions on the proposed GDDR Scheme for consideration as the development of the area takes place;
- Under analysis, each junction on the GDDR operated at or below capacity for the design year 2022 AM peak hour traffic flows. The majority of junctions analysed also showed a significant reserve capacity to cater for additional traffic if needed in the future;
- The proposed GDDR will distribute traffic through a number of additional junctions and therefore enable an increase in the overall road network capacity by freeing up capacity at other junctions. This will relieve Kiltarnan Village of unwanted through traffic; and the GDDR provides for additional distribution of traffic flows away from the M50 interchange and relieves a number of junctions in the study area.

4 GEOMETRIC DESIGN OF RECOMMENDED ROUTE

4.1 GENERAL

A description of the mainline and other roads to be constructed as part of the Scheme is given in this section of the document. The geometric design of the mainline and ancillary roads is based primarily on the 'Design Manual for Roads and Bridges' published by the National Roads Authority (NRA DMRB) in December 2000 and the Traffic Management Guidelines published by the Department of the Environment, Heritage and Local Government (DoEHLG) and the Dublin Transportation Office (DTO).

The geometric design codes of practice are contained in Volume 6 of the NRA DMRB. It has been considered appropriate to adopt these codes of practice for the design of the proposed scheme. The requirements of the above codes of practice, along with all other documents as published by the NRA in the form of the DMRB are considered for design compliance.

The geometric layout of the scheme is illustrated in Figures. 4.1 to 4.3.

4.2 DESIGN CODES

The geometric design of the GDDR scheme is in accordance with the following geometric design codes contained in Volume 6 of the DMRB:-

- TD 09/05 - Road Link Design
- TD 16/93 - Geometric Design of Roundabouts
- TD 42/95 - Geometric Design of Major / Minor Priority Junctions
- TD 50/04 - Geometric Layout of Signal Controlled Junctions and Signalised Roundabouts

NRA TD 09/05 identifies the requirements for the horizontal and vertical design of the GDDR carriageways. The dualled section of the GDDR has been designed to a minimum design speed of 85kph and a minimum design speed of 60kph has been adopted for the single carriageway section of the GDDR. A design speed of 60kph has also been adopted for the single carriageway Link Road.

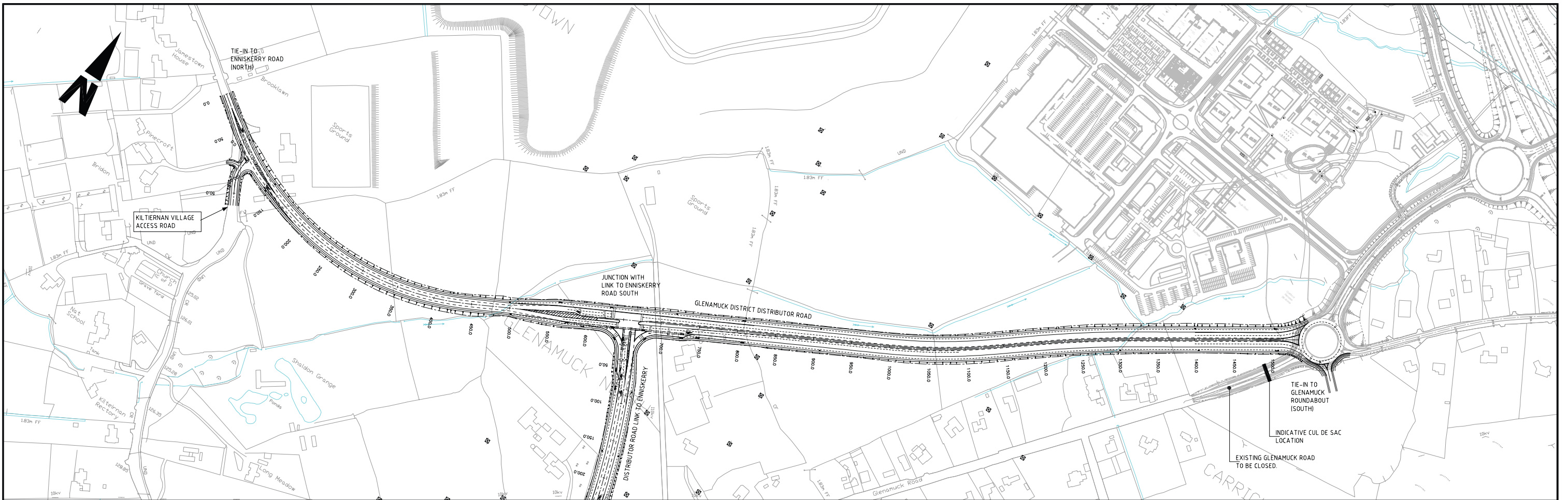
4.3 JUNCTION STRATEGY

The junction strategy adopted was mainly influenced by the traffic requirements, the geometric standards of the NRA DMRB and specific infrastructural requirements of DLRCC. The aim of the design philosophy was to provide drivers with consistent junction types and layouts and not to cause confusion. The safest road schemes are usually the most straightforward that contain consistent urban junction designs.

As discussed in Chapter 3, the junction requirements for the GDRR scheme are complex. The complexities arise mainly from the significant traffic volumes to be catered for; the need to provide strategically located junctions to meet the infrastructural needs, the allocation road space and infrastructure for future public transport provision and the provision of high quality pedestrian and cyclist infrastructure.

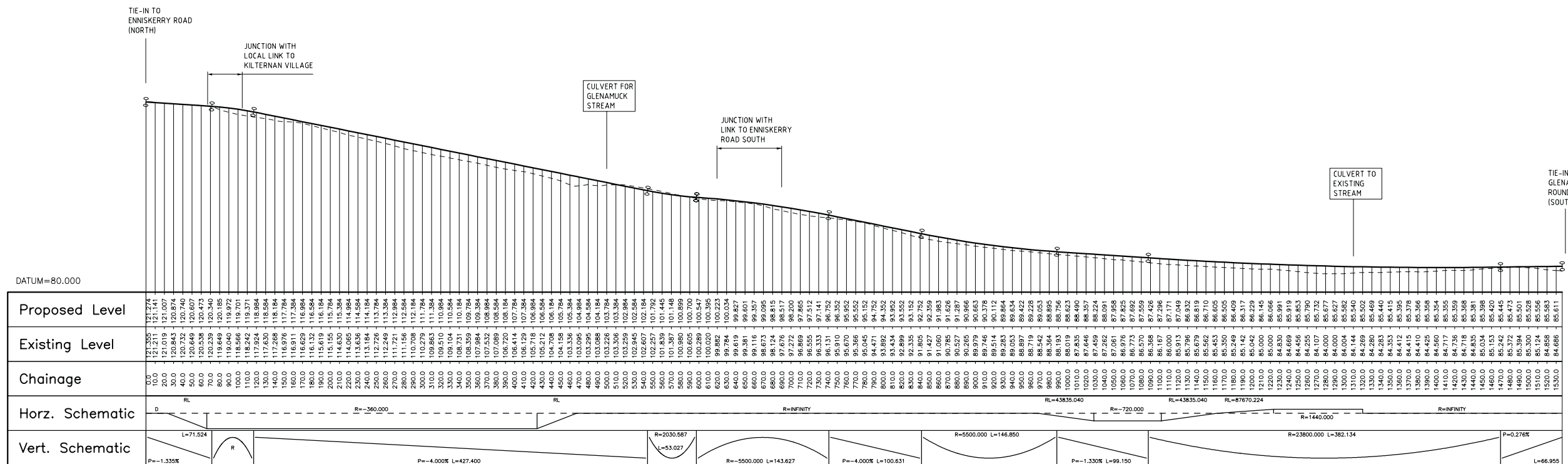
The junction strategy adopted used the following methodology:

1. Identification of key existing road network connectivity, e.g. Enniskerry Road, Glenamuck Road.
2. Identification of key future road network connectivity, e.g. GDDR, Link Road.
3. Distribution of traffic efficiently to the primary destinations, e.g. M50 and development lands.
4. Achievement of traffic relief to Kiltarnan Village to facilitate the development of the village centre
5. Achievement of traffic relief to the existing Glenamuck Road
6. Identification of future junction layouts to facilitate development of adjacent lands



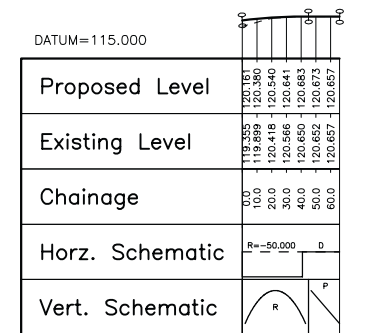
PLAN ON PROPOSED GLENAMUCK DISTRICT DISTRIBUTOR ROAD

Scale Horiz 1:2500



PROPOSED VERTICAL ALIGNMENT OF GLENAMUCK DISTRICT DISTRIBUTOR ROAD

Scale Horiz 1:2500 Vert 1:500



KILTIERNAN ACCESS ROAD
Scale Horiz 1:2500 Vert 1:500

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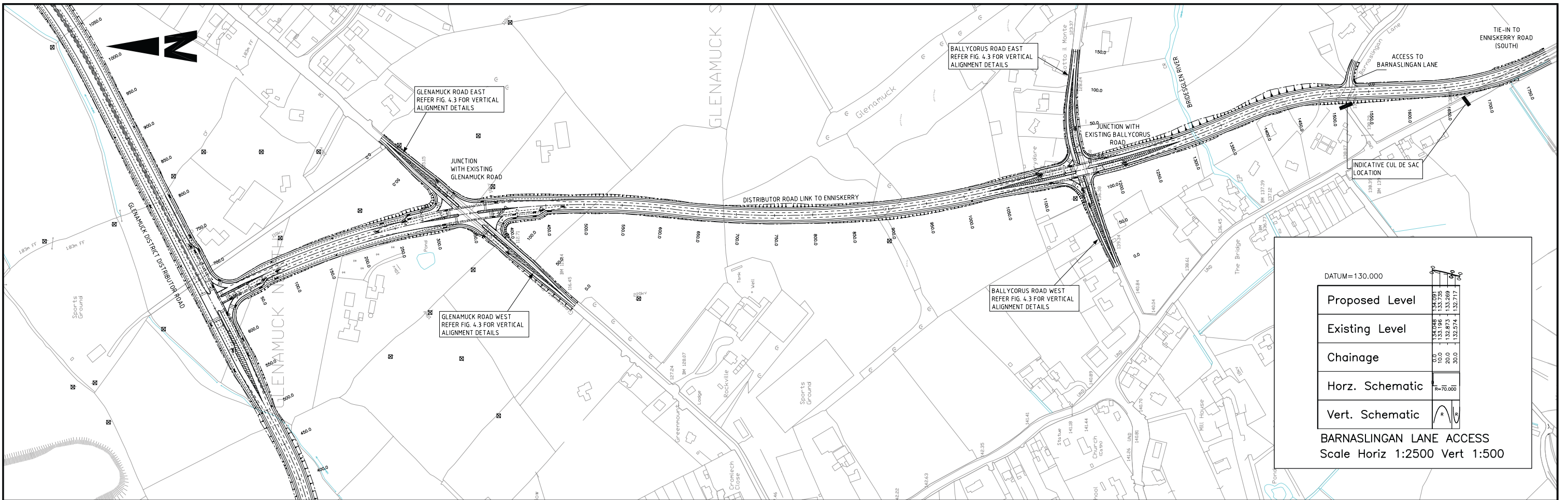
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No.	Date	Amendment / Issue	App.
A03	Jan.'06	Cul de Sac locations added	MN
A02	Jan.'06	Junctions & alignments amended	MN
A01	Dec.'05	APPROVAL ISSUE	MN
No.	Date	Amendment / Issue	App.

Project:
GLENAMUCK DISTRICT DISTRIBUTOR ROAD

Title:
 Horizontal & Vertical Alignment of
 Proposed Glenamuck District
 Distributor Road

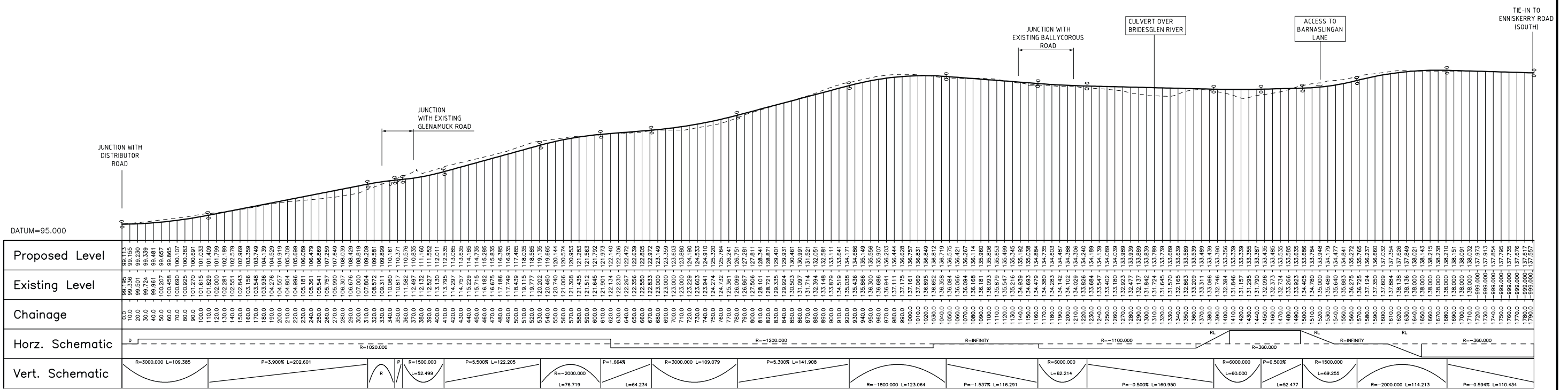
Drawn by:	Pah	Job No:	MDT0205
Checked by:	PB	File No:	MDT0205DG0001
Approved by:	MN	Drw. No:	
Scale:	H: 1/2500 @ A1 V: 1/500 @ A1	Rev:	
Date:	Dec. '05	Fig. 4.1	A03



DATUM=130.000	
Proposed Level	134.095
Existing Level	133.735
Chainage	0.0
Horz. Schematic	R=70.000
Vert. Schematic	R
BARNASLINGAN LANE ACCESS	
Scale Horiz 1:2500 Vert 1:500	

PLAN ON PROPOSED DISTRIBUTOR ROAD LINK TO ENNISKERRY ROAD (South)

Scale Horiz 1:2500



DATUM=95.000	
Proposed Level	99.113
Existing Level	99.336
Chainage	0.0
Horz. Schematic	R=3000.000 L=109.385
Vert. Schematic	P=3.900% L=202.601

PROPOSED VERTICAL ALIGNMENT OF DISTRIBUTOR ROAD LINK TO ENNISKERRY ROAD (South)

Scale Horiz 1:2500 Vert 1:500

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NOTES

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A03	Jan '06	CU	Cul de Sac locations added	MN
A02	Jan '06	CU	Junctions & alignments amended	MN
A01	Dec '05	CU	APPROVAL ISSUE	MN
No.	Date	CU	Amendment / Issue	App.

Project:

GLENAMUCK DISTRICT DISTRIBUTOR ROAD

Title:

Horizontal & Vertical Alignment of Proposed Distributor Road Link to Enniskerry Road (South)

Drawn by:	Pah	Job No:	MDT0205
Checked by:	PB	File No:	MDT0205DG0002
Approved by:	MN	Drw. No:	
Scale:	H: 1/2500 @ A1 V: 1/500 @ A1	Rev:	
Date:	Dec. '05	Fig. 4.2	A03

The principal key road network connectivity junctions (as identified in Chapter 3) are as follows:

- Junction 1 – Roundabout junction with the GDDR, Ballyogan link road and Glenamuck Road
- Junction 3/9 – Signalised junction between the GDDR and the Link Roads
- Junction 5 – Signalised junction between the Link Road and the existing Glenamuck Road
- Junction 11 – Priority junction between the Link Road and the realigned Enniskerry Road
- Junction 12 – Signalised junction between the Link Road and Ballycorus Road

As described in Chapter 3, other potential junctions in the area are development driven (i.e. will be designed and constructed subject to future development and planning applications on zoned lands). These junction nodes include the following:

- Junction 2 - Signalised junction north of Kiltiernan Village
- Junction 6 - Signalised junction on the Link Road between Junction 5 and 12
- Junction 3/9 – Signalised junction between the GDDR and the Link Road
- Junction 7 - Signalised junction on the Enniskerry Road between Junction 8 and 12
- Junction 10 - Signalised junction on the GDDR between Junction 3/9 and 1
- Junction 13 - Signalised junction on the existing Glenamuck Road between Junction 4 and 1
- Junction 14 – Junction on the existing Glenamuck Road between Junction 5 and 8

4.3.1 Principle Junction Summary of the Proposed GDDR and Link Road

It is proposed that the above junction strategy will meet the local objective of free flowing traffic with safe and strategically placed junctions to connect the GDDR and Link Road with the existing local road network and consequently minimising the provision of junctions on the network. Table 4.1 summarises the key junction types as discussed.

Table 4.1: Summary of Key Junction Types on the GDDR Scheme

	Junction 1	Junction 3/9	Junction 5	Junction 11	Junction 12
GDDR	Roundabout (as existing)	Signal		Priority	
Link Road		Signal	Signal		Signal

The above table summarises the five key junctions on the proposed GDDR scheme road network. Junction 1 is on the existing road network and will remain a roundabout junction in the proposed scheme. Through the junction strategy, it is recommended that junctions 3/9, 5 and 12 be signalised in order to promote a consistency of junction types on the network. This will enable the provision of a linked co-ordinated traffic signal system between the three key junctions and the future development access junctions. The aim of such a system would be to produce a signal system, which firstly can provide preference on the mainline (green wave) and secondly produce minimum total queue lengths and delay on the proposed road network. The proposed junction 11 between the GDDR and the Enniskerry road north of Kiltiernan Village is a priority junction. This junction type should both encourage the GDDR as a bypass of the village and discourage the village as a through route for traffic.

4.4 ROAD TYPES

The road name and design speed for all roads concerned with the GDDR scheme are given in Table 4.2.

Table 4.2: Road Name and Target Minimum Design Speed.

Road Name	Target Design Speed
GDDR (Dual Carriageway Section)	85 kph
GDDR (Single Carriageway Section)	60 kph
Link Road (Single Carriageway)	60 kph
Kiltiernan Village (Enniskerry Road)	50 kph

4.5 GEOMETRIC DESIGN

4.5.1 Horizontal and Vertical Alignment of Mainline GDDR

The proposed GDDR is approximately 1.5km long and starts at a tie-in to the Enniskerry Road north of Kiltiernan Village and runs to the existing roundabout junction to the south of the Carrickmines Interchange

The GDDR consists of 500m of single carriageway from chainage 0.0m to 500.0, a transitional section of 100m from single to dual carriageway from chainage 500.0 to 600.0 at the proposed junction with the Link Road and a 935m section of dual carriageway from chainage from 600.0 to 1,535.0 at the existing roundabout junction. The extent of the GDDR runs from the tie-in with the Enniskerry Road to the junction with the proposed Link Road at chainage 660.0 and on to the roundabout junction roundabout junction at chainage 1,535.0.

The horizontal and vertical alignment of the mainline GDDR is shown on Fig 4.1 The horizontal geometry follows the alignment of the Glenamuck Stream and water/sewer services as much as possible while the vertical geometry is intended to follow the existing topography where possible. The geometry of the proposed GDDR complies with the appropriate target design speeds given in Table 4.2 without the need for Departures from Standard.

4.5.2 Horizontal and Vertical Alignment of Link Road

The proposed Link Road is approximately 1.8km long and starts at the junction with the GDDR and runs to the tie-in with the Enniskerry Road south of Kiltiernan Village.

The Link Road consists of approximately 1.8km of single carriageway from chainage 0.0m to approximately 1792. The extent of the Link Road runs from the junction with the GDDR at chainage 0.0m to the junction with the existing Glenamuck Road at chainage 349.706m, to the junction with the existing Ballycorus Road at chainage 1158.346m and on to the tie-in with the Enniskerry Road at chainage 1791.939.

The horizontal and vertical alignment of the Link Road is shown in Fig 4.2 The horizontal alignment minimises land sterilisation and impact on private dwellings (though one house on Ballycorus Road will need to be acquired) and the vertical alignment generally follows the existing topography where standards allow. The geometry of the proposed Link Road complies with the appropriate target design speed given in Table 4.2 without the need for Departures from Standards.

4.5.3 Horizontal and Vertical Alignment of Other Roads

4.5.3.1 Realigned Enniskerry Road Tie-in with GDDR Junction 11

It is proposed to realign a short portion of the Enniskerry Road near the proposed Junction 11 with the GDDR. In total, a length of approximately 70m would be realigned. The horizontal and vertical geometry of the proposed realignment is shown in Fig. 4.1.

The realigned section of the Enniskerry Road consists of 70m of single carriageway from chainage 0.0m to 70.0, at the proposed junction with the GDDR.

4.5.3.2 Alignments at Glenamuck Road and Ballycorus Road Junctions

New junctions are proposed on the existing Glenamuck Road and Ballycorus Road. To facilitate the design of these junctions it is proposed to realign sections of the existing roads. Typically, the existing roads are realigned for between 100m and 200m on approach to the proposed junctions. These realignments are illustrated in Fig 4.2.

4.5.4 Visibility and Stopping Sight Distance

The horizontal and vertical alignment of the proposed GDDR Scheme complies with the required visibility and sightline standards set down in Table 3 of TD 09/05.

All junction design complies with the required junction intervisibility and sightline/stopping sight distance standards set down in Figure 2/3 of TD 50/99 and Table 3 of TD 09/05 respectively.

4.5.5 Relaxations or Departures from Standards

No Relaxations or Departures from Standards are required for the design of the Scheme as defined by the NRA DMRB.

4.5.6 Cyclist/Pedestrian Facilities

As previously stated provision is made for both cycle ways and footpaths on both sides of the GDDR and the Link Road. The provision of footpaths and cycle paths is important to improve safety for different road users. In addition, the GDDR scheme has been designed to accommodate the possible provision of bus lanes along its entire length; therefore, high quality pedestrian facilities are required.

Provision is made at the four new junctions for pedestrian crossing facilities in the form of signalised pedestrian crossings with refuge islands. These will provide continuous footpaths along both sides of the entire length of both the GDDR and Link Road. The GDDR footpaths and cycle paths are to be both 2.0m wide and can be tied into any other future pedestrian or cycle infrastructure provision adjacent to the GDDR scheme as part of future developments. The width of each cycle lane will be reduced to 1.75m as it passes through each proposed junction at grade. The existing footpaths on the Glenamuck Road will be realigned to tie into the proposed footpaths on the Link Road. These provisions are illustrated in Figures 3.13 to 3.17 and Figure 4.3.

4.5.7 Public Transport Infrastructure

As discussed in Chapter 3, the GDDR Scheme improves access to existing and proposed future public transport infrastructure in the study area. The Scheme design includes provision for future public transport infrastructure on all proposed road.

When, in the future there is a requirement for bus priority on the scheme, the design has an allocation of road space and infrastructure for future public transport provision including bus lanes and bus

priority at each junction. The scheme has been designed to accommodate future 3.0 to 3.5m wide bus lanes in both proposed hard shoulders and grass verges shown in Figures 3.9 to 3.11.

4.5.8 Road Closures

As discussed in Section 2.6, the scheme layout requires a number of road closures ('Cul de sacs') on existing roads. These are shown below in Table 4.3 and illustrated on Figures 4.1 and 4.2.

Table 4.3 Proposed Road Closures

Reference	Proposed Road Closures
Existing Glenamuck Road	The existing Glenamuck Road will be cul-de-saced adjacent to Ch. 1,500 approx. on the GDDR Mainline. The existing Glenamuck Road Arm to the roundabout junction south of the Carrickmines Interchange is to be removed. (See Figure 4.1)
Enniskerry Road	This road will be cul-de-saced south of Kiltiernan Village adjacent to the proposed tie-in between the Link Road and the existing Enniskerry Road at Ch. 1,700 on the GDDR Link Road. (See Figure 4.2)
Barnaslingan Lane	This lane will be cul-de-saced to the west of the GDDR link Road adjacent to Ch. 1,525 on the GDDR Link Road. This section of the lane will remain connected to the Enniskerry Road. (See Figure 4.2)

4.5.9 Public Rights Of Way

Extinguishment of public rights of way will be in accordance with the relevant statutory procedures.

4.6 GROUND CONDITIONS

4.6.1 Ground Conditions

The assessment of the soil, geology and hydrogeological environment in the Glenamuck Study Area involves interpretation of available information from the following sources:

- Geology of Kildare-Wicklow Sheet 16. Geological Survey of Ireland (GSI).
- Kiltiernan Water & Drainage Scheme Ground Investigation (July 1999) IGSL.
- Glenamuck Road Foul Sewer & Trunk Watermain Ground Investigation (March 2005) IGSL.

Reference to the Geological Survey of Ireland (GSI) Sheet 16 "Geology of Kildare-Wicklow" Scale 1:100,000 indicates that bedrock geology along the Glenamuck Road is Leinster Granite. The Glenamuck Road is located to the north of the Glencullen Fracture in the northern Pluton of the Leinster Granite. The Northern Pluton is a rounded body with a broadly concentric internal zonation of granite types (Bruck and O'Connor 1977). The granite in the region of the Glenamuck Road is of Type 3, namely Muscovite Porphyritic, i.e. with large crystals of muscovite, a platy mineral.

A few probes and trial pits were constructed local to the proposed Glenamuck district distributor road as part of a ground investigation for a proposed pipeline in July 1999 for Dun Laoghaire Rathdown County Council. The logs indicate 0.3-0.5m Topsoil overlying Glacial deposits of firm silty gravelly CLAY with cobbles and boulders and sandy clayey GRAVEL with cobbles and boulders. The majority of locations were dry however one groundwater seepage was noted at 1.2m depth in the gravelly clay. Refusal, indicating rockhead or boulder obstruction, was consistently met at between 2.8m and 4.1m depth.

There is no ground investigation information available within the vicinity of the proposed distributor road link to Enniskerry Road (south).

It is recommended that a further ground investigation be carried out along the finalised road alignment in order to confirm the ground conditions. This should comprise trial pits, dynamic probing and laboratory testing.

4.6.2 Geotechnical / Earthworks Design

The majority of the road alignment is on low embankments with short lengths of small cuttings. Slopes will be constructed to 1:2 (vertical : horizontal) using imported Class 2 General Fill. Where soft ground and / or near surface groundwater is identified a Class 6 starter layer will be required.

Based on the information available, all soil removal should be easily excavated with an excavator.

Based on the preliminary design information, it is anticipated that approximately 28,000m³ of material will be excavated from the cuttings. It is unlikely that the material will be suitable for embankment construction although it could possibly be reused as a Class 4 material.

It is anticipated that the quantity of topsoil for removal will be approximately 22,000m³. All topsoil should be stockpiled for reuse.

The requirement for construction of the embankments is approximately 50,000m³ of fill. It is anticipated that this material will be imported from outside the site. This material should come from established sites for which the requirements for planning and other regulations have been met.

Based on the information available, groundwater is unlikely to be problematic during construction activities. Any groundwater inflow during excavation could be dealt with through localised pumping.

Any localised soft ground identified should be removed and replaced with Class 6 material. The soft ground should be disposed of off-site, mixed with topsoil or used in non-structural areas of the project.

4.7 PAVEMENT

4.7.1 General Pavement Design

It is proposed that the pavements for the GDDR and Link Road be designed in accordance with HD 23/99 of the NRA DMRB. The construction is recommended to be based on the forecast maximum AADT flow in one direction at Year of Opening (2007). The indicative percentage of HGV's should be taken from the DTO SATURN model outputs. The commercial vehicles per day, in one direction on the GDDR and Link Road for the Year of Opening (2007) should be used for the pavement design.

4.7.2 Design Life

The pavement design life should be designed in accordance with HD26. A minimum design life of 20 years is recommended.

4.7.3 Capping

A capping layer is recommended in cuttings and on embankments below the earthworks outline with HD25/94 used as a general basis for design.

4.8 DRAINAGE

4.8.1 Introduction

The lands crossed by the proposed scheme form part of the Carrickmines and Shanganagh Catchment. This catchment drains into Killiney Bay via the Shanganagh River.

Existing drainage in the area of the proposed Distributor Road consists of a network of small streams and ditches draining the currently, predominantly agricultural land. These watercourses discharge into the Glenamuck Stream which is a tributary of the Carrickmines River. The Enniskerry and Glenamuck Roads are situated in the area of the proposed Distributor Road. Their road drainage consists of direct over the edge or gully discharge to a network of ditches. These in turn discharge, either directly or via the network of small streams to the Glenamuck Stream. Fig. 4.4a and Fig. 4.4b show a ditch on the Enniskerry Road and the Glenamuck Stream (downstream of the proposed Distributor Road) respectively.



Fig. 4.4a: Enniskerry Road



Fig. 4.4b: Glenamuck Stream

The south end of the proposed Link Road also crosses predominantly agricultural land, which is drained by a network of streams and ditches. These outfall to the Bride's Glen River, which turns into the Shanganagh River further downstream.

This chapter outlines the road drainage design and associated measures to minimise the impact of the road on the existing drainage catchments.

Figure 4.5 shows the catchment areas for the proposed watercourse crossings and Figures 4.6 to 4.10 illustrate the proposed drainage measures for the proposed scheme and should be read in conjunction with the remainder of this chapter.

4.8.2 Road Drainage Design

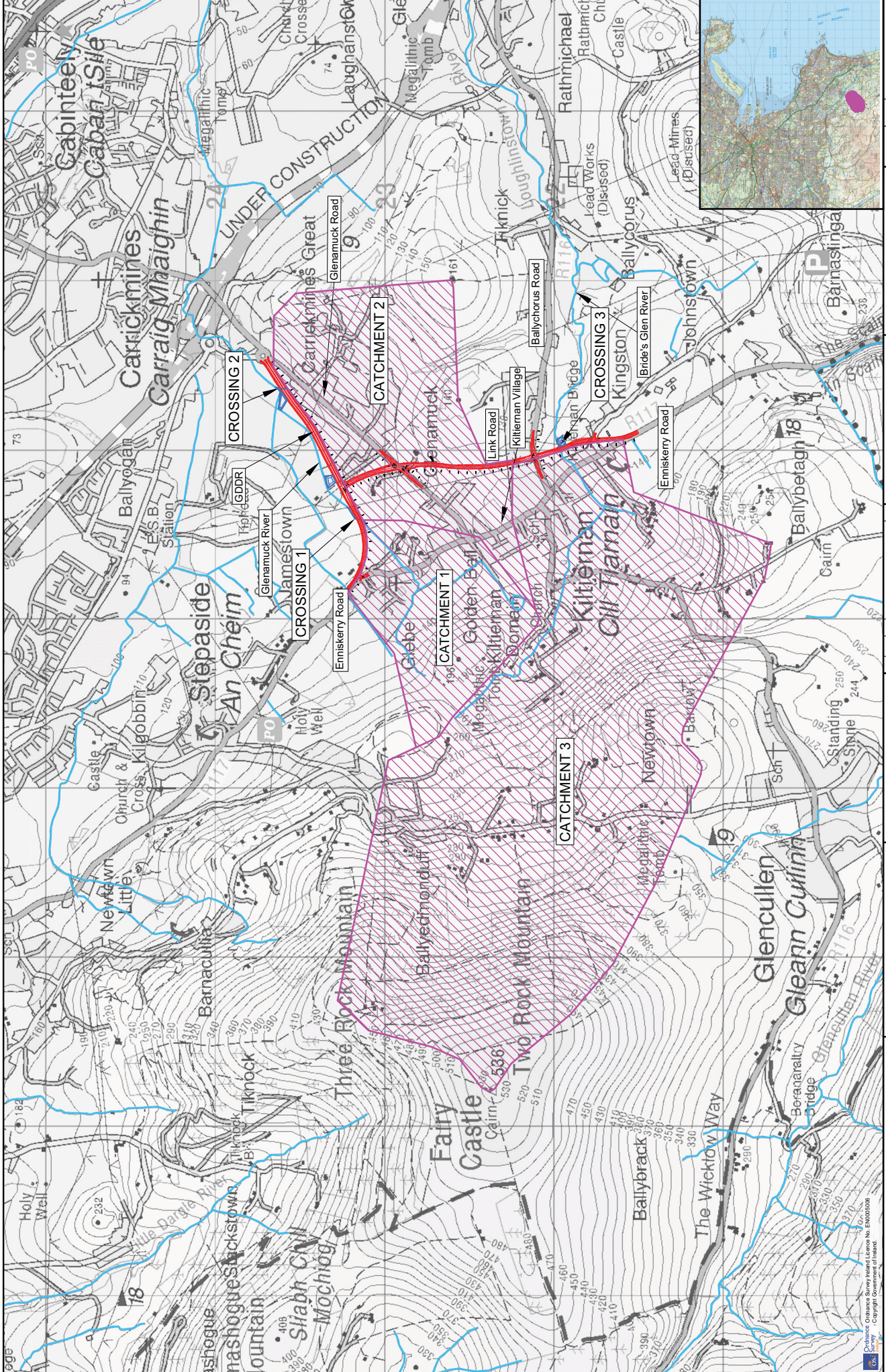
The road drainage system will remove storm water from the road surface and discharge it to existing watercourses. The road drainage design must ensure that the risk of flooding on the actual roadway is reduced to acceptable levels.

Design Manual for Roads and Bridge, Volume 4, Section 2, Part 3, HD33/96 "Surface and Sub-surface Drainage Systems for Highways" (2005) was used for the preliminary road drainage design.

4.8.2.1 Design Flows

The preliminary road drainage design is based on the Modified Rational method with a rainfall intensity of 50mm/hr used. The road drainage network is designed to accommodate, without surcharge, a 1 in 2 year storm and a 1 in 5 year storm with surcharge, but no flooding.

The runoff from the road areas was calculated using the following runoff impermeability parameters:



Drawn by:	NL	Job No.:	MD170206
Checked by:	JH	File No.:	MD170206R000
Approved by:	MN	Dwg. No.:	Rev:
Scale:	1:500 @ A1	Date:	Feb '08
		Fig 4.5	
		A01	

CONTRIBUTING CATCHMENTS
TO PROPOSED CROSSING

**GLENAMUCK DISTRICT
DISTRIBUTOR ROAD**

No.	Date	%	Amendment / Issue
A01	Jun '08		ISSUE FOR APPROVAL

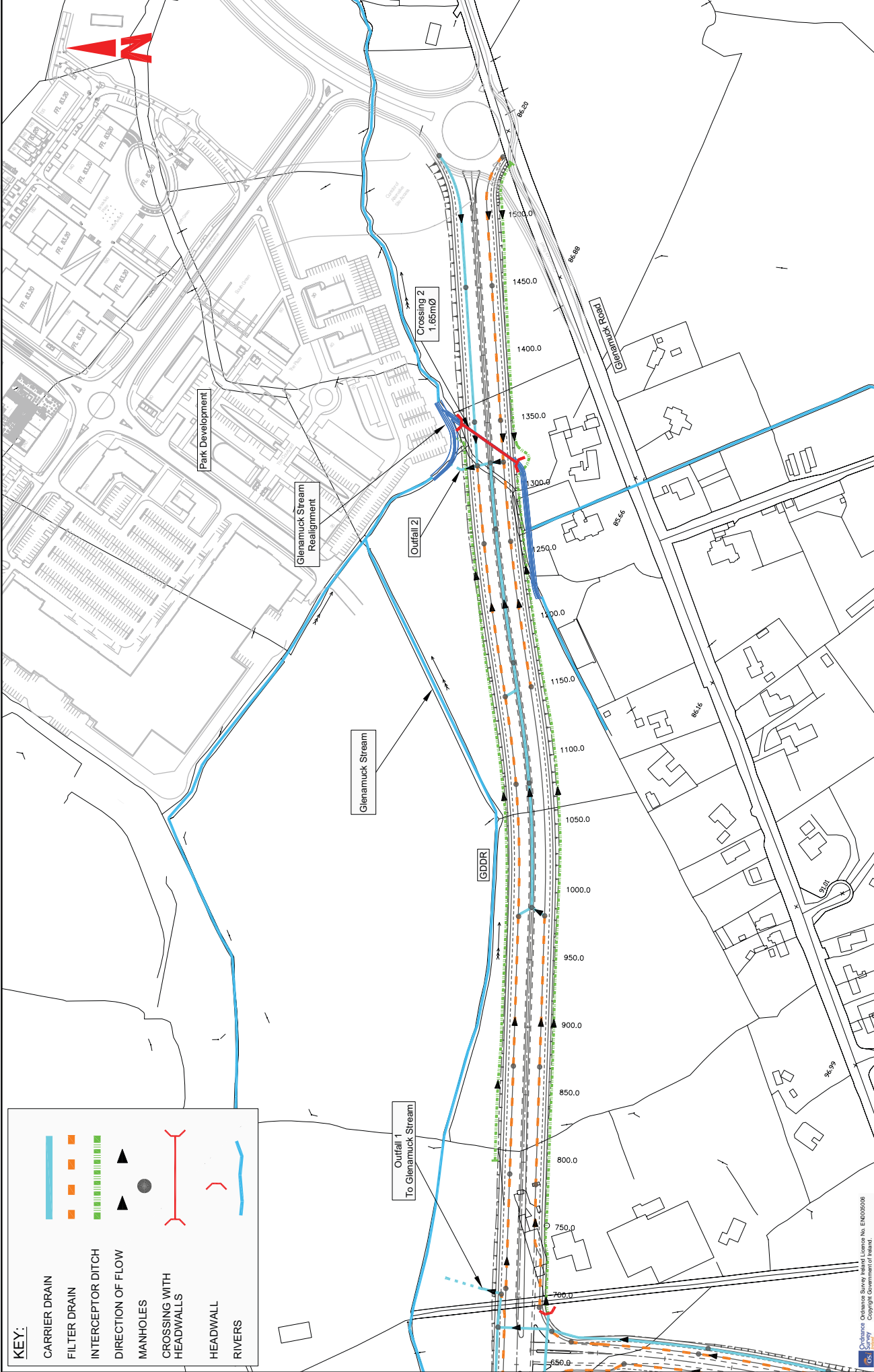
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KEY:

	CARRIER DRAIN
	FILTER DRAIN
	INTERCEPTOR DITCH
	DIRECTION OF FLOW
	MANHOLES
	CROSSING WITH HEADWALLS
	HEADWALL
	RIVERS

NOTES

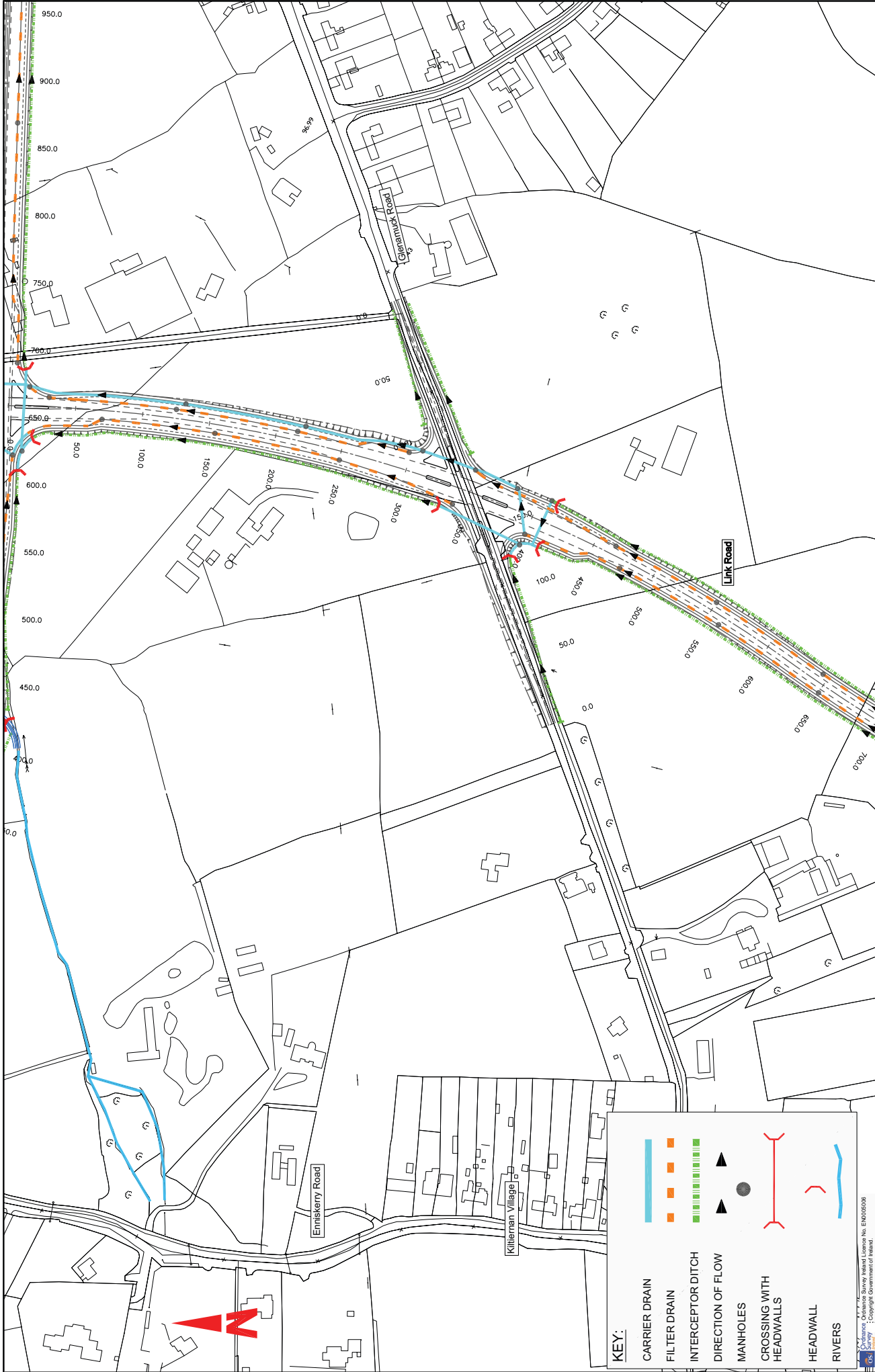
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Project:
 GLENAMUCK DISTRICT
 DISTRIBUTOR ROAD
 SHEET 2 OF 5
 INDICATIVE DRAINAGE LAYOUT

Drawn by:	NL	Job No.:	MDT0205
Checked by:	JH	File No.:	MDT05060001
Approved by:	MN	Disc. No.:	Rev:
Scale:	1:1250 @ A1	Date:	Feb. 08
		Fig 4.7	
		A02	



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Project:
GLENAMUCK DISTRICT DISTRIBUTOR ROAD
 SHEET 3 OF 5

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Drawn by: NL Job No: MD70205
Checked by: JH File No: MD70205R001
Approved by: MN MN Dwg. No:
 Scale: 1:1250 @ A1 Fig 4.8
 Date: Feb. 08 Rev:

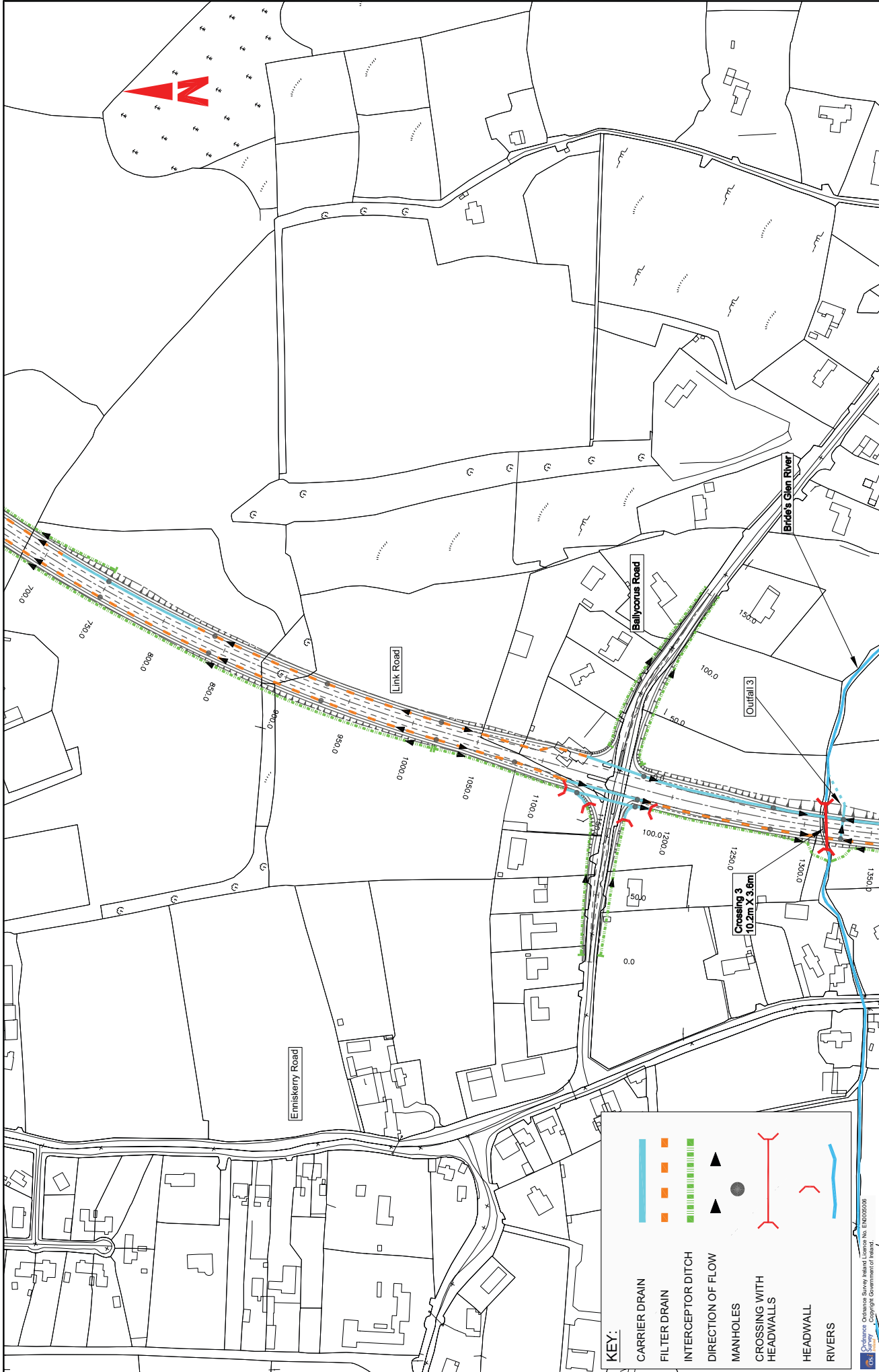
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KEY:

- CARRIER DRAIN
- FILTER DRAIN
- INTERCEPTOR DITCH
- DIRECTION OF FLOW
- MANHOLES
- CROSSING WITH HEADWALLS
- HEADWALL
- RIVERS

ORDNANCE SURVEY IRELAND
 Licence No. EN0000008
 2008



KEY:

	CARRIER DRAIN
	FILTER DRAIN
	INTERCEPTOR DITCH
	DIRECTION OF FLOW
	MANHOLES
	CROSSING WITH HEADWALLS
	HEADWALL
	RIVERS

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No.	Date	Appr.	Issue
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100	11/25/09	MN	Approval to Issue

INDICATIVE DRAINAGE LAYOUT
SHEET 4 OF 5

GLENAMUCK DISTRICT
DISTRIBUTOR ROAD

Project:
 GLENAMUCK DISTRICT
 DISTRIBUTOR ROAD

Title:
 INDICATIVE DRAINAGE LAYOUT
 SHEET 4 OF 5

Drawn by: NL Job No: MDT0205
Checked by: JH File No: MDT0506R001
Approved by: MN Dwg. No:
Scale: 1:1250 @ A1 Fig 4.9
Date: Feb. 08

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Scale: 1:1250 @ A1

Fig 4.9

A02



<p>Client:  Dún Laoghaire-Rathdown County Council Comhairle Chontae Dúin Laoghaire - Fear an Aduin Dún Laoghaire-Ráth an Duin Phone: 01 2847100 Fax: 01 2846989</p>		<p>Project: GLENAMUCK DISTRICT DISTRIBUTOR ROAD SHEET 5 OF 5</p>		<p>Title: INDICATIVE DRAINAGE LAYOUT</p>																																																																																																																																																																																																																																																																																																																																																																																																																			
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KEY:

- CARRIER DRAIN
- FILTER DRAIN
- INTERCEPTOR DITCH
- DIRECTION OF FLOW
- MANHOLES
- CROSSING WITH HEADWALLS
- HEADWALL
- RIVERS

Client:

Dún Laoghaire-Rathdown County Council
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 Phone: 01 2847100 Fax: 01 2846989

RPS Consulting Engineers
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 Droichead Átha, Co. Dublin,
 Ireland
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 F: +353 1 283 9976
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- 100% for paved areas and the median
- 50% for cuttings and embankments
- 50% for grass verges

4.8.2.2 Methodology

It is proposed that the surface water collection system will convey the storm runoff to a series of filter and carrier drains laid in the road's verge and median as required. The piped drainage network will convey the storm runoff to a suitable outfall point. These drains will be laid with a minimum 1.2m depth of cover.

Filter drains are to be provided when the road is in cutting or on embankment less than 1.5m high. The maximum diameter of the filter drains will be 375mm. An additional carrier drain running parallel will be used if the capacity of a 375mm filter drain is insufficient.

Carrier drains will be provided on embankments of greater than 1.5m height. Kerbs and gullies will be used to collect the surface water and discharge to the carrier drains. Narrow filter drains may be provided in parallel to the carrier drains to collect sub-surface water if necessary.

Where the road intersects the natural catchments in cutting or embankments, interceptor ditches may be provided to intercept land runoff and discharge to an existing watercourse. This is necessary to prevent erosion of cut faces or ponding at the toe of embankments. A typical interceptor ditch arrangement is shown in Fig. 4.11. If there is difficulty achieving adequate cover for an interceptor ditch flowing under a road, a backdrop manhole will be considered in order to lower the depth of the interceptor ditch.

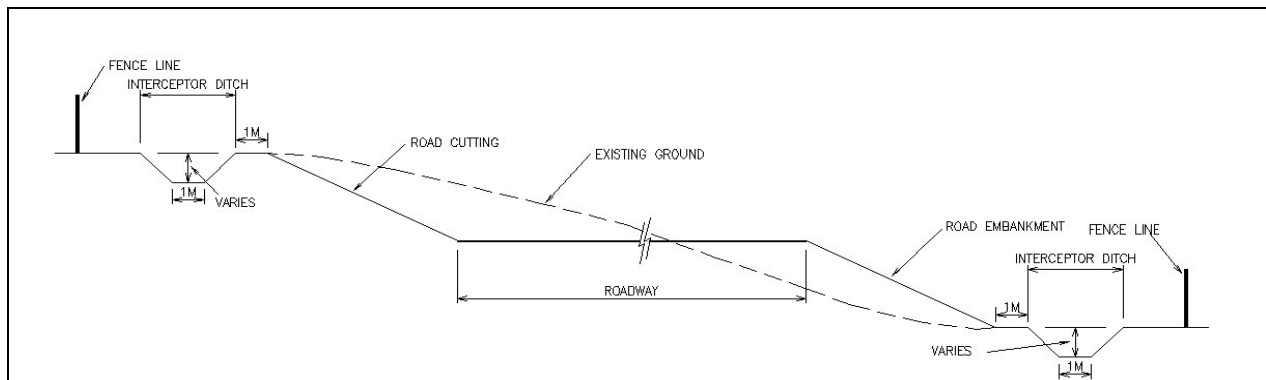


Fig. 4.11: Typical Interceptor Ditch Arrangement

Existing roads in the area presently outfall directly to nearby watercourses. The existing roads which slope towards the proposed road will outfall to interceptor ditches and then to a nearby watercourse. Filter drains may be used instead of ditches where there are land take issues. Ditches will be designed to accommodate a 1 in 100yr storm in accordance with *Design Manual for Roads and Bridge, Volume 4, Section 2, Part 1, HD106/04 "Drainage of Runoff from Natural Catchments"* (2004).

4.8.2.3 Road Drainage Networks

It is proposed that the scheme be divided into three sections based on outline road drainage catchment areas. Figures 4.6 to 4.10 illustrate the preliminary design of the road drainage network. The schematic road drainage network shown may be subject to change at detailed design stage.

Section 1 (Chainage 0m to 700m on Distributor Road and Chainage 1,020 to 0 on Link Road)

These combined segments of road are approximately 1,720m in length. The Distributor Road segment has two lanes plus hard shoulders and the proposed road drainage network consists of a combination of carrier and filter drains. The two-lane Link Road segment also has hard shoulders and comprises mostly of filter drains as the road is predominantly in cut and on low embankments.

The network will discharge to outfall 1 at Ch. 700 on the Distributor Road to the Glenamuck Stream. The proposed outfall location for this catchment is shown on Figure 4.6. Note that the road drainage attenuation is not shown and may be combined at a later stage with development flood attenuation provisions.

This section of the road drainage network is calculated to discharge a Q2 peak flow of approximately 629 l/s.

Section 2 (Chainage 700m to 1,540m on Distributor Road)

This section of the Distributor Road is four laned, also has grass verges, is approximately 840m in length and comprises primarily of filter drains.

This network will discharge to outfall 2 at Ch. 1320 on the Distributor Road to the Glenamuck Stream. The proposed outfall location for this catchment is shown on Figure 4.7. Note that the road drainage attenuation is not shown and may be combined at a later stage with development flood attenuation provisions.

This section of the road drainage network is calculated to discharge a Q2 peak flow of approximately 426 l/s.

Section 3 (Chainage 1,790m to 1,020m on Link Road)

This section of the Link Road is two laned, also has hard shoulders, is approximately 770m in length and comprises of filter and carrier drains.

The network will discharge to outfall 3 at Ch. 1,330 on the Link Road to the Bride's Glen River. The proposed outfall location for this catchment is shown on Figure 4.10. Note that the road drainage attenuation is not shown and may be combined at a later stage with development flood attenuation provisions.

This section of the road drainage network is calculated to discharge a Q2 peak flow of approximately 249 l/s.

4.8.3 Flood Attenuation and Water Quality Control

The proposed road scheme will create significant impervious areas within the existing catchments. These impervious areas will increase the rate of storm runoff within the existing catchments unless attenuation is provided.

The below sources were referenced in the preliminary flood attenuation and water quality control assessment:

1. "Greater Dublin Strategic Drainage Study (GSDSDS) – Regional Policies – New Development" (2004)
2. Construction Industry Research Association (CIRIA) "Sustainable Urban Drainage Systems (SUDS), and the Design Manual for Scotland and Northern Ireland" (2000)

4.8.3.1 Flood Attenuation Measures

In the absence of Development flood attenuation proposals, it is considered that attenuation ponds may be the most appropriate method for attenuating the surface water runoff from the proposed roads. Underground, on-line storage systems were considered, but deemed ineffective due to the relatively high gradients of the road alignments. Attenuation is not deemed necessary for interceptor drains as they collect surface water from areas whose runoff characteristics are not being altered by these works.

Using the method described in the *Greater Dublin Strategic Drainage Study (GSDSDS)*, the flows from the proposed road were calculated and the appropriate volumes for attenuation ponds at each outfall derived. The GSDSDS specifies that new developments on greenfield sites should have sufficient storage so that during a 100 year storm the runoff from the site does not exceed the site's existing greenfield runoff flows. Flow control devices may be used to ensure that the specified discharge is not exceeded. The attenuation ponds' volume requirements are significant as a result of a combination of the stringent GSDSDS requirements, the low existing greenfield runoff rate from the site and the proposed road's high percentage of impervious area.

The ground levels of the site and location of a suitable outfall are the most important factors when siting attenuation ponds. It is necessary to ensure that the road's surface water can gravitate from the road to the attenuation pond to the watercourse.

Attenuation ponds located at each of the proposed drainage outfall locations would require to have the typical characteristics detailed in Table 4.4 in order to achieve the necessary attenuation of peak flows. The parameters in Table 4.4 are based on a preliminary design and are subject to detailed design.

Table 4.4: Typical Attenuation Pond Details

Pond	Road	Chainage	Depth	Area	Volume
		<i>m</i>	<i>m</i>	<i>ha</i>	<i>m³</i>
1	Distributor	700	2.65	0.32	3300
2	Distributor	1320	1.60	0.39	2400
3	Link	1330	3.00	0.23	1370

As these attenuation ponds would be dry for the majority of the time, they could be used as parts of amenity green space areas. To accommodate this, the pond's surface would be of grass and for public safety the internal side slopes would be proposed to be flatter than 1(V) in 4(H).

4.8.3.2 Water Quality Control

Glenamuck Stream and Bride's Glen River are part of the Carrickmines and Shanganagh Catchment, which is salmonid. A River Catchment Study of the South Eastern Motorway compiled in 2001 also noted that Bride's Glen River contains trout. Road runoff can affect the water quality of the receiving watercourse. It can contain suspended solids, volatile solids, oil, organic matter, chloride and metals. If the rainfall intensity of a storm event is sufficient, insoluble pollutants can be mobilised from the road surface. The road drainage system must, therefore, include measures to improve the quality of road runoff prior to discharge to receiving waters.

Petrol/oil and grit interceptors, in accordance with BS EN 858, are proposed to be located at outfalls to watercourses, which have surface water from the proposed roads flowing through them. These devices can retain sediments, petrol and oil and prevent the pollutants being discharged to the receiving watercourse. However, these interceptors can become a source of pollution if not properly maintained. The Local Authority should adopt a program of regular cleaning, maintenance and inspection of the interceptors to ensure they function correctly.

Shut-off Valves are also proposed to be constructed on all outfall pipes. In the event of an accidental spillage on the road (e.g. milk, petrol) these valves can be shut. This will prevent contaminants reaching the receiving waters.

4.8.3.3 Stormwater Management during Construction and Operation

Protecting water quality is a high priority not only during the operation of the road scheme but also during the construction phase. At the construction stage it is important to protect against sediment erosion. A sediment erosion control plan should be implemented at the construction stage in order to prevent soil erosion and excess sediments or other material from reaching the receiving watercourses.

The sediment erosion control plan should detail measures such as:

1. The designation of appropriate locations and methods for stockpiling soil, aggregates, chemicals ...etc
2. Restricting vehicular movement to prevent unnecessary erosion
3. Revegetating exposed areas as soon as practicable
4. Use of temporary sediment trapping devices (e.g. silt fences, hay bales ...etc)
5. Routing flows from the site through settlement ponds or filter channels

4.8.4 Proposed Watercourse Crossings

4.8.4.1 Proposed Water Course Realignment

There are two areas where watercourse realignments are required. These are illustrated in Figures 4.6 and 4.7. These diversions are necessary to minimise culvert length, create a suitable environment for fish passage and to move river confluences away from the proposed roads' paths.

In order to protect the existing riparian environment the design principles to be used are summarised as follows:

1. Existing alignment will be mirrored where possible
2. Ensure smooth transitions from existing to new alignments
3. Diversion cross-sections should be based on existing local channel cross-sections, with the existing channel width being the maximum possible design width of the new channel
4. The channels should be lined with natural material to encourage vegetation and a natural habitat
5. Landscaping shall be provided to help maintain a stable stream alignment and establish channel-side habitat
6. Minimise any change in channel length to preserve existing velocities
7. Erosion protection should be added where required

4.8.4.2 Proposed Watercourse Crossings

A box culvert (crossing 1) will be constructed on the Glenamuck Stream at Ch. 428 on the Distributor Road. A pipe culvert (crossing 2) will be placed at Ch. 1320 on the Distributor Road for a tributary of the Glenamuck Stream which has a land drain feeding into it. A bridge (crossing 3) will be used for the Bride's Glen River under the Link Road. The locations of these crossings are shown in Figures 4.6, 4.7 and 4.10. Table 4.5 summarises the crossings' details.

Table 4.5: Watercourse Crossing Details

Crossing No.	Watercourse	Catchment Area <i>km²</i>	100 Year Design Flow <i>m³/s</i>	Structure	Height	Span	Length
					<i>m</i>	<i>m</i>	<i>m</i>
1	Glenamuck Stream	0.86	4.27	box culvert	1.5	2.4	35.4
2	Glenamuck Stream tributary	1.46	2.56	pipe culvert	1.65	n/a	48.0
3	Brides Glen River	5.07	20.53	bridge	3.6	10.2	31.7

Figure 4.5 shows the catchments contributing to the flows through each of the watercourse crossings. The catchment flows were calculated using the flow equation from the Institute of Hydrology's "Flood Estimation for small Catchments - Report No.124" (1994). This equation calculated the mean annual flow. The mean annual flow was multiplied by 1.65 to increase the confidence levels to 65%. The mean annual flow was also increased to take account of urbanisation. The Office of Public Works recommends the use of a 100 year design flow for the design of crossings in areas where

developments are expected. The mean annual flow was increased to the 100 year flow by multiplying it by a growth factor of 2.6, as recommended in the Greater Dublin Strategic Drainage Study (2004). Since early 2005, the OPW (Office of Public Works) have required the use of a factor of 1.2 to take account of climate change. This was also included in the calculations. The use of these factors all minimise the probability of flooding upstream of the culvert.

The below sources were referenced in the preliminary culvert design:

1. CIRIA “*Culvert Design Guide - Report 168*” (1997)
2. O’Donaill, Cian, “*Culvert Hydraulics and Section 50 Consent*” Office of Public Works (2001)
3. Eastern Regional Fisheries Board “*Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites*” (2000)
4. *Design Manual for Roads and Bridge, Volume 4, Section 2, Part 7, HD107/04 “Design of Outfalls and Culvert Details*” (2004)
5. National Roads Authority “*Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*” (2005)

The water crossings were designed using Hec-Ras, which is a software package created by the US Army Corps of Engineers. This package is used to hydraulically model watercourses, especially when structures are involved. The crossings have a 300mm freeboard and are designed to accommodate the 100 year design flow. Erosion protection will be placed where required especially at the culvert’s downstream exit.

Screens at the ends of culverts are susceptible to blockages and are not favoured by Fisheries Boards. As the area around the Glenamuck Stream will be developed, the two culverts under the Distributor Road may require security screens as a matter of public safety. This will be investigated further at detailed design stage.

A Section 50 application to the OPW will be necessary at detailed design stage.

4.8.4.3 Environmental Considerations

Fish are an important asset to any area. As previously mentioned, the Glenamuck Stream and Bride’s Glen River are part of the Carrickmines and Shanganagh Catchments, which are salmonid. Therefore, all detailed design work and construction will be undertaken in consultation with the Eastern Regional Fisheries Board (ERFB).

Often, the culverting of streams damages the existing riparian environment. The proposed works require the culverting of the Glenamuck Stream and a tributary of the Glenamuck Stream. The below fish friendly measures will be considered in the detailed design and construction of the culverts:

1. Restriction of drainage works from May to September
2. Use of head walls
3. Maximise daylight in the culvert
4. Minimise length of culverts
5. Keeping the flow velocity low enough for fish to swim against the watercourse flow
6. Fish passage maintained at all times
7. Have transition pools at either end of the culvert
8. Have a low flow channel
9. In box culverts, avoid use of concrete beds by utilising precast concrete arches or similar to maintain the existing bed and minimise in-stream works.
10. If box or pipe culverts are to be used:

- Lay pipe to a flat gradient
- Culvert invert should be 300mm below existing inlet
- Stone pitching provided in culverts to increase roughness

As mentioned in Section 4.8.3.2, the Brides Glen River contains trout. Culverting the river would require a very large box culvert, a temporary river diversion during construction and velocity reducing measures to allow the passage of fish through the culvert. It was decided a bridge would be the most suitable option in terms of minimising the disturbance to the river and its fish, especially during construction.

To facilitate the movement of mammals, it will be examined at detailed design stage whether the provision of mammal ledges or mammal pipes are necessary.

4.8.5 Conclusion

The preliminary drainage design, based on information currently available, has shown how the impacts of the proposed roads on the existing drainage catchments can be minimised.

4.9 ROAD SIGNAGE AND PUBLIC LIGHTING

Proper signage and adequate lighting are important aspects of major road schemes particularly on approach to junctions where driver confusion may occur. In urban areas, it is considered necessary to provide lighting over the full extent of new road links.

4.9.1 Road Signage

The purpose of a road sign is to convey information in a clear and concise manner so as to reduce driver confusion and consequently improve the safety of the road.

There are three broad categories of road sign:

- (a) Information signs – used to provide road users information about routes and places and facilities of particular value and interest
- (b) Regulatory - used to indicate the existence of road regulations or implements such regulations, or both
- (c) Warning Signs – used to alert drivers to danger or potential danger ahead, indicating a possible need for extra caution and a consequent reduction in speed.

The required road signage is recommended to be examined in more detail during the detailed design. Strategic direction signing is very important to ensure the most efficient route for the road user and to discourage alternative routes, which could lead to congestion within Kiltarnan Village. The signs will be designed in accordance with the 'Traffic Signs Manual' (1996) published by the Department of the Environment, Heritage and Local Government. It is envisaged all of the proposed signs will be accommodated within the landtake for the scheme.

4.9.2 Public Lighting

Public Lighting is recommended to be provided in this Scheme at all key junction and on the mainline GDDR and the Link Road. This is a safety requirement for users of the roadways and where provided, is done so to mandatory road safety and design standards. The main purposes for provision of route lighting are as follows: -

- (a) To allow the users of motorcars, motor cycles, pedal cycles and other vehicles to proceed safely.

(b) To allow pedestrians to see hazards, orientate themselves, recognise other pedestrians and to give a sense of security.

(c) To improve the night time appearance of the road environment.

In the lighting of thoroughfares, the relative importance of these items need to be weighed up, particularly in relation to the former two concerns, as the needs of motorists, cyclists and pedestrians differ. The final item, which is an amenity aspect, is important to all road users and residents. The daytime appearance of the installation is also a very important consideration.

4.9.3 Codes & Standards

Primary Design Codes

It is recommended that the lighting scheme be designed and installed in accordance with the following:

- BS 5489-1:2003 “Code of Practice for Lighting of roads and public amenity areas”;
- BS EN 13201-1 “Selection of Lighting Classes”;
- BS EN 13201-2 “Road Lighting Performance Requirements”;
- BS EN 13201-3 “Road Lighting Calculation of Performance”;
- BS EN 13201-4 “Road Lighting methods of measuring Lighting Performance”;
- CIE 115 – 1995 “Recommendations for the Lighting of Roads for Motor and Pedestrian Traffic”.

Statutory & Regulatory Compliances

It is recommended that the full design and installation be in accordance with the following Statutory and Regulatory requirements: -

- ETCI Regulations (current edition);
- Safety, Health & Welfare at Work Act 1989 and subsequent instruments;
- Electricity supply companies standards and procedures.

Specific Environmental measures included

The following specific constraints are proposed with regard to environmental impact and intrusion of lighting:

- All lighting will utilise compact high-pressure sodium lamps in flat glass IP65 lanterns;
- Lanterns will be of the “full cut-off” type, designed so that no light emits above the horizontal plane;
- All lighting columns will be of the slim folded, galvanised steel type;
- The general mounting height for columns on the road and junctions will be 8m, 10m & 12m;
- Columns will not be mounted on structures, wherever feasible.

It is anticipated that the proposed location of the public lighting be examined in more detail during the Detailed Design stage.

4.10 SERVICE RELOCATIONS

4.10.1 Introduction

The proposed route corridor passes predominantly through green fields

There are a significant number of utility services in the vicinity of the route corridor of the proposed GDDR Scheme, in particular at the proposed junctions with the existing Glenamuck Road and the Enniskerry Road. The construction of the proposed GDDR and link road will inevitably result in some disruption to existing utility services. All service providers whose plant and apparatus will be affected were contacted in order to locate their existing services in the area. These utility providers were: -

- Electrical Equipment (Electricity Supply Board – ESB/ESBI)
- Gas (Bord Gais)
- Telecommunications (Eircom/Esat/Cable & Wireless/NTL)
- Water Supply (Dun Laoghaire-Rathdown County Council)
- Drainage (Dun Laoghaire-Rathdown County Council)

The disruption of utilities along the route has implications for the design and construction stages of road schemes as follows: -

- It will be necessary to re-route sections of existing services, with connections back to the existing apparatus at the terminal points of these diversions;
- Provision must be made for any proposed additional services and/or extensions to existing networks where these works can be anticipated;
- For existing services, it will be necessary to maintain existing services as far as possible during construction. This may entail temporary diversions of services and/or staging of the works in the construction phase.

The location of all confirmed existing services are shown in Figures 4.12 and 4.13.

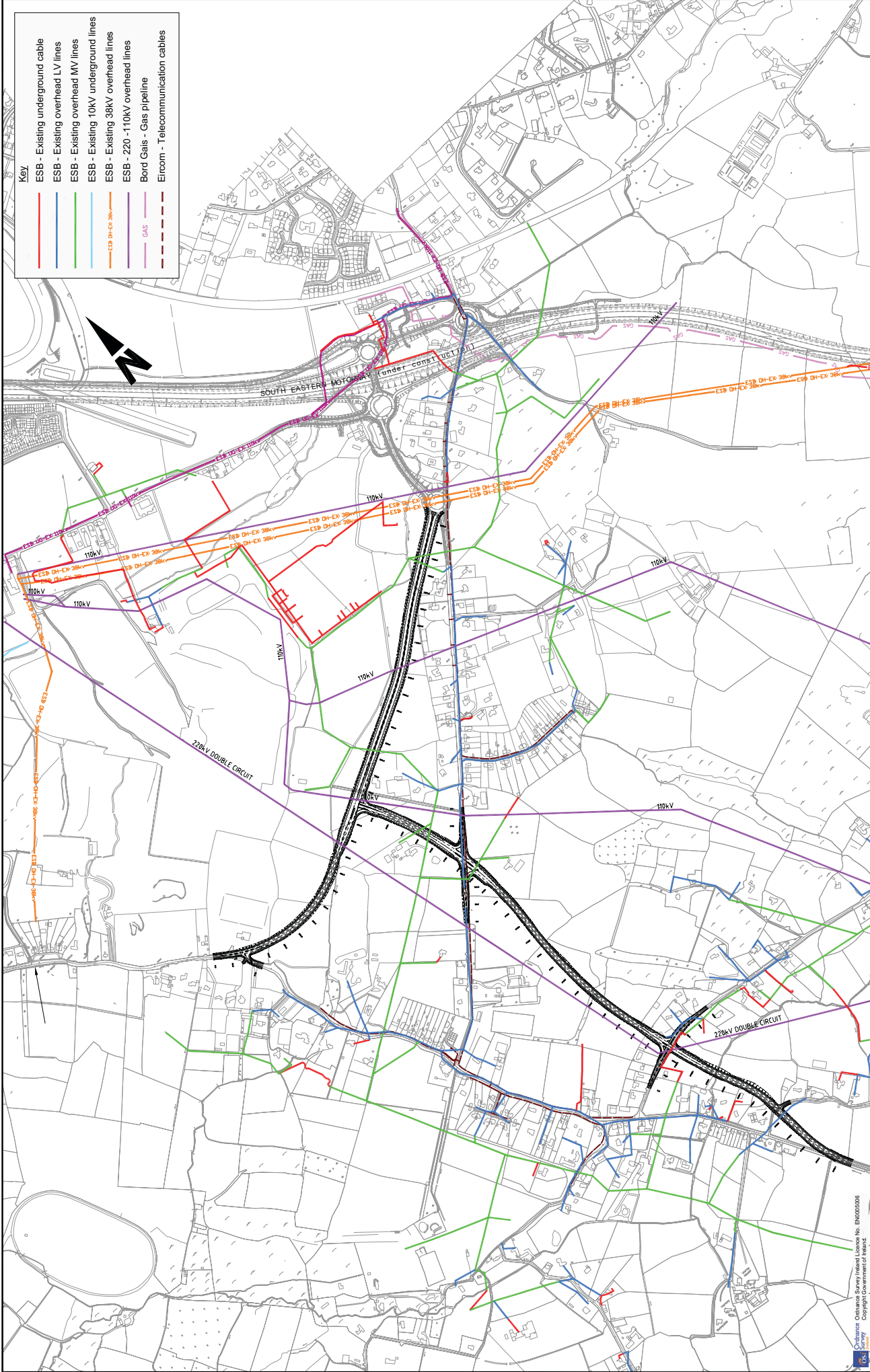
4.10.2 Description of Services Affected

The Electricity Supply Board have low voltage (LV) apparatus existing within the route corridor that will be affected. These predominantly comprise of 10 kV cables running overhead. ESBI have also indicated that there are high voltage (HV) apparatus running in the route corridor. The high voltage overheads in the route corridor consist of 38kV, 110kV and 220kV apparatus. It is envisaged and proposed the 10kV overhead be realigned underground as necessary subject to detailed design. The 38kV apparatus will not be affected by the proposed scheme. It is proposed that the 110kV high voltage lines be left in place where possible or raised or undergrounded as required by the ESB subject to detailed design. It is envisaged that the 220kV apparatus will be left in place, protected and worked under, or adjacent to, only where absolutely necessary.

All construction works will take place in liaison with the ESB and will take into account all of the requirements of the ESB, particularly safety requirements, in relation to working in the vicinity of the overhead powerlines.

Bord Gais have indicated that there are no apparatus belonging to them running within the route corridor.

Eircom have a number of apparatus within the area, particularly along the existing Glenamuck and Enniskerry Roads. It is proposed that these services be left in place where possible and realigned where necessary.



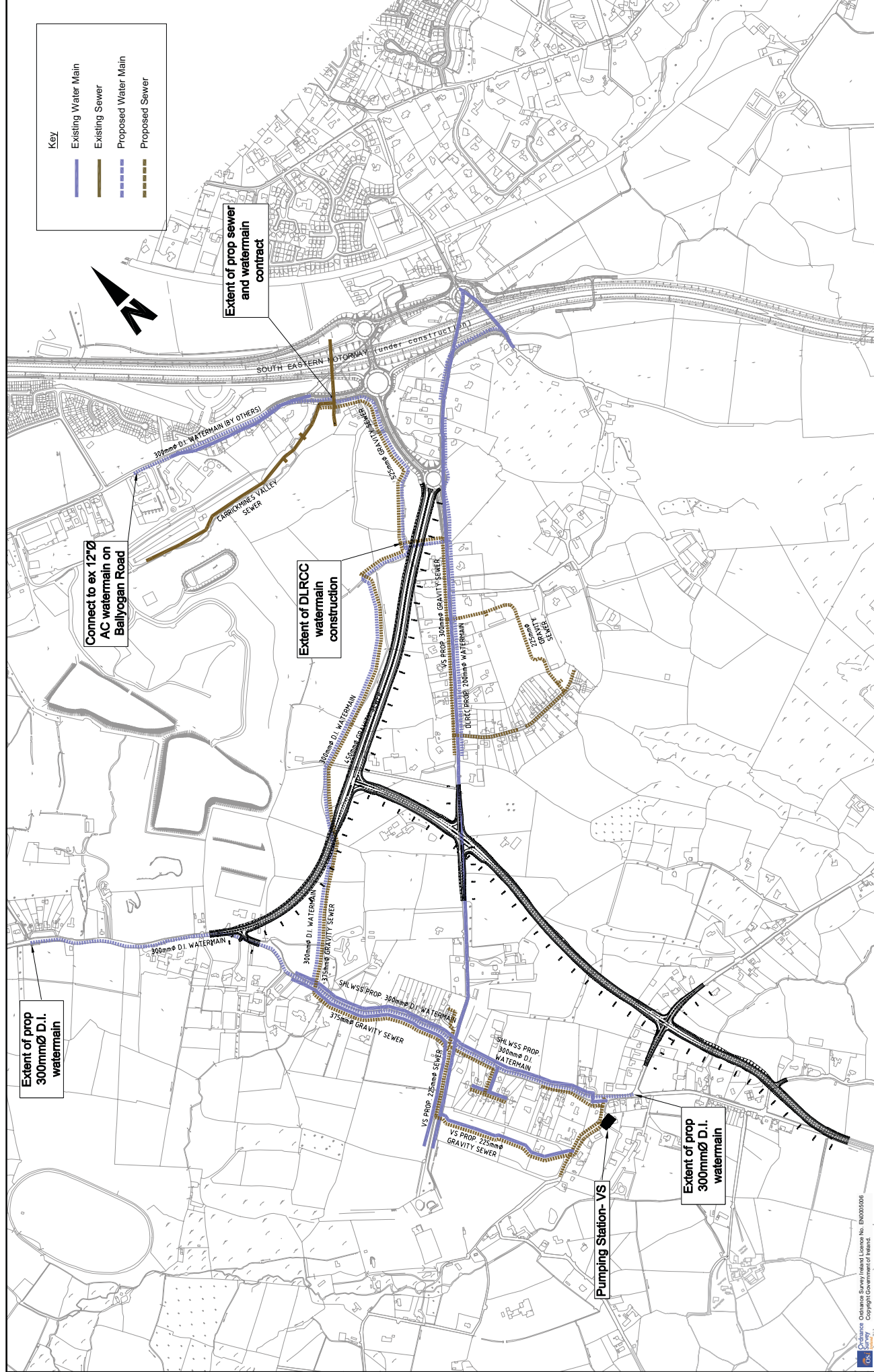
Key	
	ESB - Existing underground cable
	ESB - Existing overhead LV lines
	ESB - Existing overhead MV lines
	ESB - Existing 10kV underground lines
	ESB - Existing 38kV overhead lines
	ESB - 220 - 110kV overhead lines
	Bord Gais - Gas pipeline
	Eircom - Telecommunication cables

<p>CLIENT</p> <p>Dún Laoghaire-Rathdown County Council County Hall, Marine Road, Dún Laoghaire, Co. Dublin Phone: 01 2867700 Fax: 01 2868669</p>	<p>NOTES</p> <ol style="list-style-type: none"> This drawing is the property of RPS Consulting Engineers Ltd. It is a confidential document and must not be copied, used, or its content divulged without prior written consent. All Levels refer to Ordnance Survey Datum, Malin Head. DO NOT SCALE, use figured dimensions only. If in doubt ask. 	<p>Project:</p> <p>GLENAMUCK DISTRICT DISTRIBUTOR ROAD</p> <p>EXISTING UTILITIES</p> <p>ESB, EIRCOM AND BORD GAIS</p>	<p>Drawn by: PH Checked by: JD Approved by: MN Scale: 1:10,000 Date: Jan-20</p>

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Key	
	Existing Water Main
	Existing Sewer
	Proposed Water Main
	Proposed Sewer

Drawn by:	PH	Job No.	MDT0205
Checked by:	JD	File No.	MDT0205/10001.dwg
Approved by:	MN	Fig. No.	
Scale:	1:10,000	Date:	Jan-05

Project: **GLENAMUCK DISTRICT DISTRIBUTOR ROAD**

Title: **EXISTING UTILITIES WATERMANS AND SEWERS**

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 Dúin Laoghaire-Ráth an Dúin

Figure No. 4.13

Esat, Cable & Wireless and NTL have all indicated that there are no apparatus belonging to them running within the route corridor.

Dun Laoghaire-Rathdown County Council has indicated that there are four water mains and three foul and surface water drains affected by the Scheme. The proposed alignment is such that the locations where the route corridor crosses the above services are all in embankment and therefore the services may be protected and left in place.

Further consultations with all of the Utility Providers are necessary and should be undertaken at detailed design stage, to ascertain their full requirements in relation to existing and proposed services in the route corridor.

4.11 BOUNDARY TREATMENT

At present, the study area is predominantly rural in character. The form of boundary treatment to be implemented should be appropriate to the adjacent landuse. Where agriculture is predominant, timber post and rail fencing is recommended, though the detail and exact form of fence may depend on the particular animals, if any, present on the adjacent lands, e.g. particular provisions may be necessary for bloodstock.

Where gardens or property associated with dwellings is impacted upon, particular provisions may be as agreed between residents and DLRCC.

As development in the area proceeds, it is likely that boundary treatments will need to be amended to suit the particular developments taking place. Such amendments to the boundary treatments should be carefully considered as part of the planning process.

Particular boundary treatments may also be necessary to mitigate visual, noise and vibration impacts of the scheme. The recommendations of the Environmental Impact Report should be followed in such situations.

4.12 SAFETY AUDIT

4.12.1 General

A Stage 1 Safety Audit will be carried out on the Scheme upon completion of the preliminary design. The Safety Audit will be carried out in accordance with the relevant sections of the NRA DMRB standard HD 19/01 and the draft National Road Safety Audit Guidelines published by the NRA.

Upon receipt of the Safety Audit Report, any issues will be dealt with in a response document to the Safety Audit to be prepared by the design team. This document will comment on the recommendations within the Safety Audit.

5 ENVIRONMENTAL ASSESSMENT

5.1 INTRODUCTION

An Environmental Study has been undertaken to assess the environmental impact(s) of the proposed GDDR as described in this Preliminary Design Report. An Environmental Study has been prepared to describe the existing environment, potential impacts of the proposed scheme during the construction and operational phase and to recommend mitigation measures in order alleviate negative impacts. This study has been prepared in accordance with the Roads Act 1993 (Section 50) as amended by the European Communities (Environmental Impact Assessment) Regulations, 1989 to 2001. The 1993 Roads Act incorporates the requirements of the European Commission (EC) Environmental Assessment Directive 85/337/EC as amended by the Environmental Assessment Directive 97/11/EC.

Section 50 of the Roads Act 1993 as amended by the EIS Regulations (S.I. No. 93/1993) also specifies the information required within an EIA. The Environmental Assessment was written according to these requirements. In addition, the guidelines set out in the Environmental Protection Agency (EPA) publications *Guidelines on the Information to be Contained in Environmental Impact Statements* and *Advice Notes on Current Practice in the Preparation of Environmental Impact Statements*, and in the *UK Design Manual for Roads and Bridges*, Volume 11 *Environmental Assessment* were generally followed when undertaking this Environmental Assessment. The guidelines set out in the NRA Environmental Assessment and Construction Guidelines have also been followed during the preparation of this Environmental Study

5.2 ENVIRONMENTAL DISCIPLINE

The environmental assessment includes a number of different disciplines that affect the human environment, natural environment, material assets and archaeological and architectural heritage within the study area of the proposed scheme. Each environmental discipline discussed later in this section identify, describe and assess the impact of the GDDR for that particular discipline. Note that further details can be obtained from the Environmental Study.

5.2.1 Community

This section assesses the impact on the community in relation to the social and economic functioning of the community affected by the GDDR. The GDDR is located in a semi-rural area north and south of the existing Glenamuck Road. It is approximately 6km southwest of Dunlaoghaire and 13km southeast of Dublin City Centre. The study area consists of mainly grazing lands, which are now zoned predominately for residential and economic development including some rural amenity/agricultural and open space amenity zonings. The proposed scheme will pass through six townlands including Kingston, Jamestown, Glenamuck North, Glenamuck South, Carrickmines Great and Kiltiernan.

There has been little economic activity in the Glenamuck area in the past though this pattern is changing with new development emerging rapidly. A significant amount of land in the Glenamuck area is zoned for economic development. While at present, the area acts essentially as a commuter suburb for people travelling to work in the city and other nearby areas like the Sandyford Industrial Estate, the proposed development and its development potential will add significant economic advancement of this area.

Under a Do Nothing Scenario (without the proposed scheme in place) the expansion of the area generally and the development of zoned lands would generate very large volumes of traffic. The existing Glenamuck and Enniskerry Roads would not be able to meet the capacity and traffic demands. It is considered that this would impede future development of the area. The Policies of the Dunlaoghaire Rathdown County Development Plan would fail to be delivered with regard to providing this road and as such would have a broader significant adverse impact on the wider strategic development policies.

The Do Something Scenario (with the scheme in place) will generally have a positive impact on the community. The area would open up for development and employment and would improve economic

prosperity in the area. This in addition would gradually increase the population of the area. The existing Glenamuck Road will become less trafficked and provide for a safer route with decreased air, noise and traffic nuisances. The new route will also provide for sustainable travel and decrease strategic traffic volumes to the M50 from entering into Kiltiernan Village. The proposed cul-de-sacs will increase travel distances for car users however this is considered to be a slight negative impact.

Once the scheme is in operation no mitigation measures will be required in terms of demography, economic activity, employment or community services. There are a number of mitigation measures proposed for the construction phase, which are designed to minimise disruption and inconvenience to local residents. These measures include a construction traffic management plan, location of compound sites etc.

5.2.2 Air

A baseline air quality assessment was carried out along the existing and proposed route corridors. Ambient air quality monitoring for nitrogen dioxide (NO₂), sulphur dioxide (SO₂) and benzene was carried out at six locations between January and February 2006.

The survey identifies the existing pollutant trends within the study area and aims to establish sufficient spatial information in order to determine compliance with relevant ambient air legislation. The relevant Irish ambient air standards have been adopted from the European Commission Directives 92/62/EC, 1999/30/EC and 2000/69/EC and are cited as the Air Quality Standards Regulations which came into force in Ireland in June 2002 (S.I No 271/2002).

A detailed air dispersion model has been prepared in order to predict the future air quality trends as a result of traffic variations with the existing and proposed routes. This model estimates future predictions for the five main polluting emissions NO₂, CO, VOCs, PM₁₀ and Benzene. Detailed modelling was undertaken for the years 2004 (Base Year), 2007 (Opening Year) and 2022 (Design Year). The air quality predictions of the future air quality was undertaken for the existing and proposed road networks encompassing all sensitive receptors including residential dwellings and schools. Air pollution predictions were performed at these receptors both with and without the proposed scheme in operation and at a worst case speed scenario of 5km/hr to represent gridlock conditions.

In general, the results of the predicted pollutant concentrations show uniform spatial and temporal variation. The predicted worst case air pollution in 2004 was at Kiltiernan Village. If the proposed road does not go ahead the highest predicted pollutant concentrations will remain in the village. With the road in operation the highest pollutant concentrations are predicted to occur at the Ballyogan Link Road Roundabout. The worst case pollutant concentrations are predicted to increase in future years with or without the proposed road in operation. Worst-case pollutant levels are predicted to be slightly higher with the proposed road in operation compared to the Do Nothing Scenario for both 2007 and 2022. For all modelled pollutants and all model scenarios, the predicted concentrations are shown to comply with the current and future air emissions limits.

The scope for mitigation of any adverse effect on air quality (during the operational phase of the scheme) through route choice or design is limited in comparison with reductions in emission rates achievable through improved vehicle technology. EU Directives have outlined improved emission criteria which manufacturers are required to achieve from vehicles produced in the past and in future years. The introduction of the National Car Test (NCT) has also helped to reduce transport emissions by ensuring that all vehicles on Irish Roads over 4 years old undergo an emissions test.

There are a number of construction impacts that could develop in particular dust. The potential for impact from dust depends on the distance to potentially sensitive locations, the type of construction activity carried out in conjunction with environmental factors including rainfall, wind speed and direction. The majority of any dust produced will be deposited close to the potential source and any impacts from dust deposition will typically be within several hundred metres of the construction area. If a satisfactory environmental dust minimisation plan is implemented the effect of the construction on air quality will not be significant.

5.2.3 Climate

The potential impact to climate, is shown by the amount of CO₂ emissions predicted by the proposed scheme. The total predicted CO₂ were generated for 2007 (Opening Year) and 2022 (Design Year) both with and without the proposed road in operation, at a traffic speed of 5km/hr. The results of this basic prediction indicate that with the proposed road in operation, the total CO₂ generated by traffic will be approximately 13% higher than that generated without the road in operation in 2007. This increase is primarily due to the increased number of road users and the increased road network lengths that are predicted in the traffic assessment with the proposed road in operation. In 2022, the potential increase in greenhouse gas emissions with the road in operation is predicted to be 51% higher than the corresponding scenario without the road in operation. This increased variation is as a result of two factors – the reduction in the Do Nothing scenario whereby traffic volumes decrease without the road and the significant increase in traffic (especially along the GDDR) compared to 2007. The results suggest that the potential impact to climate from the proposed scheme, in terms of greenhouse gas emissions, will be more significant in the 2022 future scenario year.

5.2.4 Noise & Vibration

5.2.4.1 Noise

Noise is defined as unwanted sound is measured in units called decibels (dB). Environmental noise levels are usually assessed in terms of A-weighted decibels, the dB(A). The A-weighting approximates to the response of the human ear. There are two main components of noise due to traffic. The first is dominant when traffic is not free flowing and is generated by the engine exhaust system and transmission. The second noise source is due to the interaction of tyres with the road surface which is dominant at moderate to high speeds under free flow conditions.

The EU directive 2002/49/EC includes a noise indicator L_{den} , which is a composite of long term L_{Aeq} (the daytime average noise level for the period 07:00 – 19:00) for day, evening and night (termed L_{day} , $L_{evening}$ and L_{night}). The NRA Guidelines for the Treatment of Noise and Vibration on National Road Schemes has been followed for this assessment. These guidelines use the traffic noise parameter L_{den} with a design goal, where feasible, of 60dB. Mitigation measures are required when the following three conditions are satisfied:

- (a) the combined maximum traffic noise level, i.e. the relevant noise level from the proposed road scheme together with other traffic in the vicinity is greater than the design goal,
- (b) the relevant noise level is at least 1dB more than the expected traffic noise level without the proposed scheme in place, and
- (c) the contribution to the increase in the relevant noise level from the proposed scheme is at least 1dBN.

Baseline noise measurements were undertaken at 13 locations and noise levels were predicated at 15 locations. The road layouts were obtained from supplied drawings and the traffic flow rates and diurnal distributions were supplied for the opening and design years. The maximum values are on the dual carriageway section and are 49400 vehicles per day with a 3.5 % heavy commercial vehicle content for the year 2022. The results show that 9 locations exceeded the three conditions outlined above. were above the 60 L_{den} . A series of mitigation measures have been proposed for the construction and operational phases of the proposed scheme. These include measures such as the erection of noise barriers as summarised in **Table 5.1**, adherence to the BS5228 standard (Noise Control on Construction and Demolition Sites) and restricted work hours.

Table 5.1: Indicative Noise Barriers

Chainage	Location and Description of Noise Barrier
Glenamuck District Distributor Road, Dual Carriageway, speed limit 80km/h.	
1070S	From Ch. 1000:1.8 m barrier @6m south of carriageway to Ch.1050: 2m barrier @6m south of carriageway to Ch.1270: 1.6 m barrier @6m south of carriageway to Ch.1360
1110S	
1150S	
1250S	
1300S	
Enniskerry Road, Single Carriageway, speed limit 60km/h.	
450E	From Ch.410:1.6 m barrier @6m east of carriageway to Ch.490.
1410W	From Ch.1350: 2.8m barrier @6m west of carriageway to Ch.1395; 3.0m barrier to Ch.1405; 2.8m barrier to Ch.1460.
15000E	From Ch.1480:1.5 m barrier @6m east of carriageway to Ch.1510.

Note: There are an infinite number of barrier height, distance, and length combinations that will reduce the noise to a particular level. The above barriers are indicative only. The specification shall be checked at final design stage.

5.2.4.2 Vibration

It has been found that ground vibrations produced by road traffic are unlikely to cause perceptible structural vibrations in buildings located close to normal road surfaces. The ground vibration from the operation of the new road would be expected to be orders of magnitude less than that required to cause disturbance (about 1 mm/s) or structural damage (> 8 mm/s). The vibration will be less than that caused by the surfaces of the existing road. In addition, the maximum allowable vibration levels during general construction (particularly piling and blasting) shall follow and adhere to those as specified in the NRA Guidelines for the Treatment of Noise on National Road Schemes.

5.2.5 Landscape & Visual

The proposed route is located in areas of gently undulating agricultural land/urban fringe in the foothills of the Dublin Mountains. The site is located on the southeastern limits of development for Dublin City. The site topography is dominated by the massive rounded hills and mountains which form the northern edge of the Wicklow Mountains. The area is dominated by urban housing but remnants of the formerly extensive agricultural lands remain, particularly in the southern part of the study area. During a site visit, fields were noted for grazing horses, cattle and sheep. Existing site features of visual note include the well developed hedgerows and overhead electricity power lines which cross the rounded low hills to the south of the study area. Mature trees are also located within the study area, predominately located with gardens adjacent to the existing Glenamuck Road. Suck blocks of woodland and visually significant trees create a pleasant setting for the area and assist in restricting views both into and out from the landscape surrounding the proposed road. The study area therefore has an enclosed feeling.

The Dunlaoghaire Rathdown County Development Plan 2004 – 2010 identifies a number of important landscape and visual objectives including *to preserve and protect trees and woodland* and *to preserve views*. The Development Plan states that trees or woodland that are significant features in the local landscape shall be protected wherever possible. Groups of trees are marked for protection on either side of the Glenamuck Road, Stepside Golf Course and woodland between the Glenamuck Road and Ballycorus Road. In addition, the Development Plan states that important views will be protected where such views encourage public enjoyment or prospects are of special amenity value. The

Development Plan Policy is to prevent development that will block or otherwise interfere with such views. A view to the south is protected along part of the Ballycorus Road towards the Wicklow Mountains.

It will not be possible to view the proposed GDDR from Kiltiernan Village or Stepside. In addition, long sections of the Enniskerry Road and Stepside Road north and south of the Golden Ball will also have no view of the proposed scheme and as such there will be no impact. At such locations where traffic is diverted off the local road network to the new road there will be a reduction in visual impact as a result of lower traffic movements resulting in slight positive visual impacts. However, the protected view, mentioned earlier, on the Ballycorus Road will be impacted by the proposed scheme. A small portion of the view will be crossed however the view to the Wicklow Mountains will remain as the new road is at grade at this location. The predicted visual impact on the Ballycorus protected view is moderate negative. No other important views from visitor amenity or tourist sites will be affected by this proposal.

Visual impacts will occur on residential properties that are located within the immediate vicinity of the proposed road as summarised in **Table 5.2**. Five Specific Landscape Mitigation (SLM) measures have been identified in order to alleviate negative landscape impacts. A landscape plan will be devised which will include the retention of existing hedgerows and trees as far as possible, the introduction of new planting such as larger size trees and evergreen shrubs to act as screening from any significantly affected properties. Generally, planting along the road will consist of woodland/woodland fringe mix using local occurring and native species. Fringe planting along the scheme will be included to provide a variety of woodland understorey and edge of character. Species will be planted as whips and feathered transplants, at close densities with avenues of standard planting at strategic locations (approaches to roundabouts and junctions) for immediate impact. In general the pioneer species and fringe planting will establish a low canopy within five to ten years, with the climax species developing a tall fuller canopy over a ten to twenty year period. The landscaping and planting will be managed and monitored as it develops. This will include the maintenance of the landscape works which is an integral part of the on-going site management. Works will include replacement of defective plant material, litter picking, weed control and monitoring of early growing seasons etc.

Table 5.2: Visual Impacts on Residential Properties

Degree of Visual Impact	Number of Properties (Before Mitigation)	Number of Properties (After Mitigation)
Substantial Negative Visual Impact	19	12
Moderate Negative Visual Impact	8	8
Slight Negative Visual Impact	11	10
No Change	24	32
Slight Positive Visual Impact	8	8

5.2.6 Terrestrial Ecology

A walkover of the proposed scheme was undertaken to identify of characteristic species of flora and fauna on and in the vicinity of the GDDR. This followed the methodology of the Phase 1 Habitat Survey (JNCC 1990). Habitats, plant species and vegetation types that would be affected by the propose road were recorded, as were trees greater than 30cm diameter at breast height. Attention was given to signs of mammals and birds and to nearby habitats where these might be affected by the proposals. The description of habitats and dominant species encountered were determined from the Heritage Councils Guide to Habitats in Ireland (Fossit 2000).

None of the lands for the proposed scheme are subject to an ecological designation (pNHA, cSAC or SPA) and there is no plant species protected under the Flora Protection Order 1999 recorded during the site visit. The Natural Heritage Area (NHA) of Dingle Glen is located approximately 6km east of the proposed scheme, however this will not be impacted by the proposed scheme. No habitats of significant value (in a county sense) occur along this route. The richest sites of ecological interest are two streams which are edged by trees and bushes and used by fauna for feeding and communication. The tree belt at Ch900 on the Enniskerry link is also of local interest and contains the least common

plant, the soft grass *Holcus mollis*. In terms of the NATURA rating scheme all the area would be rated as E (*Low Value – widely found habitats with typical but relatively low species diversity and low wildlife value*) except for the above features which might reach the D level (*Moderate value, locally important – sites containing some semi-natural habitat or locally important for wildlife*).

There was evidence of rabbit and hare along the proposed scheme, however there no signs of regular use by otters or badgers but these species are likely to occur sporadically. Badgers do occur in Glenamuck and in the Dingle Glen pNHA and would visit the fields on occasion for feeding however no setts were noted anywhere along this section of the route. Good bat habitat occurs along the existing Glenamuck Road. The area is well linked to other trees and buildings for roosting. The bird activity noted were common species from field and gardens. Other species of note were a dipper, sparrowhawk, yellowhammer and pheasant. The main impacts on these species would include loss of habitat, disturbance and fragmentation.

Underpasses will be required along the proposed scheme where watercourses will be crossed to facilitate existing mammal activity. Pre-construction badger and otter surveys will be undertaken to further identify mammal activity other than aforementioned areas and to establish the need for additional measures. Specific landscaping with tall growing trees will also be installed where bat activity was noted particularly at the treeline located at approximately Ch 900 to allow bats cross the roads in flight. Pre-construction bat surveys will also be undertaken to examine buildings prior to demolition. It should be noted that during the construction phase consultation and agreement with the NPWS regarding fauna mitigation measures will be required and in addition where mammal species are affected by construction works a licence may be required from the NPWS. Finally, additional ground will be found close to the present Glenamuck Road and in proximity to existing trees to establish a broadleaved stand in compensation for the loss of maple and poplar trees. The species will consist largely of oak and willow to maximise food organisms for other wildlife.

5.2.7 Aquatic Ecology

Watercourses were identified on the 1:50,000 *Discovery Series* Ordnance Survey Map 50 and on drawings provided by RPS. A total of two potentially affected streams / rivers and four potential impact locations were identified in the study area for the Glenamuck District Distributor Road. Five sampling sites were established for biological assessment in the vicinity of the potential impact locations. A number of assessments were carried out on the watercourses within the study area. These included habitat assessment, salmonid habitat quality, invertebrate sampling, water quality assessment, aquatic plant assessment, assessment of fish stock and the classification of importance of freshwater.

The GDDR will have a potential impact on the Glenamuck Stream and the Shanganagh River upstream of Bride's Glen. The Glenamuck Stream will be crossed by the proposed scheme at a single location. The road will also be constructed in close proximity to the stream over a distance of approximately 1km. Trout were recorded at very low density at all three sites electrofished. Q ratings indicated slightly polluted conditions. The Shanganagh River (also know as the Loughlinstown River) flows in a generally easterly direction via Kiltiernan, Rathmichael and Loughlinstown, entering the sea at Killiney. Q-ratings indicated unpolluted conditions. Results from the EPA biological monitoring data for this watercourse indicated a deterioration in water quality in the period 1997 – 2003. However, a study in 1996 undertaken by Conservation Services indicated that the Shanganagh River has a good sustaining population of Brown Trout. The Shanganagh River is located adjacent to the densely populated area of Dublin City and suburbs and as such its high quality and populations of salmonid fish assume greater importance than might be the case in other parts of the country. This was recognised by the inclusion of the river in the Dublin Angling Initiative project in the mid 1990's. In addition, the pNHA Loughlinstown Woods is approximately 5km downstream of the proposed road crossing. This site includes wet woodland and the three species of lamprey (Sea Lamprey, Brook Lamprey and River Lamprey) listed under the Annex II of the EU Habitats Directive, could occur in the Shanganagh River. As a good brown trout river with a run of sea trout within the suburbs of Dublin, the potentially affected sections of the river are classified of regional value. Regional value is defined as *other major salmonid waters and waters with major amenity fish value. Commercially important coarse fisheries. Waters with important populations of species protected under the Wildlife Act and/or important populations of Annex II species under the Habitats Directive. Waters designated or proposed as Natural Heritage Areas by NPWS.*

The potential significant impacts of the construction and operation phases of the proposed development will be:

- Pollution of watercourses with suspended solids due to runoff of soil from construction areas, or due to disturbance of fine subsurface substrates in the course of instream construction and excavation.
- Pollution of watercourses with other substances such as fuels, lubricants, waste concrete, waste water from site toilets and wash facilities etc.
- Permanent loss of habitat where the road is constructed over or in close proximity to watercourses or where watercourses are permanently diverted to new channels to facilitate the road.
- Obstruction to upstream movement of fish due to construction of culverts or bridge aprons etc
- Pollution of watercourses with contaminated water draining from the new road during its operation
- Changes in hydrology, peak and minimum flow rates.

In the absence of adequate mitigation the proposed road would have the potential for significant construction generated pollution and pollution from runoff from the completed road on the Glenamuck Stream. Construction generated pollution will be a risk at the proposed road crossing point and along approximately 1km of the stream where the proposed road will be constructed in close proximity. Such pollution would have an adverse impact on the small trout population of the stream. This trout population is particularly vulnerable, as the recently constructed culvert at the lower end of the Glenamuck stream is likely to be impassable for upstream movement of trout in most stream flow conditions, thereby preventing the replenishment of the fish population from other sections of the Ballyogan/Shanganagh system. The proposed road has the potential to totally prevent upstream movement of trout in the Glenamuck stream in the event of unsuitable culverts being installed at the proposed crossing point. In the absence of adequate mitigation, road construction in close proximity to the stream could result in the loss of bankside (riparian) vegetation, particularly trees and bushes, which provide valuable shade and insect food for the stream's fish population. The potential unmitigated impact of the proposed road on the Glenamuck stream is classified as moderate.

In the absence of adequate mitigation for the Shanganagh River, the proposed road would potentially obstruct or prevent upstream brown trout and sea trout movement to potential spawning areas, cause the loss of approximately 20m of very good salmonid nursery habitat, and cause serious impact on the Shanganagh river downstream due to construction generated pollution and runoff pollution from the completed road. The potential unmitigated impact on the Shanganagh river is classified as major.

Several mitigation measures have been proposed for the operational and construction phases of the proposed scheme. These measures generally include but not limited to the introduction of riparian leave strips, filter drains, french drains, petrol interceptors, constraints on times for construction, fish passable/friendly designed culverts etc.

5.2.8 Soils, Geology, Hydrogeology

The assessment of soils, geology and hydrogeology takes into account groundwater vulnerability, impacts to private/public water supplies and the geological heritage of the area. The subsoils underlying the GDDR are comprised of variable sediments and thickness of Quaternary aged glacial till (boulder clay) all underlain with granite bedrock. The subsoils comprise of moderate depths of clay where deposits range from 1.4m to 7.2m below ground level. The granite bedrock is generally described as moderately weak to moderately strong and is approximately 0.5m to 20m below ground level. The granite is impermeable and considered by the Geological Society of Ireland to be unproductive in terms of well yield. Any groundwater in the area moves either in the upper weathered zone which as permeable beds of limited extent, into faults or into fracture zones. A search of the GSI well database identified two groundwater wells within 2km radius of the site. One of the wells, located in Ballybetagh, is installed in the granite bedrock. The yield from this well is classified as poor. The remaining well, located Jamestown, has no available data on record. The aquifer vulnerability classification for this site, as per the GSI vulnerability mapping guidelines, is moderate to high due to the presence of the moderately deep clayey soils in the areas of sandy soil. Hence the underlying aquifer is protected from surface activities. The hydrology of the area is dominated by a low storage

rock type recharged by the higher rainfall of the Ticknock uplands and hence a high density stream network.

The reduction of groundwater recharge in the area due to the construction of the hard-standing material of the proposed scheme is unlikely to impact on the overall hydrogeological regime of the area given the underlying low permeability clays, depth to bedrock and poor yielding aquifer. A number of mitigation measures have been proposed to alleviate the impact of the proposed scheme. These include the implementation of a sustainable drainage system, the establishment of filter drains, flow attenuation, soil sampling and the protection of water and ground water sources during construction.

5.2.9 Agricultural Properties

A desktop study and site survey were carried to establish the agricultural lands affected by the proposed scheme. The GDDR is approximately 1.5km in total and affects 16 landowners. The potential impact on an individual agricultural property has been assessed in terms of the following factors: *degree of severance, enterprise type, removal of farm buildings, land take and the overall size of the holding*. There may also be problems with animal health and welfare due to factors such as contaminated water supplies (surface and ground), noise, dust and traffic.

There are approximately 895 farms in Dublin, utilising approximately 37,369 hectares (CSO 2000). The average farm size is 42.2 hectares. The quality of the lands around Glenamuck varies depending on height, bedrock type and soil type. Overall the majority of lands are well managed and standard management practices occurring on most farms. The principle farming enterprise in the Glenamuck area is drystock farming and the majority of lands relating to this enterprise are rented/used by owner.

Approximately 8.53 hectares of agricultural land will be acquired for the proposed scheme. A number of farms will have only small areas severed and these areas will be acquired as part of the scheme and will, as such, not require access. Field drainage systems currently *in situ* may be disturbed in places disable during construction. This damage may lead to wet or flooded fields during spells of wet weather and farm productivity could be reduced. Mitigation measures for the operational phase include compensation for landtake, severed access will be reinstated and impacted water supplies will be reinstated. During the construction phase access will be maintained to severed fields, access to water facilities will be maintained at all times and issues such as noise, dust and traffic will be covered under the Construction Traffic Management Plan for the proposed scheme. In addition, those measures stated in the NRA code of practice *Guide to Process and Code of Practiced for National Road Project Planning and Acquisition of Property for National Roads* will be adhered and implemented.

5.2.10 Non-Agricultural Properties

The lands crossed by the GDDR are predominately agricultural however there is residential development in a linear pattern along the existing Glenamuck Road and Ballycorus Road. There are also limited numbers of community/recreational properties and non-agricultural commercial properties present along the scheme corridor.

There will be 1 residential property that requires demolition and as such will be a major impact. There will also be a further 18 properties that will be affected by the acquisition of the scheme. One commercial property will be affected by the acquisition of part of their holding however the impact is anticipated to be minor. Three community/recreational properties (Gael Scoil, De La Salle Palmerstown Rugby Club and Bective Rugby Club) will also be impacted by the scheme. The impact on the Gael Scoil is not significant as the school will be moving to a new premise under the Department of Education School Building Programme. The remaining properties will have minor impacts due to the loss of land and access.

The mitigation measures proposed to alleviate the above impacts during the operational phase include compensation for landtake, severed access will be reinstated and impacted water supplies will be reinstated. During the construction phase access will be maintained to severed lands, access to water facilities will be maintained at all times and issues such as noise, dust and traffic will be covered under the Construction Traffic Management Plan for the proposed scheme. In addition, those measures

stated in the NRA code of practice *Guide to Process and Code of Practiced for National Road Project Planning and Acquisition of Property for National Roads* will be adhered and implemented.

5.2.11 Archaeological, Architectural & Cultural Heritage

5.2.11.1 Archaeological Heritage

The proposed road development lies at the heart of one of the richest archaeological landscapes in Leinster. Evidence for human activity in the foothills of the Dublin Mountains extends back to the Neolithic period, through the Bronze Age and into the medieval periods. Monuments and artefacts in the area attest to ritual, social and settlement activity over several thousand years.

The proposed route will have a direct negative and significant impact on a recorded archaeological site RMP DU026-021 (ID A7) enclosure(s) site. A geophysical survey was carried out across the RMP site and the results showed that no significant responses could be associated with the recorded enclosure site. It is recommended that further archaeological investigations be carried out across this RMP site. Several linear and curvilinear earthworks and cropmarks of possible archaeological interest were identified in oblique aerial photography in fields just south of the existing Glenamuck Road. The GDDR will have a direct negative impact on these earthworks and cropmarks. However a geophysical survey carried out across the site did not reveal any features of archaeological potential that coincided with the features identified in the aerial survey, which is likely to indicate that these features are topographical in nature.

As agricultural development tends to obscure surviving subsurface archaeology there is a high potential that archaeological features or finds survive below the level of plough-zone disturbance along the route. Such sites will be revealed during the preconstruction and earthmoving phase of the proposed development.

The GDDR crosses a tributary of the Loughlinstown River in two locations and the Bridesglen River. The archaeological record has shown that rivers have acted as a focal points for both settlement and ritual activity through all periods of human settlement, this borne out in the study area by the number of recorded archaeological sites close to the rivers e.g. prehistoric and medieval settlement in Carrickmines (DU026-005), the flat cemetery in Jamestown and the earthworks site straddling the Bridesglen river (DU026-021). It is possible that subsurface archaeological evidence for human activity may come to light during any earthmoving works in the vicinity of these rivers. It is recommended that an underwater archaeological assessment in the form of a wade and metal detection survey be carried out under licence to and in consultation with the Underwater Unit of the DoEHLG and National Museum of Ireland. In addition, archaeological testing of the river banks will also be carried.

In their name and physical expression, townlands represent the cultural or natural intrinsic inheritance of a specific region. They are early in date (pre-Norman) and considered to be of archaeological potential. A section of each boundary will be partially removed by the proposed road. Three of the townland boundaries will require archaeological.

Mitigation measures other than those previously mentioned will include an overall testing strategy for the entire scheme. This is likely to take the form of archaeological trenching prior to any construction works. In the likelihood that any archaeological features be identified during these investigations further examinations would be required and may lead to preservation in-situ or preservation by record. During the construction phase any remaining archaeological items must be fenced off and its location made aware to the Contractor to avoid damage. All mitigation measures shall be undertaken in consultation and agreement with the DoEHLG.

5.2.11.2 Architectural and Cultural Heritage Field Inspection

An investigation of properties or structures of architectural heritage merit along or within approx 100m of the GDDR was undertaken. Nine properties/structures considered to be of architectural heritage merit were identified within approximately 100m of the proposed scheme. Two of these properties Shaldon Grange and Rockville House are listed in the Record of Protected Structures in Dun

Laoghaire-Rathdown County Council Development Plan 2004-2010. One feature of cultural heritage interest, cast-iron water pump, was also identified in the vicinity of the proposed Distributor Road Link to Enniskerry.

There are no properties /structures of architectural heritage merit that will be directly impacted (physically located in whole or part within the road take of the proposed scheme alignment) by the proposed scheme. There are two properties, of protected structure status previously mentioned, that will be indirectly impacted by the proposed scheme due to either the traversing of their attendant grounds or by the removal in part of whole of their boundaries. In addition, the front boundary of a property will be impacted by the proposed widening at Ballycorus however this is deemed to slight given that the front boundary is of no particular architectural interest. There will be one feature of cultural heritage interest that will be directly impacted by the proposed scheme. This feature, a cast iron water pump lies in the path of the proposed scheme. No mitigation measures have been proposed other than landscape screening from the proposed scheme which will be integrated into the landscaping proposals.

6 COST ESTIMATE

6.1 INTRODUCTION

This chapter presents the cost estimate at the Preliminary Design Stage for the construction of the GDDR Scheme. The cost predictions of a scheme are difficult due to the large variations in construction cost over recent times due to variance in land cost, material & labour cost and other factors influencing the construction costs of the scheme.

The cost of a major road scheme consists of two major elements:

- Cost of Construction
- Cost of Purchasing Land

6.2 CONSTRUCTION ELEMENTS

The construction costs have been estimated from a combination of average historical figures and 2005 prices compiled by the NRA for rural road projects. A modified version of the NRA price spreadsheet was used to estimate the cost of both the 'Reduced Dual Carriageway' and 'Standard Two Lane' of the GDDR and Link Road.

RPS has also included other elements of urban construction costs, which are not included in the NRA prices. These include:

- Footpaths
- Cycle tracks
- Traffic Islands
- Additional Kerbs
- Traffic Signal Equipment and Installation
- Road Markings
- Road Studs and Delineators

Table 6.1 displays the estimated construction costs for both the GDDR and the proposed Link Road, which will compliment the GDDR. This table also includes for the additional construction costs associated with the approach roads to the proposed scheme junctions. Table 6.1 contains a breakdown of the elements that make up the overall construction cost.

Allowance is made in the cost estimate for additional items/contingencies. This allows approximately 5% for unknown items not included in the cost estimate and for items, which may arise during construction of the Scheme. An allowance is also made for preliminaries and set-up, which is assumed as approximately 20% of the construction sub-total cost.

Risks, which cannot be foreseen in the Preliminary Design of the GDDR, include normal inflation in construction material and labour costs. These risks would not be considered particularly high in this project given the likely construction period of the Scheme i.e. less than five years.

Table 6.1: GDDR ‘Route Option C’ Scheme - Cost Estimate

Items	Cost Estimate		
	GDDR	Link Road	Total
Preliminaries (@ 20% of Sub-Total)	840,100	871,000	1,711,100
Roadwork’s General			
Site Clearance	38,700	43,500	82,200
Fencing	120,300	147,100	267,400
Work for Statutory Undertakers (Est.)	61,200	56,200	117,400
Accommodation Works (Est.)	64,500	71,200	135,700
Earthworks			
Earthworks Average Historical	951,600	933,300	1,884,900
Landscaping	156,400	213,500	369,900
Structures			
Culverts	310,000	220,000	530,000
Under and Over bridges		468,000	468,000
Main Carriageway			
Drainage	470,500	274,000	744,500
Pavements	1,330,900	1,177,900	2,508,800
Footpaths, Cycle tracks & Islands	280,500	218,500	499,000
Kerbs	84,700	121,000	205,700
Traffic Signs & Public Lighting	182,600	169,700	352,300
Traffic Signal Junctions	104,500	199,800	304,300
Road Markings	44,300	41,200	85,500
Contingencies (@ 5% of Sub-Total)	210,100	217,700	427,800
Sub-Total	4,200,700	4,354,900	8,555,600
Allow 20% to rates for Difficulty	840,100	871,000	1,711,100
Total Tender Cost (Ex. VAT)	6,091,000	6,314,600	12,405,600
V.A.T. @ 13.5%	822,300	852,500	1,674,800
Total Construction Estimate	€ 6,913,300	€ 7,167,100	€ 14,080,400

Table 6.1 above shows the estimated cost of constructing the Scheme is approximately €14.08 million inclusive of VAT at 13.5%. Construction costs include for site clearance, earthworks, drainage, fencing, structures, pavements and kerbs, footpaths, cycle tracks, traffic islands, traffic signs and road markings, signal junctions, public lighting, utilities diversions and landscaping.

6.3 COST OF PURCHASING LAND

It is difficult to generalise about the cost of land, as it will vary depending on its location and its current and potential future use. The provision of a new route near the environs of a community, as in this situation, can have the effect of altering the existing land potential i.e. agricultural to development. In this case, one of the primary objectives of the GDDR Scheme is to complement the future development plan within the study area.

Historical records of land acquisition costs in the Glenamuck/ Carrickmines area would indicate that land zoned for residential development was achieving up to € 880,000 per acre in 2002.

An Internet search² of 2005 property prices and land acquisitions on the open market within the study area of the Glenamuck Road shows that there has been very high inflation in the cost of development land in this area. This rise in development land value can be attributed to many factors, which may include the revision of the development plan for the area, the opening of the South Eastern Motorway, higher population densities and a higher demand for housing in the locality. Following this review of 2005 open market valuations, the cost of land in the Glenamuck area would be as follows: Agricultural land with hope value in Carrickmines, for example, is achieving between €700,000 and €1 million per acre, with land zoned residential currently achieving between €2 million to €2.5 million per acre. Sites with planning permission are achieving €170,000 per unit site. Lands zoned for residential areas with planning permission in the Carrickmines area have recently achieved values up to €3 million per acre.

For the purpose of land cost estimation by landuse, RPS has assumed the following cost per hectare based on the above information:

- | | |
|--|---------------|
| ▪ Residential Zoned Land | = € 4.0m/Ha |
| ▪ Residential Zoned Land with Planning Application | = € 6.175m/Ha |
| ▪ Economic Zoned Land | = € 4.0m/Ha |
| ▪ Agricultural Zoned Land | = € 2.47m/Ha |
| ▪ Recreational Zoned Land | = € 1.75m/Ha |

The following general descriptions outline the main elements involved in costing the purchase of land for the GDDR Scheme, which includes both the GDDR and the Link Road.

The GDDR passes directly through existing agricultural land, which has been designated for both economic and residential development. It passes through an area of residentially zoned land for which planning permission has already been granted along a short length of the route.

The Link Road passes directly through existing agricultural land, of which some has been designated for economic, residential and recreational development. The alignment of the Link Road passes through the existing Glenamuck Road, Ballychorus Road and Barnaslingan Lane. The above road will be upgraded on all approaches to the Link Road. These upgrades are on average 150m in length. This Link Road will have an impact on existing residential dwellings and frontages along the Glenamuck Road, Ballychorus Road and Barnaslingan Lane. The cost of compensating existing residents for dwelling demolition and loss of road frontage can be expected to be substantial given the high property values in this area.

Given the high inflation rate on the open market for land zoned for development within the study area, it is difficult to evaluate the possible cost of land purchase with any great certainty. However, the following general estimates of the cost of purchasing land for the GDDR Scheme have been calculated as a guide based on an interpretation of the figures given above:

- | | |
|--|----------------|
| ▪ GDDR | = € 26,200,000 |
| ▪ Link Road | = € 26,400,000 |
| ▪ Total GDDR Scheme Land Cost Estimate | = € 52,600,000 |

6.4 SUMMARY

The GDDR and Link Road are estimated to have a both similar construction and land cost. This is due to the fact that the differences in overall road length are offset by the cross sections of each road. The cost of land for this GDDR Scheme was a very significant factor in the route selection stage of the project and remains a significant element of the total project cost at preliminary design stage. The relative costs of land zoned for residential, economic development and employment use is likely to be significantly greater than agriculturally zoned land. Given the high inflation rate for land prices in the area it is difficult to estimate with great certainty the cost of land purchase in within the study area. Cost estimates for the landtake for each route have been presented based on an interpretation of historical and current open market valuations in the area.

² [sources: <http://archives.tcm.ie/businesspost/2005/07/10/story6206.asp> Sunday Business Post, 10/07/05; http://www.unison.ie/irish_independent/stories.php3?ca=302&si=1359172&issue_id=12214, Irish Independent, 16/03/05]